DB2® IBM Informix

IBM

Version 10.0/8.5

IBM Informix Guide to SQL: Syntax

G251-2284-02

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Note:
Before using this information and the product it supports, read the information in "Notices" on page D-1.

Third Edition (December 2005)

Contents

Introduction

In This Introduction

This introduction provides an overview of the information in this manual and describes the documentation conventions that it uses.

About This Manual

This manual describes the syntax of the Structured Query Language (SQL) and Stored Procedure Language (SPL) statements for Version 10.0 of IBM Informix Dynamic Server and Version 8.5 of IBM Informix Extended Parallel Server.

This manual is a companion volume to the *IBM Informix Guide to SQL: Reference*, the *IBM Informix Guide to SQL: Tutorial*, and the *IBM Informix Database Design and Implementation Guide*. The *IBM Informix Guide to SQL: Reference* provides reference information about the system catalog, the built-in SQL data types, and environment variables that can affect SQL statements. The *IBM Informix Guide to SQL: Tutorial* shows how to use basic and advanced SQL and SPL routines to access and manipulate the data in your databases. The *IBM Informix Database Design and Implementation Guide* shows how to use SQL to implement and manage relational databases.

Types of Users

This manual is written for the following users:

- Database users
- Database administrators
- Database-application programmers

This manual assumes that you have the following background:

- A working knowledge of your computer, your operating system, and the utilities that your operating system provides
- Some experience working with relational databases or exposure to database concepts
- Some experience with computer programming

If you have limited experience with relational databases, SQL, or your operating system, refer to the *IBM Informix Getting Started Guide* for your database server for a list of supplementary titles.

Software Dependencies

This manual assumes that you are using one of the following database servers:

- IBM Informix Extended Parallel Server, Version 8.5
- IBM Informix Dynamic Server, Version 10.0

Assumptions About Your Locale

IBM Informix products can support many languages, cultures, and code sets. All culture-specific information is brought together in a single environment, called a Global Language Support (GLS) locale.

This manual assumes that you use the U.S. 8859-1 English locale as the default locale. The default is **en_us.8859-1** (ISO 8859-1) on UNIX platforms or **en_us.1252** (Microsoft 1252) for Windows environments. These locales support U.S. English format conventions for dates, times, and currency, and also support the ISO 8859-1 or Microsoft 1252 code set, which includes the ASCII code set plus many 8-bit characters such as é, è, and ñ.

If you plan to use non-ASCII characters in your data or in SQL identifiers, or if you want to conform to localized collation rules of character data, you need to specify an appropriate nondefault locale.

For instructions on how to specify a nondefault locale, additional syntax, and other considerations related to GLS locales, see the *IBM Informix GLS User's Guide*.

Demonstration Databases

The DB–Access utility, which is provided with your IBM Informix database server products, includes one or more of the following demonstration databases:

- The **stores_demo** database illustrates a relational schema with information about a fictitious wholesale sporting-goods distributor. Many examples in IBM Informix manuals are based on the **stores_demo** database.

- For Extended Parallel Server only, the **sales_demo** database illustrates a dimensional schema for data-warehousing applications. For conceptual information about dimensional data modeling, see the *IBM Informix Database Design and Implementation Guide*.
- For Dynamic Server only, the **superstores_demo** database illustrates an object-relational schema that contains examples of extended data types, data-type inheritance and table inheritance, and user-defined routines.

For information about how to create and populate the demonstration databases, see the *IBM Informix DB–Access User's Guide*. For descriptions of the databases and their contents, see the *IBM Informix Guide to SQL: Reference*.

The scripts that you use to install the demonstration databases reside in the **$INFORMIXDIR/bin** directory on UNIX platforms and in the **%INFORMIXDIR%\bin** directory in Windows environments.

New Features in Dynamic Server, Version 10.0

For a comprehensive list of new database server features, see the *IBM Informix Getting Started Guide*. This section lists new features introduced in Version 10.00.xC1 that are relevant to this manual.

The following list provides information about the new features of IBM Informix Dynamic Server, Version 10.00.xC1, that this manual describes.

- The following new SQL statements are documented in Chapter 2, "SQL Statements," on page 2-1:
  - SAVE EXTERNAL DIRECTIVES
  - SET ENCRYPTION PASSWORD
  - SET ENVIRONMENT OPTCOMPIND
- The following SQL statements support new syntax in Version 10.0:

Statement	**New Keywords**
ALTER FRAGMENT	PARTITION
ALTER TABLE	PARTITION
CREATE INDEX	ONLINE
CREATE INDEX	PARTITION
CREATE TABLE	PARTITION
DROP INDEX	ONLINE
GRANT	DEFAULT ROLE
REVOKE	DEFAULT ROLE
SET ROLE	DEFAULT

- The DBSA (Database Server Administrator) can use the GRANT ROLE EXTEND statement to assign the new built-in role EXTEND to users. When this security feature is enabled, only users who hold the EXTEND role can register or drop external UDRs or create shared libraries in the database.
- This release introduces *default roles* that the DBA can grant or revoke. These take effect when a user who holds a default role connects to the database, so that appropriate access privileges are available for using applications that do not include GRANT statements that reference individual users. New SQL functions can return the current role or the default role of the user.

- The CREATE INDEX and DROP INDEX statements can specify the ONLINE keyword to define or drop an index without applying table locks that might interfere with concurrent users.
- Tables and indexes now can use fragmentation strategies that define multiple named fragments within the same dbspace.
- Data values returned by distributed DML operations or UDRs in databases of the same Dynamic Server instance now can return the built-in opaque data types BLOB, BOOLEAN, CLOB, and LVARCHAR. They can also return UDTs, and DISTINCT types whose base types are built-in types, if the UDTs and DISTINCT types are explicitly cast to built-in data types, and if the casts, DISTINCT types, and UDTs are defined in all the participating databases.
- The DS_NONPDQ_QUERY_MEM configuration parameter can be set to improve the performance of certain non-PDQ queries.
- This release supports *external optimizer directives* that reside in the database and that are automatically applied to specified queries. These can be enabled or disabled for a given session by a configuration parameter.
- The SET ENVIRONMENT OPTCOMPIND statement can reset the value of OPTCOMPIND dynamically, overriding the corresponding configuration parameter or environment variable setting. This can improve performance during sessions that use queries for both DS (decision-support) and OLTP (online-transaction-processing).
- The SET ENCRYPTION PASSWORD statement can specify a session password to support column-level and cell-level encryption of sensitive data. This statement, and new built-in encryption and decryption functions, can support compliance with data security and data confidentiality requirements that are mandated for some industries and jurisdictions.
- User-defined functions can include multiple INOUT parameters.

3 New Features in Dynamic Server, Version 10.00.xC3

3 For a comprehensive list of new database server features in Version 10.00.xC3, see
3 the *IBM Informix Getting Started Guide*. This section lists new features introduced in
3 Version 10.00.xC3 that this manual describes.

3 New data definition language (DDL) statements support XA-compliant external
3 data sources. Use these to apply the transactional semantics of Dynamic Server and
3 two-phase commit protocols to transactions with external data sources:

3 • CREATE XADATASOURCE
3 • CREATE XADATASOURCE TYPE
3 • DROP XADATASOURCE
3 • DROP XADATASOURCE TYPE

3 New Projection Clause syntax of the SELECT statement can control the number of
3 qualifying rows in the result set of a query:

3 • SKIP *offset*
3 • LIMIT *max*

3 The SKIP *offset* clause excludes the first *offset* qualifying rows from the result set,
3 for *offset* an integer. If you also include the LIMIT *max* clause (where LIMIT is a
3 keyword synonym for FIRST), no more than *max* rows are returned. The *offset* and
3 *max* values can be specified as literal integers in the SERIAL8 range, or as host
3 variables, or as local SPL variables. You can save the result set as a
3 collection-derived table (CDT).

If you also include the ORDER BY clause, qualifying rows are first arranged by the ORDER BY specification before SKIP *offset* and LIMIT *max* clauses are applied.

New Features in Dynamic Server, Version 10.00.xC4

For a comprehensive list of new database server features in Version 10.00.xC4, see the *IBM Informix Getting Started Guide*. In addition to documenting the new feature of Version 10.00.xC4 that is described in this section, this manual corrects errata that have been identified since the previous edition.

A new TRUNCATE data definittion language (DDL) statement of SQL removes all active rows and the entire B-tree structure of all indexes from all partitions of a specified table in the local database. Storage formerly occupied by these data rows and indexes becomes available for other tables, or you can optionally reserve the space for reuse in subsequent operations on the same table or index partition.

While the TRUNCATE statement is executing, no other session can lock or modify the table until TRUNCATE completes and is either committed or rolled back. In a database with transaction logging, a subsequent ROLLBACK statement can restore the table to its state before the transaction that included TRUNCATE began, but no operation except COMMIT or ROLLBACK can follow TRUNCATE within a transaction.

After the TRUNCATE statement successfully executes, the database server automatically resets the statistics and distributions for the table and for its indexes, as if UPDATE STATISTICS had been executed for that table. Any Delete trigger that is defined on the table is ignored when TRUNCATE executes, and the serial counter for SERIAL and SERIAL8 columns is not reset.

The table that you truncate can be a raw, temporary, or standard table. It can also be a virtual table, or a table with a virtual-index interface, provided that the virtual table or the virtual-index interface has a valid **am_truncate( )** purpose function that was explicitly registered in the **sysams** system catalog table.

This feature offers performance advantages over the DELETE *table* statement, because TRUNCATE empties a table without logging individual deleted rows or index updates, and without activating Delete triggers. Unlike the DROP TABLE statement, TRUNCATE does not remove the definitions of the table or its indexes, triggers, views, constraints, privileges, and other properties from the system catalog. The TRUNCATE statement can also make storage management more efficient through its ability to free space, or to reuse the space for the same table and its indexes.

New Features in Extended Parallel Server, Version 8.5

The following new SQL statements of IBM Informix Extended Parallel Server, Version 8.5 are documented in Chapter 2, "SQL Statements," on page 2-1:

- MERGE
- MOVE
- SET ALL_MUTABLES

For a complete list of new features in Extended Parallel Server, Version 8.5, see the *Getting Started With IBM Informix Extended Parallel Server Guide*.

Documentation Conventions

This section describes the conventions that this manual uses. These conventions make it easier to gather information from this and other volumes in the documentation set.

The following conventions are discussed:

- Typographical conventions
- Other conventions
- Syntax diagrams
- Command-line conventions
- Example code conventions

Typographical Conventions

This manual uses the following conventions to introduce new terms, illustrate screen displays, describe command syntax, and so forth.

Convention	**Meaning**
KEYWORD	Keywords of SQL, SPL, and some other programming languages appear in uppercase letters in a serif font.
italics	Within text, new terms and emphasized words appear in italics. Within syntax and code examples, variable values that you are to specify appear in italics.
boldface	Names of program entities (such as classes, events, and tables), environment variables, file and pathnames, and interface elements (such as icons, menu items, and buttons) appear in boldface.
`monospace`	Information that the product displays and information that you enter appear in a monospace typeface.
KEYSTROKE	Keys that you are to press appear in uppercase letters in a sans serif font.
>	This symbol indicates a menu item. For example, "Choose **Tools > Options**" means choose the **Options** item from the **Tools** menu.

Tip: When you are instructed to "enter" characters or to "execute" a command, immediately press RETURN after the entry. When you are instructed to "type" the text or to "press" other keys, no RETURN is required.

Feature, Product, and Platform Markup

Feature, product, and platform markup identifies paragraphs that contain feature-specific, product-specific, or platform-specific information. Some examples of this markup follow:

Dynamic Server

Identifies information that is specific to IBM Informix Dynamic Server

End of Dynamic Server

Windows Only

Identifies information that is specific to the Windows environment

End of Windows Only

This markup can apply to one or more paragraphs within a section. When an entire section applies to a particular product or platform, this is noted as part of the heading text, for example:

Table Sorting (Linux)

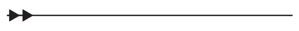
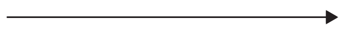
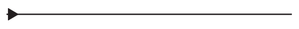
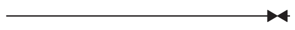
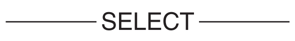
Syntax Diagrams

This guide uses syntax diagrams built with the following components to describe the syntax for statements and all commands other than system-level commands.

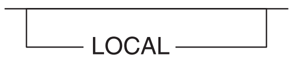
Syntax diagrams depicting SQL and command-line statements have changed in the following ways:

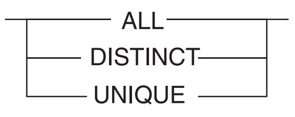
- The symbols at the beginning and end of statements are double arrows.
- The symbols at the beginning and end of syntax segment diagrams are vertical lines.
- How many times a loop can be repeated is explained in a diagram footnote, whose marker appears above the path that is describes.
- Syntax statements that are longer than one line continue on the next line.
- Product or condition-specific paths are explained in diagram footnotes, whose markers appear above the path that they describe.
- Cross-references to the descriptions of other syntax segments appear as diagram footnotes, whose markers immediately follow the name of the segment that they reference.

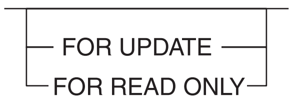
The following table describes syntax diagram components.

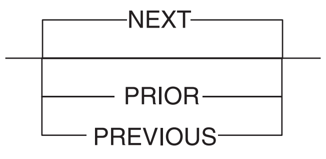
Component represented in PDF	Component represented in HTML	Meaning
	`>>----------------------`	Statement begins.
	`----------------------->`	Statement continues on next line.
	`>-----------------------`	Statement continues from previous line.
	`-----------------------><`	Statement ends.
	`--------SELECT----------`	Required item.

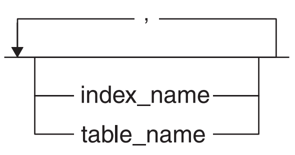
Component represented in PDF	Component represented in HTML	Meaning

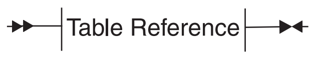
	`--+-----------------+---`
	`  '------LOCAL------'`
		Optional item.

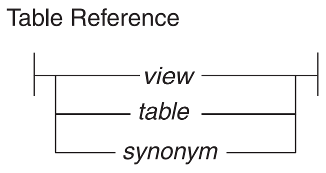
	`---+-----ALL-------+---`
	`   +--DISTINCT-----+`
	`   '---UNIQUE------'`
		Required item with choice. One and only one item must be present.

	`---+-----------------+---`
	`    +--FOR UPDATE-----+`
	`    '--FOR READ ONLY--'`
		Optional items with choice are shown below the main line, one of which you might specify.

	`    .---NEXT---------.`
	`----+----------------+---`
	`    +---PRIOR--------+`
	`    '---PREVIOUS-----'`
		The values below the main line are optional, one of which you might specify. If you do not specify an item, the value above the line will be used as the default.

	` .-------,-----------.`
	` V                   |`
	`---+-----------------+---`
	`    +---index_name---+`
	`    '---table_name---'`
		Optional items. Several items are allowed; a comma must precede each repetition.

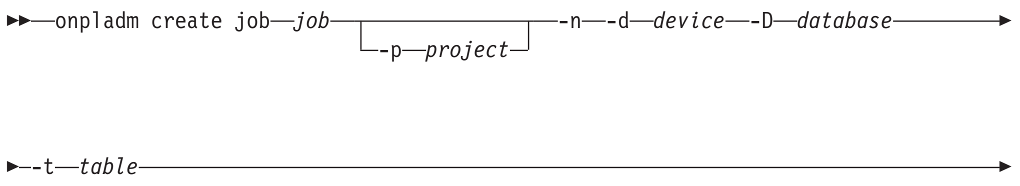
	`>>-| Table Reference |-><`	Reference to a syntax segment.

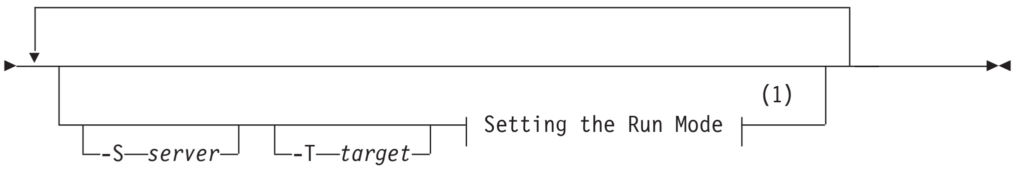
	`Table Reference`
	`|--+-----view--------+--|`
	`   +------table------+`
	`   '----synonym------'`
		Syntax segment.

How to Read a Command-Line Syntax Diagram

The following command-line syntax diagram uses some of the elements listed in the table in the previous section.

Creating a No-Conversion Job



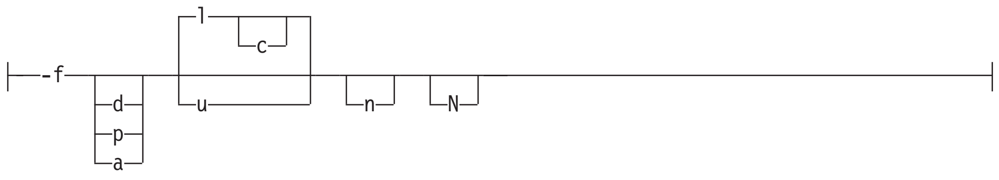


Notes:

1 See page Z-1

The second line in this diagram has a segment named “Setting the Run Mode,” which according to the diagram footnote, is on page Z-1. If this was an actual cross-reference, you would find this segment in on the first page of Appendix Z. Instead, this segment is shown in the following segment diagram. Notice that the diagram uses segment start and end components.

Setting the Run Mode:



To see how to construct a command correctly, start at the top left of the main diagram. Follow the diagram to the right, including the elements that you want. The elements in this diagram are case sensitive because the illustrates utility syntax. Other types of syntax, such as SQL, are not case sensitive.

The Creating a No-Conversion Job diagram illustrates the following steps:

1. Type **onpladm create job** and then the name of the job.
2. Optionally, type **-p** and then the name of the project.
3. Type the following required elements:
   - **-n**
   - **-d** and the name of the device
   - **-D** and the name of the database
   - **-t** and the name of the table
4. Optionally, you can choose one or more of the following elements and repeat them an arbitrary number of times:
   - **-S** and the server name
   - **-T** and the target server name
   - The run mode. To set the run mode, follow the Setting the Run Mode segment diagram to type **-f**, optionally type **d**, **p**, or **a**, and then optionally type **l** or **u**.
5. Follow the diagram to the terminator.

Your diagram is complete.

Keywords and Punctuation

Keywords are words reserved for statements and all commands except system-level commands. When a keyword appears in a syntax diagram, it is shown in uppercase letters. When you use a keyword in a command, you can write it in uppercase or lowercase letters, but you must spell the keyword exactly as it appears in the syntax diagram.

You must also use any punctuation in your statements and commands exactly as shown in the syntax diagrams.

Identifiers and Names

Variables serve as placeholders for identifiers and names in the syntax diagrams and examples. You can replace a variable with an arbitrary name, identifier, or literal, depending on the context. Variables are also used to represent complex syntax elements that are expanded in additional syntax diagrams. When a variable appears in a syntax diagram, an example, or text, it is shown in *lowercase italic*.

The following syntax diagram uses variables to illustrate the general form of a simple SELECT statement.

```
►►──SELECT──column_name──FROM──table_name──────────────────────────────►◄
```

When you write a SELECT statement of this form, you replace the variables *column_name* and *table_name* with the name of a specific column and table.

Example Code Conventions

Examples of SQL code occur throughout this manual. Except as noted, the code is not specific to any single IBM Informix application development tool.

If only SQL statements are listed in the example, they are not delimited by semicolons. For instance, you might see the code in the following example:

```
CONNECT TO stores_demo
...

DELETE FROM customer
   WHERE customer_num = 121
...

COMMIT WORK
DISCONNECT CURRENT
```

To use this SQL code for a specific product, you must apply the syntax rules for that product. For example, if you are using DB–Access, you must delimit multiple statements with semicolons. If you are using an SQL API, you must use EXEC SQL at the start of each statement and a semicolon (or other appropriate delimiter) at the end of the statement.

Tip: Ellipsis points in a code example indicate that more code would be added in a full application, but it is not necessary to show it to describe the concept being discussed.

For detailed directions on using SQL statements for a particular application development tool or SQL API, see the manual for your product.

Additional Documentation

For additional information, refer to the following types of documentation:

- Installation guides
- Online notes
- Informix error messages
- Manuals
- Online help

IBM Informix Information Center

The Informix Dynamic Server Information Center integrates the entire IBM Informix Dynamic Server 10.0 and IBM Informix Client SDK (CSDK) 2.90 documentation sets in both HTML and PDF formats. The Information Center provides full text search, a master index, logical categories, easy navigation, and links to troubleshooting and support files.

The IBM Informix Information Center site is located at http://publib.boulder.ibm.com/infocenter/ids9help/index.jsp.

Installation Guides

Installation guides are located in the **/doc** directory of the product CD or in the **/doc** directory of the product‘s compressed file if you downloaded it from the IBM Web site. Alternatively, you can obtain installation guides from the IBM Informix Online Documentation site at http://www.ibm.com/software/data/informix/pubs/library/ or the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/ids9help/index.jsp.

Online Notes

The following sections describe the online files that supplement the information in this manual. Please examine these files before you begin using your IBM Informix product. They contain vital information about application and performance issues.

Online File	Description	Format
TOC Notes	The TOC (Table of Contents) notes file provides a comprehensive directory of hyperlinks to the release notes, the fixed and known defects file, and all the documentation notes files for individual manual titles.	HTML
Documentation Notes	The documentation notes file for each manual contains important information and corrections that supplement the information in the manual or information that was modified since publication.	HTML, text
Release Notes	The release notes file describes feature differences from earlier versions of IBM Informix products and how these differences might affect current products. For some products, this file also contains information about any known problems and their workarounds.	HTML, text
Machine Notes	(Non-Windows platforms only) The machine notes file describes any platform-specific actions that you must take to configure and use IBM Informix products on your computer.	text
Fixed and Known Defects File	This text file lists issues that have been identified with the current version. It also lists customer-reported defects that have been fixed in both the current version and in previous versions.	text

Locating Online Notes

Online notes are available from the IBM Informix Online Documentation site at http://www.ibm.com/software/data/informix/pubs/library/ and in the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/ids9help/index.jsp. Additionally you can locate these files before or after installation as described below.

Before Installation

All online notes are located in the **/doc** directory of the product CD. The easiest way to access the documentation notes, the release notes, and the fixed and known defects file is through the hyperlinks from the TOC notes file.

The machine notes file and the fixed and known defects file are only provided in text format.

After Installation

On UNIX platforms in the default locale, the documentation notes, release notes, and machine notes files appear under the **$INFORMIXDIR/release/en_us/0333** directory.

Dynamic Server

On Windows the documentation and release notes files appear in the **Informix** folder. To display this folder, choose **Start > Programs > IBM** *product name version* **> Documentation Notes** or **Release Notes** from the taskbar.

Machine notes do not apply to Windows platforms.

End of Dynamic Server

Online Notes Filenames

Online notes have the following file formats:

Online File	File Format	Examples
TOC Notes	*prod_os*_toc_*version*.html	**ids_win_toc_10.0.html**
Documentation Notes	*prod_bookname*_docnotes_*version*.html/txt	**ids_hpl_docnotes_10.0.html**
Release Notes	*prod_os*_relnotes_*version*.html/txt	**ids_unix_relnotes_10.0.txt**
Machine Notes	*prod*_machine_notes_*version*.txt	**ids_machine_notes_10.0.txt**
Fixed and Known Defects File	*prod*_defects_*version*.txt ids_win_fixed_and_known _defects_*version*.txt	**ids_defects_10.0.txt** **client_defects_2.90.txt** **ids_win_fixed_and_known _defects_10.0.txt**

Informix Error Messages

This file is a comprehensive index of error messages and their corrective actions for the Informix products and version numbers.

On UNIX platforms, use the **finderr** command to read the error messages and their corrective actions.

Dynamic Server

On Windows, use the Informix Error Messages utility to read error messages and their corrective actions. To display this utility, choose **Start > Programs > IBM *product name version* > Informix Error Messages** from the taskbar.

End of Dynamic Server

You can also access these files from the IBM Informix Online Documentation site at http://www.ibm.com/software/data/informix/pubs/library/ or in the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/ids9help/index.jsp.

Manuals

Online Manuals

A CD that contains your manuals in electronic format is provided with your IBM Informix products. You can install the documentation or access it directly from the CD. For information about how to install, read, and print online manuals, see the installation insert that accompanies your CD. You can also obtain the same online manuals from the IBM Informix Online Documentation site at http://www.ibm.com/software/data/informix/pubs/library/ or in the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/ids9help/index.jsp.

Printed Manuals

To order hardcopy manuals, contact your sales representative or visit the IBM Publications Center Web site at http://www.ibm.com/software/howtobuy/data.html.

Online Help

IBM Informix online help, provided with each graphical user interface (GUI), displays information about those interfaces and the functions that they perform. Use the help facilities that each GUI provides to display the online help.

Accessibility

IBM is committed to making our documentation accessible to persons with disabilities. Our books are available in HTML format so that they can be accessed with assistive technology such as screen reader software. The syntax diagrams in our manuals are available in dotted decimal format, which is an accessible format that is available only if you are using a screen reader. For more information about the dotted decimal format, see the Accessibility appendix.

IBM Informix Dynamic Server Version 10.0 and CSDK Version 2.90 Documentation Set

The following tables list the manuals that are part of the IBM Informix Dynamic Server, Version 10.0 and the CSDK Version 2.90, documentation set. PDF and HTML versions of these manuals are available at http://www.ibm.com/software/data/informix/pubs/library/ or in the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/ids9help/index.jsp. You can order hardcopy versions of these manuals from the IBM Publications Center at http://www.ibm.com/software/howtobuy/data.html.

Table 1. Database Server Manuals

Manual	**Subject**
Administrator's Guide	Understanding, configuring, and administering your database server.
Administrator's Reference	Reference material for Informix Dynamic Server, such as the syntax of database server utilities **onmode** and **onstat**, and descriptions of configuration parameters, the **sysmaster** tables, and logical-log records.
Backup and Restore Guide	The concepts and methods you need to understand when you use the **ON-Bar** and **ontape** utilities to back up and restore data.
Built-In DataBlade Modules User's Guide	Using the following DataBlade modules that are included with Dynamic Server: • MQ DataBlade module, to allow IBM Informix database applications to communicate with other MQSeries applications. • Large Object Locator, a foundation DataBlade module that can be used by other modules that create or store large-object data.
DB-Access User's Guide	Using the **DB-Access** utility to access, modify, and retrieve data from Informix databases.
DataBlade API Function Reference	The DataBlade API functions and the subset of ESQL/C functions that the DataBlade API supports. You can use the DataBlade API to develop client LIBMI applications and C user-defined routines that access data in Informix databases.
DataBlade API Programmer's Guide	The DataBlade API, which is the C-language application-programming interface provided with Dynamic Server. You use the DataBlade API to develop client and server applications that access data stored in Informix databases.

Table 1. Database Server Manuals (continued)

Manual	**Subject**
Database Design and Implementation Guide	Designing, implementing, and managing your Informix databases.
Enterprise Replication Guide	How to design, implement, and manage an Enterprise Replication system to replicate data between multiple database servers.
Error Messages file	Causes and solutions for numbered error messages you might receive when you work with IBM Informix products.
Getting Started Guide	Describes the products bundled with IBM Informix Dynamic Server and interoperability with other IBM products. Summarizes important features of Dynamic Server and the new features for each version.
Guide to SQL: Reference	Information about Informix databases, data types, system catalog tables, environment variables, and the stores_demo demonstration database.
Guide to SQL: Syntax	Detailed descriptions of the syntax for all Informix SQL and SPL statements.
Guide to SQL: Tutorial	A tutorial on SQL, as implemented by Informix products, that describes the basic ideas and terms that are used when you work with a relational database.
High-Performance Loader User's Guide	Accessing and using the High-Performance Loader (HPL), to load and unload large quantities of data to and from Informix databases.
Installation Guide for Microsoft Windows	Instructions for installing IBM Informix Dynamic Server on Windows.
Installation Guide for UNIX and Linux	Instructions for installing IBM Informix Dynamic Server on UNIX and Linux.
J/Foundation Developer's Guide	Writing user-defined routines (UDRs) in the Java programming language for Informix Dynamic Server with J/Foundation.
Migration Guide	Conversion to and reversion from the latest versions of Informix database servers. Migration between different Informix database servers.
Optical Subsystem Guide	The Optical Subsystem, a utility that supports the storage of BYTE and TEXT data on optical disk.
Performance Guide	Configuring and operating IBM Informix Dynamic Server to achieve optimum performance.
R-Tree Index User's Guide	Creating R-tree indexes on appropriate data types, creating new operator classes that use the R-tree access method, and managing databases that use the R-tree secondary access method.
SNMP Subagent Guide	The IBM Informix subagent that allows a Simple Network Management Protocol (SNMP) network manager to monitor the status of Informix servers.
Storage Manager Administrator's Guide	Informix Storage Manager (ISM), which manages storage devices and media for your Informix database server.
Trusted Facility Guide	The secure-auditing capabilities of Dynamic Server, including the creation and maintenance of audit logs.
User-Defined Routines and Data Types Developer's Guide	How to define new data types and enable user-defined routines (UDRs) to extend IBM Informix Dynamic Server.
Virtual-Index Interface Programmer's Guide	Creating a secondary access method (index) with the Virtual-Index Interface (VII) to extend the built-in indexing schemes of IBM Informix Dynamic Server. Typically used with a DataBlade module.
Virtual-Table Interface Programmer's Guide	Creating a primary access method with the Virtual-Table Interface (VTI) so that users have a single SQL interface to Informix tables and to data that does not conform to the storage scheme of Informix Dynamic Server.

Table 2. Client/Connectivity Manuals

Manual	**Subject**
Client Products Installation Guide	Installing IBM Informix Client Software Developer's Kit (Client SDK) and IBM Informix Connect on computers that use UNIX, Linux, and Windows.
Embedded SQLJ User's Guide	Using IBM Informix Embedded SQLJ to embed SQL statements in Java programs.
ESQL/C Programmer's Manual	The IBM Informix implementation of embedded SQL for C.
GLS User's Guide	The Global Language Support (GLS) feature, which allows IBM Informix APIs and database servers to handle different languages, cultural conventions, and code sets.
JDBC Driver Programmer's Guide	Installing and using Informix JDBC Driver to connect to an Informix database from within a Java application or applet.
.NET Provider Reference Guide	Using Informix .NET Provider to enable .NET client applications to access and manipulate data in Informix databases.
ODBC Driver Programmer's Manual	Using the Informix ODBC Driver API to access an Informix database and interact with the Informix database server.
OLE DB Provider Programmer's Guide	Installing and configuring Informix OLE DB Provider to enable client applications, such as ActiveX Data Object (ADO) applications and Web pages, to access data on an Informix server.
Object Interface for C++ Programmer's Guide	The architecture of the C++ object interface and a complete class reference.

Table 3. DataBlade Developer's Kit Manuals

Manual	**Subject**
DataBlade Developer's Kit User's Guide	Developing and packaging DataBlade modules using BladeSmith and BladePack.
DataBlade Module Development Overview	Basic orientation for developing DataBlade modules. Includes an example illustrating the development of a DataBlade module.
DataBlade Module Installation and Registration Guide	Installing DataBlade modules and using BladeManager to manage DataBlade modules in Informix databases.

Compliance with Industry Standards

The American National Standards Institute (ANSI) and the International Organization of Standardization (ISO) have jointly established a set of industry standards for the Structured Query Language (SQL). IBM Informix SQL-based products are fully compliant with SQL-92 Entry Level (published as ANSI X3.135-1992), which is identical to ISO 9075:1992. In addition, many features of IBM Informix database servers comply with the SQL-92 Intermediate and Full Level and X/Open SQL Common Applications Environment (CAE) standards.

IBM Welcomes Your Comments

We want to know about any corrections or clarifications that you would find useful in our manuals, which will help us improve future versions. Include the following information:

- The name and version of the manual that you are using
- Section and page number
- Your suggestions about the manual

Send your comments to us at the following email address:

docinf@us.ibm.com

This email address is reserved for reporting errors and omissions in our documentation. For immediate help with a technical problem, contact IBM Technical Support. For instructions, see the IBM Informix Technical Support website at http://www-306.ibm.com/software/data/informix/support/contact.html.

We appreciate your suggestions.

Chapter 1. Overview of SQL Syntax

In This Chapter

This chapter provides information about how to use the SQL statements, SPL statements, and syntax segments that subsequent chapters of this book discuss. The chapter is organized into the following sections.

Section	Scope
"How to Enter SQL Statements"	How to use syntax diagrams and descriptions to enter SQL statements correctly
"How to Enter SQL Comments" on page 1-3	How to enter comments in SQL statements
"Categories of SQL Statements" on page 1-6	The SQL statements, listed by functional category
"ANSI/ISO Compliance and Extensions" on page 1-8	The SQL statements, listed by degree of ANSI/ISO compliance

How to Enter SQL Statements

SQL is a free-form language, like C or PASCAL, that generally ignores whitespace characters like TAB, LINEFEED, and extra blank spaces between statements or statement elements. At least one blank character or other delimiter, however, must separate keywords and identifiers from other syntax tokens.

SQL is lettercase-insensitive, except within quoted strings; see also "Identifier" on page 5-22. In an ANSI-compliant database, if you do not delimit the *owner* of an object by single (′) quotation marks, and the **ANSIOWNER** environment variable was not set to 1 when the database server was initialized, the database server stores the *owner* name in uppercase letters.

Statement descriptions are provided in this manual to help you to enter SQL statements successfully. A statement description includes this information:

- A brief introduction that explains what the statement does
- A syntax diagram that shows how to enter the statement correctly
- A syntax table that explains each input parameter in the syntax diagram
- Rules of usage, typically with examples that illustrate these rules

For some statements, this information is provided for individual clauses.

Most statement descriptions conclude with references to related information in this manual and in other manuals.

Chapter 2 provides descriptions of each SQL statement, arranged in alphabetical order. Chapter 3 describes each of the SPL statements, using the same format.

The major aids for entering SQL statements include:

- The combination of the syntax diagram and syntax table
- The examples of syntax that appear in the rules of usage
- The references to related information

Using Syntax Diagrams and Syntax Tables

Before you try to use the syntax diagrams in this chapter, it is helpful to read the section "Syntax Diagrams" on page xv of the Introduction. This section is the key to understanding the syntax diagrams and explains the elements that can appear in a syntax diagram and the paths that connect the elements to each other. This section also includes an example that illustrates the elements of typical syntax diagrams. The narrative that follows the example diagram shows how to read the diagram in order to enter the statement successfully.

Notes to the diagram can reference other syntax segments or can specify various restrictions. If you are using an application programming interface, such as ESQL/C or 4GL, only the SQL syntax rules that both your client application and the database server support are valid.

When a syntax diagram includes input specifications that are not keywords or punctuation symbols, such as identifiers, expressions, filenames, host variables, the syntax diagram is followed by a table that describes how to enter the term without generating errors. Each syntax table includes four columns:

- The **Element** column lists each variable term in the syntax diagram.
- The **Description** column briefly describes the term and identifies the default value, if the term has one.
- The **Restrictions** column summarizes the restrictions on the term, such as acceptable ranges of values. (For some diagrams, restrictions that cannot be tersely summarized appear in the **Usage** notes, rather than in this column.)
- The **Syntax** column points to the SQL segment that gives the detailed syntax for the term. For a few terms, such as the names of host variables, pathnames, or literal characters, no page reference is provided.

The diagrams generally provide an intuitive notation for what is valid in a given SQL statement, but for some statements, dependencies or restrictions among syntax elements are identified only in the text of the Usage section.

Using Examples

To understand the main syntax diagram and subdiagrams for a statement, study the examples of syntax that appear in the rules of usage for each statement. These examples have two purposes:

- To show how to accomplish specific tasks with the statement or its clauses
- To show how to use syntax of the statement or its clauses in a concrete way

Tip: An efficient way to understand a syntax diagram is to find an example of the syntax and compare it with the keywords and parameters in the syntax diagram. By mapping the concrete elements of the example to the abstract elements of the syntax diagram, you can understand the syntax diagram and use it more effectively.

For an explanation of the conventions used in the examples in this manual, see "Example Code Conventions" on page xviii of the Introduction.

These code examples are program fragments to illustrate valid syntax, rather than complete SQL programs. In some code examples, ellipsis (. . .) symbols indicate that additional code has been omitted. To save space, however, ellipses are not shown at the beginning or end of the program fragments.

Using Related Information

For help in understanding concepts and terms in the SQL statement description, check the "Related Information" section at the end of each statement.

This section points to related information in this manual and other manuals to help you understand the statement in question. The section provides some or all of the following information:

- The names of related statements that might contain a fuller discussion of topics in this statement
- The titles of other manuals that provide extended discussions of topics in this statement

Tip: If you do not have extensive knowledge and experience with SQL, the *IBM Informix Guide to SQL: Tutorial* gives you the basic SQL knowledge that you need to understand and use the statement descriptions in this manual.

How to Enter SQL Comments

You can add comments to clarify the purpose or effect of particular SQL statements. You can also use comment symbols during program development to disable individual statements without deleting them from your source code.

Your comments can help you or others to understand the role of the statement within a program, SPL routine, or command file. The code examples in this manual sometimes include comments that clarify the role of an SQL statement within the code, but your own SQL programs will be easier to read and to maintain if you document them with frequent comments.

The following table shows the SQL comment indicators that you can enter in your code. Here a *Y* in a column signifies that you can use the symbol with the product or with the type of database identified in the column heading. An *N* in a column signifies that you cannot use the symbol with the indicated product or with a database of the indicated ANSI-compliance status.

Comment Symbol	**ESQL/C**	**SPL Routine**	**DB–Access**	**ANSI-Compliant Databases**	**Databases Not ANSI Compliant**	**Description**
double hyphen (--)	Y	Y	Y	Y	Y	The double hyphen precedes a comment within a single line. To comment more than one line, put double hyphen symbols at the beginning of each comment line.
braces ({ . . . })	N	Y	Y	Y	Y	Braces enclose the comment. The { precedes the comment, and the } follows it. Braces can delimit single- or multiple-line comments, but comments cannot be nested.
slash and asterisk /* . . . */	Y	Y	Y	Y	Y	C-language style slash and asterisk (/* */) paired delimiters enclose the comment. The /* precedes the comment, and the */ follows it. These can delimit single-line or multiple-line comments, but comments cannot be nested.

Characters within the comment are ignored by the database server.

The section "Optimizer Directives" on page 5-34 describes a context where information within comments can influence query plans of Dynamic Server.

If the product that you use supports all of these comment symbols, your choice of a comment symbol depends on requirements for ANSI/ISO compliance:
- Double hyphen (--) complies with the ANSI/ISO standard for SQL.
- Braces ({ }) are an Informix extension to the ANSI/ISO standard.
- C-style slash-and-asterisk (/* . . . */) comply with the SQL-99 standard.

If ANSI/ISO compliance is not an issue, your choice of comment symbols is a matter of personal preference.

In DB–Access, you can use any of these comment symbols when you enter SQL statements with the SQL editor and when you create SQL command files with the SQL editor or a system editor. C-style (/* . . . */) comments, however, are not supported by DB–Access within CONNECT, DISCONNECT, INFO, LOAD, OUTPUT, SET CONNECT, nor UNLOAD statements.

An SQL command file is an operating-system file that contains one or more SQL statements. Command files are also known as command scripts. For more information about command files, see the discussion of command scripts in the *IBM Informix Guide to SQL: Tutorial*. For information on how to create and modify command files with the SQL editor or a system editor in DB–Access, see the *IBM Informix DB–Access User's Guide*.

You can use either comment symbol in any line of an SPL routine. See the discussion of how to comment and document an SPL routine in the *IBM Informix Guide to SQL: Tutorial*.

In ESQL/C, the double hyphen (`--`) can begin a comment that extends to the end of the same line. For information on language-specific comment symbols in ESQL/C programs, see the *IBM Informix ESQL/C Programmer's Manual*.

Examples of SQL Comment Symbols

These examples illustrate different ways to use the SQL comment indicators.

Examples of the Double-Hyphen Symbol

The next example uses the double hyphen (`--`) to include a comment after an SQL statement. The comment appears on the same line as the statement.

```
SELECT * FROM customer -- Selects all columns and rows
```

The following example uses the same SQL statement and the same comment as in the preceding example, but places the comment on a separate line:

```
SELECT * FROM customer
   -- Selects all columns and rows
```

In the following example, the user enters the same SQL statement as in the preceding example but now enters a multiple-line comment:

```
SELECT * FROM customer
   -- Selects all columns and rows
   -- from the customer table
```

Examples of the Braces Symbols

This example uses braces ({ }) to delimit a comment after an SQL statement. In this example, the comment appears on the same line as the statement.

```
SELECT * FROM customer {Selects all columns and rows}
```

The next example uses the same SQL statement and the same comment as in the preceding example, but the comment appears on a line by itself:

```
SELECT * FROM customer
   {Selects all columns and rows}
```

In the following example, the same SQL statement as in the preceding example is followed by a multiple-line comment:

```
SELECT * FROM customer
   {Selects all columns and rows
    from the customer table}
```

Non-ASCII Characters in SQL Comments

You can enter non-ASCII characters (including multibyte characters) in SQL comments if the database locale supports the non-ASCII characters. For further information on the GLS aspects of SQL comments, see the *IBM Informix GLS User's Guide*.

Categories of SQL Statements

SQL statements are traditionally divided into the following logical categories:

- **Data definition statements**. These *data definition language* (DDL) statements can declare, rename, modify, or destroy objects in the local database.
- **Data manipulation statements**. These *data manipulation language* (DML) statements can retrieve, insert, delete, or modify data values.
- **Cursor manipulation statements**. These statements can declare, open, and close *cursors*, which are data structures for operations on multiple rows of data.
- **Dynamic management statements**. These statements support memory management and allow users to specify at runtime the details of DML operations.
- **Data access statements**. These statements specify access privileges and support concurrent access to the database by multiple users.
- **Data integrity statement**s. These implement transaction logging and support the referential integrity of the database.
- **Optimization statements**. These can be used to improve the performance of operations on the database.
- **Routine definition statements**. These can declare, define, modify, execute, or destroy user-defined routines that the database stores.
- **Client/server connection statements**. These can open or close a connection between a database and a client application.
- **Auxiliary statements**. These can provide information about the database. (This is also a residual category for statements that are not closely related to the other statement categories.)
- **Optical subsystem statements**. These statements are separately documented in *IBM Informix Optical Subsystem Guide*.

The SQL statements of each category are listed in the pages that follow.

As Chapter 2 indicates, some statements (and some statement options, as noted in the syntax diagrams) are specific to Dynamic Server (sometimes abbreviated as ″IDS″) or are specific to Extended Parallel Server (sometimes abbreviated as ″XPS″).

Data Definition Language Statements

3 ALTER ACCESS_METHOD
3 ALTER FRAGMENT
3 ALTER FUNCTION
3 ALTER INDEX
3 ALTER PROCEDURE
3 ALTER ROUTINE
3 ALTER SEQUENCE
3 ALTER TABLE
3 CLOSE DATABASE
3 CREATE ACCESS_METHOD
3 CREATE AGGREGATE
3 CREATE CAST
3 CREATE DATABASE
3 CREATE DISTINCT TYPE
3 CREATE DUPLICATE
3 CREATE EXTERNAL TABLE
3 CREATE FUNCTION
3 CREATE FUNCTION FROM
3 CREATE INDEX
3 CREATE OPAQUE TYPE
3 CREATE OPCLASS
3 CREATE PROCEDURE
3 CREATE PROCEDURE FROM
3 CREATE ROLE
3 CREATE ROUTINE FROM
3 CREATE ROW TYPE
3 CREATE SCHEMA
3 CREATE SEQUENCE
3 CREATE SYNONYM
3 CREATE TABLE
3 CREATE Temporary TABLE
3 CREATE TRIGGER
3 CREATE VIEW
3 CREATE XADATASOURCE

3 CREATE XADATASOURCE TYPE
3 DROP ACCESS_METHOD
3 DROP AGGREGATE
3 DROP CAST
3 DROP DATABASE
3 DROP DUPLICATE
3 DROP FUNCTION
3 DROP INDEX
3 DROP OPCLASS
3 DROP PROCEDURE
3 DROP ROLE
3 DROP ROUTINE
3 DROP ROW TYPE
3 DROP SEQUENCE
3 DROP SYNONYM
3 DROP TABLE
3 DROP TRIGGER
3 DROP TYPE
3 DROP VIEW
3 DROP XADATASOURCE
3 DROP XADATASOURCE TYPE
3 MOVE
3 RENAME COLUMN
3 RENAME DATABASE
3 RENAME INDEX
3 RENAME SEQUENCE
3 RENAME TABLE
3 TRUNCATE

Data Manipulation Language Statements

DELETE
INSERT
LOAD
MERGE
SELECT
UNLOAD
UPDATE

Note: The DELETE, INSERT, SELECT, and UPDATE statements are DML statements in the ANSI/ISO standard for SQL. Although LOAD, UNLOAD, and MERGE resemble DML in their functionality, these are out-of-scope for most references in this manual to "DML statements."

Data Integrity Statements

BEGIN WORK
COMMIT WORK
ROLLBACK WORK
SET Database Object Mode
SET LOG
SET PLOAD FILE
SET Transaction Mode
START VIOLATIONS TABLE
STOP VIOLATIONS TABLE

Cursor Manipulation Statements

CLOSE
DECLARE
FETCH
FLUSH
FREE
OPEN
PUT
SET AUTOFREE

Dynamic Management Statements

ALLOCATE COLLECTION
ALLOCATE DESCRIPTOR
ALLOCATE ROW
DEALLOCATE COLLECTION
DEALLOCATE DESCRIPTOR
DEALLOCATE ROW
DESCRIBE
DESCRIBE INPUT
EXECUTE
EXECUTE IMMEDIATE
FREE
GET DESCRIPTOR
INFO
PREPARE
SET DEFERRED_PREPARE
SET DESCRIPTOR

Data Access Statements

GRANT
GRANT FRAGMENT
LOCK TABLE
REVOKE
REVOKE FRAGMENT
SET ISOLATION
SET LOCK MODE
SET ROLE
SET SESSION AUTHORIZATION
SET TRANSACTION
SET Transaction Mode
UNLOCK TABLE

Optimization Statements

SAVE EXTERNAL DIRECTIVES
SET ALL_MUTABLES
SET Default Table Space
SET Default Table Type
SET ENVIRONMENT
SET EXPLAIN
SET OPTIMIZATION
SET PDQPRIORITY
SET Residency
SET SCHEDULE LEVEL
SET STATEMENT CACHE
UPDATE STATISTICS

Routine Definition Statements

ALTER FUNCTION
ALTER PROCEDURE
ALTER ROUTINE
CREATE FUNCTION
CREATE FUNCTION FROM
CREATE PROCEDURE
CREATE PROCEDURE FROM
CREATE ROUTINE FROM
DROP FUNCTION
DROP PROCEDURE
DROP ROUTINE
EXECUTE FUNCTION
EXECUTE PROCEDURE
SET DEBUG FILE TO

Auxiliary Statements

GET DIAGNOSTICS
INFO
OUTPUT

SET COLLATION
SET DATASKIP
SET ENCRYPTION PASSWORD
WHENEVER

Client/Server Connection Statements

CONNECT
DATABASE
DISCONNECT
SET CONNECTION

Optical Subsystem Statements (IDS)

ALTER OPTICAL CLUSTER
CREATE OPTICAL CLUSTER
DROP OPTICAL CLUSTER
RELEASE
RESERVE
SET MOUNTING TIMEOUT

Important: See the *IBM Informix Optical Subsystem Guide* for more information.

ANSI/ISO Compliance and Extensions

Lists that follow show statements that match the ANSI SQL-92 standard at the entry level, statements that are ANSI compliant but include Informix extensions, and statements that are Informix extensions to the ANSI/ISO standard.

ANSI/ISO-Compliant Statements

CLOSE
COMMIT WORK
EXECUTE IMMEDIATE
ROLLBACK WORK
SET SESSION AUTHORIZATION
SET TRANSACTION

ANSI/ISO-Compliant Statements with Informix Extensions

ALLOCATE DESCRIPTOR
ALTER TABLE
CONNECT
CREATE SCHEMA

CREATE TABLE
CREATE Temporary TABLE
CREATE VIEW
DEALLOCATE DESCRIPTOR
DECLARE
DELETE
DESCRIBE
DESCRIBE INPUT
DISCONNECT
EXECUTE
FETCH

GET DESCRIPTOR
GET DIAGNOSTICS

GRANT
INSERT
OPEN
PREPARE
REVOKE

SELECT
SET CONNECTION
SET CONSTRAINTS
SET DESCRIPTOR
SET Transaction Mode

UPDATE
WHENEVER

Statements that are Extensions to the ANSI/ISO Standard

ALLOCATE COLLECTION
ALLOCATE ROW
ALTER ACCESS_METHOD
ALTER FRAGMENT
ALTER FUNCTION
ALTER INDEX
ALTER OPTICAL CLUSTER
ALTER PROCEDURE
ALTER ROUTINE
ALTER SEQUENCE
BEGIN WORK
CLOSE DATABASE
CREATE ACCESS_METHOD
CREATE AGGREGATE
CREATE CAST
CREATE DATABASE
CREATE DISTINCT TYPE
CREATE DUPLICATE
CREATE EXTERNAL TABLE
CREATE FUNCTION
CREATE FUNCTION FROM
CREATE INDEX
CREATE OPAQUE TYPE
CREATE OPCLASS
CREATE OPTICAL CLUSTER
CREATE PROCEDURE
CREATE PROCEDURE FROM
CREATE ROLE
CREATE ROUTINE FROM
CREATE ROW TYPE
CREATE SEQUENCE
CREATE SYNONYM
CREATE TRIGGER
CREATE XADATASOURCE
CREATE XADATASOURCE TYPE

DATABASE
DEALLOCATE COLLECTION
DEALLOCATE ROW
DROP ACCESS_METHOD

DROP AGGREGATE
DROP CAST
DROP DATABASE
DROP DUPLICATE DROP FUNCTION
DROP INDEX
DROP OPCLASS
DROP OPTICAL CLUSTER
DROP PROCEDURE
DROP ROLE
DROP ROUTINE
DROP ROW TYPE
DROP SEQUENCE
DROP SYNONYM
DROP TABLE
DROP TRIGGER
DROP TYPE
DROP VIEW
DROP XADATASOURCE
DROP XADATASOURCE TYPE

EXECUTE FUNCTION
EXECUTE PROCEDURE

FLUSH
FREE

GET DIAGNOSTICS
GRANT FRAGMENT

LOAD
LOCK TABLE

MERGE
MOVE

OUTPUT

PUT

RELEASE
RENAME COLUMN
RENAME DATABASE
RENAME INDEX
RENAME SEQUENCE
RENAME TABLE
RESERVE
REVOKE FRAGMENT

SAVE EXTERNAL DIRECTIVES
SET ALL_MUTABLES
SET AUTOFREE
SET COLLATION
SET Database Object Mode
SET DATASKIP
SET DEBUG FILE TO
SET Default Table Space
SET Default Table Type
SET DEFERRED_PREPARE
SET ENCRYPTION PASSWORD
SET ENVIRONMENT
SET EXPLAIN
SET ISOLATION
SET LOCK MODE
SET LOG
SET MOUNTING TIMEOUT
SET OPTIMIZATION
SET PDQPRIORITY
SET PLOAD FILE
SET Residency
SET ROLE
SET SCHEDULE LEVEL
SET STATEMENT CACHE
START VIOLATIONS TABLE
STOP VIOLATIONS TABLE

TRUNCATE

UNLOAD
UNLOCK TABLE
UPDATE STATISTICS

Chapter 2. SQL Statements

In This Chapter

This chapter describes the syntax and semantics of SQL statements that are recognized by Dynamic Server or by Extended Parallel Server. Statements (and statement segments, and notes describing usage) that are not explicitly restricted to one of these database servers are valid for both.

The statement descriptions appear in alphabetical order. For some statements, important details of the semantics appear in other volumes of this documentation set, as indicated by cross-references.

For many statements, the syntax diagram, or the table of terms immediately following the diagram, or both, includes references to syntax segments in Chapter 4, “Data Types and Expressions,” on page 4-1 or in Chapter 5, “Other Syntax Segments,” on page 5-1.

When the name of an SQL statement includes lowercase characters, such as ”CREATE Temporary TABLE,” it means that the first mixed-lettercase string in the statement name is not an SQL keyword, but that two or more different SQL keywords can follow the preceding uppercase keyword.

For an explanation of the structure of statement descriptions, see Chapter 1, “Overview of SQL Syntax,” on page 1-1.

ALLOCATE COLLECTION

Use the ALLOCATE COLLECTION statement to allocate memory for a variable of a collection data type (such as LIST, MULTISET, or SET) or an untyped collection variable.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. Use this statement with ESQL/C.

Syntax

```
►►──ALLOCATE COLLECTION──variable──────────────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
variable	Name of the typed or untyped collection variable to allocate	Must be an unallocated ESQL/C collection-type host variable	Language-specific rules for names

Usage

The ALLOCATE COLLECTION statement allocates memory for an ESQL/C variable that can store the value of a collection data type.

To create a collection variable for an ESQL/C program:

1. Declare the collection variable as a client collection variable in an ESQL/C program.

   The collection variable can be a typed or untyped collection variable.
2. Allocate memory for the collection variable with the ALLOCATE COLLECTION statement.

The ALLOCATE COLLECTION statement sets **SQLCODE** (that is, **sqlca.sqlcode**) to zero (0) if the memory allocation was successful and to a negative error code if the allocation failed.

You must explicitly release memory with the DEALLOCATE COLLECTION statement. After you free the collection variable with the DEALLOCATE COLLECTION statement, you can reuse the collection variable.

Tip: The ALLOCATE COLLECTION statement allocates memory for an ESQL/C collection variable only. To allocate memory for an ESQL/C row variable, use the ALLOCATE ROW statement.

Examples

The following example shows how to allocate resources with the ALLOCATE COLLECTION statement for the untyped collection variable, **a_set**:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection a_set;
EXEC SQL END DECLARE SECTION;
. . .
EXEC SQL allocate collection :a_set;
```

The following example uses ALLOCATE COLLECTION to allocate resources for a typed collection variable, **a_typed_set**:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection set(integer not null) a_typed_set;
EXEC SQL END DECLARE SECTION;
. . .
EXEC SQL allocate collection :a_typed_set;
```

Related Information

Related examples: Refer to the collection-variable example in PUT.

Related statements: ALLOCATE ROW and DEALLOCATE COLLECTION

For a discussion of collection data types in ESQL/C programs, see the *IBM Informix ESQL/C Programmer's Manual*.

ALLOCATE DESCRIPTOR

Use the ALLOCATE DESCRIPTOR statement to allocate memory for a system-descriptor area (SDA). Use this statement with ESQL/C.

Syntax

```
►►──ALLOCATE DESCRIPTOR──┬─'descriptor'───┬──┬──────────────────────────┬──────────►◄
                         └─descriptor_var─┘  └─WITH MAX──┬─items─────┬──┘
                                                         └─items_var─┘
```

Element	Description	Restrictions	Syntax
descriptor	Name of an unallocated system-descriptor area	Enclose in single (') quotes. Must be unique among SDA names	"Quoted String" on page 4-142.
descriptor_var	Host variable that stores the name of a system-descriptor area	Must contain name of unallocated system-descriptor area	Language specific
items	Number of item descriptors in *descriptor.* Default value is `100`.	Must be an unsigned INTEGER greater than zero	"Literal Number" on page 4-137
items_var	Host variable that contains the number of items	Data type must be INTEGER or SMALLINT	Language specific

Usage

The ALLOCATE DESCRIPTOR statement creates a *system-descriptor area*, which is a location in memory that holds information that the DESCRIBE statement can display, or that holds information about the WHERE clause of a query.

A system-descriptor area (SDA) contains one or more fields called *item descriptors*. Each item descriptor holds a data value that the database server can receive or send. The item descriptors also contain information about the data, such as data type, length, scale, precision, and nullability.

A system-descriptor area holds information that a DESCRIBE...USING SQL DESCRIPTOR statement obtains or that holds information about the WHERE clause of a dynamically executed statement.

If the name that you assign to a system-descriptor area matches the name of an existing system-descriptor area, the database server returns an error. If you free the descriptor with the DEALLOCATE DESCRIPTOR statement, however, you can reuse the same descriptor name.

WITH MAX Clause

You can use the WITH MAX clause to indicate the maximum number of item descriptors you need. When you use this clause, the COUNT field is set to the number of *items that* you specify. If you do not specify the WITH MAX clause, the default value of the COUNT field is `100`. You can change the value of the COUNT field with the SET DESCRIPTOR statement.

The following examples show valid ALLOCATE DESCRIPTOR statements. Each example includes the WITH MAX clause. The first line uses embedded variable names to identify the system-descriptor area and to specify the desired number of item descriptors. The second line uses a quoted string to identify the system-descriptor area and an unsigned integer to specify the desired number of item descriptors.

```
EXEC SQL allocate descriptor :descname with max :occ;

EXEC SQL allocate descriptor 'desc1' with max 3;
```

Related Information

Related statements: DEALLOCATE DESCRIPTOR, DECLARE, DESCRIBE, EXECUTE, FETCH, GET DESCRIPTOR, OPEN, PREPARE, PUT, and SET DESCRIPTOR

For more information on system-descriptor areas, refer to the *IBM Informix ESQL/C Programmer's Manual*.

ALLOCATE ROW

Use the ALLOCATE ROW statement to allocate memory for a **row** variable. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. Use this statement with ESQL/C.

Syntax

```
►►──ALLOCATE ROW──variable──────────────────────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
variable	Name of a typed or untyped **row** variable to allocate	Must be an unallocated ESQL/C row-type host variable	Language specific

Usage

The ALLOCATE ROW statement allocates memory for a host variable that stores row-type data. To create a **row** variable, an ESQL/C program must do the following:

1. Declare the **row** variable. The row variable can be a typed or untyped **row** variable.
2. Allocate memory for the **row** variable with the ALLOCATE ROW statement.

The following example shows how to allocate resources with the ALLOCATE ROW statement for the typed **row** variable, **a_row**:

```
EXEC SQL BEGIN DECLARE SECTION;
   row (a int, b int) a_row;
EXEC SQL END DECLARE SECTION;
. . .
EXEC SQL allocate row :a_row;
```

The ALLOCATE ROW statement sets **SQLCODE** (the contents of **sqlca.sqlcode**) to zero (0) if the memory allocation operation was successful, or to a negative error code if the allocation failed.

You must explicitly release memory with the DEALLOCATE ROW statement. Once you free the **row** variable with the DEALLOCATE ROW statement, you can reuse the **row** variable.

Tip: The ALLOCATE ROW statement allocates memory for an ESQL/C **row** variable only. To allocate memory for an ESQL/C **collection** variable, use the ALLOCATE COLLECTION statement.

When you use the same **row** variable in multiple function calls without deallocating it, a memory leak on the client computer results. Because there is no way to determine if a pointer is valid when it is passed, ESQL/C assumes that the pointer is not valid and assigns it to a new memory location.

Related Information

Related statements: ALLOCATE COLLECTION and DEALLOCATE ROW

For a discussion of complex data types in ESQL/C programs, see the *IBM Informix ESQL/C Programmer's Manual*.

ALTER ACCESS_METHOD

The ALTER ACCESS_METHOD statement changes the attributes of a user-defined access method in the **sysams** system catalog table.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──ALTER ACCESS_METHOD──access_method─────────────────────────────────────►


    ┌─,──────────────────────────────────────┐
    ▼                                (1)     │
►──┬─┬─MODIFY─┬─┤ Purpose Option ├────────┬┴──────────────────────────────►◄
   │ └─ADD────┘                           │
   └─DROP──purpose_keyword────────────────┘
```

Notes:

1 See "Purpose Options" on page 5-46

Element	Description	Restrictions	Syntax
access _method	Name of the access method to alter	Access method must be registered in the **sysams** system catalog table by a previous CREATE ACCESS_METHOD statement	"Database Object Name" on page 5-17
purpose _keyword	A keyword that indicates which feature to change	Keyword must be associated with the access method by a previous CREATE or ALTER ACCESS_METHOD statement	"Purpose Functions, Methods, Flags, and Values" on page 5-47

Usage

Use ALTER ACCESS_METHOD to modify the definition of a user-defined access method. You must be the owner of the access method or have DBA privileges to alter an access method.

When you alter an access method, you change the purpose-option specifications (purpose functions, purpose methods, purpose flags, or purpose values) that define the access method. For example, you might alter an access method to assign a new user-defined function or method name or to provide a multiplier for the scan cost on a table.

If a transaction is in progress, the database server waits to alter the access method until after the transaction is committed or rolled back. No other users can execute the access method until the transaction has completed.

Example

The following statement alters the **remote** user-defined access method:

```
ALTER ACCESS_METHOD remote
   ADD am_scancost = FS_scancost,
   ADD am_rowids,
   DROP am_getbyid,
   MODIFY am_costfactor = 0.9;
```

The preceding example makes the following changes to the access method:

- Adds a user-defined function or method named **FS_scancost( )**, which is associated in the **sysams** table with the **am_scancost** keyword
- Sets (adds) the **am_rowids** flag
- Drops the user-defined function or method associated with the **am_getbyid** keyword
- Modifies the **am_costfactor** value

Related Information

Related statements: CREATE ACCESS_METHOD and DROP ACCESS_METHOD

For information about how to set purpose-option specifications, see "Purpose Options" on page 5-46.

For the schema of the **sysams** system catalog table, see the *IBM Informix Guide to SQL: Reference*.

For more information on primary-access methods, see the *IBM Informix Virtual-Table Interface Programmer's Guide*.

For more information on secondary-access methods, see the *IBM Informix Virtual-Index Interface Programmer's Guide* and the *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

For a discussion of privileges, see the GRANT statement in this chapter, or the *IBM Informix Database Design and Implementation Guide*.

ALTER FRAGMENT

Use the ALTER FRAGMENT statement to change the distribution strategy or the storage location of an existing table or index.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>--ALTER FRAGMENT ON------------------------------------------------------->


                                                (1)
>--+-TABLE--surviving_table--+-| ATTACH Clause |------------+-+------------><
   |                         |                  (2)         | |
   |                         +-| DETACH Clause |------------+ |
   |                         |                (3)           | |
   |                         +-| INIT Clause |--------------+ |
   |                         |               (4)            | |
   |                         +-| ADD Clause |---------------+ |
   |                         | (5)                  (6)     | |
   |                         '------+-| DROP Clause |-------+ |
   |                                |                 (7)   | |
   |                                '-| MODIFY Clause |-----' |
   |    (5)                                         (3)       |
   '-------INDEX--surviving_index--+-| INIT Clause |------+---'
                                   |                (4)   |
                                   +-| ADD Clause |-------+
                                   |                  (6) |
                                   +-| DROP Clause |------+
                                   |                  (7) |
                                   '-| MODIFY Clause |----'
```

Notes:

1 See “ATTACH Clause” on page 2-13

2 See “DETACH Clause” on page 2-19

3 See “INIT Clause” on page 2-20

4 See “ADD Clause” on page 2-26

5 Dynamic Server only

6 See “DROP Clause (IDS)” on page 2-27

7 See “MODIFY Clause (IDS)” on page 2-28

Element	Description	Restrictions	Syntax
surviving _index	Index on which to modify the distribution or storage	Must exist when the statement executes	“Database Object Name” on page 5-17
surviving _table	Table on which to modify the distribution or storage	Must exist. See “Restrictions on the ALTER FRAGMENT Statement” on page 2-12.	“Database Object Name” on page 5-17

Usage

The ALTER FRAGMENT statement applies only to table fragments or index fragments that are located at the current site (or the current cluster, for Extended Parallel Server). No remote information is accessed or updated.

You must have the Alter or the DBA privilege to change the fragmentation strategy of a table. You must have the Index or the DBA privilege to alter the fragmentation strategy of an index.

Attention: This statement can cause indexes to be dropped and rebuilt. Before undertaking alter operations, check corresponding sections in your *IBM Informix Performance Guide* to review effects and strategies.

Clauses of the ALTER FRAGMENT statement support the following tasks.

Clause	**Effect**
ATTACH	Combines two or more tables that have the same schema into a single fragmented table
DETACH	Detaches a table fragment (or in Extended Parallel Server, a slice) from a fragmentation strategy, and places it in a new table
INIT	Provides the following options: • Defines and initializes a fragmentation strategy on a table • Creates a fragmentation strategy for tables • Changes the order of evaluation of fragment expressions • Alters the fragmentation strategy of a table or index • Changes the storage location of an existing table
ADD	Adds an additional fragment to an existing fragmentation list
DROP	Drops an existing fragment from a fragmentation list
MODIFY	Changes an existing fragmentation expression

Use the CREATE TABLE statement or the INIT clause of the ALTER FRAGMENT statement to create fragmented tables.

After a dbspace has been renamed successfully by the **onspaces** utility, only the new name can reference the renamed dbspace. Existing fragmentation strategies for tables or indexes are automatically updated, however, by the database server to replace the old dbspace name with the new name. You do not need to take any additional action to update a distribution strategy or storage location that was defined using the old dbspace name, but you must use the new name if you reference the dbspace in an ALTER FRAGMENT or ALTER TABLE statement.

Restrictions on the ALTER FRAGMENT Statement

You cannot use the ALTER FRAGMENT statement on a temporary table, an external table, or on a view. If your table or index is not already fragmented, the only clauses available to you are INIT and ATTACH.

In Extended Parallel Server, you cannot use ALTER FRAGMENT on a generalized-key (GK) index. If the *surviving_table* has hash fragmentation, the only clauses available are ATTACH and INIT. You cannot use ALTER FRAGMENT on any table that has a dependent GK index defined on it. In addition, you cannot use this statement on a table that has range fragmentation.

In Dynamic Server, you cannot use ALTER FRAGMENT on a typed table that is part of a table hierarchy.

ALTER FRAGMENT and Transaction Logging

If your database supports transaction logging, ALTER FRAGMENT is executed within a single transaction. If the fragmentation strategy uses large numbers of records, you might run out of log space or disk space. (To alter a fragmentation strategy, the database server requires extra disk space that it later frees.)

If you run out of log space or disk space, try one of the following procedures to reduce your log-space or disk-space requirements:

- Turn off logging and turn it back on again at the end of the operation. This procedure indirectly requires a backup of the **root** dbspace.
- Split the operations into multiple ALTER FRAGMENT statements, moving a smaller portion of records each time.

For information about log-space requirements and disk-space requirements, see your *IBM Informix Administrator's Guide*. That guide also contains detailed instructions about how to turn off logging. For information about backups, refer to your *IBM Informix Backup and Restore Guide*.

Determining the Number of Rows in the Fragment

You can place as many rows into a fragment as the available space in the partition, dbspace, or dbslice allows.

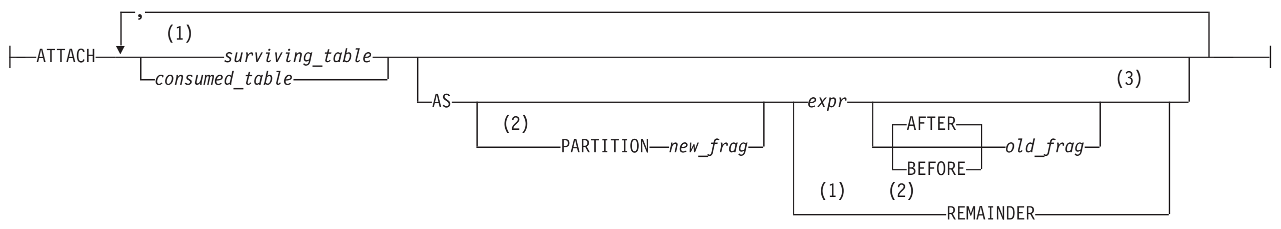
To find out how many rows are in a fragment:

1. Run the UPDATE STATISTICS statement on the table. This step fills the **sysfragments** system catalog table with the current table information.
2. Query the **sysfragments** system catalog table to examine the **npused** and **nrows** values. The **npused** column shows the number of data pages used in the fragment, and the **nrows** column shows the number of rows in the fragment.

ATTACH Clause

Use the ATTACH clause of the ALTER FRAGMENT ON TABLE statement to combine tables that have identical structures into a fragmentation strategy.

ATTACH Clause:



Notes:

1 Use path no more than once

2 Dynamic Server only; required if another *surviving_table* fragment has same name as dbspace

3 Required for fragmentation by expression; optional for round-robin fragmentation

Element	Description	Restrictions	Syntax
consumed _table	Table that loses its identity to be merged with *surviving_table*	Must exist. Cannot include serial columns nor unique, referential, or primary key constraints. See also "General Restrictions for the ATTACH Clause" on page 2-14.	"Database Object Name" on page 5-17
expr	Expression defining which rows are stored in a fragment of a fragmented-by-expression table	Can include only columns from the current table and only data values from a single row. See also "General Restrictions for the ATTACH Clause" on page 2-14.	"Condition" on page 4-5; "Expression" on page 4-34
new_frag	Name declared here for *consumed_table* fragment. Default is the dbspace name.	Must be unique among the names of partitions and of dbspaces that store fragments of *surviving_table*	"Identifier" on page 5-22
old_frag	Partition or dbspace where a *surviving_table* fragment exists	Must exist. See also "Altering Hybrid-Fragmented Tables (XPS)" on page 2-16.	"Identifier" on page 5-22
surviving _table	Table on which to modify the distribution or storage location	Must exist. Cannot have any constraints. See also "Restrictions on the ALTER FRAGMENT Statement" on page 2-12.	"Database Object Name" on page 5-17

To use this clause, you must have the DBA privilege or else be the owner of the specified tables. The ATTACH clause supports the following tasks:

- Creates a single fragmented table by combining two or more identically-structured, nonfragmented tables

  (See "Combining Nonfragmented Tables to Create a Fragmented Table" on page 2-15.)
- Attaches one or more tables to a fragmented table

  (See "Attaching a Table to a Fragmented Table" on page 2-15.)

General Restrictions for the ATTACH Clause

This clause is not valid in ALTER FRAGMENT ON INDEX statements.

Any tables that you attach must have been created previously in separate partitions. You cannot attach the same table more than once.

All consumed tables listed in the ATTACH clause must have the same structure as the surviving table. The number, names, data types, and relative position of the columns must be identical.

The *expression* cannot include aggregates, subqueries, or variant functions.

Additional Restrictions on the ATTACH Clause in Dynamic Server:
User-defined routines and references to fields of a ROW-type column are not valid. You cannot attach a fragmented table to another fragmented table.

All of the dbspaces that store the fragments must have the same page size.

Additional Restrictions on the ATTACH Clause in XPS: In addition to the general restrictions, every consumed table must be of the same usage type as the surviving table. For information about how to specify the usage type of a table, refer to "Logging Options" on page 2-172.

The ATTACH clause is not valid under either of the following conditions:

- If the consumed tables contain data that belongs in some existing fragment of the surviving table
- If existing data in the surviving table would belong in a new fragment

Thus, you cannot use the ATTACH clause for data movement among fragments. To perform this task, see the "INIT Clause" on page 2-20.

Using the BEFORE, AFTER, and REMAINDER Options

The BEFORE and AFTER options allow you to place a new fragment either before or after an existing dbspace. You cannot use the BEFORE and AFTER options when the distribution scheme is round-robin.

When you attach a new fragment without an explicit BEFORE or AFTER option, the database server places the added fragment at the end of the fragmentation list, unless a remainder fragment exists. If a remainder fragment exists, the new fragment is placed just before the remainder fragment. You cannot attach a new fragment after the remainder fragment.

In Extended Parallel Server, when you create or append to a hybrid-fragmented table, the positioning specification (BEFORE or AFTER) applies to an entire dbslice. You can use any dbspace in a dbslice to identify the dbslice for the BEFORE or AFTER position.

If you omit the AS PARTITION *fragment* specification, the name of the fragment is the name of the dbspace where it is stored.

Combining Nonfragmented Tables to Create a Fragmented Table

When you transform tables with identical table structures into fragments in a single table, you allow the database server to manage the fragmentation instead of allowing the application to manage the fragmentation. The distribution scheme can be round-robin or expression based.

To make a single, fragmented table from two or more identically-structured, nonfragmented tables, the ATTACH clause must contain the surviving table in the *attach list*. The attach list is the list of tables in the ATTACH clause.

In Dynamic Server, to include a **rowid** column in the newly-created single, fragmented table, attach all tables first and then add the **rowid** with the ALTER TABLE statement.

Attaching a Table to a Fragmented Table

To attach a nonfragmented table to an already fragmented table, the nonfragmented table must have been created in a separate dbspace and must have the same table structure as the fragmented table. In the following example, a round-robin distribution scheme fragments the table **cur_acct**, and the table **old_acct** is a nonfragmented table that resides in a separate dbspace. The following example shows how to attach (as the consumed table) **old_acct** to **cur_acct** (as the surviving table):

```
ALTER FRAGMENT ON TABLE cur_acct ATTACH old_acct
```

In Dynamic Server, when you attach one or more tables to a fragmented table, a *consumed_table* must be nonfragmented.

In Extended Parallel Server, when you attach one or more tables to a fragmented table, a *consumed_table* can be nonfragmented or have hash fragmentation. If you specify a *consumed_table* that has hash fragmentation, the hash column specification must match that of the *surviving_table* and of any other *consumed_table* involved in the attach operation.

Altering Hybrid-Fragmented Tables (XPS)

When you alter a hybrid-fragmented table with an ATTACH or DETACH clause, you need specify only one dbspace to identify the entire set of dbspaces associated with a given expression in the base fragmentation strategy of the table. The set of dbspaces associated with an expression in the base fragmentation strategy of the table might have been defined as one or more dbslices or dbspaces. For more information, see "Fragmenting by HYBRID (XPS)" on page 2-195.

If you know the dbslice name, but not the names of any of the dbspaces that make it up, you can name the first dbspace in the dbslice by appending `.1` to the dbslice name. For example, if the dbslice were named **dbsl1**, you could specify `dbsl1.1`.

Effect of the ATTACH Clause

After an ATTACH operation, all consumed tables no longer exist. Any CHECK constraints or NOT NULL constraints on the consumed tables also no longer exist. You must reference the records that were in the consumed tables through the surviving table.

What Happens to Indexes?: A detached index on the surviving table retains its same fragmentation strategy. That is, a detached index does not automatically adjust to accommodate the new fragmentation of the surviving table. For more information on what happens to indexes, see the discussion about altering table fragments in your *IBM Informix Performance Guide*.

In a logging database, an ATTACH operation extends any attached index on the surviving table according to the new fragmentation strategy of the surviving table. All rows in the consumed table are subject to these automatically adjusted indexes. For information on whether the database server completely rebuilds the index on the surviving table or reuses an index that was on the consumed table, see your *IBM Informix Performance Guide*.

In a nonlogging database of Dynamic Server, an ATTACH operation does not extend indexes on the surviving table according to the new fragmentation strategy of the surviving table. To extend the fragmentation strategy of an attached index according to the new fragmentation strategy of the surviving table, you must drop the index and re-create it on the surviving table.

What Happens to BYTE and TEXT Columns?: When an ATTACH occurs, BYTE and TEXT fragments of the consumed table become part of the surviving table and continue to be associated with the same rows and data fragments as they were before the ATTACH operation.

In Dynamic Server, each BYTE and TEXT column in every table that is specified in the ATTACH clause must have the same storage type, either blobspace or tblspace. If the BYTE or TEXT column is stored in a blobspace, the same column in all tables must be in the same blobspace. If the BYTE or TEXT column is stored in a tblspace, the same column must be stored in a tblspace in all tables.

In Extended Parallel Server, BYTE and TEXT columns are stored in separate, additional fragments that the database server creates for that purpose in the same dbspace as each regular table fragment where a given row resides.

What Happens to Triggers and Views?: When you attach tables, triggers on the surviving table survive the ATTACH, but triggers on the consumed table are automatically dropped. No triggers are activated by the ATTACH clause, but subsequent data-manipulation operations on the new rows can activate triggers.

Views on the surviving table survive the ATTACH operation, but views on the consumed table are automatically dropped.

What Happens with the Distribution Scheme?: You can attach a nonfragmented table to a table with any type of supported distribution scheme. In general, the resulting table has the same fragmentation strategy as the prior fragmentation strategy of the surviving_table.

When you attach two or more nonfragmented tables, however, the distribution scheme can either be based on expression or round-robin.

For Dynamic Server, only the following distribution schemes can result from combining the distribution schemes of the tables in the ATTACH clause.

Prior Distribution Scheme of Surviving Table	Prior Distribution Scheme of Consumed Table	Resulting Distribution Scheme
None	None	Round-robin or expression
Round-robin	None	Round-robin
Expression	None	Expression

For Extended Parallel Server, this table shows the distribution schemes that can result from different distribution schemes of the tables in the ATTACH clause.

Prior Distribution Scheme of Surviving Table	Prior Distribution Scheme of Consumed Table	Resulting Distribution Scheme
None	None	Round-robin or expression
None	Hash	Hybrid
Round-robin	None	Round-robin
Expression	None	Expression
Hash	None	Hybrid
Hash	Hash	Hybrid
Hybrid	None	Hybrid
Hybrid	Hash	Hybrid

In Extended Parallel Server, when you attach a nonfragmented table to a table that has hash fragmentation, the resulting table has hybrid fragmentation. You can attach a table with a hash distribution scheme to a table that currently has no fragmentation, or hash fragmentation, or hybrid fragmentation. In any of these situations, the resulting table has a hybrid distribution scheme.

The following examples illustrate the use of the ATTACH clause to create fragmented tables with different distribution schemes.

Round-Robin Distribution Scheme: The following example combines nonfragmented tables **pen_types** and **pen_makers** into a single, fragmented table, **pen_types**. Table **pen_types** resides in dbspace **dbsp1,** and table **pen_makers** resides in dbspace **dbsp2**. Table structures are identical in each table.

```
ALTER FRAGMENT ON TABLE pen_types ATTACH pen_types, pen_makers
```

After you execute the ATTACH clause, the database server fragments the table **pen_types** using a round-robin scheme into two dbspaces: the dbspace that contained **pen_types** and the dbspace that contained **pen_makers**. Table **pen_makers** is consumed and no longer exists; all rows that were in table **pen_makers** are now in table **pen_types**.

Expression Distribution Scheme: Consider the following example that combines tables **cur_acct** and **new_acct** and uses an expression-based distribution scheme. Table **cur_acct** was originally created as a fragmented table and has fragments in dbspaces **dbsp1** and **dbsp2**. The first statement of the example shows that table **cur_acct** was created with an expression-based distribution scheme. The second statement of the example creates table **new_acct** in **dbsp3** without a fragmentation strategy. The third statement combines the tables **cur_acct** and **new_acct**. Table structures (columns) are identical in each table.

```
CREATE TABLE cur_acct (a int) FRAGMENT BY EXPRESSION
   a < 5 in dbsp1, a >= 5 and a < 10 in dbsp2;
CREATE TABLE new_acct (a int) IN dbsp3;
ALTER FRAGMENT ON TABLE cur_acct ATTACH new_acct AS a>=10;
```

When you examine the **sysfragments** system catalog table after you alter the fragment, you see that table **cur_acct** is fragmented by expression into three dbspaces. For additional information about the **sysfragments** system catalog table, see the *IBM Informix Guide to SQL: Reference*.

In addition to simple range rules, you can use the ATTACH clause to fragment by expression with hash or arbitrary rules. For a discussion of all types of expressions that you can use in an expression-based distribution scheme, see page "Fragmenting by EXPRESSION" on page 2-192.

Warning: When you specify a date value as the default value for a parameter, make sure to specify 4 digits instead of 2 digits for the year. If you specify a 2-digit year, the setting of the **DBCENTURY** environment variable can affect how the database server interprets the date value. For more information, see the *IBM Informix Guide to SQL: Reference*.

Hybrid Fragmentation Distribution Scheme (XPS): Consider a case where monthly sales data is added to the **sales_info** table defined below. Due to the large amount of data, the table is distributed evenly across multiple coservers with a system-defined hash function. To manage monthly additions of data to the table, it is also fragmented by a date expression. The combined hybrid fragmentation is declared in the following CREATE TABLE statement:

```
CREATE TABLE sales_info (order_num INT, sale_date DATE, ...)
   FRAGMENT BY HYBRID (order_num) EXPRESSION
      sale_date >= '01/01/1996' AND sale_date < '02/01/1996'
         IN sales_slice_9601,
      sale_date >= '02/01/1996' AND sale_date < '03/01/1996'
         IN sales_slice_9602,
   . . .
      sale_date >= '12/01/1996' AND sale_date < '01/01/1997'
         IN sales_slice_9612;
```

Values for a new month are originally loaded from an external source. The data values are distributed evenly across the same coservers on which the **sales_info** table is defined, using a system-defined hash function on the same column:

```
CREATE TABLE jan_97 (order_num INT, sale_date DATE, ...)
   FRAGMENT BY HASH (order_num) IN sales_slice_9701
INSERT INTO jan_97 SELECT (...) FROM ... ;
```

After data values are loaded, you can attach the new table to **sales_info.** You can issue the following ALTER FRAGMENT statement to attach the new table:

```
ALTER FRAGMENT ON TABLE sales_info ATTACH jan_97
   AS sale_date >= '01/01/1997' AND sale_date < '02/01/1997'
```

DETACH Clause

Use the DETACH clause of the ALTER FRAGMENT ON TABLE statement to detach a table fragment from a distribution scheme and place the contents into a new nonfragmented table. This clause is not valid in ALTER FRAGMENT ON INDEX statements.

In Extended Parallel Server, the new table can also be a table with hash fragmentation.

For an explanation of distribution schemes, see "FRAGMENT BY Clause" on page 2-190.

DETACH Clause:

```
|--DETACH--+------------------+--fragment--new_table--------------------------|
           |  (1)             |
           '---------PARTITION'
```

Notes:

1 Dynamic Server only

Element	Description	Restrictions	Syntax
fragment	Partition (IDS only), dbspace, or dbslice (XPS only) that contains the table fragment to be detached. With hybrid-fragmentation, *dbslice* identifies a set of dbspaces. See "Altering Hybrid-Fragmented Tables (XPS)" on page 2-16.	Must exist at the time of execution	"Identifier" on page 5-22
new_table	Nonfragmented table that results after you execute the ALTER FRAGMENT statement. (In XPS, this can also be a hash-fragmented table.)	Must not exist before execution	"Database Object Name" on page 5-17

The new table that results from executing the DETACH clause does not inherit any indexes nor constraints from the original table. Only data values remain.

Similarly, the new table does not inherit any privileges from the original table. Instead, the new table has the default privileges of any new table. For further information on default table-level privileges, see the GRANT statement on "Table-Level Privileges" on page 2-374.

The DETACH clause cannot be applied to a table if that table is the parent of a referential constraint or if a **rowid** column is defined on the table.

In Dynamic Server, if you omit the PARTITION keyword, the name of the fragment must be the name of the dbspace where the fragment is stored.

In Extended Parallel Server, you cannot use the DETACH clause if the table has a dependent generalized key (GK) index defined on it.

Detach with BYTE and TEXT Columns

If the DETACH clause specifies the first fragment of a table that includes simple large objects of data type BYTE or TEXT, the database server applies locks on the blobspaces of every fragment of the table. To detach any other fragment of the table locks only the blobspaces of the specified fragment, rather than the blobspaces of all fragments, so fewer locks are required if the fragment is not the first.

Detach That Results in a Nonfragmented Table

The following example uses the table **cur_acct** fragmented into two dbspaces, **dbsp1** and **dbsp2**:

```
ALTER FRAGMENT ON TABLE cur_acct DETACH dbsp2 accounts
```

This example detaches **dbsp2** from the distribution scheme for **cur_acct** and places the rows in a new table, **accounts**. Table **accounts** now has the same structure (column names, number of columns, data types, and so on) as table **cur_acct**, but the table **accounts** does not contain any indexes or constraints from the table **cur_acct**. Both tables are now nonfragmented. The following example shows a table that contains three fragments:

```
ALTER FRAGMENT ON TABLE bus_acct DETACH dbsp3 cli_acct
```

This statement detaches **dbsp3** from the distribution scheme for **bus_acct** and places the rows in a new table, **cli_acct**. Table **cli_acct** now has the same structure (column names, number of columns, data types, and so on) as **bus_acct,** but the table **cli_acct** does not contain any indexes or constraints from the table **bus_acct**. Table **cli_acct** is a nonfragmented table, and table **bus_acct** remains a fragmented table.

Detach That Results in a Table with Hash Fragmentation (XPS)

The new table is a hash-fragmented table if the *surviving_table* had hybrid fragmentation and the detached dbslice has more than one fragment. In a hybrid-fragmented table, the dbslice is detached if you specify any dbspace in that slice. For example, see the **sales_info** table discussed in the "Hybrid Fragmentation Distribution Scheme (XPS)" on page 2-18. Once the January 1997 data is available in **sales_info**, you might archive year-old **sales_info** data.

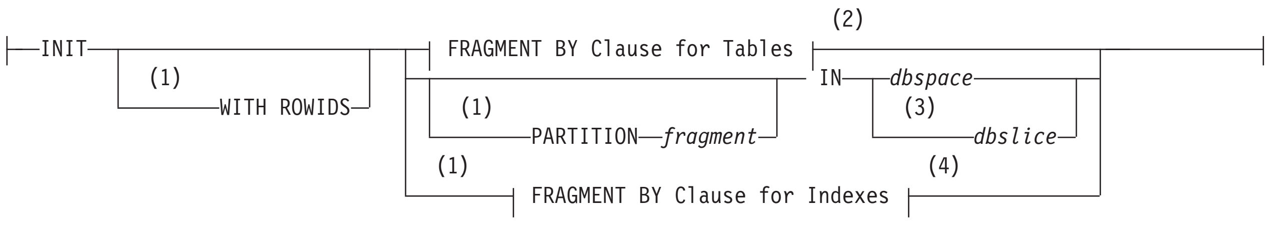
```
ALTER FRAGMENT ON TABLE sales_info
   DETACH sales_slice_9601.1 jan_96
```

In this example, data from January 1996 is detached from the **sales_info** table and placed in a new table called **jan_96**.

INIT Clause

The INIT clause of the ALTER FRAGMENT statement can define or modify the fragmentation strategy or the storage location of an existing table or (for Dynamic Server) an existing index. The INIT clause has the following syntax.

INIT Clause:



Notes:

1 Dynamic Server only

2 See 2-22

3 Extended Parallel Server only

4 See "FRAGMENT BY Clause for Indexes (IDS)" on page 2-24

Element	Description	Restrictions	Syntax
dbslice	Dbslice storing fragmented data	Must exist at time of execution	"Identifier" on page 5-22
dbspace	Dbspace storing fragmented data	Must exist at time of execution	"Identifier" on page 5-22
fragment	Partition within *dbspace*	No more than 2048 for same table	"Identifier" on page 5-22

The INIT clause can accomplish tasks that include the following:

- Move a nonfragmented table from one partition (IDS only) or dbslice (XPS only) or dbspace to another partition or to another dbslice or dbspace.
- Convert a fragmented table to a nonfragmented table.
- Fragment an existing non-fragmented table without redefining it.
- Convert a fragmentation strategy to another fragmentation strategy.
- Fragment an existing index that is not fragmented without redefining the index (IDS only).
- Convert a fragmented index to a nonfragmented index (IDS only).
- Add a new **rowid** column to the table definition (IDS only).

With Extended Parallel Server, you cannot use the INIT clause to change the fragmentation strategy of a table that has a GK index.

When you use the INIT clause to modify a table, the **tabid** value in the system catalog tables changes for the affected table. The **constrid** value of all unique and referential constraints on the table also changes.

For more information about the storage spaces in which you can store a table, see "Using the IN Clause" on page 2-189.

Attention: When you execute the ALTER FRAGMENT statement with this clause, it results in data movement if the table contains any data. If data values move, the potential exists for significant logging, for the transaction being aborted as a long transaction, and for a relatively long exclusive lock being held on the affected tables. Use this statement when it does not interfere with day-to-day operations.

WITH ROWIDS Option (IDS)

Nonfragmented tables contain a hidden column called **rowid**. Its integer value defines the physical location of a row.

3 To include a **rowid** column in a fragmented table, you must explicitly request it by
3 using the WITH ROWIDS clause in CREATE TABLE (or ADD ROWIDS in ALTER
3 TABLE, or WITH ROWIDS in ALTER FRAGMENT INIT). The **rowid** in a row of a
3 fragmented table does not identify a physical location for the row in the same way
3 that a **rowid** in a non-fragmented table does.

When you use the WITH ROWIDS option to add a new **rowid** column to a fragmented table, the database server assigns a unique **rowid** number to each row and creates an index that it can use to find the physical location of the row. Performance using this access method is comparable to using a SERIAL or SERIAL8 column. The **rowid** value of a row cannot be updated, but remains stable during the existence of the row. Each row requires an additional four bytes to store the **rowid** column after you specify the WITH ROWIDS option.

Attention: It is recommended that users creating new applications move toward using primary keys as a method of row identification instead of using **rowid** values.

Converting a Fragmented Table to a Nonfragmented Table

You might decide that you no longer want a table to be fragmented. You can use the INIT clause to convert a fragmented table to a nonfragmented table. The following example shows the original fragmentation definition, as well as how to use the INIT clause of the ALTER FRAGMENT statement to convert the table:

```
CREATE TABLE checks (col1 INT, col2 INT)
   FRAGMENT BY ROUND ROBIN IN dbsp1, dbsp2, dbsp3;

ALTER FRAGMENT ON TABLE checks INIT IN dbsp1;
```

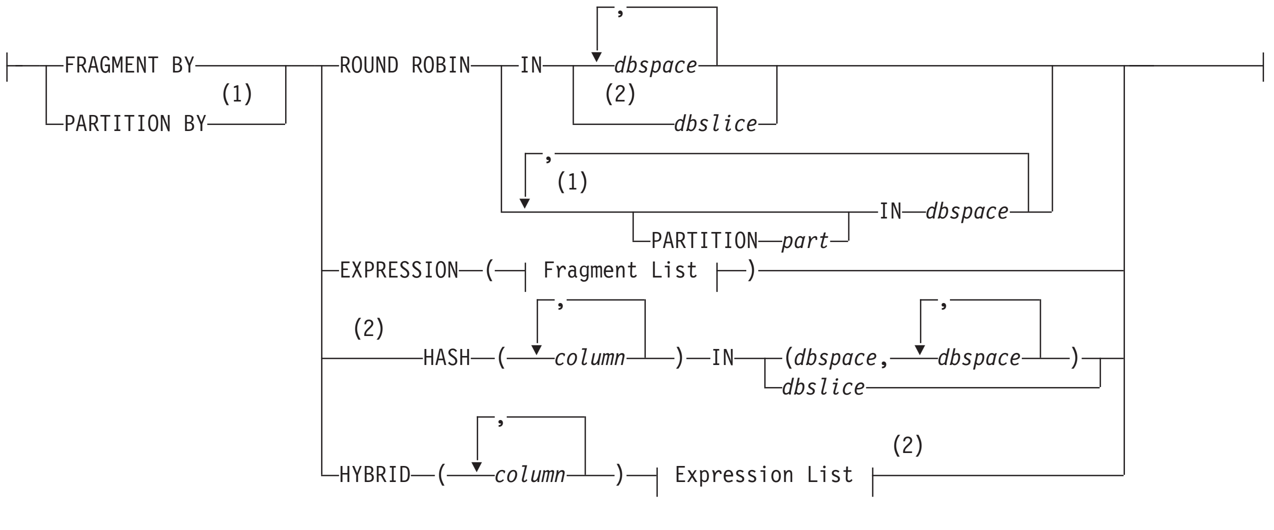
You must use the IN *dbspace* clause to place the table in a dbspace explicitly.

When you use the INIT clause to change a fragmented table to a nonfragmented table, all attached indexes become nonfragmented indexes. In addition, constraints that do not use existing user-defined indexes (detached indexes) become nonfragmented indexes. All newly nonfragmented indexes exist in the same dbspace as the new nonfragmented table.

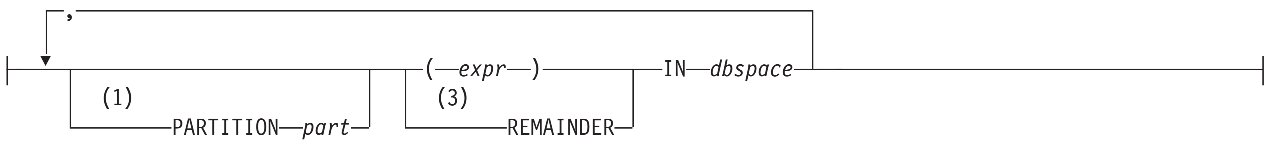
Using the INIT clause to change a fragmented table to a nonfragmented table has no effect on the fragmentation strategy of detached indexes, nor of constraints that use detached indexes.

Use the FRAGMENT BY portion of the INIT clause to fragment an existing non-fragmented table, or to convert one fragmentation strategy to another.

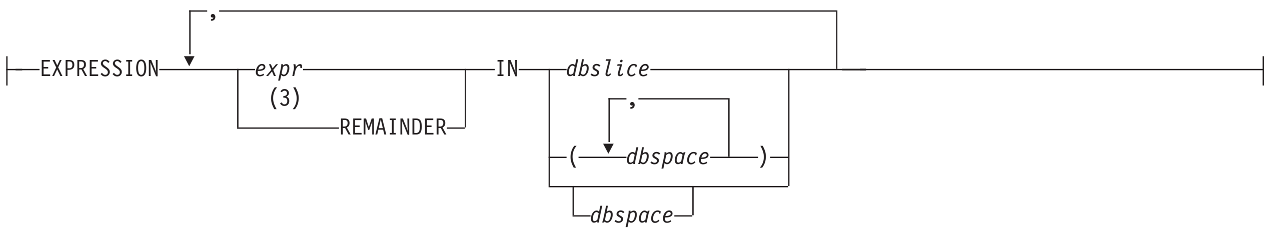
FRAGMENT BY Clause for Tables:


FRAGMENT BY
PARTITION BY (1)
ROUND ROBIN
IN
,
dbspace
(2) dbslice
, (1)
PARTITION part
IN dbspace
EXPRESSION (Fragment List)
(2) HASH (, column) IN (dbspace, , dbspace)
dbslice
HYBRID (, column) Expression List (2)

Fragment List:



Expression List:



Notes:

1 Dynamic Server only

2 Extended Parallel Server only

3 If included, must be the last item in fragment list

Element	Description	Restrictions	Syntax
column	Column to which the strategy applies	Must exist in the table	"Identifier" on page 5-22
dbslice	Dbslice that contains the table fragment	Must be defined	"Identifier" on page 5-22
dbspace	Dbspace that contains the table fragment	Must specify at least 2 but no more than 2,048 dbspaces	"Identifier" on page 5-22
expr	Expression that defines a table fragment	Must evaluate to a Boolean value (t or f)	"Expression" on page 4-34
part	Name declared here for a partition of *dbspace* that contains the table fragment	Must be unique among names of fragments of *table* in *dbspace*	"Identifier" on page 5-22

In the HYBRID option of Extended Parallel Server, *column* identifies a column on which to apply the hash portion of the hybrid table fragmentation strategy. The expression can reference columns only from the current table and data values only from a single row. Subqueries, aggregates, and the built-in CURRENT, DATE, and TODAY functions are not valid in the expression.

For more information on the available fragmentation strategies for tables, see the "FRAGMENT BY Clause" on page 2-190.

Changing an Existing Fragmentation Strategy on a Table

You can redefine a fragmentation strategy on a table if you decide that your initial strategy does not fulfill your needs. When you alter a fragmentation strategy, the database server discards the existing fragmentation strategy and moves records to fragments as defined in the new fragmentation strategy.

The following example shows the statement that originally defined the fragmentation strategy on the table **account** and then shows an ALTER FRAGMENT statement that redefines the fragmentation strategy:

```
CREATE TABLE account (col1 INT, col2 INT)
   FRAGMENT BY ROUND ROBIN IN dbsp1, dbsp2;
ALTER FRAGMENT ON TABLE account
   INIT FRAGMENT BY EXPRESSION
   col1 < 0 IN dbsp1,
   col2 >= 0 IN dbsp2;
```

If an existing dbspace is full when you redefine a fragmentation strategy, you must not use it in the new fragmentation strategy.

Defining a Fragmentation Strategy on a Nonfragmented Table

The INIT clause can define a fragmentation strategy on a nonfragmented table, regardless of whether the table was created with a storage option.

```
CREATE TABLE balances (col1 INT, col2 INT) IN dbsp1;
ALTER FRAGMENT ON TABLE balances INIT
   FRAGMENT BY EXPRESSION col1 <= 500 IN dbsp1,
      col1 > 500 AND col1 <=1000 IN dbsp2, REMAINDER IN dbsp3;
```

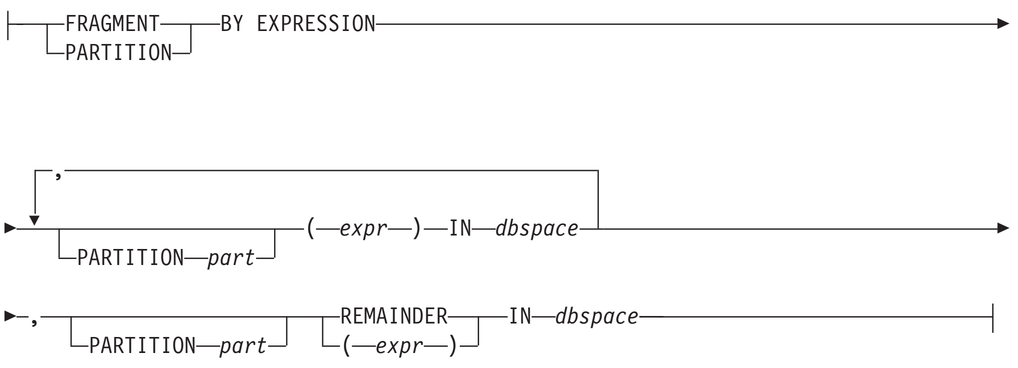
In Dynamic Server, when you use the INIT clause to fragment an existing nonfragmented table, all indexes on the table become fragmented in the same way as the table.

In Extended Parallel Server, when the INIT clause fragments an existing nonfragmented table, any indexes retain their existing fragmentation strategy.

FRAGMENT BY Clause for Indexes (IDS)

The INIT FRAGMENT BY clause for indexes of the ALTER FRAGMENT statement can fragment an existing nonfragmented index by an expression-based distribution scheme without redefining the index.

FRAGMENT BY Clause for Indexes:



Element	Description	Restrictions	Syntax
dbspace	Dbspace that contains the fragmented information	Must specify at least two, but no more than 2,048 dbspaces	"Identifier" on page 5-22
expr	Expression defining an index fragment	Must return a Boolean value	"Condition" on page 4-5; "Expression" on page 4-34
part	Name that you declare here for a partition of the specified *dbspace*	Required for any partition in the same dbspace as another partition of the same index	"Identifier" on page 5-22

The keywords FRAGMENT BY and PARTITION BY are synonyms in this context. You can convert an existing fragmentation strategy to another expression-based fragmentation strategy. Dynamic Server discards the existing fragmentation strategy and moves the data records to fragments that you define in the new fragmentation strategy. (To convert an existing fragmented index to a nonfragmented index, you can use the INIT clause to specify IN *dbspace* or else PARTITION *partition* IN *dbspace* as the only storage specification for a previously fragmented index.)

The *expression* can contain only columns from the current table and data values from only a single row. No subqueries nor aggregates are allowed. The built-in CURRENT, DATE, and TODAY functions are not valid here.

Fragmenting Unique and System Indexes

You can fragment unique indexes on a table that uses a round-robin or expression-based distribution scheme, but any columns referenced in the fragment expression must be indexed columns. If your index fragmentation strategy violates this restriction, the ALTER FRAGMENT INIT statement fails, and work is rolled back.

You might have an attached unique index on a table fragmented by **Column A**. If you attempt to use ALTER FRAGMENT INIT to change the table fragmentation to **Column B**, the statement fails because the unique index is defined on **Column A**. To resolve this issue, use the INIT clause on the index to detach it from the table fragmentation strategy and fragment it separately.

System indexes (such as those used in referential constraints and unique constraints) use user-defined indexes if the indexes exist. If no user-defined indexes can be used, system indexes remain nonfragmented and are moved to the dbspace where the database was created. To fragment a system index, create the fragmented index on the constraint columns and then use the ALTER TABLE statement to add the constraint.

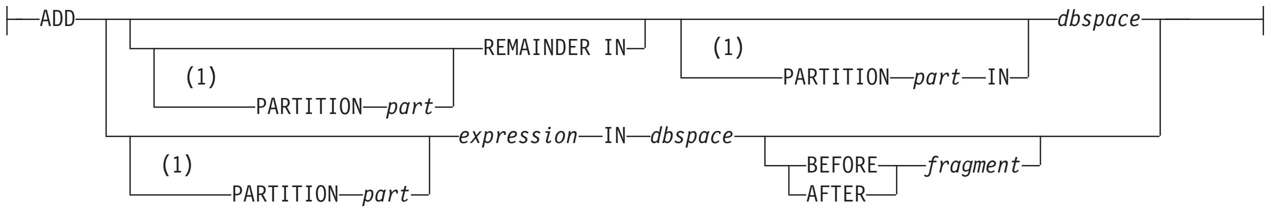
Detaching an Index from a Table-Fragmentation Strategy (IDS)

You can detach an index from a table-fragmentation strategy with the INIT clause of the ALTER TABLE FOR INDEX statement, so that an attached index becomes a detached index. This breaks any dependency of the index on the table fragmentation strategy. If the INIT clause specifies only IN *dbspace* or PARTITION *fragment* IN *dbspace* for a previously fragmented index, or specifies an index fragmentation strategy that differs from the storage option of the table, then the index becomes a detached index.

ADD Clause

Use the ADD clause to add another fragment to an existing fragment list for a table or (for Dynamic Server only) for an index.

ADD Clause:



Notes:

1 Dynamic Server only

Element	Description	Restrictions	Syntax
fragment	Name of an existing fragment in the fragmentation list	Must exist at the time when you execute the statement	"Identifier" on page 5-22
expression	Expression that defines the new fragment that is to be added	Must return a Boolean value (`t` or `f`)	"Condition" on page 4-5; "Expression" on page 4-34
dbspace	Name of dbspace to be added to the fragmentation scheme	Must exist at the time when you execute the statement	"Identifier" on page 5-22
part	Name that you declare here for the fragment. The default name is the name of the dbspace	Required for any partition in the same *dbspace* as another partition of the same index	"Identifier" on page 5-22

The *expression* can contain *column* names only from the current table and data values only from a single row. No subqueries or aggregates are allowed. In addition, the built-in current, date, and time functions are not valid here.

Adding a New Dbspace to a Round-Robin Distribution Scheme

You can add more dbspaces to a round-robin distribution scheme. The following example shows the original round-robin definition:

```
CREATE TABLE book (col1 INT, col2 INT)
   FRAGMENT BY ROUND ROBIN IN dbsp1, dbsp4;
```

To add another dbspace, use the ADD clause, as in this example:

```
ALTER FRAGMENT ON TABLE book ADD dbsp3;
```

Adding a New Partition to a Round-Robin Distribution Scheme (IDS)

In Dynamic Server, you can add a partition of a dbspace to an existing round-robin distribution scheme. The name must be unique within the distribution among partitions of the same dbspace. The following example specifies the same original round-robin fragmentation definition as in the previous section:

```
CREATE TABLE book (col1 INT, col2 INT) FRAGMENT BY ROUND ROBIN IN dbsp1, dbsp4;
```

To add a new fragment that is stored in a partition within a dbspace, you can use the ADD clause, as in the following example:

```
ALTER FRAGMENT ON TABLE book
   ADD PARTITION chapter3 IN dbsp1;
```

The new distribution uses **dbsp1**, **dbsp4**, and **chapter3** as storage locations for a 3-part round-robin fragmentation scheme. The records in the fragment **chapter3** are stored in a separate partition of **dbsp1** from the records in the first fragment, which are stored in a partition whose default name is **dbsp1**. (The database server issues an error if you attempt to declare the same name for different fragments of the same fragmented table or index.)

Adding Fragment Expressions

Adding a fragment expression to the fragmentation list in an expression-based distribution scheme can relocate records from existing fragments into the new fragment. When you add a new fragment into the middle of the fragmentation list, the database server reevaluates all the data existing in fragments after the new fragment. The next example shows the original expression definition:

```
FRAGMENT BY EXPRESSION c1 < 100 IN dbsp1, c1 >= 100 AND c1 < 200 IN dbsp2,
   REMAINDER IN dbsp3;
```

To add another fragment in a new partition of **dbspace dbsp2** to hold rows for **c1** values between `200` and `299`, use the following ALTER FRAGMENT statement:

```
ALTER FRAGMENT ON TABLE news
   ADD PARTITION century3 (c1 >= 200 AND c1 < 300) IN dbsp2;
```

Any rows that were formerly in the remainder fragment but that fit the criteria `(c1 >= 200` AND `c1 < 300)` move to the new **century3** partition in dbspace **dbsp2**.

Using the BEFORE and AFTER Options

The BEFORE and AFTER options can position the new fragment either before or after an existing fragment within the fragmentation list. The name of a fragment is the name of the partition where it is stored (or the name of the dbspace, if the dbspace has only one partition). You cannot use the BEFORE and AFTER options if the distribution scheme is round-robin.

When you attach a new fragment without an explicit BEFORE or AFTER option, the database server places the added fragment at the end of the fragmentation list, unless a remainder fragment exists. If a remainder fragment exists, the new fragment is placed immediately before the remainder fragment. You cannot attach a new fragment after the remainder fragment.

Using the REMAINDER Option

You cannot add a remainder fragment if one already exists. If you add a new fragment when a remainder exists, the database server retrieves and reevaluates all records in the remainder fragment; some records might move to the new fragment. The remainder fragment is always the last item in the fragment list.

DROP Clause (IDS)

Use the DROP clause to remove an existing fragment from the fragmentation list of a fragmented table or index.

DROP Clause:

```
|--DROP--+-----------+--fragment----------------------------------------|
         '-PARTITION-'
```

Element	Description	Restrictions	Syntax
fragment	Name of a partition of the dbspace that stores the dropped fragment	Must exist when you execute the statement	"Identifier" on page 5-22

If the table is fragmented by expression, you cannot drop a fragment containing data that cannot be moved to another fragment. (If the distribution scheme has a REMAINDER option, or if the expressions overlap, you can drop a fragment that contains data.) You cannot drop a fragment if the table has only two fragments.

When you want to make a fragmented table nonfragmented, use either the INIT clause or the DETACH clause of the ALTER FRAGMENT statement.

If the *fragment* was not given a name when it was created or added then the name of the dbspace is also the name of the fragment.

When you drop a fragment, the underlying partition or dbspace is not affected. Only the fragment data values within that partition or dbspace are affected.

When you drop a fragment, the database server attempts to move all records in the dropped fragment to another fragment. In this case, the destination fragment might not have enough space for the additional records. If this happens, follow one of the procedures that "ALTER FRAGMENT and Transaction Logging" on page 2-13 describes to increase your available space, and retry the procedure.

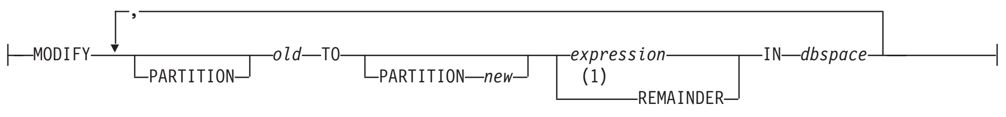
The following examples show how to drop a fragment from a fragmentation list. The first line shows how to drop an index fragment, and the second line shows how to drop a table fragment.

```
ALTER FRAGMENT ON INDEX cust_indx DROP dbsp2;

ALTER FRAGMENT ON TABLE customer DROP dbsp1;
```

MODIFY Clause (IDS)

Use the MODIFY clause to change an existing fragment expression on an existing partition in the fragmentation list of a table or of an index. You can also use the MODIFY clause to relocate a fragment corresponding to an expression from one dbspace to a different dbspace.

MODIFY Clause:



Notes:

1 Use this path no more than once

Element	Description	Restrictions	Syntax
dbspace	Dbspace that stores the modified information	Must exist at time of execution	"Identifier" on page 5-22
expression	Modified expression	Can specify columns in current table only and data from only a single row	"Condition" on page 4-5; "Expression" on page 4-34
new	Name that you declare here for a partition of *dbspace*	Must be unique in fragmentation list among names of partitions of *dbspace*	"Identifier" on page 5-22
old	Name of an existing fragment	Must exist at time of execution	"Identifier" on page 5-22

Here *dbspace* and *old* (or *old* and *new*) can be identical, if you are not changing the storage location.

You must declare a *new* partition (using the PARTITION keyword) if more than one fragment of the same table or index is named the same as the *dbspace*.

The *expression* must evaluate to a Boolean value (true or false).

No subqueries or aggregates are allowed in the *expression*. In addition, the built-in CURRENT, DATE, and TODAY functions are not valid.

When you use the MODIFY clause, the underlying dbspaces are not affected. Only the fragment data values within the partitions or dbspaces are affected.

You cannot change a REMAINDER fragment into a nonremainder fragment if records within the REMAINDER fragment do not satisfy the new *expression*.

When you use the MODIFY clause to change an expression without changing the storage location for the expression, you must use the same name for the *old* and the *new* fragment (or else the same name for *old* and for *dbspace*, if the dbspace consists of only a single partition, as in the following example):

```
ALTER FRAGMENT ON TABLE cust_acct
   MODIFY dbsp1 TO acct_num < 65 IN dbsp1
```

When you use the MODIFY clause to move an expression from one dbspace to another, *old* is the name of the dbspace where the expression was previously located, and *dbspace* is the new location for the expression:

```
ALTER FRAGMENT ON TABLE cust_acct
   MODIFY dbsp1 TO acct_num < 35 IN dbsp2
```

Here the distribution scheme for the **cust_acct** table is modified so that all row items in column **acct_num** that are less than 35 are now contained in the dbspace **dbsp2**. These items were formerly contained in the dbspace **dbsp1**.

When you use the MODIFY clause to move an expression from one partition of a dbspace to another partition, *old* is the name of the partition where information fragmented by the expression was previously located, and *new* is the name of the partition that is the new location for the expression, as in the following example:

```
ALTER FRAGMENT ON TABLE cust_acct
   MODIFY PARTITION part1 TO PARTITION part2 (acct_num < 35) IN dbsp2
```

Here the distribution scheme for the **cust_acct** table is modified so that all row items in column **acct_num** that have a value less than 35 are now contained in the partition **part2** of dbspace **dbsp2**. These items were formerly contained in the partition **part1**.

To use the MODIFY clause both to change the *expression* and to move its corresponding fragment to a new storage location, you must change the *expression* and you must also specify the name of a different *dbspace* or partition.

If the indexes on a table are attached indexes, and you modify the table, the index fragmentation strategy is also modified.

Related Information

Related statements: CREATE TABLE, CREATE INDEX, and ALTER TABLE

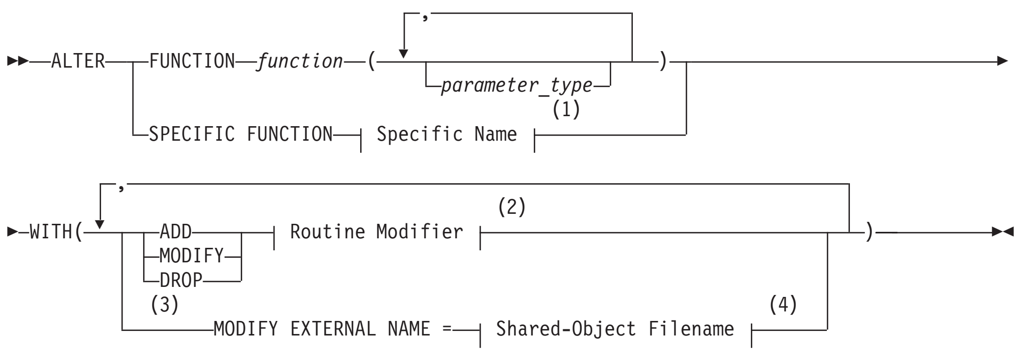
For a discussion of fragmentation strategy, refer to the *IBM Informix Database Design and Implementation Guide*.

For information on how to maximize performance when you make fragment modifications, see your *IBM Informix Performance Guide*.

ALTER FUNCTION

Use the ALTER FUNCTION statement to change the routine modifiers or pathname of a user-defined function. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 See “Specific Name” on page 5-68

2 See “Routine Modifier” on page 5-54

3 External routines only

4 See “Shared-Object Filename” on page 5-65

Element	Description	Restrictions	Syntax
function	User-defined function to be modified	Must be registered in the database. If the name does not uniquely identify a function, you must enter one or more appropriate values for *parameter_type.*	“Database Object Name” on page 5-17
parameter_type	Data type of a parameter	Must be the same data types (and specified in the same order) as in the definition of *function*	“Identifier” on page 5-22

Usage

The ALTER FUNCTION statement can modify a user-defined function to tune its performance by modifying characteristics that control how the function executes. You can also add or replace related user-defined routines (UDRs) that provide alternatives for the query optimizer, which can improve performance.

All modifications take effect on the next invocation of the function.

Only the UDR owner or the DBA can use the ALTER FUNCTION statement.

Keywords That Introduce Modifications

Use the following keywords to introduce what you modify in the UDR.

Keyword	Effect on Specified Routine Modifier
ADD	Add a new routine modifier to the UDR
MODIFY	Change an attribute of the routine modifier
DROP	Delete the routine modifier from the UDR
MODIFY EXTERNAL NAME (for external functions only)	Replace the file specification of the executable file. When the IFX_EXTEND_ROLE configuration parameter = ON, this option is valid only for users to whom the DBSA has granted the EXTEND role. With IFX_EXTEND_ROLE = OFF (or not set), the UDR owner or the DBA can use this option.
WITH	Introduces all modifications

If the routine modifier is a BOOLEAN value, MODIFY sets the value to be `t` (equivalent of using the keyword ADD to add the routine modifier). For example, both of the following statements alter the **func1** function so that it can be executed in parallel in the context of a parallelizable data query:

```
ALTER FUNCTION func1 WITH (MODIFY PARALLELIZABLE)
ALTER FUNCTION func1 WITH (ADD PARALLELIZABLE)
```

See also "Altering Routine Modifiers Example" on page 2-38.

Related Information

Related Statements: ALTER PROCEDURE, ALTER ROUTINE, CREATE FUNCTION, and CREATE PROCEDURE

For a discussion of how to create and use SPL routines, see the *IBM Informix Guide to SQL: Tutorial*. For a discussion of how to create and use external routines, see *IBM Informix User-Defined Routines and Data Types Developer's Guide* and the *IBM Informix DataBlade API Programmer's Guide*.

ALTER INDEX

Use the ALTER INDEX statement to change the clustering attribute or the locking mode of an existing index.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
                              (1)
►►──ALTER INDEX──index──┬────────────TO──┬─────┬──CLUSTER──┬──────────────────────────►◄
                        │                └─NOT─┘           │
                        │     (2)                          │
                        └────────────LOCK MODE──┬─NORMAL─┬─┘
                                                └─COARSE─┘
```

Notes:

1 Dynamic Server only

2 Extended Parallel Server only

Element	Description	Restrictions	Syntax
index	Name of the index to be altered	Must exist	"Database Object Name" on page 5-17

Usage

ALTER INDEX is valid only for indexes that the CREATE INDEX statement created explicitly. ALTER INDEX cannot modify an index on a temporary table, nor an index that the database server created implicitly to support a constraint.

You cannot change the collating order of an existing index. If you use ALTER INDEX to modify an index after the SET COLLATION statement of Dynamic Server has specified a non-default collating order, the SET COLLATION statement has no effect on the index.

TO CLUSTER Option

The TO CLUSTER option causes the database server to reorder the rows of the physical table according to the indexed order.

The next example shows how you can use the ALTER INDEX TO CLUSTER statement to order the rows in the **orders** table physically. The CREATE INDEX statement creates an index on the **customer_num** column of the table. Then the ALTER INDEX statement causes the physical ordering of the rows.

```
CREATE INDEX ix_cust ON orders (customer_num);
ALTER INDEX ix_cust TO CLUSTER;
```

For an ascending index, TO CLUSTER puts rows in lowest-to-highest order. For a descending index, the rows are reordered in highest-to-lowest order.

When you reorder, the entire file is rewritten. This process can take a long time, and it requires sufficient disk space to maintain two copies of the table.

While a table is clustering, it is locked IN EXCLUSIVE MODE. When another process is using the table to which the index name belongs, the database server cannot execute the ALTER INDEX statement with the TO CLUSTER option; it returns an error unless lock mode is set to WAIT. (When lock mode is set to WAIT, the database server retries the ALTER INDEX statement.)

Over time, if you modify the table, you can expect the benefit of an earlier cluster to disappear because rows are added in space-available order, not sequentially. You can recluster the table to regain performance by issuing another ALTER INDEX TO CLUSTER statement on the clustered index. You do not need to drop a clustered index before you issue another ALTER INDEX TO CLUSTER statement on a currently clustered index.

Extended Parallel Server cannot use the CLUSTER option on STANDARD tables.

TO NOT CLUSTER Option

The TO NOT CLUSTER option drops the cluster attribute on the index name without affecting the physical table. Because no more than one clustered index can exist on a given table, you must use the TO NOT CLUSTER option to release the cluster attribute from one index before you assign it to another index on the same table. The following statements illustrate how to remove clustering from one index and how a second index physically reclusters the table:

```
CREATE UNIQUE INDEX ix_ord ON orders (order_num);

CREATE CLUSTER INDEX ix_cust ON orders (customer_num);
. . .
ALTER INDEX ix_cust TO NOT CLUSTER;

ALTER INDEX ix_ord TO CLUSTER;
```

The first two statements create indexes for the **orders** table and cluster the physical table in ascending order on the **customer_num** column. The last two statements recluster the physical table in ascending order on the **order_num** column.

LOCK MODE Options (XPS)

Use the LOCK MODE clause to specify the locking granularity of the index.

When you use the COARSE mode, index-level locks are acquired on the index instead of item-level or page-level locks. This mode reduces the number of lock calls on an index. The COARSE mode offers performance advantages when you know that the index is unlikely to change; for example, when read-only operations are performed on the index.

Use the NORMAL mode to place item-level or page-level locks on the index as necessary. Use this mode when the index gets updated frequently.

When the database server executes the LOCK MODE COARSE option, it acquires an exclusive lock on the table for the duration of the ALTER INDEX statement. Any transactions currently using a lock of finer granularity must complete before the database server switches to the COARSE lock mode.

Related Information

Related statements: CREATE INDEX and CREATE TABLE

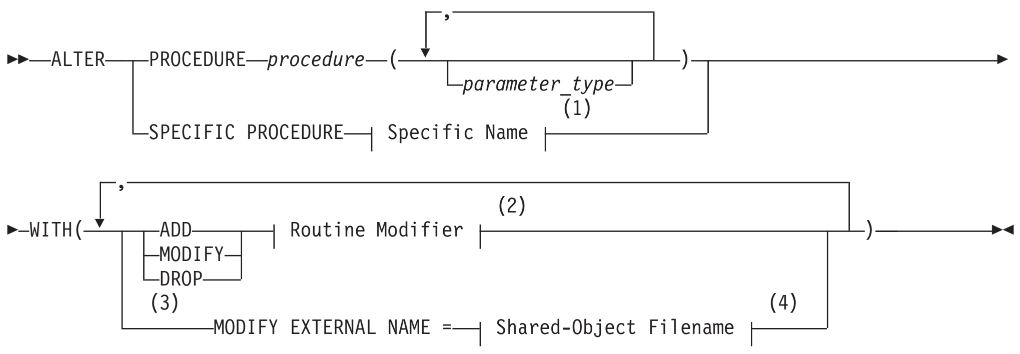
For a discussion of the performance implications of clustered indexes, see your *IBM Informix Performance Guide*.

ALTER PROCEDURE

Use the ALTER PROCEDURE statement to change the routine modifiers or pathname of a previously defined external procedure.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 See "Specific Name" on page 5-68

2 See "Routine Modifier" on page 5-54

3 External routines only

4 See "Shared-Object Filename" on page 5-65

Element	Description	Restrictions	Syntax
procedure	User-defined procedure to modify	Must be registered in the database. If the name does not uniquely identify a function, you must enter one or more appropriate values for *parameter_type*.	"Database Object Name" on page 5-17
parameter_type	Data type of a parameter	Must be the same data types (and specified in the same order) as in the definition of *procedure*	"Identifier" on page 5-22

Usage

The ALTER PROCEDURE statement enables you to modify an external procedure to tune its performance by modifying characteristics that control how it executes. You can also add or replace related UDRs that provide alternatives for the optimizer, which can improve performance. All modifications take effect on the next invocation of the procedure.

Only the UDR owner or the DBA can use the ALTER PROCEDURE statement.

If the procedure name is not unique among routines registered in the database, you must enter one or more appropriate values for *parameter_type*.

The following keywords introduce what you want to modify in *procedure*.

Keyword	Effect
ADD	Add a new routine modifier to the UDR
MODIFY	Change an attribute of a routine modifier
DROP	Delete a routine modifier from the UDR
MODIFY EXTERNAL NAME (for external procedures only)	Replace the file specification of the executable file. When the IFX_EXTEND_ROLE configuration parameter = ON, this option is valid only for users to whom the DBSA has granted the EXTEND role. With IFX_EXTEND_ROLE = OFF (or not set), the UDR owner or the DBA can use this option.
MODIFY EXTERNAL NAME (for external procedures only)	Replace the file specification of the executable file. (Valid only for users who have the EXTEND role)
WITH	Introduces all modifications

If the routine modifier is a BOOLEAN value, MODIFY sets the value to be `T` (equivalent to using the keyword ADD to add the routine modifier). For example, both of the following statements alter the **proc1** procedure so that it can be executed in parallel in the context of a parallelizable data query:

```
ALTER PROCEDURE proc1 WITH (MODIFY PARALLELIZABLE)
ALTER PROCEDURE proc1 WITH (ADD PARALLELIZABLE)
```

See also "Altering Routine Modifiers Example" on page 2-38.

Related Information

Related statements: ALTER ROUTINE, CREATE PROCEDURE, DROP PROCEDURE, and DROP ROUTINE.

For a discussion of SPL routines, see the *IBM Informix Guide to SQL: Tutorial*.

For a discussion of how to create and use external routines, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

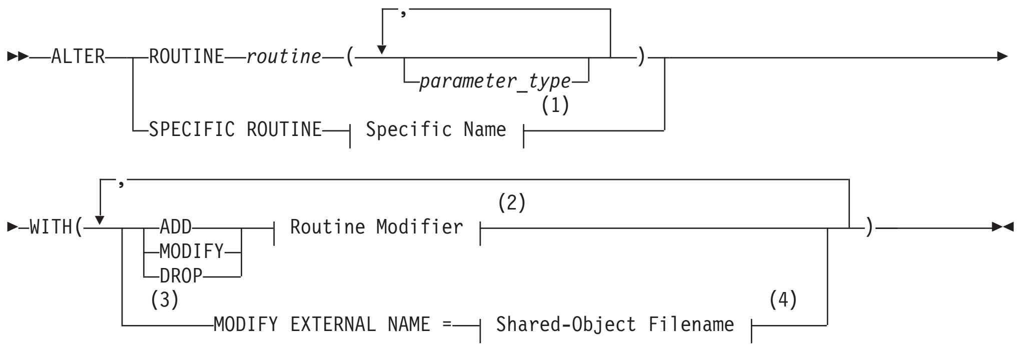
For information about how to create C UDRs, see the *IBM Informix DataBlade API Programmer's Guide*.

ALTER ROUTINE

Use the ALTER ROUTINE statement to change the routine modifiers or pathname of a previously defined user-defined routine (UDR).

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 See "Specific Name" on page 5-68

2 See "Routine Modifier" on page 5-54

3 External routines only

4 See "Shared-Object Filename" on page 5-65

Element	Description	Restrictions	Syntax
routine	User-defined routine to modify	Must be registered in the database. If the name does not uniquely identify a routine, you must enter one or more appropriate values for *parameter_type.*	Database "Database Object Name" on page 5-17
parameter_type	Data type of a parameter	Must be the same data types (and specified in the same order) as in the definition of *routine*	"Identifier" on page 5-22

Usage

The ALTER ROUTINE statement allows you to modify a previously defined UDR to tune its performance by modifying characteristics that control how the UDR executes. You can also add or replace related UDRs that provide alternatives for the optimizer, which can improve performance.

This statement is useful when you do not know whether a UDR is a user-defined function or a user-defined procedure. When you use this statement, the database server alters the appropriate user-defined procedure or user-defined function.

All modifications take effect on the next invocation of the UDR.

Only the UDR owner or the DBA can use the ALTER ROUTINE statement.

Restrictions

If the name does not uniquely identify a UDR, you must enter one or more appropriate values for *parameter_type*.

When you use this statement, the type of UDR cannot be ambiguous. The UDR that you specify must refer to either a user-defined function or a user-defined procedure. If either of the following conditions exist, the database server returns an error:

- The name (and parameters) that you specify applies to both a user-defined procedure and a user-defined function.
- The specific name that you specify applies to both a user-defined function and a user-defined procedure.

Keywords That Introduce Modifications

Use these keywords to introduce the items in the UDR that you want to modify:

Keyword	Effect
ADD	Add a routine modifier to the UDR
DROP	Delete a routine modifier from the UDR
MODIFY	Change an attribute of the routine modifier
MODIFY EXTERNAL NAME (for external routines only)	Replace the file specification of the executable file. When the IFX_EXTEND_ROLE configuration parameter = ON, this option is valid only for users to whom the DBSA has granted the EXTEND role. With IFX_EXTEND_ROLE = OFF (or not set), the UDR owner or the DBA can use this option.
WITH	Introduces all modifications

If the routine modifier is a BOOLEAN value, MODIFY sets the value to be `T` (equivalent to using the keyword ADD to add the routine modifier).

For example, both of the following statements alter the **func1** UDR so that it can be executed in parallel in the context of a parallelizable data query statement:

```
ALTER ROUTINE func1 WITH (MODIFY PARALLELIZABLE)
ALTER ROUTINE func1 WITH (ADD PARALLELIZABLE)
```

Altering Routine Modifiers Example

Suppose you have an external function **func1** that is set to handle NULL values and has a cost per invocation set to `40`. The following ALTER ROUTINE statement adjusts the settings of the function by dropping the ability to handle NULL values, tunes the **func1** by changing the cost per invocation to `20`, and indicates that the function can execute in parallel:

```
ALTER ROUTINE func1(CHAR, INT, BOOLEAN)
   WITH (
      DROP HANDLESNULLS,
      MODIFY PERCALL_COST = 20,
      ADD PARALLELIZABLE
      )
```

Because the name **func1** is not unique to the database, the data type parameters are specified so that the routine signature is unique. If this function had a Specific Name, for example, **raise_sal**, specified when it was created, you could identify the function with the following first line:

```
ALTER SPECIFIC ROUTINE raise_sal
```

Related Information

Related Statements: ALTER FUNCTION, ALTER PROCEDURE, CREATE FUNCTION, CREATE PROCEDURE, DROP FUNCTION, DROP PROCEDURE, and DROP ROUTINE.

For a discussion of how to create and use SPL routines, see the *IBM Informix Guide to SQL: Tutorial*.

For a discussion of how to create and use external routines, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

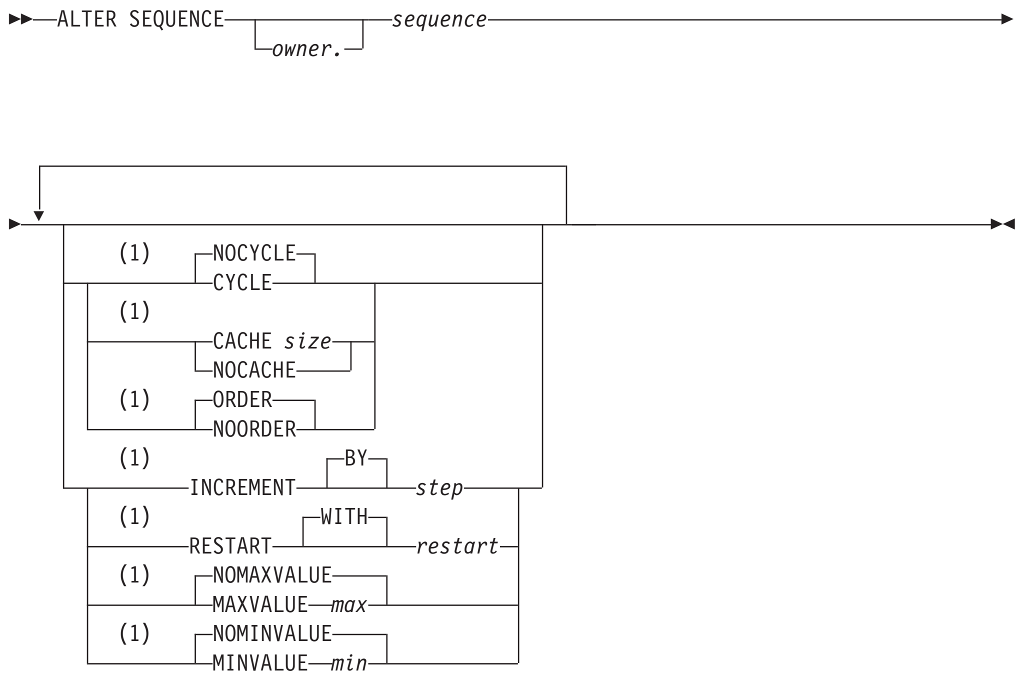
For information about how to create C UDRs, see the *IBM Informix DataBlade API Programmer's Guide*.

ALTER SEQUENCE

Use the ALTER SEQUENCE statement to modify the definition of a sequence object.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 Use path no more than once

Element	Description	Restrictions	Syntax
max	New upper limit on values	Must be integer > **CURRVAL** and *restart*	"Literal Number" on page 4-137
min	New lower limit on values	Must be integer < **CURRVAL** and *restart*	"Literal Number" on page 4-137
owner	Owner of *sequence*	Cannot be changed by this statement	"Owner Name" on page 5-43
restart	New first value in sequence	Must be integer in the INT8 range	"Literal Number" on page 4-137
sequence	Name of existing sequence	Must exist. Cannot be a synonym.	"Identifier" on page 5-22
size	New number of values to preallocate in memory	Integer > 2 but < cardinality of values in one cycle (= |(*max* - *min*)/*step*|)	"Literal Number" on page 4-137
step	New interval between successive values	Must be a nonzero integer	"Literal Number" on page 4-137

Usage

ALTER SEQUENCE redefines an existing sequence object. It only affects subsequently generated values (and any unused values in the sequence cache).

You cannot use the ALTER SEQUENCE statement to rename a sequence nor to change the owner of a sequence.

You must be the owner, or the DBA, or else have the Alter privilege on the sequence to modify its definition. Only elements of the sequence definition that you specify explicitly in the ALTER SEQUENCE statement are modified. An error occurs if you make contradictory changes, such as specifying both MAXVALUE and NOMAXVALUE, or both the CYCLE and NOCYCLE options.

INCREMENT BY Option

Use the INCREMENT BY option to specify a new interval between successive numbers in a sequence. The interval, or *step* value, can be a positive whole number (for ascending sequences) or a negative whole number (for descending sequences) in the INT8 range. The BY keyword is optional.

RESTART WITH Option

Use the RESTART WITH option to specify a new first number of the sequence. The *restart* value must be an integer within the INT8 range that is greater than or equal to the *min* value (for an ascending sequence) or that is less than or equal to the *max* value (for a descending sequence), if *min* or *max* is specified in the ALTER SEQUENCE statement. The WITH keyword is optional.

When you modify a sequence using the RESTART option, the *restart* value is stored in the **syssequences** system catalog table only until the first use of the sequence object in a **NEXTVAL** expression. After that, the value is reset in the system catalog. Use of the **dbschema** utility can increment sequence objects in the database, creating gaps in the generated numbers that might not be expected in applications that require serialized integers.

MAXVALUE or NOMAXVALUE Option

Use the MAXVALUE option to specify a new upper limit of values in the sequence. The maximum value, or *max*, must be an integer in the INT8 range that is greater than *sequence***.CURRVAL** and *restart* (or greater than the *origin* in the original CREATE SEQUENCE statement, if *restart* is not specified).

Use the NOMAXVALUE option to replace the current limit with a new default maximum of `2e64` for ascending sequences or `-1` for descending sequences.

MINVALUE or NOMINVALUE Option

Use the MINVALUE option to specify a new lower limit of values in the sequence. The minimum value, or *min*, must be an integer the INT8 range that is less than *sequence***.CURRVAL** and *restart* (or less than the *origin* in the original CREATE SEQUENCE statement, if *restart* is not specified).

Use the NOMINVALUE option to replace the current lower limit with a default of 1 for ascending sequences or `-(2e64)` for descending sequences.

CYCLE or NOCYCLE Option

Use the CYCLE option to continue generating sequence values after the sequence reaches the maximum (ascending) or minimum (descending) limit, to replace the

NOCYCLE attribute. After an ascending sequence reaches *max*, it generates the *min* value for the next value. After a descending sequence reaches *min*, it generates the *max* value for the next sequence value.

Use the NOCYCLE option to prevent the sequence from generating more values after reaching the declared limit. Once the sequence reaches the limit, the next reference to *sequence*.**NEXTVAL** returns an error message.

CACHE or NOCACHE Option

Use the CACHE option to specify a new number of sequence values that are preallocated in memory for rapid access. The cache size must be a whole number in the INT range that is less than the number of values in a cycle (or less than (|*max* - *min*)/*step*|). The minimum size is 2 preallocated values.

Use NOCACHE to have no values preallocated in memory. (See also the description of SEQ_CACHE_SIZE in "CREATE SEQUENCE" on page 2-165.)

ORDER or NOORDER Option

These keywords have no effect on the behavior of the sequence. The sequence always issues values to users in the order of their requests, as if the ORDER keyword were always specified. The ORDER and NOORDER keywords are accepted by the ALTER SEQUENCE statement, however, for compatibility with implementations of sequence objects in other dialects of SQL.

Related Information

Related statements: CREATE SEQUENCE, DROP SEQUENCE, RENAME SEQUENCE, CREATE SYNONYM, DROP SYNONYM, GRANT, REVOKE, INSERT, UPDATE, and SELECT

For information about the **syssequences** system catalog table in which sequence objects are registered, see the *IBM Informix Guide to SQL: Reference*.

For information about initializing, generating, or reading values from a sequence, see "NEXTVAL and CURRVAL Operators (IDS)" on page 4-61.

ALTER TABLE

Use the ALTER TABLE statement to modify the definition of an existing table.

Syntax

```
                                                         (1)
>>──ALTER TABLE──┬─table───┬──┬─┤ Basic Table Options ├──────┬────────────────><
                 └─synonym─┘  │                          (2) │
                              └─┤ Logging TYPE Options ├─────┘
```

Notes:

1 See page 2-44

2 See page 2-63

Element	Description	Restrictions	Syntax
synonym	Synonym for the table to be altered	Synonym and its table must exist; **USETABLENAME** not set	Database Object Name, p. 5-17
table	Name of table to be altered	Must exist in current database	Database Object Name, p. 5-17

Usage

In Dynamic Server, the database server performs the actions in the ALTER TABLE statement in the order that you specify. If any action fails, the entire operation is cancelled.

Altering a table on which a view depends might invalidate the view.

Warning: The clauses available with this statement have varying performance implications. Before you undertake alter operations, check corresponding sections in your *IBM Informix Performance Guide* to review effects and strategies.

You cannot alter a temporary table. You also cannot alter a violations or diagnostics table. In addition, you cannot add, drop, or modify a column if the table that contains the column has a violation table or a diagnostics table associated with it. If the **USETABLENAME** environment variable is set, you cannot specify a *synonym* for the table in the ALTER TABLE statement.

In Extended Parallel Server, if a table has range fragmentation, only the Logging TYPE options and LOCK MODE clause are valid. All other ALTER TABLE options return an error.

For a RAW or (in Extended Parallel Server) a STATIC table, the Logging TYPE options are the only part of the ALTER TABLE statement that you can use.

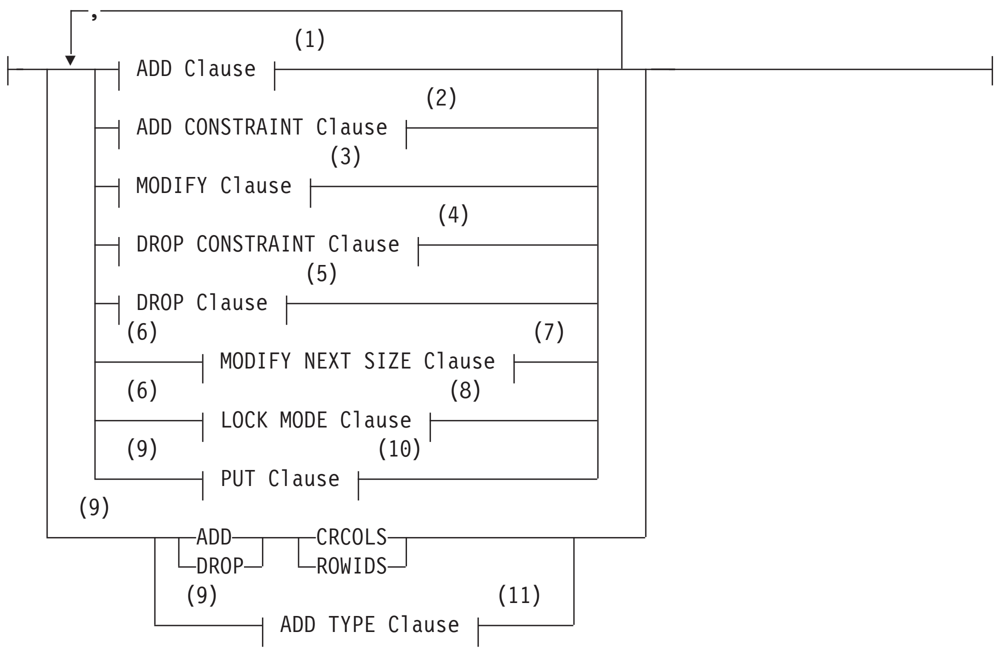
To use ALTER TABLE, you must meet one of the following conditions:
- You must have DBA privilege on the database containing the table.
- You must own the table (and for Extended Parallel Server, you must also have the Resource privilege).
- You must have the Alter privilege on the specified table and the Resource privilege on the database where the table resides.

- To add a referential constraint, you must have the DBA or References privilege on either the referenced columns or the referenced table.
- To drop a constraint, you must have the DBA privilege or be the owner of the constraint. If you are the owner of the constraint but not the owner of the table, you must have Alter privilege on the specified table. You do not need the References privilege to drop a constraint.

Basic Table Options

The Basic Table Options segment of ALTER TABLE has the following syntax.

Basic Table Options:



Notes:

1	See page 2-45
2	See page 2-59
3	See page 2-53
4	See page 2-61
5	See page 2-52
6	Use path once
7	See page 2-61
8	See page 2-62
9	Dynamic Server only
10	See page 2-58
11	See page 2-64

You can use the Basic Table Options segment to modify the schema of a table by adding, modifying, or dropping columns and constraints, or changing the extent size or locking granularity of a table. The database server performs alterations in the order that you specify. If any of the actions fails, the entire operation is cancelled.

With Dynamic Server, you can also associate a table with a named ROW type or specify a new storage space to store large-object data. You can also add or drop **rowid** columns and shadow columns for Enterprise Replication. You cannot, however, specify these options in conjunction with any other alterations.

Using the ADD ROWIDS Keywords (IDS)

Use the ADD ROWIDS keywords to add a new column called **rowid** to a fragmented table. (Fragmented tables do not contain the hidden **rowid** column by default.) When you add a **rowid** column, the database server assigns a unique number to each row that remains stable for the life of the row. The database server creates an index that it uses to find the physical location of the row. After you add the **rowid** column, each row of the table contains an additional 4 bytes to store the **rowid** value.

Tip: Use the ADD ROWIDS clause only on fragmented tables. In nonfragmented tables, the **rowid** column remains unchanged. It is recommended that you use primary keys as an access method rather than exploiting the **rowid** column.

For additional information about the **rowid** column, refer to your *IBM Informix Administrator's Reference*.

Using the DROP ROWIDS Keywords (IDS)

The DROP ROWIDS keywords can drop a **rowid** column that you added (with either the CREATE TABLE or ALTER FRAGMENT statement) to a fragmented table. You cannot drop the **rowid** column of a nonfragmented table.

Using the ADD CRCOLS Keywords (IDS)

The add CRCOLS keywords create shadow columns, **cdrserver** and **cdrtime**, that Enterprise Replication uses for conflict resolution. These columns enable the database server to use the time-stamp or SPL conflict-resolution rule. For more information, refer to "Using the WITH CRCOLS Option (IDS)" on page 2-188 and to the *IBM Informix Dynamic Server Enterprise Replication Guide*.

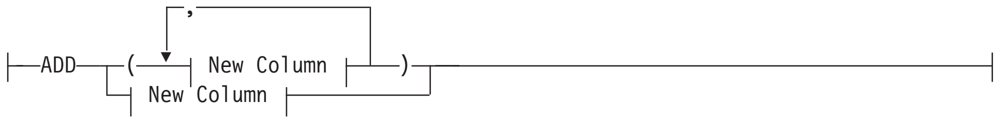
Using the DROP CRCOLS Keywords (IDS)

Use the DROP CRCOLS keywords to drop the **cdrserver** and **cdrtime** shadow columns. You cannot drop these columns if Enterprise Replication is in use.

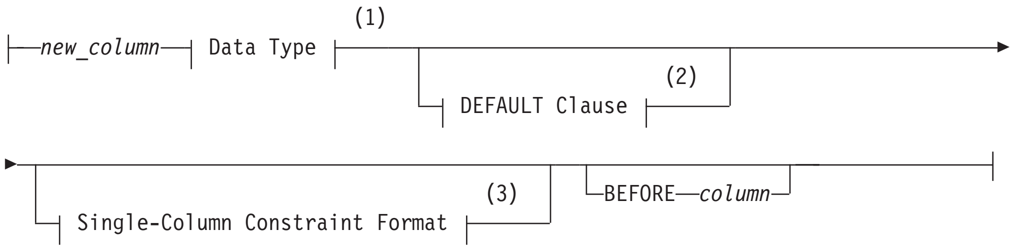
ADD Clause

Use the ADD Column clause to add a column to a table.

ADD Column Clause:



New Column:



Notes:

1 See page 4-18

2 See page 2-46

3 See page 2-47

Element	Description	Restrictions	Syntax
column	Name of column before which *new_column* is to be placed	Must already exist in the table	Identifier, p. 5-22
new_column	Name of column that you are adding	You cannot add a serial column if the table contains data	Identifier, p. 5-22

The following restrictions apply to the ADD clause:
- You cannot add a serial column to a table that contains data.
- In Extended Parallel Server, you cannot add a column to a table that has a bit-mapped index.
- You cannot add columns beyond the maximum row size of 32,767 bytes.

Using the BEFORE Option

The BEFORE option specifies the column before which to add the new columns. In the following example, the BEFORE option directs the database server to add the **item_weight** column before the **total_price** column:

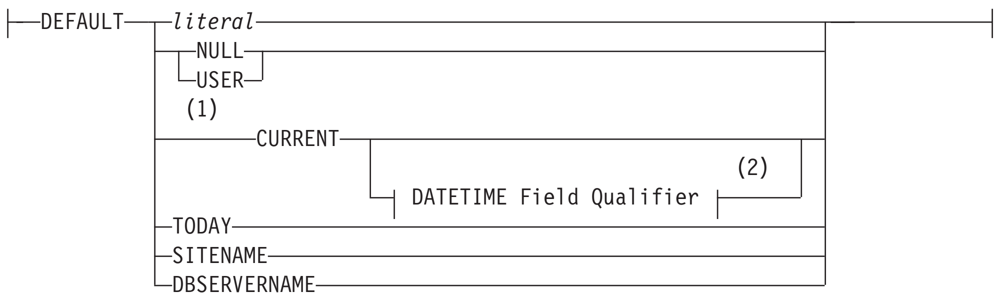
```
ALTER TABLE items
   ADD (item_weight DECIMAL(6,2) NOT NULL BEFORE total_price)
```

If you do not include the BEFORE option, the database server adds the new column or list of columns to the end of the table definition by default.

DEFAULT Clause

Use the DEFAULT clause to specify value that the database server should insert in a column when an explicit value for the column is not specified.

DEFAULT Clause:



Notes:

1 Informix extension

2 See page 4-32

Element	Description	Restrictions	Syntax
literal	Literal default value for the column	Must be appropriate for the data type of the column. See "Using a Literal as a Default Value" on page 2-175.	Expression, p. 4-34

You cannot specify a default value for serial columns. If the table that you are altering already has rows in it when you add a column that contains a default value, the database server inserts the default value for all pre-existing rows.

The following example adds a column to the **items** table. In **items**, the new column **item_weight** has a literal default value:

```
ALTER TABLE items
   ADD item_weight DECIMAL (6, 2) DEFAULT 2.00
   BEFORE total_price
```

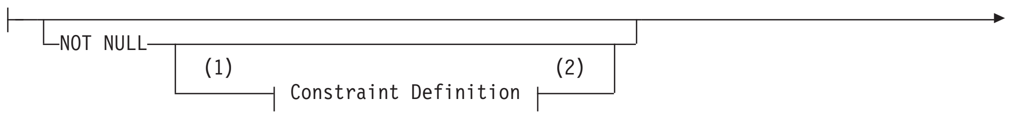
In this example, each existing row in the **items** table has a default value of `2.00` for the **item_weight** column.

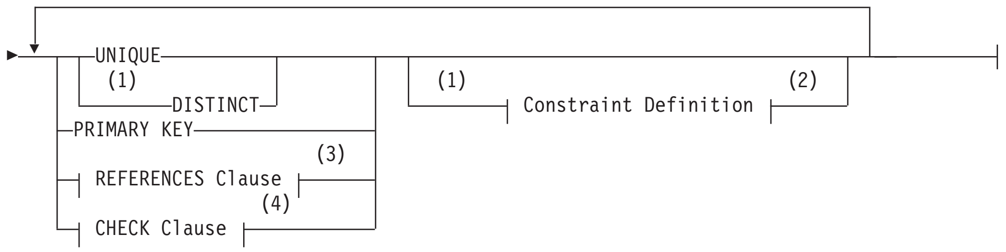
For more information about the options of the DEFAULT clause, refer to "DEFAULT Clause" on page 2-174.

Single-Column Constraint Format

Use the Single-Column Constraint Format to associate constraints with a specified column.

Single-Column Constraint Format:





Notes:

1 Informix extension

2 See page 2-49

3 See page 2-49

4 See page 2-51

You cannot specify a primary-key or unique constraint on a new column if the table contains data. In the case of a unique constraint, however, the table can contain a *single* row of data. When you want to add a column with a primary-key constraint, the table must be empty when you issue the ALTER TABLE statement.

The following rules apply when you place primary-key or unique constraints on existing columns:

- When you place a primary-key or unique constraint on a column or set of columns, the database server creates an internal B-tree index on the constrained column or set of columns unless a user-created index was defined on the column or set of columns.
- When you place a primary-key or unique constraint on a column or set of columns, and a unique index already exists on that column or set of columns, the constraint shares the index. If the existing index allows duplicates, however, the database server returns an error. You must then drop the existing index before you add the constraint.
- When you place a primary-key or unique constraint on a column or set of columns, and a referential constraint already exists on that column or set of columns, the duplicate index is upgraded to UNIQUE (if possible), and the index is shared.

You cannot place a unique constraint on a BYTE or TEXT column, nor can you place referential constraints on columns of these types. A check constraint on a BYTE or TEXT column can check only for IS NULL, IS NOT NULL, or LENGTH.

When you place a referential constraint on a column or set of columns, and an index already exists on that column or set of columns, the index is upgraded to UNIQUE (if possible) and the index is shared.

Using NOT NULL Constraints with ADD

If a table contains data, when you add a column with a NOT NULL constraint you must also include a DEFAULT clause. If the table is empty, however, you can add a column and apply only the NOT NULL constraint. The following statement is valid whether or not the table contains data:

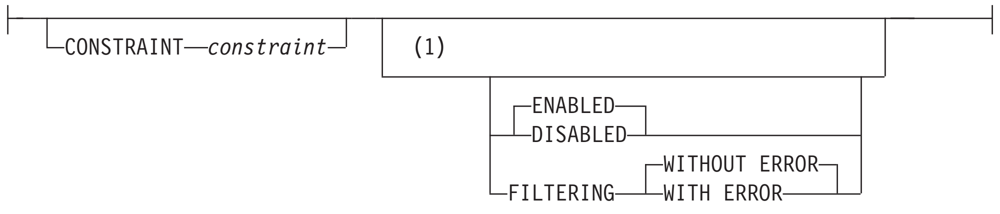
```
ALTER TABLE items
   ADD (item_weight DECIMAL(6,2)
   DEFAULT 2.0 NOT NULL
      BEFORE total_price)
```

Constraint Definition

In Dynamic Server, use the Constraint Definition portion of the ALTER TABLE statement to declare the name of a constraint and to set the mode of the constraint to disabled, enabled, or filtering.

In Extended Parallel Server, use the Constraint Definition portion of the ALTER TABLE statement to declare the name of a constraint.

Constraint Definition:



Notes:

1 Dynamic Server only

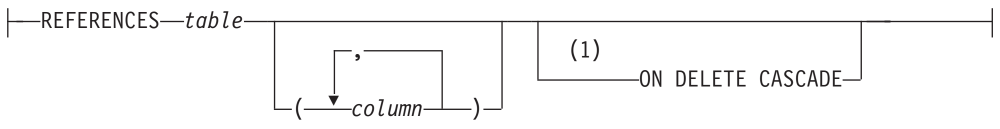
Element	Description	Restrictions	Syntax
constraint	Name declared here for the constraint	Must be unique among the names of indexes and constraints in database	Identifier, p. 5-22

For more information about constraint-mode options, see "Choosing a Constraint-Mode Option (IDS)" on page 2-183.

REFERENCES Clause

The REFERENCES clause has the following syntax.

REFERENCES Clause:



Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
column	Referenced column in the referenced table	See "Restrictions on Referential Constraints" on page 2-50.	Identifier, p. 5-22
table	The referenced table	The referenced and the referencing tables must reside in the same database	Database Object Name, p. 5-17

The REFERENCES clause allows you to place a foreign-key reference on a column. The referenced column can be in the same table as the referencing column, or in a different table in the same database.

If the referenced table is different from the referencing table, the default *column* is the primary-key column. If the referenced table is the same as the referencing table, there is no default.

Restrictions on Referential Constraints

You must have the REFERENCES privilege to create a referential constraint.

The following restrictions apply to the *column* that is specified (the referenced column) in the REFERENCES clause:

- The referenced and referencing tables must be in the same database.
- The referenced column (or set of columns) must have a unique or primary-key constraint.
- The referencing and referenced columns must be the same data type.

  (The only exception is that a referencing column must be an integer data type if the referenced column is a serial data type.)
- You cannot place a referential constraint on a BYTE or TEXT column.
- Constraints uses the collation in effect at their time of creation.
- A column-level REFERENCES clause can include only a single column name.
- Maximum number of columns in a table-level REFERENCES clause is 16.
- In Dynamic Server, the total length of the columns in a table-level REFERENCES clause cannot exceed 390 bytes.
- In Extended Parallel Server, the total length of the columns in a table-level REFERENCES clause cannot exceed 255 bytes.

Default Column for the References Clause

If the referenced table is different from the referencing table, you do not need to specify the referenced column; the default column is the primary-key column (or columns) of the referenced table. If the referenced table is the same as the referencing table, you must specify the referenced column.

The following example creates a new column in the **cust_calls** table, **ref_order**. The **ref_order** column is a foreign key that references the **order_num** column in the **orders** table.

```
ALTER TABLE cust_calls
   ADD ref_order INTEGER
   REFERENCES orders (order_num)
   BEFORE user_id
```

When you place a referential constraint on a column or set of columns, and a duplicate or unique index already exists on that column or set of columns, the index is shared.

Using the ON DELETE CASCADE Option

Use the ON DELETE CASCADE option if you want rows deleted in the child table when corresponding rows are deleted in the parent table. If you do not specify cascading deletes, the default behavior of the database server prevents you from deleting data in a table if other tables reference it.

If you specify this option, when you delete a row in the parent table, the database server also deletes any rows associated with that row (foreign keys) in a child table. The advantage of the ON DELETE CASCADE option is that it allows you to reduce the quantity of SQL statements needed to perform delete actions.

For example, in the **stores_demo** database, the **stock** table contains the **stock_num** column as a primary key. The **catalog** table refers to the **stock_num** column as a foreign key. The following ALTER TABLE statements drop an existing foreign-key constraint (without cascading delete) and add a new constraint that specifies cascading deletes:

```
ALTER TABLE catalog DROP CONSTRAINT aa

ALTER TABLE catalog ADD CONSTRAINT
   (FOREIGN KEY (stock_num, manu_code) REFERENCES stock
   ON DELETE CASCADE CONSTRAINT ab)
```

With cascading deletes specified on the child table, in addition to deleting a stock item from the **stock** table, the delete cascades to the catalog table that is associated with the stock_num foreign key. This cascading delete works only if the **stock_num** that you are deleting was not ordered; otherwise, the constraint from the **items** table would disallow the cascading delete. For more information, see "Restrictions on DELETE When Tables Have Cascading Deletes" on page 2-277.

If a table has a trigger with a DELETE trigger event, you cannot define a cascading-delete referential constraint on that table. You receive an error when you attempt to add a referential constraint that specifies ON DELETE CASCADE to a table that has a delete trigger.

For information about syntax restrictions and locking implications when you delete rows from tables that have cascading deletes, see "Considerations When Tables Have Cascading Deletes" on page 2-276.

Locks Held During Creation of a Referential Constraint

When you create a referential constraint, the database server places an exclusive lock on the referenced table. The lock is released after you finish with the ALTER TABLE statement or at the end of a transaction (if you are altering the table in a database that uses transaction logging).

CHECK Clause

A check constraint designates a condition that must be met *before* data can be inserted into a column.

CHECK Clause:

```
                            (1)
|--CHECK--(--| Condition |------)----------------------------------------|
```

Notes:

1 See page 4-5

During an insert or update, if a row returns *false* for any check constraint defined on a table, the database server returns an error. No error is returned, however, if a row returns NULL for a check constraint. In some cases, you might want to use both a check constraint and a NOT NULL constraint.

Check constraints are defined using *search conditions*. The search condition cannot contain user-defined routines, subqueries, aggregates, host variables, or rowids. In addition, the condition cannot contain the variant built-in functions CURRENT, USER, SITENAME, DBSERVERNAME, or TODAY.

The check constraint cannot include columns in different tables. When you are using the ADD or MODIFY clause, the check constraint cannot depend upon values in other columns of the same table.

The next example adds a new **unit_price** column to the **items** table and includes a check constraint to ensure that the entered value is greater than `0`:

```
ALTER TABLE items
   ADD (unit_price MONEY (6,2) CHECK (unit_price > 0) )
```

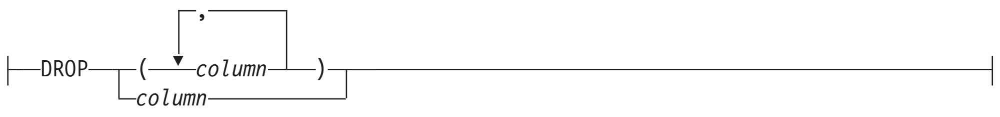
To create a constraint that checks values in more than one column, use the ADD CONSTRAINT clause. The following example builds a constraint on the column that was added in the previous example. The check constraint now spans two columns in the table.

```
ALTER TABLE items ADD CONSTRAINT CHECK (unit_price < total_price)
```

DROP Clause

Use the DROP clause to drop one or more columns from a table.

DROP Clause:



Element	Description	Restrictions	Syntax
column	Name of column to be dropped	Must exist in the table. No fragment expression can reference column, and it cannot be the last column in the table.	Identifier, p. 5-22

You cannot issue an ALTER TABLE DROP statement that would drop every column from the table. At least one column must remain in the table.

You cannot drop a column that is part of a fragmentation strategy.

In Extended Parallel Server, you cannot use the DROP clause if the table has a dependent GK index.

How Dropping a Column Affects Constraints

When you drop a column, all constraints on that column are also dropped:

- All single-column constraints are dropped.
- All referential constraints that reference the column are dropped.
- All check constraints that reference the column are dropped.
- If the column is part of a multiple-column primary-key or unique constraint, the constraints placed on the multiple columns are also dropped. This action, in turn, triggers the dropping of all referential constraints that reference the multiple columns.

Because any constraints that are associated with a column are dropped when the column is dropped, the structure of other tables might also be altered when you use this clause. For example, if the dropped column is a unique or primary key that is referenced in other tables, those referential constraints also are dropped. Therefore the structure of those other tables is also altered.

How Dropping a Column Affects Triggers

In general, when you drop a column from a table, the triggers based on that table remain unchanged. If the column that you drop appears in the action clause of a trigger, however, dropping the column can invalidate the trigger. The following statements illustrate the possible effects on triggers:

```
CREATE TABLE tab1 (i1 int, i2 int, i3 int);
CREATE TABLE tab2 (i4 int, i5 int);
CREATE TRIGGER col1trig UPDATE OF i2 ON tab1
   BEFORE(INSERT INTO tab2 VALUES(1,1));
ALTER TABLE tab2 DROP i4;
```

After the ALTER TABLE statement, **tab2** has only one column. The **col1trig** trigger is invalidated because the action clause as it is currently defined with values for two columns cannot occur.

If you drop a column that occurs in the triggering column list of an UPDATE trigger, the database server drops the column from the triggering column list. If the column is the only member of the triggering column list, the database server drops the trigger from the table. For more information on triggering columns in an UPDATE trigger, see "CREATE TRIGGER" on page 2-216.

If a trigger is invalidated when you alter the underlying table, drop and then re-create the trigger.

How Dropping a Column Affects Views

When you drop a column from a table, the views based on that table remain unchanged. That is, the database server does not automatically drop the corresponding columns from associated views.

The view is not automatically dropped because ALTER TABLE can change the order of columns in a table by dropping a column and then adding a new column with the same name. In this case, views based on the altered table continue to work, but retain their original sequence of columns.

If a view is invalidated when you alter the underlying table, you must rebuild the view by using the DROP VIEW and CREATE VIEW statements.

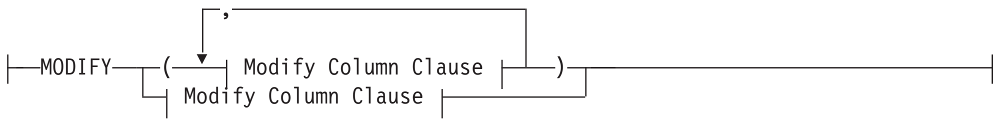
How Dropping a Column Affects a Generalized-Key Index

In Extended Parallel Server, if you drop a column from a table that has a dependent GK index, all GK indexes on the table that refer to the dropped column are dropped. Any GK indexes on other tables that refer to the dropped column are also dropped.

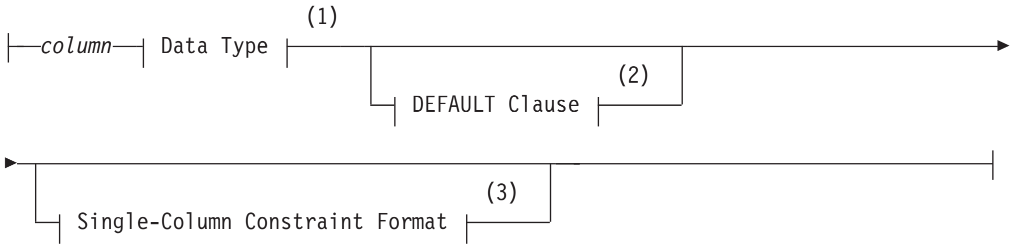
MODIFY Clause (IDS)

Use the MODIFY clause to change the data type, length, or default value of a column, to allow or disallow NULL values in a column, or to reset the serial counter of a SERIAL or SERIAL8 column.

MODIFY Clause:



Modify Column Clause:



Notes:

1 See page 4-18

2 See page 2-46

3 See page 2-47

Element	Description	Restrictions	Syntax
column	Column to modify	Must exist in table. Cannot be a collection data type.	Identifier, p. 5-22

In Extended Parallel Server, you cannot use the MODIFY clause if the table has a dependent GK index.

You cannot change the data type of a column to a COLLECTION or a ROW type.

When you modify a column, *all* attributes previously associated with the column (that is, default value, single-column check constraint, or referential constraint) are dropped. When you want certain attributes of the column to remain, such as PRIMARY KEY, you must re-specify those attributes.

For example, if you are changing the data type of an existing column, **quantity**, to SMALLINT, but you want to keep the default value (in this case, 1) and the NOT NULL column attribute, you can issue this statement:

```
ALTER TABLE items MODIFY (quantity SMALLINT DEFAULT 1 NOT NULL)
```

Tip: Both attributes are specified *again* in the modify clause.

When you change the data type of a column, the database server does not perform the modification in place. The next example (for Dynamic Server only) changes a VARCHAR(15) column to an LVARCHAR(3072) column:

```
ALTER TABLE stock MODIFY (description LVARCHAR(3072))
```

When you modify a column that has column constraints associated with it, the following constraints are dropped:

- All single-column constraints are dropped.
- All referential constraints that reference the column are dropped.
- If the modified column is part of a multiple-column primary-key or unique constraint, all referential constraints that reference the multiple columns also are dropped.

For example, if you modify a column that has a unique constraint, the unique constraint is dropped. If this column was referenced by columns in other tables, those referential constraints are also dropped. In addition, if the column is part of a multiple-column primary-key or unique constraint, the multiple-column constraints are not dropped, but any referential constraints placed on the column by other tables are dropped.

For another example, suppose that a column is part of a multiple-column primary-key constraint. This primary key is referenced by foreign keys in two other tables. When this column is modified, the multiple-column primary-key constraint is not dropped, but the referential constraints placed on it by the two other tables are dropped.

Using the MODIFY Clause

The characteristics of the object you are attempting to modify can affect how you handle your modifications.

Altering BYTE and TEXT Columns

You can use the MODIFY clause to change a BYTE column to a TEXT column, and vice versa. You cannot use the MODIFY clause, however, to change a BYTE or TEXT column to any other type of column, and vice versa.

In Dynamic Server, you can also use the MODIFY clause to change a BYTE column to a BLOB column and a TEXT column to a CLOB column.

Altering the Next Serial Value

You can use the MODIFY clause to reset the next value of a SERIAL or SERIAL8 column. You cannot set the next value below the current maximum value in the column because that action can cause the database server to generate duplicate numbers. You can set the next value, however, to any value higher than the current maximum, which creates a gap in the series of values.

If the new serial value that you specify is less than the current maximum value in the serial column, the maximum value is not altered. If the maximum value is less than what you specify, the next serial number will be what you specify. The next serial value is not equivalent to one greater than the maximum serial value in the column in two situations:

- There are no rows in the table, and an initial serial value was specified when the table was created (or by a previous ALTER TABLE statement).
- There are rows in the table, but the next serial value was modified by a previous ALTER TABLE statement.

The following example sets the next serial value to 1000:

```
ALTER TABLE my_table MODIFY (serial_num serial (1000))
```

As an alternative, you can use the INSERT statement to create a gap in the series of serial values in the column. For more information, see "Inserting Values into Serial Columns" on page 2-400.

Altering the Next Serial Value in a Typed Table (IDS): You can set the initial serial number or modify the next serial number for a ROW-type field with the MODIFY clause of the ALTER TABLE statement. (You cannot set the initial number for a serial field when you create a ROW data type.)

Suppose you have ROW types **parent**, **child1**, **child2**, and **child3**.

```
CREATE ROW TYPE parent (a int);
CREATE ROW TYPE child1 (s serial) UNDER parent;
CREATE ROW TYPE child2 (b float, s8 serial8) UNDER child1;
CREATE ROW TYPE child3 (d int) UNDER child2;
```

You then create corresponding typed tables:

```
CREATE TABLE OF TYPE parent;
CREATE TABLE OF TYPE child1 UNDER parent;
CREATE TABLE OF TYPE child2 UNDER child1;
CREATE TABLE OF TYPE child3 UNDER child2;
```

To change the next SERIAL and SERIAL8 numbers to 75, you can issue the following statement:

```
ALTER TABLE child3 MODIFY (s serial(75), s8 serial8(75))
```

When the ALTER TABLE statement executes, the database server updates corresponding serial columns in the **child1**, **child2**, and **child3** tables.

Altering the Structure of Tables

When you use the MODIFY clause, you can also alter the structure of other tables. If the modified column is referenced by other tables, those referential constraints are dropped. You must add those constraints to the referencing tables again, using the ALTER TABLE statement.

When you change the data type of an existing column, all data is converted to the new data type, including numbers to characters and characters to numbers (if the characters represent numbers). The following statement changes the data type of the **quantity** column:

```
ALTER TABLE items MODIFY (quantity CHAR(6))
```

When a primary-key or unique constraint exists, however, conversion takes place only if it does not violate the constraint. If a data type conversion would result in duplicate values (by changing FLOAT to SMALLFLOAT, for example, or by truncating CHAR values), the ALTER TABLE statement fails.

Modifying Tables for NULL Values

You can modify an existing column that formerly permitted NULLs to disallow NULLs, provided that the column contains no NULL values. To do this, specify MODIFY with the same column name and data type and the NOT NULL keywords. Those keywords create a NOT NULL constraint on the column.

You can modify an existing column that did not permit NULLs to permit NULLs. To do this, specify MODIFY with the column name and the existing data type, and omit the NOT NULL keywords. The omission of the NOT NULL keywords drops the NOT NULL constraint on the column. If a unique index exists on the column, you can remove it using the DROP INDEX statement.

An alternative method of permitting NULL values in an existing column that did not permit NULL values is to use the DROP CONSTRAINT clause to drop the NOT NULL constraint on the column.

Adding a Constraint That Existing Rows Violate (IDS)

If you use the MODIFY clause to add a constraint in the enabled mode and receive an error message because existing rows would violate the constraint, take the following steps to add the constraint successfully:

1. Add the constraint in the disabled mode.

Issue the ALTER TABLE statement again, but this time specify the DISABLED keyword in the MODIFY clause.

2. Start a violations and diagnostics table for the target table with the START VIOLATIONS TABLE statement.
3. Issue the SET CONSTRAINTS statement to switch the database object mode of the constraint to the enabled mode.

   When you issue this statement, existing rows in the target table that violate the constraint are duplicated in the violations table; however, you receive an integrity-violation error message, and the constraint remains disabled.
4. Issue a SELECT statement on the violations table to retrieve the nonconforming rows that are duplicated from the target table.

   You might need to join the violations and diagnostics tables to get all the necessary information.
5. Take corrective action on the rows in the target table that violate the constraint.
6. After you fix all the nonconforming rows in the target table, issue the SET statement again to enable the constraint that was disabled.

   Now the constraint is enabled, and no integrity-violation error message is returned because all rows in the target table now satisfy the new constraint.

How Modifying a Column Affects a Generalized-Key Index (XPS)

In Extended Parallel Server, when you modify a column, all GK indexes that reference the column are dropped if the column is used in the GK index in a way that is incompatible with the new data type of the column.

For example, if a numeric column is changed to a character column, any GK indexes involving that column are dropped if they involve arithmetic expressions.

How Modifying a Column Affects Triggers

If you modify a column that appears in the triggering column list of an UPDATE trigger, the trigger is unchanged.

When you modify a column in a table, the triggers based on that table remain unchanged, but the column modification might invalidate the trigger.

The following statements illustrate the possible affects on triggers:

```
CREATE TABLE tab1 (i1 int, i2 int, i3 int);
CREATE TABLE tab2 (i4 int, i5 int);
CREATE TRIGGER col1trig UPDATE OF i2 ON tab1
   BEFORE(INSERT INTO tab2 VALUES(1,1));
ALTER TABLE tab2 MODIFY i4 char;
```

After the ALTER TABLE statement, column **i4** accepts only character values. Because character columns accept only values enclosed in quotation marks, the action clause of the **col1trig** trigger is invalidated.

If a trigger is invalidated when you modify the underlying table, drop and then re-create the trigger.

How Modifying a Column Affects Views

When you modify a column in a table, the views based on that table remain unchanged. If a view is invalidated when you alter the underlying table, you must rebuild the view.

PUT Clause (IDS)

Use the PUT clause to specify the storage space (an sbspace) for a column that contains smart large objects. This clause can specify storage characteristics for a new column or replace the storage characteristics of an existing column. The syntax is similar to the PUT clause of the CREATE TABLE statement (page 2-199), but specifies only a single column, rather than a list of columns.

PUT Clause:

```
                        ┌,─────────┐
                        ▼          │
|──PUT──column──IN──(───sbspace────┴──)──────────────────────────────────────►

►──┬─────────────────────────────────────────────┬──────────────────────────|
   │    ┌,──────────────────────────────┐        │
   │    ▼                               │        │
   └─(──┬──EXTENT SIZE──kilobytes───────┬┴──)────┘
        │ ┌─NO LOG─┐                    │
        ├─┴─LOG────┴────────────────────┤
        │ ┌─HIGH INTEG─┐                │
        ├─┴────────────┴────────────────┤
        │ ┌─NO KEEP ACCESS TIME─┐       │
        └─┴─KEEP ACCESS TIME────┴───────┘
```

Element	Description	Restrictions	Syntax
column	Column to store in the specified sbspace	Must be a UDT, or a complex, BLOB, or CLOB data type	Identifier, p. 5-22
kilobytes	Number of kilobytes to allocate for the extent size	Must be an integer value	Literal Number, p. 4-137
sbspace	Name of an area of storage for smart large objects	The sbspace must exist	Identifier, p. 5-22

When you modify the storage characteristics of a column, *all* attributes previously associated with the storage space for that column are dropped. When you want certain attributes to remain, you must specify those attributes again. For example, to retain logging, you must specify the log keyword again.

The format *column.field* is not valid here. That is, the smart large object that you are storing cannot be one field of a row type.

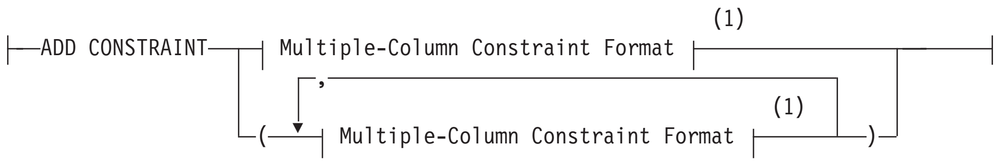
When you modify the storage characteristics of a column that holds smart large objects, the database server does not alter smart large objects that already exist, but applies the new storage characteristics only to those smart large objects that are inserted after the ALTER TABLE statement takes effect.

For more information on the available storage characteristics, refer to the counterpart of this section in the CREATE TABLE statement, "PUT Clause (IDS)" on page 2-199. For a discussion of large-object characteristics, refer to "Large-Object Data Types" on page 4-25.

ADD CONSTRAINT Clause

Use the ADD CONSTRAINT clause to specify a constraint on a new or existing column or on a set of columns.

ADD CONSTRAINT Clause:


ADD CONSTRAINT
Multiple-Column Constraint Format
(1)
(
,
Multiple-Column Constraint Format
(1)
)

Notes:

1 See page 2-59

For example, to add a unique constraint to the **fname** and **lname** columns of the **customer** table, use the following statement:

```
ALTER TABLE customer ADD CONSTRAINT UNIQUE (lname, fname)
```

To declare a name for the constraint, change the preceding statement:

```
ALTER TABLE customer
   ADD CONSTRAINT UNIQUE (lname, fname) CONSTRAINT u_cust
```

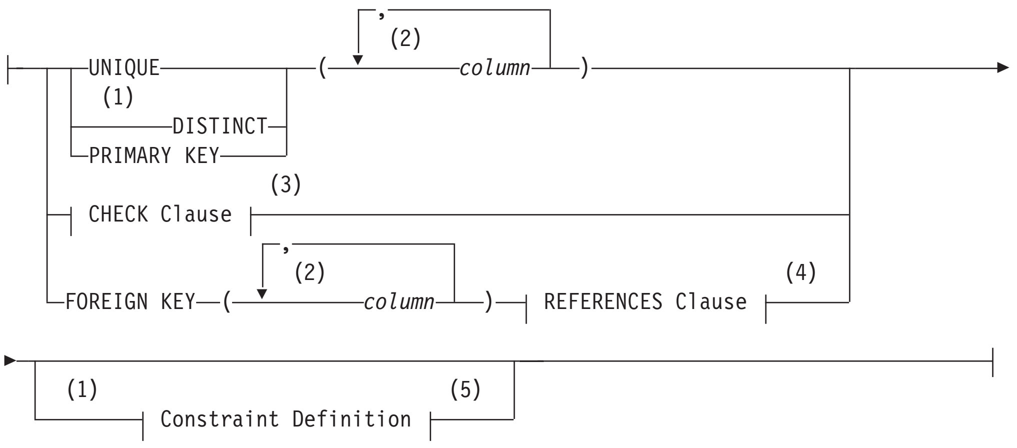
When you do not specify a name for a new constraint, the database server provides one. You can find the name of the constraint in the **sysconstraints** system catalog table. For more information about the **sysconstraints** system catalog table, see the *IBM Informix Guide to SQL: Reference*.

When you add a constraint, the collating order must be the same as when the table was created.

Multiple-Column Constraint Format

Use the Multiple-Column Constraint Format option to assign a constraint to one column or a set of columns.

Multiple-Column Constraint Format:



Notes:

1 Informix extension

2 Use path no more than 16 times

3 See page 2-51

4 See page 2-49

5 See page 2-49

Element	Description	Restrictions	Syntax
column	A column on which the constraint is placed	No more than 16 columns	Identifier, p. 5-22

A multiple-column constraint has these restrictions:
- It can include no more than 16 column names.
- In Dynamic Server, the total length of the list of columns cannot exceed 390 bytes.
- In Extended Parallel Server, the total length of the list of columns cannot exceed 255 bytes.

You can declare a name for the constraint and set its mode by means of "Constraint Definition" on page 2-49.

Adding a Primary-Key or Unique Constraint

When you place a primary-key or unique constraint on a column or set of columns, those columns must contain unique values. The database server checks for existing constraints and indexes:
- If a user-created unique index already exists on that column or set of columns, the constraint shares the index.
- If a user-created index that allows duplicates already exists on that column or set of columns, the database server returns an error.

  In this case, you must drop the existing index before adding the primary-key or unique constraint.
- If a referential constraint already exists on that column or set of columns, the duplicate index is upgraded to unique (if possible) and the index is shared.
- If no referential constraint or user-created index exists on that column or set of columns, the database server creates an internal B-tree index on the specified columns.

When you place a referential constraint on a column or set of columns, and an index already exists on that column or set of columns, the index is shared.

If you own the table or have the Alter privilege on the table, you can create a check, primary-key, or unique constraint on the table and specify yourself as the owner of the constraint. To add a referential constraint, you must have the References privilege on either the referenced columns or the referenced table. When you have the DBA privilege, you can create constraints for other users.

Recovery from Constraint Violations (IDS)

If you use the ADD CONSTRAINT clause to add a constraint in the enabled mode, you receive an error message because existing rows would violate the constraint. For a procedure to add the constraint successfully, see "Adding a Constraint That Existing Rows Violate (IDS)" on page 2-56.

DROP CONSTRAINT Clause

Use the DROP CONSTRAINT clause to drop a named constraint.

DROP CONSTRAINT Clause:

```
                          ┌─,────────────┐
                          ▼              │
├──DROP CONSTRAINT──┬─(───constraint─┴─)─┬────────────────────────────────────┤
                    └─constraint─────────┘
```

Element	Description	Restrictions	Syntax
constraint	Constraint to be dropped	Must exist.	Database Object Name, p. 5-17

To drop an existing constraint, specify the DROP CONSTRAINT keywords and the name of the constraint. Here is an example of dropping a constraint:

```
ALTER TABLE manufact DROP CONSTRAINT con_name
```

If no name is specified when the constraint is created, the database server generates the name. You can query the **sysconstraints** system catalog table for the name and owner of a constraint. For example, to find the name of the constraint placed on the **items** table, you can issue the following statement:

```
SELECT constrname FROM  sysconstraints
   WHERE tabid = (SELECT tabid FROM systables
      WHERE tabname = 'items')
```

When you drop a primary-key or unique constraint that has a corresponding foreign key, the referential constraints are dropped. For example, if you drop the primary-key constraint on the **order_num** column in the **orders** table and **order_num** exists in the **items** table as a foreign key, that referential relationship is also dropped.

You cannot use the MODIFY NEXT SIZE clause of the ALTER TABLE statement to change the size of the next extent of any system catalog table, even if you are user **informix**.

MODIFY NEXT SIZE Clause

Use the MODIFY NEXT SIZE clause to change the size of new extents.

MODIFY NEXT SIZE Clause:

```
├──MODIFY NEXT SIZE──kilobytes──────────────────────────────────────────────┤
```

Element	Description	Restrictions	Syntax
kilobytes	Length (in kilobytes) assigned here to the next extent for this table	Specification cannot be a variable, and (4(page size)) ≤ *kilobytes* ≤ (chunk size)	Expression, p. 4-34

The minimum extent size is 4 times the disk-page size. For example, on a system with 2-kilobyte pages, the minimum length is 8 kilobytes. The maximum length is equal to the chunk size. This example specifies an extent size of 32 kilobytes:

```
ALTER TABLE customer MODIFY NEXT SIZE 32
```

This clause cannot change the size of existing extents. You cannot change the size of existing extents without unloading all of the data.

To change the size of existing extents, you must unload all the data, drop the table, modify the *first-extent* and *next-extent* sizes in the CREATE TABLE definition in the database schema, re-create the database, and reload the data. For information about how to optimize extent sizes, see your *IBM Informix Administrator's Guide*.

LOCK MODE Clause

Use the LOCK MODE keywords to change the locking granularity of a table.

LOCK MODE Clause:

```
├──LOCK MODE──(──┬─PAGE──────────┬──)──────────────────────────────────────────┤
                 ├─ROW───────────┤
                 │  (1)          │
                 └────────TABLE──┘
```

Notes:

1 Extended Parallel Server only

The following table describes the locking-granularity options available.

Granularity	Effect
PAGE	Obtains and releases one lock on a whole page of rows. This is the default locking granularity. Page-level locking is especially useful when you know that the rows are grouped into pages in the same order that you are using to process all the rows. For example, if you are processing the contents of a table in the same order as its cluster index, page locking is especially appropriate.
ROW	Obtains and releases one lock per row. Row-level locking provides the highest level of concurrency. If you are using many rows at one time, the lock-management overhead can become significant. You can also exceed the maximum number of locks available, depending on the configuration of your database server.
TABLE (XPS only)	Places a lock on the entire table. This type of lock reduces update concurrency in comparison to row and page locks. A table lock reduces the lock-management overhead for a table. Multiple read-only transactions can still access the table.

Precedence and Default Behavior

The LOCK MODE setting in an ALTER TABLE statement takes precedence over the settings of the **IFX_DEF_TABLE_LOCKMODE** environment variable and the DEF_TABLE_LOCKMODE configuration parameter. For information about the **IFX_DEF_TABLE_LOCKMODE** environment variable, refer to the *IBM Informix*

Guide to SQL: Reference. For information about the DEF_TABLE_LOCKMODE configuration parameter, refer to the *IBM Informix Dynamic Server Administrator's Reference*.

Logging TYPE Options

Use the Logging TYPE options to specify that the table have particular characteristics that can improve various bulk operations on it.

Logging TYPE Options:

```
├──TYPE──(──┬─STANDARD──────────────┬──)──────────────────────────────┤
            ├─RAW───────────────────┤
            │  (1)                  │
            └─────────┬─OPERATIONAL─┤
                      └─STATIC──────┘
```

Notes:

1 Extended Parallel Server only

Here STANDARD, the default option of the CREATE TABLE statement, is used for online transaction processing (OLTP) databases. The OPERATIONAL and STATIC options are used primarily to improve performance in data warehousing databases.

A table can have any of the following logging characteristics.

Option	Effect
STANDARD	Logging table that allows rollback, recovery, and restoration from archives. This is the default. Use this type for recovery and constraints functionality on OLTP databases.
RAW	Nonlogging table that cannot have indexes or referential constraints but can be updated. Use this type for quickly loading data. In XPS, raw tables take advantage of light appends and avoid the overhead of logging, checking constraints, and building indexes.
OPERATIONAL (XPS only)	Logging table that uses light appends and cannot be restored from archive. Use this type on tables that are refreshed frequently. Light appends allow the quick addition of many rows.
STATIC (XPS only)	Nonlogging table that can contain index and referential constraints but cannot be updated. Use this type for read-only operations because there is no logging or locking overhead.

Warning: Use raw tables for fast loading of data. It is recommended that you alter the logging type to STANDARD and perform a level-0 backup before you use the table in a transaction or modify the data within the table. If you must use a raw table within a transaction, either set the isolation level to Repeatable Read or lock the table in exclusive mode to prevent concurrency problems.

The Logging TYPE option can convert a non-logging table, such as a RAW table, to a STANDARD table that supports transaction logging. If you use this feature, you should be aware that the database server does not check to see whether a level 0 archive has been performed on the table.

Operations on a RAW table are not logged and are not recoverable, so RAW tables are always at risk. When the database server converts a table that is not logged to a STANDARD table type, it is your responsibility to perform a level-0 backup before using the table in a transaction or modifying data in the table. Failure to do this might lead to recovery problems in the event of a server crash.

For more information on these logging types of tables, refer to your *IBM Informix Administrator's Guide*.

The Logging TYPE options have the following restrictions:

- You must perform a level-0 archive before the logging type of a table can be altered to STANDARD from any other logging type.
- If you want to change the logging type of a table to RAW, you must drop all indexes on the table before you do so.
- If you have triggers defined on the table, you cannot change the logging type to RAW or STATIC. These nonlogging table types do not support triggers.
- The table cannot be a SCRATCH or TEMP table, and you cannot change any of these types of tables to a SCRATCH or TEMP table.
- The table cannot have a dependent generalized-key (GK) index.

ADD TYPE Clause (IDS)

Use the ADD TYPE clause to convert a table that is not based on a named ROW data type into a typed table. This clause is an extension to the ANSI/ISO standard for SQL.

ADD TYPE Clause:

```
├──ADD TYPE──row_type──────────────────────────────────────────────────┤
```

Element	Description	Restrictions	Syntax
row_type	Identifier of an existing named ROW data type for the table	The *row_type* fields must match the column data type in their order and number	Identifier, p. 5-22

When you use the ADD TYPE clause, you assign the specified named ROW data type to a table whose columns match the fields of that data type.

In addition to the requirements common to all ALTER TABLE operations (namely DBA privilege on the database, Alter privilege on the table, and ownership of the table), all of the following must be also true when you use the ADD TYPE clause to convert an untyped table to the specified named ROW data type:

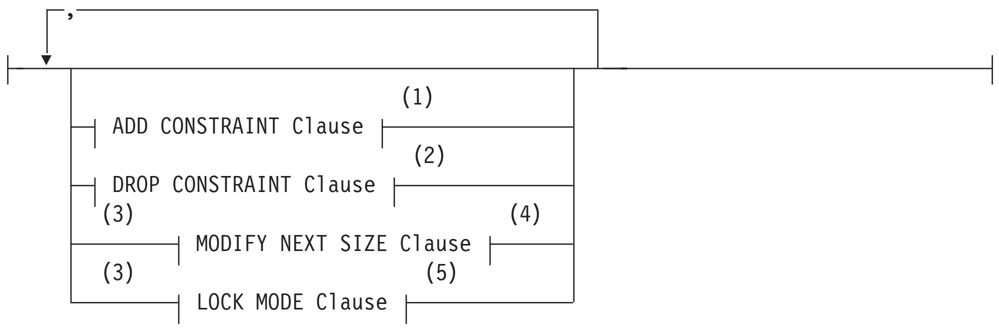
- The named ROW data type is already registered in the database.
- You hold the Usage privilege on the named ROW data type.
- There must be a 1-to-1 correspondence between the ordered set of column data types of the untyped table and the ordered set of field data types of the named ROW data type.
- The table cannot be a fragmented table that has **rowid** values.

You cannot combine the ADD TYPE clause with any clause that changes the schema of the table. No other ADD, DROP, or MODIFY clause is valid in the same ALTER TABLE statement that has the ADD TYPE clause. The ADD TYPE clause does not allow you to change column data types. (To change the data type of a column, use the MODIFY clause.)

Using the MODIFY Clause

ALTER TABLE supports only the following options for tables of ROW data types.

Typed-Table Options:



Notes:

1 See page 2-59

2 See page 2-61

3 Use path no more than once

4 See page 2-61

5 See page 2-62

Altering Subtables and Supertables

Two considerations apply to typed tables that are part of inheritance hierarchies:

- For subtables, ADD CONSTRAINT and DROP CONSTRAINT are not valid on inherited constraints.
- For supertables, ADD CONSTRAINT and DROP CONSTRAINT propagate to all subtables.

Related Infrmation

Related statements: CREATE TABLE, DROP TABLE, LOCK TABLE, and SET Database Object Mode.

For discussions of data-integrity constraints and the ON DELETE CASCADE option, see the *IBM Informix Guide to SQL: Tutorial*.

For a discussion of database and table creation, see the *IBM Informix Database Design and Implementation Guide*.

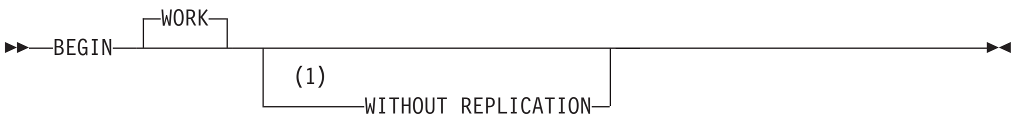
For information on how to maximize performance when you make table modifications, see your *IBM Informix Performance Guide*.

BEGIN WORK

Use the BEGIN WORK statement to start a *transaction* (a series of database operations that the COMMIT WORK or ROLLBACK WORK statement terminates).

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 Dynamic Server and ESQL/C only

Usage

The BEGIN WORK statement is valid only in a database that supports transaction logging.

Each row that an UPDATE, DELETE, or INSERT statement affects during a transaction is locked and remains locked throughout the transaction. A transaction that contains many such statements or that contains statements that affect many rows can exceed the limits that your operating system or the database server configuration imposes on the number of simultaneous locks.

If no other user is accessing the table, you can avoid locking limits and reduce locking overhead by locking the table with the LOCK TABLE statement after you begin the transaction. Like other locks, this table lock is released when the transaction terminates. The example of a transaction on "Example of BEGIN WORK" on page 2-67 includes a LOCK TABLE statement.

Important: Issue the BEGIN WORK statement only if a transaction is not in progress. If you issue a BEGIN WORK statement while you are in a transaction, the database server returns an error.

The WORK keyword is optional. The following two statements are equivalent:

```
BEGIN;
BEGIN WORK;
```

In ESQL/C, if you use the BEGIN WORK statement within a UDR called by a WHENEVER statement, specify WHENEVER SQLERROR CONTINUE and WHENEVER SQLWARNING CONTINUE before the ROLLBACK WORK statement. These statements prevent the program from looping endlessly if the ROLLBACK WORK statement encounters an error or a warning.

BEGIN WORK and ANSI-Compliant Databases

In an ANSI-compliant database, you do not need the BEGIN WORK statement because transactions are implicit; every SQL statement occurs within a transaction. The database server generates a warning when you use a BEGIN WORK statement immediately after any of the following statements:

- DATABASE
- COMMIT WORK

- CREATE DATABASE
- ROLLBACK WORK

The database server returns an error when you use a BEGIN WORK statement after any other statement in an ANSI-compliant database.

BEGIN WORK WITHOUT REPLICATION (IDS, ESQL/C)

When you use Enterprise Replication for data replication, you can use the BEGIN WORK WITHOUT REPLICATION statement to start a transaction that does not replicate to other database servers.

You cannot execute BEGIN WORK WITHOUT REPLICATION as a stand-alone embedded statement in an ESQL/C application. Instead you must execute this statement indirectly. You can use either of the following methods:

- You can use a combination of the PREPARE and EXECUTE statements to prepare and execute the BEGIN WORK WITHOUT REPLICATION statement.
- You can use the EXECUTE IMMEDIATE statement to prepare and execute BEGIN WORK WITHOUT REPLICATION in a single step.

You cannot use the DECLARE *cursor* CURSOR WITH HOLD statement with the BEGIN WORK WITHOUT REPLICATION statement.

For more information about data replication, see the *IBM Informix Dynamic Server Enterprise Replication Guide*.

Example of BEGIN WORK

The following code fragment shows how you might place statements within a transaction. The transaction is made up of the statements that occur between the BEGIN WORK and COMMIT WORK statements. The transaction locks the **stock** table (LOCK TABLE), updates rows in the **stock** table (UPDATE), deletes rows from the **stock** table (DELETE), and inserts a row into the **manufact** table (INSERT).

```
BEGIN WORK;
   LOCK TABLE stock;
   UPDATE stock SET unit_price = unit_price * 1.10
      WHERE manu_code = 'KAR';
   DELETE FROM stock WHERE description = 'baseball bat';
   INSERT INTO manufact (manu_code, manu_name, lead_time)
      VALUES ('LYM', 'LYMAN', 14);
COMMIT WORK;
```

The database server must perform this sequence of operations either completely or not at all. When you include all of these operations within a single transaction, the database server guarantees that all the statements are completely and perfectly committed to disk, or else the database is restored to the same state that it was in before the transaction began.

Related Information

Related statements: COMMIT WORK and SAVE EXTERNAL DIRECTIVES

For discussions of transactions and locking, see the *IBM Informix Guide to SQL: Tutorial*.

CLOSE

Use the CLOSE statement when you no longer need to refer to the rows that a select or function cursor retrieved, or to flush and close an insert cursor.

Use this statement with ESQL/C.

Syntax

```
>>──CLOSE──┬─cursor_id──────────┬──────────────────────────────────────────><
           │  (1)               │
           └────────cursor_id_var─┘
```

Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
cursor_id	Name of cursor to be closed	Must have been declared	"Identifier" on page 5-22
cursor_id_var	Host variable that contains the value of *cursor_id*	Must be of a character data type	Must conform to language-specific rules for names.

Usage

Closing a cursor makes the cursor unusable for any statements except OPEN or FREE and releases resources that the database server had allocated to the cursor. A CLOSE statement treats a cursor that is associated with an INSERT statement differently from one that is associated with a SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement.

In a database that is not ANSI-compliant, you can close a cursor that has not been opened or that has already been closed. No action is taken in these cases.

In an ANSI-compliant database, the database server returns an error if you close a cursor that was not open.

Closing a Select or Function Cursor

When a cursor identifier is associated with a SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement, closing the cursor terminates the SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement.

The database server releases all resources that it might have allocated to the active set of rows, for example, a temporary table that it used to hold an ordered set. The database server also releases any locks that it might have held on rows that were selected through the cursor. If a transaction contains the CLOSE statement, the database server does not release the locks until you execute COMMIT WORK or ROLLBACK WORK.

After you close a select or function cursor, you cannot execute a FETCH statement that names that cursor until you have reopened it.

Closing an Insert Cursor

When a cursor identifier is associated with an INSERT statement, the CLOSE statement writes any remaining buffered rows into the database. The number of rows that were successfully inserted into the database is returned in the third element of the **sqlerrd** array, **sqlca.sqlerrd[2]**, in the **sqlca** structure. For information on how to use **SQLERRD** to count the total number of rows that were inserted, see "Error Checking" on page 2-447.

The **SQLCODE** field of the **sqlca** structure, **sqlca.sqlcode**, indicates the result of the CLOSE statement for an insert cursor. If all buffered rows are successfully inserted, **SQLCODE** is set to zero. If an error is encountered, the **sqlca.sqlcode** field in the **SQLCODE** is set to a negative error message number.

When **SQLCODE** is zero, the row buffer space is released, and the cursor is closed; that is, you cannot execute a PUT or FLUSH statement that names the cursor until you reopen it.

Tip: When you encounter an **SQLCODE** error, a corresponding **SQLSTATE** error value also exists. For information about how to get the message text, check the GET DIAGNOSTICS statement.

If the insert is not successful, the number of successfully inserted rows is stored in **sqlerrd**. Any buffered rows that follow the last successfully inserted row are discarded. Because the insert fails, the CLOSE statement fails also, and the cursor is not closed. For example, a CLOSE statement can fail if insufficient disk space prevents some of the rows from being inserted. In this case, a second CLOSE statement can be successful because no buffered rows exist. An OPEN statement can also be successful because the OPEN statement performs an implicit close.

Closing a Collection Cursor (IDS)

You can declare both select and insert cursors on collection variables. Such cursors are called collection cursors. Use the CLOSE statement to deallocate resources that have been allocated for the collection cursor.

For more information on how to use a collection cursor, see "Fetching from a Collection Cursor (IDS)" on page 2-350 and "Inserting into a Collection Cursor (IDS)" on page 2-445.

Using End of Transaction to Close a Cursor

The COMMIT WORK and ROLLBACK WORK statements close all cursors except those that are declared with a hold. It is better to close all cursors explicitly, however. For select or function cursors, this action simply makes the intent of the program clear. It also helps to avoid a logic error if the WITH HOLD clause is later added to the declaration of a cursor.

For an insert cursor, it is important to use the CLOSE statement explicitly so that you can test the error code. Following the COMMIT WORK statement, SQLCODE reflects the result of the COMMIT statement, not the result of closing cursors. If you use a COMMIT WORK statement without first using a CLOSE statement, and if an error occurs while the last buffered rows are being written to the database, the transaction is still committed.

For how to use insert cursors and the WITH HOLD clause, see "DECLARE" on page 2-260.

In an ANSI-compliant database, a cursor cannot be closed implicitly. You must issue a CLOSE statement.

Related Information

Related statements: DECLARE, FETCH, FLUSH, FREE, OPEN, PUT, and SET AUTOFREE

For an introductory discussion of cursors, see the *IBM Informix Guide to SQL: Tutorial*.

For a more advanced discussion of cursors, see the *IBM Informix ESQL/C Programmer's Manual*.

CLOSE DATABASE

Use the CLOSE DATABASE statement to close the current database.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──CLOSE DATABASE──────────────────────────────────────────────────────►◄
```

Usage

When you issue a CLOSE DATABASE statement, you can issue only the following SQL statements immediately after it:

- CONNECT
- CREATE DATABASE
- DATABASE
- DROP DATABASE
- DISCONNECT

  (The DISCONNECT statement is valid here only if an explicit connection existed before CLOSE DATABASE was executed.)

Issue the CLOSE DATABASE statement before you drop the current database.

If your current database supports transaction logging, and if you have started a transaction, you must issue a COMMIT WORK or ROLLBACK WORK statement before you can use the CLOSE DATABASE statement.

The following example shows how to use the CLOSE DATABASE statement to drop the current database:

```
DATABASE stores_demo
. . .
CLOSE DATABASE
DROP DATABASE stores_demo
```

In ESQL/C, the CLOSE DATABASE statement cannot appear in a multistatement PREPARE operation.

If a previous CONNECT statement has established an explicit connection to a database, and that connection is still your current connection, you cannot use the CLOSE DATABASE statement to close that explicit connection. (You can use the DISCONNECT statement to close the explicit connection.)

If you use the CLOSE DATABASE statement within a UDR called by a WHENEVER statement, specify WHENEVER SQLERROR CONTINUE and WHENEVER SQLWARNING CONTINUE before the ROLLBACK WORK statement. This action prevents the program from looping if the ROLLBACK WORK statement encounters an error or a warning.

When you issue the CLOSE DATABASE statement, any declared cursors are no longer valid. You must re-declare any cursors that you want to use.

In an ANSI-compliant database, if no error is encountered while you exit from DB–Access in non-interactive mode without issuing the CLOSE DATABASE, COMMIT WORK, or DISCONNECT statement, the database server automatically commits any open transaction.

Related Information

Related statements: CONNECT, CREATE DATABASE, DATABASE, DISCONNECT, and DROP DATABASE

COMMIT WORK

Use the COMMIT WORK statement to commit all modifications made to the database from the beginning of a transaction.

Syntax

```
►►──COMMIT──┬──────┬─────────────────────────────────────────────────────►◄
            └─WORK─┘
```

Usage

The COMMIT WORK statement informs the database server that you reached the end of a series of statements that must succeed as a single unit. The database server takes the required steps to make sure that all modifications that the transaction makes are completed correctly and saved to disk.

Use COMMIT WORK only at the end of a multistatement operation in a database with transaction logging, when you are sure that you want to keep all changes made to the database from the beginning of a transaction.

The COMMIT WORK statement releases all row and table locks.

The WORK keyword is optional in a COMMIT WORK statement. The following two statements are equivalent:

```
COMMIT;
COMMIT WORK;
```

The following example shows a transaction bounded by BEGIN WORK and COMMIT WORK statements.

```
BEGIN WORK;
   DELETE FROM call_type WHERE call_code = 'O';
   INSERT INTO call_type VALUES ('S', 'order status');
COMMIT WORK;
```

In this example, the user first deletes the row from the **call_type** table where the value of the **call_code** column is O. The user then inserts a new row in the **call_type** table where the value of the **call_code** column is S. The database server guarantees that both operations succeed or else neither succeeds.

In ESQL/C, the COMMIT WORK statement closes all open cursors except those that were declared using the WITH HOLD option.

Issuing COMMIT WORK in a Database That Is Not ANSI Compliant

In a database that is not ANSI compliant, but that supports transaction logging, if you initiate a transaction with a BEGIN WORK statement, you must issue a COMMIT WORK statement at the end of the transaction. If you fail to issue a COMMIT WORK statement in this case, the database server rolls back any modifications that the transaction made to the database.

If you do not issue a BEGIN WORK statement, however, each statement executes within its own transaction. These single-statement transactions do not require either a BEGIN WORK statement or a COMMIT WORK statement.

Explicit DB-Access Transactions: When you use DB-Access in interactive mode with a database that is not ANSI-compliant but that supports transaction logging, if you select the **Commit** menu but do not issue the COMMIT WORK statement after a transaction has been started by the BEGIN WORK statement, DB-Access automatically commits the data, but issues the following warning:

```
Warning: Data commit is a result of unhandled exception in TXN PROC/FUNC
```

The purpose of this warning is to remind you to issue COMMIT WORK explicitly to end a transaction that BEGIN WORK initiated.

In non-interactive mode, however, DB-Access rolls back the current transaction if you end a session without issuing the COMMIT WORK statement.

Issuing COMMIT WORK in an ANSI-Compliant Database

In an ANSI-compliant database, you do not need BEGIN WORK to mark the beginning of a transaction. You only need to mark the end of each transaction, because a transaction is always in effect. A new transaction starts automatically after each COMMIT WORK or ROLLBACK WORK statement.

You must, however, issue an explicit COMMIT WORK statement to mark the end of each transaction. If you fail to do so, the database server rolls back any modifications that the transaction made to the database.

In an ANSI-compliant database, however, if no error is encountered while you exit from DB–Access in non-interactive mode without issuing the CLOSE DATABASE, COMMIT WORK, or DISCONNECT statement, the database server automatically commits any open transaction.

Related Information

Related statements: BEGIN WORK, SAVE EXTERNAL DIRECTIVES, and DECLARE

For a discussion of concepts related to transactions, see the *IBM Informix Guide to SQL: Tutorial*.

CONNECT

Use the CONNECT statement to connect to a database environment.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──CONNECT TO─────────────────────────────────────────────────────────────────►

                         (1)
►──┬─┤ Database Environment ├──┬──────────────────────────┬─┬────────────────────────┬─┬──►
   │                           │ (2)                      │ │ (3)               (4)  │ │
   │                           └──────AS──┬─'connection'─┬┘ └──┤ USER Clause ├───────┘ │
   │                                      └─connection_var┘                            │
   └─DEFAULT─────────────────────────────────────────────────────────────────────────┘

►──┬──────────────────────────────────┬─────────────────────────────────────────►◄
   │  (2)                             │
   └────────WITH CONCURRENT TRANSACTION┘
```

Notes:

1 See “Database Environment” on page 2-78

2 ESQL/C only

3 ESQL/C and DB-Access only

4 See “USER Clause” on page 2-80

Element	Description	Restrictions	Syntax
connection	Case-sensitive name that you declare here for a connection	Must be unique among connection names	“Quoted String” on page 4-142
connection_var	Host variable that stores the name of *connection*	Must be a fixed-length character data type	Language specific

Usage

The CONNECT statement connects an application to a *database environment*, which can be a database, a database server, or a database and a database server. If the application successfully connects to the specified database environment, the connection becomes the *current connection* for the application. SQL statements fail if the application has no current connection to a database server. If you specify a database name, the database server opens that database. You cannot include CONNECT within a PREPARE statement.

An application can connect to several database environments at the same time, and it can establish multiple connections to the same database environment, provided each connection has a unique connection name.

On UNIX, the only restriction on establishing multiple connections to the same database environment is that an application can establish only one connection to each local server that uses the shared-memory connection mechanism. To find out whether a local server uses the shared-memory connection mechanism or the local-loopback connection mechanism, examine the **$INFORMIXDIR/etc/sqlhosts** file. For more information on the **sqlhosts** file, refer to your *IBM Informix Administrator's Guide*.

On Windows, the local connection mechanism is named pipes. Multiple connections to the local server from one client can exist.

Only one connection is current at any time; other connections are dormant. The application cannot interact with a database through a dormant connection. When an application establishes a new connection, that connection becomes current, and the previous current connection becomes dormant. You can make a dormant connection current with the SET CONNECTION statement. See also "SET CONNECTION" on page 2-534.

Privileges for Executing the CONNECT Statement

The current user, or PUBLIC, must have the Connect privilege on the database specified in the CONNECT statement. The user who executes the CONNECT statement cannot have the same user name as an existing role in the database.

For information on how to use the USER clause to specify an alternate user name when the CONNECT statement connects to a database server on a remote host, see "USER Clause" on page 2-80.

Connection Identifiers

The optional connection name is a unique identifier that an application can use to refer to a connection in subsequent SET CONNECTION and DISCONNECT statements. If the application does not provide a connection name (or a connection-host variable), it can refer to the connection using the database environment. If the application makes more than one connection to the same database environment, however, each connection must have a unique name.

After you associate a connection name with a connection, you can refer to the connection using only that connection name.

Connection Context

Each connection encompasses a set of information that is called the *connection context*. The connection context includes the name of the current user, the information that the database environment associates with this name, and information on the state of the connection (such as whether an active transaction is associated with the connection). The connection context is saved when an application becomes dormant, and this context is restored when the application becomes current again. (For more information, see "Making a Dormant Connection the Current Connection" on page 2-534.)

DEFAULT Option

Use the DEFAULT option to request a connection to a default database server, called a *default connection*. The default database server can be local or remote. To designate the default database server, set its name in the **INFORMIXSERVER** environment variable. This option of CONNECT does not open a database.

If you select the DEFAULT option for the CONNECT statement, you must use the DATABASE statement or the CREATE DATABASE statement to open or create a database in the default database environment.

The Implicit Connection with DATABASE Statements

If you do not execute a CONNECT statement in your application, the first SQL statement must be one of the following *database statements* (or a single statement PREPARE for one of the following statements):

- DATABASE
- CREATE DATABASE

- DROP DATABASE

If one of these database statements is the first SQL statement in an application, the statement establishes a connection to a database server, which is known as an *implicit* connection. If the database statement specifies only a database name, the database server name is obtained from the **DBPATH** environment variable. This situation is described in “Specifying the Database Environment” on page 2-79.

An application that makes an implicit connection can establish other connections explicitly (using the CONNECT statement) but cannot establish another implicit connection unless the original implicit connection is closed. An application can terminate an implicit connection using the DISCONNECT statement. After you create an explicit connection, you cannot use any database statement to create implicit connections until after you close the explicit connection.

After *any* implicit connection is made, that connection is considered to be the default connection, regardless of whether the database server is the default that the **INFORMIXSERVER** environment variable specifies. This feature allows the application to refer to the implicit connection if additional explicit connections are made, because the implicit connection has no identifier.

For example, if you establish an implicit connection followed by an explicit connection, you can make the implicit connection current by issuing the SET CONNECTION DEFAULT statement. This means, however, that once you establish an implicit connection, you cannot use the CONNECT DEFAULT statement, because the implicit connection is now the default connection.

The database statements can always be used to open a database or create a new database on the current database server.

WITH CONCURRENT TRANSACTION Option

The WITH CONCURRENT TRANSACTION clause enables you to switch to a different connection while a transaction is active in the current connection. If the current connection was *not* established using the WITH CONCURRENT TRANSACTION clause, you cannot switch to a different connection if a transaction is active; the CONNECT or SET CONNECTION statement fails, returning an error, and the transaction in the current connection continues to be active.

In this case, the application must commit or roll back the active transaction in the current connection before it switches to a different connection.

The WITH CONCURRENT TRANSACTION clause supports the concept of multiple concurrent transactions, where each connection can have its own transaction and the COMMIT WORK and ROLLBACK WORK statements affect only the current connection. The WITH CONCURRENT TRANSACTION clause does not support global transactions in which a single transaction spans databases over multiple connections. The COMMIT WORK and ROLLBACK WORK statements do not act on databases across multiple connections.

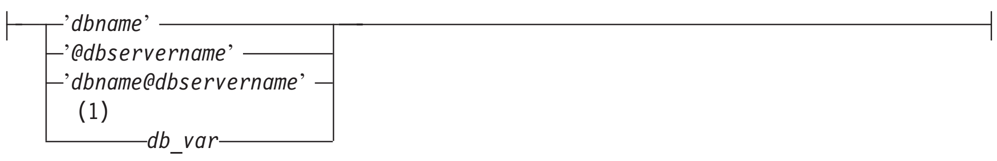
The following example illustrates how to use the WITH CONCURRRENT TRANSACTION clause:

```
main()
{
EXEC SQL connect to 'a@srv1' as 'A';
EXEC SQL connect to 'b@srv2' as 'B' with concurrent transaction;
EXEC SQL connect to 'c@srv3' as 'C' with concurrent transaction;
/*
   Execute SQL statements in connection 'C' , starting a transaction
*/
EXEC SQL set connection 'B'; -- switch to connection 'B'

/*
   Execute SQL statements starting a transaction in 'B'.
   Now there are two active transactions, one each in 'B' and 'C'.
*/

EXEC SQL set connection 'A'; -- switch to connection 'A'

/*
   Execute SQL statements starting a transaction in 'A'.
   Now there are three active transactions, one each in 'A', 'B' and 'C'.
*/

EXEC SQL set connection 'C'; -- ERROR, transaction active in 'A'

/*
   SET CONNECTION 'C' fails (current connection is still 'A')
   The transaction in 'A' must be committed or rolled back because
   connection 'A' was started without the CONCURRENT TRANSACTION
   clause.
*/
EXEC SQL commit work;   -- commit tx in current connection ('A')

/*
   Now, there are two active transactions, in 'B' and in 'C',
   which must be committed or rolled back separately
*/

EXEC SQL set connection 'B'; -- switch to connection 'B'
EXEC SQL commit work;        -- commit tx in current connection ('B')

EXEC SQL set connection 'C'; -- go back to connection 'C'
EXEC SQL commit work;         -- commit tx in current connection ('C')

EXEC SQL disconnect all;
}
```

Warning: When an application uses the WITH CONCURRENT TRANSACTION clause to establish multiple connections to the same database environment, a deadlock condition can occur.

Database Environment

Database Environment:



Notes:

1 ESQL/C only

Element	Description	Restrictions	Syntax
db_var	Host variable that contains a valid database environment (in one of the formats in the syntax diagram)	Must be a fixed-length character data type, whose contents are in a format from the syntax diagram	Language specific
dbname	Database to which to connect	Must already exist	"Identifier" on page 5-22
dbservername	Name of the database server to which a connection is made	Must already exist; blank space is not valid between @ symbol and *dbservername*. See also "Restrictions on dbservername."	"Identifier" on page 5-22

If the **DELIMIDENT** environment variable is set, any quotation (′) marks in the database environment must be single. If **DELIMIDENT** is not set, then either single (′) or double (″) quotation marks are valid here.

Restrictions on dbservername

If you specify *dbservername*, it must satisfy the following restrictions.

- If the database server that you specify is not online, you receive an error.
- On UNIX, the database server that you specify in *dbservername* must match the name of a database server in the **sqlhosts** file.
- On Windows, *dbservername* must match the name of a database server in the **sqlhosts** subkey in the registry. It is recommended that you use the **setnet32** utility to update the registry.

Specifying the Database Environment

You can specify a database server and a database, or a database server only, or a database only. How a database is located and opened depends on whether you specify a database server name in the database environment expression.

Only Database Server Specified: The *@dbservername* option establishes a connection to the database server only; it does not open a database. When you use this option, you must subsequently use the DATABASE or CREATE DATABASE statement (or a PREPARE statement for one of these statements and an EXECUTE statement) to open a database.

Database Server and Database Specified: If you specify both a database server and a database, your application connects to the database server, which locates and opens the database.

Only Database Specified: The *dbname* option establishes a connection to the default database server or to another database server in the **DBPATH** environment variable. It also locates and opens the specified database. (The same is true of the *db_var* option if this specifies only a database name.)

If you specify only *dbname*, its database server is read from the **DBPATH** environment variable. The database server in the **INFORMIXSERVER** environment variable is always added before the **DBPATH** value.

On UNIX, set the **INFORMIXSERVER** and **DBPATH** environment variables as the following example (for the C shell) shows:

```
setenv INFORMIXSERVER srvA
setenv DBPATH //srvB://srvC
```

On Windows, choose **Start > Programs > Informix > setnet32** from the Task Bar and set the **INFORMIXSERVER** and **DBPATH** environment variables:

```
set INFORMIXSERVER = srvA
set DBPATH = //srvA://srvB://srvC
```

The next example shows the resulting **DBPATH** that your application uses:

```
//srvA://srvB://srvC
```

The application first establishes a connection to the database server that **INFORMIXSERVER** specifies. The database server uses parameters in the configuration file to locate the database. If the database does not reside on the default database server, or if the default database server is not online, the application connects to the next database server in **DBPATH**. In the previous example, that database server would be **srvB**.

USER Clause

The USER clause specifies information that is used to determine whether the application can access the target computer on a remote host.

USER Clause:

```
├──USER──┬─'user_id' ──┬──USING──validation_var──────────────────────────────┤
         └─user_id_var─┘
```

Element	Description	Restrictions	Syntax
user_id	Valid login name	See "Restrictions on the User Identifier Parameter" on page 2-81.	"Quoted String" on page 4-142
user_id_var	Host variable that contains *user_id*	Must be a fixed-length character data type; same restrictions as *user_id*	Language specific
validation_var	Host variable that contains a valid password for login name in *user_id* or *user_id_var*	Must be a fixed-length character type. See "Restrictions on the Validation Variable Parameter" on page 2-80.	Language specific

The USER clause is required when the CONNECT statement connects to the database server on a remote host. Subsequent to the CONNECT statement, all database operations on the remote host use the specified user name.

In DB-Access, the USING clause is valid within files executed from DB-Access. In interactive mode, DB-Access prompts you for a password, so the USING keyword and *validation_var* are not used.

Restrictions on the Validation Variable Parameter

On UNIX, the password stored in *validation_var* must be a valid password and must exist in the **/etc/passwd** file. If the application connects to a remote database server, the password must exist in this file on both the local and remote database servers.

On Windows, the password stored in *validation_var* must be valid and must be the password entered in **User Manager**. If the application connects to a remote database server, the password must exist in the domain of both the client and the server.

Restrictions on the User Identifier Parameter

The connection is rejected if any of the following conditions occur:

- The specified user lacks the privileges to access the database specified in the database environment.
- The specified user lacks the permissions to connect to the remote host.
- You supply a USER clause but omit the USING *validation_var* specification.

In compliance with the X/Open standard for the CONNECT statement, the ESQL/C preprocessor supports a CONNECT statement that has a USER clause without the USING *validation_var* specification. If the *validation_var* is not present, however, the database server rejects the connection at runtime.

On UNIX, the *user_id* that you specify must be a valid login name and must exist in the **/etc/passwd** file. If the application connects to a remote server, the login name must exist in this file on both the local and remote database servers.

On Windows, the *user_id* that you specify must be a valid login name and must exist in **User Manager**. If the application connects to a remote server, the login name must exist in the domain of both the client and the server.

Use of the Default User ID

If you do not supply the USER clause, the default user ID is used to attempt the connection. The default user ID is the login name of the user running the application. In this case, you obtain network permissions with the standard authorization procedures. For example, on UNIX, the default user ID must match a user ID in the **/etc/hosts.equiv** file. On Windows, you must be a member of the domain, or if the database server is installed locally, you must be a valid user on the computer where it is installed.

Related Information

Related Statements: DISCONNECT, SET CONNECTION, DATABASE, and CREATE DATABASE

For more information about **sqlhosts**, refer to your *IBM Informix Administrator's Guide*.

CREATE ACCESS_METHOD

Use the CREATE ACCESS_METHOD statement to register a new primary or secondary access method in the **sysams** system catalog table.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──CREATE──┬─SECONDARY─┬──ACCESS_METHOD──access_method──────────────────────►
            └─PRIMARY───┘

      ┌─,───────────────────────────┐
      ▼                         (1) │
►─(───┤ Purpose Options ├───────────┴──)────────────────────────────────────►◄
```

Notes:

1 See "Purpose Options" on page 5-46

Element	Description	Restrictions	Syntax
access method	Name declared here for the new access method	Must be unique among access-method names in the **sysams** system catalog table	"Database Object Name" on page 5-17

Usage

The CREATE ACCESS_METHOD statement adds a user-defined access method to a database. To create an access method, you specify *purpose functions* (or *purpose methods*), *purpose flags*, or *purpose values* as attributes of the access method, and you associate keywords (based on column names in the **sysams** system catalog table) with UDRs. You must have the DBA or Resource privilege to create an access method.

For information on setting purpose options, including a list of all the purpose function keywords, refer to "Purpose Options" on page 5-46.

The PRIMARY keyword specifies a user-defined primary-access method for a virtual table. The SECONDARY keyword specifies creating a user-defined secondary-access method for a virtual index. The SECONDARY keyword (and creating virtual indexes) is not supported in the Java Virtual-Table Interface.

The following statement creates a secondary-access method named **T_tree**:

```
CREATE SECONDARY ACCESS_METHOD T_tree
(
am_getnext = ttree_getnext,

. . .
am_unique,
am_cluster,
am_sptype = 'S'
);
```

In the preceding example, the **am_getnext** keyword in the Purpose Options list is associated with the **ttree_getnext( )** UDR as the name of a method to scan for the next item that satisfies a query. This example indicates that the **T_tree** secondary access method supports unique keys and clustering, and resides in an sbspace.

Any UDR that the CREATE ACCESS_METHOD statement associates with the keyword for a purpose function task, such as the association of **ttree_getnext( )** with **am_getnext** in the preceding example, must already have been registered in the database by the CREATE FUNCTION statement (or by a functionally equivalent statement, such as CREATE PROCEDURE FROM).

The following statement creates a primary-access method named **am_tabprops** that resides in an extspace.

```
CREATE PRIMARY ACCESS_METHOD am_tabprops
(
am_open = FS_open,
am_close = FS_close,
am_beginscan = FS_beginScan,
am_create = FS_create,
am_scancost = FS_scanCost,
am_endscan = FS_endScan,
am_getnext = FS_getNext,
am_getbyid = FS_getById,
am_drop = FS_drop,
am_truncate = FS_truncate,
am_rowids,
am_sptype = 'x'
);
```

Related Information

Related statements: ALTER ACCESS_METHOD and DROP ACCESS_METHOD

For the schema of the **sysams** table, see the *IBM Informix Guide to SQL: Reference*.

For information about how to set purpose-option specifications, see "Purpose Options" on page 5-46.

For more information on primary-access methods, see the *IBM Informix Virtual-Table Interface Programmer's Guide*.

For more information on secondary-access methods, see the *IBM Informix Virtual-Index Interface Programmer's Guide* and the *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

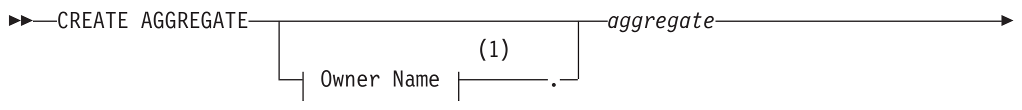
For a discussion of privileges, see the GRANT or REVOKE statements or the *IBM Informix Database Design and Implementation Guide*.

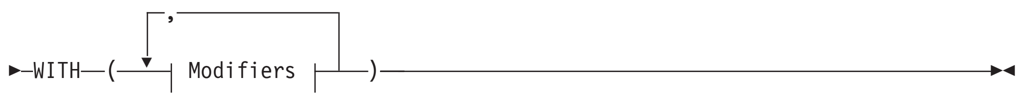
CREATE AGGREGATE

Use the CREATE AGGREGATE statement to create a new aggregate function and register it in the **sysaggregates** system catalog table. User-defined aggregates extend the functionality of the database server by performing aggregate computations that the user implements.

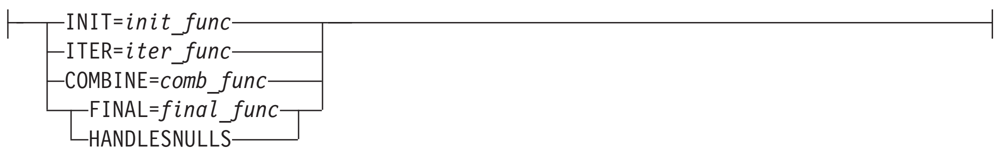
Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax





Modifiers:



Notes:

1 See "Owner Name" on page 5-43

Element	Description	Restrictions	Syntax
aggregate	Name of the new aggregate	Must be unique among names of built-in aggregates and UDRs	"Identifier" on page 5-22
comb_func	Function that merges one partial result into the other and returns the updated partial result	Must specify the combined function both for parallel queries and for sequential queries	"Database Object Name" on page 5-17
final_func	Function that converts a partial result into the result type	If this is omitted, then the returned value is the final result of *iter_func*	"Database Object Name" on page 5-17
init_func	Function that initializes the data structures required for the aggregate computation	Must be able to handle NULL arguments	"Database Object Name" on page 5-17
iter_func	Function that merges a single value with a partial result and returns updated partial result	Must specify an iterator function. If *init_func* is omitted, *iter_func* must be able to handle NULL arguments	"Database Object Name" on page 5-17

Usage

You can specify the INIT, ITER, COMBINE, FINAL, and HANDLESNULLS modifiers in any order.

Important: You must specify the ITER and COMBINE modifiers in a CREATE AGGREGATE statement. You do not have to specify the INIT, FINAL, and HANDLESNULLS modifiers in a CREATE AGGREGATE statement.

The ITER, COMBINE, FINAL, and INIT modifiers specify the support functions for a user-defined aggregate. These support functions do not have to exist at the time you create the user-defined aggregate.

If you omit the HANDLESNULLS modifier, rows with NULL aggregate argument values do not contribute to the aggregate computation. If you include the HANDLESNULLS modifier, you must define all the support functions to handle NULL values as well.

Extending the Functionality of Aggregates

Dynamic Server provides two ways to extend the functionality of aggregates. Use the CREATE AGGREGATE statement only for the second of the two cases.

- Extensions of built-in aggregates

  A built-in aggregate is an aggregate that the database server provides, such as **COUNT**, **SUM**, or **AVG**. These only support built-in data types. To extend a built-in aggregate so that it supports a user-defined data type (UDT), you must create user-defined routines that overload the binary operators for that aggregate. For further information on extending built-in aggregates, see the *IBM Informix User-Defined Routines and Data Types Developer's Guide*.
- Creation of user-defined aggregates

  A user-defined aggregate is an aggregate that you define to perform an aggregate computation that the database server does not provide. You can use user-defined aggregates with built-in data types, extended data types, or both. To create a user-defined aggregate, use the CREATE AGGREGATE statement. In this statement, you name the new aggregate and specify the support functions that compute the aggregate result. These support functions perform initialization, sequential aggregation, combination of results, and type conversion.

Example of Creating a User-Defined Aggregate: The following example defines a user-defined aggregate named **average:**

```
CREATE AGGREGATE average
   WITH (
      INIT = average_init,
      ITER = average_iter,
      COMBINE = average_combine,
      FINAL = average_final
      )
```

Before you use the **average** aggregate in a query, you must also use CREATE FUNCTION statements to create the support functions specified in the CREATE AGGREGATE statement.

The following table gives an example of the task that each support function might perform for **average**.

Keyword	Support Function	Effect
INIT	**average_init**	Allocates and initializes an extended data type storing the current sum and the current row count
ITER	**average_iter**	For each row, adds the value of the expression to the current sum and increments the current row count by one
COMBINE	**average_combine**	Adds the current sum and the current row count of one partial result to the other and returns the updated result
FINAL	**average_final**	Returns the ratio of the current sum to the current row count and converts this ratio to the result type

Parallel Execution

The database server can break up an aggregate computation into several pieces and compute them in parallel. The database server uses the INIT and ITER support functions to compute each piece sequentially. Then the database server uses the COMBINE function to combine the partial results from all the pieces into a single result value. Whether an aggregate is parallel is an optimization decision that is transparent to the user.

Related Information

Related statements: CREATE FUNCTION and DROP AGGREGATE

For information about how to invoke a user-defined aggregate, see “User-Defined Aggregates” on page 4-117 in the Expression segment.

For a description of the **sysaggregates** system catalog table that stores data about user-defined aggregates, see the *IBM Informix Guide to SQL: Reference*.

For a discussion of user-defined aggregates, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

CREATE CAST

Use the CREATE CAST statement to register a cast that converts data from one data type to another.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
                ┌─EXPLICIT─┐
►►──CREATE──────┴─IMPLICIT─┴──CAST─────────────────────────────────────────────►

►─( source_type──AS──target_type──┬──────────────────┬─)───────────────────────►◄
                                  └─WITH──function───┘
```

Element	Description	Restrictions	Syntax
function	UDR that you register to implement the cast	See "WITH Clause" on page 2-89.	"Database Object Name" on page 5-17
source_type	Data type to be converted	Must exist in the database at the time the cast is registered. See also "Source and Target Data Types" on page 2-87.	"Data Type" on page 4-18
target_type	Data type that results from the conversion	The same restrictions that apply for the *source_type* (as listed above) also apply for the *target_type*	"Data Type" on page 4-18

Usage

A cast is a mechanism that the database server uses to convert one data type to another. The database server uses casts to perform the following tasks:

- To compare two values in the WHERE clause of a SELECT, UPDATE, or DELETE statement
- To pass values as arguments to user-defined routines
- To return values from user-defined routines

To create a cast, you must have the necessary privileges on both the *source* data type and the *target* data type. All users have access privileges to use the built-in data types. To create a cast to or from an OPAQUE, DISTINCT, or named ROW data type, however, requires the Usage privilege on that data type.

The CREATE CAST statement registers a cast in the **syscasts** system catalog table. For more information on **syscasts**, see the chapter on system catalog tables in the *IBM Informix Guide to SQL: Reference*.

Source and Target Data Types

The CREATE CAST statement defines a cast that converts a *source* type to a *target* type. Both the *source* and *target* data types must exist in the database when you execute the CREATE CAST statement to register the cast. The *source* and the *target* data types have the following restrictions:

- Either the *source* or the *target* type, but not both, can be a built-in data type.
- Neither the *source* nor the *target* type can be a DISTINCT type of the other.
- Neither the *source* nor the *target* types can be a COLLECTION data type.

Explicit and Implicit Casts

To process queries with multiple data types often requires casts that convert data from one data type to another. You can use the CREATE CAST statement to create the following kinds of casts:

- Use the CREATE EXPLICIT CAST statement to define an *explicit* cast.
- Use the CREATE IMPLICIT CAST statement to define an *implicit* cast.

Explicit Casts: An explicit cast is a cast that you must specifically invoke, with either the CAST AS keywords or with the cast operator (::). The database server does *not* automatically invoke an explicit cast to resolve data type conversions. The EXPLICIT keyword is optional; by default, the CREATE CAST statement creates an explicit cast.

The following CREATE CAST statement defines an explicit cast from the **rate_of_return** opaque data type to the **percent** distinct data type:

```
CREATE EXPLICIT CAST (rate_of_return AS percent
   WITH rate_to_prcnt)
```

The following SELECT statement explicitly invokes this explicit cast in its WHERE clause to compare the **bond_rate** column (of type **rate_of_return**) to the **initial_APR** column (of type **percent**):

```
SELECT bond_rate FROM bond
WHERE bond_rate::percent > initial_APR
```

Implicit Casts: The database server invokes built-in casts to convert from one built-in data type to another built-in type that is not directly substitutable. For example, the database server performs conversion of a character type such as CHAR to a numeric type such as INTEGER through a built-in cast.

An implicit cast is a cast that the database server can invoke automatically when it encounters data types that cannot be compared with built-in casts. This type of cast enables the database server to automatically handle conversions between other data types.

To define an implicit cast, specify the IMPLICIT keyword in the CREATE CAST statement. For example, the following CREATE CAST statement specifies that the database server should automatically use the **prcnt_to_char( )** function to convert from the CHAR data type to a distinct data type, **percent**:

```
CREATE IMPLICIT CAST (CHAR AS percent WITH char_to_prcnt)
```

This cast only supports automatic conversion *from* the CHAR data type *to* **percent**. For the database server to convert *from* **percent** *to* CHAR, you also need to define another implicit cast, as follows:

```
CREATE IMPLICIT CAST (percent AS CHAR WITH prcnt_to_char)
```

The database server automatically invokes the **char_to_prcnt( )** function to evaluate the WHERE clause of the following SELECT statement:

```
SELECT commission FROM sales_rep WHERE commission > "25%"
```

Users can also invoke implicit casts explicitly. For more information on how to explicitly invoke a cast function, see "Explicit Casts" on page 2-88.

When a built-in cast does not exist for conversion between data types, you can create user-defined casts to make the necessary conversion.

WITH Clause

The WITH clause of the CREATE CAST statement specifies the name of the user-defined function to invoke to perform the cast. This function is called the cast function. You must specify a *function name* unless the *source data type* and the *target data type* have identical representations. Two data types have identical representations when the following conditions are met:

- Both data types have the same length and alignment.
- Both data types are passed by reference or both are passed by value.

The cast function must be registered in the same database as the cast at the time the cast is invoked, but need not exist when the cast is created. The CREATE CAST statement does not check privileges on the specified *function name*, or even verify that the cast function exists. Each time a user invokes the cast explicitly or implicitly, the database server verifies that the user has the Execute privilege on the cast function.

Related Information

Related statements: CREATE FUNCTION, CREATE DISTINCT TYPE, CREATE OPAQUE TYPE, CREATE ROW TYPE, and DROP CAST

For more information about data types, casting, and conversion, see the Data Types segment in this manual and the *IBM Informix Guide to SQL: Reference*.

For examples that show how to create and use casts, see the *IBM Informix Database Design and Implementation Guide*.

CREATE DATABASE

Use the CREATE DATABASE statement to create a new database.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──CREATE DATABASE──database──┬──────────────┬──────────────────────────────►
                               └─IN──dbspace─┘

►─┬────────────────────────────────┬─────────────────────────────────────────►◄
  └─WITH─┬─┬──────────┬──LOG─┬─┘
         │ └─BUFFERED─┘      │
         └─LOG MODE ANSI─────┘
```

Element	Description	Restrictions	Syntax
database	Name that you declare here for the new database that you are creating	Must be unique among names of databases of the database server	"Database Name" on page 5-15
dbspace	The dbspace to store the data for this database; default is the **root** dbspace	Must already exist	"Identifier" on page 5-22

Usage

This statement is an extension to ANSI-standard syntax. (The ANSI/ISO standard for the SQL language does not specify any syntax for construction of a database, the process by which a database comes into existence.)

The *database* that CREATE DATABASE specifies becomes the current database.

The *database* name that you declare must be unique within the database server environment in which you are working. The database server creates the system catalog tables that describe the structure of the new database.

When you create a database, you alone can access it. It remains inaccessible to other users until you, as DBA, grant database privileges. For information on how to grant database privileges, see "GRANT" on page 2-371.

If a previous CONNECT statement has established an explicit connection to a database, and that connection is still your current connection, you cannot use the CREATE DATABASE statement (nor any SQL statement that creates an implicit connection) until after you use DISCONNECT to close the explicit connection.

In ESQL/C, the CREATE DATABASE statement cannot appear in a multistatement PREPARE operation.

If you do not specify the dbspace, the database server creates the system catalog tables in the **root** dbspace. The following statement creates the **vehicles** database in the **root** dbspace:

```
CREATE DATABASE vehicles
```

The following statement creates the **vehicles** database in the **research** dbspace:

```
CREATE DATABASE vehicles IN research
```

In Extended Parallel Server, you can create a database in the dbspace of the primary coserver (coserver 1) only.

Logging Options

The logging options of the CREATE DATABASE statement determine the type of logging that is done for the database. In the event of a failure, the database server uses the log to re-create all committed transactions in your database.

If you do not specify the WITH LOG option, you cannot use transactions nor the statements that support transaction logging (BEGIN WORK, COMMIT WORK, ROLLBACK WORK, SET IMPLICIT TRANSACTION, SET LOG, and SET ISOLATION).

If you are using Extended Parallel Server, the CREATE DATABASE statement always creates a database with logging. If you do not specify the WITH LOG option, the unbuffered log type is used by default.

Designating Buffered Logging

The following example creates a database that uses a buffered log:

```
CREATE DATABASE vehicles WITH BUFFERED LOG
```

If you use a buffered log, you marginally enhance the performance of logging at the risk of not being able to re-create the last few transactions after a failure. (See the discussion of buffered logging in the *IBM Informix Database Design and Implementation Guide*.)

ANSI-Compliant Databases

When you use the LOG MODE ANSI option in the CREATE DATABASE statement, the database that you create is an ANSI-compliant database. The following example creates an ANSI-compliant database:

```
CREATE DATABASE employees WITH LOG MODE ANSI
```

ANSI-compliant databases are different from databases that are not ANSI compliant in several ways, including the following features:

- All statements are automatically contained in transactions.
- All databases use unbuffered logging.
- Owner naming is enforced.

  You must qualify with the owner name any table, view, synonym, index, or constraint, unless you are the owner. Unless you enclose the name between quotation marks, alphabetic characters in owner names default to uppercase.
- For databases, the default isolation level is REPEATABLE READ.
- Default privileges on objects differ from those in databases that are not ANSI compliant. Users do not receive PUBLIC privilege to tables and synonyms by default.

Other slight differences exist between databases that are ANSI compliant and those that are not. These differences are noted with the related SQL statement in this manual. For a detailed discussion of the differences between ANSI compliant databases and databases that are not ANSI-compliant, see the *IBM Informix Database Design and Implementation Guide*.

Creating an ANSI-compliant database does not mean that you automatically receive warnings for Informix extensions to the ANSI/ISO standard for SQL syntax when you run the database. You must also use the -**ansi** flag or the **DBANSIWARN** environment variable to receive such warnings.

For additional information about -**ansi** and **DBANSIWARN**, see the *IBM Informix Guide to SQL: Reference*.

Related Information

Related statements: CLOSE DATABASE, CONNECT, DATABASE, and DROP DATABASE

CREATE DISTINCT TYPE

Use the CREATE DISTINCT TYPE statement to create a new distinct data type.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──CREATE DISTINCT TYPE──distinct_type──AS──source_type──────────────────────────►◄
```

Element	Description	Restrictions	Syntax
distinct_type	Name that you declare here for the new distinct data type	In an ANSI-compliant database, the combination of the owner and data type must be unique within the database. In a database that is not ANSI compliant, the name must be unique among names of data types in the database.	"Data Type" on page 4-18
source_type	Name of existing type on which the new type is based	Must be either a built-in data type or one created with the CREATE DISTINCT TYPE, CREATE OPAQUE TYPE, or CREATE ROW TYPE statement	"Data Type" on page 4-18

Usage

A *distinct type* is a data type based on a built-in data type or on an existing opaque data type, a named ROW data type, or another distinct data type. Distinct data types are strongly typed. Although the distinct type has the same physical representation of data as its source type, values of the two types cannot be compared without an explicit cast from one type to the other.

To create a distinct data type, you must have the Resource privilege on the database. Any user with the Resource privilege can create a distinct type from one of the built-in data types, which user **informix** owns.

Important: You cannot create a distinct type on the *SERIAL* or *SERIAL8* data types.

To create a distinct type from an opaque type, from a named ROW type, or from another distinct type, you must be the owner of the data type or have the Usage privilege on the data type.

By default, after a distinct type is defined, only the owner of the distinct type and the DBA can use it. The owner of the distinct type, however, can grant to other users the Usage privilege on the distinct type.

A distinct type has the same storage structure as its source type. The following statement creates the distinct type **birthday**, based on the built-in DATE data type:

```
CREATE DISTINCT TYPE birthday AS DATE
```

Although Dynamic Server uses the same storage format for the distinct type as it does for its source type, a distinct type and its source type cannot be compared in an operation unless one type is explicitly cast to the other type.

Privileges on Distinct Types

To create a distinct type, you must have the Resource privilege on the database. When you create the distinct type, only you, the owner, have Usage privilege on this type. Use the GRANT or REVOKE statements to grant or revoke Usage privilege to other database users.

To find out what privileges exist on a particular type, check the **sysxtdtypes** system catalog table for the owner name and the **sysxtdtypeauth** system catalog table for additional data type privileges that might have been granted. For more information on system catalog tables, see the *IBM Informix Guide to SQL: Reference*.

The DB–Access utility can also display privileges on distinct types.

Support Functions and Casts

When you create a distinct type, Dynamic Server automatically defines two explicit casts:

- A cast from the distinct type to its source type
- A cast from the source type to the distinct type

Because the two data types have the same representation (the same length and alignment), no support functions are required to implement the casts.

You can create an implicit cast between a distinct type and its source type. To create an implicit cast, use the Table Options clause to specify the format of the external data. You must first drop the default explicit cast, however, between the distinct type and its source type.

All support functions and casts that are defined on the source type can be used on the distinct type. Casts and support functions that are defined on the distinct type, however, are not available to the source type. Use the Table Options clause to specify the format of the external data.

Manipulating Distinct Types

When you compare or manipulate data of a distinct type and its source type, you must explicitly cast one type to the other in the following situations:

- To insert or update a column of one type with values of the other type
- To use a relational operator to add, subtract, multiply, divide, compare, or otherwise manipulate two values, one of the source type and one of the distinct type

For example, suppose you create a distinct type, **dist_type**, that is based on the NUMERIC data type. You then create a table with two columns, one of type **dist_type** and one of type NUMERIC.

```
CREATE DISTINCT TYPE dist_type AS NUMERIC;
CREATE TABLE t(col1 dist_type, col2 NUMERIC);
```

To directly compare the distinct type and its source type or assign a value of the source type to a column of the distinct type, you must cast one type to the other, as the following examples show:

```
INSERT INTO tab (col1) VALUES (3.5::dist_type);

SELECT col1, col2
   FROM t WHERE (col1::NUMERIC) > col2;

SELECT col1, col2, (col1 + col2::dist_type) sum_col
   FROM tab;
```

Related Information

Related statements: CREATE CAST, CREATE FUNCTION, CREATE OPAQUE TYPE, CREATE ROW TYPE, DROP TYPE, and DROP ROW TYPE

For information and examples that show how to use and cast distinct types, see the *IBM Informix Guide to SQL: Tutorial*.

For more information on when you might create a distinct type, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

CREATE DUPLICATE

Use the CREATE DUPLICATE statement to create a duplicate copy of an existing table for read-only use in a specified dbslice or in specified dbspaces across coservers.

Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
                                                  ┌─,──────┐
                                                  ▼        │
>>──CREATE DUPLICATE OF TABLE──table──IN──┬─(──────dbspace─┴──)─┬─────────────><
                                          └─dbslice─────────────┘
```

Element	Description	Restrictions	Syntax
dbslice	Name of a dbslice in which to duplicate one fragment of *table*	Must exist and must contain at most one dbspace on each target coserver	"Identifier" on page 5-22
dbspace	Name of a dbspace in which to duplicate one fragment of *table*	Must exist; must not contain an original or duplicate fragment of *table*	"Identifier" on page 5-22
table	Name of the original table from which to create a duplicate	Must exist in the database. See also "Supported Operations" on page 2-97.	"Database Object Name" on page 5-17

Usage

If the original *table* resides entirely on a single coserver, you can create duplicate copies of small tables across coservers for read-only use. For each attached index of the original table, a similarly defined index is built on each table duplicate, using the same dbspaces as the table.

Because query operators read the local copy of the table, duplicating small tables across coservers might improve the performance of some queries.

If a local copy of a duplicated table exists but is not available because the dbspace that stores it is offline (or for some similar reason), a query that requires access to the table fails. The database server does not attempt to access the original table.

The location of a duplicated table can be either a dbslice or a comma-separated list of dbspaces. You can combine dbslices and lists of dbspaces in a single CREATE DUPLICATE statement.

- If the original table is not fragmented, the dbspace list need provide only a single dbspace on each coserver.

  For example, if the table **tab1** is not fragmented, enter the following statement to create a duplicate on the remaining three of the four coservers. If the original table is stored in the dbspace **db1** on coserver 1 and **db2** is on coserver 2, **db3** is on coserver 3, and **db4** is on coserver 4.

  ```
  CREATE DUPLICATE OF TABLE tab1 IN (db2, db3, db4)
  ```
- If the original table is fragmented with one fragment in the first dbspace of several dbslices that contain dbspaces on all coservers, you can create duplicate copies of the table in the remaining dbspaces of the dbslice.

  For example, you might create the **tab3** table in the first dbspace of three dbslices, each of which contains a dbspace on each coserver, as follows:

```
CREATE TABLE tab3 (...)
   FRAGMENT BY HASH (....) IN dbsl1.1, dbsl2.1, dbsl3.1;
```

To duplicate the **tab3** table across the remaining coservers, use the following statement:

```
CREATE DUPLICATE OF TABLE tab3 IN dbsl1, dbsl2, dbsl3
```

- You can mix dbslice names and dbspace lists in the same CREATE DUPLICATE statement. For example, instead of using dbspaces in a dbslice, for the previous example, you might enter the following statement in which **dbsp2a** is on coserver 2, **dbsp3a** is on coserver 3, and **dbsp4a** is on coserver 4:

```
CREATE DUPLICATE OF  TABLE tab3 IN
   dbsl1, dbsl2, (dbsp2a, dbsp3a, dbsp4a)
```

The first fragment of the original table is duplicated into **dbsl1**, which contains a dbspace on each coserver, the second fragment into **dbsl2**, which also contains a dbspace on each coserver, and the third fragment into the list of dbspaces.

Only one fragment of a duplicated table can reside in any single dbspace. You cannot list an existing dbspace of the duplicated table in the list of dbspaces into which it is duplicated, but it is not an error for an existing dbspace to be a member of a dbslice that specifies duplication dbspaces. Matching dbspaces in the dbslice are ignored.

The CREATE DUPLICATE statement requires the ALTER privilege.

Supported Operations

The following operations are permitted on duplicated tables:

- SELECT
- UPDATE STATISTICS
- LOCK and UNLOCK
- SET Residency
- DROP TABLE

You cannot duplicate a table in certain circumstances. The table must not:

- Have GK or detached indexes
- Use range fragmentation
- Be a temporary table
- Be a violations or diagnostic table
- Contain BYTE, TEXT, SERIAL, or SERIAL8 columns
- Have referential constraints

The CREATE DUPLICATE statement does not support incremental duplication. It also does not support multiple duplicates of the same table on a single coserver, nor duplication of tables that are fragmented across coservers.

If you need to take a dbspace offline and it contains a copy of a duplicated table, or if you need to update data in a duplicated table, first drop all duplicates of the table, as described in "DROP DUPLICATE" on page 2-299.

Related Information

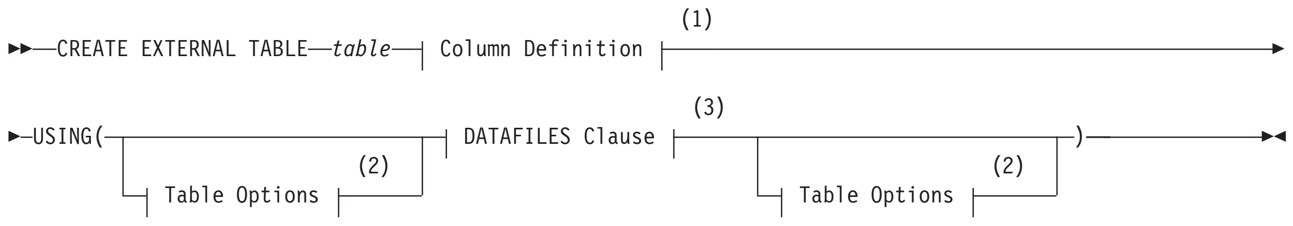
DROP DUPLICATE

CREATE EXTERNAL TABLE (XPS)

Use the CREATE EXTERNAL TABLE statement to define an external source that is not part of your database to load and unload data for your database.

Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 See "Column Definition"

2 See "Table Options" on page 2-103

3 See "DATAFILES Clause" on page 2-102

Element	Description	Restrictions	Syntax
table	Name declared here for a table to store external data	Must be unique among names of tables, views, and synonyms in the current database	"Database Object Name" on page 5-17

Usage

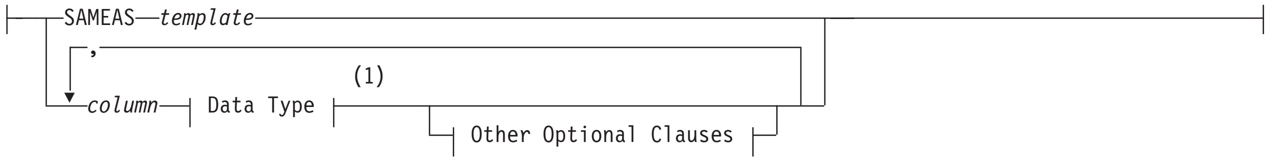
The first portion of the syntax diagram declares the name of the table and defines its columns and any column-level constraints.

The portion that follows the USING keyword identifies external files that the database server opens when you use the external table, and specifies additional options for characteristics of the external table.

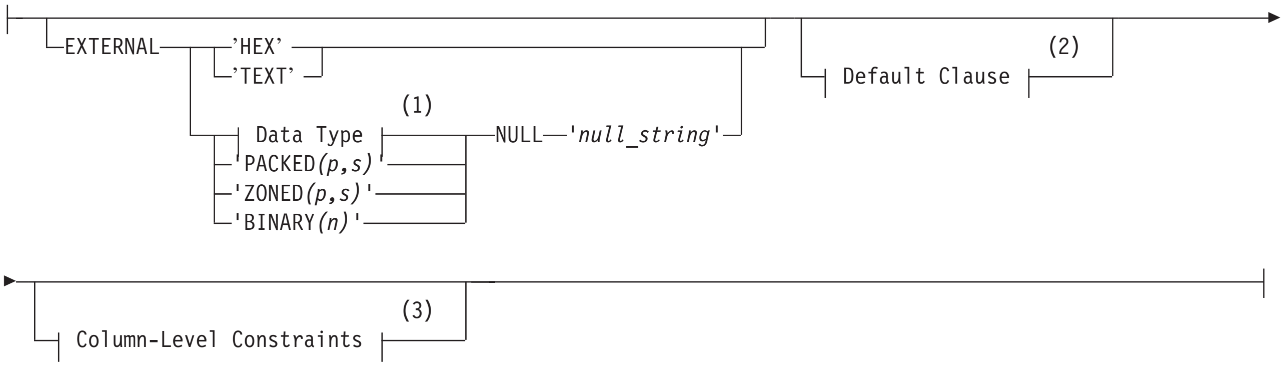
After executing the CREATE EXTERNAL TABLE statement, you can move data to and from the external source with an INSERT INTO ... SELECT statement. See the section "INTO EXTERNAL Clause (XPS)" on page 2-523 for more information about loading the results of a query into an external table.

Column Definition

Column Definition:



Other Optional Clauses:



Notes:

1 See “Data Type” on page 4-18

2 See “DEFAULT Clause” on page 2-174

3 See “Column-Level Constraints” on page 2-101

Element	Description	Restrictions	Syntax
column	One column name for each column of the external table	For each column, you must specify a built-in data type	“Identifier” on page 5-22
n	Number of 8-bit bytes to represent the integer	For FIXED format binary integers; *big-endian* byte order	*n*=2 for 16-bit integers *n*=4 for 32-bit integers
p	Precision (number of digits)	For FIXED-format files only	“Literal Number” on page 4-137
s	Scale (digits in fractional part)	For FIXED-format files only	“Literal Number” on page 4-137
null_string	Value to represent NULL	See “Defining NULL Values” on page 2-100.	“Quoted String” on page 4-142
template	Existing table with the same schema as the external table	Cannot be subset of columns nor differ in any column data type	“Database Object Name” on page 5-17

Using the SAMEAS Clause

The SAMEAS *template* clause uses all the column names and data types from the *template* table in the definition of new table. You cannot, however, use indexes in the external table definition, and you cannot use the SAMEAS clause for FIXED-format files.

Using the EXTERNAL Keyword

Use the EXTERNAL keyword to specify a data type for each column of your external table that has a data type different from the internal table. For example, you might have a VARCHAR column in the internal table that you want to map to a CHAR column in the external table.

You must specify an external type for every column that is in fixed format. You cannot specify an external type for delimited format columns except for BYTE and TEXT columns where your specification is optional. For more information, see “TEXT and HEX External Types” on page 2-100.

Integer Data Types: Besides valid Informix integer data types, you can specify packed decimal, zoned decimal, and IBM-format binary representation of integers.

For packed or zoned decimal, specify *precision* (total number of digits in the number) and *scale* (number of digits that are to the right of the decimal point). Packed decimal representation can store two digits, or a digit and a sign, in each byte. Zoned decimal requires (p + 1) bytes to store p digits and the sign.

Big-Endian Format: The database server also supports two IBM-format binary representations of integers: BINARY(2) for 16-bit integer storage and BINARY(4) for 32-bit integer storage. The most significant byte of each number has the lowest address; that is, binary-format integers are stored big-end first (big-endian format) in the manner of IBM and Motorola processors. Intel processors and some others store binary-format integers little-end first, a storage method that the database server does not support for external data.

Defining NULL Values: The packed decimal, zoned decimal, and binary data types do not have a natural NULL value, so you must define a value to be interpreted as a NULL when loading or unloading data from an external source. You can define the *null_string* as a number outside the set of numbers stored in the data file (for example, -9999.99). You can also define a bit pattern in the field as a hexadecimal pattern, such as `0xffff`, that is to be interpreted as a NULL.

The database server uses the NULL representation for a FIXED-format external table to both interpret values as the data is loaded into the database and to format NULL values into the appropriate data type when data is unloaded to an external table.

The following examples are of column definitions with NULL values for a FIXED-format external table:

```
i smallint external "binary (2)" null "-32767"
li integer external "binary (4)" null "-99999"
d decimal (5,2) external "packed (5,2)" null "0xffffff"
z decimal (4,2) external "zoned (4,2)" null "0x0f0f0f0f"
z1 decimal (3,2) external "zoned (3,2)" null "-1.00"
```

If the packed decimal or zoned decimal is stored with all bits cleared to represent a NULL value, the *null_string* can be defined as `0x0`. The following rules apply to the value assigned to a *null_string*:

- The NULL representation must fit into the length of the external field.
- If a bit pattern is defined, the *null_string* is not case sensitive.
- If a bit pattern is defined, the *null_string* must begin with `0x`.
- For numeric fields, the left-most fields are assigned zeros by the database server if the bit pattern does not fill the entire field.
- If the NULL representation is not a bit pattern, the NULL value must be a valid number for that field.

Warning: If a row that contains a NULL value is unloaded into an external table and the column that receives the NULL value has no NULL value defined, the database server inserts a zero into the column.

TEXT and HEX External Types: An Informix BYTE or TEXT column can be encoded in either the TEXT or HEX external type. You can use only delimited BYTE and TEXT formats with these external types. Fixed formats are not allowed. In addition, you cannot use these external types with any other type of delimited-format columns (such as character columns).

You do not need to specify these external types. If you do not define an external column specifically, Informix TEXT columns default to TEXT and Informix BYTE columns default to HEX.

The database server interprets two adjacent field delimiters as a NULL value.

User-defined delimiters are limited to one byte each. During unloading, delimiters and backslash (\ ) symbols are escaped. During loading, any character that follows a backslash is interpreted as a literal. In TEXT format, nonprintable characters are directly embedded in the data file. For delimiter rules in a multibyte locale, see the *IBM Informix GLS User's Guide*.

For more information on BYTE and TEXT data, see your *IBM Informix Administrator's Guide*.

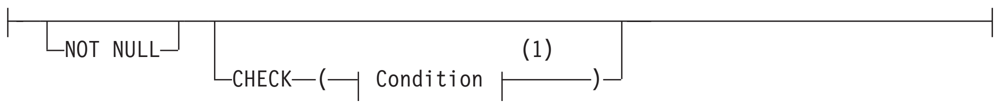
Manipulating Data in Fixed Format Files

For files in FIXED format, you must declare the column name and the EXTERNAL item for each column to set the name and number of characters. For FIXED-format files, the only data type allowed is CHAR. You can use the keyword NULL to specify what string to interpret as a NULL value.

Column-Level Constraints

Use column-level constraints to limit the type of data that is allowed in a column. Constraints at the column level are limited to a single column.

Column-Level Constraints:



Notes:

1 See "Condition" on page 4-5

Using the NOT NULL Constraint

If you do not indicate a default value for a column, the default is NULL *unless* you place a not-NULL constraint on the column. In that case, no default value exists for the column. If you place a NOT NULL constraint on a column (and no default value is specified), the data in the external table must have a value set for the column when loading through the external table.

When no reject file exists and no value is encountered, the database server returns an error and the loading stops. When a reject file exists and no value is encountered, the error is reported in the reject file and the load continues.

Using the CHECK Constraint

Check constraints allow you to designate conditions that must be met *before* data can be assigned to a column during an INSERT or UPDATE statement. When a reject file does not exist and a row evaluates to *false* for any check constraint defined on a table during an insert or update, the database server returns an error. When there is a reject file and a row evaluates to *false* for a check constraint defined on the table, the error is reported in the reject file and the statement continues to execute.

Check constraints are defined with *search conditions*. The search condition cannot contain subqueries, aggregates, host variables, or SPL routines. In addition, it cannot include the built-in functions CURRENT, USER, SITENAME, DBSERVERNAME, or TODAY. When you define a check constraint at the column level, the only column that the check constraint can check against is the column itself. In other words, the check constraint cannot depend upon values in other columns of the table.

DATAFILES Clause

The DATAFILES clause specifies external files that are opened when you use external tables.

DATAFILES Clause:

```
├──DATAFILES──────────────────────────────────────────────────────────►


      ┌─,────────────────────────────────────────────────────────┐
      ▼                                                          │
►─(──────'──┬─DISK─┬──:──┬─coserver_num───┬──:──┬─fixed_path─────┬─'─┴─)───────┤
            └─PIPE─┘     └─coserver_group─┘     └─formatted_path─┘
```

Element	Description	Restrictions	Syntax
coserver_group	Coserver group that contains the external data	Must exist	"Identifier" on page 5-22
coserver_num	Numeric ID of coserver containing the external data	Must exist	"Literal Number" on page 4-137
fixed_path	Pathname for input or output files in the definition of the external table	Must exist	Must conform to operating-system rules.
formatted_path	Formatted pathname that uses pattern-matching characters	Must exist	Must conform to operating-system rules.

You can use cogroup names and coserver numbers when you describe the input or output files for the external table definition. You can identify the DATAFILES either by coserver number or by cogroup name. A coserver number contains only digits. A cogroup name is a valid identifier that begins with a letter but otherwise contains any combination of letters, digits, and underscore symbols.

If you use only some of the available coservers for reading or writing files, you can designate these coservers as a cogroup using **onutil** and then use the cogroup name, rather than explicitly specifying each coserver and file separately. Whenever you use all coservers to manage external files, you can use the predefined *coserver_group*.

For examples of the DATAFILES clause, see "Examples" on page 2-106.

Using Formatting Characters

You can use a formatted pathname to designate a filename. If you use a formatted pathname, you can take advantage of the substitution characters `%c`, `%n`, and `%r` (*first ... last*).

Formatting String	Effect
%c	Replaced with the number of the coserver that manages the file

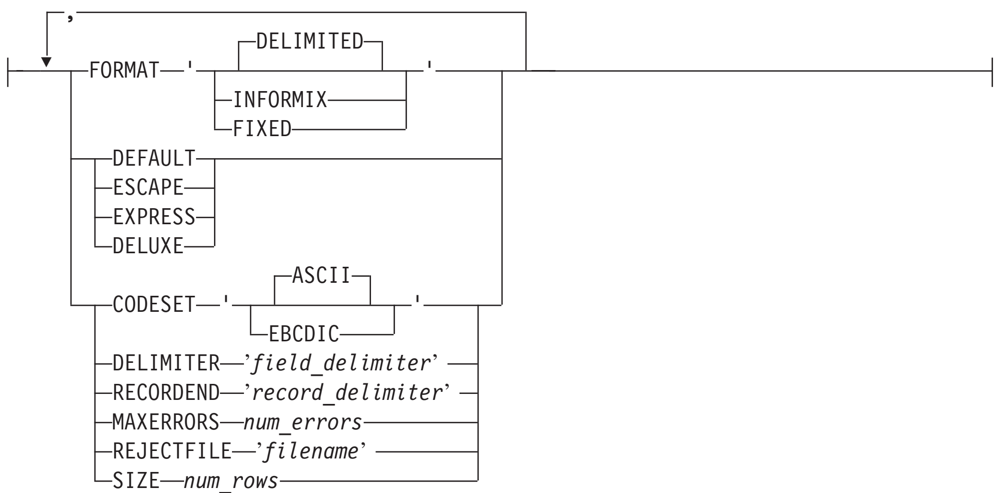
%n	Replaced with the name of the node on which the coserver that manages the file resides
%r(*first ... last*)	Specifies multiple files on a single coserver

Important: The formatted pathname option does not support the `%o` formatting string.

Table Options

These options specify additional characteristics that define the table.

Table Options:



Element	Description	Restrictions	Syntax
field_delimiter	Character to separate fields. Default is pipe (|) character	For nonprinting characters, use octal	"Quoted String" on page 4-142
filename	Full pathname for conversion error messages from coservers	See "Reject Files" on page 2-104.	Must conform to operating-system rules.
num_errors	Errors per coserver before load operations are terminated	Value is ignored unless **MAXERRORS** is set	"Literal Number" on page 4-137
num_rows	Approximate number of rows contained in the external table	Cannot be a negative number	"Literal Number" on page 4-137
quoted_string	ASCII character specified here as the escape character	Only a single character is valid	"Quoted String" on page 4-142
record_delimiter	Character to separate records Default is Newline (`\n`)	For nonprinting characters, use octal	"Quoted String" on page 4-142

The *num_errors* specification is ignored during unload tasks. If the **MAXERRORS** environment variable is not set, the database server processes all data in load operations, regardless of the number of errors or *num_errors* value.

If the **RECORDEND** environment variable is not set, *record_delimiter* defaults to the Newline character (`\n`). To specify a nonprinting character as the record delimiter or field delimiter, you must encode it as the octal representation of the ASCII character. For example, `\006` can represent CTRL-F.

Use the table options keywords as the following table describes. You can use each keyword whenever you plan to load or unload data unless only one of the two modes is specified.

Keyword	Description
CODESET	Specifies the type of code set of the data
DEFAULT (load only)	Specifies replacing missing values in delimited input files with column defaults (if they are defined) instead of NULLs, so input files can be sparsely populated. Files do not need an entry for every column in the file where a default is the value to be loaded.
DELIMITER	Specifies the character that separates fields in a delimited text file
DELUXE (load only)	Sets a flag causing the database server to load data in deluxe mode Deluxe mode is required for loading into STANDARD tables.
ESCAPE	Defines a character to mark ASCII special characters in ASCII-text-based data files
EXPRESS	Sets a flag that causes the database server to attempt to load data in express mode If you request express mode but indexes or unique constraints exist on the table or the table contains BYTE or TEXT data, or the target table is not RAW or OPERATIONAL, the load stops with an error message that reports the problem.
FORMAT	Specifies the format of the data in the data files
MAXERRORS	Sets the number of errors that are allowed per coserver before the database server stops the load
RECORDEND	Specifies the character that separates records in a delimited text file
REJECTFILE	Sets the full pathname where all coservers write data-conversion errors If not specified or if files cannot be opened, any error ends the load job abnormally. See also “Reject Files” on page 2-104.
SIZE	The approximate number of rows in the external table. This can improve performance when external table is used in a join query.

Important: Check constraints on external tables are designed to be evaluated only when loading data. The database server cannot enforce check constraints on external tables because the data can be freely altered outside the control of the database server. If you want to restrict rows that are written to an external table during unload, use a WHERE clause to filter the rows.

Reject Files

Rows that have conversion errors during a load or rows that violate check constraints on the external table are written to a reject file on the coserver that performs the conversion. Each coserver manages its own reject file. The REJECTFILE clause declares the name of the reject file on each coserver.

You can use the formatting characters `%c` and `%n` (but not `%r`) in the filename format. Use the `%c` formatting characters to make the filenames unique. For more information on how to format characters, see the section "Using Formatting Characters" on page 2-102.

If you perform another load to the same table during the same session, any earlier reject file of the same name is overwritten.

Reject file entries have the following format:

```
coserver-number, filename, record, reason-code,
   field-name: bad-line
```

The following table describes these elements of the reject file:

Element	Description
coserver-number	Number of the coserver from which the file is read
filename	Name of the input file
record	Record number in the input file where the error was detected
reason-code	Description of the error
field-name	External field name where the first error in the line occurred, or `<none>` if the rejection is not specific to a particular column
bad-line	Line that caused the error (delimited or fixed-position character files only), up to 80 characters

The reject file writes the *coserver-number, filename, record*, *field-name,* and *reason-code* in ASCII. The *bad-line* information varies with the type of input file.

- For delimited files or fixed-position character files, up to 80 characters of the bad line are copied directly into the reject file.
- For Informix internal data files, the bad line information is not placed in the reject file because you cannot edit the binary representation in a file; but the *coserver-number, filename, record, reason-code*, and *field-name* are still reported in the reject file so you can isolate the problem. Use the Table Options clause to specify the format of the external data.

Errors that can cause a row to be rejected include the following.

Error Text	Explanation
CONSTRAINT *constraint name*	This constraint was violated.
CONVERT_ERR	Any field encounters a conversion error.
MISSING_DELIMITER	No delimiter was found.
MISSING_RECORDEND	No record end was found.
NOT NULL	A NULL was found in *field-name*.
ROW_TOO_LONG	The input record is longer than 32 kilobytes.

Examples

The examples in this section show how to specify the DATAFILES field.

Assume that the database server is running on four nodes, and one file is to be read from each node. All files have the same name. The DATAFILES specification can then be as follows:

```
DATAFILES ("DISK:cogroup_all:/work2/unload.dir/mytbl")
```

Now, consider a system with 16 coservers where only three coservers have tape drives attached (for example, coservers 2, 5, and 9). If you define a cogroup for these coservers before you run load and unload commands, you can use the cogroup name rather than a list of individual coservers when you execute the commands. To set up the cogroup, run **onutil**.

```
% onutil
1> create cogroup tape_group
2> from coserver.2, coserver.5, coserver.9;
Cogroup successfully created.
```

Then define the file locations for named pipes:

```
DATAFILES ("PIPE:tape_group:/usr/local/TAPE.%c")
```

The filenames expand as follows:

```
DATAFILES ("pipe:2:/usr/local/TAPE.2",
      "pipe:5:/usr/local/TAPE.5",
      "pipe:9:/usr/local/TAPE.9")
```

If, instead, you want to process three files on each of two coservers, define the files as follows:

```
DATAFILES ("DISK:1:/work2/extern.dir/mytbl.%r(1..3)",
      "DISK:2:/work2/extern.dir/mytbl.%r(4..6)")
```

The expanded list follows:

```
DATAFILES ("disk:1:/work2/extern.dir/mytbl.1",
      "disk:1:/work2/extern.dir/mytbl.2",
      "disk:1:/work2/extern.dir/mytbl.3",
      "disk:2:/work2/extern.dir/mytbl.4",
      "disk:2:/work2/extern.dir/mytbl.5",
      "disk:2:/work2/extern.dir/mytbl.6")
```

Related Information

Related statements: INSERT and SET PLOAD FILE

See also the INTO Table Clauses of SELECT.

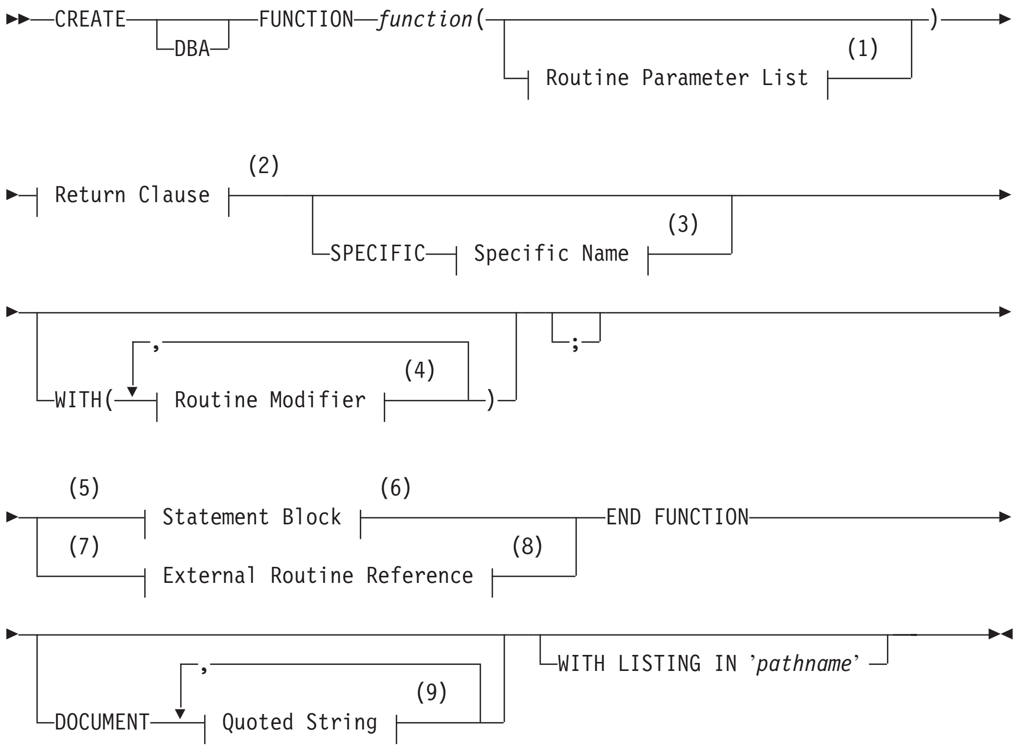
For more information on external tables, refer to your *IBM Informix Administrator's Reference*.

CREATE FUNCTION

Use the CREATE FUNCTION statement to create a user-defined function, register an external function, or to write and register an SPL function.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 See "Routine Parameter List" on page 5-61

2 See "Return Clause" on page 5-51

3 See "Specific Name" on page 5-68

4 See "Routine Modifier" on page 5-54

5 Stored Procedure Language only

6 See "Statement Block" on page 5-69

7 External routines only

8 See "External Routine Reference" on page 5-20

9 See "Quoted String" on page 4-142

Element	Description	Restrictions	Syntax
function	Name of new function that is defined here	You must have the appropriate language privileges. See "GRANT" on page 2-371 and "Overloading the Name of a Function" on page 2-109.	"Database Object Name" on page 5-17
pathname	Pathname to a file in which compile-time warnings are stored	The specified pathname must exist on the computer where the database resides	The path and filename must conform to your operating-system rules.

Tip: If you are trying to create a function from text of source code that is in a separate file, use the CREATE FUNCTION FROM statement.

Usage

Dynamic Server supports user-defined functions written in these languages:

- Stored Procedure Language (SPL)
- One of the external languages (C or Java) that Dynamic Server supports (*external functions*)

When the IFX_EXTEND_ROLE configuration parameter of is set to ON, only users to whom the DBSA grants the built-in EXTEND role can create external functions.

How many values a function can return is language-dependent. Functions written in SPL can return one or more values. External functions written in the C or Java languages must return exactly one value. But a C function can return a collection type, and external functions in queries can return additional values indirectly from OUT parameters (and for the Java language, from INOUT parameters) that Dynamic Server can process as statement-local variables (SVLs).

For information on how this manual uses the terms UDR, function, and procedure as well as recommended usage, see "Relationship Between Routines, Functions, and Procedures" on page 2-146 and "Using CREATE PROCEDURE Versus CREATE FUNCTION" on page 2-146, respectively.

The entire length of a CREATE FUNCTION statement must be less than 64 kilobytes. This length is the literal length of the statement, including whitespace characters such as blank spaces and tabs.

In ESQL/C, you can use a CREATE FUNCTION statement only within a PREPARE statement. If you want to create a user-defined function for which the text is known at compile time, you must put the text in a file and specify this file with the CREATE FUNCTION FROM statement.

Functions use the collating order that was in effect when they were created. See SET COLLATION for information about using non-default collation.

Privileges Necessary for Using CREATE FUNCTION

You must have the Resource privilege on a database to create a function within that database.

Before you can create an SPL function, you must also have the Usage privilege on the SPL language . For more information, see "Usage Privilege in Stored Procedure Language" on page 2-382.

By default, Usage privilege on SPL is granted to PUBLIC. You must also have at least Resource privilege on a database to create an SPL function in that database.

DBA Keyword and Privileges on the Created Function

The level of privilege necessary to execute a UDR depends on whether the UDR is created with the DBA keyword.

If you create a UDR with the DBA keyword, it is known as a DBA-privileged UDR. You need the DBA privilege to create or execute a DBA-privileged UDR.

If you omit the DBA keyword, the UDR is known as an owner-privileged UDR.

If you create an owner-privileged UDR in an ANSI-compliant database, anyone can execute the UDR.

If you create an owner-privileged UDR in a database that is not ANSI compliant, the **NODEFDAC** environment variable prevents privileges on that UDR from being granted to PUBLIC. If this environment variable is set, the owner of a UDR must grant the Execute privilege for that UDR to other users.

If an external C or Java language function has a negator function, you must grant the Execute privilege on both the external function and on its negator function before users can execute the external function.

Overloading the Name of a Function

Because Dynamic Server supports *routine overloading*, you can define more than one function with the same name, but different parameter lists. You might want to overload functions in the following situations:

- You create a user-defined function with the same name as a built-in function (such as **equal( )**) to process a new user-defined data type.
- You create *type hierarchies*, in which subtypes inherit data representation and functions from supertypes.
- You create *distinct types*, which are data types that have the same internal storage representation as an existing data type, but have different names and cannot be compared to the source type without casting. Distinct types inherit support functions from their source types.

For a brief description of the routine signature that uniquely identifies each user-defined function, see "Routine Overloading and Naming UDRs with a Routine Signature (IDS)" on page 5-19.

Using the SPECIFIC Clause to Specify a Specific Name: You can declare a specific name, unique to the database, for a user-defined function. A specific name is useful when you are overloading a function.

DOCUMENT Clause

The quoted string in the DOCUMENT clause provides a synopsis and description of the UDR. The string is stored in the **sysprocbody** system catalog table and is intended for the user of the UDR. Anyone with access to the database can query the **sysprocbody** system catalog table to obtain a description of one or all of the UDRs stored in the database.

For example, the following query obtains a description of the SPL function **update_by_pct**, that "SPL Functions" on page 2-110 shows:

```
SELECT data FROM sysprocbody b, sysprocedures p
WHERE b.procid = p.procid
      --join between the two catalog tables
   AND p.procname = 'update_by_pct'
      -- look for procedure named update_by_pct
   AND b.datakey  = 'D'-- want user document;
```

The preceding query returns the following text:

```
USAGE: Update a price by a percentage
Enter an integer percentage from 1 - 100
and a part id number
```

A UDR or application program can query the system catalog tables to fetch the DOCUMENT clause and display it for a user.

For C and Java language functions, you can include a DOCUMENT clause at the end of the CREATE FUNCTION statement, whether or not you use the END FUNCTION keywords.

WITH LISTING IN Clause

The WITH LISTING IN clause specifies a filename where compile time warnings are sent. After you compile a UDR, this file holds one or more warning messages.

If you do not use the WITH LISTING IN clause, the compiler does not generate a list of warnings.

On UNIX platforms, if you specify a filename but not a directory, this listing file is created in your home directory on the computer where the database resides. If you do not have a home directory on this computer, the file is created in the root directory (the directory named "/").

On Windows systems, if you specify a filename but not a directory, this listing file is created in your current working directory if the database is on the local computer. Otherwise, the default directory is **%INFORMIXDIR%\bin**.

SPL Functions

SPL functions are UDRs written in SPL that return one or more values. To write and register an SPL function, use a CREATE FUNCTION statement. Embed appropriate SQL and SPL statements between the CREATE FUNCTION and END FUNCTION keywords. You can also follow the function with the DOCUMENT and WITH FILE IN options.

SPL functions are parsed, optimized (as far as possible), and stored in the system catalog tables in executable format. The body of an SPL function is stored in the **sysprocbody** system catalog table. Other information about the function is stored in other system catalog tables, including **sysprocedures**, **sysprocplan**, and **sysprocauth**. For more information about these system catalog tables, see the *IBM Informix Guide to SQL: Reference*.

The END FUNCTION keywords are required in every SPL function, and a semicolon (**;**) must follow the clause that immediately precedes the statement block. The following code example creates an SPL function:

```
CREATE FUNCTION update_by_pct ( pct INT, pid CHAR(10))
   RETURNING INT;
   DEFINE n INT;
   UPDATE inventory SET price = price + price * (pct/100)
      WHERE part_id = pid;
   LET n = price;
   RETURN price;
END FUNCTION
   DOCUMENT "USAGE: Update a price by a percentage",
         "Enter an integer percentage from 1 - 100",
         "and a part id number"
   WITH LISTING IN '/tmp/warn_file'
```

For more information on how to write SPL functions, see the chapter about SPL routines in *IBM Informix Guide to SQL: Tutorial*.

See also the section "Transactions in SPL Routines" on page 5-72.

You can include valid SQL or SPL language statements in SPL functions. See, however, the following sections in Chapter 5 that describe restrictions on SQL and SPL statements within SPL routines: "Subset of SPL Statements Valid in the Statement Block" on page 5-69; "SQL Statements Not Valid in an SPL Statement Block" on page 5-70; and "Restrictions on SPL Routines in Data-Manipulation Statements" on page 5-71.

Internal representation

External functions are functions you write in an external language (that is, a programming language other than SPL) that Dynamic Server supports.

To create a C user-defined function:

1. Write the C function.
2. Compile the function and store the compiled code in a shared library (the shared-object file for C).
3. Register the function in the database server with the CREATE FUNCTION statement.

To create a user-defined function written in the Java language:

1. Write a Java static method, which can use the JDBC functions to interact with the database server.
2. Compile the Java source file and create a **.jar** file (the shared-object file for Java).
3. Execute the **install_jar( )** procedure with the EXECUTE PROCEDURE statement to install the jar file in the current database.
4. If the UDR uses user-defined types, create a map between SQL data types and Java classes. Use the **setUDTExtName( )** procedure that is explained in "EXECUTE PROCEDURE" on page 2-336.
5. Register the UDR with the CREATE FUNCTION statement.

Rather than storing the body of an external routine directly in the database, the database server stores only the pathname of the shared-object file that contains the compiled version of the routine. When it executes the external routine, the database server invokes the external object code.

The database server stores information about an external function in system catalog tables, including **sysprocbody** and **sysprocauth**. For more information on the system catalog, see the *IBM Informix Guide to SQL: Reference*.

Example of Registering a C User-Defined Function

The following example registers an external C user-defined function named **equal( )** in the database. This function takes two arguments of the type **basetype1** and returns a single Boolean value. The external routine reference name specifies the path to the C shared library where the function object code is actually stored. This library contains a C function **basetype1_equal( )**, which is invoked during execution of the **equal( )** function.

```
CREATE FUNCTION equal ( arg1 basetype1, arg2 basetype1)
RETURNING BOOLEAN;
EXTERNAL NAME
"/usr/lib/basetype1/lib/libbtype1.so(basetype1_equal)"
LANGUAGE C
END FUNCTION
```

Example of Registering a UDR Written in the Java Language

The following CREATE FUNCTION statement registers the user-defined function, **sql_explosive_reaction( )**. This function is discussed in "sqlj.install_jar" on page 2-339.

```
CREATE FUNCTION sql_explosive_reaction(int) RETURNS int WITH (class="jvp")
   EXTERNAL NAME "course_jar:Chemistry.explosiveReaction" LANGUAGE JAVA
```

This function returns a single INTEGER value. The EXTERNAL NAME clause specifies that the Java implementation of the **sql_explosive_reaction( )** function is a method called **explosiveReaction( )**, which resides in the **Chemistry** Java class that resides in the **course_jar** jar file.

Ownership of Created Database Objects

The user who creates an owner-privileged UDR, rather than the user who executes the UDR, owns any database objects that are created by the UDR when the UDR is executed, unless another owner is specified for the created object.

For example, assume that user **mike** creates this user-defined function:

```
CREATE FUNCTION func1 () RETURNING INT;
   CREATE TABLE tab1 (colx INT);
   RETURN 1;
END FUNCTION
```

If user **joan** now executes function **func1**, user **mike**, not user **joan**, is the owner of the newly created table **tab1**.

In the case of a DBA-privileged UDR, however, the user who executes a UDR (rather than the UDR owner) owns any database objects created by the UDR, unless another owner is specified for the database object within the UDR.

For example, assume that user **mike** creates this user-defined function:

```
CREATE DBA FUNCTION func2 () RETURNING INT;
   CREATE TABLE tab2 (coly INT);
   RETURN 1;
END FUNCTION;
```

If user **joan** now executes function **func2**, user **joan**, not user **mike**, is the owner of the newly created table **tab2**.

See also the section "Support for Roles and User Identity" on page 5-72.

Related Information

Related statements: ALTER FUNCTION, ALTER ROUTINE, CREATE PROCEDURE, CREATE FUNCTION FROM, DROP FUNCTION, DROP ROUTINE, GRANT, EXECUTE FUNCTION, PREPARE, REVOKE, and UPDATE STATISTICS

Chapter 3 of this manual describes the SPL language. For a discussion of how to create and use SPL routines, see the *IBM Informix Guide to SQL: Tutorial*.

For a discussion of how to create and use external routines, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*. For information about how to create C UDRs, see the *IBM Informix DataBlade API Programmer's Guide*.

CREATE FUNCTION FROM

Use the CREATE FUNCTION FROM statement to access a user-defined function whose CREATE FUNCTION statement resides in a separate file.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. Use this statement with ESQL/C.

Syntax

```
>>──CREATE FUNCTION FROM──┬─'file'───┬──────────────────────────────────><
                          └─file_var─┘
```

Element	Description	Restrictions	Syntax
file	Path and filename of a file that contains the full CREATE FUNCTION statement text. Default pathname is current directory.	Must exist and contain exactly one CREATE FUNCTION statement	Must conform to operating-system rules.
file_var	Variable storing value of *file*	Same as for *file*	Language specific

Usage

Functions written in the C or Java language are called *external* functions. When the IFX_EXTEND_ROLE configuration parameter is set to ON, only users who have been granted the built-in EXTEND role can create external functions.

An ESQL/C program cannot directly create a user-defined function. That is, it cannot contain the CREATE FUNCTION statement.

To create these functions within an ESQL/C program:

1. Create a source file with the CREATE FUNCTION statement.
2. Use the CREATE FUNCTION FROM statement to send the contents of this source file to the database server for execution.

   The file that you specify in the *file* parameter can contain only one CREATE FUNCTION statement.

For example, suppose that the following CREATE FUNCTION statement is in a separate file, called **del_ord.sql**:

```
CREATE FUNCTION delete_order( p_order_num int) RETURNING int, int;
   DEFINE item_count int;
   SELECT count(*) INTO item_count FROM items
      WHERE order_num = p_order_num;
   DELETE FROM orders WHERE order_num = p_order_num;
   RETURN p_order_num, item_count;
END FUNCTION;
```

In the ESQL/C program, you can access the **delete_order( )** SPL function with the following CREATE FUNCTION FROM statement:

```
EXEC SQL create function from 'del_ord.sql';
```

If you are not sure whether the UDR in the file is a user-defined function or a user-defined procedure, use the CREATE ROUTINE FROM statement.

The filename that you provide is relative. If you provide a simple filename with no pathname (as in the preceding example), the client application looks for the file in the current directory.

Important: The ESQL/C preprocessor does not process the contents of the file that you specify. It only sends the contents to the database server for execution. Therefore, there is no syntactic check that the file that you specify in CREATE FUNCTION FROM actually contains a CREATE FUNCTION statement. To improve readability of the code, however, it is recommended that you match these two statements.

Related Information

Related statements: CREATE FUNCTION, CREATE PROCEDURE, CREATE PROCEDURE FROM, and CREATE ROUTINE FROM

CREATE INDEX

Use the CREATE INDEX statement to create an index for one or more columns in a table, or on values returned by a UDR that uses column values as arguments.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──CREATE──────────────────────────────────────────────────────────────────────────────>

                           (1)                                (2)
>──┤ Index-Type Options ├──────┤ Index Scope ├─┤ Index-Key Specs ├─────────────────────────>
   │                                                         └─┤ Index Options ├─┘   │
   │ (3)                                             (4)                             │
   └──────GK INDEX──index──ON──static──(─┤ GK SELECT Clause ├──────)─────────────────┘
                                                                   └─USING BITMAP─┘

>──┬───────────────────────────────┬──┬───────────────┬──────────────────────────────────><
   │ (3)                       (5) │  │ (6)           │
   └──────┤ LOCK MODE Options ├────┘  └───────ONLINE──┘
```

Index Scope:

```
├──INDEX──index──ON──┬─table───┬────────────────────────────────────────────────────────┤
                     └─synonym─┘
```

Index Options:

```
├──┬────────────────────────────────────────┬──┬──────────────────────────────┬─────────────>
   │ (6)                                (7) │  │                          (8) │
   └──────┤ USING Access-Method Clause ├────┘  └─┤ FILLFACTOR Option ├────────┘

>──┬───────────────────────────────┬──┬────────────────────────────────┬───────────────────┤
   │                           (9) │  │ (6)                       (10) │
   ├─┤ Storage Options ├───────────┤  └──────────┤ Index Modes ├──────┘
   │ (3)                           │
   └────────USING BITMAP───────────┘
```

Notes:

1 See "Index-Type Options" on page 2-117

2 See "Index-Key Specification" on page 2-118

3 Extended Parallel Server only

4 See "SELECT Clause for Generalized-Key Index" on page 2-132

5 See "LOCK MODE Options (XPS)" on page 2-132

6 Dynamic Server only

7 See "USING Access-Method Clause (IDS)" on page 2-123

8 See "FILLFACTOR Option" on page 2-125

9 See "Storage Options" on page 2-125

10 See "Index Modes (IDS)" on page 2-130

Element	Description	Restrictions	Syntax
index	Name declared here for a new index	Must be unique among names of indexes in the database	"Database Object Name" on page 5-17
static	Table on which a Generalized Key index is created (XPS)	Table must exist and be static; it cannot be a virtual table	"Database Object Name" on page 5-17
synonym, table	Name or synonym of a standard or temporary *table* to be indexed	Synonym and its table must exist in the current database	"Database Object Name" on page 5-17

Usage

When you issue the CREATE INDEX statement, the table is locked in exclusive mode. If another process is using the table, CREATE INDEX returns an error. (For an exception, however, see "The ONLINE Keyword (IDS)" on page 2-302.)

Indexes use the collation that was in effect when CREATE INDEX executed.

A *secondary-access method* (sometimes referred to as an *index-access method*) is a set of database server functions that build, access, and manipulate an index structure such as a B-tree, R-tree, or an index structure that a DataBlade module provides, in order to speed up the retrieval of data.

In Dynamic Server, neither *synonym* nor *table* can refer to a virtual table.

If you are using Extended Parallel Server, use the USING BITMAP keywords to store the list of records in each key of the index as a compressed bitmap. The storage option is not compatible with a bitmap index because bitmap indexes must be fragmented in the same way as the table.

Index-Type Options

The index-type options let you specify attributes of the index.

Index-Type Options:

```
|--+----------+--+---------+----------------------------------------|
   +-DISTINCT-+  '-CLUSTER-'
   '-UNIQUE---'
```

UNIQUE or DISTINCT Option

Use the UNIQUE or DISTINCT keyword to require that the columns on which the index is based accept only unique data. If you do not specify the UNIQUE or DISTINCT keyword, the index allows duplicate values in the indexed column (or in the set of indexed columns). The following example creates a unique index:

```
CREATE UNIQUE INDEX c_num_ix ON customer (customer_num)
```

A unique index prevents duplicate values in the **customer_num** column. A column with a unique index can have, at most, one NULL value.

The DISTINCT and UNIQUE keywords are synonyms in this context, so the following statement has the same effect as the previous example:

```
CREATE DISTINCT INDEX c_num_ix ON customer (customer_num)
```

The index in both examples is maintained in ascending order, which is the default order.

You can also prevent duplicates in a column or set of columns by creating a unique constraint with the CREATE TABLE or ALTER TABLE statement. You cannot specify an R-tree secondary-access method for a UNIQUE index key. For more information on how to create unique constraints, see the CREATE TABLE or ALTER TABLE statements.

See also the section "Differences Between a Unique Constraint and a Unique Index" on page 2-178.

How Indexes Affect Primary-Key, Unique, and Referential Constraints: The database server creates internal B-tree indexes for primary-key, unique, and referential constraints. If a primary-key, unique, or referential constraint is added after the table is created, any user-created indexes on the constrained columns are used, if appropriate. An appropriate index is one that indexes the same columns that are used in the primary-key, referential, or unique constraint. If an appropriate user-created index is not available, the database server creates a nonfragmented internal index on the constrained column or columns.

CLUSTER Option

Use the CLUSTER keyword to reorder the rows of the table in the order that the index designates. The CREATE CLUSTER INDEX statement fails if a CLUSTER index already exists on the same table.

```
CREATE CLUSTER INDEX c_clust_ix ON customer (zipcode)
```

This statement creates an index on the **customer** table and physically orders the rows according to their postal code values, in (by default) ascending order.

If the CLUSTER option is specified in addition to fragments on, the data values are clustered only within each fragment, and not globally across the entire table.

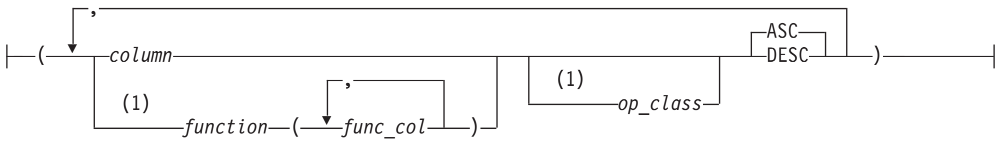
In Dynamic Server, you cannot specify the CLUSTER option and the ONLINE keyword in the same statement. In addition, some secondary-access methods (such as R-tree) do not support clustering. Before you specify CLUSTER for your index, be sure that the index uses an access method that supports clustering.

If you are using Extended Parallel Server, you cannot use the CLUSTER option on STANDARD tables. In addition, you cannot specify the CLUSTER option and storage options in the same CREATE INDEX statement (see "Storage Options" on page 2-125). When you create a clustered index, the **constrid** of any unique or referential constraints on the associated table changes. The **constrid** is stored in the **sysconstraints** system catalog table.

Index-Key Specification

Use the Index-Key Specification of the CREATE INDEX statement to define the key value for the index, to specify whether to sort the index in ascending or descending order, and to identify a default operator class if the secondary access method in the USING clause has no default operator class, or to override its default operator class.

Index-Key Specification:



Notes:

1 Dynamic Server only

Element	Description	Restrictions	Syntax
column	Column or columns used as a key to this index	See "Using a Column or Column List as the Index Key" on page 2-119.	"Identifier" on page 5-22
function	User-defined function used as a key to this index	Must be a nonvariant function that does not return a large object data type. Cannot be a built-in algebraic, exponential, log, or hex function.	"Database Object Name" on page 5-17
func_col	Columns whose values are arguments to *function*	See "Using a Function as an Index Key (IDS)" on page 2-120.	"Identifier" on page 5-22
op_class	Operator class associated with *column* or *function* for this index	If the secondary-access method in the USING clause has no default operator class, you must specify one here. (See "Using an Operator Class (IDS)" on page 2-123.)	"Identifier" on page 5-22

The index-key value can be one or more columns that contain built-in data types. If you specify multiple columns, the concatenation of values from the set of columns is treated as a single composite column for indexing.

In Dynamic Server, the index-key value also can be one of the following:

- A column of type LVARCHAR(*size*), if *size* is smaller than 387 bytes
- One or more columns that contain user-defined data types
- One or more values that a user-defined function returns (referred to as a *functional index*)
- A combination of columns and functions

The 387-byte LVARCHAR size limit is for dbspaces of the default (2 kilobyte) page size, but dbspaces of larger page sizes can support larger index key sizes, as listed in the following table.

Table 2-1. Maximum Index Key Size for Selected Page Sizes

Page Size	Maximum Index Key Size
2 kilobytes	387 bytes
4 kilobytes	796 bytes
8 kilobytes	1,615 bytes
12 kilobytes	2,435 bytes
16 kilobytes	3,245 bytes

Using a Column or Column List as the Index Key

These restrictions apply to a column or column list specified as the index key:

- All the columns must exist and must be in the table being indexed.
- The maximum number of columns and total width of all columns depends on the database server. See "Creating Composite Indexes" on page 2-120.
- You cannot add an ascending index to a column or column list that already has a unique constraint on it. See "Using the ASC and DESC Sort-Order Options" on page 2-121.
- You cannot add a unique index to a column or to a column list that has a primary-key constraint. The reason is that defining the column or column list as the primary key causes the database server to create a unique internal index on

the column or column list; you cannot create another unique index on this column or column list with the CREATE INDEX statement.
- The number of indexes that you can create on the same column or the same set of columns is restricted. See "Restrictions on the Number of Indexes on a Set of Columns" on page 2-122.

In Dynamic Server, these additional restrictions apply to indexes:
- You cannot create an index on a column of an external table.
- The column cannot be of a collection data type.

Using a Function as an Index Key (IDS)

A *functional index* is indexed on the value that the specified function returns, rather than on the value of a column. For example, the following statement creates a functional index on table **zones** using the value that the function **Area( )** returns as the key:

```
CREATE INDEX zone_func_ind ON zones (Area(length,width));
```

You can create functional indexes within an SPL routine. You can also create an index on a nonvariant user-defined function that does not return a large object. The functional index can be a B-tree index, an R-tree index, or a user-defined secondary-access method. The ONLINE keyword, however, is not valid when you create a functional index; see "The ONLINE Keyword (IDS)" on page 2-302.

Creating Composite Indexes

A *simple* index lists only one *column* (or for IDS, only one *column* or *function*) in its Index Key Specification. Any other index is a *composite* index. You should list the columns in a composite index in the order from most frequently used to least frequently used.

In Dynamic Server, if you use SET COLLATION to specify a non-default locale, you can create multiple indexes on the same set of columns, using different collations. (Such indexes are useful only on NCHAR or NVARCHAR columns.)

The following example creates a composite index using the **stock_num** and **manu_code** columns of the **stock** table:

```
CREATE UNIQUE INDEX st_man_ix ON stock (stock_num, manu_code)
```

The UNIQUE keyword prevents any duplicates of a given combination of **stock_num** and **manu_code**. The index is in ascending order by default.

You can include up to 16 columns in a composite index. The total width of all indexed columns in a single composite index cannot exceed 380 bytes.

In Dynamic Server, an *index key part* is either a column in a table, or the result of a user-defined function on one or more columns. A composite index can have up to 16 key parts that are columns, or up to 341 key parts that are values returned by a UDR. This limit is language-dependent and applies to UDRs written in SPL or Java; functional indexes based on C language UDRs can have up to 102 key parts. A composite index can have any of the following items as an index key:
- One or more columns
- One or more values that a user-defined function returns (referred to as a functional index)
- A combination of columns and user-defined functions

For dbspaces of the default page size of 2 kilobytes, the total width of all indexed columns in a single CREATE INDEX statement cannot exceed 387 bytes, except for functional indexes of Dynamic Server, whose language-dependent limits are described earlier in this section.

Whether the index is based directly on column values in the table, or on functions that take column values as arguments, the maximum size of the index key depends only on page size. The maximum index key size for functional indexes in dbspaces larger than 2 kilobytes are the same as for non-functional indexes. The only difference between limits on column indexes and functional indexes is the number of key parts. A column based index can have no more than 16 key parts and a functional index has different language-dependent limits on key parts. For a given page size, the maximum index key size is the same for both column-based and functional indexes.

Using the ASC and DESC Sort-Order Options

The ASC option specifies an index maintained in ascending order; this is the default order. The DESC option can specify an index that is maintained in descending order. These ASC and DESC options are valid with B-trees only.

Effects of Unique Constraints on Sort Order Options: When a column or list of columns is defined as unique in a CREATE TABLE or ALTER TABLE statement, the database server implements that UNIQUE CONSTRAINT by creating a unique ascending index. Thus, you cannot use the CREATE INDEX statement to add an ascending index to a column or column list that is already defined as unique.

However, you can create a descending index on such columns, and you can include such columns in composite ascending indexes in different combinations. For example, the following sequence of statements is valid:

```
CREATE TABLE customer (
   customer_num  SERIAL(101) UNIQUE,
   fname                CHAR(15),
   lname                CHAR(15),
   company              CHAR(20),
   address1             CHAR(20),
   address2             CHAR(20),
   city                 CHAR(15),
   state                CHAR(2),
   zipcode              CHAR(5),
   phone                CHAR(18)
   )

CREATE INDEX c_temp1 ON customer (customer_num DESC)
CREATE INDEX c_temp2 ON customer (customer_num, zipcode)
```

In this example, the **customer_num** column has a unique constraint placed on it. The first CREATE INDEX statement places an index sorted in descending order on the **customer_num** column. The second CREATE INDEX includes the **customer_num** column as part of a composite index. For more information on composite indexes, see "Creating Composite Indexes" on page 2-120.

Bidirectional Traversal of Indexes: If you do not specify the ASC or DESC keywords when you create an index on a single column, key values are stored in ascending order by default; but the bidirectional-traversal capability of the database server lets you create just one index on a column and use that index for queries that specify sorting of results in either ascending or descending order of the sort column.

Because of this capability, it does not matter whether you create a single-column index as an ascending or descending index. Whichever storage order you choose for an index, the database server can traverse that index in ascending or descending order when it processes queries.

If you create a composite index on a table, however, the ASC and DESC keywords might be required. For example, if you want to enter a SELECT statement whose ORDER BY clause sorts on multiple columns and sorts each column in a different order, and you want to use an index for this query, you need to create a composite index that corresponds to the ORDER BY columns. For example, suppose that you want to enter the following query:

```
SELECT stock_num, manu_code, description, unit_price
   FROM stock ORDER BY manu_code ASC, unit_price DESC
```

This query sorts first in ascending order by the value of the **manu_code** column and then in descending order by the value of the **unit_price** column. To use an index for this query, you need to issue a CREATE INDEX statement that corresponds to the requirements of the ORDER BY clause. For example, you can enter either of the following statements to create the index:

```
CREATE INDEX stock_idx1 ON stock
   (manu_code ASC, unit_price DESC);
CREATE INDEX stock_idx2 ON stock
   (manu_code DESC, unit_price ASC);
```

The composite index that was used for this query (**stock_idx1** or **stock_idx2**) cannot be used for queries in which you specify the same sort direction for the two columns in the ORDER BY clause. For example, suppose that you want to enter the following queries:

```
SELECT stock_num, manu_code, description, unit_price
   FROM stock ORDER BY manu_code ASC, unit_price ASC;
SELECT stock_num, manu_code, description, unit_price
   FROM stock ORDER BY manu_code DESC, unit_price DESC;
```

If you want to use a composite index to improve the performance of these queries, you need to enter one of the following CREATE INDEX statements. You can use either one of the created indexes (**stock_idx3** or **stock_idx4**) to improve the performance of the preceding queries.

```
CREATE INDEX stock_idx3 ON stock
   (manu_code ASC, unit_price ASC);
CREATE INDEX stock_idx4 ON stock
   (manu_code DESC, unit_price DESC);
```

You can create no more than one ascending index and one descending index on a column. Because of the bidirectional-traversal capability of the database server, you only need to create one of the indexes. Creating both would achieve exactly the same results for an ascending or descending sort on the **stock_num** column.

After INSERT or DELETE operations are performed on an indexed table, the number of index entries can vary within a page, and the number of index pages that a table requires can depend on whether the index specifies ascending or descending order. For some load and DML operations, a descending single-column or multi-column index might cause the database server to allocate more index pages than an ascending index requires.

Restrictions on the Number of Indexes on a Set of Columns: You can create multiple indexes on a set of columns, provided that each index has a unique combination of ascending and descending columns. For example, to create all possible indexes on the **stock_num** and **manu_code** columns of the **stock** table, you could create four indexes:

- The **ix1** index on both columns in ascending order
- The **ix2** index on both columns in descending order
- The **ix3** index on **stock_num** in ascending order and on **manu_code** in descending order
- The **ix4** index on **stock_num** in descending order and on **manu_code** in ascending order

Because of the bidirectional-traversal capability of the database server, you do not need to create these four indexes. You only need to create two indexes:

- The **ix1** and **ix2** indexes achieve the same results for sorts in which the user specifies the same sort direction (ascending or descending) for both columns, so you only need one index of this pair.
- The **ix3** and **ix4** indexes achieve the same results for sorts in which the user specifies different sort directions for the two columns (ascending on the first column and descending on the second column or vice versa). Thus, you only need to create one index of this pair. (See also “Bidirectional Traversal of Indexes” on page 2-121.)

Dynamic Server can also support multiple indexes on the same combination of ascending and descending columns, if each index has a different collating order; see “SET COLLATION” on page 2-531.

Using an Operator Class (IDS)

An *operator class* is the set of operators associated with a secondary-access method for query optimization and building the index. You must specify an operator class when you create an index if either one of the following is true:

- No default operator class for the secondary-access method exists. (A user-defined access method can provide no default operator class.)
- You want to use an operator class that is different from the default operator class that the secondary-access method provides.

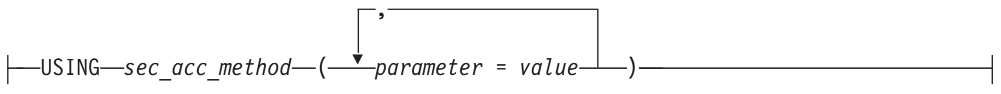
If you use an alternative access method, and if the access method has a default operator class, you can omit the operator class here; but if you do not specify an operator class and the secondary-access method does not have a default operator class, the database server returns an error. For more information, see “Default Operator Classes” on page 2-144. The following CREATE INDEX statement creates a B-tree index on the **cust_tab** table that uses the **abs_btree_ops** operator class for the **cust_num** key:

```
CREATE INDEX c_num1_ix ON cust_tab (cust_num abs_btree_ops);
```

USING Access-Method Clause (IDS)

The USING clause specifies the secondary-access method for the new index.

USING Access-Method Clause:



Element	Description	Restrictions	Syntax
parameter	Secondary-access-method parameter for this index	See the user documentation for your user-defined access method	"Quoted String" on page 4-142
sec_acc _method	Secondary-access method for this index	Method can be a B-tree, R-tree, or user-defined access method, such as one that a DataBlade module defines	"Identifier" on page 5-22
value	Value of the specified *parameter*	Must be a valid literal value for *parameter* in this secondary-access method	"Quoted String" on page 4-142 or "Literal Number" on page 4-137

A *secondary-access method* is a set of routines that perform all of the operations needed for an index, such as create, drop, insert, delete, update, and scan.

The database server provides the following secondary-access methods:

- The generic B-tree index is the built-in secondary-access method.

  A B-tree index is good for a query that retrieves a range of data values. The database server implements this secondary-access method and registers it as **btree** in the system catalog tables.
- The R-tree method is a registered secondary-access method.

  An R-tree index is good for searches on multidimensional data. The database server registers this secondary-access method as **rtree** in the system catalog tables of a database. An R-tree secondary-access method is not valid for a UNIQUE index key. An R-tree index cannot be clustered, and cannot be stored in a dbspace that has a non-default page size. For more information on R-tree indexes, see the *IBM Informix R-Tree Index User's Guide*.

The access method that you specify must be registered in the **sysams** system catalog table. The default secondary-access method is B-tree.

If the access method is B-tree, you can create only one index for each unique combination of ascending and descending columnar or functional keys with operator classes. (This restriction does not apply to other secondary-access methods.) By default, CREATE INDEX creates a generic B-tree index. If you want to create an index with a secondary-access method other than B-tree, you must specify the name of the secondary-access method in the USING clause.

Some user-defined access methods are packaged as DataBlade modules. Some DataBlade modules provide indexes that require specific parameters when you create them. For more information about user-defined access methods, refer to the documentation of your secondary access-method or DataBlade module.

The following example (for a database that implements R-tree indexes) creates an R-tree index on the **location** column that contains an opaque data type, **point**, and performs a query with a filter on the **location** column.

```
CREATE INDEX loc_ix ON TABLE emp (location) USING rtree;
SELECT name FROM emp WHERE location N_equator_equals point('500, 0');
```

The following CREATE INDEX statement creates an index that uses the **fulltext** secondary-access method, which takes two parameters: WORD_SUPPORT and PHRASE_SUPPORT. It indexes a table **t**, which has two columns: **i**, an integer column, and **data**, a TEXT column.

```
CREATE INDEX tx ON t(data)
   USING fulltext (WORD_SUPPORT='PATTERN',
   PHRASE_SUPPORT='MAXIMUM');
```

FILLFACTOR Option

The FILLFACTOR option takes effect only in the following cases:

- when you build an index on a table that contains more than 5,000 rows and that uses more than 100 table pages
- when you create an index on a fragmented table
- when you create a fragmented index on a nonfragmented table.

Use the FILLFACTOR option to provide for expansion of an index at a later date or to create compacted indexes.

FILLFACTOR Option:

```
├──FILLFACTOR──percent──────────────────────────────────────────────┤
```

Element	Description	Restrictions	Syntax
percent	Percentage of each index page that is filled by index data when the index is created. The default is 90.	1 ≤ *percent* ≤100	"Literal Number" on page 4-137

When the index is created, the database server initially fills only that percentage of the nodes specified with the FILLFACTOR value.

The FILLFACTOR can also be set as a parameter in the ONCONFIG file. The FILLFACTOR clause on the CREATE INDEX statement overrides the setting in the ONCONFIG file. For more information about the ONCONFIG file and the parameters you can use, see your *IBM Informix Administrator's Guide*.

Providing a Low Percentage Value

If you provide a low percentage value, such as 50, you allow room for growth in your index. The nodes of the index initially fill to a certain percentage and contain space for inserts. The amount of available space depends on the number of keys in each page as well as the percentage value.

For example, with a 50-percent FILLFACTOR value, the page would be half full and could accommodate doubling in size. A low percentage value can result in faster inserts and can be used for indexes that you expect to grow.

Providing a High Percentage Value

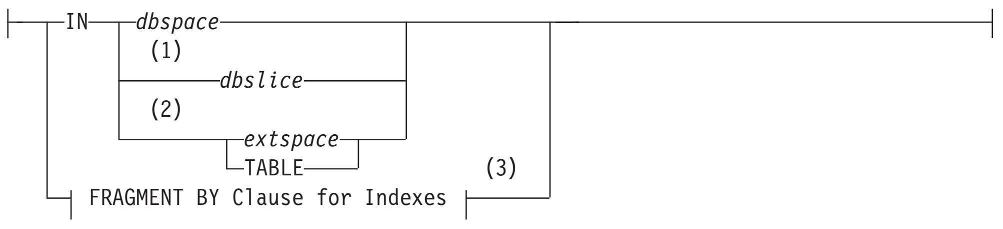
If you provide a high percentage value, such as 99, indexes are compacted, and any new index inserts result in splitting nodes. The maximum density is 100 percent. With a 100-percent FILLFACTOR value, the index has no room available for growth; any addition to the index results in splitting the nodes.

A 99-percent FILLFACTOR value allows room for at least one insertion per node. A high percentage value can result in faster queries and is appropriate for indexes that you do not expect to grow, or for mostly read-only indexes.

Storage Options

The storage options specify the distribution scheme of an index. You can use the IN clause to specify a storage space for the entire index, or you can use the FRAGMENT BY clause to fragment the index across multiple storage spaces.

Storage Options:



Notes:

1 Extended Parallel Server only

2 Dynamic Server only

3 See "FRAGMENT BY Clause for Indexes" on page 2-127

Element	Description	Restrictions	Syntax
dbslice	The dbslice that contains all of the index fragments	Must exist	"Identifier" on page 5-22
dbspace	The dbspace in which to store the index	Must exist	"Identifier" on page 5-22
extspace	Name assigned by the **onspaces** command to a storage area outside the database server	Must exist	See the documentation for your access method.

If you specify any storage option (except IN TABLE), you create a *detached index.* Detached indexes are indexes that are created with a specified distribution scheme. Even if the distribution scheme specified for the index is identical to that specified for the table, the index is still considered to be detached. If the distribution scheme of a table changes, all detached indexes continue to use the distribution scheme that the Storage Option clause specified.

For information on locally detached and globally detached indexes, see "FRAGMENT BY Clause for Indexes" on page 2-127. If you are using Extended Parallel Server, you cannot use the CLUSTER option and storage options in the same CREATE INDEX statement. See "CLUSTER Option" on page 2-118.

IN Clause

Use the IN clause to specify a storage space to hold the entire index. The storage space that you specify must already exist.

Storing an Index in a dbspace: Use the IN *dbspace* clause to specify the dbspace where you want your index to reside. When you use this clause with any option except the TABLE keyword, you create a detached index.

The IN *dbspace* clause allows you to isolate an index. For example, if the **customer** table is created in the **custdata** dbspace, but you want to create an index in a separate dbspace called **custind**, use the following statements:

```
CREATE TABLE customer
   . . .
   IN custdata EXTENT SIZE 16

CREATE INDEX idx_cust ON customer (customer_num) IN custind
```

Storing an Index Fragment in a Named Partition (IDS): Besides the option of storing a fragment of the index in a dbspace, Dynamic Server supports storing fragments of the index in a named subset of the dbspace, called a *partition*. Unless you explicitly declare names for the fragments in the PARTITION BY or

FRAGMENT BY clause, each fragment, by default, has the same name as the dbspace where it resides. This includes all fragmented tables and indexes migrated from earlier releases of Dynamic Server.

Storing an Index in a dbslice (XPS): Using Extended Parallel Server, the IN *dbslice* clause allows you to fragment an index across multiple dbspaces. The database server fragments the table by round-robin in the dbspaces that make up the dbslice when the table is created.

Storing Data in an extspace (IDS): In general, use the *extspace* storage option in conjunction with the "USING Access-Method Clause (IDS)" on page 2-123. For more information, refer to the user documentation for your custom-access method.

Creating an Attached Index with the IN TABLE Keywords (IDS): In some earlier releases of Dynamic Server, if you did not use the storage options to specify a distribution scheme, then, by default, the index used the same distribution scheme as the table on which it was built. Such an index is called an *attached index.* If you omit the Storage Options clause, Dynamic Server creates new indexes as detached indexes by default, but supports existing attached indexes created by earlier release versions. (The **DEFAULT_ATTACH** environment variable, however, can override the default behavior so that the new index is attached.)

You can also specify IN TABLE as the storage option to create an attached index, even if the **DEFAULT_ATTACH** environment variable is not set. An attached index is created in the same dbspace (or dbspaces, if the table is fragmented) as the table on which it is built. If the distribution scheme of a table changes, all attached indexes start using the new distribution scheme.

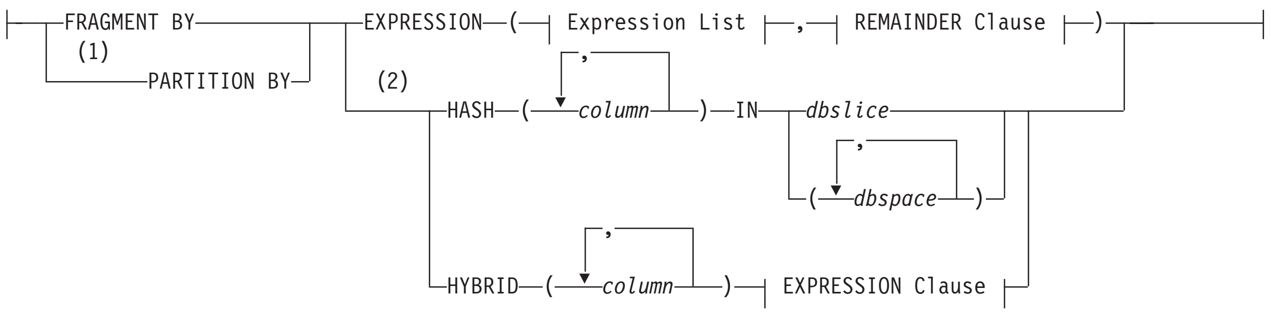
Only B-tree indexes that are nonfragmented and that are on nonfragmented tables can be attached. All other indexes, including extensibility related indexes, such as R-trees and functional indexes, must be detached. You cannot create an attached index using a collating order different from that of the table, nor different from what **DB_LOCALE** specifies. For information about the **DB_LOCALE** and **DEFAULT_ATTACH** environment variables, see the *IBM Informix Guide to SQL: Reference*.

Important: Attached indexes are supported in this release for backward compatibility with Dynamic Server 7.x, but IBM does not recommend use of the **DEFAULT_ATTACH** environment variable nor of the IN TABLE storage option in new applications. Attached indexes are a deprecated feature that might not be supported in some future release of Dynamic Server.

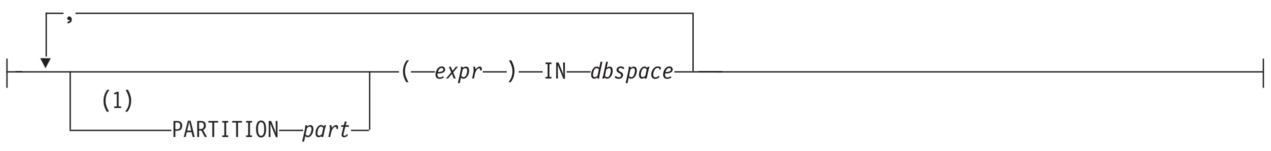
FRAGMENT BY Clause for Indexes

Use the FRAGMENT BY clause to create a detached index and to define its fragmentation strategy across dbspaces, partitions (IDS), or dbslices (XPS).

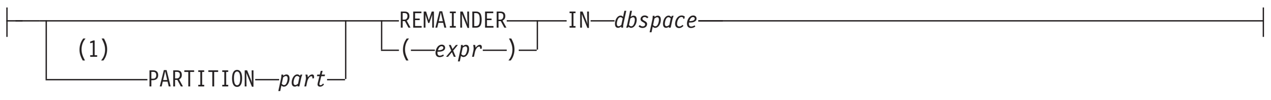
FRAGMENT BY Clause for Indexes:



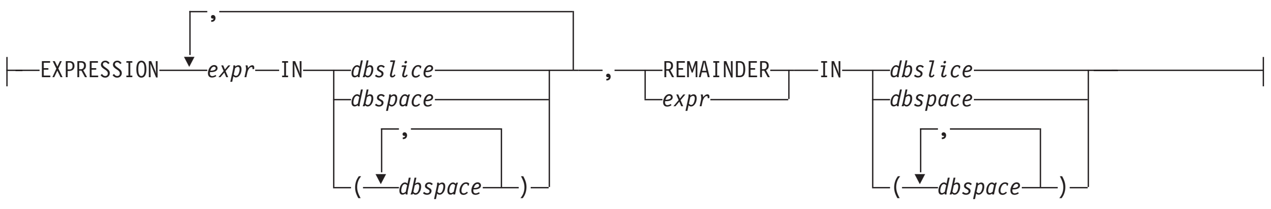
Expression List:



REMAINDER Clause:



EXPRESSION Clause:



Notes:

1 Dynamic Server only

2 Extended Parallel Server only

Element	Description	Restrictions	Syntax
column	Column on which to fragment the index	Must exist in the current table	"Identifier" on page 5-22
dbslice	Dbslice storing all the index fragments	Must exist	"Identifier" on page 5-22
dbspace	Dbspace in which to store the index fragment that *expr* defines	Must exist. Include no more than 2,048 *dbspace* names	"Identifier" on page 5-22
expr	Expression defining which index keys each fragment stores	See "Restrictions on Fragmentation Expressions" on page 2-129.	"Expression" on page 4-34; "Condition" on page 4-5
part	Name that you declare here for a partition of a dbspace	Required for any partition in the same *dbspace* as another partition of the same index	"Identifier" on page 5-22

Here the IN keyword introduces the name of a storage space where an index fragment is to be stored. If you list multiple *dbspace* names after the IN keyword, use parentheses to delimit the *dbspace* list. The parentheses around the list of fragment definitions that follow the EXPRESSION keyword are optional.

Restrictions on Fragmentation Expressions

The following restrictions apply to the expression:

- Each fragment expression can contain columns only from the current table, with data values only from a single row.
- The columns contained in a fragment expression must be the same as the indexed columns or a subset of the indexed columns.
- The expression must return a BOOLEAN (true or false) value.
- No subqueries, aggregates, user-defined routines, nor references to fields of a ROW type column are valid.
- The built-in CURRENT, DATE, and TODAY functions are not valid.

In Extended Parallel Server, you can fragment indexes on any column of a table, even if the table spans multiple coservers. The columns that you specify in the FRAGMENT BY clause do not need to be part of the index key.

Detached indexes of Extended Parallel Server can be either locally detached or globally detached. A *locally detached index* is an index in which, for each data tuple in a table, the corresponding index tuple is guaranteed to be on the same coserver. The table and index fragmentation strategies need not be identical if co-locality can be guaranteed. If the data tuple and index tuple co-locality do not exist, then the index is a *globally-detached index*. For performance implications of globally-detached indexes, see your *IBM Informix Performance Guide*. For more information on options for distribution strategies in Extended Parallel Server, see “Fragmenting by EXPRESSION” on page 2-192, “Fragmenting by HASH (XPS)” on page 2-194, and “Fragmenting by HYBRID (XPS)” on page 2-195, respectively, in the description of the CREATE TABLE statement.

Fragmentation of System Indexes

System indexes (such as those that implement referential constraints and unique constraints) utilize user-defined indexes if they exist. If no user-defined indexes can be utilized, system indexes remain nonfragmented, and are moved to the dbspace where the database was created.

To fragment a system index, create the fragmented index on the constraint columns, and then add the constraint using the ALTER TABLE statement.

Fragmentation of Unique Indexes (IDS)

You can fragment unique indexes on a table that uses a round-robin or an expression-based distribution scheme, but any columns referenced in the fragment expression must be indexed columns. If your index fragmentation strategy violates this restriction, the CREATE INDEX statement fails, and work is rolled back.

Fragmentation of Indexes on Temporary Tables

You can fragment a unique index on a temporary table only if the underlying table uses an expression-based distribution scheme. That is, the CREATE Temporary TABLE statement that defines the temporary table must specify an explicit expression-based distribution scheme.

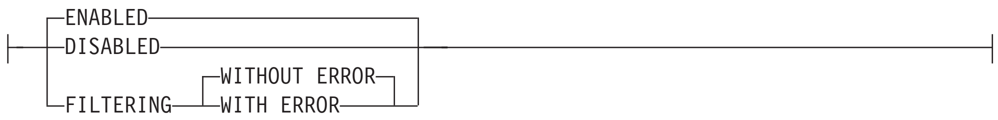
If you try to create a fragmented, unique index on a temporary table for which you did not specify a fragmentation strategy when you created the table, the database server creates the index in the first dbspace that the **DBSPACETEMP** environment variable specifies. For more information on the **DBSPACETEMP** environment variable, see the *IBM Informix Guide to SQL: Reference*.

For more information on the default storage characteristics of temporary tables, see "Where Temporary Tables are Stored" on page 2-214.

Index Modes (IDS)

Use the index mode options to specify the behavior of the index during insert, delete, and update operations.

Index Modes:



The following table explains the index modes

Mode	Effect
DISABLED	The database server does not update the index after insert, delete, and update operations that modify the base table. The optimizer does not use the index during the execution of queries.
ENABLED	The database server updates the index after insert, delete, and update operations that modify the base table. The optimizer uses the index during query execution. If an insert or update operation causes a duplicate key value to be added to a unique index, the statement fails.
FILTERING	The database server updates a unique index after insert, delete, and update operations that modify the base table. (This option is not available with duplicate indexes.) The optimizer uses the index during query execution. If an insert or update operation causes a duplicate key value to be added to a unique index in filtering mode, the statement continues processing, but the bad row is written to the violations table associated with the base table. Diagnostic information about the unique-index violation is written to the diagnostics table associated with the base table.

If you specify filtering for a unique index, you can also specify one of the following error options.

Error Option	Effect
WITHOUT ERROR	A unique-index violation during an insert or update operation returns no integrity-violation error to the user.
WITH ERROR	Any unique-index violation during an insert or update operation returns an integrity-violation error to the user.

Specifying Modes for Unique Indexes

You must observe the following rules when you specify modes for unique indexes in CREATE INDEX statements:

- You can set the mode of a unique index to enabled, disabled, or filtering.
- If you do not specify a mode, then by default the index is enabled.
- For an index set to filtering mode, if you do not specify an error option, the default is WITHOUT ERROR.
- When you add a new unique index to an existing base table and specify the disabled mode for the index, your CREATE INDEX statement succeeds even if duplicate values in the indexed column would cause a unique-index violation.
- When you add a new unique index to an existing base table and specify the enabled or filtering mode for the index, your CREATE INDEX statement succeeds provided that no duplicate values exist in the indexed column that would cause a unique-index violation. However, if any duplicate values exist in the indexed column, your CREATE INDEX statement fails and returns an error.
- When you add a new unique index to an existing base table in the enabled or filtering mode, and duplicate values exist in the indexed column, erroneous rows in the base table are not filtered to the violations table. Thus, you cannot use a violations table to detect the erroneous rows in the base table.

Adding a Unique Index When Duplicate Values Exist in the Column: If you attempt to add a unique index in the enabled mode but receive an error message because duplicate values are in the indexed column, take the following steps to add the index successfully:

1. Add the index in the disabled mode. Issue the CREATE INDEX statement again, but this time specify the DISABLED keyword.
2. Start a violations and diagnostics table for the target table with the START VIOLATIONS TABLE statement.
3. Issue a SET Database Object Mode statement to change the mode of the index to enabled. When you issue this statement, existing rows in the target table that violate the unique-index requirement are duplicated in the violations table. You receive an integrity-violation error message, however, and the index remains disabled.
4. Issue a SELECT statement on the violations table to retrieve the nonconforming rows that are duplicated from the target table. You might need to join the violations and diagnostics tables to get all the necessary information.
5. Take corrective action on the rows in the target table that violate the unique-index requirement.
6. After you fix all the nonconforming rows in the target table, issue the SET Database Object Mode statement again to switch the disabled index to the enabled mode. This time the index is enabled, and no integrity violation error message is returned because all rows in the target table now satisfy the new unique-index requirement.

Specifying Modes for Duplicate Indexes

You must observe the following rules when you specify modes for duplicate indexes in CREATE INDEX statements:

- You can set a duplicate index to enabled or disabled mode. Filtering mode is available only for unique indexes.
- If you do not specify the mode of a duplicate index, by default the index is enabled.

How the Database Server Treats Disabled Indexes (IDS)

Whether a disabled index is a unique or duplicate index, the database server effectively ignores the index during data-manipulation (DML) operations.

When an index is disabled, the database server stops updating it and stops using it during queries, but the catalog information about the disabled index is retained. You cannot create a new index on a column or set of columns if a disabled index on that column or set of columns already exists. Similarly, you cannot create an active (enabled) unique, foreign-key, or primary-key constraint on a column or on a set of columns if the indexes on which the active constraint depends are disabled.

LOCK MODE Options (XPS)

The LOCK MODE options specify the locking granularity of the index.

LOCK MODE Options:

```
                  ┌NORMAL┐
├──LOCK MODE──────┴COARSE┴──────────────────────────────────────────────┤
```

In COARSE lock mode, index-level locks are acquired on the index instead of item-level or page-level locks. This mode reduces the number of lock calls on the index. Use the coarse-lock mode when you know the index is not going to change, as when only read-only operations are performed on the index.

If you specify no lock mode, the default is NORMAL. That is, the database server places item-level or page-level locks on the index as necessary.

Generalized-Key Indexes (XPS)

If you are using Extended Parallel Server, you can create *generalized-key* (GK) indexes. Keys in a conventional index consist of one or more columns of the STATIC table that is being indexed. A GK index stores information about the records in a STATIC table based on the results of a query.

GK indexes provide a form of pre-computed index capability that supports faster query processing, especially in data-warehousing environments. The optimizer can use the GK index to improve performance.

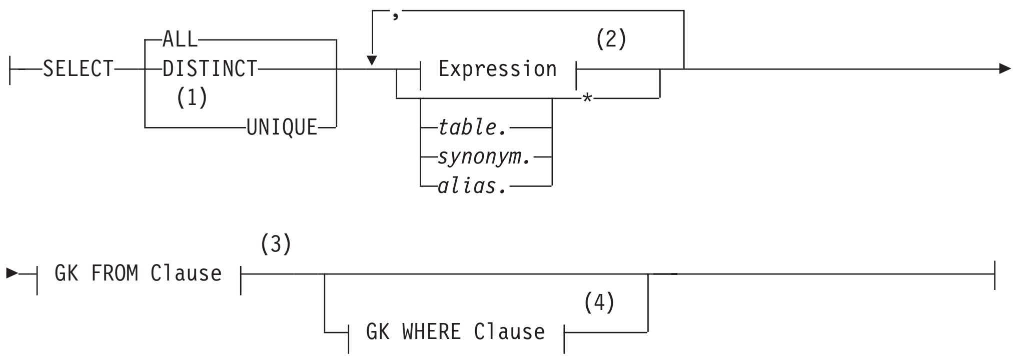
A GK index is *defined on* a table when that table is the one being indexed. A GK index *depends on* a table when the table appears in the FROM clause of the index. Before you create a GK index, keep the following issues in mind:

- All tables used in a GK index must be STATIC tables. If you try to change the type of a table to a non-static type while a GK index depends on that table, the database server returns an error.
- Any table involved in a GK index must be a STATIC type. UPDATE, DELETE, INSERT, and LOAD operations are not valid on such a table until you drop the dependent GK index and the table type changes.

Key-only index scans are not available with GK indexes.

SELECT Clause for Generalized-Key Index: In Extended Parallel Server, the options of the GK SELECT clause are a subset of the options of "SELECT" on page 2-479. The GK SELECT clause has this syntax:

GK SELECT Clause:



Notes:

1 Informix extension

2 See "Expression" on page 4-34

3 See "FROM Clause for Generalized-Key Index"

4 See "WHERE Clause for Generalized-Key Index" on page 2-134

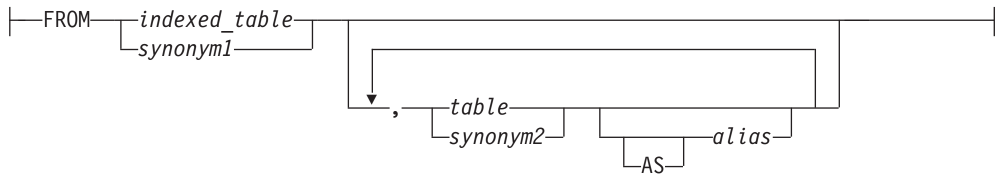
Element	Description	Restrictions	Syntax
alias	Temporary name assigned to the table in the FROM clause	You cannot use an alias for the table on which the index is built	"Identifier" on page 5-22
synonym, *table*	Synonym or table from which to retrieve data	The synonym and the table to which it points must exist	"Database Object Name" on page 5-17

The following restrictions apply to expressions in the GK SELECT clause:

- It cannot refer to any SPL routine.
- It cannot include the USER, TODAY, CURRENT, DBINFO built-in functions, nor any function that refers to a point in time or interval.

FROM Clause for Generalized-Key Index:

GK FROM Clause:



Element	Description	Restrictions	Syntax
alias	Temporary name for a table	You cannot use an alias with *indexed_table*	"Identifier" on page 5-22
indexed_table, *synonym1*	Table on which the index is being built	The FROM clause must include the indexed table	"Database Object Name" on page 5-17
synonym2, *table*	Synonym or identifier of table from which to retrieve data	The synonym and the table to which it points must exist	"Database Object Name" on page 5-17

All tables that appear in the FROM clause must be local static tables. That is views, non-static tables, and remote tables are not valid in the FROM clause.

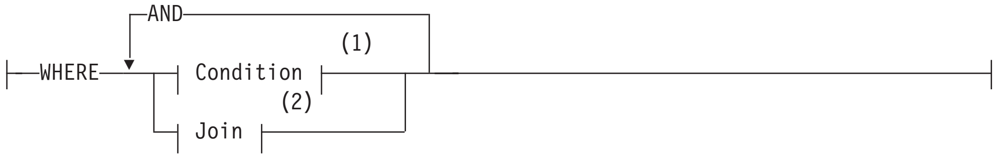
Tables that you specify in the FROM clause must be *transitively joined on key* to the indexed table. Table **A** is transitively joined on key to table **B** if **A** and **B** are joined with equal joins on the unique-key columns of **A**.

Suppose that tables **A**, **B**, and **C** each have **col1** as a primary key. In the following example, **B** is joined on key to **A** and **C** is joined on key to **B**. **C** is transitively joined on key to **A**.

```
CREATE GK INDEX gki
   (SELECT A.col1, A.col2 FROM A, B, C
      WHERE A.col1 = B.col1 AND B.col1 = C.col1)
```

WHERE Clause for Generalized-Key Index:

GK WHERE Clause:



Notes:

1 See "Condition" on page 4-5

2 See "Specifying a Join in the WHERE Clause" on page 2-511

The WHERE clause for a GK index has the following restrictions:

- It cannot include USER, TODAY, CURRENT, or DBINFO built-in functions, nor any function that references a time value or a time-interval value.
- It cannot refer to any SPL routine.
- It cannot include any subquery.
- It cannot include any aggregate function.
- It cannot include any IN, LIKE, or MATCHES expression.

The ONLINE Keyword (IDS)

By default, CREATE INDEX attempts to place an exclusive lock on the indexed table to prevent all other users from accessing the table while the index is being created. The CREATE INDEX statement fails if another user already has a lock on the table, or is currently accessing the table at the Dirty Read isolation level.

The DBA can reduce the risk of non-exclusive access errors, and can increase the availability of the indexed table, by including the ONLINE keyword as the last specification of the CREATE INDEX statement. This instructs the database server to create the *online index* while concurrent users can continue to access the table.

The database server builds the index, even if other users are performing Dirty Read and DML operations on the indexed table, until the new index has been created. Immediately after you issue the CREATE INDEX . . . ONLINE statement, the new index is not visible to the query optimizer for use in query plans or cost estimates, and the database server does not support any other DDL operations on the indexed table, until after the specified index has been built without errors. At this time, the database server briefly locks the table while updating the system catalog with information about the new index.

The indexed table in a CREATE INDEX . . . ONLINE statement can be permanent or temporary, logged or unlogged, and fragmented or non-fragmented. You cannot specify the ONLINE keyword, however, when you create a functional index, a clustered index, a virtual index, or an R-tree index.

The following statement instructs the database server to create a unique online index called **idx_1** on the **lname** column of the **customer** table:

```
CREATE UNIQUE INDEX idx_1 ON customer(lname) ONLINE;
```

If, while this index is being constructed, other users insert into the **customer** table new rows in which **lname** is not unique, the database server issues an error after it has created the new **idx_1** index and registered it in the system catalog.

The term *online index* refers to the locking strategy that the database follows in creating or dropping an index with the ONLINE keyword, rather than to properties of the index that persist after its creation (or its destruction) has completed. This term appears in some error messages, however, and in recovery or restore operations, the database server re-creates as an online index any index that you created as an online index.

No more than one CREATE INDEX . . . ONLINE or DROP INDEX . . . ONLINE statement can concurrently reference online indexes on the same table, or online indexes that have the same identifier.

Related Information

Related statements: ALTER INDEX, CREATE OPCLASS, CREATE TABLE, DROP INDEX, RENAME INDEX, and SET Database Object Mode

For a discussion of the structure of indexes, see your *IBM Informix Administrator's Reference*.

For a discussion of the different types of indexes and information about performance issues with indexes, see your *IBM Informix Performance Guide*.

For a discussion of the GLS aspects of the CREATE INDEX statement, see the *IBM Informix GLS User's Guide*.

For information about operator classes, refer to the CREATE OPCLASS statement and *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

For information about the indexes that DataBlade modules provide, refer to your DataBlade module documentation.

CREATE OPAQUE TYPE

Use the CREATE OPAQUE TYPE statement to create an opaque data type.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──CREATE OPAQUE TYPE──type────────────────────────────────────────────────►

►─(──INTERNALLENGTH── =──┬─length───┬──┬──────────────────────────────────┬─)──────►◄
                         └─VARIABLE─┘  │    ┌─,──────────────────────┐     │
                                       │    ▼                   (1)  │     │
                                       └─,──┤ Opaque-Type Modifier ├─┴─────┘
```

Notes:

1 See "Opaque-Type Modifier" on page 2-137

Element	Description	Restrictions	Syntax
length	Number of bytes needed to store a value of this data type	Positive integer returned when **sizeof( )** directive is applied to the type structure	"Literal Number" on page 4-137
type	Name that you declare here for the new opaque data type	Must be unique among data type names in the database	"Identifier" on page 5-22; "Data Type" on page 4-18

Usage

The CREATE OPAQUE TYPE statement registers a new opaque data type in the **sysxtdtypes** system catalog table.

To create an opaque type, you must have the Resource privilege on the database. When you create the opaque type, only you, the owner, have the Usage privilege on the new opaque data type. You can use the GRANT or REVOKE statements to grant or revoke the Usage privilege of other users of the database.

To view the privileges on a data type, check the **sysxtdtypes** system catalog table for the owner name, and check the **sysxtdtypeauth** system catalog table for additional type privileges that might have been granted.

For details of system catalog tables, see the *IBM Informix Guide to SQL: Reference*.

The DB–Access utility can also display privileges on opaque data types.

Declaring a Name for an Opaque Type

The name that you declare for an opaque data type is an SQL identifier. When you create an opaque type in a database that is not ANSI-compliant, the name must be unique among the names of data types within the database.

When you create an opaque type in an ANSI-compliant database, *owner***.***type* combination must be unique within the database. The owner name is case sensitive. If you do not put quotes around the owner name, the name of the opaque-type *owner* is stored in uppercase letters.

INTERNALLENGTH Modifier

The INTERNALLENGTH modifier specifies the storage size that is required for the opaque data type as fixed length or varying length.

Fixed-Length Opaque Types: A fixed-length opaque type has an internal structure of fixed size. To create a fixed-length opaque type, specify the size of the internal structure, in bytes, for the INTERNALLENGTH modifier. The next example creates a fixed-length opaque type called **fixlen_typ** and allocates 8 bytes for storing this data type.

```
CREATE OPAQUE TYPE fixlen_typ(INTERNALLENGTH=8, CANNOTHASH)
```

Varying-Length Opaque Types: A varying-length opaque type has an internal structure whose size might vary from one value to another. For example, the internal structure of an opaque data type might hold the actual value of a string up to a certain size, but beyond this size it might use an LO-pointer to a CLOB to hold the value.

To create a varying-length opaque data type, use the VARIABLE keyword with the INTERNALLENGTH modifier. The following statement creates a variable-length opaque data type called **varlen_typ**:

```
CREATE OPAQUE TYPE varlen_typ
(INTERNALLENGTH=VARIABLE, MAXLEN=1024)
```

Opaque-Type Modifier

Opaque-Type Modifier:

```
|--+-----------------------+--------------------------------------------|
   +-MAXLEN=length---------+
   +-CANNOTHASH------------+
   +-PASSEDBYVALUE---------+
   '-ALIGNMENT=align_value-'
```

Element	Description	Restrictions	Syntax
align_value	Byte boundary on which to align an opaque type that is passed to a user-defined routine. Default is 4 bytes.	Must be 1, 2, 4, or 8, depending on the C definition of the opaque data type and hardware and compiler used to build the object file for the data type	"Literal Number" on page 4-137
length	Maximum length to allocate for instances of varying-length opaque types. Default is 2 kilobytes.	Must be a positive integer ≤ 32 kilobytes. Do not specify for fixed-length data types. Values that exceed this length return errors.	"Literal Number" on page 4-137

Modifiers can specify the following optional information for opaque types:

- MAXLEN specifies the maximum length for varying-length types.
- CANNOTHASH specifies that the database server cannot use the built-in hash function on the opaque type.
- ALIGNMENT specifies the byte boundary on which the database server aligns the opaque type.
- PASSEDBYVALUE specifies that an opaque type that requires 4 bytes or fewer of storage is passed by value.

By default, opaque types are passed to user-defined routines by reference.

Defining an Opaque Type

To define a new opaque data type to the database server, you must provide the following information in the C or Java language:

- A data structure that serves as the internal storage of the opaque data type

  The internal storage details of the type are hidden, or opaque. Once you define a new opaque data type, the database server can manipulate it without knowledge of the C or Java structure in which it is stored.
- Support functions that allow the database server to interact with this internal structure.

  The support functions tell the database server how to interact with the internal structure of the data type. These support functions must be written in the C or Java programming language.
- Additional user-defined functions that other support functions or end users can invoke to operate on the opaque type (optional)

  Possible support functions include operator functions and cast functions. Before you can use these functions in SQL statements, they must be registered with the appropriate CREATE CAST, CREATE PROCEDURE, or CREATE FUNCTION statement.

The following table summarizes the support functions for an opaque data type.

Function	Description	Invoked
input( )	Converts the opaque type from its external LVARCHAR representation to its internal representation	When a client application sends a character representation of the opaque type in an INSERT, UPDATE, or LOAD statement
output( )	Converts the opaque type from its internal representation to its external LVARCHAR representation	When the database server sends a character representation of the opaque type as a result of a SELECT or FETCH statement
receive( )	Converts the opaque type from its internal representation on the client computer to its internal representation on the server computer Provides platform-independent results regardless of differences between client and server computer types	When a client application sends an internal representation of the opaque type in an INSERT, UPDATE, or LOAD statement
send( )	Converts the opaque type from its internal representation on the server computer to its internal representation on the client computer Provides platform-independent results regardless of differences between client and database server computer types	When the database server sends an internal representation of the opaque type as a result of a SELECT or FETCH statement
db_receive( )	Converts the opaque type from its internal representation on the local database to the **dbsendrecv** type for transfer to an external database on the local server	When a local database receives a **dbsendrecv** type from an external database on the local database server
db_send( )	Converts the opaque type from its internal representation on the local database to the **dbsendrecv** type for transfer to an external database on the local server	When a local database sends a **dbsendrecv** type to an external database on the local database server
server_receive( )	Converts the opaque type from its internal representation on the local server computer to the **srvsendrecv** type for transfer to a remote database server Use any name for this function.	When the local database server receives a **srvsendrecv** type from a remote database server

Function	Description	Invoked
server_send( )	Converts the opaque type from its internal representation on the local server computer to the **srvsendrecv** type for transfer to a remote database server Use any name for this function.	When the local database server sends a **srvsendrecv** type to a remote database server
import( )	Performs any tasks needed to convert from the external (character) representation of an opaque type to the internal format for a bulk copy	When DB–Access (LOAD) or the High Performance Loader (HPL) initiates a bulk copy from a text file to a database
export ( )	Performs any tasks needed to convert from the internal representation of an opaque type to the external (character) format for a bulk copy	When DB–Access (UNLOAD) or the High Performance Loader initiates a bulk copy from a database to a text file
importbinary( )	Performs any tasks needed to convert from the internal representation of an opaque type on the client computer to the internal representation on the server computer for a bulk copy	When DB–Access (LOAD) or the High Performance Loader initiates a bulk copy from a binary file to a database
exportbinary( )	Performs any tasks needed to convert from the internal representation of an opaque type on the server computer to the internal representation on the client computer for a bulk copy	When DB–Access (UNLOAD) or the High Performance Loader initiates a bulk copy from a database to a binary file
assign( )	Performs any processing required before storing the opaque type to disk This support function must be named **assign( )**.	When the database server executes INSERT, UPDATE, or LOAD, before it stores the opaque type to disk
destroy( )	Performs any processing necessary before removing a row that contains the opaque type This support function must be named **destroy( ).**	When the database server executes the DELETE or DROP TABLE, before it removes the opaque type from disk
lohandles( )	Returns a list of the LO-pointer structures (pointers to smart large objects) in an opaque type	When the database server must search opaque types for references to smart large objects; when **oncheck** runs, or an archive is performed
compare( )	Compares two values of the opaque type and returns an integer value to indicate whether the first value is less than, equal to, or greater than the second value	When the database server encounters an ORDER BY, UNIQUE, DISTINCT, or UNION clause in a SELECT statement, or when CREATE INDEX creates a B-tree index

After you write the necessary support functions for the opaque type, use the CREATE FUNCTION statement to register these support functions in the same database as the opaque type. Certain support functions convert other data types to or from the new opaque type. After you create and register these support functions, use the CREATE CAST statement to associate each function with a particular cast. The cast must be registered in the same database as the support function.

After you have written the necessary C language or Java language source code to define an opaque data type, you then use the CREATE OPAQUE TYPE statement to register the opaque data type in the database.

Related Information

Related statements: CREATE CAST, CREATE DISTINCT TYPE, CREATE FUNCTION, CREATE ROW TYPE, CREATE TABLE, and DROP TYPE

For a description of an opaque type, see the *IBM Informix Guide to SQL: Reference*.

For information on how to define an opaque type, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

For information on how to use the Java language to define an opaque type, see the *J/Foundation Developer's Guide*.

For information about the GLS aspects of the CREATE OPAQUE TYPE statement, refer to the *IBM Informix GLS User's Guide*.

CREATE OPCLASS

Use the CREATE OPCLASS statement to create an *operator class* for a *secondary-access method*.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──CREATE OPCLASS──opclass──FOR──sec_acc_method──────────────────────────────►


               ┌─,──────────────────────────────┐
               ▼                                │
►─STRATEGIES──(───┤ Strategy Specification ├──┴──)────────────────────────────►

            ┌─,──────────────────┐
            ▼                    │
►─SUPPORT──(───support_function──┴──)──────────────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
opclass	Name that you declare here for a new operator class	Must be unique among operator classes within the database	"Identifier" on page 5-22
sec_acc_method	Secondary-access method with which the new operator class is associated	Must already exist and must be registered in the **sysams** table	"Identifier" on page 5-22
support_function	Support function that the secondary-access method requires	Must be listed in the order expected by the access method	"Identifier" on page 5-22

Usage

An *operator class* is the set of operators that support a secondary-access method for query optimization and building the index. A *secondary-access method* (sometimes referred to as an *index access method*) is a set of database server functions that build, access, and manipulate an index structure such as a B-tree, R-tree, or an index structure that a DataBlade module provides.

The database server provides the B-tree and R-tree secondary-access methods. For more information on the **btree** secondary-access method, see "Default Operator Classes" on page 2-144.

Define a new operator class when you want one of the following:
- An index to use a different order for the data than the sequence that the default operator class provides
- A set of operators that is different from any existing operator classes that are associated with a particular secondary-access method

You must have the Resource privilege or be the DBA to create an operator class. The actual name of an operator class is an SQL identifier. When you create an operator class, the*opclass* name must be unique within the database.

When you create an operator class in an ANSI-compliant database, the *owner.opclass* combination must be unique within the database. The owner name is case sensitive. If you do not put quotes around the *owner* name (or else set the **ANSIOWNER** environment variable), the name of the operator-class owner is stored in uppercase letters.

The following CREATE OPCLASS statement creates a new operator class called **abs_btree_ops** for the **btree** secondary-access method:

```
CREATE OPCLASS abs_btree_ops FOR btree
   STRATEGIES (abs_lt, abs_lte, abs_eq, abs_gte, abs_gt)
   SUPPORT (abs_cmp)
```

An operator class has two kinds of operator-class functions:

- Strategy functions

  Specify strategy functions of an operator class in the STRATEGY clause of the CREATE OPCLASS statement. In the preceding CREATE OPCLASS code example, the **abs_btree_ops** operator class has five strategy functions.
- Support functions

  Specify support functions of an operator class in the SUPPORT clause. In the preceding CREATE OPCLASS code example, the **abs_btree_ops** operator class has one support function.

STRATEGIES Clause

Strategy functions are functions that users can invoke within a DML statement to operate on a specific data type. The query optimizer uses the strategy functions to determine whether a given index can be used to process a query.

If a query includes a UDF or a column on which an index exists, and if the qualifying operator in the query matches any function in the STRATEGIES clause, then the query optimizer considers using the index for the query. For more information on query plans, see your *IBM Informix Performance Guide*.

When you create a new operator class, the STRATEGIES clause identifies the strategy functions for the secondary-access method. Each strategy specification lists the name of a strategy function (and optionally, the data types of its parameters). You must list these functions in the order that the secondary-access method expects. For the specific order of strategy operators for the default operator classes for a B-tree index and for an R-tree index, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Strategy Specification

The STRATEGIES keyword introduces a comma-separated list of function names or function signatures for the new operator class. Each element of this list is called a *strategy specification* and has the following syntax:

Strategy Specification:

```
├──strategy_function──┬──────────────────────────────────────────────────┬────┤
                      └─(──input_type──,──input_type──┬────────────────┬─)─┘
                                                      └─,──output_type─┘
```

Element	Description	Restrictions	Syntax
input_type	Data type of an input parameter to the strategy function for which you intend to use a specific secondary-access method	A *strategy function* accepts two input parameter and can have one optional output parameter	"Data Type" on page 4-18
output_type	Data type of the optional output parameter of the strategy function	Optional output parameter for side-effect indexes	"Data Type" on page 4-18
strategy_function	Strategy function to associate with the specified operator class	Must be listed in the order that the specified secondary-access method expects	Database "Database Object Name" on page 5-17

Each *strategy_function* is an external function. The CREATE OPCLASS statement does not verify that a user-defined function of the name you specify exists. However, for the secondary-access method to use the strategy function, the external function must be:

- Compiled in a shared library
- Registered in the database with the CREATE FUNCTION statement

Optionally, you can specify the signature of a strategy function in addition to its name. A strategy function requires two input parameters and an optional output parameter. To specify the function signature, specify:

- An *input data type* for each of the two input parameters of the strategy function, in the order that the strategy function uses them
- Optionally, one *output data type* for an output parameter of the strategy function

You can specify UDTs as well as built-in data types. If you do not specify the function signature, the database server assumes that each strategy function takes two arguments of the same data type and returns a BOOLEAN value.

Indexes on Side-Effect Data

Side-effect data are additional values that a strategy function returns after a query that contains the strategy function. For example, an image DataBlade module might use a *fuzzy* index to search image data. The index ranks the images according to how closely they match the search criteria. The database server returns the rank values as side-effect data with the qualifying images.

SUPPORT Clause

Support functions are functions that the secondary-access method uses internally to build and search the index. Specify these functions for the secondary-access method in the SUPPORT clause of the CREATE OPCLASS statement.

You must list the names of the support functions in the order that the secondary-access method expects. For the specific order of support operators for the default operator classes for a B-tree index and an R-tree index, refer to "Default Operator Classes" on page 2-144.

The support function is an external function. CREATE OPCLASS does not verify that a specified support function exists. For the secondary-access method to use a support function, however, the support function must meet these criteria:

- Be compiled in a shared library
- Be registered in the database with the CREATE FUNCTION statement

Default Operator Classes

Each secondary-access method has a default operator class that is associated with it. By default, the CREATE INDEX statement associates the default operator class with an index. For example, the following CREATE INDEX statement creates a B-tree index on the **zipcode** column and automatically associates the default B-tree operator class with this column:

```
CREATE INDEX zip_ix ON customer(zipcode)
```

For each of the secondary-access methods that Dynamic Server provides, it provides a *default operator class*, as follows:

- The default B-tree operator class is a built-in operator class.

  The database server implements the operator-class functions for this operator class and registers it as **btree_ops** in the system catalog tables of a database.
- The default R-tree operator class is a registered operator class.

  The database server registers this operator class as **rtree_ops** in the system catalog tables. The database server does *not* implement the operator-class functions for the default R-tree operator class.

Important: To use an R-tree index, you must install a spatial DataBlade module such as the Geodetic DataBlade module or any other third-party DataBlade module that implements the R-tree index. These implement the R-tree operator-class functions.

DataBlade modules can provide other types of secondary-access methods. If a DataBlade module provides a secondary-access method, it might also provide a default operator class. For more information, refer to your DataBlade module user's guide.

Related Information

Related statements: CREATE FUNCTION, CREATE INDEX, and DROP OPCLASS

For information on support functions and how to create and extend an operator class, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

For more about R-tree indexes, see the *IBM Informix R-Tree Index User's Guide*.

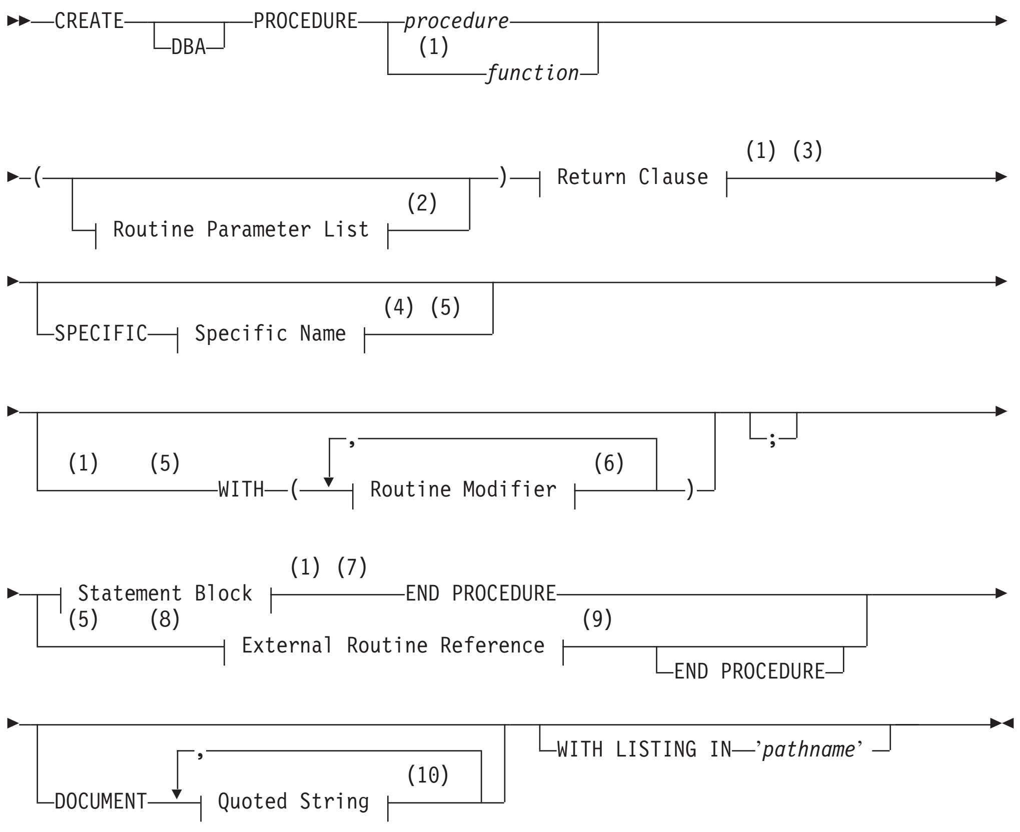
For information about the GLS aspects of the CREATE OPCLASS statement, refer to the *IBM Informix GLS User's Guide*.

CREATE PROCEDURE

Use the CREATE PROCEDURE statement to create a user-defined procedure. (To create a procedure from text of source code that is in a separate file, use the CREATE PROCEDURE FROM statement.)

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 Stored Procedure Language only

2 See "Routine Parameter List" on page 5-61

3 See "Return Clause" on page 5-51

4 See "Specific Name" on page 5-68

5 Dynamic Server only

6 See "Routine Modifier" on page 5-54

7 See "Statement Block" on page 5-69

8 External routines only

9 See "External Routine Reference" on page 5-20

10 See "Quoted String" on page 4-142

Element	Description	Restrictions	Syntax
function, *procedure*	Name declared here for a new SPL procedure or function	(XPS) The name must be unique among all SPL routines in the database. (IDS) See "Procedure Names in Dynamic Server" on page 2-147.	"Database Object Name" on page 5-17
pathname	File to store compile-time warnings	Must exist on the computer where the database resides	Operating system specific

Usage

The entire length of a CREATE PROCEDURE statement must be less than 64 kilobytes. This length is the literal length of the CREATE PROCEDURE statement, including blank spaces, tabs, and other whitespace characters.

In ESQL/C, you can use CREATE PROCEDURE only as text within a PREPARE statement. If you want to create a procedure for which the text is known at compile time, you must use a CREATE PROCEDURE FROM statement.

Routines use the collating order that was in effect when they were created. See SET COLLATION statement of Dynamic Server for information about using non-default collation.

Using CREATE PROCEDURE Versus CREATE FUNCTION

In Extended Parallel Server, besides using this statement to create SPL procedures, you must use CREATE PROCEDURE to write and register an SPL routine that returns one or more values (that is, an SPL function). Extended Parallel Server does not support the CREATE FUNCTION statement.

In Dynamic Server, although you can use CREATE PROCEDURE to write and register an SPL routine that returns one or more values (that is, an SPL function), it is recommended that you use CREATE FUNCTION instead. To register an external function, you must use CREATE FUNCTION.

Use the CREATE PROCEDURE statement to write and register an SPL procedure or to register an external procedure.

For information on how terms such as user-defined procedures and user-defined functions are used in this manual, see "Relationship Between Routines, Functions, and Procedures" on page 2-146.

Relationship Between Routines, Functions, and Procedures

A *procedure* is a routine that can accept arguments but does not return any values. A *function* is a routine that can accept arguments and returns one or more values. *User-defined routine* (UDR*)* is a generic term that includes both user-defined procedures and user-defined functions. For information about named and unnamed returned values, see "Return Clause" on page 5-51.

You can write a UDR in SPL (a SPL *routine*) or in an external language (an *external routine)* that the database server supports. Where the term UDR appears in the manual, it can refer to both SPL routines and external routines.

The term *user-defined procedure* refers to SPL procedures and external procedures. *User-defined function* refers to SPL functions and external functions.

In the documentation of earlier releases, the term *stored procedure* was used for both SPL procedures and SPL functions. In this manual, the term *SPL routine* replaces the term stored procedure. When it is necessary to distinguish between an SPL function and an SPL procedure, this manual does so.

The term *external routine* applies to an external procedure or (for Dynamic Server) an external function, both constructs designating UDRs that are written in a programming language other than SPL. When it is necessary to distinguish between an external function and an external procedure, this manual does so.

Extended Parallel Server does not support external routines, but the term user-defined routine (UDR) encompasses both *SPL routines* and *external routines*. Wherever the term UDR appears, it is applicable to SPL routines.

Privileges Necessary for Using CREATE PROCEDURE

You must have the Resource privilege on a database to create a user-defined procedure within that database.

In Dynamic Server, before you can create an SPL procedure, you must also have the Usage privilege on the SPL language. For more information, see "Usage Privilege in Stored Procedure Language" on page 2-382.

By default, the Usage privilege on SPL is granted to PUBLIC. You must also have at least the Resource privilege on a database to create an SPL procedure within that database.

DBA Keyword and Privileges on the Procedure

If you create a UDR with the DBA keyword, it is known as a *DBA-privileged UDR*. You need the DBA privilege to create or execute a DBA-privileged UDR. If you omit the DBA keyword, the UDR is known as an *owner-privileged* UDR.

If you create an owner-privileged UDR in an ANSI-compliant database, anyone can execute the UDR.

If you create an owner-privileged UDR in a database that is not ANSI compliant, setting the **NODEFDAC** environment variable prevents privileges on that UDR from being granted to PUBLIC. If this environment variable is set, the owner of a UDR must grant the Execute privilege for that UDR to other users.

Procedure Names in Extended Parallel Server

In Extended Parallel Server, the name for any SPL routine that you create must be unique among the names of all SPL routines in the database.

Procedure Names in Dynamic Server

Because Dynamic Server offers *routine overloading*, you can define more than one user-defined routine (UDR) with the same name, but different parameter lists. You might want to overload UDRs in the following situations:

- You create a UDR with the same name as a built-in routine (such as **equal( )**) to process a new user-defined data type.
- You create *type hierarchies* in which subtypes inherit data representation and UDRs from supertypes.
- You create *distinct types*, which are data types that have the same internal storage representation as an existing data type, but have different names and cannot be compared to the source type without casting. Distinct types inherit UDRs from their source types.

For a brief description of the routine signature that uniquely identifies each UDR, see “Routine Overloading and Naming UDRs with a Routine Signature (IDS)” on page 5-19.

Using the SPECIFIC Clause to Specify a Specific Name: You can declare a *specific name* that is unique in the database for a user-defined procedure. A specific name is useful when you are overloading a procedure.

DOCUMENT Clause

The quoted string in the DOCUMENT clause provides a synopsis and description of a UDR. The string is stored in the **sysprocbody** system catalog table and is intended for the user of the UDR.

Anyone with access to the database can query the **sysprocbody** system catalog table to obtain a description of one or all the UDRs stored in the database. A UDR or application program can query the system catalog tables to fetch the DOCUMENT clause and display it for a user.

For example, to find the description of the SPL procedure **raise_prices**, shown in “SPL Procedures” on page 2-148, enter a query such as this example:

```
SELECT data FROM sysprocbody b, sysprocedures p
WHERE b.procid = p.procid
      --join between the two catalog tables
   AND p.procname = 'raise_prices'
      -- look for procedure named raise_prices
   AND b.datakey  = 'D';-- want user document
```

The preceding query returns the following text:

```
USAGE: EXECUTE PROCEDURE raise_prices( xxx )
xxx = percentage from 1 - 100
```

For external procedures, you can use a DOCUMENT clause at the end of the CREATE PROCEDURE statement, whether or not you use the END PROCEDURE keywords.

Using the WITH LISTING IN Option

The WITH LISTING IN clause specifies a filename where compile time warnings are sent. After you compile a UDR, this file holds one or more warning messages. This listing file is created on the computer where the database resides.

If you do not use the WITH LISTING IN clause, the compiler does not generate a list of warnings.

On UNIX, if you specify a filename but not a directory, this listing file is created in your home directory on the computer where the database resides. If you do not have a home directory on this computer, the file is created in the root directory (the directory named “/”).

On Windows, if you specify a filename but not a directory, this listing file is created in your current working directory if the database is on the local computer. Otherwise, the default directory is **%INFORMIXDIR%\bin**.

SPL Procedures

SPL procedures are UDRs written in Stored Procedure Language (SPL) that do not return a value. To write and register an SPL routine, use the CREATE PROCEDURE statement. Embed appropriate SQL and SPL statements between the

CREATE PROCEDURE and END PROCEDURE keywords. You can also follow the UDR definition with the DOCUMENT and WITH FILE IN options.

SPL routines are parsed, optimized (as far as possible), and stored in the system catalog tables in executable format. The body of an SPL routine is stored in the **sysprocbody** system catalog table. Other information about the routine is stored in other system catalog tables, including **sysprocedures**, **sysprocplan**, and **sysprocauth**.

If the Statement Block portion of the CREATE PROCEDURE statement is empty, no operation takes place when you call the procedure. You might use such a ″dummy″ procedure in the development stage when you intend to establish the existence of a procedure but have not yet coded it.

If you specify an optional clause after the parameter list, you must place a semicolon after the clause that immediately precedes the Statement Block.

The following example creates an SPL procedure:

```
CREATE PROCEDURE raise_prices ( per_cent INT )
   UPDATE stock SET unit_price =
      unit_price + (unit_price * (per_cent/100) );
END PROCEDURE
   DOCUMENT "USAGE: EXECUTE PROCEDURE raise_prices( xxx )",
   "xxx = percentage from 1 - 100 "
   WITH LISTING IN '/tmp/warn_file'
```

External Procedures (IDS)

External procedures are procedures you write in an external language that the database server supports.

To create a C user-defined procedure:

1. Write a C function that does not return a value.
2. Compile the C function and store the compiled code in a shared library (the shared-object file for C).
3. Register the C function in the database server with the CREATE PROCEDURE statement.

To create a user-defined procedure written in the Java language:

1. Write a Java static method, which can use the JDBC functions to interact with the database server.
2. Compile the Java source and create a jar file (the shared-object file).
3. Execute the **install_jar( )** procedure with the EXECUTE PROCEDURE statement to install the jar file in the current database.
4. If the UDR uses user-defined types, create a mapping between SQL data types and Java classes, using the **setUDTExtName( )** procedure that is explained in “EXECUTE PROCEDURE” on page 2-336.
5. Register the UDR with the CREATE PROCEDURE statement. (If an external routine returns a value, you must register it with the CREATE FUNCTION statement, rather than CREATE PROCEDURE.)

Rather than storing the body of an external routine directly in the database, the database server stores only the pathname of the shared-object file that contains the compiled version of the routine. The database server executes an external routine by invoking the external object code.

When the IFX_EXTEND_ROLE configuration parameter is set to ON, only users who have the built-in EXTEND role can create external procedures.

Registering a User-Defined Procedure

This example registers a C user-defined procedure named **check_owner( )** that takes one argument of the type LVARCHAR. The external routine reference specifies the path to the C shared library where the procedure object code is stored. This library contains a C function **unix_owner( )**, which is invoked during execution of the **check_owner( )** procedure.

```
CREATE PROCEDURE check_owner ( owner lvarchar )
   EXTERNAL NAME "/usr/lib/ext_lib/genlib.so(unix_owner)"
   LANGUAGE C
END PROCEDURE
```

This example registers a user-defined procedure named **showusers( )** that is written in the Java language:

```
CREATE PROCEDURE showusers()
   WITH (CLASS = "jvp") EXTERNAL NAME 'admin_jar:admin.showusers'
   LANGUAGE JAVA
```

The EXTERNAL NAME clause specifies that the Java implementation of the **showusers( )** procedure is a method called **showusers( )**, which resides in the **admin** Java class that resides in the **admin_jar** jar file.

Ownership of Created Database Objects

The user who creates an owner-privileged UDR owns any database objects that the UDR creates when it executes, unless some other *owner* is specified for the object. In other words, the UDR owner, not the user who executes the owner-privileged UDR, is the owner of any database objects created by the UDR unless another owner is specified in the DDL statement that creates the database object.

In the case of a DBA-privileged UDR, however, the user who executes the UDR, not the UDR owner, owns any database objects that the UDR creates, unless some other owner is specified for the database object within the UDR.

For examples, see "Ownership of Created Database Objects" on page 2-112 in the description of the CREATE FUNCTION statement.

Using sysbdopen( ) and sysdbclose( ) Stored Procedures (XPS)

To set the initial environment for one or more sessions, create and install the **sysdbopen( )** SPL procedure. The primary function of these procedures is to initialize properties of a session without requiring the properties to be explicitly defined within the session. These procedures are executed whenever users connect to a database where the procedures are installed. Such procedures are useful if users access databases through client applications that cannot modify application code or set environment options or environment variables.

You can also create the **sysdbclose( )** SPL procedure which is executed when a user disconnects from the database.

You can include valid SQL or SPL language statements that are appropriate when a database is opened or closed. See the following sections for restrictions on SQL and SPL statements within SPL routines:

- "Subset of SPL Statements Valid in the Statement Block" on page 5-69.
- "SQL Statements Not Valid in an SPL Statement Block" on page 5-70.
- "Restrictions on SPL Routines in Data-Manipulation Statements" on page 5-71.

Important: The **sysdbopen( )** and **sysdbclose( )** procedures are exceptions to the scope rule for stored procedures. In ordinary UDR procedures, the scope of variables and statements is local. SET PDQPRIORITY and SET ENVIRONMENT statement settings do not persist when these SPL procedures exit. In **sysdbopen( )** and **sysdbclose( )** procedures, however, statements that set the session environment remain in effect until another statement resets the options.

For example, you might create the following procedure, which sets the isolation level to Dirty Read and turns on the **IMPLICIT_PDQ** environment variable, to be executed when any user connect to the database:

```
create procedure public.sysdbopen()
   set role engineer;
end procedure;
```

Procedures do not accept arguments or return values. The **sysdbopen( )** and **sysdbclose( )** procedures must be executed from the connection coserver and must be installed in each database where you want to execute them. You can create the following four SPL procedures.

Procedure Name	Description
***user*.sysdbopen( )**	This procedure is executed when the specified ***user*** opens the database as the current database.
public.sysdbopen( )	If no ***user*.sysdbopen( )** procedure applies, this procedure is executed when any user opens the database as the current database. To avoid duplicating SPL code, you can call this procedure from a user-specific procedure.
***user*.sysdbclose( )**	This procedure is executed when the specified ***user*** closes the database, disconnects from the database server, or the user session ends. If the **sysdbclose( )** procedure did not exist when a session opened the database, however, it is not executed when the session closes the database.
public.sysdbclose( )	If no ***user*.sysdbopen( )** procedure applies, this procedure is executed when the specified ***user*** closes the database, disconnects from the database server, or the user session ends. If the **sysdbclose( )** procedure did not exist when a session opened the database, however, it is not executed when the session closes the database.

See also the section “Transactions in SPL Routines” on page 5-72.

Make sure that you set permissions appropriately to allow intended users to execute the SPL procedure statements. For example, if the SPL procedure executes a command that writes output to a local directory, permissions must be set to allow users to write to this directory. If you want the procedure to continue if permission failures occur, include an ON EXCEPTION error handler for this condition.

See also the section “Support for Roles and User Identity” on page 5-72.

Warning: If a **sysdbopen( )** procedure fails, the database cannot be opened. If a **sysdbclose( )** procedure fails, the failure is ignored. While you are writing and debugging a **sysdbopen( )** procedure, set the **DEBUG** environment variable to NODBPROC before you connect to the database. When **DEBUG** is set to NODBPROC, the procedure is not executed, and failures cannot prevent the database from opening. Failures from these procedures can be generated by the system or simulated by the procedures with the RAISE EXCEPTION statement of SPL. For more information, refer to the description of RAISE EXCEPTION in Chapter 3.

Only a user with DBA privileges can install these procedures. For security reasons, non-DBAs cannot prevent execution of these procedures. For some applications, however, such as *ad hoc* query applications, users can execute commands and SQL statements that subsequently change the environment.

For general information about how to write and install SPL procedures, refer to the chapter about SPL routines in *IBM Informix Guide to SQL: Tutorial*.

Related Information

Related statements: ALTER FUNCTION, ALTER PROCEDURE, ALTER ROUTINE, CREATE FUNCTION, CREATE FUNCTION FROM, CREATE PROCEDURE FROM, DROP FUNCTION, DROP PROCEDURE, DROP ROUTINE, EXECUTE FUNCTION, EXECUTE PROCEDURE, GRANT, PREPARE, REVOKE, and UPDATE STATISTICS.

For a discussion of how to create and use SPL routines, see the *IBM Informix Guide to SQL: Tutorial*. For a discussion of external routines, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

For information about how to create C UDRs, see the *IBM Informix DataBlade API Programmer's Guide*. For more information on the **NODEFDAC** environment variable and the related system catalog tables (**sysprocedures**, **sysprocplan**, **sysprocbody** and **sysprocauth**), see the *IBM Informix Guide to SQL: Reference*.

CREATE PROCEDURE FROM

Use the CREATE PROCEDURE FROM statement to access a user-defined procedure. The actual text of the CREATE PROCEDURE statement resides in a separate file.

This statement is an extension to the ANSI/ISO standard for SQL. You can use this statement with ESQL/C.

In Extended Parallel Server, which does not support the CREATE FUNCTION FROM statement, you can use the CREATE PROCEDURE FROM statement to create a SPL routine from a file, whether or not the SPL routine returns a value.

Syntax

```
►►──CREATE PROCEDURE FROM──┬─'file'───┬──────────────────────────────────────►◄
                           └─file_var─┘
```

Element	Description	Restrictions	Syntax
file	Pathname and filename of file that contains full text of a CREATE PROCEDURE statement. Default pathname is the current directory.	Must exist, and can contain only one CREATE PROCEDURE statement. See also "Default Directory That Holds the File" on page 2-154.	Operating-system specific
file_var	Name of a program variable that contains *file* specification	Must be of a character data type; its contents have same restrictions as *file*	Language specific

Usage

You cannot create a user-defined procedure directly in an ESQL/C program. That is, the program cannot contain the CREATE PROCEDURE statement.

To use a user-defined procedure in an ESQL/C program:

1. Create a source file with the CREATE PROCEDURE statement.
2. Use the CREATE PROCEDURE FROM statement to send the contents of this source file to the database server for execution.

   The file can contain only one CREATE PROCEDURE statement.

For example, suppose that the following CREATE PROCEDURE statement is in a separate file, called **raise_pr.sql**:

```
CREATE PROCEDURE raise_prices( per_cent int )
   UPDATE stock -- increase by percentage;
   SET unit_price = unit_price +
      ( unit_price * (per_cent / 100) );
END PROCEDURE;
```

In the ESQL/C program, you can access the **raise_prices( )** SPL procedure with the following CREATE PROCEDURE FROM statement:

```
EXEC SQL create procedure from 'raise_pr.sql';
```

In Dynamic Server, if you are not sure whether the UDR in the file returns a value, use the CREATE ROUTINE FROM statement.

When the IFX_EXTEND_ROLE configuration parameter is set to ON, only users who have the built-in EXTEND role can create external routines.

User-defined procedures, like user-defined functions, use the collating order that was in effect when they were created. See SET COLLATION for information about using non-default collation.

Default Directory That Holds the File

The database server treats the specified filename (and any pathname) as relative.

On UNIX, if you specify a simple filename instead of a full pathname as the *file* parameter, the client application looks for the file in your home directory on the computer where the database resides. If you do not have a home directory on this computer, the default directory is the root directory.

On Windows, if you specify a filename but no directory as the *file* parameter, the client application looks for the file in your current working directory if the database is on the local computer. Otherwise, the default directory is **%INFORMIXDIR%\bin**.

Important: The ESQL/C preprocessor does not process the contents of the file that you specify. It only sends the contents to the database server for execution. Therefore, there is no syntactic check that the file that you specify in CREATE PROCEDURE FROM actually contains a CREATE PROCEDURE statement. To improve readability of the code, however, it is recommended that you match these two statements.

Related Information

Related statements: CREATE PROCEDURE, CREATE FUNCTION FROM, and CREATE ROUTINE FROM

CREATE ROLE

Use the CREATE ROLE statement to declare and register a new role.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──CREATE ROLE──┬─role───┬──────────────────────────────────────────────►◄
                 └─'role'─┘
```

Element	Description	Restrictions	Syntax
role	Name declared here for a role that the DBA creates	Must be unique among *role* and user names in the database. Maximum number of bytes is 32.	"Owner Name" on page 5-43

Usage

CREATE ROLE declares a new role and registers it in the system catalog. A role can associate a set of authorization identifiers with a set of access privileges on database objects. The system catalog maintains information about the roles (and their corresponding privileges) that are granted to users or to other roles.

Only the database administrator (DBA) can use CREATE ROLE to create a new role. The DBA can assign the privileges required for some work task to a role, such as **engineer**, and then use the GRANT statement to assign that role to specific users, instead of granting that set of privileges to each user individually.

The *role* name is an *authorization identifier*. It cannot be a user name that is known to the database server or to the operating system of the database server. The *role* name cannot already be listed in the **username** column of the **sysusers** system catalog table, nor in the **grantor** or **grantee** columns of the **systabauth**, **syscolauth**, **sysfragauth**, **sysprocauth**, or **sysroleauth** system catalog tables.

In Dynamic Server, the *role* name also cannot match the name of any user or role that is already listed in the **grantor** or **grantee** columns of the **sysxtdtypeauth** system catalog table, nor any built-in role, such as EXTEND or NONE.

After a role is created, the DBA can use the GRANT statement to assign the role to PUBLIC, to users, or to other roles, and to grant specific privileges to the role. (A role cannot, however, hold database-level privileges.) After a role is granted successfully to a user or to PUBLIC, the user must use the SET ROLE statement to enable the role. Only then can the user exercise the privileges of the role.

To create the role **engineer**, for example, enter the following statement:

```
CREATE ROLE engineer
```

To grant access privileges to the role **engineer**, the DBA can issue GRANT statements that include **engineer** in the list of grantees:

```
GRANT USAGE ON LANGUAGE SPL TO engineer
```

To assign the role **engineer** to user **kaycee**, the DBA could issue this statement:

```
GRANT ROLE engineer TO kaycee
```

To activate the role **engineer**, user **kaycee** must issue the following statement:

```
SET ROLE engineer
```

If this SET ROLE statement is successful, user **kaycee** acquires whatever privileges have been granted to the role **engineer**, in addition to any other privileges that **kaycee** already holds as an individual or as PUBLIC.

A user can be granted several roles, but no more than one non-default role, as specified by SET ROLE, can be enabled for any user at a given time.

An exception to requiring SET ROLE to explicitly enable a role is any default role that the DBA specifies in the GRANT DEFAULT ROLE *role* TO *user* statement. If that statement succeeds, the default *role* is automatically enabled when *user* connects to the database. Any role can be a default role. (Similarly, users to whom the Dynamic Server DBSA grants the EXTEND role need not execute SET ROLE before they can create and drop external routines and shared libraries.)

CREATE ROLE, when used with the GRANT and SET ROLE statements, enables a DBA to create one set of privileges for a role and then grant the role to many users, instead of granting the same set of privileges individually to many users.

With the GRANT DEFAULT ROLE and SET ROLE DEFAULT statements, *default roles* enable a DBA to assign privileges to a role that is activated automatically when any user who holds that default role connects to the database. This feature is useful when an application performs operations that require specific access privileges, but the application does not include SET ROLE statements.

The REVOKE statement can cancel access privileges of a role, remove users from a role, or cancel the default status of a role for one or more users. A role exists until either the DBA or a user to whom the role was granted with the WITH GRANT OPTION keywords uses the DROP ROLE statement to drop the role.

Related Information

Related statements: DROP ROLE, GRANT, REVOKE, and SET ROLE

For a discussion of how to use roles, see the *IBM Informix Database Design and Implementation Guide*.

CREATE ROUTINE FROM

Use the CREATE ROUTINE FROM statement to register a UDR by referencing the text of a CREATE FUNCTION or CREATE PROCEDURE statement that resides in a separate file. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. You can use this statement with ESQL/C.

Syntax

```
►►──CREATE ROUTINE FROM──┬─'file'───┬──────────────────────────────────────►◄
                         └─file_var─┘
```

Element	Description	Restrictions	Syntax
file	Pathname and filename for the text of a CREATE PROCEDURE or CREATE FUNCTION statement. Default path is the current directory.	Must exist and can contain only one CREATE FUNCTION or CREATE PROCEDURE statement.	Operating-system dependent
file_var	Name of a program variable that contains *file* specification	Must be a character data type; contents must satisfy *file* restrictions	Language specific

Usage

ESQL/C programs cannot use the CREATE FUNCTION or CREATE PROCEDURE statement directly to define a UDR. You must instead do this:

1. Create a source file with the CREATE FUNCTION or CREATE PROCEDURE statement.
2. Execute the CREATE ROUTINE FROM statement from an ESQL/C program to send the contents of this source file to the database server for execution. The file that you specify can contain only one CREATE FUNCTION or CREATE PROCEDURE statement.

The file specification that you provide is relative. If you include no pathname, the client application looks for the file in the current directory.

If you do not know at compile time whether the UDR in the file is a function or a procedure, use the CREATE ROUTINE FROM statement in the ESQL/C program. If you know whether the UDR is a function or a procedure, you can improve the readability of your code by using the matching SQL statement to access the source file:

- To access user-defined functions, use CREATE FUNCTION FROM.
- To access user-defined procedures, use CREATE PROCEDURE FROM.

When the IFX_EXTEND_ROLE configuration parameter is set to ON, only users to whom the Database System Administrator (DBSA) has granted the built-in EXTEND role can create external routines.

Routines use the collating order that was in effect when they were created. See SET COLLATION for information about using non-default collation.

Related Information

Related statements: CREATE FUNCTION, CREATE FUNCTION FROM, CREATE PROCEDURE, and CREATE PROCEDURE FROM

CREATE ROW TYPE

Use the CREATE ROW TYPE statement to create a named ROW type.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>--CREATE ROW TYPE--row_type----------------------------------------------------->

>--+-----------------------------------------+--+--------------------+-----------><
   |                      (1)                |  '-UNDER--supertype--'
   '-(--| Field Definition |---------)--------'
```

Notes:

1 See “Field Definition” on page 2-160

Element	Description	Restrictions	Syntax
row_type	Name that you declare here for a new named ROW data type	See “Procedure for Creating a Subtype” on page 2-160.	“Identifier” on page 5-22
supertype	Name of the supertype within a data type inheritance hierarchy	Must already exist in the database as a named ROW type	“Data Type” on page 4-18

Usage

The CREATE ROW TYPE statement declares a named ROW data type and registers it in the system catalog. You can assign a named ROW data type to a table or view to create a *typed table* or *typed view*. You can also define a column as a named ROW type. Although you can assign a ROW type to a table to define the schema of the table, ROW data types are not the same as table rows. Table rows consist of one or more *columns*; ROW data types consist of one or more *fields*, defined using the Field Definition syntax.

A named ROW data type is valid in most contexts where you can specify a data type. Named ROW types are said to be *strongly typed.* No two named ROW types are equivalent, even if they are structurally equivalent.

ROW types without identifiers are called *unnamed ROW types*. Any two unnamed ROW types are considered equivalent if they are structurally equivalent. For more information, see “ROW Data Types” on page 4-29.

Privileges on named ROW type columns are the same as privileges on any column. For more information, see “Table-Level Privileges” on page 2-374. (To see what privileges you have on a column, check the **syscolauth** system catalog table, which is described in the *IBM Informix Guide to SQL: Reference*.)

Privileges on Named Row Data Types

Privileges for operations on a typed table (a table that is assigned a named ROW data type) are the same as privileges on any table. For more information, see “Table-Level Privileges” on page 2-374. This table shows which access privileges you need to create a named ROW type.

Task	Privileges Required
Create a named ROW type	Resource privilege on the database
Create a named ROW type as a subtype under a supertype	Under privilege on the supertype, as well as the Resource privilege

For information about Resource and Under privileges and the ALL keyword in the context of privileges, see the GRANT statement.

To find out what privileges exist on a ROW type, check the **sysxtdtypes** system catalog table for the *owner* name and the **sysxtdtypeauth** system catalog table for privileges on the ROW type that might have been granted to users or to roles.

To find out what privileges you have on a given table, check the **systabauth** system catalog table. For more information on system catalog tables, see the *IBM Informix Guide to SQL: Reference*.

Inheritance and Named ROW Types

A named ROW type can belong to an inheritance hierarchy, as either a subtype or a supertype. Use the UNDER clause in the CREATE ROW TYPE statement to create a named ROW data type as a subtype of an existing ROW data type.

The supertype must also be a named ROW data type. If you create a named ROW data type under an existing supertype, then the new type name *row_type* becomes the name of the subtype.

When you create a named ROW type as a subtype, the subtype inherits all fields of the supertype. In addition, you can add new fields to the subtype when you create it. The new fields are specific to the subtype alone.

You cannot substitute a ROW type in an inheritance hierarchy for its supertype or for its subtype. For example, consider a type hierarchy in which **person_t** is the supertype and **employee_t** is the subtype. If a column is of type **person_t**, the column can only contain **person_t** data. It cannot contain **employee_t** data. Likewise, if a column is of type **employee_t**, the column can only contain **employee_t** data. It cannot contain **person_t** data.

Creating a Subtype

In most cases, you add new fields when you create a named ROW type as a subtype of another named ROW type (its supertype). To create the fields of a named ROW type, use the field definition clause, as described in "Field Definition" on page 2-160. When you create a subtype, you must use the UNDER keyword to associate the supertype with the named ROW type that you want to create. The next example creates the **employee_t** type under the **person_t** type:

```
CREATE ROW TYPE employee_t (salary NUMERIC(10,2),
   bonus NUMERIC(10,2)) UNDER person_t;
```

The **employee_t** type inherits all the fields of **person_t** and has two additional fields: **salary** and **bonus**; but the **person_t** type is not altered.

Type Hierarchies

When you create a subtype, you create a *type hierarchy*. In a type hierarchy, each subtype that you create inherits its properties from a single supertype. If you create a named ROW type **customer_t** under **person_t**, **customer_t** inherits all the fields of **person_t**. If you create another named ROW type, **salesrep_t** under **customer_t**, **salesrep_t** inherits all the fields of **customer_t**.

Thus, **salesrep_t** inherits all the fields that **customer_t** inherited from **person_t** as well as all the fields defined specifically for **customer_t**. For a discussion of type inheritance, refer to the *IBM Informix Guide to SQL: Tutorial*.

Procedure for Creating a Subtype

Before you create a named ROW type as a subtype in an inheritance hierarchy, check the following information:

- Verify that you are authorized to create new data types. You must have the Resource privilege on the database. You can find this information in the **sysusers** system catalog table.
- Verify that the supertype exists. You can find this information in the **sysxtdtypes** system catalog table.
- Verify that you are authorized to create subtypes to that supertype. You must have the Under privilege on the supertype. You can find this information in the **sysusers** system catalog table.
- Verify that the name that you declare for the named ROW type is unique. In an ANSI-compliant database, the *owner.type* combination must be unique within the database. In a database that is not ANSI-compliant, the name must be unique among data type names in the database. To verify whether the name for a new data type is unique, check the **sysxtdtypes** system catalog table. The name must not be the name of an existing data type.
- If you are defining fields for the ROW type, check that no duplicate field names exist in both new and inherited fields.

Important: When you create a subtype, you cannot redefine fields that it inherited for its supertype. If you attempt to redefine these fields, the database server returns an error.

You cannot apply constraints to named ROW data types, but you can specify constraints when you create or alter a table that uses the named ROW types. You can also specify NOT NULL constraints on individual fields of a ROW type.

Field Definition

Use the Field Definition clause to define a new field in a named ROW type.

Field Definition:

```
|--field--data_type--+----------+-----------------------------------------|
                     '-NOT NULL-'
```

Element	Description	Restrictions	Syntax
data_type	Data type of the field	See "Restrictions on Serial and Simple-Large-Object Data Types" on page 2-161.	"Identifier" on page 5-22
field	Name of a field in *row_type*	Must be unique among field names of this ROW type and of its supertype	"Identifier" on page 5-22

The NOT NULL constraint on the named ROW type field applies to the corresponding columns when a typed table of the named ROW type is created.

Restrictions on Serial and Simple-Large-Object Data Types

Serial and simple-large-object data types cannot be nested within a table. Therefore, if a ROW type contains a BYTE, TEXT, SERIAL, or SERIAL8 field, you cannot use the ROW type to define a column in a table that is not based on a ROW type. For example, the following code example produces an error:

```
CREATE ROW TYPE serialtype (s serial, s8 serial8);
CREATE TABLE tab1 (col1 serialtype) --INVALID CODE
```

You cannot create a ROW type that has a BYTE or TEXT value that is stored in a separate storage space. That is, you cannot use the IN clause to specify the storage location. For example, the following example produces an error:

```
CREATE ROW TYPE row1 (field1 byte IN blobspace1) --INVALID CODE
```

A table hierarchy can include no more than one SERIAL and no more than one SERIAL8 column. If a supertable has a SERIAL column, none of its subtables can contain a SERIAL column (but a subtable can have a SERIAL8 column if no other subtable contains a SERIAL8 column). Consequently, when you create the named ROW types on which the table hierarchy is to be based, they can contain at most one SERIAL field and one SERIAL8 field among them.

You cannot set the starting SERIAL or SERIAL8 value in the CREATE ROW TYPE statement. To modify the value for a serial field, you must use either the MODIFY clause of the ALTER TABLE statement, or else use the INSERT statement to insert a value that is larger than the current maximum (or default) serial value.

Serial fields in ROW types have performance implications across a table hierarchy. To insert data into a subtable whose supertable (or its supertable) contains the serial counter, the database server must also open the supertable, update the serial value, and close the supertable, thus adding extra overhead.

3 In contexts where these restrictions or performance issues for SERIAL and
3 SERIAL8 data types conflict with your design goals, you might consider using
3 sequence objects to emulate the functionality of serial fields or serial columns.

Related Information

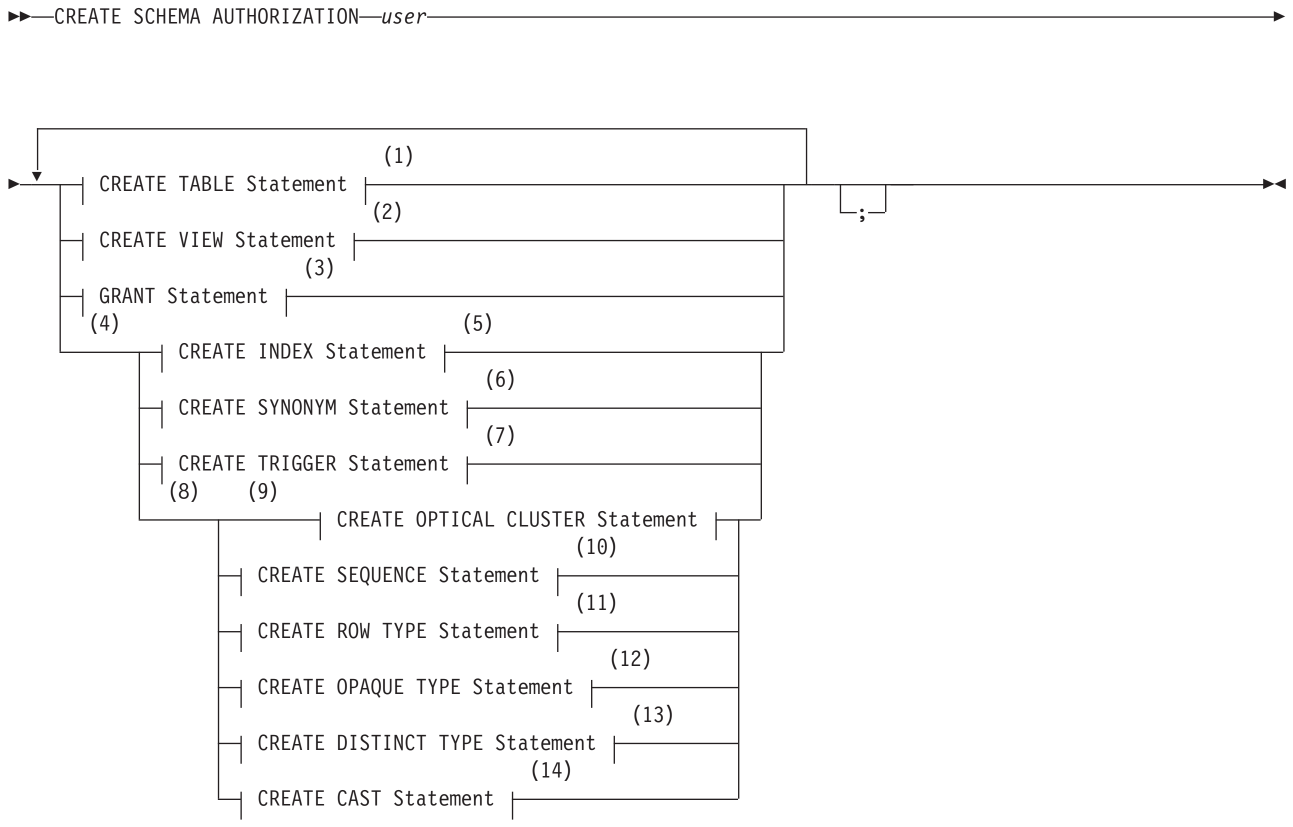
Related statements: DROP ROW TYPE, CREATE TABLE, CREATE CAST, GRANT, and REVOKE

For a discussion of named ROW types, see the *IBM Informix Database Design and Implementation Guide* and the *IBM Informix Guide to SQL: Reference*.

CREATE SCHEMA

Use the CREATE SCHEMA statement to issue a block of data definition language (DDL) and GRANT statements as a unit. Use this statement with DB–Access.

Syntax


CREATE SCHEMA AUTHORIZATION
user
CREATE TABLE Statement (1)
CREATE VIEW Statement (2)
GRANT Statement (3)
(4)
CREATE INDEX Statement (5)
CREATE SYNONYM Statement (6)
CREATE TRIGGER Statement (7)
(8) (9)
CREATE OPTICAL CLUSTER Statement
CREATE SEQUENCE Statement (10)
CREATE ROW TYPE Statement (11)
CREATE OPAQUE TYPE Statement (12)
CREATE DISTINCT TYPE Statement (13)
CREATE CAST Statement (14)
;

Notes:

1 See "CREATE TABLE" on page 2-171

2 See "CREATE VIEW" on page 2-247

3 See "GRANT" on page 2-371

4 Informix extension

5 See "CREATE INDEX" on page 2-116

6 See "CREATE SYNONYM" on page 2-168

7 See "CREATE TRIGGER" on page 2-216

8 Dynamic Server only

9 Optical Subsystem only. See the *IBM Informix: Optical Subsystem Guide.*

10 See "CREATE SEQUENCE" on page 2-165

11 See "CREATE ROW TYPE" on page 2-158

12 See "CREATE OPAQUE TYPE" on page 2-136

13 See "CREATE DISTINCT TYPE" on page 2-93

14 See “CREATE CAST” on page 2-87

Element	Description	Restrictions	Syntax
user	User who owns the database objects that this statement creates	If you have DBA privileges, you can specify the name of any user. Otherwise, you must have the Resource privilege, and you must specify your own user name.	“Owner Name” on page 5-43

Usage

The CREATE SCHEMA statement allows the DBA to specify an owner for all database objects that the CREATE SCHEMA statement creates. You cannot issue CREATE SCHEMA until you have created the database that stores the objects.

Users with the Resource privilege can create a schema for themselves. In this case, *user* must be the name of the person with the Resource privilege who is running the CREATE SCHEMA statement. Anyone with the DBA privilege can also create a schema for someone else. In this case, *user* can specify a user other than the person who is running the CREATE SCHEMA statement.

You can put CREATE and GRANT statements in any logical order, as the following example shows. Statements are considered part of the CREATE SCHEMA statement until a semicolon (;) or an end-of-file symbol is reached.

```
CREATE SCHEMA AUTHORIZATION sarah
   CREATE TABLE mytable (mytime DATE, mytext TEXT)
   GRANT SELECT, UPDATE, DELETE ON mytable TO rick
   CREATE VIEW myview AS
      SELECT * FROM mytable WHERE mytime > '12/31/2004'
   CREATE INDEX idxtime ON mytable (mytime);
```

Creating Database Objects Within CREATE SCHEMA

All database objects that a CREATE SCHEMA statement creates are owned by *user*, even if you do not explicitly name each database object. If you are the DBA, you can create database objects for another user. If you are not the DBA, specifying an owner other than yourself results in an error message.

You can only grant privileges with the CREATE SCHEMA statement; you cannot use CREATE SCHEMA to revoke or to drop privileges.

If you create a database object or use the GRANT statement outside a CREATE SCHEMA statement, you receive warnings if you use the **-ansi** flag or set **DBANSIWARN**.

Related Information

Related statements: CREATE CAST, CREATE DISTINCT TYPE, CREATE INDEX, CREATE OPAQUE TYPE, CREATE OPCLASS, CREATE ROW TYPE, CREATE SEQUENCE, CREATE SYNONYM, CREATE TABLE, CREATE VIEW, and GRANT

For a discussion of how to create a database, see the *IBM Informix Database Design and Implementation Guide*.

CREATE SCRATCH TABLE

Use the CREATE SCRATCH TABLE statement to create a non-logging temporary table in the current database. Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>--CREATE--SCRATCH--TABLE--table--| Scratch Table Definition |------------------------------------><
```

Scratch Table Definition:

```
      .-,----------------------------.
      V                       (1)    |
|--(----| Column Definition |--------+-----------------------------------------------------+--)--------->
                                     |          .-,-----------------------------------.    |
                                     |          V                               (2)   |    |
                                     '-,--+-----| Multiple-Column Constraint Format |-+----'
                                               |                              (1)       |
                                               '-| Column Definition |------------------'

>--+--------------------------+---------------------------------------------------------------------|
   '-| Scratch Table Options |-'
```

Scratch Table Options:

```
|--+--------------------------------------+--+-----------------------------+------------------------|
   '-IN--+-dbslice----------------------+-'  '-LOCK MODE--+-PAGE--+-------'
         +-dbspace----------------------+                 +-ROW---+
         |                         (3)  |                 '-TABLE-'
         '-| FRAGMENT BY Clause |-------'
```

Notes:

1 See "Column Definition" on page 2-173

2 See "Multiple-Column Constraint Format" on page 2-211

3 See "FRAGMENT BY Clause" on page 2-190

Element	Description	Restrictions	Syntax
dbslice	Name of dbslice to store *table*	Must already exist	"Identifier" on page 5-22
dbspace	Name of dbspace to store *table*. Default is the dbspace that stores the current database.	Must already exist	"Identifier" on page 5-22
table	Name that you declare here for a nonlogging temporary table	Must be unique in the current session	"Database Object Name" on page 5-17

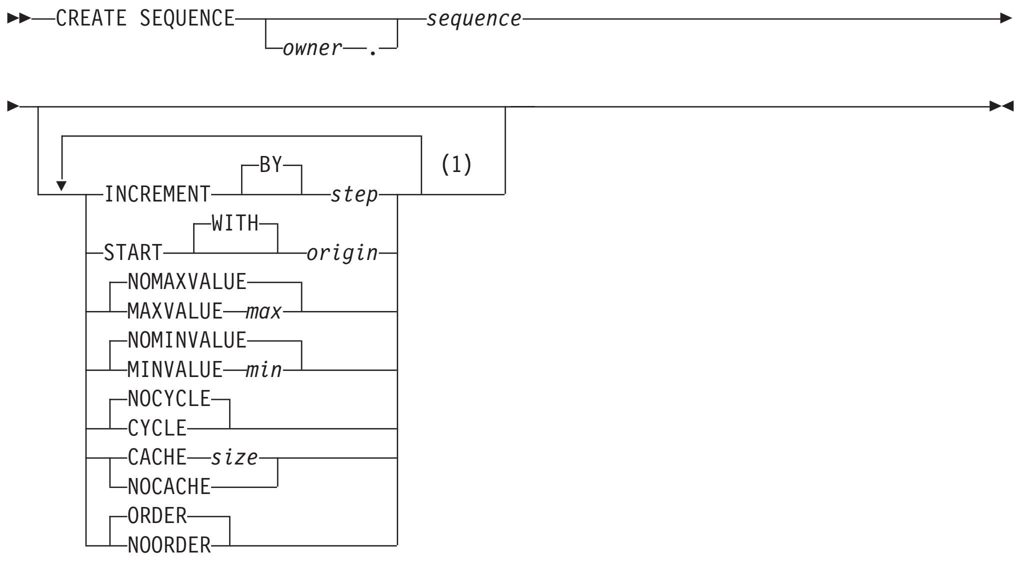
Usage

The CREATE SCRATCH TABLE statement is a special case of the CREATE Temporary TABLE statement. For the complete syntax and semantics of the CREATE SCRATCH TABLE statement, see "CREATE Temporary TABLE" on page 2-209.

CREATE SEQUENCE

Use the CREATE SEQUENCE statement to create a sequence database object from which multiple users can generate unique integers. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 Each keyword option can appear no more than once.

Element	Description	Restrictions	Syntax
max	Upper limit of values	Must be an integer > *origin*	"Literal Number" on page 4-137
min	Lower limit of values	Must be an integer less than *origin*	"Literal Number" on page 4-137
origin	First number in the sequence	Must be an integer in INT8 range	"Literal Number" on page 4-137
owner	Owner of *sequence*	Must be an authorization identifier	"Owner Name" on page 5-43
sequence	Name that you declare here for the new sequence	Must be unique among sequence, table, view, and synonym names	"Identifier" on page 5-22
size	Number of values that are preallocated in memory	Integer > 1, but < cardinality of a cycle (= |(*max* - *min*)/*step*|)	"Literal Number" on page 4-137
step	Interval between successive values	Nonzero integer in INT range	"Literal Number" on page 4-137

Usage

A sequence (sometimes called a *sequence generator* or *sequence object*) returns a monotonically ascending or descending series of unique integers, one at a time. The CREATE SEQUENCE statement defines a new sequence object, declares its identifier, and registers it in the **syssequences** system catalog table.

Authorized users of a sequence can request a new value by including the *sequence*.**NEXTVAL** expression in DML statements. The *sequence*.**CURRVAL** expression returns the current value of the specified *sequence*. **NEXTVAL** and **CURRVAL** expressions are valid only within SELECT, DELETE, INSERT, and UPDATE statements; Dynamic Server returns an error if you attempt to invoke the built-in **NEXTVAL** or **CURRVAL** functions in any other context.

Generated values logically resemble the SERIAL8 data type, but can be negative, and are unique within the sequence. Because the database server generates the values, sequences support a much higher level of concurrency than a serial column can. The values are independent of transactions; a generated value cannot be rolled back, even if the transaction in which it was generated fails.

You can use a sequence to generate primary key values automatically, using one sequence for many tables, or each table can have its own sequence.

CREATE SEQUENCE can specify the following characteristics of a sequence:

- Initial value
- Size and sign of the increment between values.
- Maximum and minimum values
- Whether the sequence recycles values after reaching its limit
- How many values are preallocated in memory for rapid access

A database can support multiple sequences concurrently, but the name of a sequence (or in an ANSI-compliant database, the *owner*.*sequence* combination) must be unique within the current database among the names of tables, temporary tables, views, synonyms, and sequences.

An error occurs if you include contradictory options, such as specifying both the MINVALUE and NOMINVALUE options, or both CACHE and NOCACHE.

INCREMENT BY Option

Use the INCREMENT BY option to specify the interval between successive numbers in the sequence. The BY keyword is optional. The interval, or *step* value, can be a positive whole number (for an *ascending* sequence) or a negative whole number (for a *descending* sequence) in the INT8 range. If you do not specify any *step* value, the default interval between successive generated values is 1, and the sequence is an ascending sequence.

START WITH Option

Use the START WITH option to specify the first number of the sequence. This *origin* value must be an integer within the INT8 range that is greater than or equal to the *min* value (for an ascending sequence) or that is less than or equal to the *max* value (for a descending sequence), if *min* or *max* is specified in the CREATE SEQUENCE statement. The WITH keyword is optional.

If you do not specify an *origin* value, the default initial value is *min* for an ascending sequence or *max* for a descending sequence. (The MAXVALUE or NOMAXVALUE Option and MINVALUE or NOMINVALUE Option sections that follow describe the *max* and *min* specifications respectively.)

MAXVALUE or NOMAXVALUE Option

Use the MAXVALUE option to specify the upper limit of values in a sequence. The maximum value, or *max*, must be an integer in the INT8 range that is greater than the value of the *origin*.

If you do not specify a *max* value, the default is NOMAXVALUE. This default setting supports values that are less than or equal to `2e64` for ascending sequences, or less than or equal to `-1` for descending sequences.

MINVALUE or NOMINVALUE Option

Use the MINVALUE option to specify the lower limit of values, or *min*. This integer must be in the INT8 range and be less than the value of*origin*.

If you do not specify a *min* value, the default is NOMINVALUE. This default setting supports values that are greater than or equal to `1` for ascending sequences, or greater than or equal to `-(2e64)` for descending sequences.

CYCLE or NOCYCLE Option

Use the CYCLE option to continue generating sequence values after the sequence reaches the maximum (ascending) or minimum (descending) limit. After an ascending sequence reaches the *max* value, it generates the *min* value for the next sequence value. After a descending sequence reaches the *min* value, it generates the *max* value for the next sequence value.

The default is NOCYCLE. At this default setting, the sequence cannot generate more values after reaching the declared limit. Once the sequence reaches the limit, the next reference to *sequence*.**NEXTVAL** returns an error.

CACHE or NOCACHE Option

Use the CACHE option to specify the number of sequence values that are preallocated in memory for rapid access. This feature can enhance the performance of a heavily used sequence. The cache *size* must be a positive whole number in the INT range. If you specify the CYCLE option, then *size* must be less than the number of values in a cycle (or less than `|`(*max* - *min*)/*step*`|`). The minimum is `2` preallocated values. The default is `20` preallocated values.

The NOCACHE keyword specifies that no generated values (that is, zero) are preallocated in memory for this sequence object.

The configuration parameter SEQ_CACHE_SIZE specifies the maximum number of sequence objects that can have preallocated values in the sequence cache. If this configuration parameter is not set, then by default no more than 10 different sequence objects can be defined with the CACHE option.

ORDER or NOORDER Option

These keywords have no effect on the behavior of the sequence. The sequence always issues values to users in the order of their requests, as if the ORDER keyword were always specified. The ORDER and NOORDER keywords are accepted by the CREATE SEQUENCE statement for compatibility with implementations of sequence objects in other dialects of SQL.

Related Information

Related statements: ALTER SEQUENCE, DROP SEQUENCE, RENAME SEQUENCE, CREATE SYNONYM, DROP SYNONYM, GRANT, and REVOKE

For information about the **syssequences** system catalog table in which sequence objects are registered, see the *IBM Informix Guide to SQL: Reference*.

For information about initializing a sequence and generating or reading values from a sequence, see "NEXTVAL and CURRVAL Operators (IDS)" on page 4-61.

CREATE SYNONYM

Use the CREATE SYNONYM statement to declare and register an alternative name for an existing table, view, or sequence object.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
             ┌─PUBLIC──┐
►►──CREATE───┤         ├──SYNONYM──synonym──FOR──┬─table─────────┬─────────────►◄
             └─PRIVATE─┘                         ├─view──────────┤
                                                 │ (1)           │
                                                 └───────sequence┘
```

Notes:

1 Dynamic Server only

Element	Description	Restrictions	Syntax
sequence	Name of a local sequence	Must exist in the current database	"Identifier" on page 5-22
table, view	Name of table or view for which *synonym* is being created	Must exist in the current database, or in a database specified in a qualifier	"Database Object Name" on page 5-17
synonym	Synonym declared here for the name of a table, view, or sequence	Must be unique among table object names; see also Usage notes	"Database Object Name" on page 5-17

Usage

Users have the same privileges for a synonym that they have for the database object that the synonym references. The **syssynonyms**, **syssyntable**, and **systables** system catalog tables maintain information about synonyms.

You cannot create a synonym for a synonym in the same database.

The identifier of the synonym must be unique among the names of tables, temporary tables, views, and sequence objects in the same database. (See, however, the section "Synonyms with the Same Name" on page 2-169.)

Once a synonym is created, it persists until the owner executes the DROP SYNONYM statement. (This persistence distinguishes a synonym from an alias that you can declare in the FROM clause of a SELECT statement; the alias is in scope only during execution of that SELECT statement.) If a synonym refers to a table, view, or sequence in the same database, the synonym is automatically dropped if the referenced table, view, or sequence object is dropped.

Synonyms for Remote and External Tables and Views

A synonym can be created for any table or view in any database on your database server. This example declares a synonym for a table outside your current database, in the **payables** database of your current database server.

```
CREATE SYNONYM mysum FOR payables:jean.summary
```

You can also create a synonym for a table or view that exists in a database of a database server that is not your current database server. Both database servers must be online when you create the synonym. In a network, the remote database server verifies that the table or view referenced by the synonym exists when you create the synonym. The next example creates a synonym for a table supported by a remote database server:

```
CREATE SYNONYM mysum FOR payables@phoenix:jean.summary
```

The identifier **mysum** now refers to the table **jean.summary**, which is in the **payables** database on the **phoenix** database server. If the **summary** table is dropped from the **payables** database, the **mysum** synonym is left intact. Subsequent attempts to use **mysum** return the error: `Table not found`.

Dynamic Server, however, does not support synonyms for these external objects:

- Typed tables (including any table that is part of a table hierarchy)
- Tables or views that contain any extended data types
- Sequence objects outside the local database

PUBLIC and PRIVATE Synonyms

If you use the PUBLIC keyword (or no keyword at all), anyone who has access to the database can use your synonym. If the database is not ANSI-compliant, a user does not need to know the name of the owner of a public synonym. Any synonym in a database that is not ANSI-compliant *and* was created in an Informix database server earlier than Version 5.0 is a public synonym.

In an ANSI-compliant database, all synonyms are private. If you use the PUBLIC or PRIVATE keywords, the database server issues a syntax error.

If you use the PRIVATE keyword to declare a synonym in a database that is not ANSI-compliant, the unqualified synonym can be used by its owner. Other users must qualify the synonym with the name of the owner.

Synonyms with the Same Name

In an ANSI-compliant database, the *owner*.*synonym* combination must be unique among all synonyms, tables, views, and sequences. You must specify *owner* when you refer to a synonym that you do not own, as in this example:

```
CREATE SYNONYM emp FOR accting.employee
```

In a database that is not ANSI-compliant, no two public synonyms can have the same identifier, and the identifier of a synonym must also be unique among the names of tables, views, and sequences in the same database.

The *owner*.*synonym* combination of a private synonym must be unique among all the synonyms in the database. That is, more than one private synonym with the same name can exist in the same database, but a different user must own each of these synonyms. The same user cannot create both a private and a public synonym that have the same name. For example, the following code generates an error:

```
CREATE SYNONYM our_custs FOR customer;
CREATE PRIVATE SYNONYM our_custs FOR cust_calls;-- ERROR!!!
```

A private synonym can be declared with the same name as a public synonym only if the two synonyms have different owners. If you own a private synonym, and a public synonym exists with the same name, the database server resolves the unqualified name as the private synonym. (In this case, you must specify *owner*.*synonym* to reference the public synonym.) If you use DROP SYNONYM with the unqualified synonym identifier when your private synonym and the public synonym of another user both have the same identifier, only your private synonym is dropped. If you repeat the same DROP SYNONYM statement, the database server drops the public synonym.

Chaining Synonyms

If you create a synonym for a table or view that is not in the current database, and this table or view is dropped, the synonym stays in place. You can create a new synonym for the dropped table or view with the name of the dropped table or view as the synonym, which points to another external or remote table or view. (Synonyms for external sequence objects are not supported.)

In this way, you can move a table or view to a new location and chain synonyms together so that the original synonyms remain valid. (You can chain up to 16 synonyms in this manner.)

The following steps chain two synonyms together for the **customer** table, which will ultimately reside on the **zoo** database server (the CREATE TABLE statements are not complete):

1. In the **stores_demo** database on the database server that is called **training**, issue the following statement:
   ```
   CREATE TABLE customer (lname CHAR(15)...)
   ```
2. On the database server called **accntg**, issue the following statement:
   ```
   CREATE SYNONYM cust FOR stores_demo@training:customer
   ```
3. On the database server called **zoo**, issue the following statement:
   ```
   CREATE TABLE customer (lname CHAR(15)...)
   ```
4. On the database server called **training**, issue the following statement:
   ```
   DROP TABLE customer
   CREATE SYNONYM customer FOR stores_demo@zoo:customer
   ```

The synonym **cust** on the **accntg** database server now points to the **customer** table on the **zoo** database server.

The following steps show an example of chaining two synonyms together and changing the table to which a synonym points:

1. On the database server called **training**, issue the following statement:
   ```
   CREATE TABLE customer (lname CHAR(15)...)
   ```
2. On the database server called **accntg**, issue the following statement:
   ```
   CREATE SYNONYM cust FOR stores_demo@training:customer
   ```
3. On the database server called **training**, issue the following statement:
   ```
   DROP TABLE customer
   CREATE TABLE customer (lastname CHAR(20)...)
   ```

The synonym **cust** on the **accntg** database server now points to a new version of the **customer** table on the **training** database server.

Related Information

Related statement: DROP SYNONYM.

For a discussion of concepts related to synonyms, see the *IBM Informix Database Design and Implementation Guide*.

CREATE TABLE

Use the CREATE TABLE statement to create a new permanent table in the current database, to place data-integrity constraints on columns, to designate where the table is stored, to define a fragmentation strategy, to indicate the size of its initial and subsequent extents, and to specify how to lock the new table.

You can use the CREATE TABLE statement to create relational-database tables or to create typed tables (object-relational tables). For information on how to create temporary tables, see “CREATE Temporary TABLE” on page 2-209.

Syntax

```
          ┌─STANDARD─────────────┐
►►──CREATE─┼─RAW──────────────────┼──TABLE──table──┤ Table Definition ├────────────────────►◄
          │ (1)                  │
          ├──────────STATIC──────┤
          │ (1)                  │
          └──────────OPERATIONAL─┘
```

Table Definition:

```
       ┌─,──────────────────────────┐
       ▼                        (2) │                                                      (4)
├──┬─(───┤ Column Definition ├──────┴──┬─────────────────────────────────────────────┬─)──┤ Options ├──┬──────┤
   │                                   │      ┌─,──────────────────────────────────┐ │                 │
   │                                   │      ▼                                (3) │ │                 │
   │                                   └─,──┬──┤ Multiple-Column Constraint ├──────┴─┘                 │
   │                                        │                             (2)      │                   │
   │                                        └──┤ Column Definition ├───────────────┘                   │
   │ (5)    (6)                          (7)                                                           │
   └──────────────┤ OF TYPE Clause ├──────────────────────────────────────────────────────────────────┘
```

Notes:

1 Extended Parallel Server only

2 See page 2-173

3 See page 2-184

4 See page 2-187

5 Informix extension

6 Dynamic Server only

7 See page 2-204

Element	Description	Restrictions	Syntax
table	Name that you declare here for the new table	Must be unique among the names of tables, synonyms, views, and sequences in the database	Identifier, p. 5-22

Usage

The CREATE TABLE statement can include various clauses, some of which are identified in the following list. Clauses whose names are followed by ″(IDS)″ are not supported by Extended Parallel Server. Similarly, clauses whose names are followed by ″(XPS)″ are not supported by Dynamic Server.

Clause	Page	What the Clause Specifies
Logging Options	2-172	Logging characteristics of the new table
Column Definition	2-173	Name and other attributes of an individual column
DEFAULT	2-174	Default value for an individual column
Single-Column Constraint	2-176	Data-integrity constraints on an individual column
REFERENCES	2-179	Referential-integrity constraints with other columns
CHECK	2-181	Check constraints with other columns
Constraint Definition (IDS)	2-182	Name and other attributes of a constraint
Multiple-Column Constraint	2-184	Data-integrity constraints on a set of columns
WITH CRDCOLS (IDS)	2-188	Two shadow columns for Enterprise Replication
Storage Options	2-188	Attributes of where the table is physically stored
IN	2-189	Storage object to hold the new table (or part of it)
FRAGMENT BY *or* PARTITION BY	2-190	Distribution scheme of a fragmented table
WITH ROWIDS (IDS)	2-191	Hidden column in a fragmented table
RANGE METHOD (XPS)	2-195	Fragmentation strategy based on column values
PUT (IDS)	2-199	Storage location for BLOB or CLOB column values
EXTENT SIZE	2-201	Size of the first and subsequent extents
USING ACCESS METHOD (IDS)	2-202	How to access the new table
LOCK MODE	2-203	Locking granularity of the new table
OF TYPE (IDS)	2-204	Named ROW type of a new typed table
UNDER (IDS)	2-205	Supertable of a new subtable in a table hierarchy

When you create a new table, every column must have a data type associated with it. The *table* name must be unique among all the names of tables, views, sequences, and synonyms within the same database, but the names of columns need only be unique among the column names of the same table.

In an ANSI-compliant database, the combination *owner.table* must be unique among tables, synonyms, views, and sequence objects within the database.

In DB–Access, using CREATE TABLE outside the CREATE SCHEMA statement generates warnings if you use the **-ansi** flag or if you set **DBANSIWARN**.

In ESQL/C, using CREATE TABLE generates warnings if you compile with the **-ansi** flag or set **DBANSIWARN**. For information about the **DBANSIWARN** environment variable, see the *IBM Informix Guide to SQL: Reference*.

Logging Options

Use the Logging Type options to specify logging characteristics that can improve performance in various bulk operations on the table. Other than the default option (STANDARD) that is used for OLTP databases, these logging options are used primarily to improve performance in data warehousing databases.

A table can have either of the following logging characteristics.

Logging Type	Effect
STANDARD	Logging table that allows rollback, recovery, and restoration from archives. This type is the default.

	Use this type of table for all the recovery and constraints functionality that OLTP databases require.
RAW	Nonlogging table that cannot have indexes or referential constraints but can be updated. Use this type of table for quickly loading data.

By using raw tables with Extended Parallel Server, you can take advantage of light appends and avoid the overhead of logging, checking constraints, and building indexes.

Warning: Use raw tables for fast loading of data, but set the logging type to STANDARD and perform a level-0 backup before you use the table in a transaction or modify the data within the table. If you must use a raw table within a transaction, either set the isolation level to Repeatable Read or lock the table in exclusive mode to prevent concurrency problems.

Extended Parallel Server supports two additional logging type options.

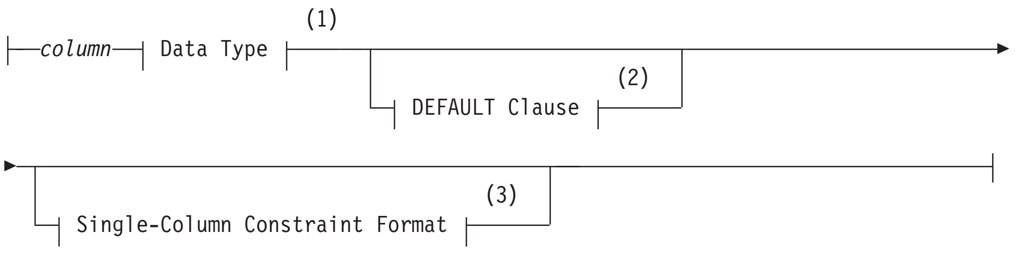
Option	**Effect**
OPERATIONAL	Logging table that uses light appends; it cannot be restored from archive. Use this type on tables that are refreshed frequently, because light appends allow the quick addition of many rows.
STATIC	Nonlogging table that can contain index and referential constraints but cannot be updated. Use this type for read-only operations, because no logging or locking overhead occurs.

For more information on these logging types of tables, refer to your *IBM Informix Administrator's Guide*.

Column Definition

Use the column definition portion of CREATE TABLE to list the name, data type, default values, and constraints of a *single column*.

Column Definition:



Notes:

1 See page 4-18

2 See page 2-174

3 See page 2-176

Element	Description	Restrictions	Syntax
column	Name of a column in the table	Must be unique in this table	Identifier, p. 5-22

Because the maximum row size is 32,767 bytes, no more than approximately 195 columns in the table can be of the data types BYTE, TEXT, ROW, LVARCHAR, NVARCHAR, VARCHAR, and varying-length UDTs. (The upper limit on columns of these data types also depends on other data describing the table that the database server stores in the same partition.) No more than approximately 97 columns can be of COLLECTION data types (SET, LIST, and MULTISET).

As with any SQL identifier, syntactic ambiguities (and sometimes error messages or unexpected behavior) can occur if the *column* name is a keyword, or if it is the same as the *table* name, or the name of another table that you subsequently join with the *table*). For information about the keywords of Dynamic Server, see Appendix A, "Reserved Words for IBM Informix Dynamic Server," on page A-1.

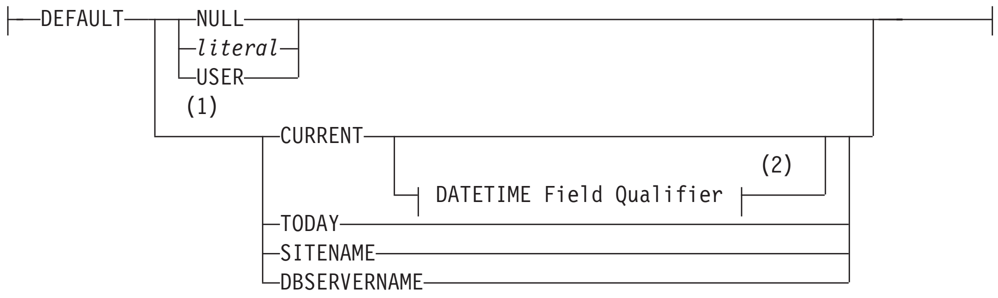
For more information on the keywords of Extended Parallel Server, see Appendix B, "Reserved Words for IBM Informix Extended Parallel Server," on page B-1. For more information on the ambiguities that can occur, see "Use of Keywords as Identifiers" on page 5-23.

In Dynamic Server, if you define a column of a table to be of a named ROW type, the table does not adopt any constraints of the named ROW.

DEFAULT Clause

Use the DEFAULT clause to specify the default value for the database server to insert into a column when no explicit value for the column is specified.

DEFAULT Clause:



Notes:

1 Informix extension

2 See page 4-32

Element	Description	Restrictions	Syntax
literal	String of alphabetic or numeric characters	Must be an appropriate data type for the column. See "Using a Literal as a Default Value" on page 2-175.	Expression, p. 4-34

You cannot specify default values for SERIAL or SERIAL8 columns.

Using NULL as a Default Value

If you specify no default value for a column, the default is NULL unless you place a NOT NULL constraint on the column. In this case, no default exists.

If you specify NULL as the default value for a column, you cannot specify a NOT NULL constraint as part of the column definition. (For details of NOT NULL constraints, see "Using the NOT NULL Constraint" on page 2-177.)

NULL is not a valid default value for a column that is part of a primary key.

If the column is a BYTE or TEXT data type, NULL is the only valid default value.

In Dynamic Server, if the column is a BLOB or CLOB data type, NULL is the only valid default value.

Using a Literal as a Default Value

You can designate a *literal* value as a default value. A literal value is a string of alphabetic or numeric characters. To use a literal value as a default value, you must adhere to the syntax restrictions in the following table.

For Columns of Data Type	Format of Default Value
BOOLEAN	Use `'t'` or `'f'` (respectively for *true* or *false*) as a Quoted String, p. 4-142.
CHAR, CHARACTER VARYING, DATE, VARCHAR, NCHAR, NVARCHAR, LVARCHAR	Quoted String, p. 4-142. See note that follows for DATE.
DATETIME	Literal DATETIME, p. 4-132
DECIMAL, MONEY, FLOAT, SMALLFLOAT	Literal Number, p. 4-137
INTEGER, SMALLINT, DECIMAL, MONEY, FLOAT, SMALLFLOAT, INT8	Literal Number, p. 4-137
INTERVAL	Literal INTERVAL, p. 4-135
Opaque data types (IDS)	Quoted String, p. 4-142 in Single-Column Constraint format (p. 2-176)

DATE literals must be of the format that the **DBDATE** (or else **GL_DATE**) environment variable specifies. In the default locale, if neither **DBDATE** nor **GL_DATE** is set, date literals must be of the *mm/dd/yyyy* format.

Using a Built-in Function as a Default Value

You can specify a built-in function as the default column value. The following table lists built-in functions that you can specify, the data type requirements, and the recommended size (in bytes) for their corresponding columns.

Built-In Function	Data Type Requirement	Recommended Size
CURRENT	DATETIME column with matching qualifier	Enough bytes to store the longest DATETIME value for the locale
DBSERVERNAME, SITENAME	CHAR, VARCHAR, NCHAR, NVARCHAR, or CHARACTER VARYING column	128 bytes
TODAY	DATE column	Enough bytes to store the longest DATE value for the locale
USER	CHAR, VARCHAR, NCHAR, NVARCHAR, or CHARACTER VARYING column	32 bytes

These column sizes are recommended because, if the column length is too small to store the default value during INSERT or ALTER TABLE operations, the database server returns an error.

In Dynamic Server, you cannot designate a built-in function (that is, CURRENT, USER, TODAY, SITENAME, or DBSERVERNAME) as the default value for a column that holds an opaque or distinct data type. In addition, larger column sizes are required if the data values are encrypted, or if they are encoded in the Unicode character set of the **UTF-8** locale. (See the description of the SET ENCRYPTION statement later in this chapter for more information about the storage size requirements for encrypted data.)

For descriptions of these functions, see "Constant Expressions" on page 4-53.

The following example creates a table called **accounts**. In **accounts**, the **acc_num**,**acc_type**, and **acc_descr** columns have literal default values. The **acc_id** column defaults to the login name of the user.

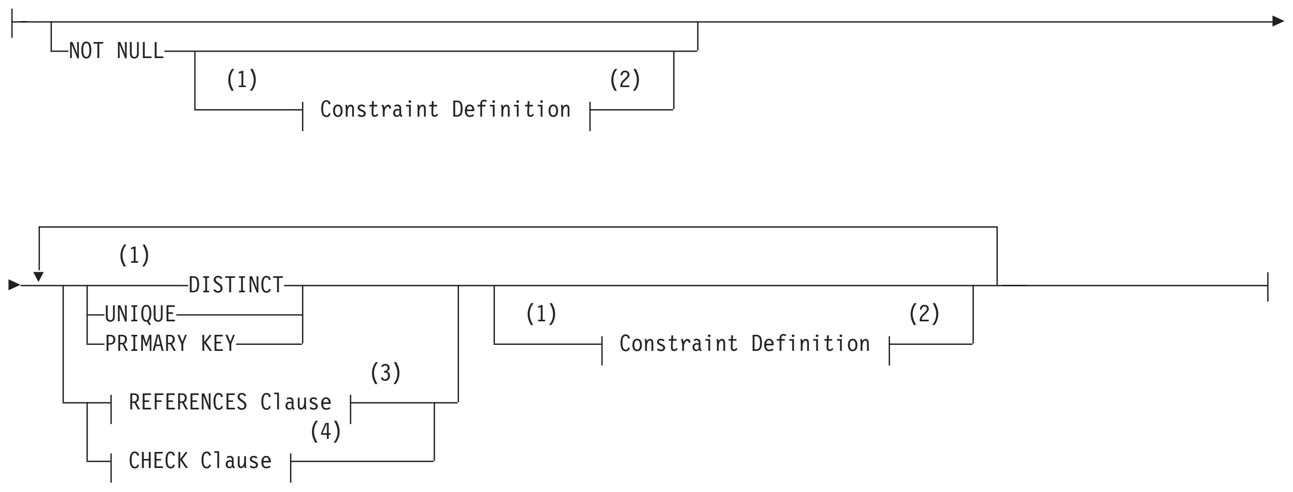
```
CREATE TABLE accounts (
   acc_num INTEGER DEFAULT 1,
   acc_type CHAR(1) DEFAULT 'A',
   acc_descr CHAR(20) DEFAULT 'New Account',
   acc_id CHAR(32) DEFAULT USER)
```

Single-Column Constraint Format

Use the Single-Column Constraint format to associate one or more constraints with a column, in order to perform any of the following tasks:

- Create one or more data-integrity constraints for a column.
- Specify a meaningful name for a constraint.
- Specify the constraint-mode that controls the behavior of a constraint during insert, delete, and update operations.

Single-Column Constraint Format:



Notes:

1 Informix extension

2 See page 2-182

3 See page 2-179

4 See page 2-181

The following example creates a standard table with two constraints: **num**, a primary-key constraint on the **acc_num** column; and **code,** a unique constraint on the **acc_code** column:

```
CREATE TABLE accounts (
   acc_num   INTEGER PRIMARY KEY CONSTRAINT num,
   acc_code  INTEGER UNIQUE CONSTRAINT code,
   acc_descr CHAR(30))
```

The types of constraints used in this example are defined in sections that follow.

Restrictions on Using the Single-Column Constraint Format

The single-column constraint format cannot specify a constraint that involves more than one column. Thus, you cannot use the single-column constraint format to define a composite key. For information on multiple-column constraints, see "Multiple-Column Constraint Format" on page 2-184.

You cannot place unique, primary-key, or referential constraints on BYTE or TEXT columns. You can, however, check for NULL or non-NULL values with a check constraint.

You cannot place unique constraints, primary-key constraints, or referential constraints on BLOB or CLOB columns of Dynamic Server.

Using the NOT NULL Constraint

Use the NOT NULL keywords to require that a column receive a value during insert or update operations. If you place a NOT NULL constraint on a column (and no default value is specified), you *must* enter a value into this column when you insert a row or update that column in a row. If you do not enter a value, the database server returns an error, because no default value exists.

The following example creates the **newitems** table. In **newitems**, the column **manucode** does not have a default value nor does it allow NULL values.

```
CREATE TABLE newitems (
   newitem_num INTEGER,
   manucode CHAR(3) NOT NULL,
   promotype INTEGER,
   descrip CHAR(20))
```

You cannot specify NULL as the explicit default value for a column if you also specify the NOT NULL constraint.

Using the UNIQUE or DISTINCT Constraints

Use the UNIQUE or DISTINCT keyword to require that a column or set of columns accepts only unique data values. You cannot insert values that duplicate the values of some other row into a column that has a unique constraint. When you create a UNIQUE or DISTINCT constraint, the database server automatically creates an internal index on the constrained column or columns. (In this context, the keyword DISTINCT is a synonym for UNIQUE.)

You cannot place a unique constraint on a column that already has a primary-key constraint. You cannot place a unique constraint on a BYTE or TEXT column.

As previously noted, you cannot place a unique or primary-key constraint on a BLOB or CLOB column of Dynamic Server.

Opaque data types support a unique constraint only where a secondary-access method supports uniqueness for that type. The default secondary-access method is a generic B-tree, which supports the **equal( )** operator function. Therefore, if the definition of the opaque type includes the **equal( )** function, a column of that opaque type can have a unique constraint.

The following example creates a simple table that has a unique constraint on one of its columns:

```
CREATE TABLE accounts
   (acc_name  CHAR(12),
    acc_num   SERIAL UNIQUE CONSTRAINT acc_num)
```

For an explanation of the constraint name, refer to "Declaring a Constraint Name" on page 2-182.

Differences Between a Unique Constraint and a Unique Index

Although a unique index and a unique constraint are functionally similar, besides various differences in the syntax by which you declare, alter, or destroy them, there are additional differences between these two types of database objects:

- In DDL statements, they are registered or dropped in different tables of the system catalog
- In DML statements, enabled unique constraints on a logged table are checked at the end of a statement, but unique indexes are checked on a row-by-row basis, thereby preventing any insert or update of a row that might potentially violate the uniqueness of the specified column (or for a multiple-column column constraint or index, the column list).

For example, if you stored the values 1, 2, and 3 in rows of a logged table that has an INT column, an UPDATE operation on that table that specifies `SET c = c + 1` would fail with an error if there were a unique index on the column `c`, but the statement would succeed if the column had a unique constraint.

Using the PRIMARY KEY Constraint

A *primary key* is a column (or a set of columns, if you use the multiple-column constraint format) that contains a non-NULL, unique value for each row in a table. When you define a PRIMARY KEY constraint, the database server automatically creates an internal index on the column or columns that make up the primary key.

You can designate only one primary key for a table. If you define a single column as the primary key, then it is unique by definition. You cannot explicitly give the same column a unique constraint.

In Dynamic Server, you cannot place a unique or primary-key constraint on a BLOB or CLOB column.

Opaque types of Dynamic Server support a primary key constraint only where a secondary-access method supports the uniqueness for that type. The default secondary-access method is a generic B-tree, which supports the **equal( )** function. Therefore, if the definition of the opaque type includes the **equal( )** function, a column of that opaque type can have a primary-key constraint.

You cannot place a primary-key constraint on a BYTE or TEXT column.

In the previous two examples, a unique constraint was placed on the column **acc_num**. The following example creates this column as the primary key for the **accounts** table:

```
CREATE TABLE accounts
   (acc_name  CHAR(12),
    acc_num   SERIAL PRIMARY KEY CONSTRAINT acc_num)
```

REFERENCES Clause

Use the REFERENCES clause to establish a referential relationship:

- Within a table (that is, between two columns of the same table)
- Between two tables (in other words, create a foreign key)

REFERENCES Clause:

```
├──REFERENCES──table──┬──────────────────┬──┬────────────────────────┬───────┤
                      │   ┌─,─────┐      │  │   (1)                  │
                      │   ▼       │      │  └──────ON DELETE CASCADE─┘
                      └─(───column─┴──)──┘
```

Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
column	A referenced column	See "Restrictions on Referential Constraints" on page 2-179.	Identifier, p. 5-22
table	The referenced table	Must reside in the same database as the referencing table	Database Object Name, p. 5-17

The *referencing* column (the column being defined) is the column or set of columns that refers to the referenced column or set of columns. The referencing column can contain NULL and duplicate values, but values in the referenced column (or set of columns) must be unique.

The relationship between referenced and referencing columns is called a *parent-child* relationship, where the parent is the referenced column (primary key) and the child is the referencing column (foreign key). The referential constraint establishes this parent-child relationship.

When you create a referential constraint, the database server automatically creates an internal index on the constrained column or columns.

Restrictions on Referential Constraints

You must have the References privilege to create a referential constraint.

When you use the REFERENCES clause, you must observe the following restrictions:

- The referenced and referencing tables must be in the same database.
- The referenced column (or set of columns when you use the multiple-column constraint format) must have a unique or primary-key constraint.
- The data types of the referencing and referenced columns must be identical.

  The only exception is that a referencing column must be an integer data type if the referenced column is a SERIAL or SERIAL8 data type.
- You cannot place a referential constraint on a BYTE or TEXT column.
- You cannot place a referential constraint on a BLOB or CLOB column.

- When you use the single-column constraint format, you can reference only one column.
- In Dynamic Server, when you use the multiple-column constraint format, the maximum number of columns in the REFERENCES clause is 16, and the total length of the columns cannot exceed 390 bytes if the page size is 2 kilobytes. (The maximum length increases with the page size.)
- In Extended Parallel Server, when you use the multiple-column constraint format, the maximum number of columns in the REFERENCES clause is 16, and the total length of the columns cannot exceed 380 bytes.

Default Values for the Referenced Column

If the referenced table is different from the referencing table, you do not need to specify the referenced column; the default column is the primary-key column (or columns) of the referenced table. If the referenced table is the same as the referencing table, you must specify the referenced column.

Referential Relationships Within a Table

You can establish a referential relationship between two columns of the same table. In the following example, the **emp_num** column in the **employee** table uniquely identifies every employee through an employee number. The **mgr_num** column in that table contains the employee number of the manager who manages that employee. In this case, **mgr_num** references **emp_num**. Duplicate values appear in the **mgr_num** column because managers manage more than one employee.

```
CREATE TABLE employee
   (
   emp_num INTEGER PRIMARY KEY,
   mgr_num INTEGER REFERENCES employee (emp_num)
   )
```

Locking Implications of Creating a Referential Constraint

When you create a referential constraint, an exclusive lock is placed on the referenced table. The lock is released when the CREATE TABLE statement is finished. If you are creating a table in a database that supports transaction logging, and you are using transactions, the lock is released at the end of the transaction.

Example That Uses the Single-Column Constraint Format

The following example uses the single-column constraint format to create a referential relationship between the **sub_accounts** and **accounts** tables. The **ref_num** column in the **sub_accounts** table references the **acc_num** column (the primary key) in the **accounts** table.

```
CREATE TABLE accounts (
   acc_num INTEGER PRIMARY KEY,
   acc_type INTEGER,
   acc_descr CHAR(20))
CREATE TABLE sub_accounts (
   sub_acc INTEGER PRIMARY KEY,
   ref_num INTEGER REFERENCES accounts (acc_num),
   sub_descr CHAR(20))
```

When you use the single-column constraint format, you do not explicitly specify the **ref_num** column as a foreign key. To use the FOREIGN KEY keyword, use the "Multiple-Column Constraint Format" on page 2-184.

Using the ON DELETE CASCADE Option

Use the ON DELETE CASCADE option to specify whether you want rows deleted in a child table when corresponding rows are deleted in the parent table. If you do not specify cascading deletes, the default behavior of the database server prevents you from deleting data in a table if other tables reference it.

If you specify this option, later when you delete a row in the parent table, the database server also deletes any rows associated with that row (foreign keys) in a child table. The principal advantage to the cascading-deletes feature is that it allows you to reduce the quantity of SQL statements you need to perform delete actions.

For example, the **all_candy** table contains the **candy_num** column as a primary key. The **hard_candy** table refers to the **candy_num** column as a foreign key. The following CREATE TABLE statement creates the **hard_candy** table with the cascading-delete option on the foreign key:

```
CREATE TABLE all_candy
   (candy_num SERIAL PRIMARY KEY,
    candy_maker CHAR(25));

CREATE TABLE hard_candy
   (candy_num INT,
    candy_flavor CHAR(20),
    FOREIGN KEY (candy_num) REFERENCES all_candy
    ON DELETE CASCADE)
```

Because ON DELETE CASCADE is specified for the dependent table, when a row of the **all_candy** table is deleted, the corresponding rows of the **hard_candy** table are also deleted. For information about syntax restrictions and locking implications when you delete rows from tables that have cascading deletes, see “Considerations When Tables Have Cascading Deletes” on page 2-276.

CHECK Clause

Use the CHECK clause to designate conditions that must be met *before* data can be assigned to a column during an INSERT or UPDATE statement.

CHECK Clause:

```
                                (1)
|--CHECK--(--| Condition |-------)---------------------------------------|
```

Notes:

1 See page 4-5

In Dynamic Server, the *condition* cannot include a user-defined routine.

During an insert or update, if the check constraint of a row evaluates to *false*, the database server returns an error. The database server does not return an error if a row evaluates to NULL for a check constraint. In some cases, you might want to use both a check constraint and a NOT NULL constraint.

Using a Search Condition

The *search condition* that defines a check constraint cannot contain the following elements: user-defined routines, subqueries, aggregates, host variables, or rowids. In addition, the search condition cannot contain the following built-in functions: CURRENT, USER, SITENAME, DBSERVERNAME, or TODAY.

When you specify a date value in a search condition, make sure you specify four digits for the year, so that the **DBCENTURY** environment variable has no effect on the condition. When you specify a two-digit year, the **DBCENTURY** environment variable can produce unpredictable results if the condition depends on an abbreviated year value. For more information about **DBCENTURY**, see the *IBM Informix Guide to SQL: Reference*.

More generally, the database server saves the settings of environment variables from the time of creation of check constraints. If any of these settings are subsequently changed in a way that can affect the evaluation of a condition in a check constraint, the new settings are disregarded, and the original environment variable settings are used when the condition is evaluated.

With a BYTE or TEXT column, you can check for NULL or not-NULL values. This constraint is the only constraint allowed on a BYTE or TEXT column.

Restrictions When Using the Single-Column Constraint Format

When you use the single-column constraint format to define a check constraint, the check constraint cannot depend on values in other columns of the table. The following example creates the **my_accounts** table that has two columns with check constraints, each in the single-column constraint format:

```
CREATE TABLE my_accounts (
   chk_id   SERIAL PRIMARY KEY,
   acct1    MONEY CHECK (acct1 BETWEEN 0 AND 99999),
   acct2    MONEY CHECK (acct2 BETWEEN 0 AND 99999))
```

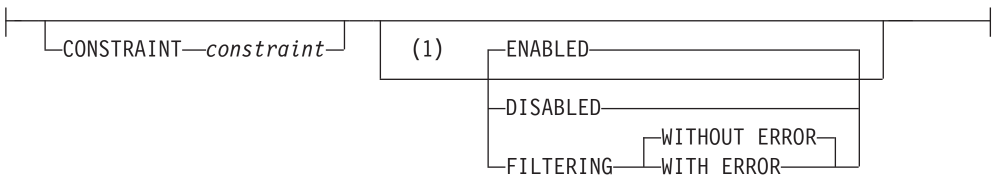
Both **acct1** and **acct2** are columns of MONEY data type whose values must be between 0 and 99999. If, however, you want to test that **acct1** has a larger balance than **acct2**, you cannot use the single-column constraint format. To create a constraint that checks values in more than one column, you must use the "Multiple-Column Constraint Format" on page 2-184.

Constraint Definition

Use the constraint definition portion of CREATE TABLE for these purposes:

- To declare a name for the constraint
- To set a constraint to disabled, enabled, or filtering mode (IDS)

Constraint Definition:



Notes:

1 Dynamic Server only

Element	Description	Restrictions	Syntax
constraint	Name of constraint	Must be unique for the table among index and constraint names	Identifier, p. 5-22

Declaring a Constraint Name

The database server implements the constraint as an index. Whenever you use the single- or multiple-column constraint format to place a data restriction on a column, but without declaring a *constraint* name, the database server creates a constraint and adds a row for that constraint in the **sysconstraints** system catalog table. The database server also generates an identifier and adds a row to the **sysindexes** system catalog table for each new primary-key, unique, or referential constraint that does not share an index with an existing constraint. Even if you declare a name for a constraint, the database server generates the name that appears in the **sysindexes** table.

If you want, you can specify a meaningful name for the constraint. The name must be unique among the names of constraints and indexes in the database.

Constraint names appear in error messages having to do with constraint violations. You can use this name when you use the DROP CONSTRAINT clause of the ALTER TABLE statement.

In Dynamic Server, you also specify a constraint name when you change the mode of constraint with the SET Database Object Mode statement or the SET Transaction Mode statement, and in the DROP INDEX statement for constraints that are implemented as indexes with user-defined names.

In an ANSI-compliant database, when you declare the name of a constraint of any type, the combination of the *owner* name and *constraint* name must be unique within the database.

In Dynamic Server, the system catalog table that holds information about indexes is the **sysindices** table.

Constraint Names That the Database Server Generates: If you do not specify a constraint name, the database server generates a constraint name using the following template:

```
<constraint_type><tabid>_<constraintid>
```

In this template, *constraint_type* is the letter **u** for unique or primary-key constraints, **r** for referential constraints, **c** for check constraints, and **n** for NOT NULL constraints. In the template, *tabid* and *constraintid* are values from the **tabid** and **constrid** columns of the **systables** and **sysconstraints** system catalog tables, respectively. For example, the constraint name for a unique constraint might look like " **u111_14**" (with a leading blank space).

If the generated name conflicts with an existing identifier, the database server returns an error, and you must then supply an explicit constraint name.

The generated index name in **sysindexes** (or **sysindices**) has this format:

```
[blankspace]<tabid>_<constraintid>
```

For example, the index name might be something like " **111_14** " (quotation marks used here to show the blank space).

Choosing a Constraint-Mode Option (IDS)

Use the constraint-mode options to control the behavior of constraints in INSERT, DELETE, and UPDATE operations. These are the options.

Mode	Effect
DISABLED	Does not enforce the constraint during INSERT, DELETE, and UPDATE operations

ENABLED	Enforces the constraint during INSERT, DELETE, and UPDATE operations If a target row causes a violation of the constraint, the statement fails. This mode is the default.
FILTERING	Enforces the constraint during INSERT, DELETE, and UPDATE operations If a target row causes a violation of the constraint, the statement continues processing. The database server writes the row in question to the violations table associated with the target table and writes diagnostic information to the associated diagnostics table.

If you choose filtering mode, you can specify the WITHOUT ERROR or WITH ERROR options. The following list explains these options.

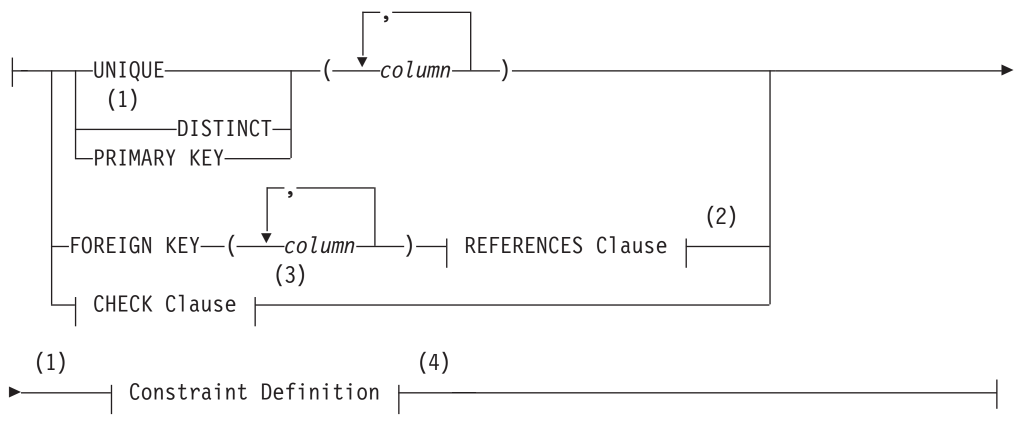
Error Option	**Effect**
WITHOUT ERROR	Does not return an integrity-violation error when a filtering-mode constraint is violated during an insert, delete, or update operation. This is the default error option.
WITH ERROR	Returns an integrity-violation error when a filtering-mode constraint is violated during an insert, delete, or update operation

To reset the constraint mode of a table, see "SET Database Object Mode" on page 2-539. For information about where the database server stores rows that violate a constraint set to FILTERING, see "START VIOLATIONS TABLE" on page 2-609.

Multiple-Column Constraint Format

Use the multiple-column constraint format to associate one or more columns with a constraint. This alternative to the single-column constraint format allows you to associate multiple columns with a constraint.

Multiple-Column Constraint Format:



Notes:

1 Informix extension

2 See page 2-179

3 See page 2-181

4 See page 2-182

Element	Description	Restrictions	Syntax
column	Columns on which to place constraint	Not BYTE, TEXT, BLOB, CLOB	Identifier, p. 5-22

You can include a maximum of 16 columns in a constraint list. For databases where the page size is two kilobytes, the total length of the list of columns cannot exceed 380 bytes.

When you define a unique constraint (by using the UNIQUE or DISTINCT keyword), a column cannot appear in the constraint list more than once.

Using the multiple-column constraint format, you can perform these tasks:

- Create data-integrity constraints for a set of one or more columns
- Specify a mnemonic name for a constraint
- Specify the constraint-mode option that controls the behavior of a constraint during insert, delete, and update operations.

When you use this format, you can create composite primary and foreign keys, or define check constraints that compare data in different columns.

See also the section "Differences Between a Unique Constraint and a Unique Index" on page 2-178.

Restrictions with the Multiple-Column Constraint Format

When you use the multiple-column constraint format, you cannot define any default values for columns. In addition, you cannot establish a referential relationship between two columns of the same table.

To define a default value for a column or establish a referential relationship between two columns of the same table, refer to "Single-Column Constraint Format" on page 2-176 and "Referential Relationships Within a Table" on page 2-180 respectively.

Using Large-Object Types in Constraints: You cannot place unique, primary-key, or referential (FOREIGN KEY) constraints on BYTE or TEXT columns. You can, however, check for NULL or non-NULL values with a check constraint.

You cannot place unique or primary-key constraints on BLOB or CLOB columns.

You can find detailed discussions of specific constraints in the following sections:

Constraint	For more information, see	For an example, see
CHECK	"CHECK Clause" on page 2-181	"Defining Check Constraints Across Columns" on page 2-186
DISTINCT	"Using the UNIQUE or DISTINCT Constraints" on page 2-177	"Examples of the Multiple-Column Constraint Format" on page 2-186
FOREIGN KEY	"Using the FOREIGN KEY Constraint" on page 2-186	"Defining Composite Primary and Foreign Keys" on page 2-187
PRIMARY KEY	"Using the PRIMARY KEY Constraint" on page 2-178	"Defining Composite Primary and Foreign Keys" on page 2-187
UNIQUE	"Using the UNIQUE or DISTINCT Constraints" on page 2-177	"Examples of the Multiple-Column Constraint Format" on page 2-186

Using the FOREIGN KEY Constraint

A foreign key *joins* and establishes dependencies between tables. That is, it creates a referential constraint. (For more information on referential constraints, see the "REFERENCES Clause" on page 2-179.)

A foreign key references a unique or primary key in a table. For every entry in the foreign-key columns, a matching entry must exist in the unique or primary-key columns if all foreign-key columns contain non-NULL values.

You cannot specify BYTE or TEXT columns as foreign keys.

You cannot specify BLOB or CLOB columns as foreign keys.

Examples of the Multiple-Column Constraint Format

The following example creates a standard table, called **accounts**, with a unique constraint, called **acc_num**, using the multiple-column constraint format. (Nothing in this example, however, would prevent you from using the single-column constraint format to define this constraint.)

```
CREATE TABLE accounts
   (acc_name CHAR(12),
    acc_num  SERIAL,
    UNIQUE  (acc_num) CONSTRAINT acc_num)
```

For constraint names, see "Declaring a Constraint Name" on page 2-182.

Defining Check Constraints Across Columns: When you use the multiple-column constraint format to define check constraints, a check constraint can apply to more than one column in the same table. (You cannot, however, create a check constraint whose *condition* uses a value from a column in another table.)

This example compares two columns, **acct1** and **acct2**, in the new table:

```
CREATE TABLE my_accounts
   (
   chk_id   SERIAL PRIMARY KEY,
   acct1    MONEY,
   acct2    MONEY,
   CHECK (0 < acct1 AND acct1 < 99999),
   CHECK (0 < acct2 AND acct2 < 99999),
   CHECK (acct1 > acct2)
   )
```

In this example, the **acct1** column must be greater than the **acct2** column, or the insert or update fails.

Defining Composite Primary and Foreign Keys: When you use the multiple-column constraint format, you can create a composite key. A *composite key* specifies multiple columns for a primary-key or foreign-key constraint.

The next example creates two tables. The first table has a composite key that acts as a primary key, and the second table has a composite key that acts as a foreign key.

```
CREATE TABLE accounts (
   acc_num INTEGER,
   acc_type INTEGER,
   acc_descr CHAR(20),
   PRIMARY KEY (acc_num, acc_type))

CREATE TABLE sub_accounts (
   sub_acc INTEGER PRIMARY KEY,
   ref_num INTEGER NOT NULL,
   ref_type INTEGER NOT NULL,
   sub_descr CHAR(20),
   FOREIGN KEY (ref_num, ref_type) REFERENCES accounts
      (acc_num, acc_type))
```

In this example, the foreign key of the **sub_accounts** table, **ref_num** and **ref_type**, references the composite key, **acc_num** and **acc_type**, in the **accounts** table. If, during an insert or update, you tried to insert a row into the **sub_accounts** table whose value for **ref_num** and **ref_type** did not exactly correspond to the values for **acc_num** and **acc_type** in an existing row in the **accounts** table, the database server would return an error.

A referential constraint must have a one-to-one relationship between referencing and referenced columns. In other words, if the primary key is a set of columns (a composite key), then the foreign key also must be a set of columns that corresponds to the composite key.

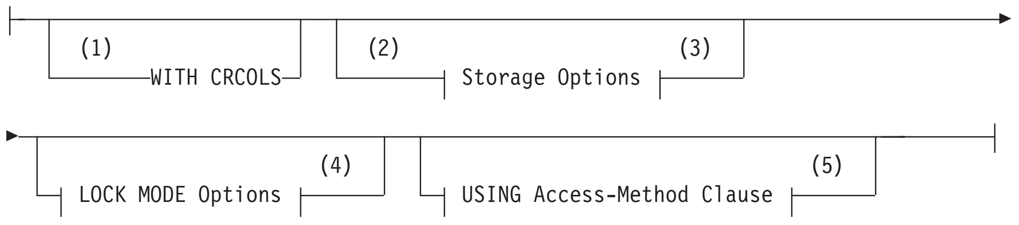
Because of the default behavior of the database server, when you create the foreign-key reference, you do not have to reference the composite-key columns (**acc_num** and **acc_type**) explicitly. You can rewrite the references section of the previous example as follows:

```
FOREIGN KEY (ref_num, ref_type) REFERENCES accounts
```

Options Clauses

The Options clauses of the CREATE TABLE statement let you specify storage locations, extent size, locking modes, and user-defined access methods.

Options:



Notes:

1 Dynamic Server only

2 Informix extension

3 See page 2-188

4 See page 2-203

5 See page 2-202

Using the WITH CRCOLS Option (IDS)

Use the WITH CRCOLS keywords to create two shadow columns that Enterprise Replication uses for conflict resolution. The first column, **cdrserver**, contains the identity of the database server where the last modification occurred. The second column, **cdrtime**, contains the time stamp of the last modification. You must add these columns before you can use time-stamp or UDR conflict resolution.

For most database operations, the **cdrserver** and **cdrtime** columns are hidden. For example, if you include the WITH CRCOLS keywords when you create a table, the **cdrserver** and **cdrtime** columns have the following behavior:

- They do not appear when you issue the statement:
  ```
  SELECT * from tablename
  ```
- They do not appear in DB–Access when you ask for information about the columns of the table.
- They are not included in the number of columns (**ncols**) in the **systables** system catalog table entry for *tablename*.

To view the contents of **cdrserver** and **cdrtime**, explicitly specify the columns in the projection list of a SELECT statement, as the following example shows:

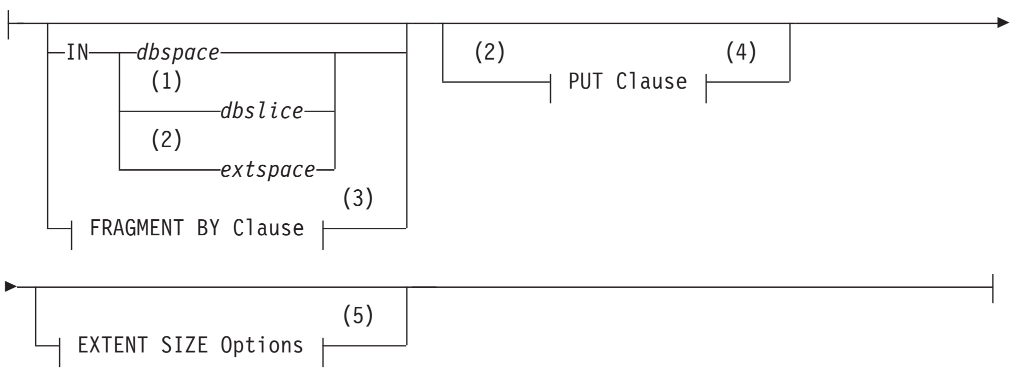
```
SELECT cdrserver, cdrtime FROM tablename
```

For more information about how to use this option, refer to the *IBM Informix Dynamic Server Enterprise Replication Guide*.

Storage Options

3 Use these options to specify the storage location, distribution scheme, and extent size for the table. This is an extension to the ANSI/ISO standard for SQL syntax.

Storage Options:



Notes:

1 Extended Parallel Server only

2 Dynamic Server only

3 See page 2-190

4 See page 2-199

5 See page 2-201

Element	Description	Restrictions	Syntax
dbslice	Dbslice to store the table	Must already exist	Identifier, p. 5-22
dbspace	Dbspace to store the table	Must already exist	Identifier, p. 5-22
extspace	Name declared in the **onspaces** command to a storage area outside the database server	Must already exist	See documentation for your access method.

If you use the "USING Access-Method Clause (IDS)" on page 2-202 to specify an access method, that method must support the storage space.

You can specify a dbspace for the table that is different from the storage location for the database, or fragment the table among dbspaces, or among partitions of one or more dbspaces. If you specify no IN clause nor fragmentation scheme, the new table resides in the same dbspace where the current database resides.

In Dynamic Server, you can use the PUT clause to specify storage options for smart large objects. For more information, see "PUT Clause (IDS)" on page 2-199.

Note: If your table contains simple large objects (TEXT or BYTE), you can specify a separate blobspace for each object. For information on storing simple large objects, refer to "Large-Object Data Types" on page 4-25.

Using the IN Clause

Use the IN clause to specify a storage space for the table. The storage space that you specify must already exist.

Storing Data in a dbspace: You can use the IN clause to isolate a table. For example, if the **history** database is in the **dbs1** dbspace, but you want the **family** data placed in a separate dbspace called **famdata**, use the following statements:

```
CREATE DATABASE history IN dbs1

CREATE TABLE family
   (
   id_num      SERIAL(101) UNIQUE,
   name        CHAR(40),
   nickname    CHAR(20),
   mother      CHAR(40),
   father      CHAR(40)
   )
   IN famdata
```

For more information about how to store and manage your tables in separate dbspaces, see your *IBM Informix Administrator's Guide*.

Storing Data in a Partition of a dbspace (IDS): Besides the option of storing the table (or a fragment of it) in a dbspace, Dynamic Server supports storing fragments of a table in a subset of a dbspace, called a *partition*. Unless you explicitly declare names for the fragments in the PARTITION BY clause, each fragment, by default, has the same name as the dbspace where it resides. This includes all fragmented tables and indexes migrated from earlier releases of Dynamic Server.

You can store fragments of the same table in multiple partitions of the same dbspace, but each name that you declare after the PARTITION keyword must be unique among partitions of that dbspace. The PARTITION keyword is required when you store more than one fragment of the table in the same dbspace. You can also use the PARTITION keyword to declare a more meaningful name for a dbspace that has only one partition.

Storing Data in a dbslice (XPS): If you are using Extended Parallel Server, the IN *dbslice* clause allows you to fragment a table across a group of dbspaces that share the same naming convention. The database server fragments the table by round-robin in the dbspaces that make up the dbslice at the time the table is created.

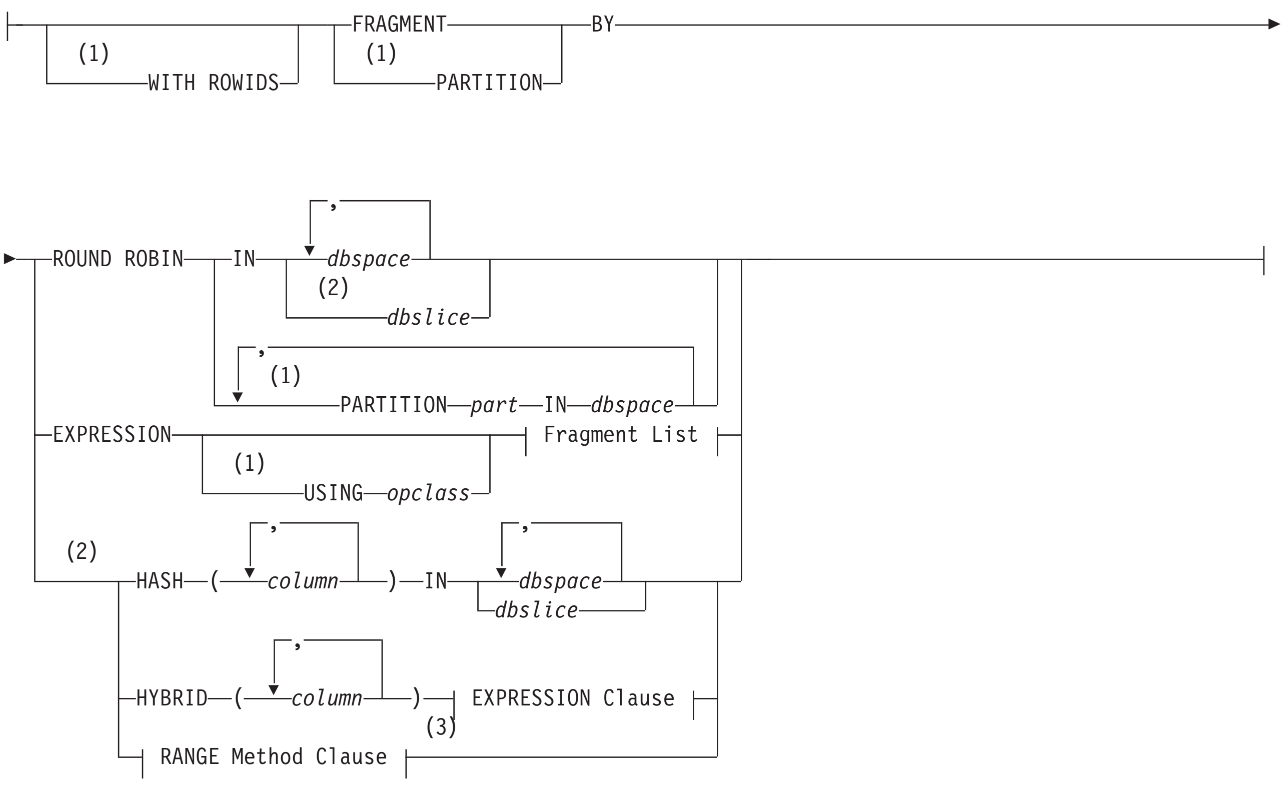
To fragment a table across a dbslice, you can use either the IN *dbslice* syntax or the FRAGMENT BY ROUND ROBIN IN *dbslice* syntax.

Storing Data in an extspace (IDS): In general, use the *extspace* storage option in conjunction with the "USING Access-Method Clause (IDS)" on page 2-202. For more information, refer to the documentation of your access method.

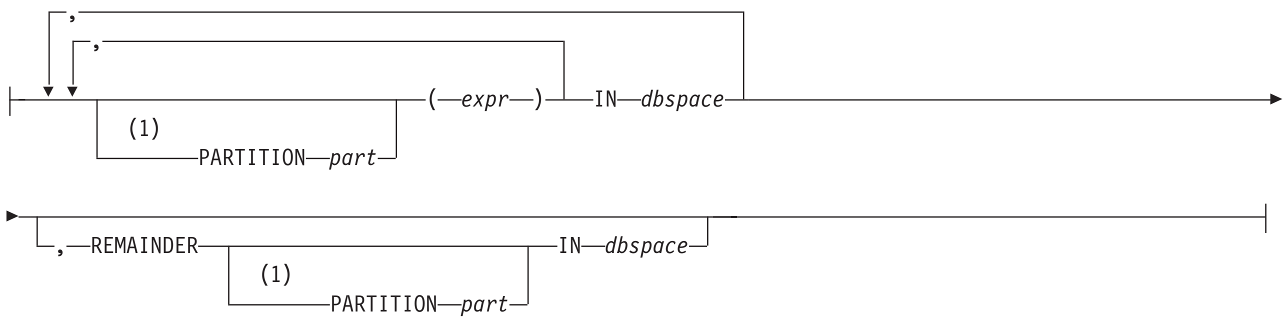
FRAGMENT BY Clause

Use the FRAGMENT BY clause to create fragmented tables and to specify their distribution scheme. (The keywords PARTITION BY are a synonym for FRAGMENT BY in Dynamic Server.)

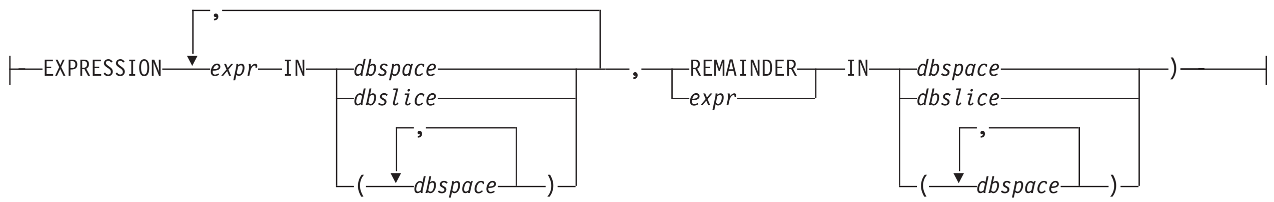
FRAGMENT BY Clause for Tables:



Fragment List:



EXPRESSION Clause:



Notes:

1 Dynamic Server only

2 Extended Parallel Server only

3 See page 2-195

Element	Description	Restrictions	Syntax
column	Column to which to apply the fragmentation strategy	Must be a column within the table	Identifier, p. 5-22
dbslice, *dbspace*	Dbslice or dbspace to store the table fragment	The *dbslice* must be defined. You can specify no more than 2,048 *dbspaces*.	Identifier, p. 5-22
expr	Expression that defines a table fragment using a range, hash, or arbitrary rule	Columns can be from the current table only, and data values can be from only a single row. Value returned must be Boolean (true or false).	Expression, p. 4-34
opclass	No default operator class	Must be defined and must be associated with a B-tree index	Identifier, p. 5-22
part	Name that you declare here for a partition of a dbspace	Required for any *partition* in the same dbspace as another *partition* of the same table	Identifier, p. 5-22

When you fragment a table, the IN keyword is followed by the name of the storage space where a table fragment is to be stored.

Using the WITH ROWIDS Option (IDS)

Nonfragmented tables contain a hidden column called **rowid**, but by default, fragmented tables have no **rowid** column. You can use the WITH ROWIDS keywords to add the **rowid** column to a fragmented table. Each row is automatically assigned a unique **rowid** value that remains stable for the life of the row and that the database server can use to find the physical location of the row. Each row requires an additional four bytes to store the **rowid**.

Important: This is a deprecated feature. Use primary keys as an access method rather than the **rowid** column.

You cannot use the WITH ROWIDS clause with typed tables.

Fragmenting by ROUND ROBIN

In a round-robin distribution scheme, specify at least two dbspaces (in Extended Parallel Server) or partitions (in Dynamic Server) where you want the fragments to be placed. As records are inserted into the table, they are placed in the first available fragment. The database server balances the load among the specified fragments as you insert records and distributes the rows in such a way that the fragments always maintain approximately the same number of rows. In this distribution scheme, the database server must scan all fragments when it searches for a row.

With Extended Parallel Server, you can specify a dbslice to fragment a table across a group of dbspaces that share the same naming convention. For a syntax alternative to `FRAGMENT BY ROUND ROBIN IN` *dbslice* that achieves the same results, see "Storing Data in a dbslice (XPS)" on page 2-190.

With Dynamic Server, you can use the PUT clause to specify round-robin fragmentation for smart large objects. For more information, see the "PUT Clause (IDS)" on page 2-199.

Fragmenting by EXPRESSION

In an *expression-based* distribution scheme, each fragment expression in a rule specifies a storage space. Each fragment expression in the rule isolates data and aids the database server in searching for rows.

To fragment a table by expression, specify one of the following rules:

- Range rule

  A range rule specifies fragment expressions that use a range to specify which rows are placed in a fragment, as the next example shows:

  ```
  FRAGMENT BY EXPRESSION c1 < 100 IN dbsp1,
  c1 >= 100 AND c1 < 200 IN dbsp2, c1 >= 200 IN dbsp3
  ```

- Arbitrary rule

  An arbitrary rule specifies fragment expressions based on a predefined SQL expression that typically uses OR clauses to group data, as the following example shows:

  ```
  FRAGMENT BY EXPRESSION
  zip_num = 95228 OR zip_num = 95443 IN dbsp2,
  zip_num = 91120 OR zip_num = 92310 IN dbsp4,
  REMAINDER IN dbsp5
  ```

Warning: See the note about the **DBCENTURY** environment variable and date values in fragment expressions in the section "Logging Options" on page 2-172.

The USING Opclass Option (IDS): With the USING *operator class* option, you can specify a nondefault operator class for the fragmentation strategy. The secondary-access method of the chosen operator class must have a B-tree index structure.

In the following example, the **abs_btree_ops** operator class specifies several user-defined strategy functions that order integers based on their absolute values:

```
CREATE OPCLASS abs_btree_ops FOR btree
   STRATEGIES (abs_lt, abs_lte, abs_eq, abs_gte, abs_gt)
   SUPPORT (abs_cmp)
```

For the fragmentation strategy, you can specify the **abs_btree_ops** operator class in the USING clause and use its strategy functions to fragment the table, as follows:

```
FRAGMENT BY EXPRESSION USING abs_btree_ops
   (abs_lt(x,345)) IN dbsp1,
   (abs_gte(x,345) AND abs_lte(x,500)) IN dbsp2,
   (abs_gt(x,500)) IN dbsp3
```

For information on how to create and extend an operator class, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

User-Defined Functions in Fragment Expressions (IDS): For rows that include user-defined data types, you can use comparison conditions or user-defined functions to define the range rules. In the following example, comparison conditions define the range rules for the **long1** column, which contains an opaque data type:

```
FRAGMENT BY EXPRESSION
long1 < '3001' IN dbsp1,
long1 BETWEEN '3001' AND '6000' IN dbsp2,
long1 > '6000' IN dbsp3
```

An implicit, user-defined cast converts `3001` and `6000` to the opaque type.

Alternatively, you can use user-defined functions to define the range rules for the opaque data type of the **long1** column:

```
FRAGMENT BY EXPRESSION
(lessthan(long1,'3001')) IN dbsp1,
(greaterthanorequal(long1,'3001') AND
lessthanorequal(long,'6000')) IN dbsp2,
(greaterthan(long1,'6000')) IN dbsp3
```

Explicit user-defined functions require parentheses around the entire fragment expression before the IN clause, as the previous example shows.

User-defined functions in a fragment expression can be written in SPL or in the C or Java language. These functions must satisfy four requirements:

- They must evaluate to a Boolean value.
- They must be nonvariant.
- They must reside within the same database as the table.
- They must not generate OUT nor INOUT parameters.

For information on how to create UDRs for fragment expressions, refer to *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Using the REMAINDER Keyword: Use the REMAINDER keyword to specify the storage space in which to store valid values that fall outside the specified expression or expressions. If you do not specify a remainder, and a row is inserted or updated with values that do not correspond to any fragment definition, the database server returns an error.

The following example uses an arbitrary rule to define five fragments for specific values of the **c1** column, and a sixth fragment for all other values:

```
3    CREATE TABLE T1 (c1 INT) FRAGMENT BY EXPRESSION
3    PARTITION PART_1 (c1 = 10) IN dbs1,
3    PARTITION PART_2 (c1 = 20) IN dbs1,
3    PARTITION PART_3 (c1 = 30) IN dbs1,
3    PARTITION PART_4 (c1 = 40) IN dbs2,
3    PARTITION PART_5 (c1 = 50) IN dbs2,
3    PARTITION PART_6 REMAINDER IN dbs2;
```

Here the first three fragments are stored in partitions of the **dbs1** dbspace, and the
3 other fragments, including the remainder, are stored in partitions of the **dbs2**
dbspace. Explicit fragment names are required in this example, because each dbspace has multiple partitions.

Fragmenting by HASH (XPS)

A hash-distribution scheme distributes the rows as you insert them, so that the fragments maintain approximately the same number of rows. In this distribution scheme, the database server can eliminate fragments when it searches for a row because the hash is known internally. For example, if you have a large database, as in a data-warehousing environment, you can fragment your tables across disks that belong to different coservers. If you expect to perform many queries that scan most of the data, a system-defined hash-distribution scheme can balance the I/O processing. The following example uses eight coservers with one dbspace defined on each coserver.

```
CREATE TABLE customer
   (
    cust_id integer,
    descr char(45),
    level char(15),
    sale_type char(10),
    channel char(30),
    corp char(45),
    cust char(45),
    vert_mkt char(30),
    state_prov char(20),
    country char(15),
    org_cust_id char(20)
)
FRAGMENT BY HASH (cust_id) IN
      customer1_spc,
      customer2_spc,
      customer3_spc,
      customer4_spc,
      customer5_spc,
      customer6_spc,
      customer7_spc,
      customer8_spc
EXTENT SIZE 20 NEXT SIZE 16
```

You can also specify a *dbslice.* When you specify a dbslice, the database server fragments the table across the dbspaces that make up the dbslice.

Serial Columns in HASH-Distribution Schemes: If you base table fragmentation on a SERIAL or SERIAL8 column, only a hash-distribution scheme is valid. In addition, the serial column must be the only column in the hashing key. (These restrictions apply only to *table* distributions. Fragmentation schemes for *indexes* that are based on SERIAL or SERIAL8 columns are not subject to these restrictions.)

The following excerpt is from a CREATE TABLE statement:

```
CREATE TABLE customer
   (
    cust_id serial,
   . . .
)
FRAGMENT BY HASH (cust_id) IN customer1_spc, customer2_spc
```

You might notice a difference between serial-column values in fragmented and nonfragmented tables. The database server assigns serial values round-robin across fragments, so a fragment might contain values from noncontiguous ranges. For example, if there are two fragments, the first serial value is placed in the first fragment, the second serial value is placed in the second fragment, the third value is placed in the first fragment, and so on.

Fragmenting by HYBRID (XPS)

The HYBRID clause allows you to apply two distribution schemes to the same table. You can use a combination of hash- and expression-distribution schemes or a combination of range-distribution schemes on a table. This section discusses the hash and expression form of hybrid fragmentation. For details of range fragmentation, see "RANGE Method Clause (XPS)" on page 2-195.

In hybrid fragmentation, the EXPRESSION clause determines the base fragmentation strategy of the table, associating an expression with a set of dbspaces (dbspace, dbslice, or dbspacelist format) for data storage. The hash columns determine the dbspace within the specified set of dbspaces.

When you specify a dbslice, the database server fragments the table across the dbspaces that make up the dbslice. Similarly, if you specify a dbspace list, the database server fragments the table across the dbspaces in that list. In the next example, **my_hybrid** distributes rows based on two columns of the table. The value of **col1** determines in which dbslice the row belongs.

The hash value of **col2** determines which dbspace (within the previously determined dbslice) to insert into.

```
CREATE TABLE my_hybrid
      (col1 INT, col2 DATE, col3 CHAR(10))
   HYBRID (col2) EXPRESSION col1 < 100 IN dbslice1,
      col1 >= 100 and col1 < 200 IN dbslice2,REMAINDER IN dbslice3
```

For more information on an expression-based distribution scheme, see "Fragmenting by EXPRESSION" on page 2-192.

RANGE Method Clause (XPS)

In Extended Parallel Server, you can use a range-fragmentation method as a convenient alternative to fragmenting by the EXPRESSION or HYBRID clauses. This provides a method to implicitly and uniformly distribute data whose fragmentation column values are dense or naturally uniform.

In a range-fragmented table, each dbspace stores a contiguous, completely bound and non-overlapping range of integer values over one or two columns. In other words, the database server implicitly clusters rows within the fragments, based on the range of the values in the fragmentation column.

RANGE Method Clause:

```
                                                      ┌─,──────┐
                                           (1)        ↓        │
├──┬─RANGE─(─column─┤ Range Definition ├─────)─IN─┬─dbspace─┬──┬──────────────────────┬─┬──────────┤
   │                                              └─dbslice─┘  └─REMAINDER IN─dbspace─┘ │
   └─HYBRID─┤ First Range Specification ├┤ Second Range Specification ├─────────────────┘
```

First Range Specification:

```
                                              (1)
├──┬─(─RANGE─(─column─┤ Range Definition ├─────)─)─┬─────────────────────────────┤
   └─(─RANGE─(─column─)─)──────────────────────────┘
```

Second Range Specification:

```
                                                  (2)
├──┬─RANGE─(─column─)─┤ Range IN Clause ├───────────────────────────┬─────────────┤
   │                                      (1)                   (2) │
   └─RANGE─(─column─┤ Range Definition ├─────)─┤ Range IN Clause ├──┘
```

Notes:

1 See page 2-196

2 See page 2-197

Element	Description	Restrictions	Syntax
column	Column on which to apply the fragmentation strategy	Must be in the current table and must be of data type INT or SMALL INT	Identifier, p. 5-22
dbslice	Dbslice that contains the dbspaces where the table fragments reside	Must exist when you execute the statement	Identifier, p. 5-22
dbspace	Dbspace that contains the table fragment	Must exist when you execute the statement. The maximum number of dbspaces is 2048.	Identifier, p. 5-22

For hybrid strategies with two range definitions, the second *column* must have a different column name from the first. For hybrid strategies with exactly one range definition, both occurrences of *column* must specify the same column.

If you list more than one *dbslice*, including a remainder *dbslice*, each dbslice must contain the same number of dbspaces. Unless you are specifying the dbspace in the REMAINDER option, you must specify at least two dbspaces.

Range Definition

Use the range definition to specify the minimum and maximum values of the entire range.

Range Definition:

```
├──┬─────────────┬──┬─────┬─max_val──────────────────────────────┤
   └─MIN─min_val─┘  └─MAX─┘
```

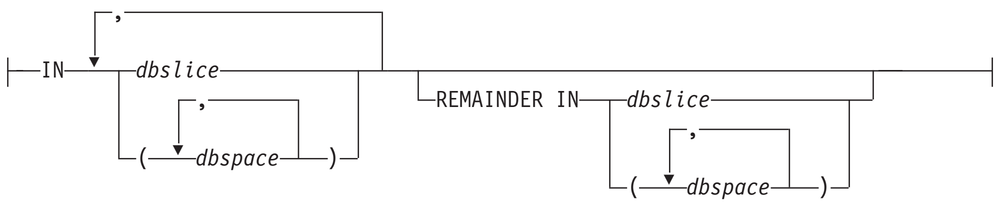
Element	Description	Restrictions	Syntax
max_val	Maximum value in the range	Must be an INT or SMALLINT greater than or equal to *min_val*, if *min_val* is supplied	Literal Number, p. 4-137
min_val	Minimum value in the range; the default is `0`.	Must be an INT or SMALLINT less than or equal to *max_val*	Literal Number, p. 4-137

You do not need to specify a minimum value. The minimum and maximum values define the exact range of values to allocate for each storage space.

Range IN Clause

Use the IN clause to specify the storage spaces in which to distribute the data.

Range IN Clause:



Element	Description	Restrictions	Syntax
dbslice	Dbslice that contains the dbspaces to store table fragments	Must exist	Identifier, p. 5-22
dbspace	Dbspace to store the table fragment	Must exist	Identifier, p. 5-22

If you specify more than one dbslice, including a remainder dbslice, each dbslice must contain the same number of dbspaces.

Unless you are specifying the dbspace in the REMAINDER option, the minimum number of dbspaces that you can specify is two. The maximum number of dbspaces that you can specify is 2,048.

When you use a range-fragmentation method, the number of integer values between the minimum and maximum specified values must be equal to or greater than the number of storage spaces specified, so that the database server can allocate non-overlapping contiguous ranges across the dbspaces. For example, the following code returns an error, because the allocations for the range cannot be distributed across all specified dbspaces:

```
CREATE TABLE Tab1 (Col1 INT...)
   FRAGMENT BY RANGE (Col1 MIN 5 MAX 7)
      IN db1, db2, db3, db4, db5, db6 -- returns an error
```

The error for this example occurs because the specified range contains three values (5, 6, and 7), but six dbspaces are specified; three values cannot be distributed across six dbspaces.

Using the REMAINDER Keyword

Use the REMAINDER keyword to specify the storage space in which to store valid values that fall outside the specified expression or expressions.

If you do not specify a remainder and a row is inserted or updated such that it no longer belongs to any storage space, the database server returns an error.

Restrictions

If you fragment a table with range fragmentation, you cannot perform the following operations on the table after it is created:

- You cannot change the fragmentation strategy (ALTER FRAGMENT).
- You cannot rename the columns of the table (RENAME COLUMN).
- You cannot alter the table in any way except to change the table type or to change the lock mode.

That is, the Usage-TYPE options and the Lock Mode clause are the only valid options of ALTER TABLE for a table that has range fragmentation.

Examples

The following examples illustrate range fragmentation in its simple and hybrid forms.

Simple Range-Fragmentation Strategy: The following example shows a simple range-fragmentation strategy:

```
CREATE TABLE Tab1 (Col1 INT...)
   FRAGMENT BY RANGE (Col1 MIN 100 MAX 200)
      IN db1, db2, db3, db4
```

In this example, the database server fragments the table according to the following allocations.

Storage Space	Holds Values	Storage Space	Holds Values
db1	100 <= **Col1** < 125	**db3**	150 <= **Col1** < 175
db2	125 <= **Col1** < 150	**db4**	175 <= **Col1** < 200

The previous table shows allocations that can also be made with an expression-based fragmentation scheme:

```
CREATE TABLE ... FRAGMENT BY EXPRESSION
   Col1 >= 100 AND Col1 < 125 IN db1
   Col1 >= 125 AND Col1 < 150 IN db2
   Col1 >= 150 AND Col1 < 175 IN db3
   Col1 >= 175 AND Col1 < 200 IN db4
```

As the examples show, the range-fragmentation example requires much less coding to achieve the same results. The same is true for the hybrid-range fragmentation compared to hybrid-expression fragmentation methods.

Column-Major-Range Allocation: The following example demonstrates the syntax for column-major-range allocation, a hybrid-range fragmentation strategy:

```
CREATE TABLE tab2 (col2 INT, colx char (5))
   FRAGMENT BY HYBRID
      ( RANGE (col2 MIN 100 MAX 220))
      RANGE (col2)
      IN dbsl1, dbsl2, dbsl3
```

This type of fragmentation creates a distribution across dbslices and provides a further subdivision within each dbslice (across the dbspaces in the dbslice) such that when a query specifies a value for col1 (for example, `WHERE col1 = 127`), the query uniquely identifies a dbspace. To take advantage of the additional subdivision, you must specify more than one dbslice.

Row-Major-Range Allocation: The following example demonstrates the syntax for row-major-range allocation, a hybrid-range fragmentation strategy:

```
CREATE TABLE tab3 (col3 INT, colx char (5))
   FRAGMENT BY HYBRID
      ( RANGE (col3) )
      RANGE (col3 MIN 100 MAX 220)
      IN dbsl1, dbsl2, dbsl3
```

This fragmentation strategy is the counterpart to the column-major-range allocation. The advantages and restrictions are equivalent.

Independent-Range Allocation: The following example demonstrates the syntax for an independent-range allocation, a hybrid-range fragmentation strategy:

```
CREATE TABLE tab4 (col4 INT, colx char (5), col5 INT)
   FRAGMENT BY HYBRID
      ( RANGE (col4 MIN 100 MAX 200) )
      RANGE (col5 MIN 500 MAX 800)
      IN dbsl1, dbsl2, dbsl3
```

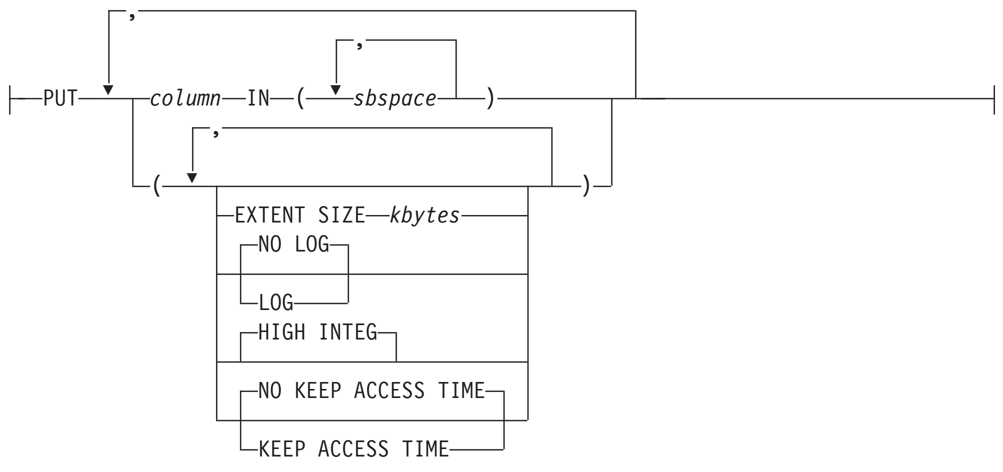
In this type of range fragmentation, the two columns are independent, and therefore the range allocations are independent. The range allocation for a dbspace on both columns is the conjunctive combination of the range allocation on each of the two independent columns.

This type of fragmentation does not provide subdivisions within either column. With this type of fragmentation, a query that specifies values for both columns (such as, `WHERE col4 = 128 and col5 = 650`) uniquely identifies the dbspace at the intersection of the two dbslices identified by the columns independently.

PUT Clause (IDS)

Use the PUT clause to specify the storage spaces and characteristics for each column that will contain smart large objects.

PUT Clause:



Element	Description	Restrictions	Syntax
column	Column to store in *sbspace*	Must contain a BLOB, CLOB, user-defined, or complex data type	Identifier, p. 5-22
kbytes	Number of kilobytes to allocate for the extent size	Must be an integer value	Literal Number, p. 4-137
sbspace	Name of an area of storage	Must exist	Identifier, p. 5-22

The column cannot be in the form *column.field*. That is, the smart large object that you are storing cannot be one field of a row type.

A smart large object is contained in a single sbspace. The SBSPACENAME configuration parameter specifies the system default in which smart large objects are created, unless you specify another area.

Specifying more than one sbspace distributes the smart large objects in a round-robin distribution scheme, so that the number of smart large objects in each space is approximately equal. The **syscolattribs** system catalog table contains one row for each sbspace that you specify in the PUT clause.

When you fragment smart large objects across different sbspaces, you can work with smaller sbspaces. If you limit the size of an sbspace, backup and archive operations can perform more quickly. For an example that uses the PUT clause, see "Alternative to Full Logging" on page 2-201.

Six storage options are available to store BLOB and CLOB data:

Option	Effect
EXTENT SIZE	Specifies how many kilobytes in a smart-large-object extent. The database server might round the EXTENT SIZE up so that the extents are multiples of the sbspace page size.
HIGH INTEG	Produces user-data pages that contain a page header and a page trailer to detect incomplete writes and data corruption. This is the default data-integrity behavior.
KEEP ACCESS TIME	Records, in the smart-large-object metadata, the system time when the smart large object was last read or written.
LOG	Follows the logging procedure used with the current database log for the corresponding smart large object. This option can generate large amounts of log traffic and increase the risk of filling the logical log. (See also "Alternative to Full Logging" on page 2-201.)
NO KEEP ACCESS TIME	Does not record the system time when the smart large object was last read or written. This provides better performance than the KEEP ACCESS TIME option and is the default tracking behavior.
NO LOG	Turns off logging. This option is the default behavior.

If a user-defined or complex data type contains more than one large object, the specified large-object storage options apply to all large objects in the type unless the storage options are overridden when the large object is created.

Important: The PUT clause does not affect the storage of simple-large-object data types (BYTE and TEXT). For information on how to store BYTE and TEXT data, see "Large-Object Data Types" on page 4-25.

Alternative to Full Logging

Instead of full logging, you can turn off logging when you load the smart large object initially and then turn logging back on once the object is loaded.

Use the NO LOG option to turn off logging. If you use NO LOG, you can restore the smart-large-object metadata later to a state in which no structural inconsistencies exist. In most cases, no transaction inconsistencies will exist either, but that result is not guaranteed.

The following statement creates the **greek** table. Data values for the table are fragmented into the **dbs1** and **dbs2** dbspaces. The PUT clause assigns the smart-large-object data in the **gamma** and **delta** columns to the **sb1** and **sb2** sbspaces, respectively. The TEXT data values in the **eps** column are assigned to the **blb1** blobspace.

```
CREATE TABLE greek
(alpha INTEGER,
 beta  VARCHAR(150),
 gamma CLOB,
 delta BLOB,
 eps   TEXT IN blb1)
   FRAGMENT BY EXPRESSION
   alpha <= 5 IN dbs1, alpha > 5 IN dbs2
   PUT gamma IN (sb1), delta IN (sb2)
```

EXTENT SIZE Options

The EXTENT SIZE options can define the size of extents assigned to the table.

EXTENT SIZE Options:

```
|--+----------------------------------+--+--------------------------------+--|
   '--EXTENT SIZE--first_kilobytes--'  '--NEXT SIZE--next_kilobytes--'
```

Element	Description	Restrictions	Syntax
first_kilobytes	Length in kilobytes of the first extent for the table; default is 16.	Must return a positive number; maximum is the chunk size	Expression, p.4-34
next_kilobytes	Length in kilobytes of each subsequent extent; default is 16.	Must return a positive number; maximum is the chunk size	Expression, p.4-34

The minimum length of *first_kilobytes* (and of *next_kilobytes*) is four times the disk-page size on your system. For example, if you have a 2-kilobyte page system, the minimum length is 8 kilobytes.

The next example specifies a first extent of 20 kilobytes and allows the rest of the extents to use the default size:

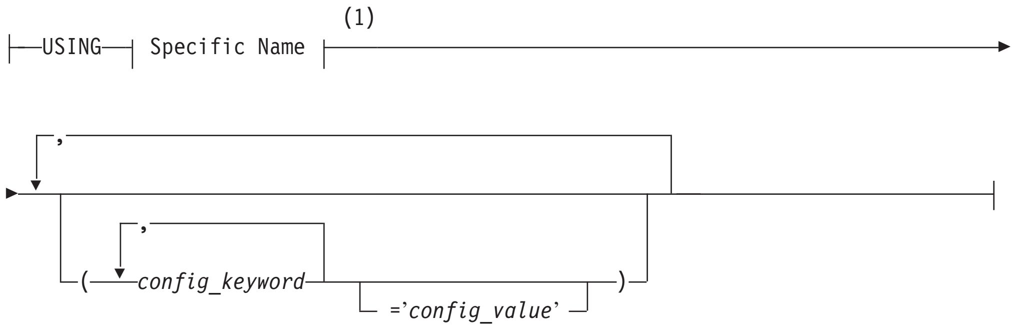
```
CREATE TABLE emp_info
   (
   f_name     CHAR(20),
   l_name     CHAR(20),
   position   CHAR(20),
   start_date DATETIME YEAR TO DAY,
   comments   VARCHAR(255)
   )
EXTENT SIZE 20
```

If you need to revise the extent sizes of a table, you can modify the extent and next-extent sizes in the generated schema files of an unloaded table. For example, to make a database more efficient, you might unload a table, modify the extent sizes in the schema files, and then create and load a new table. For information about how to optimize extents, see your *IBM Informix Administrator's Guide*.

USING Access-Method Clause (IDS)

The USING Access Method clause can specify an access method.

USING Access-Method Clause:



Notes:

1 See page 5-68

Element	Description	Restrictions	Syntax
config_keyword	Configuration keyword associated with the specified access method	No more than 18 bytes. The access method must exist.	Literal keyword
config_value	Value of the specified configuration keyword	No more than 236 bytes. Must be defined by the access method.	Quoted String, p. 4-142

A *primary-access method* is a set of routines to perform DDL and DML operations, such as create, drop, insert, delete, update, and scan, to make a table available to the database server. Dynamic Server provides a built-in primary-access method.

You store and manage a virtual table either outside of the database server in an extspace or inside the database server in an sbspace. (See "Storage Options" on page 2-188.) You can access a virtual table with SQL statements. Access to a virtual table requires a user-defined primary-access method.

DataBlade modules can provide other primary-access methods to access virtual tables. When you access a virtual table, the database server calls the routines associated with that access method rather than the built-in table routines. For more information on these other primary-access methods, refer to your access-method documentation.

You can retrieve a list of configuration values for an access method from a table descriptor (**mi_am_table_desc**) using the MI_TAB_AMPARAM macro. Not all keywords require configuration values.

The access method must already exist. For example, if an access method called **textfile** exists, you can specify it with the following syntax:

```
CREATE TABLE mybook
   (... )
   IN myextspace
   USING textfile (DELIMITER=':')
```

LOCK MODE Options

Use the LOCK MODE options to specify the locking granularity of the table.

LOCK MODE Options:

```
├──LOCK MODE──┬─PAGE──────┬──────────────────────────────────────────────┤
              ├─ROW───────┤
              │  (1)      │
              └───────TABLE┘
```

Notes:

1   Extended Parallel Server only

You can subsequently change the lock mode of the table with the ALTER TABLE statement.

Granularity	Effect
PAGE	Obtains and releases one lock on a whole page of rows This is the default locking granularity. Page-level locking is especially useful when you know that the rows are grouped into pages in the same order that you are using to process all the rows. For example, if you are processing the contents of a table in the same order as its cluster index, page locking is appropriate.
ROW	Obtains and releases one lock per row Row-level locking provides the highest level of concurrency. If you are using many rows at one time, however, the lock-management overhead can become significant. You might also exceed the maximum number of locks available, depending on the configuration of your database server.
TABLE (XPS)	Places a lock on the entire table This type of lock reduces update concurrency compared to row and page locks. A table lock reduces the lock-management overhead for the table With table locking, multiple read-only transactions can still access the table.

The following table describes the locking-granularity options available.

Precedence and Default Behavior

In Dynamic Server, you do not have to specify the lock mode each time you create a new table. You can globally set the locking granularity of all new tables in the following environments:

- Database session of an individual user

You can set the **IFX_DEF_TABLE_LOCKMODE** environment variable to specify the lock mode of new tables during your current session.

- Database server (all sessions on the database server)

  If you are a DBA, you can set the DEF_TABLE_LOCKMODE configuration parameter in the ONCONFIG file to determine the lock mode of all new tables in the database server.

  If you are not a DBA, you can set the **IFX_DEF_TABLE_LOCKMODE** environment variable for the database server, before you run **oninit**, to specify the lock mode of all new tables of the database server.

The LOCK MODE setting in a CREATE TABLE statement takes precedence over the settings of the **IFX_DEF_TABLE_LOCKMODE** environment variable and the DEF_TABLE_LOCKMODE configuration parameter.

If CREATE TABLE specifies no lock mode setting, the default mode depends on the setting of the **IFX_DEF_TABLE_LOCKMODE** environment variable or the DEF_TABLE_LOCKMODE configuration parameter. For information about **IFX_DEF_TABLE_LOCKMODE**, refer to the *IBM Informix Guide to SQL: Reference*. For information about the DEF_TABLE_LOCKMODE configuration parameter, refer to the *IBM Informix Administrator's Reference*.

OF TYPE Clause (IDS)

Use the OF TYPE clause to create a *typed table* for an object-relational database. A typed table is a table to which you assign a named ROW data type.

OF TYPE Clause:

```
|--OF TYPE--row_type--+------------------------------------------------------+------->
                      |    .-,----------------------------------------.      |
                      |    V                                      (1) |      |
                      '-(----| Multiple-Column Constraint Format |-----+--)--'

                                 (2)
>--+---------------------+--| Options |-------------------------------------------|
   '-UNDER--supertable---'
```

Notes:

1 See page 2-184

2 See page 2-187

Element	Description	Restrictions	Syntax
row_type	Name of the ROW type on which this table is based	Must be a named ROW data type registered in the local database	Data Type, p. 4-18; Identifier, p. 5-22
supertable	Name of the table from which this table inherits its properties	Must already exist as a typed table	Database Object Name, p. 5-17

If you use the UNDER clause, the *row_type* must be derived from the ROW type of the *supertable*. A type hierarchy must already exist in which the named ROW type of the new table is a subtype of the named ROW type of the *supertable*.

Jagged rows are any set rows from a table hierarchy in which the number of columns is not fixed among the typed tables within the hierarchy. Some APIs, such as ESQL/C and JDBC, do not support queries that return jagged rows.

When you create a typed table, CREATE TABLE cannot specify names for its columns, because the column names were declared when you created the ROW type. Columns of a typed table correspond to the fields of the named ROW type. The ALTER TABLE statement cannot add additional columns to a typed table.

For example, suppose you create a named ROW type, **student_t,** as follows:

```
CREATE ROW TYPE student_t
   (name       VARCHAR(30),
    average     REAL,
    birthdate   DATETIME YEAR TO DAY)
```

If a table is assigned the type **student_t**, the table is a typed table whose columns are of the same name and data type, and in the same order, as the fields of the type **student_t**. For example, the following CREATE TABLE statement creates a typed table named **students** whose type is **student_t**:

```
CREATE TABLE students OF TYPE student_t
```

The **students** table has the following columns:

```
name      VARCHAR(30)
average   REAL
birthdate DATETIME
```

For more information about ROW types, refer to the CREATE ROW TYPE statement on page 1-194.

Using Large-Object Data in Typed Tables

Use the BLOB or CLOB instead of BYTE or TEXT data types when you create a typed table that contains columns for large objects. For backward compatibility, you can create a named-ROW type that contains BYTE or TEXT fields and use that ROW type to re-create an existing (untyped) table as a typed table. Although you can use a ROW type that contains BYTE or TEXT fields to create a typed table, such a ROW type is not valid as a column. You can, however, use a ROW type that contains BLOB or CLOB fields both in typed tables and in columns.

Using the UNDER Clause

Use the UNDER clause to specify inheritance (that is, define the new table as a subtable). The subtable inherits properties from the specified supertable. In addition, you can define new properties specific to the subtable.

Continuing the example shown in “OF TYPE Clause (IDS)” on page 2-204, the following statements create a typed table, **grad_students**, that inherits all of the columns of the **students** table but also has columns for **adviser** and **field_of_study** that correspond to fields in the **grad_student_t** ROW type:

```
CREATE ROW TYPE grad_student_t
   (adviser       CHAR(25),
    field_of_study CHAR(40)) UNDER student_t;

CREATE TABLE grad_students OF TYPE grad_student_t  UNDER students;
```

When you use the UNDER clause, the subtable inherits these properties:

- All columns in the supertable
- All constraints defined on the supertable

- All indexes defined on the supertable
- All triggers defined on the supertable.
- All referential integrity constraints
- The access method
- The storage option specification (including fragmentation strategy)

  If a subtable defines no fragments, but if its supertable has fragments defined, then the subtable inherits the fragments of the supertable.

Tip: Any heritable attributes that are added to a supertable after subtables have been created are automatically inherited by existing subtables. You do not need to add all heritable attributes to a supertable before you create its subtables.

Restrictions on Table Hierarchies: Inheritance occurs in one direction only, namely from supertable to subtable. Properties of subtables are *not* inherited by supertables. The section "System Catalog Information" on page 2-207 lists the inherited database objects for which the system catalog maintains no information regarding subtables.

No two tables in a table hierarchy can have the same data type. For example, the final line of the next code example is invalid, because the tables **tab2** and **tab3** cannot have the same row type (**rowtype2**):

```
        create row type rowtype1 (...);
        create row type rowtype2 (...) under rowtype1;
        create table tab1 of type rowtype1;
        create table tab2 of type rowtype2 under tab1;
--Invalid -->           create table tab3 of type rowtype2 under tab1;
```

Privileges on Tables

The privileges on a table describe both who can access the information in the table and who can create new tables. For more information about access privileges, see "GRANT" on page 2-371.

In an ANSI-compliant database, no default table-level privileges exist. You must grant these privileges explicitly.

Setting the environment variable **NODEFDAC** to yes prevents default privileges from being granted to PUBLIC on new tables in a database that is not ANSI compliant, as described in the *IBM Informix Guide to SQL: Reference*. For more information about privileges, see the *IBM Informix Guide to SQL: Tutorial*.

Default Index Creation Strategy for Constraints

When you create a table with unique or primary-key constraints, the database server creates an internal index that is unique and ascending for each constraint.

When you create a table with a referential constraint, the database server creates an internal index that is ascending and that allows duplicate values for each column that you specify in the referential constraint.

An internal index occupies the same storage location as its table. For fragmented tables, the fragments of an internal index occupy the same dbspace partitions that you specify for the table fragments (or in some cases, the database dbspace).

If you require an index fragmentation strategy that is independent of the underlying table fragmentation, do not define the constraint when you create the table. Instead, use the CREATE INDEX statement to create a unique index with the desired fragmentation strategy. Then use the ALTER TABLE statement to add the constraint. The new constraint uses the previously defined index.

Important: In a database without logging, *detached checking* is the only kind of constraint checking available. Detached checking means that constraint checking is performed on a row-by-row basis.

System Catalog Information

When you create a table, the database server adds information about the table to the **systables** system catalog table, and column information to **syscolumns** system catalog table. The **sysfragments** system catalog table contains information about fragmentation strategies and the location of fragments. The **sysblobs** system catalog table contains information about the location of dbspaces and of simple large objects. (The **syschunks** table in the **sysmaster** database contains information about the location of smart large objects.)

The **systabauth**, **syscolauth**, **sysfragauth**, **sysprocauth**, **sysusers**, and **sysxtdtypeauth** tables contain information about the privileges that various CREATE TABLE options require. The **systables**, **sysxtdtypes**, and **sysinherits** system catalog tables provide information about table types.

Constraints, indexes, and triggers are recorded in the system catalog for the supertable, but not for subtables that inherit them. Fragmentation information, however, is recorded for both supertables and subtables. For more information about inheritance, refer to the *IBM Informix Guide to SQL: Tutorial*.

Related Information

Related statements: ALTER TABLE, CREATE INDEX, CREATE DATABASE, CREATE EXTERNAL TABLE (XPS), CREATE ROW TYPE, CREATE Temporary TABLE, DROP TABLE, SET Database Object Mode, and SET Transaction Mode

For Extended Parallel Server, see also SET Default Table Type and SET Default Table Space.

For discussions of database and table creation, including discussions on data types, data-integrity constraints, and tables in hierarchies, see the *IBM Informix Database Design and Implementation Guide*.

For information about the system catalog tables that store information about objects in the database, see the *IBM Informix Guide to SQL: Reference*. For information about the **syschunks** table (in the **sysmaster** database) that contains information about the location of smart large objects, see your *IBM Informix Administrator's Reference*.

CREATE TEMP TABLE

Use the CREATE TEMP TABLE statement to create a temporary table in the current database.

Syntax

```
>>──CREATE──TEMP──TABLE──table──┤ Table Definition ├──────────────────────────────────────────────><
```

Table Definition:

```
     ┌─,──────────────────────┐
     ↓                   (1)  │                                                        (3)
├──(──┤ Column Definition ├──┴──┬───────────────────────────────────────┬──)──┤ Options ├──────────►
                                │       ┌─,─────────────────────────┐   │
                                │       ↓                      (2)  │   │
                                └─,──┬─┤ Multiple-Column Constraint ├─┴──┘
                                     │                    (1)       │
                                     └─┤ Column Definition ├────────┘

►──┬─────────────┬──────────────────────────────────────────────────────────────────────────────┤
   └─WITH NO LOG─┘
```

Notes:

1 See page 2-209

2 See page 2-211

3 See page 2-212

Element	Description	Restrictions	Syntax
table	Name declared here for a temporary table	Must be unique among the names of temporary tables in the same session	Identifier, p. 5-22

Usage

The CREATE TEMP TABLE statement is a special case of the CREATE Temporary TABLE statement. The CREATE Temporary TABLE statement can also create a SCRATCH table in an Extended Parallel Server database.

For the complete syntax and semantics of the CREATE TEMP TABLE statement, see "CREATE Temporary TABLE" on page 2-209.

CREATE Temporary TABLE

Use the CREATE Temporary TABLE statement to create a temporary table in the current database.

Syntax

```
>>──CREATE──┬─TEMP────────────┬─TABLE──table──┤ Table Definition ├──────────────────────────────><
            │  (1)            │
            └─────────SCRATCH─┘
```

Table Definition:

```
     ┌─,──────────────────────────┐
     ▼                      (2)   │
├──(───┤ Column Definition ├──────┴─┬───────────────────────────────────────────────────┬─)──────►
                                    │     ┌─,─────────────────────────────────────┐     │
                                    │     ▼                                  (3)  │     │
                                    └─,─┬─┤ Multiple-Column Constraint Format ├───┴─────┘
                                        │                        (2)             │
                                        └─┤ Column Definition ├──────────────────┘

                         (4)
►──┬─────────────┬─┤ Options ├────────────────────────────────────────────────────────────────────┤
   └─WITH NO LOG─┘
```

Notes:

1 Extended Parallel Server only

2 See page 2-209

3 See page 2-211

4 See page 2-212

Element	Description	Restrictions	Syntax
table	Name declared here for a table	Must be unique in session	Database Object Name, p. 5-17

Usage

You must have the Connect privilege on the database to create a temporary table. The temporary table is visible only to the user who created it.

In DB–Access, using the CREATE Temporary Table statement outside the CREATE SCHEMA statement generates warnings if you set **DBANSIWARN**.

In ESQL/C, the CREATE Temporary TABLE statement generates warnings if you use the **-ansi** flag or set the **DBANSIWARN** environment variable.

Using the TEMP Option

When you create a TEMP table, you can build indexes and constraints on the table.

Using the SCRATCH Option (XPS)

Use the SCRATCH keyword to reduce the overhead of transaction logging. A scratch table is a nonlogging temporary table that does not support indexes or referential constraints. A scratch table is identical to a TEMP table created with the WITH NO LOG option. Operations on scratch tables are not included in transaction-log operations.

Naming a Temporary Table

A temporary table is associated with a session, not with a database. When you create a temporary table, you cannot create another temporary table with the same name (even for another database) until you drop the first temporary table or end the session. The name must be different from the name of any other table, view, sequence object, or synonym in the current database, but it need not be different from the temporary table names that are declared by other users.

In an ANSI-compliant database, the combination *owner*.*table* must be unique in the database.

Using the WITH NO LOG Option

In Extended Parallel Server, you should use a SCRATCH table rather than a TEMP...WITH NO LOG table. The behavior of a temporary table that you create with the WITH NO LOG option is the same as that of a SCRATCH table.

Use the WITH NO LOG option to reduce the overhead of transaction logging. If you specify WITH NO LOG, operations on the temporary table are not included in the transaction-log operations. The WITH NO LOG option is required on all temporary tables that you create in temporary dbspaces.

In Dynamic Server, if you use the WITH NO LOG option in a database that does not use logging, the WITH NO LOG keywords are ignored. If your database does not have logging, every table behaves as if the WITH NO LOG option were specified.

Once you turn off logging on a temporary table, you cannot turn it back on; a temporary table, therefore, is either always logged or else never logged.

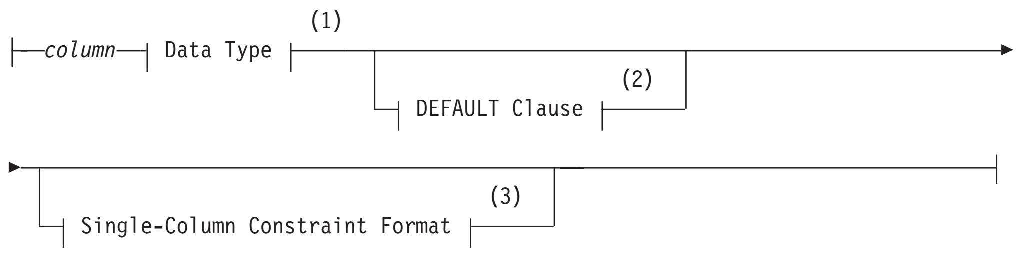
The following temporary table is not logged in a database that uses logging:

```
CREATE TEMP TABLE tab2 (fname CHAR(15), lname CHAR(15))
   WITH NO LOG
```

Column Definition

Use the Column Definition segment of CREATE Temporary TABLE to list the name, data type, default value, and constraints of a single column.

Column Definition:



Notes:

1 See page 4-18

2 See page 2-174

3 See page 2-211

Element	Description	Restrictions	Syntax
column	Name declared here for a column in the table	Must be unique in its table	Identifier, p. 5-22

This portion of the CREATE Temporary TABLE statement is almost identical to the corresponding section in the CREATE TABLE statement. The difference is that fewer types of constraints are allowed in a temporary table.

Single-Column Constraint Format

Use the single-column constraint format to create one or more data-integrity constraints for a single column in a temporary table.

Single-Colum Constraint Format:

```
├──NOT NULL──┬──┬─UNIQUE──────────┬──┬────────────────────────────────────────────┤
             │  │  (1)            │  │
             │  ├───────DISTINCT──┤  │
             │  └─PRIMARY KEY─────┘  │
             │                 (2)   │
             └──┤ CHECK Clause ├─────┘
```

Notes:

1 Informix extension

2 See page 2-181

This is a subset of the syntax of "Single-Column Constraint Format" on page 2-176 that the CREATE TABLE statement supports.

You can find detailed discussions of specific constraints in these sections.

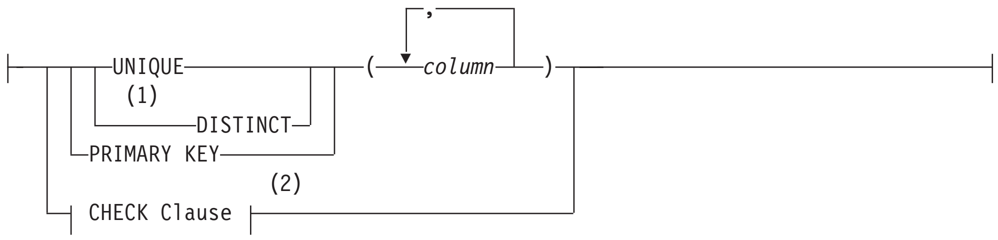
Constraint	**For more information, see**
CHECK	"CHECK Clause" on page 2-181
DISTINCT	"Using the UNIQUE or DISTINCT Constraints" on page 2-177
NOT NULL	"Using the NOT NULL Constraint" on page 2-177
PRIMARY KEY	"Using the PRIMARY KEY Constraint" on page 2-178
UNIQUE	"Using the UNIQUE or DISTINCT Constraints" on page 2-177

Constraints that you define on temporary tables are always enabled.

Multiple-Column Constraint Format

Use the multiple-column constraint format to associate one or more columns with a constraint. This alternative to the single-column constraint format allows you to associate multiple columns with a constraint.

Multiple-Column Constraint Format:



Notes:

1 Informix extension

2 See page 2-181

Element	Description	Restrictions	Syntax
column	Name of column or columns on which the constraint is placed	Must be unique in a table, but the same name can be in different tables of the same database	Identifier, p. 5-22

This is a subset of the syntax of "Multiple-Column Constraint Format" on page 2-184 that the CREATE TABLE statement supports.

This alternative to the single-column constraint segment of CREATE Temporary TABLE can associate multiple columns with a constraint. Constraints that you define on temporary tables are always enabled.

The following table indicates where you can find detailed discussions of specific constraints.

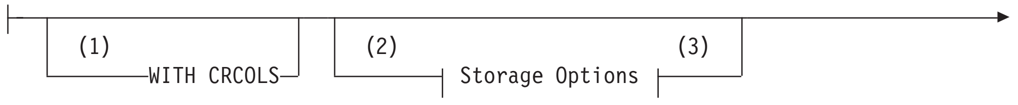
Constraint	For more information, see	For an example, see
CHECK	"CHECK Clause" on page 2-181	"Defining Check Constraints Across Columns" on page 2-186
DISTINCT	"Using the UNIQUE or DISTINCT Constraints" on page 2-177	"Examples of the Multiple-Column Constraint Format" on page 2-186
PRIMARY KEY	"Using the PRIMARY KEY Constraint" on page 2-178	"Defining Composite Primary and Foreign Keys" on page 2-187
UNIQUE	"Using the UNIQUE or DISTINCT Constraints" on page 2-177	"Examples of the Multiple-Column Constraint Format" on page 2-186

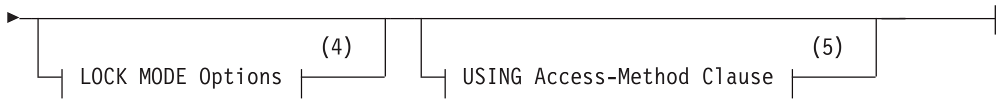
See also the section "Differences Between a Unique Constraint and a Unique Index" on page 2-178.

Temporary Table Options

The Options clauses of CREATE Temporary TABLE let you specify storage locations, locking modes, and user-defined access methods. You cannot specify the size of the initial or next extents for a temporary table. Extents for a temporary table always have a size of eight pages.

Options:





Notes:

1 Dynamic Server only

2 Informix extension

3 See page 2-213

4 See page 2-203

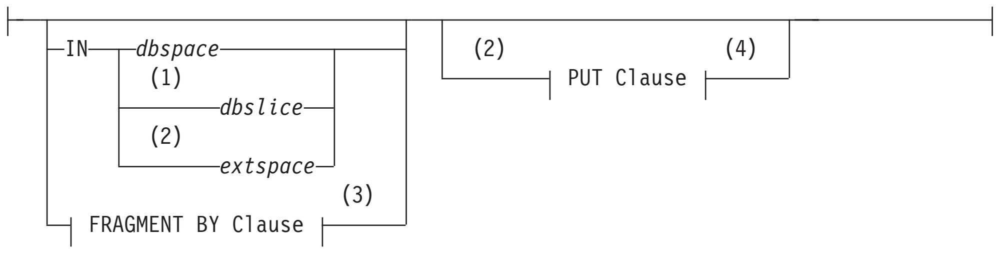
5 See page 2-202

This is a subset of the syntax of "Options Clauses" on page 2-187 that the CREATE TABLE statement supports.

Storage Options

Use the storage-option segment of the CREATE Temporary Table statement to specify the storage location and distribution scheme for the table. This is an extension to the ANSI/ISO standard for SQL syntax. Unlike the corresponding storage-options segment of the CREATE TABLE statement, no EXTENT SIZE options are supported for temporary tables.

Storage Options:



Notes:

1 Extended Parallel Server only

2 Dynamic Server only

3 See page 2-190

4 See page 2-199

Element	Description	Restrictions	Syntax
dbspace	Dbspace in which to store the table.	Must already exist	Identifier, p. 5-22
dbslice	Name of the dbslice in which to store the table	Must already exist	Identifier, p. 5-22
extspace	Name that **onspaces** assigned to a storage area outside the database server	Must already exist	See documentation for access method.

To create a fragmented, unique index on a temporary table, you must specify an explicit expression-based distribution scheme for a temporary table in the CREATE Temporary TABLE statement.

If you are using Extended Parallel Server, you can fragment a temporary table across multiple dbspaces that different coservers manage.

Where Temporary Tables are Stored

The distribution scheme that you specify with the CREATE Temporary TABLE statement (either with the IN clause or the FRAGMENT BY clause) takes precedence over the information that the **DBSPACETEMP** environment variable or the DBSPACETEMP configuration parameter specifies.

3 If you do not specify an explicit distribution scheme for a temporary table, its
3 storage location depends on the **DBSPACETEMP** (or DBSPACETEMP) setting.

- If **DBSPACETEMP** and DBSPACETEMP are not set, all temporary tables are created without fragmentation in the same dbspace where the database was created (or in **rootdbs**, if the database was not created in another dbspace).
- If only one dbspace for temporary tables is specified by **DBSPACETEMP** (or by DBSPACETEMP, if **DBSPACETEMP** is not set), all temporary tables are created without fragmentation in the specified dbspace.
- If **DBSPACETEMP** (or DBSPACETEMP, if **DBSPACETEMP** is not set) specifies two or more dbspaces for temporary tables, then each temporary table is created in one of the specified dbspaces.

  In a non-logging database, each temporary table is created in a temporary dbspace; in a databases that support transaction logging, the temporary table is created in a standard dbspace. The database server keeps track of which of these dbspaces was most recently used, and when it receives the next request to allocate temporary storage, the database server uses the next available dbspace (in a round-robin pattern) in order to allocate I/O operations approximately evenly among those dbspaces.

3 For example, if you create three temporary tables in a database with logging where
3 **DBSPACETEMP** specifies **tempspc1**, **tempspc2**, and **tempspc3** as the default
3 dbspaces for temporary tables, then the first table is created in the dbspace called
3 **tempspc1**, the second table is created in **tempspc2**, and the third one is created in
3 **tempspc3**, if these are the only requests for temporary storage.

Temporary tables created with SELECT... INTO TEMP or SELECT... INTO
3 SCRATCH also behave this way, so that **DBSPACETEMP** (or DBSPACETEMP)
settings that specify multiple dbspaces result in round-robin fragmentation.

For more information on the **DBSPACETEMP** environment variable, see the *IBM Informix Guide to SQL: Reference*. For more information on the DBSPACETEMP configuration parameter, see your *IBM Informix Administrator's Reference*.

The following example shows how to insert data into a temporary table called **result_tmp** to output to a file the results of a user-defined function (**f_one**) that returns multiple rows:

```
CREATE TEMP TABLE result_tmp( ... );
INSERT INTO result_tmp EXECUTE FUNCTION f_one();
UNLOAD TO 'file' SELECT * FROM temp1;
```

In Extended Parallel Server, to re-create this example, use the EXECUTE PROCEDURE statement instead of the EXECUTE FUNCTION statement.

Differences between Temporary and Permanent Tables

Compared to permanent tables, temporary tables differ in these ways:

- They have fewer types of constraints available.
- They have fewer options that you can specify.
- They are not visible to other users or sessions.

- They do not appear in the system catalog tables.
- They are not preserved.

  For more information, see "Duration of Temporary Tables" on page 2-215.

In Extended Parallel Server, you can use the following data definition statements on a temporary table from a secondary coserver: CREATE Temporary TABLE, CREATE INDEX, CREATE SCHEMA, DROP TABLE, and DROP INDEX.

The INFO statement and the **Info Menu** option of DB–Access cannot reference temporary tables.

Duration of Temporary Tables

The duration of a temporary table depends on whether or not it is logged.

A logged temporary table exists until one of the following situations occurs:
- The application disconnects.
- A DROP TABLE statement is issued on the temporary table.
- The database is closed.

When any of these events occur, the temporary table is deleted.

Nonlogging temporary tables include tables that were created using the WITH NO LOG option of CREATE TEMP TABLE and all SCRATCH tables.

A nonlogging temporary table exists until one of the following events occurs:
- The application disconnects.
- A DROP TABLE statement is issued on the temporary table.

Because these tables do not disappear when the database is closed, you can use a nonlogging temporary table to transfer data from one database to another while the application remains connected.

Related Information

Related statements: ALTER TABLE, CREATE TABLE, CREATE DATABASE, DROP TABLE, and SELECT

If you use Extended Parallel Server, see also SET Default Table Type and SET Default Table Space.

For additional information about the **DBANSIWARN** and **DBSPACETEMP** environment variables, refer to the *IBM Informix Guide to SQL: Reference*.

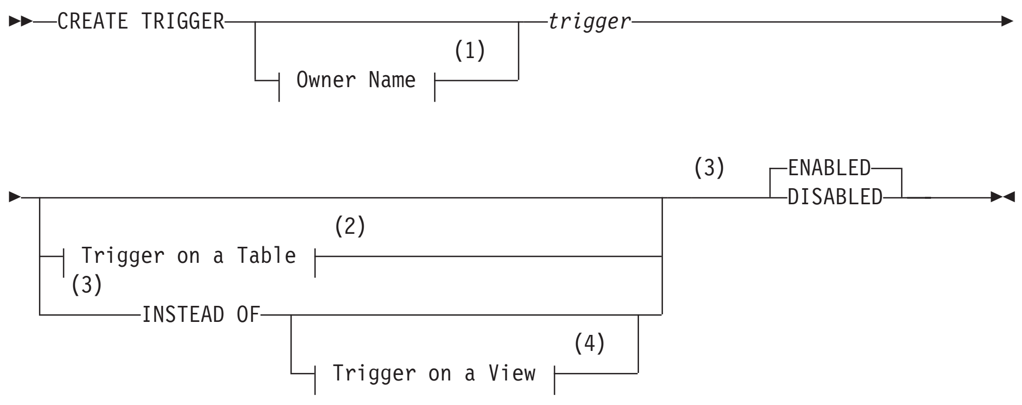
For additional information about the ONCONFIG parameter DBSPACETEMP, see your *IBM Informix Administrator's Guide*.

CREATE TRIGGER

Use the CREATE TRIGGER statement to define a trigger on a table.

This is an extension to the ANSI/ISO standard for SQL. For Dynamic Server, you can also use CREATE TRIGGER to define an INSTEAD OF trigger on a view.

Syntax



Notes:

1 See page 5-43

2 See page 2-217

3 Dynamic Server only

4 See page 2-243

Element	Description	Restrictions	Syntax
trigger	Name that you declare here for a new trigger	Must be unique among the names of triggers in the current database	Identifier, p. 5-22

Usage

A *trigger*, unless disabled, automatically executes a specified set of SQL statements, called the *trigger action*, when a specified *trigger event* occurs.

The trigger event that initiates the trigger action can be an INSERT, DELETE, UPDATE, or (for triggers on IDS tables only) a SELECT statement. The event must specify the table or view on which the trigger is defined. (SELECT or UPDATE events for triggers on tables can also specify one or more columns.)

You can use the CREATE TRIGGER statement in two distinct ways:
- You can define a trigger on a table in the current database.
- For Dynamic Server, you can also define an INSTEAD OF trigger on a view in the current database.

Any SQL statement that is an instance of the trigger event is called a *triggering statement*. When the event occurs, triggers defined on tables and triggers defined on views differ in whether the triggering statement is executed:
- For tables, the trigger event and the trigger action both execute.
- For views, only the trigger action executes, instead of the event.

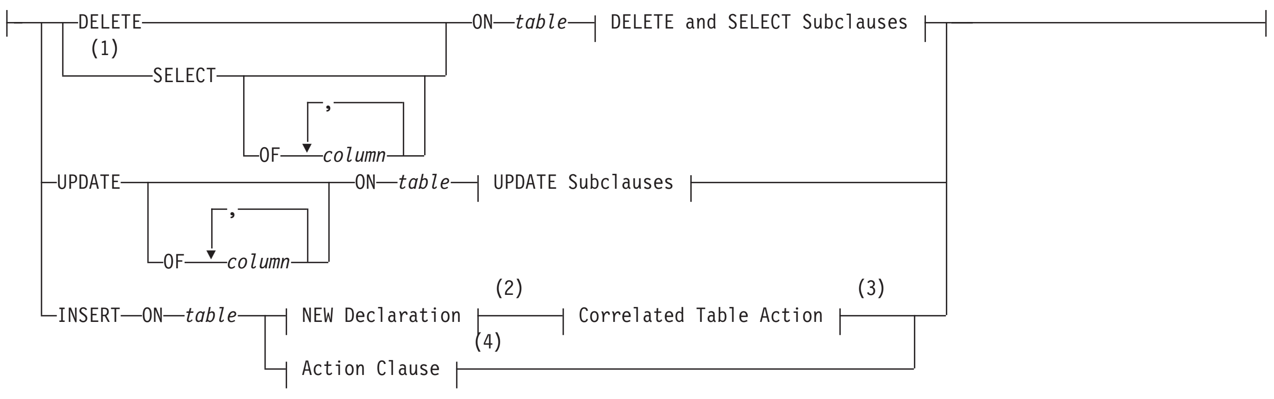
The CREATE TRIGGER statement can support the integrity of data in the database by defining rules by which specified DML operations (the triggering events) cause the database server to take specified actions. The following sections describe the syntax elements. Sections whose names are followed by ″(IDS)″ describe features that are not supported by Extended Parallel Server.

Clause	Page	Effect
Defining a Trigger Event and Actions	2-217	Associates triggered actions with an event
Trigger Modes (IDS)	2-219	Enables or disables the trigger
Insert Events and Delete Events	2-222	Defines Insert events and Delete events
Update Events	2-222	Defines Update events
Select Events (IDS)	2-223	Defines Select events
Action Clause	2-226	Defines triggered actions
REFERENCING Clause for Delete	2-228	Declares qualifier for deleted values
REFERENCING Clause for Insert	2-229	Declares qualifier for inserted values
REFERENCING Clause for Update	2-230	Declares qualifiers for old and new values
REFERENCING Clause for Select (IDS)	2-231	Declares qualifier for result set values
Correlated Table Action	2-231	Defines triggered actions
Triggered Action List	2-232	Defines triggered actions
INSTEAD OF Trigger on Views (IDS)	2-243	Defines a trigger on views
Action Clause of INSTEAD OF Triggers (IDS)	2-244	Triggered actions on views

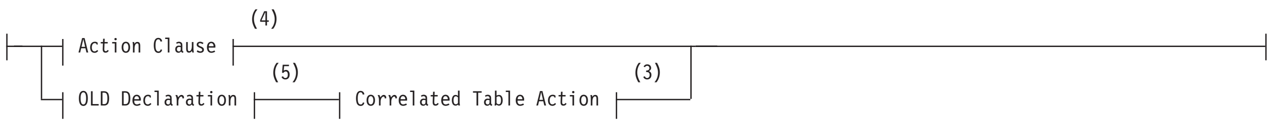
Defining a Trigger Event and Action

This syntax defines the event and action of a trigger on a table or on a view.

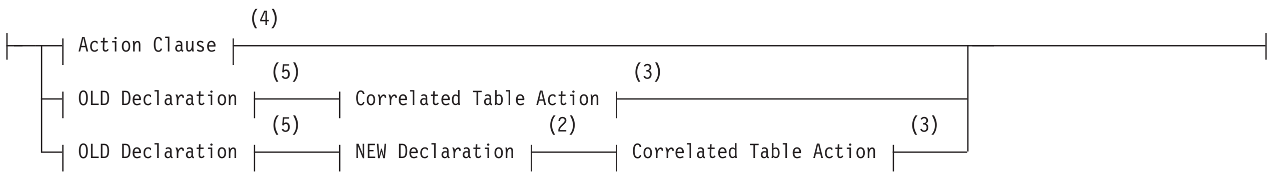
Trigger on a Table:



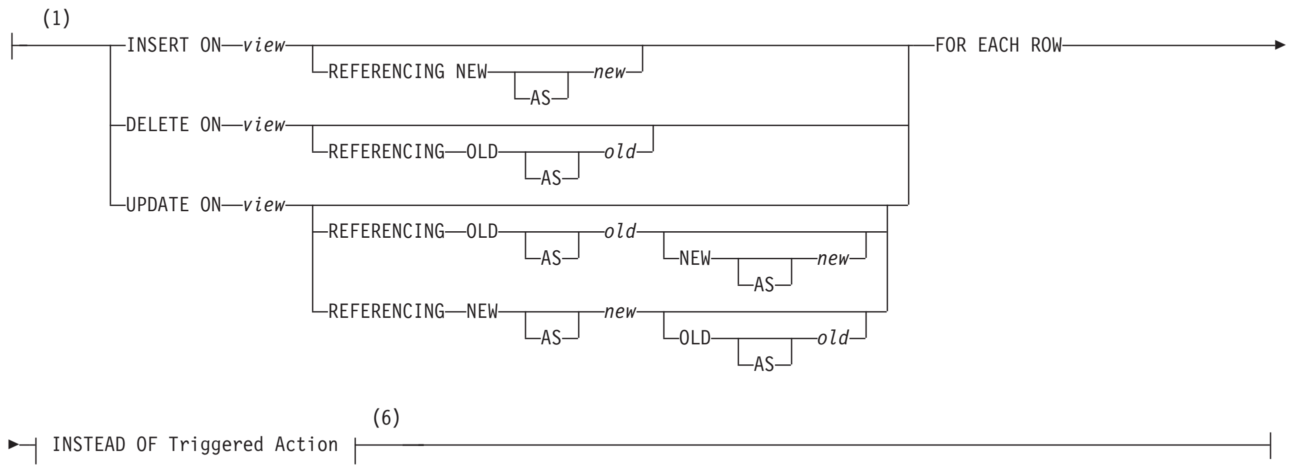
DELETE and SELECT Subclauses:



UPDATE Subclauses:



Trigger on a View:



Notes:

1 Dynamic Server only

2 See page 2-229

3 See page 2-231

4 See page 2-226

5 See page 2-230

6 See page 2-243

Element	Description	Restrictions	Syntax
column	The name of a column in the triggering *table*	Must exist	Identifier, p. 5-22
new, old	Old or new correlation name that you declare here	Unique in this trigger	Identifier, p. 5-22
table, view	Name or synonym of the triggering table or view. The *table* or *view* can include an *owner*. qualifier.	Must exist in the current database	Database Object Name, p. 5-17

The left-hand portion of the main diagram (including the *table* or *view*) defines the *trigger event* (sometimes called the *triggering event*). The rest of the diagram declares correlation names and defines the *trigger action* (sometimes called the *triggered action*). (For triggers on tables, see "Action Clause" on page 2-226 and "Correlated Table Action" on page 2-231. For INSTEAD OF triggers on views, see "The Action Clause of INSTEAD OF Triggers (IDS)" on page 2-244.)

Restrictions on Triggers

To create a trigger on a table or a view, you must own the table or view, or have DBA status. For the relationship between the privileges of the trigger owner and those of other users, see “Privileges to Execute Trigger Actions” on page 2-239.

The table on which you create a trigger must exist in the current database. You cannot create a trigger on any of the following types of tables:

- A diagnostics table, a violations table, or a table in another database
- A raw table, a temporary table, or a system catalog table

Extended Parallel Server does not support triggers on a static or scratch tables, and does not support light appends on operational tables on which a trigger is defined. (Light appends are described in the *IBM Informix Administrator's Guide*.)

For additional restrictions on INSTEAD OF triggers on views, see “Restrictions on INSTEAD OF Triggers on Views (IDS)” on page 2-245.

In DB–Access, if you want to define a trigger as part of a schema, place the CREATE TRIGGER statement inside a CREATE SCHEMA statement.

If you are embedding the CREATE TRIGGER statement in an ESQL/C program, you cannot use a host variable in the trigger definition.

You can use the DROP TRIGGER statement to remove an existing trigger. If you use DROP TABLE or DROP VIEW to remove triggering tables or views from the database, all triggers on those tables or views are also dropped.

Trigger Modes (IDS)

You can set a trigger mode to enable or disable a trigger when you create it.

Trigger Modes

```
      ┌─ENABLED──┐
►►────┴─DISABLED─┴───────────────────────────────────────────────►◄
```

You can create triggers on tables or on views in ENABLED or DISABLED mode.

- When a trigger is created in ENABLED mode, the database server executes the trigger action when the trigger event is encountered. (If you specify no mode when you create a trigger, ENABLED is the default mode.)
- When a trigger is created in DISABLED mode, the trigger event does not cause execution of the trigger action. In effect, the database server ignores the trigger and its action, even though the **systriggers** system catalog table maintains information about the disabled trigger.

You can also use the SET TRIGGERS option of the Database Object Mode statement to set an existing trigger to the ENABLED or DISABLED mode.

After a DISABLED trigger is enabled by the SET TRIGGERS statement, the database server can execute the trigger action when the trigger event is encountered, but the trigger does not perform retroactively. The database server does not attempt to execute the trigger for rows that were selected, inserted, deleted, or updated while the trigger was disabled and before it was enabled.

Warning: Because the behavior of a trigger varies according to its ENABLED or DISABLED mode, be cautious about disabling a trigger. If disabling a trigger will eventually destroy the semantic integrity of the database, do not disable the trigger.

Trigger Inheritance in a Table Hierarchy (IDS)

By default, any trigger that you define on a typed table of Dynamic Server is inherited by all its subtables.

If you define a trigger on a subtable of a typed table, however, this trigger overrides any trigger for the same type of triggering event (Select, Delete, Insert, or Update) that the subtable inherits from its supertable. A trigger that you set on a subtable is inherited by all its dependent tables, but has no effect on its supertable.

If a subtable within a table hierarchy is under more than one table that defines the same type of trigger, the subtable inherits only the trigger from the most proximate table above it in the hierarchy, because that trigger overrides any inherited trigger that is defined for the same type of triggering event.

This behavior is important when you require a trigger to be enabled in a supertable, but to be disabled in its subtable. You cannot use the SET TRIGGERS option of the SET Database Object Mode statement to disable an inherited trigger selectively within a hierarchy. Similarly, the DROP TRIGGER statement cannot destroy an inherited trigger without also destroying the trigger on the supertable. In this situation, you must instead define a trigger with no Action clause on the subtable. Because triggers are not additive, this empty trigger overrides the inherited trigger and executes for the subtable and for any subtables under the subtable, which are not subject to further overrides.

Triggers and SPL Routines

You cannot define a trigger in an SPL routine that is called inside a DML (data manipulation language) statement, as listed in "Data Manipulation Language Statements" on page 1-7. Thus, the following statement returns an error if the **sp_items** procedure includes the CREATE TRIGGER statement:

```
INSERT INTO items EXECUTE PROCEDURE sp_items
```

SPL variables are not valid in CREATE TRIGGER statements. An SPL routine called by a trigger cannot perform INSERT, DELETE, or UPDATE operations on any table or view that is not local to the current database. See also "Rules for SPL Routines" on page 2-238 for additional restrictions on SPL routines that are invoked in triggered actions.

Trigger Events

The *trigger event* specifies what DML statements can initiate the trigger. The event can be an INSERT, DELETE, or UPDATE operation on the *table* or *view*, or (for IDS tables only) a SELECT operation that manipulates the *table*. You must specify exactly one trigger event. Any SQL statement that is an instance of the trigger event is called a *triggering statement.*

For each *table*, you can define only one trigger that is activated by an INSERT statement and only one trigger that is activated by a DELETE statement. The same table, however, can have multiple triggers that are activated by UPDATE or SELECT statements, provided that each trigger specifies a disjunct set of columns in defining the UPDATE or SELECT event on the table.

You cannot specify a DELETE event if the triggering table has a referential constraint that specifies ON DELETE CASCADE.

You are responsible for guaranteeing that the triggering statement returns the same result with and without the trigger action on a table. See also the sections "Action Clause" on page 2-226 and "Triggered-Action List" on page 2-232.

A triggering statement from an external database server can activate the trigger.

As the following example shows, an Insert trigger on **newtab**, managed by **dbserver1**, is activated by an INSERT statement from **dbserver2**. The trigger executes as if the INSERT originated on **dbserver1**.

```
-- Trigger on stores_demo@dbserver1:newtab
CREATE TRIGGER ins_tr INSERT ON newtab
   REFERENCING new AS post_ins
   FOR EACH ROW(EXECUTE PROCEDURE nt_pct (post_ins.mc));
-- Triggering statement from dbserver2
INSERT INTO stores_demo@dbserver1:newtab
   SELECT item_num, order_num, quantity, stock_num, manu_code,
   total_price FROM items;
```

Dynamic Server also supports INSTEAD OF triggers on views, which are initiated when a triggering DML operation references the specified view. The INSTEAD OF trigger replaces the trigger event with the specified trigger action on a view, rather than execute the triggering INSERT, DELETE, or UPDATE operation. A *view* can have no more than one INSTEAD OF trigger defined for each type of event (INSERT, DELETE, or UPDATE). You can, however, define a trigger on one or more other views, each with its own INSTEAD OF trigger.

Trigger Events with Cursors

For triggers on tables, if the triggering statement uses a cursor, each part of the trigger action (including BEFORE, FOR EACH ROW, and AFTER, if these are specified for the trigger) is activated for each row that the cursor processes.

This behavior differs from what occurs when a triggering statement does not use a cursor and updates multiple rows. In this case, any BEFORE and AFTER triggered actions execute only once, but the FOR EACH ROW action list is executed for each row processed by the triggering statement. For additional information about trigger actions, see "Action Clause" on page 2-226

Privileges on the Trigger Event

You must have appropriate Insert, Delete, Update, or Select privilege on the triggering table or view to execute a triggering INSERT, DELETE, UPDATE, or SELECT statement as the trigger event. The triggering statement might still fail, however, if you do not also have the privileges necessary to execute one of the SQL statements in the trigger action. When the trigger actions are executed, the database server checks your privileges for each SQL statement in the trigger definition, as if the statement were being executed independently of the trigger. For information on the privileges needed to execute the trigger actions, see "Privileges to Execute Trigger Actions" on page 2-239.

Performance Impact of Triggers

The INSERT, DELETE, UPDATE, and SELECT statements that initiate triggers might appear to execute slowly because they activate additional SQL statements, and the user might not know that other actions are occurring.

The execution time for a trigger event depends on the complexity of the trigger action and whether it initiates other triggers. The time increases as the number of cascading triggers increases. For more information on triggers that initiate other triggers, see “Cascading Triggers” on page 2-240.

INSERT Events and DELETE Events

INSERT and DELETE events on tables are defined by those keywords and by the ON *table* clause, using the following syntax.

INSERT or DELETE Event on a Table:

```
├──┬─INSERT─┬──ON──table──────────────────────────────────────────────┤
   └─DELETE─┘
```

Element	Description	Restrictions	Syntax
table	Name of the triggering table	Must exist in the database	Identifier, p. 5-22

An Insert trigger is activated when an INSERT statement includes the specified *table* (or a synonym for *table*) in its INTO clause. Similarly, a Delete trigger is activated when a DELETE statement includes the specified *table* (or a synonym for *table*) in its FROM clause.

For triggers on views, the INSTEAD OF keywords must immediately precede the INSERT, DELETE, or UPDATE keyword that specifies the type of trigger event, and the name or synonym of a *view* (rather than of a table) must follow the ON keyword. The section “INSTEAD OF Triggers on Views (IDS)” on page 2-243 describes the syntax for defining INSTEAD OF trigger events.

No more than one Insert trigger, and no more than one Delete trigger, can be defined on one table.

If you define a trigger on a subtable within a table hierarchy, and the subtable supports cascading deletes, then a DELETE operation on the supertable activates the Delete trigger on the subtable.

See also the section “Re-Entrancy of Triggers” on page 2-236 for information about dependencies and restrictions on the actions of Insert triggers and Delete triggers.

UPDATE Event

UPDATE events (and SELECT events) can include an optional *column* list.

UPDATE Event:

```
├──UPDATE──┬───────────────────┬──ON──table──────────────────────────┤
           │      ┌─,────┐     │
           │      ▼      │     │
           └─OF───column─┴─────┘
```

Element	Description	Restrictions	Syntax
column	Column that activates the trigger	Must exist in the triggering table	Identifier, p. 5-22
table	Name of the triggering table	Must exist in the database	Identifier, p. 5-22

If you define more than one Update trigger on the same table, the *column* list is required, and the *column* lists for each trigger must be mutually exclusive. If you omit the OF *column* list, updating any column of *table* activates the trigger.

The OF *column* clause is not valid for an INSTEAD OF trigger on a view.

An UPDATE on the triggering table can activate the trigger in two cases:
- The UPDATE statement references any column in the *column* list.
- The UPDATE event definition has no OF *column* list specification.

Whether it updates one column or more than one column from the *column* list, a triggering UPDATE statement activates the Update trigger only once.

Defining Multiple Update Triggers

Multiple Update triggers on a table cannot include the same columns. In the following example, **trig3** is not valid on the **items** table because its column list includes **stock_num**, which is a triggering column in **trig1**.

```
CREATE TRIGGER trig1 UPDATE OF item_num, stock_num ON items
   REFERENCING OLD AS pre NEW AS post
   FOR EACH ROW(EXECUTE PROCEDURE proc1());
CREATE TRIGGER trig2 UPDATE OF manu_code ON items
   BEFORE(EXECUTE PROCEDURE proc2());
-- Invalid trigger: stock_num occurs in trig1
CREATE TRIGGER trig3 UPDATE OF order_num, stock_num ON items
   BEFORE(EXECUTE PROCEDURE proc3());
```

When an UPDATE statement updates multiple columns that have different triggers, the column numbers of the triggering columns determine the order of trigger execution. Execution begins with the smallest triggering column number and proceeds in order to the largest triggering column number. The following example shows that table **taba** has four columns (**a**, **b**, **c**, **d**):

```
CREATE TABLE taba (a int, b int, c int, d int)
```

Define **trig1** as an update on columns **a** and **c**, and define **trig2** as an update on columns **b** and **d**, as the following example shows:

```
CREATE TRIGGER trig1 UPDATE OF a, c ON taba
   AFTER (UPDATE tabb SET y = y + 1);

CREATE TRIGGER trig2 UPDATE OF b, d ON taba
   AFTER (UPDATE tabb SET z = z + 1);
```

The following example shows a triggering statement for the Update trigger:

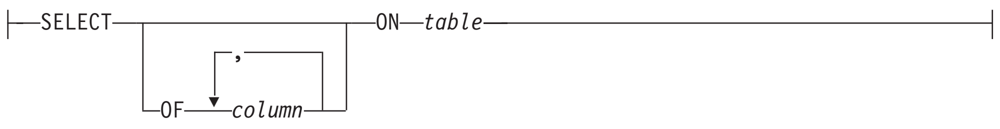
```
UPDATE taba SET (b, c) = (b + 1, c + 1)
```

Then **trig1** for columns **a** and **c** executes first, and **trig2** for columns **b** and **d** executes next. In this case, the smallest column number in the two triggers is column 1 (**a**), and the next is column 2 (**b**).

SELECT Event (IDS)

DELETE and INSERT events are defined by those keywords (and the ON *table* clause), but SELECT and UPDATE events also support an optional *column* list.

SELECT Event:



Element	Description	Restrictions	Syntax
column	Column that activates the trigger	Must exist in the triggering *table*	Identifier, p. 5-22
table	Name of the triggering table	Must exist in the database	Identifier, p. 5-22

If you define more than one Select trigger on the same table, the *column* list is required, and the *column* lists for each trigger must be mutually exclusive.

A SELECT on the triggering table can activate the trigger in two cases:
- The SELECT statement references any column in the *column* list.
- The SELECT event definition has no OF *column* list specification.

(Sections that follow, however, describe additional circumstances that can affect whether or not a SELECT statement activates a Select trigger.)

Whether it specifies one column or more than one column from the *column* list, a triggering SELECT statement activates the Select trigger only once.

The action of a Select trigger cannot include an UPDATE, INSERT, or DELETE on the triggering table. The action of a Select trigger can include UPDATE, INSERT, and DELETE actions on tables other than the triggering table. The following example defines a Select trigger on one column of a table:

```
CREATE TRIGGER mytrig
   SELECT OF cola ON mytab REFERENCING OLD AS pre
   FOR EACH ROW (INSERT INTO newtab('for each action'))
```

You cannot specify a SELECT event for an INSTEAD OF trigger on a view.

Circumstances When a Select Trigger is Activated

A query on the triggering table activates a Select trigger in these cases:
- The SELECT statement is a stand-alone SELECT statement.
- The SELECT statement occurs within a UDR called in a select list.
- The SELECT statement is a subquery in a select list.
- The SELECT statement occurs within a UDR called by EXECUTE PROCEDURE or EXECUTE FUNCTION.
- The SELECT statement selects data from a supertable in a table hierarchy. In this case the SELECT statement activates Select triggers for the supertable and all the subtables in the hierarchy.

For information on SELECT statements that do not activate a Select trigger, see "Circumstances When a Select Trigger is Not Activated" on page 2-226.

Stand-alone SELECT Statements

A Select trigger is activated if the triggering column appears in the select list of the projection clause of a stand-alone SELECT statement.

For example, if a Select trigger is defined to execute whenever column **col1** of table **tab1** is selected, then both of the following stand-alone SELECT statements activate the Select trigger:

```
SELECT * FROM tab1;
SELECT col1 FROM tab1;
```

SELECT Statements Within UDRs in the Select List

A Select trigger is activated by a UDR if the UDR contains a SELECT statement within its statement block, and the UDR also appears in the select list of the projection clause of a SELECT statement. For example, assume that a UDR named **my_rtn** contains this SELECT statement in its statement block:

```
SELECT col1 FROM tab1
```

Now suppose that the following SELECT statement invokes the **my_rtn** UDR in its select list:

```
SELECT my_rtn() FROM tab2
```

This SELECT statement activates the Select trigger defined on column **col1** of table **tab1** when the **my_rtn** UDR is executed.

UDRs That EXECUTE PROCEDURE and EXECUTE FUNCTION Call

A Select trigger is activated by a UDR if the UDR contains a SELECT statement within its statement block and the UDR is called by an EXECUTE PROCEDURE or (for IDS triggers only) the EXECUTE FUNCTION statement. For example, assume that the user-defined procedure named **my_rtn** contains the following SELECT statement in its statement block:

```
SELECT col1 FROM tab1
```

Now suppose that the following statement invokes the **my_rtn** procedure:

```
EXECUTE PROCEDURE my_rtn()
```

This statement activates the Select trigger defined on column **col1** of table **tab1** when the SELECT statement within the statement block is executed**.**

Subqueries in the Select List

A Select trigger can be activated by a subquery that appears in the select list of the Projection clause of a SELECT statement.

For example, if a Select trigger was defined on **col1** of **tab1**, the subquery in the following SELECT statement activates that trigger:

```
SELECT (SELECT col1 FROM tab1 WHERE col1=1), colx, col y FROM tabz
```

Select Triggers in Table Hierarchies

A subtable in a Dynamic Server database inherits the Select triggers that are defined on its supertable. When you select from a supertable, the SELECT statement activates the Select triggers on the supertable and the inherited Select triggers on the subtables in the table hierarchy.

For example, assume that table **tab1** is the supertable and table **tab2** is the subtable in a table hierarchy. If the Select trigger **trig1** is defined on table **tab1**, a SELECT statement on table **tab1** activates the Select trigger **trig1** for the rows in table **tab1** and the inherited Select trigger **trig1** for the rows in table **tab2**.

If you add a Select trigger to a subtable, this Select trigger can override the Select trigger that the subtable inherits from its supertable. For example, if the Select trigger **trig1** is defined on column **col1** in supertable **tab1**, the subtable **tab2** inherits this trigger. But if you define a Select trigger named **trig2** on column **col1** in subtable **tab2**, and a SELECT statement selects from **col1** in supertable **tab1**, this SELECT statement activates trigger **trig1** for the rows in table **tab1** and trigger **trig2** (not trigger **trig1**) for the rows in table **tab2**. In other words, the trigger that you add to the subtable overrides the trigger that the subtable inherits from the supertable.

Circumstances When a Select Trigger is Not Activated

In Dynamic Server, a SELECT statement on the triggering table does not activate a Select trigger in certain circumstances:

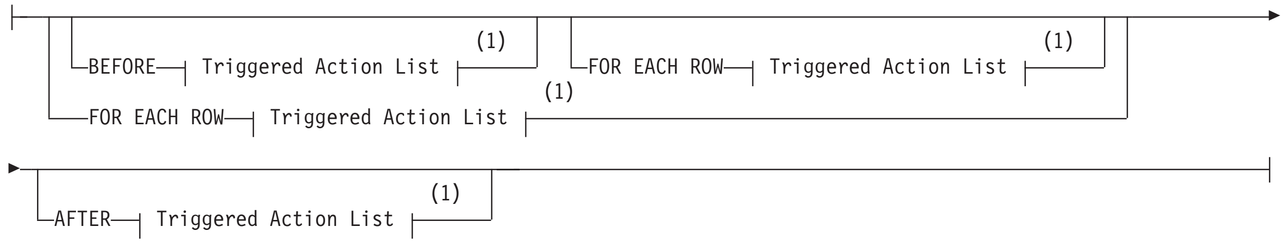
- If a subquery or UDR that contains the triggering SELECT statement appears in any clause of a SELECT statement other than the Projection clause, the Select trigger is not activated.

  For example, if the subquery or UDR appears in the WHERE clause or HAVING clause of a SELECT statement, the SELECT statement within the subquery or UDR does not activate the Select trigger.
- If the trigger action of a Select trigger calls a UDR that includes a triggering SELECT statement, the Select trigger on the SELECT in the UDR is not activated. Cascading Select triggers are not supported.
- If a SELECT statement contains a built-in aggregate or user-defined aggregate in its Projection clause, the Select trigger is not activated. For example, the following SELECT statement does not activate a Select trigger defined on **col1** of **tab1**:

  ```
  SELECT MIN(col1) FROM tab1
  ```
- A SELECT statement that includes the UNION or UNION ALL operator does not activate a Select trigger.
- The SELECT clause of INSERT does not activate a Select trigger.
- If the Projection clause of a SELECT includes the DISTINCT or UNIQUE keywords, the SELECT statement does not activate a Select trigger.
- Select triggers are not supported on scroll cursors.
- If a SELECT statement refers to a remote triggering table, the Select trigger is not activated on the remote database server.
- Columns in the ORDER BY list of a query activate no Select triggers (nor any other triggers) unless also listed in the Projection clause.

Action Clause

Action Clause:



Notes:

1 See page “Triggered-Action List” on page 2-232

The action clause defines trigger actions and can specify when they occur. You must define at least one trigger action, using the keywords BEFORE, FOR EACH ROW, or AFTER to indicate when the action occurs relative to execution of the triggering statement.

You can specify actions for any or all of these three options on a single trigger, but any BEFORE action list must be specified first, and any AFTER action list must be specified last. For more information on the action clause when a REFERENCING clause is also specified, see “Correlated Table Action” on page 2-231.

BEFORE Actions

The list of BEFORE trigger actions execute once before the triggering statement executes. Even if the triggering statement does not process any rows, the database server executes the BEFORE trigger actions.

FOR EACH ROW Actions

After a row of the triggering table is processed, the database server executes all of the statements of the FOR EACH ROW trigger action list; this cycle is repeated for every row that the triggering statement processes. (But if the triggering statement does not insert, delete, update, or select any rows, the database server does not execute the FOR EACH ROW trigger actions.)

In Extended Parallel Server, you cannot define FOR EACH ROW actions on tables that have globally-detached indexes.

In Dynamic Server, the FOR EACH ROW action list of a Select trigger is executed once for each instance of a row. For example, the same row can appear more than once in the result of a query joining two tables. For more information on FOR EACH ROW actions, see “FOR EACH ROW Actions” on page 2-227.

AFTER Actions

The specified set of AFTER trigger actions executes once after the action of the triggering statement is complete. If the triggering statement does not process any rows, the AFTER trigger actions still execute.

Actions of Multiple Triggers

When an UPDATE statement activates multiple triggers, the trigger actions merge. Assume that **taba** has columns **a**, **b**, **c**, and **d**, as this example shows:

```
CREATE TABLE taba (a int, b int, c int, d int)
```

Next, assume that you define **trig1** on columns **a** and **c**, and **trig2** on columns **b** and **d**. If both triggers specify BEFORE, FOR EACH ROW, and AFTER actions, then the trigger actions are executed in the following order:

1. BEFORE action list for trigger (**a**, **c**)
2. BEFORE action list for trigger (**b**, **d**)
3. FOR EACH ROW action list for trigger (**a**, **c**)
4. FOR EACH ROW action list for trigger (**b**, **d**)
5. AFTER action list for trigger (**a**, **c**)
6. AFTER action list for trigger (**b**, **d**)

The database server treats all the triggers that are activated by the same triggering statement as a single trigger, and the trigger action is the merged-action list. All the rules that govern a trigger action apply to the merged list as one list, and no distinction is made between the two original triggers.

Guaranteeing Row-Order Independence

In a FOR EACH ROW triggered-action list, the result might depend on the order of the rows being processed. You can ensure that the result is independent of row order by following these suggestions:

- Avoid selecting the triggering table in the FOR EACH ROW section.

  If the triggering statement affects multiple rows in the triggering table, the result of the SELECT statement in the FOR EACH ROW section varies as each row is processed. This condition also applies to any cascading triggers. See "Cascading Triggers" on page 2-240.
- In the FOR EACH ROW section, avoid updating a table with values derived from the current row of the triggering table.

  If the trigger actions modify any row in the table more than once, the final result for that row depends on the order in which rows from the triggering table are processed.
- Avoid modifying a table in the FOR EACH ROW section that is selected by another statement in the same FOR EACH ROW trigger action, including any cascading trigger actions.

If FOR EACH ROW actions modify a table, the changes might not be complete when a subsequent action of the trigger refers to the table. In this case, the result might differ, depending on the order in which rows are processed.

The database server does not enforce rules to prevent these situations because doing so would restrict the set of tables from which a trigger action can select. Furthermore, the result of most trigger actions is independent of row order. Consequently, you are responsible for ensuring that the results of the trigger actions are independent of row order.

RERERENCING Clauses

The REFERENCING clause for any event declares a *correlation name* that can be used to qualify column values in the triggering table. These names enable FOR EACH ROW actions to reference new values in the result of trigger events.

They also enable FOR EACH ROW actions to reference old column values that existed in the triggering table prior to modification by trigger events.

Correlation names are not valid if the triggered action includes both the INSERT statement and the BEFORE WHEN or AFTER WHEN keywords. This restriction does not affect triggered actions that specify the FOR EACH ROW keywords without the BEFORE or AFTER keywords, or that include no INSERT statement.

REFERENCING Clause for Delete

REFERENCING Clause for Delete:

```
|--REFERENCING--OLD--+----+--correlation------------------------------|
                     '-AS-'
```

Element	Description	Restrictions	Syntax
correlation	Name declared here to qualify old column value for use within the trigger action	Must be unique within this CREATE TRIGGER statement	Identifier, p. 5-22

The *correlation* is a qualifier for the column value in the triggering table before the triggering statement executed. The *correlation* is in scope in the FOR EACH ROW trigger action list. See “Correlated Table Action” on page 2-231.

To use a correlation name in a trigger action to refer to an old column value, prefix the column name with the correlation name and a period (**.**) symbol. For example, if the NEW *correlation* name is **post**, refer to the new value for the column **fname** as **post.fname**.

If the trigger event is a DELETE statement, using the new correlation name as a qualifier causes an error, because the column has no value after the row is deleted. For the rules that govern the use of correlation names, see “Using Correlation Names in Triggered Actions” on page 2-234.

You can use the REFERENCING clause for Delete only if you define a FOR EACH ROW trigger action.

In Extended Parallel Server, the OLD *correlation* value cannot be a BYTE or TEXT value. That is, it cannot refer to a BYTE or TEXT column.

REFERENCING Clause for Insert

REFERENCING Clause for Insert:

```
├──REFERENCING──NEW──┬──────┬──correlation──────────────────────────────────┤
                     └─AS───┘
```

Element	Description	Restrictions	Syntax
correlation	Name that you declare here for a new column value for use within the trigger action	Must be unique within this CREATE TRIGGER statement	Identifier, p. 5-22

The *correlation* is a name for the new column value after the triggering statement has executed. Its scope of reference is only the FOR EACH ROW trigger action list; see “Correlated Table Action” on page 2-231. To use the correlation name, precede the column name with the *correlation* name, followed by a period (**.**) symbol. Thus, if the NEW *correlation* name is **post**, refer to the new value for the column **fname** as **post.fname**.

If the trigger event is an INSERT statement, using the old *correlation* name as a qualifier causes an error, because no value exists before the row is inserted. For the rules that govern how to use correlation names, see “Using Correlation Names in Triggered Actions” on page 2-234. You can use the INSERT REFERENCING clause only if you define a FOR EACH ROW trigger action.

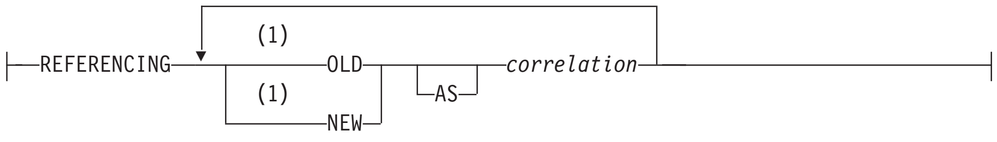
The following example illustrates use of the INSERT REFERENCING clause. This example inserts a row into **backup_table1** for every row that is inserted into **table1**. The values that are inserted into **col1** and **col2** of **backup_table1** are an exact copy of the values that were just inserted into **table1**.

```
CREATE TABLE table1 (col1 INT, col2 INT);
CREATE TABLE backup_table1 (col1 INT, col2 INT);
CREATE TRIGGER before_trig
   INSERT ON table1    REFERENCING NEW AS new
   FOR EACH ROW
   (
   INSERT INTO backup_table1 (col1, col2)
   VALUES (new.col1, new.col2)
   );
```

As the preceding example shows, the INSERT REFERENCING clause allows you to refer to data values produced by the trigger action.

REFERENCING Clause for Update

REFERENCING Clause for Update:



Notes:

1 Use path no more than once

Element	Description	Restrictions	Syntax
correlation	Name that you declare here for an old or new column value within the trigger action	Must be unique within this CREATE TRIGGER statement	Identifier, p. 5-22

The OLD *correlation* is the name of the value of the column in the triggering table before execution of the triggering statement; the NEW *correlation* identifies the corresponding value after the triggering statement executes.

The scope of reference of the *correlation* names that you declare here is only within the FOR EACH ROW trigger action list. See "Correlated Table Action" on page 2-231.

To refer to an old or new column value, prefix the column name with the *correlation* name and a period (**.**) symbol. For example, if the new *correlation* name is **post**, you can refer to the new value in column **fname** as **post.fname**.

If the trigger event is an UPDATE statement, you can define both old and new *correlation* names to refer to column values before and after the triggering UPDATE statement. For rules that govern the use of *correlation* names, see "Using Correlation Names in Triggered Actions" on page 2-234.

You can use the UPDATE REFERENCING clause only if you define a FOR EACH ROW trigger action.

In Extended Parallel Server, the OLD *correlation* value cannot be a BYTE or TEXT value. That is, it cannot refer to a BYTE or TEXT column.

REFERENCING Clause for Select (IDS)

REFERENCING Clause for Select:

```
├──REFERENCING──OLD──┬────┬──correlation───────────────────────────────────┤
                     └─AS─┘
```

Element	Description	Restrictions	Syntax
correlation	Name that you declare here for old column value for use within the trigger action	Must be unique within this CREATE TRIGGER statement	Identifier, p. 5-22

This has the same syntax as the "REFERENCING Clause for Delete" on page 2-228. The scope of reference of the *correlation* name that you declare here is only within the FOR EACH ROW trigger action list. See "Correlated Table Action" on page 2-231.

You use the *correlation* name to refer to an old column value by preceding the column name with the *correlation* name and a period (**.**) symbol. For example, if the old *correlation* name is **pre**, you can refer to the old value for the column **fname** as **pre.fname**.

If the trigger event is a SELECT statement, using the new *correlation* name as a qualifier causes an error because the column does not have a new value after the column is selected. For the rules that govern the use of correlation names, see "Using Correlation Names in Triggered Actions" on page 2-234.

You can use the SELECT REFERENCING clause only if you define a FOR EACH ROW trigger action.

Correlated Table Action

Correlated Table Action:

```
├──┬──────────────────────────────────────┬────────────────────────────►
   │                                  (1) │
   └─BEFORE──┤ Triggered-Action List ├────┘

                                     (1)
►─FOR EACH ROW──┤ Triggered-Action List ├──────────────────────────────►

►──┬──────────────────────────────────────┬────────────────────────────┤
   │                                 (1)  │
   └─AFTER──┤ Triggered-Action List ├─────┘
```

Notes:

1 See page 2-232

If the CREATE TRIGGER statement contains an INSERT REFERENCING clause, a DELETE REFERENCING clause, an UPDATE REFERENCING clause, or (for Dynamic Server only) a SELECT REFERENCING clause, you must include a FOR EACH ROW triggered-action list in the action clause. You can also include BEFORE and AFTER triggered-action lists, but they are optional.

For information on the BEFORE, FOR EACH ROW, and AFTER triggered-action lists, see "Action Clause" on page 2-226

In Extended Parallel Server, you cannot specify FOR EACH ROW actions on tables that have globally-detached indexes.

Triggered-Action List

Triggered Action List:

```
   ┌─,────────────────────────────────────────────────────────────────────┐
   │                                   ┌─,──────────────────────────────┐ │
   ▼                                   ▼                   (2)          │ │
├──┬────────────────────────────────┬─(──┤ INSERT Statement ├───────────┬─)─┴────────┤
   │                        (1)     │    │                 (3)          │
   └─WHEN──(─┤ Condition ├─────)─┘    ├─┤ DELETE Statement ├───────────┤
                                         │                 (4)          │
                                         ├─┤ UPDATE Statement ├───────────┤
                                         │                          (5) │
                                         ├─┤ EXECUTE PROCEDURE Statement ├─┤
                                         │(6)                         (7) │
                                         └────┤ EXECUTE FUNCTION Statement ├─┘
```

Notes:

1 See page 4-5

2 See page 2-395

3 See page 2-275

4 See page 2-636

5 See page 2-336

6 Dynamic Server only

7 See page 2-329

For a trigger on a table, the trigger action consists of an optional WHEN condition and the action statements. You can specify a triggered-action list for each WHEN clause, or you can specify a single list (of one or more trigger actions) if you include no WHEN clause.

Database objects that are referenced explicitly in the trigger action or in the definition of the trigger event, such as tables, columns, and UDRs, must exist when the CREATE TRIGGER statement defines the new trigger.

Attention: When you specify a date expression in the WHEN condition or in an action statement, make sure to specify four digits instead of two digits for the year. For more about abbreviated years, see the description of **DBCENTURY** in the *IBM Informix Guide to SQL: Reference*, which also describes how the behavior of some database objects can be affected by environment variable settings. Like fragmentation expressions, check constraints, and UDRs, triggers are stored in the system catalog with the creation-time settings of environment variables that can affect the evaluation of expressions like the WHEN condition. The database server ignores any subsequent changes to those settings when evaluating expressions in those database objects.

WHEN Condition

The WHEN condition makes the triggered action dependent on the outcome of a test. When you include a WHEN condition in a triggered action, the statements in the triggered action list execute only if the condition evaluates to `true`. If the WHEN condition evaluates to `false` or `unknown`, then the statements in the triggered action list are not executed.

If the triggered action is in a FOR EACH ROW section, its condition is evaluated for each row. For example, the triggered action in the following trigger executes only if the condition in the WHEN clause is true:

```
CREATE TRIGGER up_price
   UPDATE OF unit_price ON stock
   REFERENCING OLD AS pre NEW AS post
   FOR EACH ROW WHEN(post.unit_price > pre.unit_price * 2)
   (INSERT INTO warn_tab VALUES(pre.stock_num, pre.order_num,
      pre.unit_price, post.unit_price, CURRENT))
```

An SPL routine that executes inside the WHEN condition carries the same restrictions as a UDR that is called in a data manipulation statement. That is, the SPL routine cannot contain certain SQL statements. For information on which statements are restricted, see "Restrictions on SPL Routines in Data-Manipulation Statements" on page 5-71.

Action Statements

The triggered-action statements can be INSERT, DELETE, UPDATE, EXECUTE FUNCTION, or EXECUTE PROCEDURE statements. If the action list contains multiple statements, and the WHEN condition is satisfied (or is absent), then these statements execute in the order in which they appear in the list.

UDRs as Triggered Actions: User-defined functions and procedures can be triggered actions.

In Dynamic Server, you can use the EXECUTE FUNCTION statement to call any user-defined function. Use the EXECUTE PROCEDURE statement to call any user-defined procedure.

In Extended Parallel Server, you can use the EXECUTE PROCEDURE statement to execute any SPL routine.

For restrictions on using SPL routines as triggered actions, see "Rules for SPL Routines" on page 2-238 and "Triggers and SPL Routines" on page 2-220.

Achieving a Consistent Result: To guarantee that the triggering statement returns the same result with and without the triggered actions, make sure that the triggered actions in the BEFORE and FOR EACH ROW sections do not modify any table referenced in the following clauses:

- WHERE clause
- SET clause in the UPDATE statement
- SELECT clause
- EXECUTE PROCEDURE clause or EXECUTE FUNCTION clause in a multiple-row INSERT statement.

Using Reserved Words: If you use the INSERT, DELETE, UPDATE, or EXECUTE reserved words as an identifier in any of the following clauses inside a triggered action list, you must qualify them by the *owner* name, the *table* name, or both:

- FROM clause of a SELECT statement
- INTO clause of the EXECUTE PROCEDURE or EXECUTE FUNCTION statement
- GROUP BY clause

- SET clause of the UPDATE statement.

You get a syntax error if these keywords are *not* qualified when you use these clauses inside a triggered action.

If you use the keyword as a column name, it must be qualified by the table name; for example, **table.update**. If both the table name and the column name are keywords, they must be qualified by the owner name (for example, **owner.insert.update**). If the owner name, table name, and column name are all keywords, the owner name must be in quotes; for example, **'delete'.insert.update**. (These are general rules regarding reserved words as identifiers, rather than special cases for triggers. Your code will be easier to read and to maintain if you avoid using the keywords of SQL as identifiers.)

The only exception is when these keywords are the first table or column name in the list, and you do not have to qualify them. For example, **delete** in the following statement does not need to be qualified because it is the first column listed in the INTO clause:

```
CREATE TRIGGER t1 UPDATE OF b ON tab1
   FOR EACH ROW (EXECUTE PROCEDURE p2() INTO delete, d)
```

The following statements show examples in which you must qualify the column name or the table name:

- FROM clause of a SELECT statement
  ```
  CREATE TRIGGER t1 INSERT ON tab1
     BEFORE (INSERT INTO tab2 SELECT * FROM tab3, 'owner1'.update)
  ```
- INTO clause of an EXECUTE PROCEDURE statement
  ```
  CREATE TRIGGER t3 UPDATE OF b ON tab1
     FOR EACH ROW (EXECUTE PROCEDURE p2() INTO
     d, tab1.delete)
  ```
  In Dynamic Server, an INSTEAD OF trigger on a view cannot include the EXECUTE PROCEDURE INTO statement among its triggered actions.
- GROUP BY clause of a SELECT statement
  ```
  CREATE TRIGGER t4 DELETE ON tab1
     BEFORE (INSERT INTO tab3 SELECT deptno, SUM(exp)
     FROM budget GROUP BY deptno, budget.update)
  ```
- SET clause of an UPDATE statement
  ```
  CREATE TRIGGER t2 UPDATE OF a ON tab1
     BEFORE (UPDATE tab2 SET a = 10, tab2.insert = 5)
  ```

Using Correlation Names in Triggered Actions

These rules apply when you use correlation names in triggered actions:

- You can use the correlation names for the old and new column values in SQL statements of the FOR EACH ROW triggered-action list and in the WHEN condition.
- The old and new correlation names refer to all rows affected by the triggering statement.
- You cannot use the correlation name to qualify a column name in the GROUP BY, the SET, or the COUNT DISTINCT clause.
- The scope of reference of the correlation names is the entire trigger definition. This scope is statically determined, meaning that it is limited to the trigger definition; it does not encompass cascading triggers or columns that are qualified by a table name in a UDR that is a triggered action.

When to Use Correlation Names

In SQL statements of the FOR EACH ROW list, you must qualify all references to columns in the triggering table with either the old or new correlation name, unless the statement is valid independent of the triggered action.

In other words, if a column name inside a FOR EACH ROW triggered action list is not qualified by a correlation name, even if it is qualified by the triggering table name, it is interpreted as if the statement is independent of the triggered action. No special effort is made to search the definition of the triggering table for the non-qualified column name.

For example, assume that the following DELETE statement is a triggered action inside the FOR EACH ROW section of a trigger:

```
DELETE FROM tab1 WHERE col_c = col_c2
```

For the statement to be valid, both **col_c** and **col_c2** must be columns from **tab1**. If **col_c2** is intended to be a correlation reference to a column in the triggering table, it must be qualified by either the old or the new correlation name. If **col_c2** is not a column in **tab1** and is not qualified by either the old or new correlation name, you get an error.

In a statement that is valid independent of the triggered action, a column name with no *correlation* qualifier refers to the current value in the database.

In the triggered action for trigger **t1** in the next example, **mgr** in the WHERE clause of the correlated subquery is an unqualified column in the triggering table. In this case, **mgr** refers to the current column value in **empsal** because the INSERT statement is valid independent of the triggered action.

```
CREATE DATABASE db1;
CREATE TABLE empsal (empno INT, salary INT, mgr INT);
CREATE TABLE mgr (eno INT, bonus INT);
CREATE TABLE biggap (empno INT, salary INT, mgr INT);

CREATE TRIGGER t1 UPDATE OF salary ON empsal
AFTER (INSERT INTO biggap SELECT * FROM empsal WHERE salary <
   (SELECT bonus FROM mgr WHERE eno = mgr));
```

In a triggered action, an unqualified column name from the triggering table refers to the current column value, but only when the triggered statement is valid independent of the triggered action.

Qualified Versus Unqualified Value

The following table summarizes what value is retrieved when the **column** name is qualified by the *old* or by the *new* correlation name after various trigger events.

Trigger Event	*old*.column	*new*.column
INSERT	No value (error)	Inserted value
UPDATE (column updated)	Original value	Current value (N)
UPDATE (column not updated)	Original value	Current value (U)
DELETE	Original value	No value (error)

Refer to the following key when you read the previous table.

Term	Meaning
Original value	Value before the triggering statement

Current value	Value after the triggering statement
(N)	Cannot be changed by triggered action
(U)	Can be updated by triggered actions; updated value might be different from the original value because of preceding triggered actions.

Outside a FOR EACH ROW triggered-action list, you cannot qualify a column from the triggering table with either the old correlation name or the new correlation name; it always refers to the current value in the database.

In Dynamic Server, statements in the trigger action list use whatever collating order was in effect when the trigger was created, even if a different collation is in effect when the trigger action is executed. See SET COLLATION for details of how to specify a collating order different from what **DB_LOCALE** specifies.

Re-Entrancy of Triggers

In some cases a trigger can be re-entrant. In these cases the triggered action can reference the triggering table. In other words, both the trigger event and the triggered action can operate on the same table. The following list summarizes the situations in which triggers can be re-entrant and the situations in which triggers cannot be re-entrant:

- The trigger action of an Update trigger cannot be an INSERT or DELETE of the table that the trigger event updated.
- Similarly, the trigger action of an Update trigger cannot be an UPDATE of a column that the trigger event updated. (But the trigger action of an Update trigger can update a column that was not updated by the trigger event.)

  For example, assume that the following UPDATE statement, which updates columns **a** and **b** of **tab1**, is the triggering statement:

  ```
  UPDATE tab1 SET (a, b) = (a + 1, b + 1)
  ```

  Now consider the trigger actions in the following example. The first UPDATE statement is a valid trigger action, but the second one is not, because it updates column **b** again.

  ```
  UPDATE tab1 SET c = c + 1;    -- OK
  UPDATE tab1 SET b = b + 1;    -- INVALID
  ```

- If the trigger has an UPDATE event, the trigger action can be an EXECUTE PROCEDURE or EXECUTE FUNCTION statement with an INTO clause that references a column that was updated by the trigger event or any other column in the triggering table.

  When an EXECUTE PROCEDURE or EXECUTE FUNCTION statement is the trigger action, the INTO clause for an UPDATE trigger is valid only in FOR EACH ROW trigger actions, and column names that appear in the INTO clause must be from the triggering table.

  The following statement illustrates the appropriate use of the INTO clause:

  ```
  CREATE TRIGGER upd_totpr UPDATE OF quantity ON items
     REFERENCING OLD AS pre_upd NEW AS post_upd
     FOR EACH ROW(EXECUTE PROCEDURE
        calc_totpr(pre_upd.quantity,post_upd.quantity,
        pre_upd.total_price) INTO total_price)
  ```

  The column that follows the INTO keyword must be in the triggering table, but need not have been updated by the trigger event.

  When the INTO clause appears in the EXECUTE PROCEDURE or EXECUTE FUNCTION statement, the database server updates the specified columns with values returned from the UDR, immediately upon returning from the UDR.

- If the trigger has an INSERT event, the trigger action cannot be an INSERT or DELETE statement that references the triggering table.
- If the trigger has an INSERT event, the trigger action can be an UPDATE statement that references a column in the triggering table, but this column cannot be a column for which a value was supplied by the trigger event.

  If the trigger has an INSERT event, and the trigger action updates the triggering table, the columns in both statements must be mutually exclusive. For example, assume that the triggering statement inserts values for columns **cola** and **colb** of table **tab1**:

  ```
  INSERT INTO tab1 (cola, colb) VALUES (1,10)
  ```

  Now consider the following trigger actions. The first UPDATE is valid, but the second one is not, because it updates column **colb** even though the trigger event already supplied a value for column **colb**:

  ```
  UPDATE tab1 SET colc=100; --OK
  UPDATE tab1 SET colb=100; --INVALID
  ```
- If the trigger has an INSERT event, the trigger action can be an EXECUTE PROCEDURE or EXECUTE FUNCTION statement with an INTO clause that references a column that was supplied by the trigger event or a column that was not supplied by the trigger event.

  When an EXECUTE PROCEDURE or EXECUTE FUNCTION statement is the trigger action, you can specify the INTO clause for an INSERT trigger only when the trigger action occurs in the FOR EACH ROW list. In this case, the INTO clause can contain only column names from the triggering table.

  The following statement illustrates the valid use of the INTO clause:

  ```
  CREATE TRIGGER ins_totpr INSERT ON items
     REFERENCING NEW AS new_ins
     FOR EACH ROW (EXECUTE PROCEDURE calc_totpr
        (0, new_ins.quantity, 0) INTO total_price).
  ```

  The column that follows the INTO keyword can be a column in the triggering table that was supplied by the trigger event, or a column in the triggering table that was not supplied by the trigger event.

  When the INTO clause appears in the EXECUTE PROCEDURE or (for Dynamic Server only) the EXECUTE FUNCTION statement, the database server immediately updates the specified columns with values returned from the UDR.
- If the trigger action is a SELECT statement, the SELECT statement can reference the triggering table. The SELECT statement can be a trigger action in the following instances:
  - The SELECT statement appears in a subquery in the WHEN clause or in a trigger-action statement.
  - The trigger action is a UDR, and the SELECT statement appears inside the UDR.

Re-Entrancy and Cascading Triggers

The cases when a trigger cannot be re-entrant apply recursively to all cascading triggers, which are considered part of the initial trigger. In particular, this rule means that a cascading trigger cannot update any columns in the triggering table that were updated by the original triggering statement, including any nontriggering columns affected by that statement. For example, assume this UPDATE statement is the triggering statement:

```
UPDATE tab1 SET (a, b) = (a + 1, b + 1)
```

In the cascading triggers of the next example, **trig2** fails at runtime because it references column **b**, which the triggering UPDATE statement updates:

```
CREATE TRIGGER trig1 UPDATE OF a ON tab1-- Valid
   AFTER (UPDATE tab2 set e = e + 1);

CREATE TRIGGER trig2 UPDATE of e ON tab2-- Invalid
   AFTER (UPDATE tab1 set b = b + 1);
```

Now consider the following SQL statements. When the final UPDATE statement is executed, column **a** is updated and the trigger **trig1** is activated.

The trigger action again updates column **a** with an EXECUTE PROCEDURE INTO statement.

```
CREATE TABLE temp1 (a int, b int, e int);
INSERT INTO temp1 VALUES (10, 20, 30);

CREATE PROCEDURE proc(val int) RETURNING int,int;
    RETURN val+10, val+20;
END PROCEDURE;

CREATE TRIGGER trig1 UPDATE OF a ON temp1
    FOR EACH ROW (EXECUTE PROCEDURE proc(50) INTO a, e);

CREATE TRIGGER trig2 UPDATE OF e ON temp1
    FOR EACH ROW (EXECUTE PROCEDURE proc(100) INTO a, e);

UPDATE temp1 SET (a,b) = (40,50);
```

In Extended Parallel Server, to re-create this example, use the CREATE PROCEDURE statement instead of the CREATE FUNCTION statement.

Several questions arise from this example of cascading triggers. First, should the update of column **a** activate trigger **trig1** again? The answer is no. Because the trigger was activated, it is not activated a second time. If the trigger action is an EXECUTE PROCEDURE INTO or EXECUTE FUNCTION INTO statement, the only triggers that are activated are those that are defined on columns that are mutually exclusive from the columns updated until then (in the cascade of triggers) in that table. Other triggers are ignored.

Another question that arises from the example is whether trigger **trig2** should be activated. The answer is yes. The trigger **trig2** is defined on column **e.** Until now, column **e** in table **temp1** has not been modified. Trigger **trig2** is activated.

A final question that arises from the example is whether triggers **trig1** and **trig2** should be activated after the trigger action in **trig2** is performed. The answer is no. Neither trigger is activated. By this time columns **a** and **e** have been updated once, and triggers **trig1** and **trig2** have been executed once. The database server ignores and does not activate these triggers. For more about cascading triggers, see "Cascading Triggers" on page 2-240.

In Dynamic Server, as noted earlier, an INSTEAD OF trigger on a view cannot include the EXECUTE PROCEDURE INTO statement among its trigger actions. In addition, an error results if two views each have INSERT INSTEAD OF triggers with actions defined to perform insert operations on the other view.

Rules for SPL Routines

In addition to the rules listed in "Re-Entrancy of Triggers" on page 2-236, the following rules apply to an SPL routine that is specified as a trigger action:

- The SPL routine cannot be a cursor function (one that returns more than one row) in a context where only one row is expected.

- You cannot use the old or new correlation name inside the SPL routine. If you need to use the corresponding values in the routine, you must pass them as parameters. The routine should be independent of triggers, and the old or new correlation name does not have any meaning outside the trigger.

When you use an SPL routine as a trigger action, the database objects that the routine references are not checked until the routine is executed.

See also the SPL restrictions in “Triggers and SPL Routines” on page 2-220.

Privileges to Execute Trigger Actions

If you are not the trigger owner, but the privileges of the owner include WITH GRANT OPTION, you inherit the privileges of the owner (with grant option) in addition to your own privileges for each triggered SQL statement. If the trigger action is a UDR, you need Execute privilege on the UDR, or the trigger owner must have Execute privilege with grant option.

While executing the UDR, you do not carry the privileges of the trigger owner; instead, you receive the privileges granted with the UDR, as follows:

1. Privileges for a DBA UDR

   When a UDR is registered with the CREATE DBA keywords, and you are granted the Execute privilege on the UDR, the database server automatically grants you temporary DBA privileges that are available only when you are executing the UDR.
2. Privileges for a UDR without DBA restrictions

   If the UDR owner has the WITH GRANT OPTION right for the necessary privileges on the underlying database objects, you inherit these privileges when you are granted the Execute privilege.

For a UDR without DBA restrictions, all non-qualified database objects that the UDR references are implicitly qualified by the name of the UDR owner.

If the UDR owner has no WITH GRANT OPTION privilege, you have your original privileges on the underlying database objects when the UDR executes. For more information on privileges on SPL routines, refer to the *IBM Informix Guide to SQL: Tutorial*.

In Dynamic Server, a view that has no INSTEAD OF trigger has only Select (with grant option) privilege. If an INSTEAD OF trigger is created on it, however, then the view has Insert (with grant option) privilege during creation of the trigger. The view owner can now grant only Select and Insert privileges to others. This is independent of the trigger action. It is not necessary to obtain Execute (with grant option) privilege on the procedure or function. By default, Execute (without grant option) privilege is granted on each UDR in the action list.

You can use roles with triggers. Role-related statements (CREATE ROLE, DROP ROLE, GRANT ROLE, REVOKE ROLE, and SET ROLE) and SET SESSION AUTHORIZATION statements are valid in a UDR that the triggered action invokes. Privileges that a user acquired by enabling a role or by a SET SESSION AUTHORIZATION statement are not relinquished when a trigger is executed.

On a complex view (one with columns from more than one table), only the owner or DBA can create an INSTEAD OF trigger. The owner receives Select privileges when the trigger is created. Only after obtaining the required Execute privileges can the owner of the view grant privileges to other users. When the trigger on the complex view is dropped, all of these privileges are revoked.

Creating a Trigger Action That Anyone Can Use

For a trigger to be executable by anyone who has the privileges to execute the triggering statement, you can ask the DBA to create a DBA-privileged UDR and grant you the Execute privilege with the WITH GRANT OPTION right.

You then use the DBA-privileged UDR as the trigger action. Anyone can execute the trigger action because the DBA-privileged UDR carries the WITH GRANT OPTION right. When you activate the UDR, the database server applies privilege-checking rules for a DBA.

Cascading Triggers

In this section and in sections that follow, references to *nonlogging databases* do not apply to Extended Parallel Server. (In Extended Parallel Server, all databases support transaction logging.)

The database server allows triggers other than Select triggers to cascade, meaning that the trigger actions of one trigger can activate another trigger. (For further information on the restriction against cascading Select triggers, see "Circumstances When a Select Trigger is Activated" on page 2-224.)

The maximum number of triggers in a cascading series is 61: the initial trigger plus a maximum of 60 cascading triggers. When the number of cascading triggers in a series exceeds the maximum, the database server returns error number -748, with the following message:

```
Exceeded limit on maximum number of cascaded triggers.
```

The next example illustrates a series of cascading triggers that enforce referential integrity on the **manufact**, **stock**, and **items** tables in the **stores_demo** database. When a manufacturer is deleted from the **manufact** table, the first trigger, **del_manu**, deletes all the items of that manufacturer from the **stock** table. Each DELETE in the **stock** table activates a second trigger, **del_items**, that deletes all **items** of that manufacturer from the **items** table. Finally, each DELETE in the **items** table triggers SPL routine **log_order**, creating a record of any orders in the **orders** table that can no longer be filled.

```
CREATE TRIGGER del_manu
   DELETE ON manufact REFERENCING OLD AS pre_del
   FOR EACH ROW(DELETE FROM stock WHERE manu_code = pre_del.manu_code);
CREATE TRIGGER del_stock
   DELETE ON stock REFERENCING OLD AS pre_del
   FOR EACH ROW(DELETE FROM items WHERE manu_code = pre_del.manu_code);
CREATE TRIGGER del_items
   DELETE ON items REFERENCING OLD AS pre_del
   FOR EACH ROW(EXECUTE PROCEDURE log_order(pre_del.order_num));
```

When you are not using logging, referential integrity constraints on both the **manufact** and **stock** tables prohibit the triggers in this example from executing. When you use logging, however, the triggers execute successfully because constraint checking is deferred until all the trigger actions are complete, including the actions of cascading triggers. For more information about how constraints are handled when triggers execute, see "Constraint Checking" on page 2-241.

The database server prevents loops of cascading triggers by not allowing you to modify the triggering table in any cascading trigger action, except with an UPDATE statement that does not modify any column that the triggering UPDATE statement updated, or with an INSERT statement. An INSERT trigger can define UPDATE trigger actions on the same table.

Constraint Checking

When you use logging, the database server defers constraint checking on the triggering statement until after the statements in the triggered-action list execute. This is equivalent to executing a SET CONSTRAINTS ALL DEFERRED statement before executing the triggering statement. After the trigger action is completed, the database server effectively executes a SET CONSTRAINTS *constraint* IMMEDIATE statement to check the constraints that were deferred. This action allows you to write triggers so that the trigger action can resolve any constraint violations that the triggering statement creates. For more information, see "SET Database Object Mode" on page 2-539.

Consider the following example, in which the table **child** has constraint **r1**, which references the table **parent**. You define trigger **trig1** and activate it with an INSERT statement. In the trigger action, **trig1** checks to see if **parent** has a row with the value of the current **cola** in **child**; if not, it inserts it.

```
CREATE TABLE parent (cola INT PRIMARY KEY);
CREATE TABLE child (cola INT REFERENCES parent CONSTRAINT r1);
CREATE TRIGGER trig1 INSERT ON child
   REFERENCING NEW AS new
   FOR EACH ROW
   WHEN((SELECT COUNT (*) FROM parent
      WHERE cola = new.cola) = 0)
-- parent row does not exist
   (INSERT INTO parent VALUES (new.cola));
```

When you insert a row into a table that is the child table in a referential constraint, the row might not exist in the parent table. The database server does not immediately return this error on a triggering statement. Instead, it allows the trigger action to resolve the constraint violation by inserting the corresponding row into the parent table. As the previous example shows, you can check within the trigger action to see whether the parent row exists, and if so, you can provide logic to bypass the INSERT action.

For a database without logging, the database server does not defer constraint checking on the triggering statement. In this case, the database server immediately returns an error if the triggering statement violates a constraint.

You cannot use the SET Transaction Mode statement in a trigger action. The database server checks this restriction when you activate a trigger, because the statement could occur inside a UDR.

In Extended Parallel Server, rows that cause constraint violations might appear in the violations table, even if a subsequent trigger action corrects the violation.

Preventing Triggers from Overriding Each Other

When you activate multiple triggers with an UPDATE statement, a trigger can possibly override the changes that an earlier trigger made. If you do not want the trigger actions to interact, you can split the UPDATE statement into multiple UPDATE statements, each of which updates an individual column.

As another alternative, you can create a single update trigger for all columns that require a trigger action. Then, inside the trigger action, you can test for the column being updated and apply the actions in the desired order. This approach, however, is different from having the database server apply the actions of individual triggers, and it has the following disadvantages:

- If the triggering UPDATE statement sets a column to the current value, you cannot detect the UPDATE, so the trigger action is skipped. You might wish to execute the trigger action, even though the value of the column has not changed.
- If the trigger has a BEFORE action, it applies to all columns, because you cannot yet detect whether a column has changed.

External Tables

The trigger action can affect tables of other database servers. The following example shows an Update trigger on **dbserver1**, which triggers an UPDATE to **items** on **dbserver2**:

```
CREATE TRIGGER upd_nt UPDATE ON newtab
   REFERENCING new AS post
   FOR EACH ROW(UPDATE stores_demo@dbserver2:items
      SET quantity = post.qty WHERE stock_num = post.stock
      AND manu_code = post.mc)
```

If, however, a statement from an external database server initiates a trigger whose action affects tables in an external database, the trigger actions fail.

For example, the following combination of trigger action and triggering statement results in an error when the triggering statement executes:

```
-- Trigger action from dbserver1 to dbserver3:

CREATE TRIGGER upd_nt UPDATE ON newtab
REFERENCING new AS post
FOR EACH ROW(UPDATE stores_demo@dbserver3:items
   SET quantity = post.qty WHERE stock_num = post.stock
   AND manu_code = post.mc);
-- Triggering statement from dbserver2:

UPDATE stores_demo@dbserver1:newtab
   SET qty = qty * 2 WHERE s_num = 5
   AND mc = 'ANZ';
```

Logging and Recovery

You can create triggers for databases, with and without logging. If the trigger fails in a database that has transaction logging, the triggering statement and trigger actions are rolled back, as if the actions were an extension of the triggering statement, but the rest of the transaction is not rolled back.

In a database that does not have transaction logging, however, you cannot roll back when the triggering statement fails. In this case, you are responsible for maintaining data integrity in the database. The UPDATE, INSERT, or DELETE action of the triggering statement occurs before the trigger actions in the FOR EACH ROW section. If the trigger action fails for a database without logging, the application must restore the row that was changed by the triggering statement to its previous value.

If a trigger action calls a UDR, but the UDR terminates in an exception-handling section, any actions that modify data inside that section are rolled back with the triggering statement. In the following partial example, when the exception handler traps an error, it inserts a row into the table **logtab**:

```
ON EXCEPTION IN (-201)
   INSERT INTO logtab values (errno, errstr);
   RAISE EXCEPTION -201
END EXCEPTION
```

When the RAISE EXCEPTION statement returns the error, however, the database server rolls back this INSERT because it is part of the trigger actions. If the UDR is executed outside a trigger action, the INSERT is not rolled back.

The UDR that implements a trigger action cannot contain any BEGIN WORK, COMMIT WORK, or ROLLBACK WORK statements. If the database has transaction logging, you must either begin an explicit transaction before the triggering statement, or the statement itself must be an implicit transaction. In any case, no other transaction-related statement is valid inside the UDR.

You can use triggers to enforce referential actions that the database server does not currently support. In a database without logging, you are responsible for maintaining data integrity when the triggering statement fails.

INSTEAD OF Triggers on Views (IDS)

Use INSTEAD OF triggers to perform a specified trigger action on a view, rather than execute the triggering INSERT, DELETE, or UPDATE event.

```
                                                       ┌─ENABLED──┐
►►──CREATE TRIGGER──trigger──INSTEAD OF──┤ Trigger on a View ├──┴─DISABLED─┴──────────────────────────►◄
```

Trigger on a View:

```
├──┬─INSERT ON──view──┬──────────────────────────────────┬──────────────────────┬─FOR EACH ROW──────────►
   │                  └─REFERENCING NEW──┬──────┬──new──┘                      │
   │                                     └─AS───┘                              │
   ├─DELETE ON──view──┬──────────────────────────────────┬──────────────────────┤
   │                  └─REFERENCING──OLD──┬──────┬──old──┘                     │
   │                                      └─AS───┘                             │
   └─UPDATE ON──view──┬─────────────────────────────────────────────────────┬──┘
                      ├─REFERENCING──OLD──┬──────┬──old─────────────────────┤
                      │                   └─AS───┘                          │
                      └─REFERENCING NEW──┬──────┬──new──┬──────────────────────┬─┘
                                         └─AS───┘       └─OLD──┬──────┬──old───┘
                                                               └─AS───┘

                                          (1)
►──┤ INSTEAD OF Triggered Action ├────────────────────────────────────────────────────────────────────┤
```

Notes:

1 See page 2-244

Element	Description	Restrictions	Syntax
old	Name for old value in *view* column	Must be unique in this statement	Identifier, p. 5-22
new	Name for new value in *view* column	Must be unique in this statement	Identifier, p. 5-22
trigger	Name declared here for the trigger	Must be unique among the names of triggers in the database	Database Object Name, p. 5-17
view	Name or synonym of the triggering view. Can include *owner*. qualifier.	The view or synonym must exist in the current database	Database Object Name, p. 5-17

You can use the trigger action to update the tables underlying the view, in some cases updating an otherwise "non-updatable" view. You can also use INSTEAD OF triggers to substitute other actions when INSERT, DELETE, or UPDATE statements reference specific columns within the database.

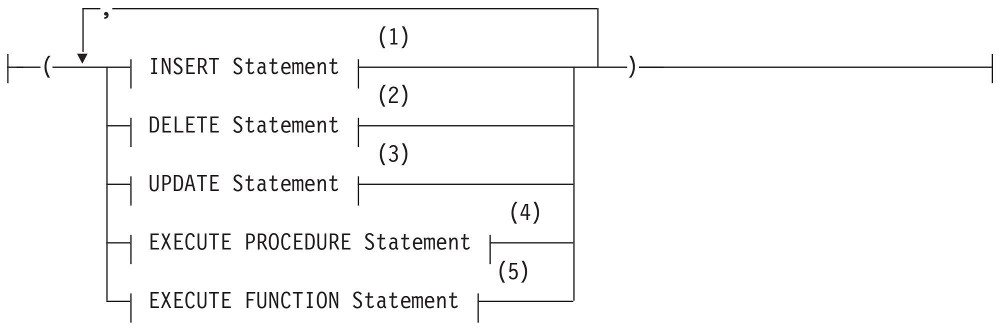
In the optional REFERENCING clause of an INSTEAD OF UPDATE trigger, the *new* correlation name can appear before or after the *old* correlation name.

The specified *view* is sometimes called the *triggering view*. The left-hand portion of this diagram (including the *view* specification) defines the *trigger event*. The rest of the diagram defines correlation names and the *trigger action*.

The Action Clause of INSTEAD OF Triggers (IDS)

When the trigger event for the specified *view* is encountered, the SQL statements of the trigger action are executed, instead of the triggering statement. Triggers defined on a view support the following syntax in the action clause.

INSTEAD OF Triggered Action:



Notes:

1 See page 2-395

2 See page 2-275

3 See page 2-636

4 See page 2-336

5 See page 2-329

This is not identical to the syntax of the trigger action for a trigger on a table, as described in the section "Triggered-Action List" on page 2-232. Because no WHEN (*condition*) is supported, the same trigger action is executed whenever the INSTEAD OF trigger event is encountered, and only one action list can be specified, rather than a separate list for each *condition*.

Restrictions on INSTEAD OF Triggers on Views (IDS)

You must be either the owner of the *view* or have the DBA status to create an INSTEAD OF trigger on a view. The owner of a simple view (based on only one table) has Insert, Update, and Delete privileges. For information about the relationship between the privileges of the trigger owner and the privileges of other users, see "Privileges to Execute Trigger Actions" on page 2-239.

If multiple tables underlie a view, only the owner of the view can create a trigger, but that owner can grant DML privileges on the view to other users.

An INSTEAD OF trigger defined on a view cannot violate the "Restrictions on Triggers" on page 2-219 and must observe the following additional rules:

- You can define an INSTEAD OF trigger only on a view, not on a table.
- The view must be local to the current database.
- The view cannot be an updatable view WITH CHECK OPTION.
- No SELECT event or WHEN clause is valid in an INSTEAD OF trigger.
- No BEFORE nor AFTER action is valid in an INSTEAD OF trigger.
- No OF *column* clause is valid in an INSTEAD OF UPDATE trigger.
- Every INSTEAD OF trigger must specify FOR EACH ROW.
- The triggered action cannot include EXECUTE PROCEDURE INTO.

A view can have no more than one INSTEAD OF trigger defined for each type of event (INSERT, DELETE, or UPDATE). It is possible, however, to define a trigger on one or more other views, each with its own INSTEAD OF trigger.

Updating Views

INSERT, DELETE, or UPDATE statements can directly modify a view only if all of the following are true of the SELECT statement that defines the view:

- All of the columns in the view are from a single table.
- No columns in the projection list are aggregate values.
- No UNIQUE or DISTINCT keyword is in the SELECT projection list.
- No GROUP BY clause nor UNION operator is in the view definition.
- The query selects no calculated values and no literal values.

By using INSTEAD OF triggers, however, you can circumvent these restrictions on the view, if the trigger action modifies the base table.

Example of an INSTEAD OF Trigger on a View

Suppose that **dept** and **emp** are tables that list departments and employees:

```
CREATE TABLE dept (
   deptno INTEGER PRIMARY KEY,
   deptname CHAR(20),
   manager_num INT
);
CREATE TABLE emp (
   empno INTEGER PRIMARY KEY,
   empname CHAR(20),
   deptno INTEGER REFERENCES dept(deptno),
   startdate DATE
);
ALTER TABLE dept ADD CONSTRAINT(FOREIGN KEY (manager_num)
      REFERENCES emp(empno));
```

The next statement defines **manager_info**, a view of columns in the **dept** and **emp** tables that includes all the managers of each department:

```
CREATE VIEW manager_info AS
   SELECT d.deptno, d.deptname, e.empno, e.empname
      FROM emp e, dept d WHERE e.empno = d.manager_num;
```

The following CREATE TRIGGER statement creates **manager_info_insert**, an INSTEAD OF trigger that is designed to insert rows into the **dept** and **emp** tables through the **manager_info** view:

```
CREATE TRIGGER manager_info_insert
   INSTEAD OF INSERT ON manager_info    --defines trigger event
      REFERENCING NEW AS n              --new manager data
   FOR EACH ROW                         --defines trigger action
      (EXECUTE PROCEDURE instab(n.deptno, n.empno));

CREATE PROCEDURE instab (dno INT, eno INT)
   INSERT INTO dept(deptno, manager_num) VALUES(dno, eno);
   INSERT INTO emp (empno, deptno) VALUES (eno, dno);
END PROCEDURE;
```

After the tables, view, trigger, and SPL routine have been created, the database server treats the following INSERT statement as a triggering event:

```
INSERT INTO manager_info(deptno, empno) VALUES (08, 4232);
```

This triggering INSERT statement is not executed, but this event causes the trigger action to be executed instead, invoking the **instab( )** SPL routine. The INSERT statements in the SPL routine insert new values into both the **emp** and **dept** base tables of the **manager_info** view.

Related Information

Related statements: CREATE PROCEDURE, CREATE VIEW,DROP TRIGGER, EXECUTE PROCEDURE, and SET Database Object Mode

For a task-oriented discussion of triggers, and for examples of INSTEAD OF DELETE (and UPDATE) triggers on views, see the *IBM Informix Guide to SQL: Tutorial*. For performance implications of triggers, see your *IBM Informix Performance Guide*.

CREATE VIEW

Use the CREATE VIEW statement to create a new view that is based on one or more existing tables and views that reside in the database, or in another database of the local database server or of a different database server.

Syntax

```
►►──CREATE VIEW──view──┬──────────────────────────┬──AS──────────────────►
                       │     ┌─,──────┐            │
                       │     ▼        │            │
                       ├──(────column─┴──)─────────┤
                       │ (1)                       │
                       └─────────OF TYPE row_type──┘

                                  (2)
►──┤ Subset of SELECT Statement ├──┬────────────────────┬──────────────►◄
                                   └─WITH CHECK OPTION──┘
```

Notes:

1 Dynamic Server only

2 See page 2-249

Element	Description	Restrictions	Syntax
column	Name that you declare here for a column in view. Default is a column name from Projection list of SELECT.	See "Naming View Columns" on page 2-249.	Identifier, p. 5-22
row_type	Named-row type for typed view	Must already exist in the database	Data Type, p. 4-18
view	Name that you declare here for the view	Must be unique among view, table, sequence, and synonym names in the database.	Database Object Name, p. 5-17

Usage

A *view* is a virtual table, defined by a SELECT statement. Except for the statements in the following list, you can specify the name or synonym of a view in any SQL statement where the name of a table is syntactically valid:

- ALTER FRAGMENT
- CREATE INDEX
- CREATE TABLE
- CREATE TRIGGER
- RENAME TABLE
- START VIOLATIONS TABLE
- STOP VIOLATIONS TABLE
- TRUNCATE
- UPDATE STATISTICS

You must specify the name of a view when you use the CREATE TRIGGER statement to define an INSTEAD OF trigger on a view, but the syntax and functionality are different from those of a trigger defined on a table.

"Updating Through Views" on page 2-251 prohibits non-updatable views in INSERT, DELETE, or UPDATE statements (where other views are valid).

To create a view, you must have the Select privilege on all columns from which the view is derived. You can query a view as if it were a table, and in some cases, you can update it as if it were a table; but a view is not a table.

The view consists of the set of rows and columns that the SELECT statement in the view definition returns each time you refer to the view in a query.

In some cases, the database server merges the SELECT statement of the user with the SELECT statement defining the view and executes the combined statements. In other cases, a query against a view might execute more slowly than expected, if the complexity of the view definition causes the database server to create a temporary table (referred to as a materialized view). For more information on materialized views, see the *IBM Informix Performance Guide*.

The view reflects changes to the underlying tables with one exception. If a SELECT * specification defines the view, the view has only the columns that existed in the underlying tables when the view was defined by CREATE VIEW. Any new columns that are subsequently added to the underlying tables with the ALTER TABLE statement do not appear in the view.

The view inherits the data types of the columns in the tables from which the view is derived. The database server determines data types of virtual columns from the nature of the expression.

The SELECT statement is stored in the **sysviews** system catalog table. When you subsequently refer to a view in another statement, the database server performs the defining SELECT statement while it executes the new statement.

In DB–Access, if you create a view outside the CREATE SCHEMA statement, you receive warnings if you use the **-ansi** flag or if you set the **DBANSIWARN** environment variable.

The following statement creates a view that is based on the **person** table. When you create a view like this, which has no OF TYPE clause, the view is referred to as an *untyped view*.

```
CREATE VIEW v1 AS SELECT * FROM person
```

Typed Views

You can create *typed views* if you have Usage privileges on the named-ROW type or if you are its owner or the DBA. If you omit the OF TYPE clause, rows in the view are considered untyped and default to an unnamed-ROW type.

Typed views, like typed tables, are based on a named-ROW type. Each column in the view corresponds to a field in the named-ROW type. The following statement creates a typed view that is based on the table **person**.

```
CREATE VIEW v2 OF TYPE person_t AS SELECT * FROM person
```

To create a typed view, you must include an OF TYPE clause. When you create a typed view, the named-ROW type that you specify immediately after the OF TYPE keywords must already exist.

Subset of SELECT Statements Valid in View Definitions

You cannot create a view on a temporary table. The FROM clause of the SELECT statement cannot include the name of a temporary table.

If Select privileges are revoked from a user for a table that is referenced in the SELECT statement defining a view that the same user owns, then that view is dropped, unless it also includes columns from tables in another database.

You cannot create a view on typed tables (including any table that is part of a table hierarchy) that reside in a remote database.

Do not use display labels in the select list of the Projection clause. Display labels in the Projection clause are interpreted as column names.

The SELECT statement in CREATE VIEW cannot include the SKIP, FIRST, or LIMIT keywords, the INTO TEMP clause, or the ORDER BY clause. For complete information about SELECT statement syntax and usage, see "SELECT" on page 2-479.

Union Views

A view that contains a UNION or UNION ALL operator in its SELECT statement is known as a *union view*. Certain restrictions apply to union views:

- If a CREATE VIEW statement defines a union view, you cannot specify the WITH CHECK OPTION keywords in the CREATE VIEW statement.
- All restrictions that apply to UNION or UNION ALL operations in stand-alone SELECT statements also apply to UNION and UNION ALL operations in the SELECT statement of a union view.

For a list of these restrictions, see "Restrictions on a Combined SELECT" on page 2-525. For an example of a CREATE VIEW statement that defines a union view, see "Naming View Columns."

Naming View Columns

The number of columns that you specify in the *column* list must match the number of columns returned by the SELECT statement that defines the view. If you do not specify a list of columns, the view inherits the column names of the underlying tables. In the following example, the view **herostock** has the same column names as the columns in Projection clause of the SELECT statement:

```
CREATE VIEW herostock AS
   SELECT stock_num, description, unit_price, unit, unit_descr
      FROM stock WHERE manu_code = 'HRO'
```

You must specify at least one column name in the following circumstances:

- If you provide names for some of the columns in a view, then you must provide names for all the columns. That is, the column list must contain an entry for every column that appears in the view.
- If the SELECT statement returns an expression, the corresponding column in the view is called a *virtual* column. You must provide a name for a virtual column. In the following example, the user must specify the column parameter because the select list of the Projection clause of the SELECT statement contains an aggregate expression:

  ```
  CREATE VIEW newview (firstcol, secondcol) AS
           SELECT sum(cola), colb FROM oldtab
  ```
- You must also specify column names in cases where any of the selected columns have duplicate column names without the table qualifiers. For example, if both

orders.order_num and **items.order_num** appear in the SELECT statement, the CREATE VIEW statement, must provide two separate column names to label them:

```
CREATE VIEW someorders (custnum,ocustnum,newprice) AS
        SELECT orders.order_num,items.order_num,
             items.total_price*1.5
           FROM orders, items
           WHERE orders.order_num = items.order_num
           AND items.total_price > 100.00
```

Here **custnum** and **ocustnum** replace the two identical column names.

- The CREATE VIEW statement must also provide column names in the column list when the SELECT statement includes a UNION or UNION ALL operator and the names of the corresponding columns in the SELECT statements are not identical.

  For example, code in the following CREATE VIEW statement must specify the column list because the second column in the first SELECT statement has a different name from the second column in the second SELECT statement:

```
CREATE VIEW myview (cola, colb) AS
        SELECT colx, coly from firsttab
        UNION
        SELECT colx, colz from secondtab
```

Using a View in the SELECT Statement

You can define a view whose columns are based on other views, but you must abide by the restrictions on creating views that are discussed in the *IBM Informix Database Design and Implementation Guide*.

WITH CHECK OPTION Keywords

The WITH CHECK OPTION keywords instruct the database server to ensure that all modifications that are made through the view to the underlying tables satisfy the definition of the view.

The following example creates a view that is named **palo_alto**, which uses all the information in the **customer** table for customers in the city of Palo Alto. The database server checks any modifications made to the **customer** table through **palo_alto** because the WITH CHECK OPTION keywords are specified.

```
CREATE VIEW palo_alto AS
   SELECT * FROM customer WHERE city = 'Palo Alto'
      WITH CHECK OPTION
```

You can insert into a view a row that does not satisfy the conditions of the view (that is, a row that is not visible through the view). You can also update a row of a view so that it no longer satisfies the conditions of the view. For example, if the view was created without the WITH CHECK OPTION keywords, you could insert a row through the view where the city is Los Altos, or you could update a row through the view by changing the city from Palo Alto to Los Altos.

To prevent such inserts and updates, you can add the WITH CHECK OPTION keywords when you create the view. These keywords ask the database server to test every inserted or updated row to ensure that it meets the conditions that are set by the WHERE clause of the view. The database server rejects the operation with an error if the row does not meet the conditions.

Even if the view was created with the WITH CHECK OPTION keywords, however, you can perform inserts and updates through the view to change columns that are not part of the view definition. A column is not part of the view definition if it does not appear in the WHERE clause of the SELECT statement that defines the view.

Updating Through Views

If a view is built on a single table, the view is *updatable* if the SELECT statement that defines the view does not contain any of the following elements:

- Columns in the projection list that are aggregate values
- Columns in the projection list that use the UNIQUE or DISTINCT keyword
- A GROUP BY clause
- A UNION operator
- A query that selects calculated or literal values.

You can DELETE from a view that selects calculated values from a single table, but INSERT and UPDATE operations are not valid on such views.

In an updatable view, you can update the values in the underlying table by inserting values into the view. If a view is built on a table that has a derived value for a column, however, that column is not updatable through the view. Other columns in the view, however, can be updated.

See also "Updating Views" on page 2-245 for information about using INSTEAD OF triggers to update views that are based on more than one table or that include columns containing aggregates or other calculated values.

Important: You cannot update or insert rows in a remote table through views that were created using the WITH CHECK OPTION keywords.

Related Information

Related statements: CREATE TABLE, CREATE TRIGGER, DROP VIEW, GRANT, REVOKE,SELECT, and SET SESSION AUTHORIZATION

For a discussion of views, see the *IBM Informix Database Design and Implementation Guide*.

For a discussion of how to use privileges and views to restrict access to the database, see the *IBM Informix Guide to SQL: Tutorial*.

CREATE XADATASOURCE

Use the CREATE XADATASOURCE statement to create a new XA-compliant data source and create an entry for it in the **sysxadatasources** system catalog table. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──CREATE XADATASOURCE──xa_source──USING──xa_type──────────────────────────►◄
```

Element	Description	Restrictions	Syntax
xa_source	Name that you declare here for the new XA data source	Must be unique among XA data source names in **sysxadatasources**	Database Object Name, p. 5-17
xa_type	Name of an existing XA data source type	Must already exist in the database in the **sysxasourcetypes** system catalog table	Database Object Name, p. 5-17

Usage

An XA-compliant data source is an external data source that complies with the X/Open DTP XA Standard for managing interactions between a transaction manager and a resource manager. To register XA-compliant data sources in the database requires two SQL statements:

- First create one or more XA-compliant data source types by using the CREATE XADATASOURCE TYPE statement.
- Then create one or more instances of XA-compliant data sources with the CREATE XADATASOURCE statement.

You can integrate transactions at the XA data source with the Dynamic Server transaction, using a 2-phase commit protocol to ensure that transactions are uniformly committed or rolled back among multiple database servers, and manage multiple external XA data sources within the same global transaction.

Any user can create an XA data source, which follows standard owner-naming rules, according to the ANSI-compliance status of the database. Only a database that uses transaction logging can support the X/Open DTP XA Standard.

Both XA data source types and instances of XA data sources are specific to one database. To support distributed transactions, they must be created in each database that interacts with the external XA data source.

The following statement creates a new XA data source instance called **informix.NewYork** of type **informix.MQSeries**.

```
CREATE XADATASOURCE informix.NewYork USING informix.MQSeries;
```

Related Information

Related statements: CREATE XADATASOURCE TYPE, DROP XADATASOURCE, DROP XADATASOURCE TYPE

For the schema of the **sysxadatasources** system catalog table, see the documentation notes to the *IBM Informix Guide to SQL: Reference*. For more information on XA data sources, see the *IBM Informix DataBlade API Programmer's Guide*.

CREATE XADATASOURCE TYPE

Use the CREATE XADATASOURCE TYPE statement to create a new XA-compliant data source type and create an entry for it in the **sysxasourcetypes** system catalog table. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
                                            ┌─,──────────────────────┐
                                            │                  (1)   │
►►──CREATE──XADATASOURCE TYPE──xa_type──(───▼─┤ Purpose Options ├────┴──)──────►◄
```

Notes:

1 See page 5-46

Element	Description	Restrictions	Syntax
xa_type	Name that you declare here for a new XA data source type	Must be unique among XA data source type names in the **sysxasourcetypes** system catalog table	Database Object Name, p. 5-17

Usage

The CREATE XADATASOURCE TYPE statement adds an XA-compliant data source type to the database.

Any user can create an XA data source type, whose owner-naming rules depend on the ANSI-compliance status of the database. Only a database that uses transaction logging can support the X/Open DTP XA Standard.

To create a data source type, you must declare its name and specify *purpose functions* and *purpose values* as attributes of the XA source type. Most of the purpose options that follow the source type name associate columns in the **sysxasourcetypes** system catalog table with the name of a UDR.

Both XA data source types and instances of XA data sources are specific to one database. To support distributed transactions, they must be created in each database that interacts with the external XA data source.

The following statement creates a new XA data source type called **MQSeries**, owned by user **informix**.

```
CREATE XADATASOURCE TYPE 'informix'.MQSeries(
                           xa_flags    = 1,
                           xa_version  = 0,
                           xa_open     = informix.mqseries_open,
                           xa_close    = informix.mqseries_close,
                           xa_start    = informix.mqseries_start,
                           xa_end      = informix.mqseries_end,
                           xa_rollback = informix.mqseries_rollback,
                           xa_prepare  = informix.mqseries_prepare,
                           xa_commit   = informix.mqseries_commit,
                           xa_recover  = informix.mqseries_recover,
                           xa_forget   = informix.mqseries_forget,
                          xa_complete = informix.mqseries_complete);
```

You need to provide one value or UDR name for each of the options listed above, but the sequence in which you list them is not critical. (The order of purpose options in this example corresponds to the order of column names in the **sysxasourcetypes** system catalog table.)

After this statement executes successfully, you can create instances of type **informix.MQSeries**. The following statement creates a new instance called **informix.MenloPark** of XA-compliant data source type **informix.MQSeries:**

```
CREATE XADATASOURCE informix.MenloPark USING informix.MQSeries;
```

Related Information

Related statements: CREATE XADATASOURCE, DROP XADATASOURCE, DROP XADATASOURCE TYPE

For information about how to enter purpose-option specifications, see “Purpose Options” on page 5-46.

For information on how to use XA data sources, see the *IBM Informix DataBlade API Programmer's Guide*.

For the schema of the **sysxasourcetypes** table, see the documentation notes to the *IBM Informix Guide to SQL: Reference*.

DATABASE

Use the DATABASE statement to open an accessible database as the current database.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DATABASE──database──┬───────────┬──────────────────────────────►◄
                        └─EXCLUSIVE─┘
```

Element	Description	Restrictions	Syntax
database	Name of the database	The database must exist	"Database Name" on page 5-15

Usage

You can use the DATABASE statement to select any database on your database server. To select a database on another database server, specify the name of the database server with the database name.

If you include the name of the current (or another) database server with the database name, the database server name cannot be uppercase. (See "Database Name" on page 5-15 for the syntax of specifying the database server name.)

Issuing a DATABASE statement when a database is already open closes the current database before opening the new one. Closing the current database releases any cursor resources that the database server holds, invalidating any cursors that you have declared up to that point. If the *user* specification was changed through a SET SESSION AUTHORIZATION statement, the original user name is restored when the new database is opened.

If a previous CONNECT statement has established an explicit connection to a database, and that connection is still your current connection, you cannot use the DATABASE statement (nor any SQL statement that creates an implicit connection) until after you use DISCONNECT to close the explicit connection.

The current user (or PUBLIC) must have the Connect privilege on the database that is specified in the DATABASE statement. The current user cannot have the same user name as an existing role in the database.

DATABASE is not a valid statement in multistatement PREPARE operations.

SQLCA.SQLWARN Settings Immediately after DATABASE Executes (ESQL/C)

Immediately after DATABASE executes, you can identify characteristics of the specified database by examining warning flags in the **sqlca** structure.

- If the first field of **sqlca.sqlwarn** is blank, then no warnings were issued.
- The second **sqlca.sqlwarn** field is set to the letter `W` if the *database* that was opened supports transaction logging.
- The third field is set to `W` if *database* is an ANSI-compliant database.
- The fourth field is set to `W` if *database* is a Dynamic Server database.

- The fifth field is set to `W` if *database* converts all floating-point data to DECIMAL format. (System lacks FLOAT and SMALLFLOAT support.)
- The seventh field is set to `W` if *database* is the secondary server (that is, running in read-only mode) in a data-replication pair.
- The eighth field is set to `W` if *database* has **DB_LOCALE** set to a locale different from the **DB_LOCALE** setting on the client system.

EXCLUSIVE Keyword

The EXCLUSIVE keyword opens the database in exclusive mode and prevents access by anyone but the current user. To allow others to access the database, you must first execute the CLOSE DATABASE statement and then reopen the database without the EXCLUSIVE keyword. The following statement opens the **stores_demo** database on the **training** database server in exclusive mode:

```
DATABASE stores_demo@training EXCLUSIVE
```

If another user has already opened the specified database, exclusive access is denied, an error is returned, and no database is opened.

Related Information

Related statements: CLOSE DATABASE, CONNECT, CREATE DATABASE, DISCONNECT, and SET CONNECTION

For discussions of how to use different data models to design and implement a database, see the *IBM Informix Database Design and Implementation Guide*.

For descriptions of the **sqlca** structure, see the *IBM Informix Guide to SQL: Tutorial* or the *IBM Informix ESQL/C Programmer's Manual*.

DEALLOCATE COLLECTION

Use the DEALLOCATE COLLECTION statement to release memory for a collection variable that was previously allocated with the ALLOCATE COLLECTION statement. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. Use this statement with ESQL/C.

Syntax

```
►►──DEALLOCATE COLLECTION──:variable─────────────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
variable	Name that identifies a typed or untyped collection variable for which to deallocate memory	Must be the name of an ESQL/C collection variable that has already been allocated	Name must conform to language-specific rules for names of variables

Usage

The DEALLOCATE COLLECTION statement frees all the memory that is associated with the ESQL/C collection variable that *variable* identifies. You must explicitly release memory resources for a collection variable with DEALLOCATE COLLECTION. Otherwise, deallocation occurs automatically at the end of the program.

The DEALLOCATE COLLECTION statement releases resources for both typed and untyped collection variables.

Tip: The DEALLOCATE COLLECTION statement deallocates memory for an ESQL/C collection variable only. To deallocate memory for an ESQL/C row variable, use the DEALLOCATE ROW statement.

If you deallocate a nonexistent collection variable or a variable that is not an ESQL/C collection variable, an error results. Once you deallocate a collection variable, you can use the ALLOCATE COLLECTION to reallocate resources and you can then reuse a collection variable.

This example shows how to deallocate resources with the DEALLOCATE COLLECTION statement for the untyped collection variable, **a_set**:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection a_set;
EXEC SQL END DECLARE SECTION;
. . .
EXEC SQL allocate collection :a_set;
. . .
EXEC SQL deallocate collection :a_set;
```

Related Information

Related example: refer to the collection variable example in PUT.

Related statements: ALLOCATE COLLECTION and DEALLOCATE ROW

For a discussion of collection data types, see the *IBM Informix ESQL/C Programmer's Manual*.

DEALLOCATE DESCRIPTOR

Use the DEALLOCATE DESCRIPTOR statement to free a previously allocated, system-descriptor area. Use this statement with ESQL/C.

Syntax

```
►►──DEALLOCATE DESCRIPTOR──┬─'descriptor' ───┬──────────────────────────────►◄
                           └─descriptor_var──┘
```

Element	Description	Restrictions	Syntax
descriptor	Name of a system-descriptor area	Use single quotes. System-descriptor area must already be allocated	"Quoted String" on page 4-142
descriptor_var	Host variable that contains the name of a system-descriptor area	System-descriptor area must already be allocated, and the variable must already have been declared	Name must conform to language-specific rules

Usage

The DEALLOCATE DESCRIPTOR statement frees all the memory that is associated with the system-descriptor area that *descriptor* or *descriptor_var* identifies. It also frees all the item descriptors (including memory for data items in the item descriptors).

You can reuse a descriptor or descriptor variable after it is deallocated. Otherwise, deallocation occurs automatically at the end of the program.

If you deallocate a nonexistent descriptor or descriptor variable, an error results.

You cannot use the DEALLOCATE DESCRIPTOR statement to deallocate an **sqlda** structure. You can use it only to free the memory that is allocated for a system-descriptor area.

The following examples show valid DEALLOCATE DESCRIPTOR statements. The first line uses an embedded-variable name, and the second line uses a quoted string to identify the allocated system-descriptor area.

```
EXEC SQL deallocate descriptor :descname;

EXEC SQL deallocate descriptor 'desc1';
```

Related Information

Related statements: ALLOCATE DESCRIPTOR, DECLARE, DESCRIBE, EXECUTE, FETCH, GET DESCRIPTOR, OPEN, PREPARE, PUT, and SET DESCRIPTOR

For more information on system-descriptor areas, refer to the *IBM Informix ESQL/C Programmer's Manual*.

DEALLOCATE ROW

Use the DEALLOCATE ROW statement to release memory for a ROW variable.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. Use this statement with ESQL/C.

Syntax

```
►►──DEALLOCATE ROW──:variable──────────────────────────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
variable	Typed or untyped row variable	Must be declared and allocated	Language specific

Usage

DEALLOCATE ROW frees all the memory that is associated with the ESQL/C typed or untyped **row** variable that *variable* identifies. If you do not explicitly release memory resources with DEALLOCATE ROW, deallocation occurs automatically at the end of the program. To deallocate memory for an ESQL/C collection variable, use the DEALLOCATE COLLECTION statement.

After you deallocate a ROW variable, you can use the ALLOCATE ROW statement to reallocate resources, and you can then reuse a ROW variable. The following example shows how to deallocate resources for the ROW variable, **a_row**, using the DEALLOCATE ROW statement:

```
EXEC SQL BEGIN DECLARE SECTION; row (a int, b int) a_row;
EXEC SQL END DECLARE SECTION;
. . .
EXEC SQL allocate row :a_row;
. . .
EXEC SQL deallocate row :a_row;
```

Related Information

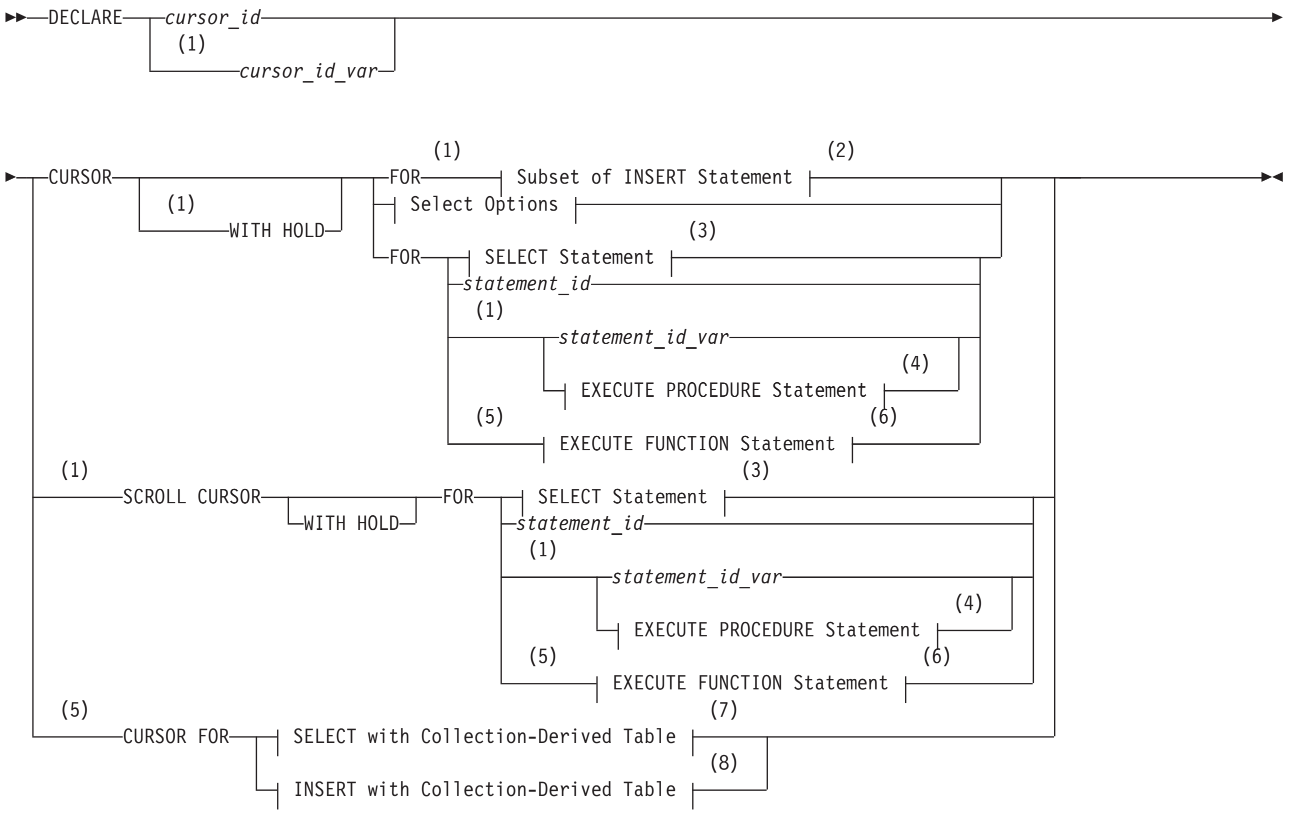
Related statements: ALLOCATE ROW and DEALLOCATE COLLECTION

For a discussion of ROW data types, see the *IBM Informix Guide to SQL: Tutorial*. For complex data types, see the *IBM Informix ESQL/C Programmer's Manual*.

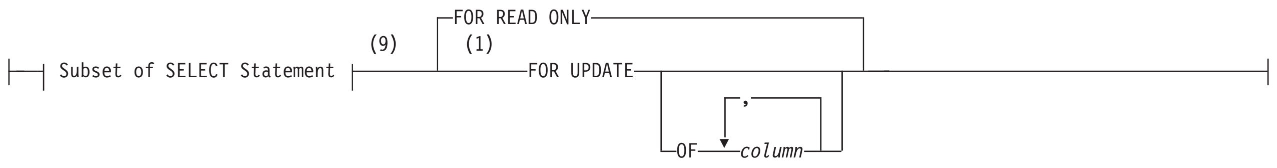
DECLARE

Use the DECLARE statement to associate a cursor with a set of rows. Use this statement with ESQL/C.

Syntax



Select Options:



Notes:

1 Informix extension

2 See “Subset of INSERT Statement Associated with a Sequential Cursor” on page 2-266

3 See “SELECT” on page 2-479

4 See “EXECUTE PROCEDURE” on page 2-336

5 Dynamic Server only

6 See “EXECUTE FUNCTION” on page 2-329

7 See “Select with a Collection-Derived Table” on page 2-271

8 See “Insert with a Collection-Derived Table” on page 2-273

9 See “Subset of SELECT Statement Associated with Cursors” on page 2-269

Element	Description	Restrictions	Syntax
column	Column to update with cursor	Must exist, but need not be listed in Select list of Projection clause	“Identifier” on page 5-22
cursor_id	Name declared here for cursor	Must be unique among names of cursors and prepared objects	“Identifier” on page 5-22
cursor_id_var	Variable holding *cursor_id*	Must have a character data type	Language-specific
statement_id	Name of prepared statement	Declared in PREPARE statement	“Identifier” on page 5-22
statement_id_var	Variable holding *statement_id*	Must have a character data type	Language-specific

Usage

A *cursor* is an identifier that you associate with a group of rows. The DECLARE statement associates the cursor with one of the following database objects:

- With an SQL statement, such as SELECT, EXECUTE FUNCTION (or EXECUTE PROCEDURE), or INSERT

  Each of these SQL statements creates a different type of cursor. For more information, see “Overview of Cursor Types” on page 2-262.
- With the statement identifier (*statement id* or *statement id variable*) of a prepared statement

  You can prepare one of the previous SQL statements and associate the prepared statement with a cursor. For more information, see “Associating a Cursor with a Prepared Statement” on page 2-271.
- Using Dynamic Server with a collection variable in an ESQL/C program

  The name of the collection variable appears in the FROM clause of a SELECT or the INTO clause of an INSERT. For more information, see “Associating a Cursor with a Prepared Statement” on page 2-271.

DECLARE assigns an identifier to the cursor, specifies its uses, and directs the ESQL/C preprocessor to allocate storage for it. DECLARE must precede any other statement that refers to the cursor during program execution.

The maximum length of a DECLARE statement is 64 kilobytes. The number of cursors and prepared objects that can exist concurrently in a single program is limited by the available memory. To avoid exceeding the limit, use the FREE statement to release some prepared statements or cursors.

A program can consist of one or more source-code files. By default, the scope of reference of a cursor is global to a program, so a cursor that was declared in one source file can be referenced from a statement in another file. In a multiple-file program, if you want to limit the scope of cursor names to the files in which they are declared, you must preprocess all of the files with the **-local** command-line option.

Multiple cursors can be declared for the same prepared statement identifier. For example, the following ESQL/C example does not return an error:

```
EXEC SQL prepare id1 from 'select * from customer';
EXEC SQL declare x cursor for id1;
EXEC SQL declare y scroll cursor for id1;
EXEC SQL declare z cursor with hold for id1;
```

If you include the **-ansi** compilation flag (or if **DBANSIWARN** is set), warnings are generated for statements that use dynamic cursor names or dynamic statement identifiers and (for Dynamic Server only) statements that use collection-derived tables. Some error checking is performed at runtime, such as these typical checks:

- Invalid use of sequential cursors as scroll cursors
- Use of undeclared cursors
- Invalid cursor names or statement names (empty)

Checks for multiple declarations of a cursor of the same name are performed at compile time only if the cursor or statement is specified as an identifier. The following example uses a host variable to store the cursor name:

```
EXEC SQL declare x cursor for select * from customer;
. . .
stcopy("x", s);
EXEC SQL declare :s cursor for select * from customer;
```

A cursor uses the collating order that was in effect when the cursor was declared, even if this is different from the collation of the session at runtime.

Overview of Cursor Types

Cursors are typically required for data manipulation language (DML) operations on more than one row of data (or on an ESQL/C collection variable). You can declare the following types of cursors with the DECLARE statement:

- A *select cursor* is a cursor associated with a SELECT statement.
- A *function cursor* is a cursor associated with an EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement.
- An *insert cursor* is a cursor associated with an INSERT statement.

Sections that follow describe each of these cursor types. Cursors can also have *sequential*, *scroll*, and *hold* characteristics (but an insert cursor cannot be a scroll cursor). These characteristics determine the structure of the cursor; see "Cursor Characteristics" on page 2-267. In addition, a select or function cursor can specify *read-only* or *update* mode. For more information, see "Select Cursor or Function Cursor" on page 2-262.

Tip: Function cursors behave the same as select cursors that are enabled as update cursors.

A cursor that is associated with a statement identifier can be used with an INSERT, SELECT, EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement that is prepared dynamically, and to use different statements with the same cursor at different times. In this case, the type of cursor depends on the statement that is prepared at the time the cursor is opened. (See "Associating a Cursor with a Prepared Statement" on page 2-271.)

Select Cursor or Function Cursor

When an SQL statement returns more than one group of values to an ESQL/C program, you must declare a cursor to save the multiple groups, or rows, of data and to access these rows one at a time. You must associate the following SQL statements with cursors:

- If you associate a SELECT statement with a cursor, the cursor is called a *select cursor*.

A select cursor is a data structure that represents a specific location within the active set of rows that the SELECT statement retrieved.

- If you associate an EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement with a cursor, the cursor is called a *function cursor*.

  The function cursor represents the columns or values that a user-defined function returns. Function cursors behave the same as select cursors that are enabled as update cursors.

In Extended Parallel Server, to create a function cursor, you must use the EXECUTE PROCEDURE statement. Extended Parallel Server does not support the EXECUTE FUNCTION statement.

In Dynamic Server, for backward compatibility, if an SPL function was created with the CREATE PROCEDURE statement, you can create a function cursor with the EXECUTE PROCEDURE statement. With external functions, you must use the EXECUTE FUNCTION statement.

When you associate a SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement with a cursor, the statement can include an INTO clause. However, if you prepare the SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement, you must omit the INTO clause in the PREPARE statement and use the INTO clause of the FETCH statement to retrieve the values from the collection cursor.

A select or function cursor can scan returned rows of data and to move data row by row into a set of receiving variables, as the following steps describe:

1. DECLARE

   Use DECLARE to define a cursor and associate it with a statement.
2. OPEN

   Use OPEN to open the cursor. The database server processes the query until it locates or constructs the first row of the active set.
3. FETCH

   Use FETCH to retrieve successive rows of data from the cursor.
4. CLOSE

   Use CLOSE to close the cursor when its active set is no longer needed.
5. FREE

   Use FREE to release the resources that are allocated for the cursor.

Using the FOR READ ONLY Option

Use the FOR READ ONLY keywords to define a cursor as a read-only cursor. A cursor declared to be read-only cannot be used to update (or delete) any row that it fetches.

The need for the FOR READ ONLY keywords depends on whether your database is ANSI compliant or not ANSI compliant.

In a database that is not ANSI compliant, the cursor that the DECLARE statement defines is a read-only cursor by default, so you do not need to specify the FOR READ ONLY keywords if you want the cursor to be a read-only cursor. The only advantage of specifying the FOR READ ONLY keywords explicitly is for better program documentation.

In an ANSI-compliant database, the cursor associated with a SELECT statement through the DECLARE statement is an update cursor by default, provided that the SELECT statement conforms to all of the restrictions for update cursors listed in "Subset of SELECT Statement Associated with Cursors" on page 2-269. If you want a select cursor to be read-only, you must use the FOR READ ONLY keywords when you declare the cursor.

The database server can use less stringent locking for a read-only cursor than for an update cursor.

The following example creates a read-only cursor:

```
EXEC SQL declare z_curs cursor for
   select * from customer_ansi
   for read only;
```

Using the FOR UPDATE Option

Use the FOR UPDATE option to declare an update cursor. You can use the update cursor to modify (update or delete) the current row.

In an ANSI-compliant database, you can use a select cursor to update or delete data if the cursor was not declared with the FOR READ ONLY keywords and it follows the restrictions on update cursors that are described in "Subset of SELECT Statement Associated with Cursors" on page 2-269. You do not need to use the FOR UPDATE keywords when you declare the cursor.

The following example declares an update cursor:

```
EXEC SQL declare new_curs cursor for
   select * from customer_notansi
   for update;
```

In an update cursor, you can update or delete rows in the active set. After you create an update cursor, you can update or delete the currently selected row by using an UPDATE or DELETE statement with the WHERE CURRENT OF clause. The words CURRENT OF refer to the row that was most recently fetched; they take the place of the usual test expressions in the WHERE clause.

An update cursor lets you perform updates that are not possible with the UPDATE statement because the decision to update and the values of the new data items can be based on the original contents of the row. Your program can evaluate or manipulate the selected data before it decides whether to update. The UPDATE statement cannot interrogate the table that is being updated.

You can specify particular columns that can be updated. The columns need not appear in the Select list of the Projection clause.

Using FOR UPDATE with a List of Columns: When you declare an update cursor, you can limit the update to specific columns by including the OF keyword and a list of columns. You can modify only those named columns in subsequent UPDATE statements. The columns need not be in the select list of the SELECT clause.

The next example declares an update cursor and specifies that this cursor can update only the **fname** and **lname** columns in the **customer_notansi** table:

```
EXEC SQL declare name_curs cursor for
   select * from customer_notansi
   for update of fname, lname;
```

By default, unless declared as FOR READ ONLY, a select cursor in a database that is ANSI compliant is an update cursor, so the FOR UPDATE keywords are optional. If you want an update cursor to be able to modify only some of the columns in a table, however, you must specify these columns in the FOR UPDATE OF *column* list.

The principal advantage to specifying columns is documentation and preventing programming errors. (The database server refuses to update any other columns.) An additional advantage is improved performance, when the SELECT statement meets the following criteria:

- The SELECT statement can be processed using an index.
- The columns that are listed are not part of the index that is used to process the SELECT statement.

If the columns that you intend to update are part of the index that is used to process the SELECT statement, the database server keeps a list of each updated row, to ensure that no row is updated twice. If the OF keyword specifies which columns can be updated, the database server determines whether or not to keep the list of updated rows. If the database server determines that the work of keeping the list is unnecessary, performance improves. If you do not use the OF *column* list, the database server always maintains a list of updated rows, although the list might be unnecessary.

The following example contains ESQL/C code that uses an update cursor with a DELETE statement to delete the current row.

Whenever the row is deleted, the cursor remains between rows. After you delete data, you must use a FETCH statement to advance the cursor to the next row before you can refer to the cursor in a DELETE or UPDATE statement.

```
EXEC SQL declare q_curs cursor for
   select * from customer where lname matches :last_name for update;

EXEC SQL open q_curs;
for (;;)
{
   EXEC SQL fetch q_curs into :cust_rec;
   if (strncmp(SQLSTATE, "00", 2) != 0)
      break;

   /* Display customer values and prompt for answer */
   printf("\n%s %s", cust_rec.fname, cust_rec.lname);
   printf("\nDelete this customer? ");
   scanf("%s", answer);

   if (answer[0] == 'y')
      EXEC SQL delete from customer where current of q_curs;
   if (strncmp(SQLSTATE, "00", 2) != 0)
      break;
}
printf("\n");
EXEC SQL close q_curs;
```

Locking with an Update Cursor: The FOR UPDATE keywords notify the database server that updating is possible and cause it to use more stringent locking than with a select cursor. You declare an update cursor to let the database server know that the program might update (or delete) any row that it fetches as part of the SELECT statement. The update cursor employs *promotable* locks for rows that the program fetches. Other programs can read the locked row, but no other program can place a promotable lock (also called a *write lock*). Before the program modifies the row, the row lock is promoted to an exclusive lock.

It is possible to declare an update cursor with the WITH HOLD keywords, but the only reason to do so is to break a long series of updates into smaller transactions. You must fetch and update a particular row in the same transaction.

If an operation involves fetching and updating a large number of rows, the lock table that the database server maintains can overflow. The usual way to prevent this overflow is to lock the entire table that is being updated. If this action is impossible, an alternative is to update through a hold cursor and to execute COMMIT WORK at frequent intervals. You must plan such an application carefully, however, because COMMIT WORK releases all locks, even those that are placed through a hold cursor.

Subset of INSERT Statement Associated with a Sequential Cursor

As indicated in the diagram for "DECLARE" on page 2-260, to create an insert cursor, you associate a sequential cursor with a restricted form of the INSERT statement. The INSERT statement must include a VALUES clause; it cannot contain an embedded SELECT statement.

The following example contains ESQL/C code that declares an insert cursor:

```
EXEC SQL declare ins_cur cursor for
   insert into stock values
   (:stock_no,:manu_code,:descr,:u_price,:unit,:u_desc);
```

The insert cursor simply inserts rows of data; it cannot be used to fetch data. When an insert cursor is opened, a buffer is created in memory. The buffer receives rows of data as the program executes PUT statements. The rows are written to disk only when the buffer is full. You can flush the buffer (that is, to write its contents into the database) when it is less than full, using the CLOSE, FLUSH, or COMMIT WORK statements. This topic is discussed further under the CLOSE, FLUSH, and PUT statements.

You must close an insert cursor to insert any buffered rows into the database before the program ends. You can lose data if you do not close the cursor properly. For a complete description of INSERT syntax and usage, see "INSERT" on page 2-395.

Insert Cursor

When you associate an INSERT statement with a cursor, the cursor is called an *insert cursor*. An insert cursor is a data structure that represents the rows that the INSERT statement is to add to the database. The insert cursor simply inserts rows of data; it cannot be used to fetch data. To create an insert cursor, you associate a cursor with a restricted form of the INSERT statement. The INSERT statement must include a VALUES clause; it cannot contain an embedded SELECT statement.

Create an insert cursor if you want to add multiple rows to the database in an INSERT operation. An insert cursor allows bulk insert data to be buffered in memory and written to disk when the buffer is full, as these steps describe:

1. Use DECLARE to define an insert cursor for the INSERT statement.
2. Open the cursor with the OPEN statement. The database server creates the insert buffer in memory and positions the cursor at the first row of the insert buffer.
3. Copy successive rows of data into the insert buffer with the PUT statement.

4. The database server writes the rows to disk only when the buffer is full. You can use the CLOSE, FLUSH, or COMMIT WORK statement to flush the buffer when it is less than full. This topic is discussed further under the PUT and CLOSE statements.
5. Close the cursor with the CLOSE statement when the insert cursor is no longer needed. You must close an insert cursor to insert any buffered rows into the database before the program ends. You can lose data if you do not close the cursor properly.
6. Free the cursor with the FREE statement. The FREE statement releases the resources that are allocated for an insert cursor.

Using an insert cursor is more efficient than embedding the INSERT statement directly. This process reduces communication between the program and the database server and also increases the speed of the insertions.

In addition to select and function cursors, insert cursors can also have the sequential cursor characteristic. To create an insert cursor, you associate a sequential cursor with a restricted form of the INSERT statement. (For more information, see "Insert Cursor" on page 2-266.) The following example contains IBM Informix ESQL/C code that declares a sequential insert cursor:

```
EXEC SQL declare ins_cur cursor for
   insert into stock values
   (:stock_no,:manu_code,:descr,:u_price,:unit,:u_desc);
```

Cursor Characteristics

You can declare a cursor as a *sequential* cursor (the default), a *scroll* cursor (by using the SCROLL keyword), or a *hold* cursor (by using the WITH HOLD keywords). The SCROLL and WITH HOLD keywords are not mutually exclusive. Sections that follow explain these structural characteristics.

A select or function cursor can be either a sequential or a scroll cursor. An insert cursor can only be a sequential cursor. Select, function, and insert cursors can optionally be hold cursors.

Creating a Sequential Cursor by Default

If you use only the CURSOR keyword, you create a sequential cursor, which can fetch only the next row in sequence from the active set. The sequential cursor can read through the active set only once each time it is opened.

If you are using a sequential cursor for a select cursor, on each execution of the FETCH statement, the database server returns the contents of the current row and locates the next row in the active set.

The following example creates a read-only sequential cursor in a database that is not ANSI compliant and an update sequential cursor in an ANSI-compliant database:

```
EXEC SQL declare s_cur cursor for
   select fname, lname into :st_fname, :st_lname
   from orders where customer_num = 114;
```

In addition to select and function cursors, insert cursors can also have the sequential cursor characteristic. To create an insert cursor, you associate a sequential cursor with a restricted form of the INSERT statement. (For more information, see "Insert Cursor" on page 2-266.) The following example declares a sequential insert cursor:

```
EXEC SQL declare ins_cur cursor for
   insert into stock values
   (:stock_no,:manu_code,:descr,:u_price,:unit,:u_desc);
```

Using the SCROLL Keyword to Create a Scroll Cursor

Use the SCROLL keyword to create a scroll cursor, which can fetch rows of the active set in any sequence.

The database server retains the active set of the cursor as a temporary table until the cursor is closed. You can fetch the first, last, or any intermediate rows of the active set as well as fetch rows repeatedly without having to close and reopen the cursor. (See FETCH.)

On a multiuser system, the rows in the tables from which the active-set rows were derived might change after the cursor is opened and a copy is made in the temporary table. If you use a scroll cursor within a transaction, you can prevent copied rows from changing either by setting the isolation level to Repeatable Read or by locking the entire table in share mode during the transaction. (See SET ISOLATION and LOCK TABLE.)

The following example creates a scroll cursor for a SELECT statement:

```
DECLARE sc_cur SCROLL CURSOR FOR SELECT * FROM orders;
```

You can create scroll cursors for select and function cursors but *not* for insert cursors. Scroll cursors cannot be declared as FOR UPDATE.

Using the WITH HOLD Keywords to Create a Hold Cursor

Use the WITH HOLD keywords to create a hold cursor. A hold cursor allows uninterrupted access to a set of rows across multiple transactions. Ordinarily, all cursors close at the end of a transaction. A hold cursor does not close; it remains open after a transaction ends.

A hold cursor can be either a sequential cursor or a scroll cursor.

You can use the WITH HOLD keywords to declare select and function cursors (sequential and scroll) and insert cursors. These keywords follow the CURSOR keyword in the DECLARE statement. The following example creates a sequential hold cursor for a SELECT:

```
DECLARE hld_cur CURSOR WITH HOLD FOR
   SELECT customer_num, lname, city FROM customer
```

You can use a select hold cursor as the following ESQL/C code example shows. This code fragment uses a hold cursor as a *master* cursor to scan one set of records and a sequential cursor as a *detail* cursor to point to records that are located in a different table. The records that the master cursor scans are the basis for updating the records to which the detail cursor points. The COMMIT WORK statement at the end of each iteration of the first WHILE loop leaves the hold cursor **c_master** open but closes the sequential cursor **c_detail** and releases all locks. This technique minimizes the resources that the database server must devote to locks and unfinished transactions, and it gives other users immediate access to updated rows.

```
EXEC SQL BEGIN DECLARE SECTION;
   int p_custnum, int save_status; long p_orddate;
EXEC SQL END DECLARE SECTION;

EXEC SQL prepare st_1 from
   'select order_date from orders where customer_num = ? for update';
EXEC SQL declare c_detail cursor for st_1;
EXEC SQL declare c_master cursor with hold for
```

```
   select customer_num from customer where city = 'Pittsburgh';

EXEC SQL open c_master;
if(SQLCODE==0) /* the open worked */
   EXEC SQL fetch c_master into :p_custnum; /* discover first customer */
while(SQLCODE==0) /* while no errors and not end of pittsburgh customers */
    {
   EXEC SQL begin work; /* start transaction for customer p_custnum */
   EXEC SQL open c_detail using :p_custnum;
   if(SQLCODE==0) /* detail open succeeded */
      EXEC SQL fetch c_detail into :p_orddate; /* get first order */
   while(SQLCODE==0) /* while no errors and not end of orders */
        {
      EXEC SQL update orders set order_date = '08/15/94'
         where current of c_detail;
      if(status==0) /* update was ok */
         EXEC SQL fetch c_detail into :p_orddate; /* next order */
      }
   if(SQLCODE==SQLNOTFOUND) /* correctly updated all found orders */
      EXEC SQL commit work; /* make updates permanent, set status */
   else /* some failure in an update */
        {
      save_status = SQLCODE; /* save error for loop control */
      EXEC SQL rollback work;
      SQLCODE = save_status; /* force loop to end */
       }
   if(SQLCODE==0) /* all updates, and the commit, worked ok */
      EXEC SQL fetch c_master into :p_custnum; /* next customer? */
   }
EXEC SQL close c_master;
```

Use either the CLOSE statement to close the hold cursor explicitly or the CLOSE DATABASE or DISCONNECT statements to close it implicitly. The CLOSE DATABASE statement closes all cursors.

Releases earlier than Version 9.40 of Dynamic Server do not support the PDQPRIORITY feature with cursors that were declared WITH HOLD.

Using an Insert Cursor with Hold: If you associate a hold cursor with an INSERT statement, you can use transactions to break a long series of PUT statements into smaller sets of PUT statements. Instead of waiting for the PUT statements to fill the buffer and cause an automatic write to the database, you can execute a COMMIT WORK statement to flush the row buffer. With a hold cursor, COMMIT WORK commits the inserted rows but leaves the cursor open for further inserts. This method can be desirable when you are inserting a large number of rows, because pending uncommitted work consumes database server resources.

Subset of SELECT Statement Associated with Cursors

As indicated in the syntax diagram for “DECLARE” on page 2-260, not all SELECT statements can be associated with a read-only or update cursor.

If the DECLARE statement includes one of these options, you must observe certain restrictions on the SELECT statement that is included in the DECLARE statement (either directly or as a prepared statement).

If the DECLARE statement includes the FOR READ ONLY option, the SELECT statement cannot have a FOR READ ONLY or FOR UPDATE option. (For a description of SELECT syntax and usage, see “SELECT” on page 2-479.)

If the DECLARE statement includes the FOR UPDATE option, the SELECT statement must conform to the following restrictions:

- The statement can select data from only one table.

- The statement cannot include any aggregate functions.
- The statement cannot include any of the following clauses or keywords: DISTINCT, FOR READ ONLY, FOR UPDATE, GROUP BY, INTO TEMP, ORDER BY, UNION, or UNIQUE.
- In Extended Parallel Server, the statement cannot include the INTO EXTERNAL and INTO SCRATCH clauses.

Examples of Cursors in Non-ANSI Compliant Databases

In a database that is not ANSI compliant, a cursor associated with a SELECT statement is a read-only cursor by default. The following example declares a read-only cursor in a non-ANSI compliant database:

```
EXEC SQL declare cust_curs cursor for
   select * from customer_notansi;
```

If you want to make it clear in the program code that this cursor is a read-only cursor, specify the FOR READ ONLY option as the following example shows:

```
EXEC SQL declare cust_curs cursor for
   select * from customer_notansi for read only;
```

If you want this cursor to be an update cursor, specify the FOR UPDATE option in your DECLARE statement. This example declares an update cursor:

```
EXEC SQL declare new_curs cursor for
   select * from customer_notansi for update;
```

If you want an update cursor to be able to modify only some columns in a table, you must specify those columns in the FOR UPDATE clause. The following example declares an update cursor that can update only the **fname** and **lname** columns in the **customer_notansi** table:

```
EXEC SQL declare name_curs cursor for
   select * from customer_notansi for update of fname, lname;
```

Examples of Cursors in ANSI-Compliant Databases

In an ANSI-compliant database, a cursor associated with a SELECT statement is an update cursor by default.

The following example declares an update cursor in an ANSI-compliant database:

```
EXEC SQL declare x_curs cursor for select * from customer_ansi;
```

To make it clear in the program documentation that this cursor is an update cursor, you can specify the FOR UPDATE option as in this example:

```
EXEC SQL declare x_curs cursor for
   select * from customer_ansi for update;
```

If you want an update cursor to be able to modify only some of the columns in a table, you must specify these columns in the FOR UPDATE option. The following example declares an update cursor and specifies that this cursor can update only the **fname** and **lname** columns in the **customer_ansi** table:

```
EXEC SQL declare y_curs cursor for
   select * from customer_ansi for update of fname, lname;
```

If you want a cursor to be a read-only cursor, you must override the default behavior of the DECLARE statement by specifying the FOR READ ONLY option in your DECLARE statement. The following example declares a read-only cursor:

```
EXEC SQL declare z_curs cursor for
   select * from customer_ansi for read only;
```

Associating a Cursor with a Prepared Statement

The PREPARE statement lets you assemble the text of an SQL statement at runtime and pass the statement text to the database server for execution. If you anticipate that a dynamically prepared SELECT, EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement that returns values could produce more than one row of data, the prepared statement must be associated with a cursor. (See PREPARE.)

The result of a PREPARE statement is a statement identifier (*statement id* or *id variable*), which is a data structure that represents the prepared statement text. To declare a cursor for the statement text, associate a cursor with the statement identifier.

You can associate a sequential cursor with any prepared SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement. You cannot associate a scroll cursor with a prepared INSERT statement or with a SELECT statement that was prepared to include a FOR UPDATE clause.

After a cursor is opened, used, and closed, a different statement can be prepared under the same statement identifier. In this way, it is possible to use a single cursor with different statements at different times. The cursor must be redeclared before you use it again.

The following example contains ESQL/C code that prepares a SELECT statement and declares a sequential cursor for the prepared statement text. The statement identifier **st_1** is first prepared from a SELECT statement that returns values; then the cursor **c_detail** is declared for **st_1**.

```
EXEC SQL prepare st_1 from
   'select order_date
      from orders where customer_num = ?';
EXEC SQL declare c_detail cursor for st_1;
```

If you want to use a prepared SELECT statement to modify data, add a FOR UPDATE clause to the statement text that you want to prepare, as the following ESQL/C example shows:

```
EXEC SQL prepare sel_1 from
   'select * from customer for update';
EXEC SQL declare sel_curs cursor for sel_1;
```

The DECLARE statement allows you to declare a cursor for an ESQL/C collection variable. Such a cursor is called a *collection cursor*. You use a collection variable to access the elements of a collection (SET, MULTISET, LIST) column. Use a cursor when you want to access one or more elements in a collection variable.

The Collection-Derived Table segment identifies the collection variable for which to declare the cursor. For more information, see “Collection-Derived Table” on page 5-5.

Select with a Collection-Derived Table

The diagram for “DECLARE” on page 2-260 refers to this section.

To declare a select cursor for a collection variable, include the Collection- Derived Table segment with the SELECT statement that you associate with the collection cursor. A select cursor allows you to select one or more elements *from* the collection variable. (For a description of SELECT syntax and usage, see “SELECT” on page 2-479.)

When you declare a select cursor for a collection variable, the DECLARE statement has the following restrictions:

- It cannot include the FOR READ ONLY keywords as cursor mode.

  The select cursor is an update cursor.
- It cannot include the SCROLL or WITH HOLD keywords.

  The select cursor must be a sequential cursor.

In addition, the SELECT statement that you associate with the collection cursor has the following restrictions:

- It cannot include the following clauses or options: WHERE, GROUP BY, ORDER BY, HAVING, INTO TEMP, and WITH REOPTIMIZATION.
- It cannot contain expressions in the select list.
- If the collection contains elements of opaque, distinct, built-in, or other collection data types, the select list must be an asterisk (*).
- Column names in the select list must be simple column names.

  These columns cannot use the following syntax:
  ```
  database@server:table.column --INVALID SYNTAX
  ```
- It *must* specify the name of the collection variable in the FROM clause.

  You cannot specify an input parameter (the question-mark (?) symbol) for the collection variable. Likewise you cannot use the virtual table format of the Collection-Derived Table segment.

Using a SELECT Cursor with a Collection Variable: A collection cursor that includes a SELECT statement with the Collection- Derived Table clause provides access to the elements in a collection variable.

To select more than one element:

1. Create a client collection variable in your ESQL/C program.
2. Declare the collection cursor for the SELECT statement with the DECLARE statement.

   To modify elements of the collection variable, declare the select cursor as an update cursor with the FOR UPDATE keywords. You can then use the WHERE CURRENT OF clause of the DELETE and UPDATE statements to delete or update elements of the collection.
3. Open this cursor with the OPEN statement.
4. Fetch the elements from the collection cursor with the FETCH statement and the INTO clause.
5. If necessary, perform any updates or deletes on the fetched data and save the modified collection variable in the collection column.

   Once the collection variable contains the correct elements, use the UPDATE or INSERT statement to save the contents of the collection variable in the actual collection column (SET, MULTISET, or LIST).
6. Close the collection cursor with the CLOSE statement.

This DECLARE statement declares a select cursor for a collection variable:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection set(integer not null) a_set;
EXEC SQL END DECLARE SECTION;
...
EXEC SQL declare set_curs cursor for select * from table(:a_set);
```

For an extended code example that uses a collection cursor for a SELECT statement, see "Fetching from a Collection Cursor (IDS)" on page 2-350.

Insert with a Collection-Derived Table

To declare an insert cursor for a collection variable, include the Collection- Derived Table segment in the INSERT statement associated with the collection cursor. An insert cursor can insert one or more elements in the collection. For a description of INSERT syntax and usage, see "INSERT" on page 2-395.

The insert cursor must be a sequential cursor. That is, the DECLARE statement cannot specify the SCROLL keyword.

When you declare an insert cursor for a collection variable, the Collection- Derived Table clause of the INSERT statement *must* contain the name of the collection variable. You cannot specify an input parameter (the question-mark (?) symbol) for the collection variable. However, you can use an input parameter in the VALUES clause of the INSERT statement. This parameter indicates that the collection element is to be provided later by the FROM clause of the PUT statement.

A collection cursor that includes an INSERT statement with the Collection- Derived Table clause allows you to insert more than one element into a collection variable.

To insert more than one element:

1. Create a client collection variable in your ESQL/C program.
2. Declare the collection cursor for the INSERT statement with the DECLARE statement.
3. Open the cursor with the OPEN statement.
4. Put the elements into the collection cursor with the PUT statement and the FROM clause.
5. Once the collection variable contains all the elements, use the UPDATE statement or the INSERT statement on a table name to save the contents of the collection variable in a collection column (SET, MULTISET, or LIST).
6. Close the collection cursor with the CLOSE statement.

This example declares an insert cursor for the **a_set** collection variable:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection multiset(smallint not null) a_mset;
   int an_element;
EXEC SQL END DECLARE SECTION;
...
EXEC SQL declare mset_curs cursor for
   insert into table(:a_mset) values (?);
EXEC SQL open mset_curs;
while (1)
{
...
   EXEC SQL put mset_curs from :an_element;
...
}
```

To insert the elements into the collection variable, use the PUT statement with the FROM clause. For a code example that uses a collection cursor for an INSERT statement, see "Inserting into a Collection Cursor (IDS)" on page 2-445.

Using Cursors with Transactions

To roll back a modification, you must perform the modification within a transaction. A transaction in a database that is not ANSI compliant begins only when the BEGIN WORK statement is executed.

In an ANSI-compliant database, transactions are always in effect.

The database server enforces these guidelines for select and update cursors to ensure that modifications can be committed or rolled back properly:

- Open an insert or update cursor within a transaction.
- Include PUT and FLUSH statements within one transaction.
- Modify data (update, insert, or delete) within one transaction.

The database server lets you open and close a hold cursor for an update outside a transaction; however, you should fetch all the rows that pertain to a given modification and then perform the modification all within a single transaction. You cannot open and close a hold cursor or an update cursor outside a transaction.

The following example uses an update cursor within a transaction:

```
EXEC SQL declare q_curs cursor for
   select customer_num, fname, lname from customer
   where lname matches :last_name for update;
EXEC SQL open q_curs;
EXEC SQL begin work;
EXEC SQL fetch q_curs into :cust_rec; /* fetch after begin */
EXEC SQL update customer set lname = 'Smith'
   where current of q_curs;
/* no error */
EXEC SQL commit work;
```

When you update a row within a transaction, the row remains locked until the cursor is closed or the transaction is committed or rolled back. If you update a row when no transaction is in effect, the row lock is released when the modified row is written to disk. If you update or delete a row outside a transaction, you cannot roll back the operation.

In a database that uses transactions, you cannot open an insert cursor outside a transaction unless it was also declared with the WITH HOLD keywords.

Related Information

Related statements: CLOSE, DELETE, EXECUTE PROCEDURE, FETCH, FREE, INSERT, OPEN, PREPARE, PUT, SELECT, and UPDATE

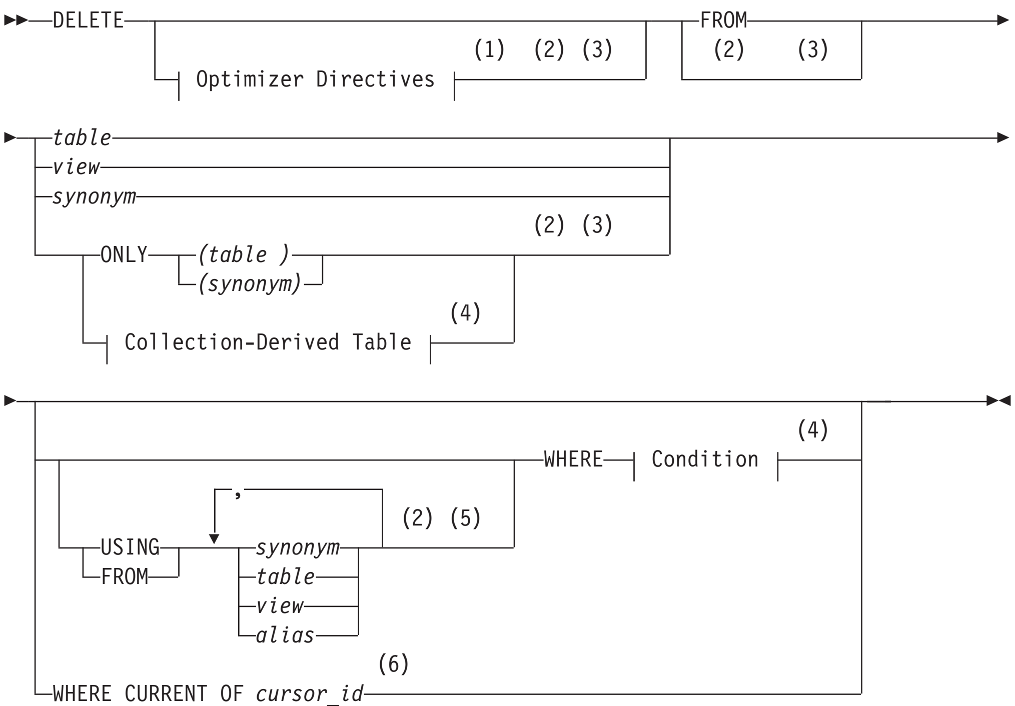
For discussions of cursors and data modification, see the *IBM Informix Guide to SQL: Tutorial*.

For more advanced issues related to cursors or using cursors with collection variables, see the *IBM Informix ESQL/C Programmer's Manual*.

DELETE

Use the DELETE statement to delete one or more rows from a table, or to delete one or more elements in an SPL or ESQL/C collection variable.

Syntax



Notes:

1 See “Optimizer Directives” on page 5-34

2 Informix extension

3 Dynamic Server only

4 See “Condition” on page 4-5

5 Extended Parallel Server only

6 ESQL/C and Stored Procedure Language only

Element	Description	Restrictions	Syntax
alias	Temporary name that you declare here for a table	You cannot use an alias for an indexed table	“Identifier” on page 5-22
cursor_id	Previously declared cursor	Must have been declared FOR UPDATE	“Identifier” on page 5-22
synonym, *table*, *view*	Table, view, or synonym with rows to be deleted	The *table* or *view* (or *synonym* and the table or view to which it points) must exist	“Database Object Name” on page 5-17

Usage

To execute the DELETE statement, you must hold the DBA access privilege on the database, or the Delete access privilege on the table.

In a database with explicit transaction logging, any DELETE statement that you execute outside a transaction is treated as a single transaction.

If you specify a *view* name, the view must be updatable. For an explanation of an updatable view, see "Updating Through Views" on page 2-251.

The database server locks each row affected by a DELETE statement within a transaction for the duration of the transaction. The type of lock that the database server uses is determined by the lock mode of the table, as set by a CREATE TABLE or ALTER TABLE statement, as follows:

- If the lock mode is ROW, the database server acquires one lock for each row affected by the delete.
- In Extended Parallel Server, if the lock mode is PAGE, the database server acquires one lock for each page affected by the delete.

If the number of rows affected is very large and the lock mode is ROW, you might exceed the limits your operating system places on the maximum number of simultaneous locks. If this occurs, you can either reduce the scope of the DELETE statement or lock the table in exclusive mode before you execute the statement.

4 If you use DELETE without a WHERE clause (to specify either a condition or the
4 active set of the cursor), all rows in the table are deleted. It is typically more
4 efficient, however, to use the TRUNCATE statement, rather than the DELETE
4 statement, to remove all rows from a table.

In DB-Access, if you omit the WHERE clause while working at the SQL menu, DB–Access prompts you to verify that you want to delete all rows from a table. You do not receive a prompt if you run execute DELETE within a command file.

In an ANSI-compliant database, data manipulation language (DML) statements are always in a transaction. You cannot execute a DELETE statement outside a transaction.

On Dynamic Server, the FROM keyword that immediately follows DELETE can be omitted if the **DELIMIDENT** environment variable has been set.

Using the ONLY Keyword (IDS)

If you use DELETE to remove rows of a supertable, rows from both the supertable and its subtables can be deleted. To delete rows from the supertable only, specify the ONLY keyword before the table name.

```
DELETE FROM ONLY(super_tab)
   WHERE name = "johnson"
```

Warning: If you use the DELETE statement on a supertable and omit the ONLY keyword and WHERE clause, all rows of the supertable and its subtables are deleted.

You cannot specify the ONLY keyword if you plan to use the WHERE CURRENT OF clause to delete the current row of the active set of a cursor.

Considerations When Tables Have Cascading Deletes

When you use the ON DELETE CASCADE option of the REFERENCES clause of either the CREATE TABLE or ALTER TABLE statement, you specify that you want deletes to cascade from one table to another. For example, in the **stores_demo** database**,** the **stock** table contains the column **stock_num** as a primary key. The **catalog** and **items** tables each contain the column **stock_num** as foreign keys with the ON DELETE CASCADE option specified. When a delete is performed from the **stock** table, rows are also deleted in the **catalog** and **items** tables, which are referenced through the foreign keys.

To have DELETE actions cascade to a table that has a referential constraint on a parent table, you need the Delete privilege only on the parent table that you reference in the DELETE statement.

4 If a DELETE operation with no WHERE clause is performed on a table that one or
4 more child tables reference with cascading deletes, Dynamic Server deletes all rows
4 from that table and from any affected child tables. (This resembles the effect of the
4 TRUNCATE statement, but Dynamic Server does not support TRUNCATE
4 operations on any table that has a child table referencing it.)

For an example of how to create a referential constraint that uses cascading deletes, see "Using the ON DELETE CASCADE Option" on page 2-180.

Restrictions on DELETE When Tables Have Cascading Deletes: You cannot use a child table in a correlated subquery to delete a row from a parent table. If two child tables reference the same parent table, and one child specifies cascading deletes but the other child does not, then if you attempt to delete a row that applies to both child tables from the parent table, the delete fails, and no rows are deleted from the parent or child tables.

Locking and Logging Implications of Cascading Deletes: During deletes, the database server places locks on all qualifying rows of the referenced and referencing tables.

Dynamic Server requires transaction logging for cascading deletes. If logging is turned off in a database that is not ANSI-compliant, even temporarily, deletes do not cascade, because you cannot roll back any actions. For example, if a parent row is deleted, but the system fails before the child rows are deleted, the database will have dangling child records, in violation of referential integrity. After logging is turned back on, however, subsequent deletes cascade.

Using the WHERE Keyword to Introduce a Condition

Use the WHERE *condition* clause to specify which rows you want to delete from the table. The *condition* after the WHERE keyword is equivalent to the *condition* in the SELECT statement. For example, the next statement deletes all the rows of the **items** table where the order number is less than 1034:

```
DELETE FROM items WHERE order_num < 1034
```

In DB-Access, if you include a WHERE clause that selects all rows in the table, DB–Access gives no prompt and deletes all rows.

In Dynamic Server, if you are deleting from a supertable in a table hierarchy, a subquery in the WHERE clause cannot reference a subtable.

When deleting from a subtable, a subquery in the WHERE clause can reference the supertable only in SELECT...FROM ONLY (*supertable*)... syntax.

Using the WHERE CURRENT OF Keywords (ESQL/C, SPL)

The WHERE CURRENT OF clause deletes the current row of the active set of a cursor. When you include this clause, the DELETE statement removes the row of the active set at the current position of the cursor. After the deletion, no current row exists; you cannot use the cursor to delete or update a row until you reposition the cursor with a FETCH statement.

You access the current row of the active set of a cursor with an update cursor. Before you can use the WHERE CURRENT OF clause, you must first create an update cursor by using the FOREACH statement (SPL) or the DECLARE statement with the FOR UPDATE clause (ESQL/C).

Unless they are declared with the FOR READ ONLY keywords, all select cursors are potentially update cursors in an ANSI-compliant database. You can use the WHERE CURRENT OF clause with any select cursor that was not declared with the FOR READ ONLY keywords.

In Dynamic Server, you cannot use WHERE CURRENT OF if you are selecting from only one table in a table hierarchy. That is, this clause is not valid with the ONLY keyword.

The WHERE CURRENT OF clause can be used to delete an element from a collection by deleting the current row of the collection-derived table that a collection variable holds. For more information, see "Collection-Derived Table" on page 5-5.

Using the USING or FROM Keyword to Introduce a Join Condition (XPS)

To delete information from a table based on information contained in one or more other tables, use the USING keyword or a second FROM keyword to introduce the list of tables that you want to join in the WHERE clause. When you use this syntax, the WHERE clause can include any complex join.

If you do not list a join in the WHERE clause, the database server ignores the tables listed after the introductory keyword (either USING or FROM). That is, the database server performs the query as if you specified no list of tables.

You can use a second FROM keyword to introduce the list of tables, but your code will be easier to read if you use the USING keyword instead.

When you introduce a list of tables that you want to join in the WHERE clause, the following restrictions for the DELETE statement exist:

- You must list the target table (the one from which rows are to be deleted) and any table that will be part of a join after the USING (or second from) keyword.
- The WHERE clause cannot contain outer joins.
- The target table cannot be a static or external table.
- The statement cannot contain cursors.
- If the target table is a view, the view must be updatable.

  That implies that the SELECT statement that defines the view cannot contain any of the following syntax elements:

  – Aggregate expressions
  – UNIQUE or DISTINCT keywords
  – UNION operator
  – GROUP BY keywords

The next example deletes the rows from the **lineitem** table whose corresponding rows in the **order** table show a **qty** of less than one.

```
DELETE FROM lineitem USING order o, lineitem l
   WHERE o.qty < 1 AND o.order_num = l.order_num
```

A delete join makes it easier to incorporate new data into a database. For example, you can:

1. Store new values in a temporary table.
2. Use a delete join (DELETE...USING statement) to remove any records from the temporary table that already exist in the table into which you want to insert the new records.
3. Insert the remaining records into the table.

In addition, you can use this syntax instead of deleting from the results of a SELECT statement that includes a join.

In ESQL/C, when you use a delete join, the entire operation occurs as a single transaction. For example, if a delete join query is supposed to delete 100 rows and an error occurs after the 50th row, the first 50 rows that are already deleted will reappear in the table.

Deleting Rows That Contain Opaque Data Types (IDS)

Some opaque data types require special processing when they are deleted. For example, if an opaque data type contains spatial or multirepresentational data, it might provide a choice of how to store the data: inside the internal structure or, for large objects, in a smart large object.

To accomplish this process, call a user-defined support function called **destroy( )**. When you use DELETE to remove a row that contains one of these opaque types, the database server automatically invokes **destroy( )** for the opaque type. This function decides how to remove the data, regardless of where it is stored. For more information on the **destroy( )** support function, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Deleting Rows That Contain Collection Data Types (IDS)

When a row contains a column that is a collection data type (LIST, MULTISET, or SET), you can search for a particular element in the collection, and delete the row or rows in which the element is found.

For example, the following statement deletes any rows from the **new_tab** table in which the **set_col** column contains the element `jimmy smith`:

```
DELETE FROM new_tab WHERE 'jimmy smith' IN set_col
```

You can also use a collection variable to delete values in a collection column by deleting one or more individual elements in a collection. For more information, see "Collection-Derived Table" on page 5-5 and the examples in "Database Name" on page 5-15 and "Example of Deleting from a Collection" on page 5-12.

Data Types in Distributed DELETE Operations (IDS)

In Dynamic Server, a DELETE (or any other SQL data-manipulation language statement) that accesses a database of another database server can only reference the built-in data types that are not opaque, DISTINCT, extended, nor large-object types. Cross-server DML operations cannot reference a column or expression of an opaque, DISTINCT, complex, large-object, nor user-defined data type (UDT).

Distributed operations that access other databases of the local Dynamic Server instance, however, can also access most *built-in opaque data types*, which are listed in "BOOLEAN and Other Built-In Opaque Data Types (IDS)" on page 4-19.

Deletes across databases of the local Dynamic Server instance can also reference UDTs, as well as DISTINCT types based on built-in data types, if all the UDTs and DISTINCT types are explicitly cast to built-in data types, and all the UDTs, DISTINCT types, and casts are defined in each of the participating databases.

Deletes cannot access a database of another database server unless both servers define TCP/IP connections in the DBSERVERNAME or DBSERVERALIAS configuration parameters. This applies to any communication between Dynamic Server instances, even if both database servers reside on the same computer.

SQLSTATE Values in an ANSI-Compliant Database

If no rows satisfy the WHERE clause of a DELETE operation on a table in an ANSI-compliant database, the database server issues a warning. You can detect this warning condition in either of the following ways:

- The GET DIAGNOSTICS statement sets the **RETURNED_SQLSTATE** field to the value `02000`. In an SQL API application, the **SQLSTATE** variable contains this same value.
- In an SQL API application, the **sqlca.sqlcode** and **SQLCODE** variables contain the value `100`.

The database server also sets **SQLSTATE** and **SQLCODE** to these values if the DELETE . . . WHERE statement is part of a multistatement prepared object, and the database server returns no rows.

SQLSTATE Values in a Database That Is Not ANSI-Compliant

In a database that is not ANSI compliant, the database server does not return a warning when it finds no rows satisfying the WHERE clause of a DELETE statement. In this case, the **SQLSTATE** code is `00000` and the **SQLCODE** code is zero (`0`). If the DELETE . . . WHERE is part of a multistatement prepared object, however, and no rows are returned, the database server does issue a warning. It sets **SQLSTATE** to `02000` and sets the **SQLCODE** value to `100`.

Related Information

Related Statements: DECLARE, FETCH, GET DIAGNOSTICS, INSERT, OPEN, SELECT, and UPDATE

For discussions of the DELETE statement, SPL routines, statement modification, cursors, and the **SQLCODE** code, see the *IBM Informix Guide to SQL: Tutorial*.

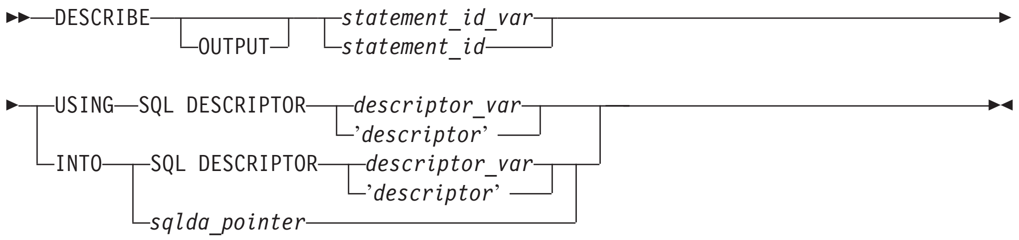
For information on how to access row and collections with ESQL/C host variables, see the chapter on complex data types in the *IBM Informix ESQL/C Programmer's Manual*.

For a discussion of the GLS aspects of the DELETE statement, see the *IBM Informix GLS User's Guide*.

DESCRIBE

Use the DESCRIBE statement to obtain information about output parameters and other features of a prepared statement before you execute it. Use this statement with ESQL/C. (See also "DESCRIBE INPUT" on page 2-286.)

Syntax



Element	Description	Restrictions	Syntax
descriptor	Name of a system-descriptor area	System-descriptor area must already be allocated	"Quoted String" on page 4-142
descriptor_var	Host variable specifying a system-descriptor area	Must contain the name of an allocated system-descriptor area	Language-specific rules for names
sqlda_pointer	Pointer to an **sqlda** structure	Cannot begin with dollar ($) sign or colon (:). An **sqlda** structure is required if dynamic SQL is used.	See the **sqlda** structure in the *IBM Informix ESQL/C Programmer's Manual*
statement_id	Statement identifier for a prepared SQL statement	Must be defined in a previous PREPARE statement	"PREPARE" on page 2-433; "Identifier" on page 5-22
statement _id_var	Host variable that contains the value of *statement_id*	Must be declared in a previous PREPARE statement	Language-specific rules for names

Usage

DESCRIBE can provide information at runtime about a prepared statement:

- The type of SQL statement that was prepared
- Whether an UPDATE or DELETE statement contains a WHERE clause
- In Dynamic Server, for a SELECT, EXECUTE FUNCTION (or EXECUTE PROCEDURE), INSERT, or UPDATE statement, the DESCRIBE statement also returns the number, data types, and size of the values, and the name of the column or expression that the query returns.
- In Extended Parallel Server, for a SELECT, EXECUTE PROCEDURE, or INSERT statement, DESCRIBE also returns the number, types, and size of the values, and the name of the column or expression that the query returns.

With this information, you can write code to allocate memory to hold retrieved values and display or process them after they are fetched.

The OUTPUT Keyword

The OUTPUT keyword specifies that only information about output parameters of the prepared statement are stored in the **sqlda** descriptor area. If you omit this keyword, DESCRIBE can return input parameters, but only for INSERT statements (and for UPDATE, if the **IFX_UPDDESC** environment variable is set in the environment where the database server is initialized).

Describing the Statement Type

The DESCRIBE statement takes a statement identifier from a PREPARE statement as input. When the DESCRIBE statement executes, the database server sets the value of the SQLCODE field of the **sqlca** to indicate the statement type (that is, the keyword with which the statement begins). If the prepared statement text contains more than one SQL statement, the DESCRIBE statement returns the type of the first statement in the text.

SQLCODE is set to zero to indicate a SELECT statement *without* an INTO TEMP clause. This situation is the most common. For any other SQL statement, SQLCODE is set to a positive integer. You can test the number against the constant names that are defined. In ESQL/C, the constant names are defined in the **sqlstypes.h** header file.

The DESCRIBE statement (and the DESCRIBE INPUT statement) use the SQLCODE field differently from any other statement, possibly returning a nonzero value when it executes successfully. You can revise standard error-checking routines to accommodate this behavior, if desired.

Checking for the Existence of a WHERE Clause

If the DESCRIBE statement detects that a prepared statement contains an UPDATE or DELETE statement without a WHERE clause, the DESCRIBE statement sets the **sqlca.sqlwarn.sqlwarn4** variable to `W`.

When you do not specify a WHERE clause in either a DELETE or UPDATE statement, the database server performs the delete or update operation on the entire table. Check the **sqlca.sqlwarn.sqlwarn4** variable to avoid unintended global changes to your table.

Describing a Statement with Runtime Parameters

If the prepared statement contains parameters for which the number of parameters or parameter data types is to be supplied at runtime, you can describe these input values. If the prepared statement text includes one of the following statements, the DESCRIBE statement returns a description of each column or expression that is included in the list:

- EXECUTE FUNCTION (or EXECUTE PROCEDURE)
- INSERT
- SELECT (without an INTO TEMP clause)
- UPDATE

  In Dynamic Server, the **IFX_UPDDESC** environment variable, as described in the *IBM Informix Guide to SQL: Reference*, must be set before you can use DESCRIBE to obtain information about an UPDATE statement.

The description includes the following information:

- The data type of the column, as defined in the table
- The length of the column, in bytes
- The name of the column or expression

For a prepared INSERT or UPDATE statement, DESCRIBE returns only the dynamic parameters (those expressed with a question mark (`?`) symbol). Using the OUTPUT keyword, however, prevents these from being returned.

You can specify a destination for the returned informations as a new or existing system-descriptor area, or as a pointer to an **sqlda** structure.

A system-descriptor area conforms to the X/Open standards.

Using the SQL DESCRIPTOR Keywords

Use the USING SQL DESCRIPTOR clause to store the description of a prepared statement list in a previously allocated system-descriptor area.

Use the INTO SQL DESCRIPTOR clause to create a new system-descriptor structure and store the description of a statement list in that structure.

To describe one of the previously mentioned statements into a system-descriptor area, DESCRIBE updates the system-descriptor area in these ways:

- It sets the COUNT field in the system-descriptor area to the number of values in the statement list. An error results if COUNT is greater than the number of item descriptors in the system-descriptor area.
- It sets the TYPE, LENGTH, NAME, SCALE, PRECISION, and NULLABLE fields in the system-descriptor area.

  In Dynamic Server, if the column has an opaque data type, the database server sets the EXTYPEID, EXTYPENAME, EXTYPELENGTH, EXTYPEOWNERLENGTH, and EXTYPEOWNERNAME fields of the item descriptor.
- It allocates memory for the DATA field for each item descriptor, based on the TYPE and LENGTH information.

After a DESCRIBE statement is executed, the SCALE and PRECISION fields contain the scale and precision of the column, respectively. If SCALE and PRECISION are set in the SET DESCRIPTOR statement, and TYPE is set to DECIMAL or MONEY, the LENGTH field is modified to adjust for the scale and precision of the decimal value. If TYPE is not set to DECIMAL or MONEY, the values for SCALE and PRECISION are not set, and LENGTH is unaffected.

You must modify system-descriptor-area information with SET DESCRIPTOR statements to show the address in memory that is to receive the described value. You can change the data type to another compatible type. This change causes data conversion to take place when data values are fetched.

You can use the system-descriptor area in prepared statements that support a USING SQL DESCRIPTOR clause, such as EXECUTE, FETCH, OPEN, and PUT.

The following examples show the use of a system descriptor in a DESCRIBE statement. In the first example, the system descriptor is a quoted string; in the second example, it is an embedded variable name.

```
main()
{
. . .
EXEC SQL allocate descriptor 'desc1' with max 3;
EXEC SQL prepare curs1 FROM 'select * from tab';
EXEC SQL describe curs1 using sql descriptor 'desc1';
}
EXEC SQL describe curs1 using sql descriptor :desc1var;
```

Using the INTO sqlda Pointer Clause

Use the INTO *sqlda_pointer* clause to allocate memory for an **sqlda** structure and store its address in an **sqlda** pointer. The DESCRIBE statement fills in the allocated memory with descriptive information. Unlike the USING clause, the INTO clause creates new **sqlda** structures to store the output from DESCRIBE.

The DESCRIBE statement sets the **sqlda.sqld** field to the number of values in the statement list. The **sqlda** structure also contains an array of data descriptors (**sqlvar** structures), one for each value in the statement list. After a DESCRIBE statement is executed, the **sqlda.sqlvar** structure has the **sqltype**, **sqllen**, and **sqlname** fields set.

In Dynamic Server, if the column has an opaque data type, DESCRIBE...INTO sets the **sqlxid**, **sqltypename**, **sqltypelen**, **sqlownerlen**, and **sqlownername** fields of the item descriptor.

The DESCRIBE statement allocates memory for an **sqlda** pointer once it is declared in a program. The application program, however, must designate the storage area of the **sqlda.sqlvar.sqldata**fields.

Describing a Collection Variable (IDS)

The DESCRIBE statement can provide information about a collection variable when you use the USING SQL DESCRIPTOR or INTO clause. You must issue the DESCRIBE statement *after* you open the select or insert cursor, because it the OPEN...USING statement specifies the name of the collection variable to use.

The next ESQL/C code fragment dynamically selects the elements of the **:a_set** collection variable into a system-descriptor area called **desc1**:

```
EXEC SQL BEGIN DECLARE SECTION;
      client collection a_set;
      int i, set_count;
      int element_type, element_value;
EXEC SQL END DECLARE SECTION;

EXEC SQL allocate collection :a_set;
EXEC SQL allocate descriptor 'desc1';
EXEC SQL select set_col into :a_set from table1;
EXEC SQL prepare set_id from 'select * from table(?)'

EXEC SQL declare set_curs cursor for set_id;
EXEC SQL open set_curs using :a_set;
EXEC SQL describe set_id using sql descriptor 'desc1';

do
{
      EXEC SQL fetch set_curs using sql descriptor 'desc1';
      ...
      EXEC SQL get descriptor 'desc1' :set_count = count;
      for (i = 1; i <= set_count; i++)
      {
         EXEC SQL get descriptor 'desc1' value :i
            :element_type = TYPE;
         switch
         {
            case SQLINTEGER:
               EXEC SQL get descriptor 'desc1' value :i
                  :element_value = data;
            ...
         } /* end switch */
      } /* end for */
} while (SQLCODE == 0);

EXEC SQL close set_curs;
EXEC SQL free set_curs;
EXEC SQL free set_id;
EXEC SQL deallocate collection :a_set;
EXEC SQL deallocate descriptor 'desc1';
```

Related Information

Related statements: ALLOCATE DESCRIPTOR, DEALLOCATE DESCRIPTOR, DECLARE, DESCRIBE INPUT, EXECUTE, FETCH, GET DESCRIPTOR, OPEN, PREPARE, PUT, and SET DESCRIPTOR

For a task-oriented discussion of the DESCRIBE statement, see the *IBM Informix Guide to SQL: Tutorial*.

For more information about how to use a system-descriptor area and **sqlda**, refer to the *IBM Informix ESQL/C Programmer's Manual*.

DESCRIBE INPUT

Use the DESCRIBE INPUT statement to return input parameter information before a prepared statement is executed.

Only Dynamic Server supports this statement. Use this statement with ESQL/C.

Syntax

```
►►──DESCRIBE INPUT──┬─statement_var─┬──────────────────────────────────────────────►
                    └─statement_id──┘

►──┬─USING──SQL DESCRIPTOR──┬─'descriptor' ──┬──┬─────────────────────────────────►◄
   │                        └─descriptor_var─┘  │
   └─INTO──┬─SQL DESCRIPTOR──┬─'descriptor' ──┬──┤
           │                 └─descriptor_var─┘ │
           │  (1)                               │
           └─────────sqlda_pointer──────────────┘
```

Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
descriptor	Name of a system-descriptor area	System-descriptor area must already be allocated	"Quoted String" on page 4-142
descriptor_var	Host variable specifying a system-descriptor area	Must contain the name of an allocated system-descriptor area	Language-specific rules for names
sqlda_pointer	Pointer to an **sqlda** structure	Cannot begin with dollar ($) sign or colon (:). An **sqlda** structure is required if dynamic SQL is used.	See the **sqlda** structure in the *IBM Informix ESQL/C Programmer's Manual*.
statement_id	Statement identifier for a prepared SQL statement	Must be defined in a previously executed PREPARE statement	"PREPARE" on page 2-433; "PREPARE" on page 2-433; "Identifier" on page 5-22
statement_var	Host variable that contains the value of *statement_id*	Variable and *statement_id* both must be declared	Language-specific rules for names

Usage

The DESCRIBE INPUT and the DESCRIBE OUTPUT statements can return information about a prepared statement to an SQL Descriptor Area (**sqlda**):

- For a SELECT, EXECUTE FUNCTION (or PROCEDURE), INSERT, or UPDATE statement, the DESCRIBE statement (with no INPUT keyword) returns the number, data types, and size of the returned values, and the name of the column or expression.
- For a SELECT, EXECUTE FUNCTION, EXECUTE PROCEDURE, DELETE, INSERT, or UPDATE statement, the DESCRIBE INPUT statement returns all the input parameters of a prepared statement.

Tip: Dynamic Server versions earlier than 9.40 do not support the *INPUT* keyword. For compatibility with legacy applications, *DESCRIBE* without *INPUT* is supported. In new applications, you should use DESCRIBE INPUT statements to provide information about dynamic parameters in the WHERE clause, in subqueries, and in other syntactic contexts where the old form of DESCRIBE cannot provide information.

With this information, you can write code to allocate memory to hold retrieved values that you can display or process after they are fetched.

The **IFX_UPDDESC** environment variable does not need to be set before you can use DESCRIBE INPUT to obtain information about an UPDATE statement.

Describing the Statement Type

This statement takes a statement identifier from a PREPARE statement as input. After DESCRIBE INPUT executes, the SQLCODE field of the **sqlca** indicates the statement type (that is, the keyword with which the statement begins). If a prepared object contains more than one SQL statement, DESCRIBE INPUT returns the type of the first statement in the prepared text.

SQLCODE is set to zero to indicate a SELECT statement *without* an INTO TEMP clause. This situation is the most common. For any other SQL statement, SQLCODE is set to a positive integer. You can compare the number with the named constants that are defined in the **sqlstypes.h** header file.

The DESCRIBE and DESCRIBE INPUT statements use SQLCODE differently from other statements, under some circumstances returning a nonzero value after successful execution. You can revise standard error-checking routines to accommodate this behavior, if desired.

Checking for Existence of a WHERE Clause

If the DESCRIBE INPUT statement detects that a prepared object contains an UPDATE or DELETE statement without a WHERE clause, the database server sets the **sqlca.sqlwarn.sqlwarn4** variable to `W`.

When you do not specify a WHERE clause in either a DELETE or UPDATE statement, the database server performs the delete or update action on the entire table. Check the **sqlca.sqlwarn.sqlwarn4** variable after DESCRIBE INPUT executes to avoid unintended global changes to your table.

Describing a Statement with Dynamic Runtime Parameters

If the prepared statement specifies a set of parameters whose cardinality or data types must be supplied at runtime, you can describe these input values. If the prepared statement text includes one of the following statements, the DESCRIBE INPUT statement returns a description of each column or expression that is included in the list:

- EXECUTE FUNCTION (or EXECUTE PROCEDURE)
- INSERT or SELECT
- UPDATE or DELETE

The description includes the following information:

- The data type of the column, as defined in the table
- The length of the column, in bytes
- The name of the column or expression
- Information about *dynamic parameters* (parameters that are expressed as question (?) mark symbols within the prepared statement)

If the database server cannot infer the data type of an expression parameter, the DESCRIBE INPUT statement returns SQLUNKNOWN as the data type.

You can specify a destination for the returned informations as a new or existing system-descriptor area, or as a pointer to an **sqlda** structure.

Using the SQL DESCRIPTOR Keywords

Specify INTO SQL DESCRIPTOR to create a new system-descriptor structure and store the description of a prepared statement list in that structure.

Use the USING SQL DESCRIPTOR clause to store the description of a prepared statement list in a previously allocated system-descriptor area. Executing the DESCRIBE INPUT . . . USING SQL DESCRIPTOR statement updates an existing system-descriptor area in the following ways:

- It allocates memory for the DATA field for each item descriptor, based on the TYPE and LENGTH information.
- It sets the COUNT field in the system-descriptor area to the number of values in the statement list. An error results if COUNT is greater than the number of item descriptors in the system-descriptor area.
- It sets the TYPE, LENGTH, NAME, SCALE, PRECISION, and NULLABLE fields in the system-descriptor area.

For columns of opaque data types, the DESCRIBE INPUT statement sets the EXTYPEID, EXTYPENAME, EXTYPELENGTH, EXTYPEOWNERLENGTH, and EXTYPEOWNERNAME fields of the item descriptor.

After a DESCRIBE INPUT statement executes, the SCALE and PRECISION fields contain the scale and precision of the column, respectively. If SCALE and PRECISION are set in the SET DESCRIPTOR statement, and TYPE is set to DECIMAL or MONEY, the LENGTH field is modified to adjust for the decimal scale and precision. If TYPE is not set to DECIMAL or MONEY, the values for SCALE and PRECISION are not set, and LENGTH is unaffected.

You must modify the system-descriptor-area information with the SET DESCRIPTOR statement to specify the address in memory that is to receive the described value. You can change the data type to another compatible type. This causes data conversion to take place when the data values are fetched.

You can also use the system-descriptor area in other statements that support a USING SQL DESCRIPTOR clause, such as EXECUTE, FETCH, OPEN, and PUT.

The following examples show the use of a system descriptor in a DESCRIBE statement. In the first example, the system descriptor is a quoted string; in the second example, it is an embedded variable name.

```
main()
{
. . .
EXEC SQL allocate descriptor 'desc1' with max 3;
EXEC SQL prepare curs1 FROM 'select * from tab';
EXEC SQL describe curs1 using sql descriptor 'desc1';
}
EXEC SQL describe curs1 using sql descriptor :desc1var;
```

A system-descriptor area conforms to the X/Open standards.

Using the INTO sqlda Pointer Clause

The INTO *sqlda_pointer* clause allocates memory for an **sqlda** structure and store its address in an **sqlda** pointer. The DESCRIBE INPUT statement fills in the allocated memory with descriptive information.

The DESCRIBE INPUT statement sets the **sqlda.sqld** field to the number of values in the statement list. The **sqlda** structure also contains an array of data descriptors (**sqlvar** structures), one for each value in the statement list. After a DESCRIBE statement is executed, the **sqlda.sqlvar** structure has the **sqltype**, **sqllen**, and **sqlname** fields set.

If the column has an opaque data type, DESCRIBE INPUT . . . INTO sets the **sqlxid**, **sqltypename**, **sqltypelen**, **sqlownerlen**, and **sqlownername** fields of the item descriptor.

The DESCRIBE INPUT statement allocates memory for an **sqlda** pointer once it is declared in a program. The application program, however, must designate the storage area of the **sqlda.sqlvar.sqldata** fields.

Describing a Collection Variable

The DESCRIBE INPUT statement can provide information about a collection variable if you use the INTO or USING SQL DESCRIPTOR clause.

You must execute the DESCRIBE INPUT statement *after* you open the select or insert cursor. Otherwise, DESCRIBE INPUT cannot get information about the collection variable because it is the OPEN . . . USING statement that specifies the name of the collection variable to use.

The next ESQL/C program fragment dynamically selects the elements of the **:a_set** collection variable into a system-descriptor area called **desc1**:

```
EXEC SQL BEGIN DECLARE SECTION;
      client collection a_set;
      int i, set_count;
      int element_type, element_value;
EXEC SQL END DECLARE SECTION;

EXEC SQL allocate collection :a_set;
EXEC SQL allocate descriptor 'desc1';
EXEC SQL select set_col into :a_set from table1;
EXEC SQL prepare set_id from
      'select * from table(?)'


EXEC SQL declare set_curs cursor for set_id;
EXEC SQL open set_curs using :a_set;
EXEC SQL describe set_id using sql descriptor 'desc1';do
{
      EXEC SQL fetch set_curs using sql descriptor 'desc1';
      ...
      EXEC SQL get descriptor 'desc1' :set_count = count;
      for (i = 1; i <= set_count; i++)
      {
         EXEC SQL get descriptor 'desc1' value :i
            :element_type = TYPE;
         switch
         {
            case SQLINTEGER:
               EXEC SQL get descriptor 'desc1' value :i
                  :element_value = data;
            ...
         } /* end switch */
      } /* end for */
} while (SQLCODE == 0);

EXEC SQL close set_curs;
EXEC SQL free set_curs;
EXEC SQL free set_id;
EXEC SQL deallocate collection :a_set;
EXEC SQL deallocate descriptor 'desc1';
```

Related Information

Related statements: ALLOCATE DESCRIPTOR, DEALLOCATE DESCRIPTOR, DECLARE, DESCRIBE, EXECUTE, FETCH, GET DESCRIPTOR, OPEN, PREPARE, PUT, and SET DESCRIPTOR

For a task-oriented discussion of the DESCRIBE statement, see the *IBM Informix Guide to SQL: Tutorial*.

For more information about how to use a system-descriptor area and **sqlda**, refer to the *IBM Informix ESQL/C Programmer's Manual*.

DISCONNECT

Use the DISCONNECT statement to terminate a connection between an application and a database server.

Syntax

```
>>──DISCONNECT──┬─CURRENT──────────────┬───────────────────────────────────────────><
                │  (1)                 │
                ├─────────┬─ALL─────┬──┤
                │         └─DEFAULT─┘  │
                └─┬─'connection'───┬───┘
                  └─connection_var─┘
```

Notes:

1 ESQL/C only

Element	Description	Restrictions	Syntax
connection	String that specifies a connection to terminate	Connection name that the CONNECT statement assigned	"Quoted String" on page 4-142
connection_var	Host variable that holds the name of a connection	Must be a fixed-length character data type	Language specific

Usage

DISCONNECT terminates a connection to a database server. If a database is open, it closes before the connection drops. Even if you made a connection to a specific database only, the connection to the database server is terminated by DISCONNECT. If DISCONNECT does not terminate the current connection, the connection context of the current environment is not changed.

DISCONNECT is not valid as statement text in a PREPARE statement.

In ESQL/C, if you disconnect with *connection* or *connection_var*, DISCONNECT generates an error if the specified connection is not a current or dormant connection.

DEFAULT Option

DISCONNECT DEFAULT disconnects the default connection.

The *default connection* is one of the following connections:

- A connection established by the CONNECT TO DEFAULT statement
- An implicit default connection established by the DATABASE or CREATE DATABASE statement

You can use DISCONNECT to disconnect the default connection. If the DATABASE statement does not specify a database server, as in the following example, the default connection is made to the default database server:

```
EXEC SQL database 'stores_demo';
. . .
EXEC SQL disconnect default;
```

If the DATABASE statement specifies a database server, as the following example shows, the default connection is made to that database server:

```
EXEC SQL database 'stores_demo@mydbsrvr';
. . .
EXEC SQL disconnect default;
```

In either case, the DEFAULT option of DISCONNECT disconnects this default connection. For more information, see "DEFAULT Option" on page 2-76.

Specifying the CURRENT Keyword

The DISCONNECT CURRENT statement terminates the current connection. For example, the DISCONNECT statement in the following program fragment terminates the current connection to the database server **mydbsrvr**:

```
CONNECT TO 'stores_demo@mydbsrvr'
. . .
DISCONNECT CURRENT
```

When a Transaction is Active

DISCONNECT generates an error during a transaction. The transaction remains active, and the application must explicitly commit it or roll it back. If an application terminates without issuing DISCONNECT (because of a system failure or program error, for example), active transactions are rolled back.

In an ANSI-compliant database, however, if no error is encountered while you exit from DB–Access in non-interactive mode without issuing the CLOSE DATABASE, COMMIT WORK, or DISCONNECT statement, the database server automatically commits any open transaction.

Disconnecting in a Thread-Safe Environment

If you issue the DISCONNECT statement in a thread-safe ESQL/C application, keep in mind that an active connection can only be disconnected from within the thread in which it is active. Therefore, one thread cannot disconnect the active connection of another thread. The DISCONNECT statement generates an error if such an attempt is made.

Once a connection becomes dormant, however, any other thread can disconnect it unless an ongoing transaction is associated with the dormant connection that was established with the WITH CONCURRENT TRANSACTION clause of CONNECT. If the dormant connection was not established with the WITH CONCURRENT TRANSACTION clause, DISCONNECT generates an error when it tries to disconnect it.

For an explanation of connections in a thread-safe ESQL/C application, see "SET CONNECTION" on page 2-534.

Specifying the ALL Option

Use the keyword ALL to terminate all connections established by the application up to that time. For example, the following DISCONNECT statement disconnects the current connection as well as all dormant connections:

```
DISCONNECT ALL
```

In ESQL/C, the ALL keyword has the same effect on multithreaded applications that it has on single-threaded applications. Execution of the DISCONNECT ALL statement causes all connections in all threads to be terminated. However, the DISCONNECT ALL statement fails if any of the connections is in use or has an ongoing transaction associated with it. If either of these conditions is true, none of the connections is disconnected.

Related Information

Related statements: CONNECT, DATABASE, and SET CONNECTION

For information on multithreaded applications, see the *IBM Informix ESQL/C Programmer's Manual*.

DROP ACCESS_METHOD

Use the DROP ACCESS_METHOD statement to remove a previously defined access method from the database.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>--DROP--ACCESS_METHOD--access_method--RESTRICT-----------------------------><
```

Element	Description	Restrictions	Syntax
access_method	Name of access method to drop	Must be registered in **sysams** system catalog table; cannot be a built-in access method	"Identifier" on page 5-22
owner	Owner of the access method	Must own the access method	"Owner Name" on page 5-43

Usage

The RESTRICT keyword is required. You cannot drop an access method if virtual tables or indexes exist that use the access method. You must be the owner of the access method or have DBA privileges to drop an access method.

If a transaction is in progress, the database server waits to drop the access method until the transaction is committed or rolled back. No other users can execute the access method until the transaction has completed.

Related Information

Related statements: ALTER ACCESS_METHOD and CREATE ACCESS_METHOD

For a description of the RESTRICT keyword, see "Specifying RESTRICT Mode" on page 2-315. For more information on primary-access methods, see the *IBM Informix Virtual-Table Interface Programmer's Guide*.

For more information on secondary-access methods, see the *IBM Informix Virtual-Index Interface Programmer's Guide*. For a discussion of privileges, see the GRANT statement or the *IBM Informix Database Design and Implementation Guide*.

DROP AGGREGATE

Use the DROP AGGREGATE statement to drop a user-defined aggregate that you created with the CREATE AGGREGATE statement.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP AGGREGATE──┬──────────┬──aggregate─────────────────────────────►◄
                    └─ owner──.┘
```

Element	Description	Restrictions	Syntax
aggregate	Name of the user-defined aggregate to be dropped	Must have been previously created with the CREATE AGGREGATE statement	"Identifier" on page 5-22
owner	Owner of the aggregate	Must own the aggregate	"Owner Name" on page 5-43

Usage

Dropping a user-defined aggregate does not drop the support functions that you defined for the aggregate in the CREATE AGGREGATE statement. The database server does not track dependency of SQL statements on user-defined aggregates that you use in the statements. For example, you can drop a user-defined aggregate that is used in an SPL routine.

The following example drops the user-defined aggregate named **my_avg**:

```
DROP AGGREGATE my_avg
```

Related Information

Related statements: CREATE AGGREGATE

For information about how to invoke a user-defined aggregate, see the discussion of user-defined aggregates in the Expression segment. For a description of the **sysaggregates** system catalog table that holds information about user-defined aggregates, see the *IBM Informix Guide to SQL: Reference*. For a discussion of user-defined aggregates, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

DROP CAST

Use the DROP CAST statement to remove an existing cast from the database.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP CAST──(──source_type──AS──target_type──)──────────────────────►◄
```

Element	Description	Restrictions	Syntax
source_type	Data type that the cast accepts as input	Must exist	"Identifier" on page 5-22; "Data Type" on page 4-18
target_type	Data type returned by the cast	Must exist	"Identifier" on page 5-22; "Data Type" on page 4-18

Usage

You must be owner of the cast or have the DBA privilege to use DROP CAST. Dropping a cast removes its definition from the **syscasts** system catalog table, so the cast cannot be invoked explicitly or implicitly. Dropping a cast has no effect on the user-defined function associated with the cast. Use the DROP FUNCTION statement to remove the user-defined function from the database.

Warning: Do not drop built-in casts, which user **informix** owns. These are required for automatic conversions between built-in data types.

A cast defined on a given data type can also be used on any DISTINCT types created from that source type. If you drop the cast, you can no longer invoke it for the DISTINCT types, but dropping a cast that is defined for a DISTINCT type has no effect on casts for its source type. When you create a DISTINCT type, the database server automatically defines an explicit cast from the DISTINCT type to its source type and another explicit cast from the source type to the DISTINCT type. When you drop the DISTINCT type, the database server automatically drops these two casts.

Related Information

Related statements: CREATE CAST and DROP FUNCTION.

For more information about data types, refer to the *IBM Informix Guide to SQL: Reference*.

DROP DATABASE

Use the DROP DATABASE statement to delete an entire database, including all system catalog tables, objects, and data.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
                                   (1)
►►──DROP DATABASE──┤ Database Name ├──────────────────────────────────────►◄
```

Notes:

1 See "Database Name" on page 5-15

Usage

The DROP DATABASE statement is an extension to the ANSI/ISO standard, which does not provide syntax for the destruction of a database.

The following statement drops the **stores_demo** database:

```
DROP DATABASE stores_demo
```

You must have the DBA privilege or be user **informix** to run the DROP DATABASE statement successfully. Otherwise, the database server issues an error message and does not drop the database.

You cannot drop the current database or a database that is currently being used by another user. All the current users of the database must first execute the CLOSE DATABASE statement before DROP DATABASE can be successful.

The DROP DATABASE statement attempts to create an implicit connection to the database that you intend to drop. If a previous CONNECT statement has established an explicit connection to another database, and that connection is still your current connection, the DROP DATABASE statement fails with error -1811. In this case, you must first use the DISCONNECT statement to close the explicit connection before you can execute the DROP DATABASE statement.

The DROP DATABASE statement cannot appear in a multistatement PREPARE statement, nor within an SPL routine.

In a DROP DATABASE operation, the database server acquires a lock on each table in the database and holds the locks until the entire operation is complete. Configure your database server with enough locks to accommodate this fact.

For example, if the database to be dropped has 2500 tables, but fewer than 2500 locks were configured for your database server, the DROP DATABASE statement fails. For more information on how to configure the number of locks available to the database server, see the discussion of the LOCKS configuration parameter in your *IBM Informix Administrator's Reference*.

In DB–Access, use the DROP DATABASE statement with caution. DB–Access does not prompt you to verify that you want to delete the entire database.

In ESQL/C, you can use an unqualified database name in a program or host variable, or you can specify the fully-qualified *database@server* format. For example, the following statement drops the **stores_demo** database of a database server called **gibson95**:

```
EXEC SQL DROP DATABASE stores_demo@gibson95
```

If this statement executes successfully, the **gibson95** database server instance continues to exist, but the **stores_demo** database of that database server no longer exists. For more information, see “Database Name” on page 5-15.

The DROP DATABASE statement cannot appear in a multistatement PREPARE statement.

Related Information

Related statements: CLOSE DATABASE, CONNECT, CREATE DATABASE, DATABASE, and DISCONNECT

DROP DUPLICATE

Use the DROP DUPLICATE statement to remove from the database all duplicate copies of a specified existing table that the CREATE DUPLICATE statement created in a specified dbslice or in specified dbspaces across coservers. The original table is not affected by the DROP DUPLICATE statement.

Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP DUPLICATE OF TABLE──┬──────────┬──table──────────────────────────────►◄
                             └─ owner──.┘
```

Element	Description	Restrictions	Syntax
owner	Owner of the duplicate table	Must own the duplicate table	"Owner Name" on page 5-43
table	Name of the table for which you want to remove all duplicates	Must exist and must be a duplicated table	"Identifier" on page 5-22

Usage

To drop all duplicate copies of a duplicated table and leave only the original table, enter the DROP DUPLICATE statement. Because duplicate tables are read-only, to update a duplicated table, you must first drop all duplicate copies.

Attached indexes on the copies of the duplicate table are also dropped when DROP DUPLICATE is successfully executed.

Related Information

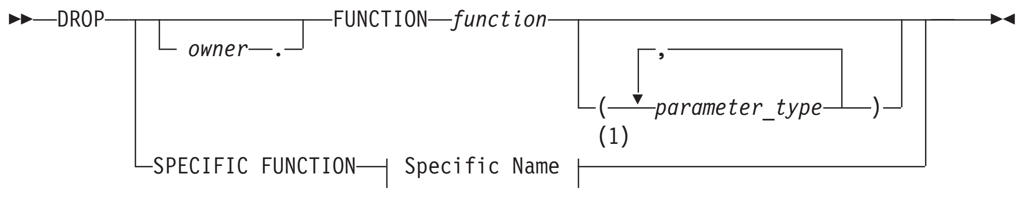
CREATE DUPLICATE

DROP FUNCTION

Use the DROP FUNCTION statement to remove a user-defined function from the database.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 See "Specific Name" on page 5-68

Element	Description	Restrictions	Syntax
function	Name of the user-defined function to be dropped	Must exist (that is, be registered) in the database. If the name does not uniquely identify a function, you must enter one or more appropriate values for *parameter_type*.	"Identifier" on page 5-22
parameter_type	Data type of the parameter	The data type (or list of data types) must be the same data types (and specified in the same order) as those specified in the CREATE FUNCTION statement when the function was created	"Identifier" on page 5-22; "Data Type" on page 4-18

Usage

Dropping a user-defined function removes the text and executable versions of the function from the database.

If you do not know if a UDR is a user-defined function or a user-defined procedure, you can drop the UDR by using the DROP ROUTINE statement.

To use the DROP FUNCTION statement, you must be the owner of the user-defined function or have the DBA privilege. To drop an external user-defined function, see also "Dropping an External Routine" on page 2-309.

You cannot drop an SPL function from within the same SPL function.

Dynamic Server can resolve a function by its *specific name*, if the function definition declared a specific name. If you use the specific name in this statement, you must also use the keyword SPECIFIC, as in the following example:

```
DROP SPECIFIC FUNCTION compare_point
```

Otherwise, if the *function* name is not unique within the database, you must specify enough *parameter_type* information to disambiguate the name. If you use parameter data types to identify a user-defined function, they follow the function name, as in the following example:

```
DROP FUNCTION compare (int, int)
```

But the database server returns an error if it cannot resolve an ambiguous function name whose signature differs from that of another function only in an unnamed ROW-type parameter. (This error cannot be anticipated by the database server when the ambiguous *function* is defined.)

Modifying User-Defined Functions (XPS)

Extended Parallel Server does not support the ALTER PROCEDURE, ALTER ROUTINE, nor ALTER FUNCTION statements. To change the text of an SPL function of Extended Parallel Server, you must first use DROP PROCEDURE to drop it, then make your revisions, and finally use CREATE PROCEDURE to register it again. Make sure to keep a copy of the function text somewhere outside the database, in case you need to re-create a function after it is dropped.

Dropping External Functions

A user-defined function (UDF) written in C language or in the Java language is called an *external function*. External functions must include the External Routine Reference clause that specifies a shared-object filename. By default, only users to whom the DBSA has granted the built-in EXTEND role can create or drop an external function. See the section "Granting the EXTEND Role (IDS)" on page 2-386 for additional information about this feature.

Related Information

Related statements: ALTER FUNCTION, CREATE FUNCTION, CREATE FUNCTION FROM, DROP PROCEDURE, DROP ROUTINE, EXECUTE FUNCTION, and GRANT

For information on how to create user-defined functions, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

DROP INDEX

Use the DROP INDEX statement to remove an index.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──DROP INDEX──┬────────────┬──index──┬────────────┬──────────────────────><
                └─ owner── .─┘         │        (1) │
                                       └─ONLINE─────┘
```

Notes:

1 Dynamic Server only

Element	Description	Restrictions	Syntax
index	Name of the index to be dropped	Must exist in the database	"Identifier" on page 5-22
owner	Name of index owner	Must own the index	"Owner Name" on page 5-43

Usage

In a typical online transaction processing (OLTP) environment, concurrent applications are connected to the database server to perform DML operations. For every query, the optimizer chooses a plan that is based on existing indexes, statistics, and directives. After numerous OLTP transactions, however, the chosen plan might no longer be the best plan for query execution. In this case, dropping an inefficient index can sometimes improve performance.

You must be the owner of the *index* or have the DBA privilege to use the DROP INDEX statement. The following example drops the index **o_num_ix** that **joed** owns. The **stores_demo** database must be the current database:

```
DROP INDEX stores_demo:joed.o_num_ix;
```

You cannot use the DROP INDEX statement to drop a unique constraint, nor to drop an index that supports a constraint; you must use the ALTER TABLE ... DROP CONSTRAINT statement to drop the constraint. When you drop the constraint, the database server automatically drops any index that exists solely to support that constraint. If you attempt to use DROP INDEX to drop an index that is shared by a unique constraint, the database server renames the specified index in the **sysindexes** system catalog table, declaring a new name in this format:

```
[space]<tabid>_<constraint_id>
```

Here *tabid* and *constraint_id* are from the **systables** and **sysconstraints** system catalog tables, respectively. The **sysconstraints.idxname** column is then updated to something like: `" 121_13"` (where quotes show the leading blank space). If this index is a unique index with only referential constraints sharing it, the index is downgraded to a duplicate index after it is renamed.

The ONLINE Keyword (IDS)

By default, DROP INDEX attempts to place an exclusive lock on the indexed table to prevent all other users from accessing the table while the index is being dropped. The DROP INDEX statement fails if another user already has a lock on the table, or is currently accessing the table at the Dirty Read isolation level.

The DBA can reduce the risk of non-exclusive access errors, and can increase the availability of the indexed table, by including the ONLINE keyword as the last specification of the DROP INDEX statement. The ONLINE keyword instructs the database server to drop the index while minimizing the duration of an exclusive locks. The index can be dropped while concurrent users are accessing the table.

After you issue the DROP INDEX ... ONLINE statement, the query optimizer does not consider using the specified index in subsequent query plans or cost estimates, and the database server does not support any other DDL operations on the indexed table, until after the specified index has been dropped. Query operations that were initiated prior to the DROP INDEX ... ONLINE statement, however, can continue to access the index until the queries are completed.

When no other users are accessing the index, the database server drops the index, and the DROP INDEX . . . ONLINE statement terminates execution.

By default, the DROP INDEX ... ONLINE statement does not wait indefinitely for locks to be released. If one or more concurrent sessions hold locks on the table, the statement might fail with error -216 or -113 unless you first issue the SET LOCK MODE TO WAIT statement to specify an indefinite wait. Otherwise, DROP INDEX ... ONLINE uses the waiting period for locks that the DEADLOCK_TIMEOUT configuration parameter specifies, or that a previous SET LOCK MODE statement specified. To avoid locking errors, execute SET LOCK MODE TO WAIT (with no specified limit) before you attempt to drop an index online.

You cannot use the CREATE INDEX statement to declare a new index that has the same identifier until after the specified index has been dropped. No more than one CREATE INDEX ... ONLINE or DROP INDEX ... ONLINE statement can concurrently reference indexes on the same table.

The indexed table can be permanent or temporary, logged or unlogged, and fragmented or non-fragmented. You cannot specify the ONLINE keyword, however, when you drop a virtual index, a clustered index, or an R-tree index.

Related Information

Related statements: ALTER TABLE, CREATE INDEX, CREATE TABLE. and CREATE Temporary TABLE. For the effect of indexes on performance, see your *IBM Informix Performance Guide*.

For more information on virtual indexes, see the *IBM Informix Virtual-Index Interface Programmer's Guide*.

DROP OPCLASS

Use the DROP OPCLASS statement to remove an existing operator class from the database.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──DROP OPCLASS──┬──────────────┬──opclass──RESTRICT──────────────────────────><
                  └─ owner── . ──┘
```

Element	Description	Restrictions	Syntax
opclass	Name of operator class to be dropped	Must have been created by a previous CREATE OPCLASS statement	“Identifier” on page 5-22
owner	Name of opclass owner	Must own the operator class	“Owner Name” on page 5-43

Usage

You must be the owner of the operator class or have the DBA privilege to use the DROP OPCLASS statement.

The RESTRICT keyword causes DROP OPCLASS to fail if the database contains indexes defined on the operator class that you plan to drop. Therefore, before you drop the operator class, you must use the DROP INDEX statement to drop any dependent indexes.

The following DROP OPCLASS statement drops an operator class called **abs_btree_ops**:

```
DROP OPCLASS abs_btree_ops RESTRICT
```

Related Information

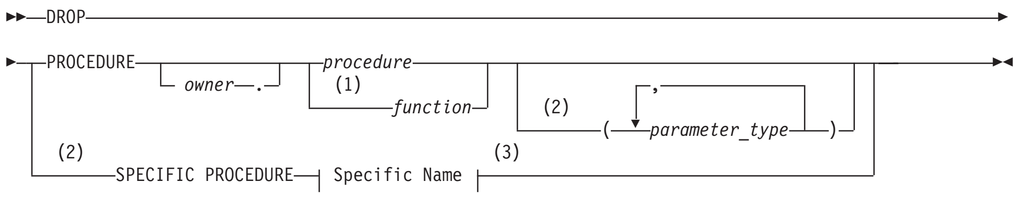
Related statement: CREATE OPCLASS, DROP INDEX

For information on how to create or extend an operator class, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

DROP PROCEDURE

Use the DROP PROCEDURE statement to drop a user-defined procedure from the database. This statement is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 Stored Procedure Language only

2 Dynamic Server only

3 See “Specific Name” on page 5-68

Element	Description	Restrictions	Syntax
function	Name of a procedure or SPL function to drop	Must exist (that is, be registered) in the database	“Identifier” on page 5-22
owner	Name of UDR owner	Must own the procedure or SPL function	“Owner Name” on page 5-43
parameter _type	The data type of the parameter	The data type (or list of data types) must be the same types (and in the same order) as those specified when the procedure was created	“Identifier” on page 5-22; “Data Type” on page 4-18
procedure	Name of user-defined procedure to drop	Must exist (that is, be registered) in the database	“Database Object Name” on page 5-17

Usage

Dropping a user-defined procedure removes the text and executable versions of the procedure. You cannot drop an SPL procedure within the same SPL procedure.

To use the DROP PROCEDURE statement, you must be the owner of the procedure or have the DBA privilege.

In Dynamic Server, for backward compatibility, you can use the DROP PROCEDURE statement to drop an SPL function that was created with the CREATE PROCEDURE statement.

In Extended Parallel Server, which does not support the DROP FUNCTION statement, use the DROP PROCEDURE statement to drop any SPL routine.

Extended Parallel Server does not support ALTER PROCEDURE, ALTER ROUTINE, or ALTER FUNCTION statements. To change the text of an SPL procedure, you must drop the procedure, modify it, and then re-create it. Make sure to keep a copy of the SPL procedure text somewhere outside the database, in case you need to re-create the procedure after it is dropped.

If the *function* or *procedure* name is not unique within the database, you must specify enough *parameter_type* information to disambiguate the name. If the database server cannot resolve an ambiguous UDR name whose signature differs from that of another UDR only in an unnamed ROW type parameter, an error is returned. (This error cannot be anticipated by the database server when the ambiguous *function* or *procedure* is defined.)

If you do not know whether a UDR is a user-defined procedure or a user-defined function, you can use the DROP ROUTINE statement. For more information, see "DROP ROUTINE" on page 2-308.

For backward compatibility, in Dynamic Server, you can use this statement to drop an SPL function that CREATE PROCEDURE created. You can include parameter data types after the name of the procedure to identify the procedure:

```
DROP PROCEDURE compare(int, int);
```

In Dynamic Server, if you use the specific name for the user-defined procedure, you must also use the keyword SPECIFIC, as in the following example:

```
DROP SPECIFIC PROCEDURE compare_point;
```

Dropping an External Procedure (IDS)

A user-defined procedure (UDR) written in C language or in the Java language is called an *external routine*. External routines must include the External Routine Reference clause that specifies a shared-object filename. By default, only users to whom the DBSA has granted the built-in EXTEND role can create or drop an external routine. See the section "Granting the EXTEND Role (IDS)" on page 2-386 for additional information about this feature.

Related Information

Related statements: CREATE PROCEDURE, CREATE PROCEDURE FROM, DROP FUNCTION, DROP ROUTINE, EXECUTE PROCEDURE, and GRANT

For information on how to create user-defined routines, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

DROP ROLE

Use the DROP ROLE statement to remove a user-defined role from the database.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP ROLE──┬─role───┬──────────────────────────────────────────────►◄
               └─'role'─┘
```

Element	Description	Restrictions	Syntax
role	Name of the role to be dropped	Must be registered in the local database. When a *role* name is enclosed in quotation marks, it is case sensitive.	"Owner Name" on page 5-43

Usage

Either the DBA or a user to whom the role was granted with the WITH GRANT OPTION keywords can issue the DROP ROLE statement. (Like a *user* name, a *role* is an authorization identifier, not a database object, so a *role* has no owner.)

After you drop a role, no user can grant or enable the dropped role, and any user who had been assigned the role loses its privileges (such as table-level privileges or routine-level privileges) when the role is dropped, unless the same privileges were granted to PUBLIC or to the user individually. If the dropped role was the default role of a user, the default role for that user becomes NULL.

The following statement drops the role **engineer**:

```
DROP ROLE engineer
```

You cannot use the DROP ROLE statement to drop a built-in role, such as the EXTEND or NONE roles of Dynamic Server.

Related Information

Related statements: CREATE ROLE, GRANT, REVOKE, and SET ROLE

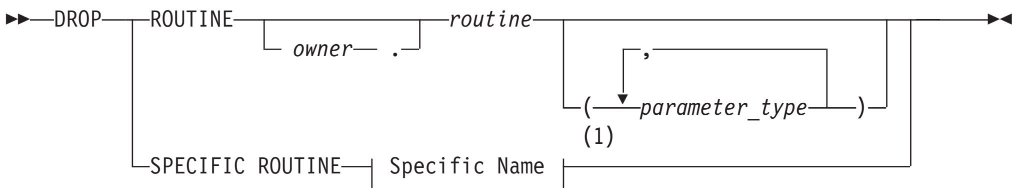
For a discussion of how to use roles, see the *IBM Informix Guide to SQL: Tutorial*.

DROP ROUTINE

Use the DROP ROUTINE statement to remove a user-defined routine (UDR) from the database.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 See "Specific Name" on page 5-68

Element	Description	Restrictions	Syntax
owner	Name of UDR owner	Must own the UDR	"Owner Name" on page 5-43
parameter_type	Data type of a parameter of *routine*	The data type (or list of data types) must be the same type (and specified in the same order) as in the UDR definition	"Identifier" on page 5-22; "Data Type" on page 4-18
routine	Name of the UDR to drop	The UDR must exist (that is, be registered) in the database	"Identifier" on page 5-22

Usage

Dropping a UDR removes the text and executable versions of the UDR from the database. If you do not know whether a UDR is a user-defined function or a user-defined procedure, this statement instructs the database server to drop the specified user-defined function or user-defined procedure.

To use the DROP ROUTINE statement, you must be the owner of the UDR or have the DBA privilege.

You cannot drop an SPL routine from within the same SPL routine.

Restrictions

To use this statement, the type of UDR cannot be ambiguous. The UDR that you specify must refer to either a user-defined function or a user-defined procedure. If either of the following conditions exist, the database server returns an error:

- The name (and parameters) that you specify apply to both a user-defined procedure and a user-defined function,
- The *specific* name that you specify applies to both a user-defined procedure and a user-defined function.

If the *routine* name is not unique within the database, you must specify enough *parameter_type* information to disambiguate the name. If the database server cannot resolve an ambiguous routine name whose signature differs from that of another routine only in an unnamed ROW type parameter, an error is returned. (This error cannot be anticipated by the database server when the ambiguous *routine* is defined.)

If you use parameter data types to identify a UDR, they follow the UDR name, as in the following example:

```
DROP ROUTINE compare(int, int)
```

If you use the specific name for the UDR, you must also include the keyword SPECIFIC, as in the following example:

```
DROP SPECIFIC ROUTINE compare_point
```

Modifying SPL Routines (XPS)

Extended Parallel Server does not support the ALTER PROCEDURE, ALTER ROUTINE, or ALTER FUNCTION statements. To change the text of an SPL routine, you must drop the routine and then re-create it. Make sure to keep a copy of the SPL routine text somewhere outside the database, in case you need to re-create the procedure after you drop it.

Dropping an External Routine

A user-defined routine (UDR) written in C language or in the Java language is called an *external routine*. External routines must include the External Routine Reference clause that specifies a shared-object filename. By default, only users to whom the DBSA has granted the built-in EXTEND role can create or drop an external routine. See the section “Granting the EXTEND Role (IDS)” on page 2-386 for additional information about this feature.

Related Information

Related statements: CREATE FUNCTION, CREATE PROCEDURE, DROP FUNCTION, DROP PROCEDURE, EXECUTE FUNCTION, EXECUTE PROCEDURE, and GRANT

DROP ROW TYPE

Use the DROP ROW TYPE statement to remove an existing named ROW data type from the database.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP ROW TYPE──┬────────────┬──row_type──RESTRICT──────────────────────────►◄
                   └─ owner──. ─┘
```

Element	Description	Restrictions	Syntax
owner	Name of owner of the ROW type	Must be the owner of row_type	"Owner Name" on page 5-43
row_type	Name of an existing named ROW data type to be dropped	Must exist. See also the **Usage** section that follows.	"Identifier" on page 5-22; "Data Type" on page 4-18

Usage

3 The DROP ROW TYPE statement removes the entry for the specified *row_type* from
3 the **sysxtdtypes** system catalog table. You must be the owner of the specified named ROW data type or have the DBA privilege to execute the DROP ROW TYPE statement.

You cannot drop a named ROW data type if its name is in use. You cannot drop a named ROW data type when any of the following conditions are true:

- Any existing tables or columns are using the named ROW data type.
- The named ROW data type is a supertype in an inheritance hierarchy.
- A view is defined on a column of the named ROW data type.

To drop a named ROW-type column from a table, use ALTER TABLE.

The DROP ROW TYPE statement cannot drop unnamed ROW data types.

The RESTRICT Keyword

The RESTRICT keyword is required with the DROP ROW TYPE statement. RESTRICT causes DROP ROW TYPE to fail if dependencies on *row_type* exist.

The DROP ROW TYPE statement fails and returns an error message if any of the following conditions is true:

- The named ROW data type is used for an existing table or column.

  Check the **systables** and **syscolumns** system catalog tables to find out whether any tables or data types use the named ROW data type.
- The named ROW data type is the supertype in an inheritance hierarchy.

  Look in the **sysinherits** system catalog table to see which named ROW data types have child types.

The following statement drops the named ROW data type **employee_t**:

```
DROP ROW TYPE employee_t RESTRICT
```

Related Information

Related statement: CREATE ROW TYPE

For a description of the system catalog tables, see the *IBM Informix Guide to SQL: Reference*.

For a discussion of named ROW data types, see the *IBM Informix Guide to SQL: Tutorial*.

For information on how to create user-defined data types, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

DROP SEQUENCE

Use the DROP SEQUENCE statement to remove a sequence from the database.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──DROP SEQUENCE──┬──────────┬──sequence──────────────────────────────────><
                   └─ owner── .┘
```

Element	Description	Restrictions	Syntax
owner	Name of sequence owner	Must own the sequence object	"Owner Name" on page 5-43
sequence	Name of a sequence	Must exist in the current database	"Identifier" on page 5-22

Usage

This statement removes the *sequence* entry from the **syssequences** system catalog table. To drop a sequence, you must be its owner or have the DBA privilege on the database. In an ANSI-compliant database, you must qualify the name of the sequence with the name of its owner (*owner.sequence*) if you are not the owner.

If you drop a sequence, any synonyms for the name of the sequence are also dropped automatically by the database server.

You cannot use a synonym to specify the identifier of the *sequence* in the DROP SEQUENCE statement.

Related Information

Related statements: ALTER SEQUENCE, CREATE SEQUENCE, RENAME SEQUENCE, GRANT, REVOKE, INSERT, UPDATE, and SELECT

DROP SYNONYM

Use the DROP SYNONYM statement to remove an existing synonym.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP SYNONYM──┬──────────┬──synonym──────────────────────────►◄
                  └─ owner──.┘
```

Element	Description	Restrictions	Syntax
owner	Name of synonym owner	Must own the synonym	"Owner Name" on page 5-43
synonym	Name of synonym to be dropped	The synonym and the table, view, or sequence object to which the synonym points must exist in the database	"Identifier" on page 5-22

Usage

3 This removes the entries for the *synonym* from the **systables**, **syssynonyms**, and **syssyntable** system catalog tables. You must own the *synonym* or have the DBA privilege to execute the DROP SYNONYM statement. Dropping a synonym has no
3 effect on the table, view, or sequence object to which the synonym points.

The following statement drops the synonym **nj_cust**, which **cathyg** owns:

```
DROP SYNONYM cathyg.nj_cust
```

3 DROP SYNONYM is not the only DDL operation that can unregister a synonym. If a table, view, or sequence is dropped, any synonyms that are in the same database and that refer to that table, view, or sequence object are also dropped.

If a synonym refers to an external table or view that is dropped, however, the synonym remains in place until you explicitly drop it using DROP SYNONYM. You can create another table, view, or synonym in place of the dropped table or view and give the new database object the name of the dropped table or view. The old synonym then refers to the new database object. For a complete discussion of synonym chaining, see the CREATE SYNONYM statement.

Related Information

Related statement: CREATE SYNONYM

For a discussion of synonyms, see the *IBM Informix Guide to SQL: Tutorial*.

DROP TABLE

Use the DROP TABLE statement to remove a table with its associated indexes and data. This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
                                               ┌CASCADE─┐
►►──DROP TABLE─┬───────────┬──┬─table───┬──────┴RESTRICT┴──────────────────►◄
               └ owner──.──┘  └─synonym─┘
```

Element	Description	Restrictions	Syntax
owner	Name of table owner	Must own the table	"Owner Name" on page 5-43
synonym	Local synonym for a table that is to be dropped	The synonym and its table must exist, and **USERTABLENAME** must not be set to 1	"Identifier" on page 5-22
table	Name of a table to drop	Must be registered in the **systables** system catalog table of the local database	"Identifier" on page 5-22

Usage

You must be the owner of the table or have the DBA privilege to use the DROP TABLE statement.

You cannot drop an Extended Parallel Server table that includes a dependent GK index unless that index is entirely dependent on the affected table.

If you issue a DROP TABLE statement, DB–Access does not prompt you to verify that you want to delete an entire table.

Effects of the DROP TABLE Statement

Use the DROP TABLE statement with caution. When you remove a table, you also delete the data stored in it, the indexes or constraints on the columns (including all the referential constraints placed on its columns), any local synonyms assigned to it, any triggers created on it, and any access privileges granted on the table. You also drop all views based on the table and any violations and diagnostics tables associated with the table.

DROP TABLE does not remove any synonyms for the table that were created in an external database. To remove external synonyms for the dropped table, you must do so explicitly with the DROP SYNONYM statement.

You can prevent users from specifying a synonym in DROP TABLE statements by setting the **USETABLENAME** environment variable. If **USETABLENAME** is set, an error results if any user attempts to specify DROP TABLE *synonym*.

Specifying CASCADE Mode

The CASCADE keyword in DROP TABLE removes related database objects, including referential constraints built on the table, views defined on the table, and any violations and diagnostics tables associated with the table.

In Dynamic Server, if the table is the supertable in an inheritance hierarchy, CASCADE drops all of the subtables as well as the supertable.

The CASCADE mode is the default mode of the DROP TABLE statement. You can also specify this mode explicitly with the CASCADE keyword.

Specifying RESTRICT Mode

The RESTRICT keyword can control the drop operation for supertables, for tables that have referential constraints and views defined on them, or for tables that have violations and diagnostics tables associated them. Using the RESTRICT option causes the drop operation to fail and an error message to be returned if any of the following conditions are true:

- Existing referential constraints reference *table.*
- Existing views are defined on *table.*
- Any violations tables or diagnostics tables are associated with *table*.
- For Dynamic Server, the *table* is the supertable in an inheritance hierarchy.

Dropping a Table That Contains Opaque Data Types (IDS)

Some opaque data types require special processing when they are deleted. For example, if an opaque type contains spatial or multi-representational data, it might provide a choice of how to store the data: inside the internal structure or, for large objects, in a smart large object.

The database server removes opaque types by calling a user-defined support function called **destroy( )**. When you execute the DROP TABLE statement on a table whose rows contain an opaque type, the database server automatically invokes the **destroy( )** function for the type. The **destroy( )** function can perform certain operations on columns of the opaque data type before the table is dropped. For more information about the **destroy( )** support function, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Tables That Cannot Be Dropped

Restrictions exist on the types of tables that you can drop:

- You cannot drop any system catalog table.
- You cannot drop a table that is not in the current database.
- You cannot drop a violations table or (in Dynamic Server) a diagnostics table.

  Before you can drop such a table, you must first issue a STOP VIOLATIONS TABLE statement on the base table with which the violations and diagnostics tables are associated.
- With Extended Parallel Server, you cannot drop a table specified in the FROM clause of a SELECT statement that defines a GK index.

The following example removes two tables in the current database. Both are owned by **joed**, the current user. Neither table has an associated violations or diagnostics table, nor a referential constraint or view defined on it.

```
DROP TABLE customer;
DROP TABLE stores_demo@accntg:joed.state;
```

Related Information

Related statements: CREATE TABLE, DROP DATABASE, and TRUNCATE (XPS) on page 2-628.

For a discussion of the data integrity of tables, see the *IBM Informix Guide to SQL: Tutorial*. For a discussion of how to create a table, see the *IBM Informix Database Design and Implementation Guide*.

DROP TRIGGER

Use the DROP TRIGGER statement to remove a trigger definition from the database.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP TRIGGER──┬──────────┬──trigger────────────────────────────────►◄
                  └─ owner──.─┘
```

Element	Description	Restrictions	Syntax
owner	Name of the owner of the trigger	Must own the trigger	"Owner Name" on page 5-43
trigger	Name of the trigger to drop	The trigger must exist in the local database	"Identifier" on page 5-22

Usage

You must be the owner of the trigger or have the DBA privilege to drop the trigger. Dropping a trigger removes the text of the trigger definition and the executable trigger from the database. The row describing the specified trigger is deleted from the **systriggers** system catalog table.

In Dynamic Server, dropping an INSTEAD OF trigger on a complex view (a view with columns from more than one table) revokes any privileges on the view that the owner of the trigger received automatically when creating the trigger, and also revokes any privileges that the owner of the trigger granted to other users. (Dropping a trigger on a simple view does not revoke any privileges.)

The following statement drops the **items_pct** trigger:

```
DROP TRIGGER items_pct
```

If a DROP TRIGGER statement appears inside an SPL routine that is called by a data manipulation (DML) statement, the database server returns an error.

Related Information

Related statements: CREATE TRIGGER, DROP TABLE

DROP TYPE

Use the DROP TYPE statement to remove a user-defined distinct or opaque data type from the database. (You cannot use this to drop a built-in data type.)

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP TYPE──┬─────────────┬──data_type──RESTRICT─────────────────────────►◄
               └─ owner── . ─┘
```

Element	Description	Restrictions	Syntax
data_type	Distinct or opaque data type to be removed	Must be an existing distinct or opaque type in the local database; cannot be a built-in data type	"Identifier" on page 5-22; "Data Type" on page 4-18
owner	Name of data type owner	Must own the data type	"Owner Name" on page 5-43

Usage

To drop a distinct or opaque data type with the DROP TYPE statement, you must be the owner of the data type or have the DBA privilege. When you use this statement, you remove the data type definition from the database (in the **sysxtdtypes** system catalog table). In general, this statement does not remove any definitions of casts or of support functions associated with that data type.

Important: When you drop a distinct type, the database server automatically drops the two explicit casts between the distinct type and the type on which it is based.

You cannot drop a distinct or opaque type if the database contains any casts, columns, or user-defined functions whose definitions reference the data type.

The following statement drops the **new_type** data type:

```
DROP TYPE new_type RESTRICT
```

Related Information

Related statements: CREATE DISTINCT TYPE, CREATE OPAQUE TYPE, CREATE ROW TYPE, DROP ROW TYPE, and CREATE TABLE

DROP VIEW

Use the DROP VIEW statement to remove a view from the database.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
                                                  ┌CASCADE─┐
►►──DROP VIEW─┬─────────────┬──┬view────┬──────────┼RESTRICT┼─────────────────────►◄
              └─ owner── . ─┘  └synonym─┘
```

Element	Description	Restrictions	Syntax
owner	Name of view owner	Must own the view	"Owner Name" on page 5-43
synonym	Synonym for a view that this statement drops	The *synonym* and the view to which it points must exist in the local database	"Identifier" on page 5-22
view	Name of a view to drop	Must exist in **systables**	"Identifier" on page 5-22

Usage

To drop a view, you must be the owner or have the DBA privilege.

When you drop a view, you also drop any other views and INSTEAD OF triggers whose definitions depend on that view. (You can also specify this default behavior explicitly with the CASCADE keyword.)

When you include the RESTRICT keyword in the DROP VIEW statement, the drop operation fails if any other existing views are defined on *view*; otherwise, these dependent views would be unregistered by the DROP VIEW operation.

You can query the **sysdepend** system catalog table to determine which views, if any, depend on another view.

The following statement drops the view that is named **cust1**:

```
DROP VIEW cust1
```

Related Information

Related statements: CREATE VIEW and DROP TABLE

For a discussion of views, see the *IBM Informix Guide to SQL: Tutorial*.

DROP XADATASOURCE

Use the DROP XADATASOURCE statement to drop a previously defined XA-compliant data source from the system catalog of the database.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP──XADATASOURCE──xa_source──RESTRICT──────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
xa_source	The XA-compliant data source to drop	Must be present in the **sysxadatasources** system catalog table	"Identifier" on page 5-22

Usage

The RESTRICT keyword is required. You must be the owner of the XA data source or hold DBA privileges to drop an access method.

The following statement drops the XA data source instance called **NewYork** that is owned by user **informix**.

```
DROP XADATASOURCE informix.NewYork RESTRICT;
```

You cannot drop an access method if it is being used in a transaction that is currently open. If an XA data source has been registered with a transaction that is not complete, you can drop the data source only after the database is closed or the session ends.

Related Information

Related statements: CREATE XADATASOURCE, CREATE XADATASOURCE TYPE, DROP XADATASOURCE TYPE

For a description of the RESTRICT keyword, see "Specifying RESTRICT Mode" on page 2-315. For information on how to use XA data sources, see the *IBM Informix DataBlade API Programmer's Guide*.

DROP XADATASOURCE TYPE

Use the DROP XADATASOURCE TYPE statement to drop a previously defined XA-compliant data source type from the database.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──DROP──XADATASOURCE TYPE──xa_type──RESTRICT──────────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
xa_type	Name of the XA data source type to be dropped	Must be present in the **sysxasourcetypes** system catalog table	"Identifier" on page 5-22

Usage

The RESTRICT keyword is required. You cannot unregister an XA data source type if virtual tables or indexes exist that use the data source. You must be user **informix** or have DBA privileges to drop an XA data source type.

The following statement drops an XA data source type called **MQSeries** owned by user **informix**:

```
DROP XADATASOURCE TYPE informix.MQSeries RESTRICT;
```

You cannot drop an XA data source type until after all the XA data source instances that use that data source type have been dropped.

Related Information

Related statements: CREATE XADATASOURCE, CREATE XADATASOURCE TYPE, DROP XADATASOURCE

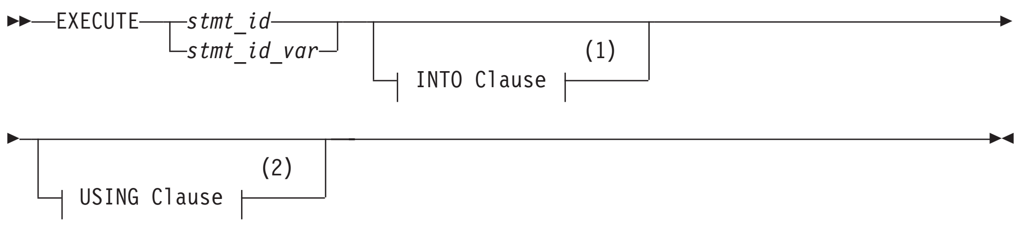
For a description of the RESTRICT keyword, see "Specifying RESTRICT Mode" on page 2-315. For information on how to use XA data sources, see the *IBM Informix DataBlade API Programmer's Guide*.

EXECUTE

Use the EXECUTE statement to run a previously prepared statement or a multiple-statement prepared object.

Only Dynamic Server supports this statement. Use this statement with ESQL/C.

Syntax



Notes:

1 See "INTO Clause" on page 2-322

2 See "USING Clause" on page 2-326

Element	Description	Restrictions	Syntax
stmt_id	Identifier of a prepared SQL statement	Must have been declared in a previous PREPARE statement	"Identifier" on page 5-22
stmt_id_var	Host variable containing the identifier of a prepared statement	Must exist and must contain a statement identifier that a previous PREPARE statement declared, and must be of a character data type	"PREPARE" on page 2-433

Usage

The EXECUTE statement passes a prepared SQL statement to the database server for execution. The following example shows an EXECUTE statement within an ESQL/C program:

```
EXEC SQL PREPARE del_1 FROM
   'DELETE FROM customer WHERE customer_num = 119';
EXEC SQL EXECUTE del_1;
```

Once prepared, an SQL statement can be executed as often as needed.

After you release the database server resources (using a FREE statement), you cannot use the statement identifier with a DECLARE cursor or with the EXECUTE statement until you prepare the statement again.

If the statement contained question mark (?) placeholders, use the USING clause to provide specific values for them before execution. For more information, see the "USING Clause" on page 2-326.

You can execute any prepared statement except those in the following list:

- A prepared SELECT statement that returns more than one row

  When you use a prepared SELECT statement to return multiple rows of data, you must use a cursor to retrieve the data rows. As an alternative, you can EXECUTE a prepared SELECT INTO TEMP statement to achieve the same result.

For more information on cursors, see "DECLARE" on page 2-260.

- A prepared EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement for an SPL function that returns more than one row

  When you prepare an EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement to invoke an SPL function that returns multiple rows, you must use a cursor to retrieve the data rows.

  For more information on how to execute a SELECT or an EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement, see "PREPARE" on page 2-433.

If you create or drop a trigger after you prepare a triggering INSERT, DELETE, or UPDATE statement, the prepared statement returns an error when you execute it.

Scope of Statement Identifiers

A program can consist of one or more source-code files. By default, the scope of reference of a statement identifier is global to the program. A statement identifier created in one file can be referenced from another file.

In a multiple-file program, if you want to limit the scope of reference of a statement identifier to the file in which it is executed, you can preprocess all the files with the **-local** command-line option.

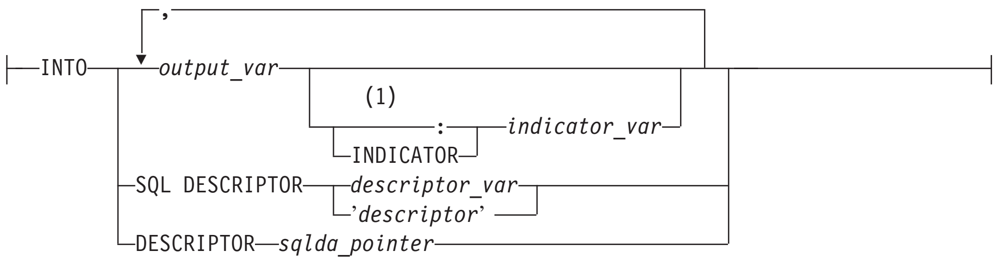
INTO Clause

Use the INTO clause to save the returned values of these SQL statements:

- A prepared singleton SELECT statement that returns only one row of column values for the columns in the select list
- A prepared EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement for an SPL function that returns only one set of values

The INTO clause of the EXECUTE statement has the following syntax:

INTO Clause:



Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
descriptor	Quoted string that identifies a system-descriptor area	Must already be allocated. Use single (') quotation marks	"Quoted String" on page 4-142
descriptor_var	Host variable that identifies a system-descriptor area	System-descriptor area must already be allocated	Language specific
indicator_var	Host variable that receives a return code if corresponding *parameter_var* is NULL value, or if truncation occurs	Cannot be DATETIME or INTERVAL data type	Language specific
output_var	Host variable whose contents replace a question-mark (?) placeholder in a prepared statement	Must be a character data type	Language specific
sqlda_pointer	Pointer to an **sqlda** structure that defines data type and memory location of values to replace a question-mark (?) placeholder in a prepared object	Cannot begin with a dollar sign ($) or a colon (**:**) symbol. An **sqlda** structure is required with dynamic SQL	"DESCRIBE INPUT" on page 2-286

This closely resembles the syntax of the "USING Clause" on page 2-326.

The INTO clause provides a concise and efficient alternative to more complicated and lengthy syntax. In addition, by placing values into variables that can be displayed, the INTO clause simplifies and enhances your ability to retrieve and display data values. For example, if you use the INTO clause, you do not have to use a cursor to retrieve values from a table.

You can store the returned values in output variables, in output SQL descriptors, or in output **sqlda** pointers.

Restrictions with the INTO Clause

If you execute a prepared SELECT statement that returns more than one row, or execute a prepared EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement for an SPL function that returns more than one group of return values, you receive an error message. In addition, if you prepare and declare a statement and then attempt to execute that statement, you receive an error message.

You cannot select a NULL value from a table column and place that value into an output variable. If you know in advance that a table column contains a NULL value, after you select the data, check the indicator variable that is associated with the column to determine if the value is NULL.

To use the INTO clause with the EXECUTE statement:

1. Declare the output variables that the EXECUTE statement uses.
2. Use PREPARE to prepare your SELECT statement or to prepare your EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement.
3. Use the EXECUTE statement, with the INTO clause, to execute your SELECT statement or to execute your EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement.

Replacing Placeholders with Parameters

You can specify any of the following items to replace the question-mark placeholders in a prepared statement before you execute it:

- A host variable name (if the number and data type of the parameters are known at compile time)
- A system descriptor that identifies a system descriptor area

- A descriptor that is a pointer to an **sqlda** structure

Sections that follow describe each of these options for specifying parameters.

Saving Values In Host or Program Variables

If you know the number of return values to be supplied at runtime and their data types, you can define the values that the SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement returns as host variables in your program. Use these host variables with the INTO keyword, followed by the names of the variables. These variables are matched with the return values in a one-to-one correspondence, from left to right.

You must supply one variable name for each value that the SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) returns. The data type of each variable must be compatible with the corresponding returned value from the prepared statement.

Saving Values in a System-Descriptor Area

If you do not know the number of return values to be supplied at runtime or their data types, you can associate output values with a system-descriptor area. A system-descriptor area describes the data type and memory location of one or more values.

A system-descriptor area conforms to the X/Open standards.

To specify a system-descriptor area as the location of output values, use the INTO SQL DESCRIPTOR clause of the EXECUTE statement. Each time that the EXECUTE statement is run, the values that the system-descriptor area describes are stored in the system-descriptor area.

The following example shows how to use the system-descriptor area to execute prepared statements in IBM Informix ESQL/C:

```
EXEC SQL allocate descriptor 'desc1';
...
sprintf(sel_stmt, "%s %s %s",
   "select fname, lname from customer",
   "where customer_num =",
   cust_num);
EXEC SQL prepare sel1 from :sel_stmt;
EXEC SQL execute sel1 into sql descriptor 'desc1';
```

The COUNT field corresponds to the number of values that the prepared statement returns. The value of COUNT must be less than or equal to the value of the occurrences that were specified when the system-descriptor area was allocated with the ALLOCATE DESCRIPTOR statement.

You can obtain the value of a field with the GET DESCRIPTOR statement and set the value with the SET DESCRIPTOR statement.

For more information, refer to the discussion of the system-descriptor area in the *IBM Informix ESQL/C Programmer's Manual*.

Saving Values in an sqlda Structure (ESQL/C)

If you do not know the number of output values to be returned at runtime or their data types, you can associate output values from an **sqlda** structure. An **sqlda** structure lists the data type and memory location of one or more return values. To specify an **sqlda** structure as the location of return values, use the INTO

DESCRIPTOR clause of the EXECUTE statement. Each time the EXECUTE statement is run, the database server places the returns values that the **sqlda** structure describes into the **sqlda** structure.

The next example uses an **sqlda** structure to execute a prepared statement:

```
struct sqlda *pointer2;
...
sprintf(sel_stmt, "%s %s %s",
   "select fname, lname from customer",
   "where customer_num =",
   cust_num);
EXEC SQL prepare sel1 from :sel_stmt;
EXEC SQL describe sel1 into pointer2;
EXEC SQL execute sel1 into descriptor pointer2;
```

The **sqlda.sqld** value specifies the number of output values that are described in occurrences of **sqlvar**. This number must correspond to the number of values that the SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement returns.

For more information, refer to the **sqlda** discussion in the *IBM Informix ESQL/C Programmer's Manual*.

This example uses the INTO clause with an EXECUTE statement in ESQL/C:

```
EXEC SQL prepare sel1 from 'select fname, lname from customer
    where customer_num =123';
EXEC SQL execute sel1 into :fname, :lname using :cust_num;
```

The next example uses the INTO clause to return multiple rows of data:

```
EXEC SQL BEGIN DECLARE SECTION;
int customer_num =100;
char fname[25];
EXEC SQL END DECLARE SECTION;

EXEC SQL prepare sel1 from 'select fname from customer
    where customer_num=?';
for ( ;customer_num < 200; customer_num++)
    {
    EXEC SQL execute sel1 into :fname using customer_num;
    printf("Customer number is %d\n", customer_num);
    printf("Customer first name is %s\n\n", fname);
    }
```

The sqlca Record and EXECUTE

After an EXECUTE statement, the **sqlca** can reflect two results:

- The **sqlca** can reflect an error within the EXECUTE statement.

  For example, when an UPDATE ...WHERE statement in a prepared statement processes zero rows, the database server sets **sqlca** to `100`.
- The **sqlca** can reflect the success or failure of the executed statement.

Returned SQLCODE Values with EXECUTE

If a prepared statement fails to access any rows when it executes, the database server returns the **SQLCODE** value of zero (`0`).

For a multistatement prepared object, however, if any statement in the following list fails to access rows, the returned **SQLCODE** value is `SQLNOTFOUND ( = 100)`:

- INSERT INTO *table* SELECT ... WHERE
- SELECT...WHERE ... INTO TEMP

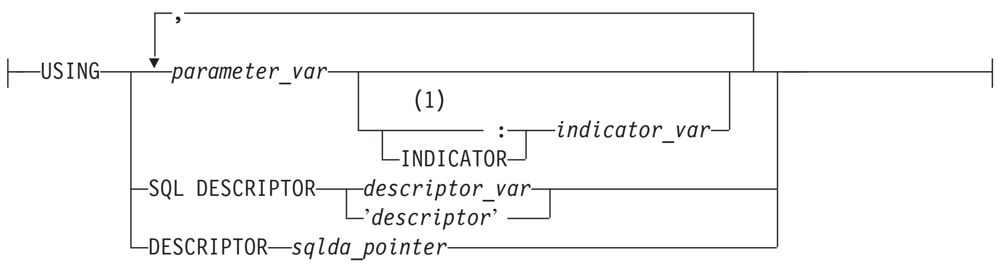
- DELETE ... WHERE
- UPDATE ... WHERE

In an ANSI-compliant database, if you prepare and execute any of the statements in the preceding list, and no rows are returned, the returned **SQLCODE** value is `SQLNOTFOUND ( = 100)`.

USING Clause

Use the USING clause to specify the values that are to replace question-mark (?) placeholders in the prepared statement. Providing values in the EXECUTE statement that replace the question-mark (?) placeholders in the prepared statement is sometimes called *parameterizing* the prepared statement.

USING Clause:



Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
descriptor	Quoted string that identifies a system-descriptor area	System-descriptor area must already be allocated. Use single (′) quotation marks.	"Quoted String" on page 4-142
descriptor_var	Host variable that identifies a system-descriptor area	System-descriptor area must already be allocated	Language specific
indicator_var	Host variable that receives a return code if corresponding *parameter_var* is NULL value, or if truncation occurs	Cannot be DATETIME or INTERVAL data type	Language specific
parameter_var	Host variable whose contents replace a question-mark (?) placeholder in a prepared statement	Must be a character data type	Language specific
sqlda_pointer	Pointer to an sqlda structure that defines data type and memory location of values to replace question-mark (?) placeholder in a prepared object	Cannot begin with a dollar sign ($) or a colon (**:**). An **sqlda** structure is required with dynamic SQL	"DESCRIBE INPUT" on page 2-286

This closely resembles the syntax of the "INTO Clause" on page 2-322.

If you know the number of parameters to be supplied at runtime and their data types, you can define the parameters that are needed by the EXECUTE statement as host variables in your program.

If you do not know the number of parameters to be supplied at runtime or their data types, you can associate input values from a system-descriptor area or an

sqlda structure. Both of these descriptor structures describe the data type and memory location of one or more values to replace question-mark (?) placeholders.

Supplying Parameters Through Host or Program Variables

You pass parameters to the database server by opening the cursor with the USING keyword, followed by the names of the variables. These variables are matched with prepared statement question-mark (?) placeholders in a one-to-one correspondence, from left to right. You must supply one storage- parameter variable for each placeholder. The data type of each variable must be compatible with the corresponding value that the prepared statement requires.

The following example executes the prepared UPDATE statement in ESQL/C:

```
stcopy ("update orders set order_date = ?
   where po_num = ?", stm1);
EXEC SQL prepare statement_1 from :stm1;
EXEC SQL execute statement_1 using :order_date, :po_num;
```

Supplying Parameters Through a System Descriptor

You can create a system-descriptor area that describes the data type and memory location of one or more values and then specify the descriptor in the USING SQL DESCRIPTOR clause of the EXECUTE statement.

Each time that the EXECUTE statement is run, the values that the system-descriptor area describes are used to replace question-mark (?) placeholders in the PREPARE statement.

The COUNT field corresponds to the number of dynamic parameters in the prepared statement. The value of COUNT must be less than or equal to the number of item descriptors that were specified when the system-descriptor area was allocated with the ALLOCATE DESCRIPTOR statement.

The following example shows how to use system descriptors to execute a prepared statement in ESQL/C:

```
EXEC SQL execute prep_stmt using sql descriptor 'desc1';
```

Supplying Parameters Through an sqlda Structure (ESQL/C)

You can specify the **sqlda** pointer in the USING DESCRIPTOR clause of the EXECUTE statement.

Each time the EXECUTE statement is run, the values that the descriptor structure describes are used to replace question-mark (?) placeholders in the PREPARE statement.

The **sqlda.sqld** value specifies the number of input values that are described in occurrences of **sqlvar**. This number must correspond to the number of dynamic parameters in the prepared statement.

The following example shows how to use an **sqlda** structure to execute a prepared statement in ESQL/C:

```
EXEC SQL execute prep_stmt using descriptor pointer2
```

Related Information

Related statements: ALLOCATE DESCRIPTOR, DEALLOCATE DESCRIPTOR, DECLARE, EXECUTE IMMEDIATE, FETCH, GET DESCRIPTOR, PREPARE, PUT, and SET DESCRIPTOR

For a task-oriented discussion of the EXECUTE statement, see the *IBM Informix Guide to SQL: Tutorial*.

For more information about concepts that relate to the EXECUTE statement, see the *IBM Informix ESQL/C Programmer's Manual*.

EXECUTE FUNCTION

Use the EXECUTE FUNCTION statement to execute a user-defined function.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──EXECUTE FUNCTION──────────────────────────────────────────────────────────────►


                                                                (3)  (1) (4)
►──┬─┬─function─────┬──(─┬────────────────────┬─)──┤ INTO Clause ├──────────────┬──►◄
   │ │ (1)          │    │  ┌─,────────────┐  │                                 │
   │ └─────SPL_var──┘    │  ▼          (2)  │  │                                 │
   │                     └─┤ Argument ├─────┴──┘                                 │
   │ (5)   (6)                             (7)                                   │
   ├────────────┤ IFX_REPLACE_MODULE Function ├──────────────────────────────────┤
   │ (5)   (8)                         (9)                                       │
   └────────────┤ jvpcontrol Function ├──────────────────────────────────────────┘
```

Notes:

1 Stored Procedure Language only

2 See "Arguments" on page 5-2

3 See "INTO Clause" on page 2-330

4 ESQL/C only

5 Dynamic Server only

6 C only

7 See "IFX_REPLACE_MODULE Function (IDS, C)" on page 4-90

8 Java only

9 See "The jvpcontrol Function (Java)" on page 2-333

Element	Description	Restrictions	Syntax
function	Name of a user-defined function to execute	Must be registered in the database	"Database Object Name" on page 5-17
SPL_var	Variable that contains the name of an SPL routine to be executed	Must be a CHAR, VARCHAR, NCHAR, or NVARCHAR data type that contains the non-NULL name of an existing SPL function	"Identifier" on page 5-22

Usage

The EXECUTE FUNCTION statement invokes a user-defined function (UDF), with arguments, and specifies where the results are to be returned.

An external function returns exactly one value.

An SPL function can return one or more values.

You cannot use the EXECUTE FUNCTION statement to execute any type of user-defined procedure that returns no value. Instead, use the EXECUTE PROCEDURE or EXECUTE ROUTINE statement to execute procedures.

You must have the Execute privilege on the user-defined function.

If a UDF has a companion function, any user who executes the function must have the Execute privilege on both the function and its companion. For example, if a function has a negator function, any user who executes the function must have the Execute privilege on both the function and its negator.

For more information, see "GRANT" on page 2-371.

How the EXECUTE FUNCTION Statement Works

For a user-defined function to be executed with the EXECUTE FUNCTION statement, the following conditions must exist:

- The qualified function name or the function signature (the function name with its parameter list) must be unique within the name space or database.
- The function must exist.
- The function must not have any OUT nor INOUT parameters.

If EXECUTE FUNCTION specifies fewer arguments than the user-defined function expects, the unspecified arguments are said to be *missing*. Missing arguments are initialized to their corresponding parameter default values, if these were defined. The syntax of specifying default values for parameters is described in "Routine Parameter List" on page 5-61.

EXECUTE FUNCTION returns an error under the following conditions:

- It specifies more arguments than the user-defined function expects.
- One or more arguments are missing and do not have default values.

  Unlike Dynamic Server, Extended Parallel Server can invoke a function with missing arguments, but the function might fail if a missing argument causes another error (for example, an undefined value for a variable).
- The fully qualified function name or the function signature is not unique.
- No function with the specified name or signature that you specify is found.
- You use it to attempt to execute a user-defined procedure.

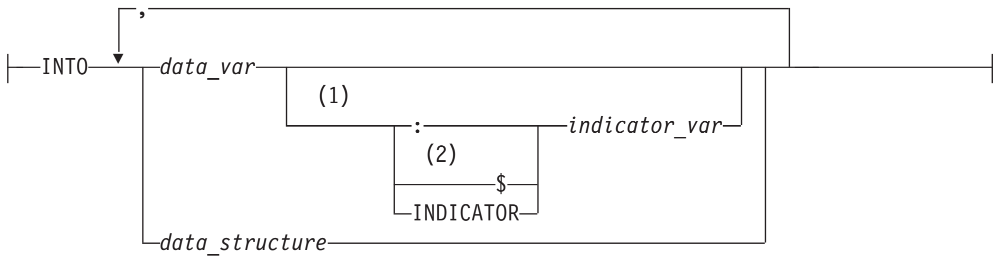
If the *function* name is not unique within the database, you must specify enough *parameter_type* information to disambiguate the name. See the section "Arguments" on page 5-2 for additional information about how to specify parameters when invoking a function.

In Dynamic Server, the *specific name* of an external UDR is valid in some DDL statements, but is not valid in contexts where you invoke the function.

If Dynamic Server cannot resolve an ambiguous function name whose signature differs from that of another routine only in an unnamed-ROW type parameter, an error is returned. (This error cannot be anticipated by the database server when the ambiguous function is defined.)

INTO Clause

INTO Clause:



Notes:

1 ESQL/C only

2 Informix extension

Element	Description	Restrictions	Syntax
data_structure	Structure that was declared as a host variable	Individual elements of structure must be compatible with the data types of the returned values	Language specific
data_var	Variable to receive the value that a user-defined function returns	See "Data Variables" on page 2-331.	Language specific
indicator_var	Program variable to store a return code if the corresponding *data_var* receives a NULL value	Use an indicator variable if the value of the corresponding *data_var* might be NULL	Language specific

You must include an INTO clause with EXECUTE FUNCTION to specify the variables that receive the values that a user-defined function returns. If the function returns more than one value, the values are returned into the list of variables in the order in which you specify them.

If the EXECUTE FUNCTION statement stands alone (that is, it is not part of a DECLARE statement and does not use the INTO clause), it must execute a noncursor function. A noncursor function returns only one row of values. The following example shows a SELECT statement in IBM Informix ESQL/C:

```
EXEC SQL execute function cust_num(fname, lname, company_name) into :c_num;
```

Data Variables

If you issue EXECUTE FUNCTION within an ESQL/C program, *data_var* must be a host variable. Within an SPL routine, *data_var* must be an SPL variable.

If you issue EXECUTE FUNCTION within a CREATE TRIGGER statement, *data_var* must be a column name in the triggering table or in another table.

INTO Clause with Indicator Variables (ESQL/C)

You should use an indicator variable if the possibility exists that data returned from the user-defined function is NULL. For more information about indicator variables, see the *IBM Informix ESQL/C Programmer's Manual*.

INTO Clause with Cursors

If EXECUTE FUNCTION calls a UDF that returns more than one row of values, it must execute a cursor function. A cursor function can return one or more rows of values and must be associated with a function cursor to execute.

If the SPL function returns more than one row or a collection data type, you must access the rows or collection elements with a cursor.

To return more than one row of values, an external function (one written in the C or Java language) must be defined as an iterator function. For more information on iterator functions, see the *IBM Informix DataBlade API Programmer's Guide*.

In an SPL routine, if a SELECT returns more than one row, you must use the FOREACH statement to access the rows individually. The INTO clause of the SELECT statement can store the fetched values. For more information, see "FOREACH" on page 3-20.

To return more than one row of values, an SPL function must include the WITH RESUME keywords in its RETURN statement. For more information on how to write SPL functions, see the *IBM Informix Guide to SQL: Tutorial*.

In an IBM Informix ESQL/C program, the DECLARE statement can declare a function cursor and the FETCH statement can return rows individually from the cursor. You can put the INTO clause in the EXECUTE FUNCTION or in the FETCH statement, but you cannot put it in both. The following IBM Informix ESQL/C code examples show different ways you can use the INTO clause:

- Using the INTO clause in the EXECUTE FUNCTION statement:
```
EXEC SQL declare f_curs cursor for
   execute function get_orders(customer_num)
   into :ord_num, :ord_date;
EXEC SQL open f_curs;
while (SQLCODE == 0)
   EXEC SQL fetch f_curs;
EXEC SQL close f_curs;
```
- Using the INTO clause in the FETCH statement:
```
EXEC SQL declare f_curs cursor for
   execute function get_orders(customer_num);
EXEC SQL open f_curs;
while (SQLCODE == 0)
   EXEC SQL fetch f_curs into :ord_num, :ord_date;
EXEC SQL close f_curs;
```

Alternatives to PREPARE ... EXECUTE FUNCTION ... INTO

In ESQL/C, you cannot prepare an EXECUTE FUNCTION statement that includes the INTO clause. For similar functionality, however, follow these steps:

1. Prepare the EXECUTE FUNCTION statement with no INTO clause.
2. Declare a function cursor for the prepared statement.
3. Open the cursor.
4. Execute the FETCH statement with an INTO clause to fetch the returned values into program variables.

Alternatively, you can do the following:

1. Declare a cursor for the EXECUTE FUNCTION statement without first preparing the statement, and include the INTO clause in the EXECUTE FUNCTION when you declare the cursor.
2. Open the cursor.
3. Fetch the returned values from the cursor without using the INTO clause of the FETCH statement.

Dynamic Routine-Name Specification of SPL Functions

Dynamic routine-name specification simplifies the writing of an SPL function that calls another SPL routine whose name is not known until runtime. To specify the name of an SPL routine in the EXECUTE FUNCTION statement, instead of listing the explicit name of an SPL routine, you can use an SPL variable to hold the routine name. For more information about how to execute SPL functions dynamically, see the *IBM Informix Guide to SQL: Tutorial*.

The jvpcontrol Function (Java)

The **jvpcontrol( )** function is a built-in iterative function that you can use to obtain information about a Java Virtual Processor (JVP) class.

The jvpcontrol Function:

```
├──informix.jvpcontrol──(──"──┬─MEMORY──┬──jvp_id──"──)─────────────────────┤
                              └─THREADS─┘
```

Element	Description	Restrictions	Syntax
jvp_id	Name of the Java Virtual Processor (JVP) class about which you seek information	The specified Java Virtual Processor class must exist	"Identifier" on page 5-22

You must associate this function with the equivalent of a cursor in the Java language.

Using the MEMORY Keyword

When you specify the MEMORY keyword, the **jvpcontrol** function returns the memory usage on the JVP class that you specify. The following example requests information about the memory usage of the JVP class named **4**:

```
EXECUTE FUNCTION INFORMIX.JVPCONTROL ("MEMORY 4");
```

Using the THREADS Keyword

When you specify the THREADS keyword, the **jvpcontrol** function returns a list of the threads running on the JVP class that you specify. The following example requests information about the threads running on the JVP class named 4:

```
EXECUTE FUNCTION INFORMIX.JVPCONTROL ("THREADS 4");
```

The IFX_REPLACE_MODULE Function (IDS, C)

IFX_REPLACE_MODULE is a built-in function that replaces the shared-object file specification of a C language UDR with a new file specification. The built-in EXTEND role must be granted to you and set before you can call this function.

The pathnames to the old and to the new shared-object files can be the same or different, but the filenames must be different. The following example replaces the shared-object file called**foo.o** of a C UDR with a new file called **fog.o**:

```
EXECUTE FUNCTION IFX_REPLACE_MODULE (/usr/local/foo.o, /usr/local/fog.o, "C");
```

For additional details of the **IFX_REPLACE_MODULE** function, see the section "IFX_REPLACE_MODULE Function (IDS, C)" on page 4-90.

Related Information

Related statements: CALL, CREATE FUNCTION, CREATE FUNCTION FROM, DROP FUNCTION, DROP ROUTINE, EXECUTE PROCEDURE, and FOREACH

EXECUTE IMMEDIATE

Use the EXECUTE IMMEDIATE statement to perform the functions of the PREPARE, EXECUTE, and FREE statements.

Use this statement with ESQL/C.

Syntax

```
                               ┌─;─────────┐
                               ▼           │
►►──EXECUTE IMMEDIATE──┬─'───statement───┴─'─┬──────────────────────────────►◄
                       └─statement_var───────┘
```

Element	Description	Restrictions	Syntax
statement	A valid SQL statement	See the same sections of Usage that are listed below for *statement_var*	See this chapter.
statement_var	Host variable that contains a character string of one or more SQL statements	Must be a previously declared character-type variable. See "EXECUTE IMMEDIATE and Restricted Statements" on page 2-334 and "Restrictions on Allowed Statements" on page 2-335.	Language specific

Usage

The EXECUTE IMMEDIATE statement makes it easy to execute dynamically a single simple SQL statement that is constructed during program execution. For example, you can obtain the name of a database from program input, construct the DATABASE statement as a program variable, and then use EXECUTE IMMEDIATE to execute the statement, which opens the database.

The quoted string that includes one or more SQL statements, or the contents of *statement_var*, is parsed and executed if correct; then all data structures and memory resources are released immediately. In the usual method of dynamic execution, these operations require separate PREPARE, EXECUTE, and FREE statements.

The maximum length of an EXECUTE IMMEDIATE statement is 64 kilobytes.

EXECUTE IMMEDIATE and Restricted Statements

You cannot use the EXECUTE IMMEDIATE statement to execute the following SQL statements. Although the EXECUTE PROCEDURE statement appears on this list, the restriction applies only to EXECUTE PROCEDURE statements that return values.

CLOSE	OPEN
CONNECT	OUTPUT
DECLARE	PREPARE
DISCONNECT	SELECT
EXECUTE	SET AUTOFREE
EXECUTE FUNCTION	SET CONNECTION
EXECUTE PROCEDURE	SET DEFERRED_PREPARE
FETCH	SET DESCRIPTOR
GET DESCRIPTOR	WHENEVER
GET DIAGNOSTICS	

In addition, you cannot use the EXECUTE IMMEDIATE statement to execute the following statements in text that contains multiple statements that are separated by semicolons:

CLOSE DATABASE	DROP DATABASE
CREATE DATABASE	SELECT (except SELECT INTO TEMP)
DATABASE	

Use the PREPARE statement and either a cursor or the EXECUTE statement to execute a dynamically constructed SELECT statement.

Restrictions on Allowed Statements

The following restrictions apply to the statement that is contained in the quoted string or in the statement variable:

- The statement cannot contain a host-language comment.
- Names of host-language variables are not recognized as such in prepared text.

  The only identifiers that you can use are names defined in the database, such as table names and column names.
- The statement cannot reference a host-variable list or a descriptor; it must not contain any question-mark (?) placeholders, which are allowed with a PREPARE statement.
- The text must not include any embedded SQL statement prefix, such as the dollar sign ($) or the keywords EXEC SQL.

  Although it is not required, the SQL statement terminator (;) can be included in the statement text.
- In Dynamic Server, a SELECT or INSERT statement specified within the EXECUTE statement cannot contain a Collection-Derived Table clause.

  EXECUTE IMMEDIATE cannot process input host variables, which are required for a collection variable. Use the EXECUTE statement or a cursor to process prepared accesses to collection variables.

Examples of the EXECUTE IMMEDIATE Statement

The following examples show EXECUTE IMMEDIATE statements in ESQL/C. Both examples use host variables that contain a CREATE DATABASE statement. The first example uses the SQL statement terminator (;) inside the quoted string.

```
sprintf(cdb_text1, "create database %s;", usr_db_id);
EXEC SQL execute immediate :cdb_text;

sprintf(cdb_text2, "create database %s", usr_db_id);
EXEC SQL execute immediate :cdb_text;
```

Related Information

Related statements: EXECUTE, FREE, and PREPARE

For a discussion of quick execution, see the *IBM Informix Guide to SQL: Tutorial*.

EXECUTE PROCEDURE

Use the EXECUTE PROCEDURE statement to invoke a user-defined procedure. This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──EXECUTE PROCEDURE──────────────────────────────────────────────────────────────►

►──┬─┬─procedure──────┬──(─┬──────────────────────┬─)─┬───────────────────────────┬─┬──────►◄
   │ │  (1)           │    │ ┌─,──────────────┐   │   │       ┌─,────────────┐    │ │
   │ ├────────SPL_var─┤    │ ▼          (2)     │   │   │ (1)   ▼              │    │ │
   │ └─function───────┘    └───┤ Argument ├─────┴───┘   └─────INTO───output_var─┴────┘ │
   │ (3)    (4)                               (5)                                    │
   ├──────────────┤ SQLJ Built-In Procedures ├──────────────────────────────────────┤
   │ (3)    (6)                                    (7)                               │
   └──────────────┤ IFX_UNLOAD_MODULE Procedure ├───────────────────────────────────┘
```

Notes:

1 Stored Procedure Language only

2 See "Arguments" on page 5-2

3 Dynamic Server only

4 Java only

5 See 2-338

6 C only

7 See "IFX_REPLACE_MODULE Function (IDS, C)" on page 4-90

Element	Description	Restrictions	Syntax
function	SPL function to execute	Must exist	"Database Object Name" on page 5-17
output_var	Host variable or program variable that receives the returned value from UDR	In the context of a CREATE TRIGGER statement, must contain column names in the triggering table or in another table	Language specific
procedure	User-defined procedure to execute	Must exist	"Database Object Name" on page 5-17
SPL_var	Variable that contains the name of the SPL routine to execute	Must be a character data type that contains the non-NULL name of an SPL routine.	"Identifier" on page 5-22

Usage

The EXECUTE PROCEDURE statement invokes the named user-defined procedure and specifies its arguments.

In Dynamic Server, for backward compatibility, you can use the EXECUTE PROCEDURE statement to execute an SPL function that you created with the CREATE PROCEDURE statement.

In Extended Parallel Server, use the EXECUTE PROCEDURE statement to execute any SPL routine. Extended Parallel Server does not support the EXECUTE FUNCTION statement.

In ESQL/C, if the EXECUTE PROCEDURE statement returns more than one row, it must be enclosed within an SPL FOREACH loop or accessed through a cursor.

Causes of Errors

EXECUTE PROCEDURE returns an error under the following conditions:

- It has more arguments than the called procedure expects.
- One or more arguments are missing and do not have default values. Unlike Dynamic Server, Extended Parallel Server can invoke procedures with missing arguments, but the procedure might fail if a missing argument causes another error (for example, an undefined value for a variable).
- The fully qualified procedure name or the routine signature is not unique.
- No procedure with the specified name or signature is found.

If the *procedure* name is not unique within the database, you must specify enough *parameter_type* information to disambiguate the name. See "Arguments" on page 5-2 for additional information about how to specify parameters when invoking a procedure. (In Dynamic Server, the *specific name* of an external UDR is valid in DDL statements, but is not valid in contexts where you invoke the procedure.)

Using the INTO Clause

Use the INTO clause to specify where to store the values that the SPL function returns.

If an SPL function returns more than one value, the values are returned into the list of variables in the order in which you specify them. If an SPL function returns more than one row or a collection data type, you must access the rows or collection elements with a cursor.

You cannot prepare an EXECUTE PROCEDURE statement that has an INTO clause. For more information, see "Alternatives to PREPARE ... EXECUTE FUNCTION ... INTO" on page 2-332.

Dynamic Routine-Name Specification of SPL Procedures

Dynamic routine-name specification simplifies the writing of an SPL routine that calls another SPL routine whose name is not known until runtime. To specify the name of an SPL routine in the EXECUTE PROCEDURE statement, instead of listing the explicit name of an SPL routine, you can use an SPL variable to hold the routine name.

If the SPL variable names an SPL routine that returns a value (an SPL function), include the INTO clause of EXECUTE PROCEDURE to specify a *receiving variable* (or variables) to hold the value (or values) that the SPL function returns. For more information on how to execute SPL procedures dynamically, see the *IBM Informix Guide to SQL: Tutorial*.

IFX_UNLOAD_MODULE Procedure (IDS, C)

The **IFX_UNLOAD_MODULE** procedure unloads a shared-object file from memory.

IFX_UNLOAD_MODULE Procedure:

```
├──IFX_UNLOAD_MODULE──(──module_name──,──"C"──)──────────────────────────────┤
```

Element	Description	Restrictions	Syntax
module_name	Full pathname of file to unload	Shared-object file must exist and be unused. Pathname can be up to 255 characters long.	"Quoted String" on page 4-142

The **IFX_UNLOAD_MODULE** procedure can only unload an unused shared-object file; that is, when no executing SQL statements (in any database) are using any UDRs in the specified shared-object file. If any UDR in the shared-object file is currently in use, then **IFX_UNLOAD_MODULE** raises an error.

On UNIX, for example, suppose you want to unload the **circle.so** shared library, which contains C UDRs. If this library resides in the **/usr/apps/opaque_types** directory, you can use the following EXECUTE PROCEDURE statement to execute the **IFX_UNLOAD_MODULE** procedure:

```
EXECUTE PROCEDURE ifx_unload_module(        "/usr/apps/opaque_types/circle.so", "C");
```

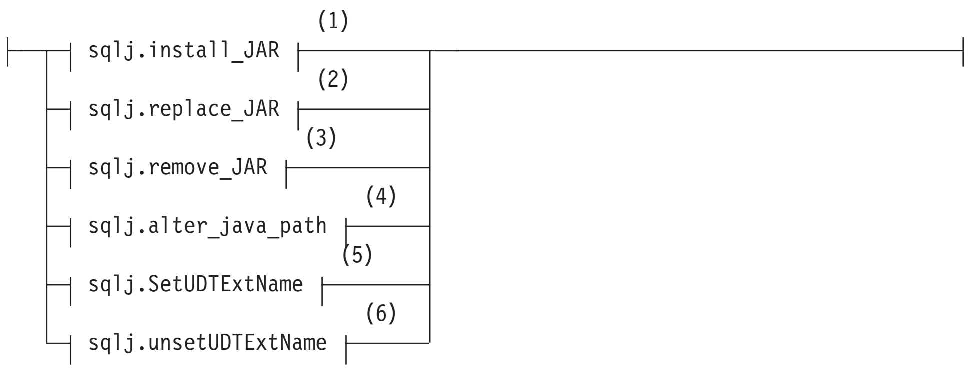
On Windows, for example, suppose you want to unload the **circle.dll** dynamic link library, which contains C UDRs. If this library is in the **C:\usr\apps\opaque_types** directory, you can use the following EXECUTE PROCEDURE statement to execute the **IFX_UNLOAD_MODULE** procedure:

```
EXECUTE PROCEDURE ifx_unload_module(        "C:\usr\apps\opaque_types\circle.dll", "C");
```

For more information on how to use **IFX_UNLOAD_MODULE** to unload a shared-object file, see the chapter on how to design a UDR in *IBM Informix User-Defined Routines and Data Types Developer's Guide*. For information on how to use the **IFX_REPLACE_MODULE** function, see "IFX_REPLACE_MODULE Function (IDS, C)" on page 4-90.

Use the SQLJ Driver built-in procedures for one of the following tasks:
- To install, replace, or remove a set of Java classes
- To specify a path for Java class resolution for Java classes that are included in a JAR file
- To map or remove the mapping between a user-defined type and the Java type to which it corresponds

SQLJ Driver Built-In Procedures:



Notes:

1 See "sqlj.install_jar" on page 2-339

2 See "sqlj.replace_jar" on page 2-340

3 See "sqlj.remove_jar" on page 2-340

4 See “sqlj.alter_java_path” on page 2-341

5 See “sqlj.setUDTextName” on page 2-342

6 See “sqlj.unsetUDTExtName” on page 2-342

The SQLJ built-in procedures are stored in the **sysprocedures** system catalog table. They are grouped under the **sqlj** schema.

Tip: For any Java static method, the first built-in procedure that you execute must be the **sqlj.install_jar( )** procedure. You must install the jar file before you can create a UDR or map a user-defined data type to a Java type. Similarly, you cannot use any of the other SQLJ built-in procedures until you have used **sqlj.install_jar( )**.

sqlj.install_jar

Use the **sqlj.install_jar( )** procedure to install a jar file in the current database and assign it a jar identifier.

sqlj.install_jar:

```
                                                 (1)      ┌─0──────┐
├──sqlj.install_jar──(──jar_file──,──┤ Jar Name ├──────,──┴─deploy─┴──)──────────┤
```

Notes:

1 See “Jar Name” on page 5-33

Element	Description	Restrictions	Syntax
deploy	Integer that causes the procedure to search for deployment descriptor files in the jar file	None	“Literal Number” on page 4-137
jar_file	URL of the jar file that contains the UDR written in Java	Maximum length of the URL is 255 bytes	“Quoted String” on page 4-142

For example, consider a Java class **Chemistry** that contains the following static method **explosiveReaction( )**:

```
public static int explosiveReaction(int ingredient);
```

Here the **Chemistry** class resides in this jar file on the server computer:

```
/students/data/Courses.jar
```

You can install all classes in the **Courses.jar** jar file in the current database with the following call to the **sqlj.install_jar( )** procedure:

```
EXECUTE PROCEDURE
   sqlj.install_jar("file://students/data/Courses.jar", "course_jar")
```

The **sqlj.install_jar( )** procedure assigns the jar ID, **course_jar**, to the **Courses.jar** file that it has installed in the current database.

After you define a jar ID in the database, you can use that jar ID when you create and execute a UDR written in Java.

When you specify a nonzero number for the third argument, the database server searches through any included deployment descriptor files. For example, you might want to include descriptor files that include SQL statements to register and grant privileges on UDRs in the jar file.

sqlj.replace_jar

Use the **sqlj.replace_jar( )** procedure to replace a previously installed jar file with a new version. When you use this syntax, you provide only the new jar file and assign it to the jar ID for which you want to replace the file.

sqlj.replace_jar:

```
                                                   (1)
├──sqlj.replace_jar──(──jar_file──,──┤ Jar Name ├──────)──────────────────────┤
```

Notes:

1 See "Jar Name" on page 5-33

Element	Description	Restrictions	Syntax
jar_file	URL of the jar file that contains the UDR written in Java	The maximum length of the URL is 255 bytes	"Quoted String" on page 4-142

If you attempt to replace a jar file that is referenced by one or more UDRs, the database server generates an error. You must drop the referencing UDRs before replacing the jar file.

For example, the following call replaces the **Courses.jar** file, which had previously been installed for the **course_jar** identifier, with the **Subjects.jar** file:

```
EXECUTE PROCEDURE
   sqlj.replace_jar("file://students/data/Subjects.jar",
   "course_jar")
```

Before you replace the **Course.jar** file, you must drop the user-defined function **sql_explosive_reaction( )** with the DROP FUNCTION (or DROP ROUTINE) statement.

sqlj.remove_jar

Use the **sqlj.remove_jar( )** procedure to remove a previously installed jar file from the current database.

sqlj.remove_jar:

```
                                        (1)       ┌─0──────┐
├──sqlj.remove_jar──(──┤ Jar Name ├──────,──┴─deploy─┴──)──────────────────┤
```

Notes:

1 See "Jar Name" on page 5-33

Element	Description	Restrictions	Syntax
deploy	Integer that causes the procedure to search for deployment descriptor files in the jar file	None	"Literal Number" on page 4-137

If you attempt to remove a jar file that is referenced by one or more UDRs, the database server generates an error. You must drop the referencing UDRs before you replace the jar file. For example, the following SQL statements remove the jar file associated with the **course_jar** jar id:

```
DROP FUNCTION sql_explosive_reaction;
EXECUTE PROCEDURE sqlj.remove_jar("course_jar")
```

When you specify a nonzero number for the second argument, the database server searches through any included deployment descriptor files. For example, you might want to include descriptor files that include SQL statements to revoke privileges on UDRs in the associated jar file and drop them from the database.

sqlj.alter_java_path

Use **sqlj.alter_java_path( )** to specify the *jar-file path* to use when the routine manager resolves related Java classes for the jar file of a UDR written in Java.

sqlj.alter_java_path:

```
├──sqlj.alter_java_path──────────────────────────────────────────────────────►


                                   ┌──────────────────┐
                 (1)               ▼                  │                            (1)
►──(──┤ Jar Name ├──────(───package_id.──┴──┬─ *─────────┬─,──┤ Jar Name ├────────))──────────┤
                                            └─class_id───┘
```

Notes:

1 See "Jar Name" on page 5-33

Element	Description	Restrictions	Syntax
class_id	Java class that contains method to implement the UDR	Java class must exist in the jar file that *jar_id* specifies. Identifier must not exceed 255 bytes.	Language specific
package_id	Name of the package that contains the Java class	The fully qualified identifier of *package_id.class_id* must not exceed 255 bytes	Language specific

The jar IDs that you specify, namely the jar ID for which you are altering the jar-file path and the resolution jar ID, must both have been installed with the **sqlj.install_jar** procedure. When you invoke a UDR written in the Java language, the routine manager attempts to load the Java class in which the UDR resides. At this time, it must resolve the references that this Java class makes to other Java classes.

The three types of such class references are these:

1. References to Java classes that the JVPCLASSPATH configuration parameter specifies (such as Java system classes like **java.util.Vector**)
2. References to classes that are in the same jar file as the UDR
3. References to classes that are outside the jar file that contains the UDR.

The routine manager implicitly resolves classes of type 1 and 2 in the preceding list. To resolve type 3 references, it examines all the jar files in the jar file path that the latest call to **sqlj.alter_java_path( )** specified.

The routine manager throws an exception if it cannot resolve a class reference. The routine manager checks the jar file path for class references *after* it performs the implicit type 1 and type 2 resolutions.

If you want a Java class to be loaded from the jar file that the jar file path specifies, make sure the Java class is *not* present in the JVPCLASSPATH configuration parameter. Otherwise, the system loader picks up that Java class first, which might result in a different class being loaded than what you expect.

Suppose that the **sqlj.install_jar( )** procedure and CREATE FUNCTION have been executed as the preceding sections describe. The following SQL statement invokes **sql_explosive_reaction( )** function in the **course_jar** jar file:

```
EXECUTE PROCEDURE alter_java_path("course_jar",
   "(professor/*, prof_jar)");
EXECUTE FUNCTION sql_explosive_reaction(10000)
```

The routine manager attempts to load the class **Chemistry**. It uses the path that the call to **sqlj.alter_java_path( )** specifies to resolve any class references. Therefore, it checks the classes that are in the **professor** package of the jar file that **prof_jar** identifies.

sqlj.setUDTextName

Use the **sqlj.setUDTextName( )** procedure to define the mapping between a user-defined data type and a Java class.

sqlj.SetUDTextName:

```
                                     ┌─────────────────┐
                                     ▼                 │
├──sqlj.SetUDTextName──(──data_type──,──┴─┬─────────────┬─┴──class_id──)───────┤
                                          └─package_id,─┘
```

Element	Description	Restrictions	Syntax
class_id	Java class that contains the Java data type	Qualified name *package_id.class_id* must not exceed 255 bytes	Language-specific rules for Java identifiers
data_type	User-defined type for which to create a mapping	Name must not exceed 255 bytes	"Identifier" on page 5-22
package_id	Name of package that contains the *class_id* Java class	Same length restrictions as *class_id*	Language-specific rules for Java identifiers

You must have registered the user-defined data type in the CREATE DISTINCT TYPE, CREATE OPAQUE TYPE, or CREATE ROW TYPE statement.

To look up the Java class for a user-defined data type, the database server searches in the jar-file path, which the **sqlj.alter_java_path( )** procedure has specified. For more information on the jar-file path, see "sqlj.alter_java_path" on page 2-341.

On the client side, the driver looks into the **CLASSPATH** path on the client environment before it asks the database server for the name of the Java class.

The **setUDTextName** procedure is an extension to the SQLJ:SQL *Routines using the Java Programming Language* specification.

sqlj.unsetUDTExtName

Use the **sqlj.unsetUDTextName( )** procedure to remove the mapping from a user-defined data type to a Java class.

sqlj.unsetUDTExtName:

```
├──sqlj.unsetUDTExtName──(──data_type──)───────────────────────────────┤
```

Element	Description	Restrictions	Syntax
data_type	User-defined data type for which to remove the mapping	Must exist	"Identifier" on page 5-22

This procedure removes the SQL-to-Java mapping and consequently removes any cached copy of the Java class from database server shared memory.

The **unsetUDTextName** procedure is an extension to the SQLJ:SQL *Routines Using the Java Programming Language* specification.

Related Information

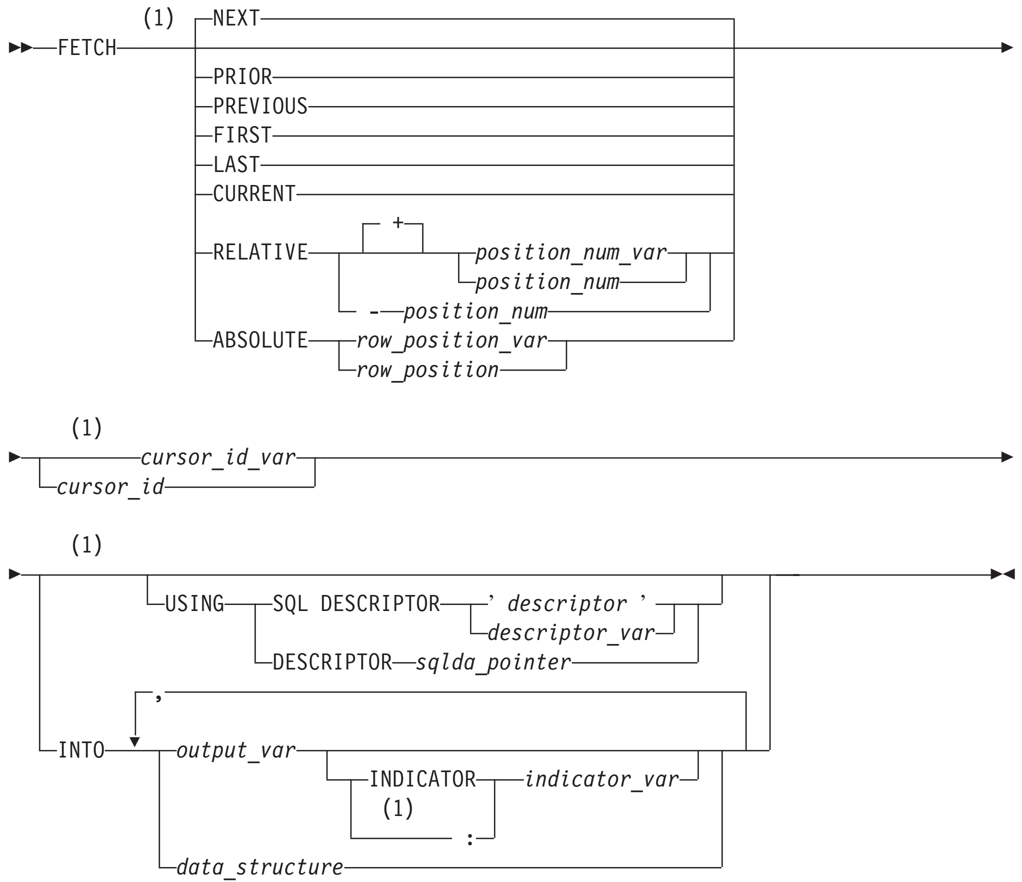
Related statements: CREATE FUNCTION, CREATE PROCEDURE, EXECUTE FUNCTION, GRANT, CALL, FOREACH, and LET

FETCH

Use the FETCH statement to move a cursor to a new row in the active set and to retrieve the row values from memory.

Use this statement with ESQL/C.

Syntax



Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
cursor_id	Cursor to retrieve rows	Must be open	"Identifier" on page 5-22
cursor_id_var	Host variable storing *cursor_id*	Must be character data type	Language specific
data_structure	Structure as a host variable	Must store fetched values	Language specific
descriptor	System-descriptor area	Must have been allocated	"Quoted String" on page 4-142
descriptor_var	Host variable storing *descriptor*	Must be allocated	Language specific
indicator_var	Host variable for return code if *output_var* can be NULL value	See "Using Indicator Variables" on page 2-347.	Language specific
output_var	Host variable for fetched value	Must store value from row	Language specific
position_num	Position relative to current row	Value `0` fetches current row	"Literal Number" on page 4-137
position_num_var	Host variable (= *position_num)*	Value `0` fetches current row	Language specific
row_position	Ordinal position in active set	Must be an integer >1	"Literal Number" on page 4-137
row_position_var	Host variable (= *row_ position)*	Must be 1 or greater	Language specific
sqlda_pointer	Pointer to an **sqlda** structure	Cannot begin with **$** nor **:**	See ESQL/C manual.

Usage

How the database server creates, stores, and fetches members of the active set of rows depends on whether the cursor is a sequential cursor or a scroll cursor.

In X/Open mode, if a cursor-direction value (such as `NEXT` or `RELATIVE`) is specified, a warning message is issued, indicating that the statement does not conform to X/Open standards.

FETCH with a Sequential Cursor

A sequential cursor can fetch only the next row in sequence from the active set. The only option available is the default option, NEXT. A sequential cursor can read through a table only once each time the table is opened. The following ESQL/C example illustrates the FETCH statement with a sequential cursor:

```
EXEC SQL FETCH seq_curs into :fname, :lname;
EXEC SQL FETCH NEXT seq_curs into ;fname, :lname;
```

When the program opens a sequential cursor, the database server processes the query to the point of locating or constructing the first row of data. The goal of the database server is to tie up as few resources as possible.

Because the sequential cursor can retrieve only the next row, the database server can frequently create the active set one row at a time.

On each FETCH operation, the database server returns the contents of the current row and locates the next row. This one-row-at-a-time strategy is not possible if the database server must create the entire active set to determine which row is the first row (as would be the case if the SELECT statement included an ORDER BY clause).

FETCH with a Scroll Cursor

These ESQL/C examples illustrate the FETCH statement with a scroll cursor:

```
EXEC SQL fetch previous q_curs into :orders;
EXEC SQL fetch last q_curs into :orders;
EXEC SQL fetch relative -10 q_curs into :orders;
printf("Which row? ");
scanf("%d",row_num);
EXEC SQL fetch absolute :row_num q_curs into :orders;
```

A scroll cursor can fetch any row in the active set, either by specifying an absolute row position or a relative offset. Use the following cursor-position options to specify a particular row that you want to retrieve.

Keyword	**Effect**
NEXT	Retrieves next row in active set
PREVIOUS	Retrieves previous row in active set
PRIOR	Retrieves previous row in active set (Synonymous with PREVIOUS.)
FIRST	Retrieves the first row in active set
LAST	Retrieves the last row in active set
CURRENT	Retrieves the current row in active set (the same row as returned by the previous FETCH statement from the scroll cursor)
RELATIVE	Retrieves *n*th row, relative to the current cursor position in the active set, where *position_num (*or *position_num_var)* supplies *n.* A negative value indicates the *n*th row prior to the current cursor position. If *position_num* = `0`, the current row is fetched.
ABSOLUTE	Retrieves *n*th row in active set, where *row_position_var* (or *row_position*) = *n* . Absolute row positions are numbered from 1.

Tip: Do not confuse row-position values with **rowid** values. A **rowid** value is based on the position of a row in its table and remains valid until the table is rebuilt. A row-position value (a value that the ABSOLUTE keyword retrieves) is the relative position of the row in the current active set of the cursor; the next time the cursor is opened, different rows might be selected.

How the Database Server Implements Scroll Cursors

Because it cannot anticipate which row the program will ask for next, the database server must retain all the rows in the active set until the scroll cursor closes. When a scroll cursor opens, the database server implements the active set as a temporary table, although it might not populate this table immediately.

The first time a row is fetched, the database server copies it into the temporary table as well as returning it to the program.

When a row is fetched for the second time, it can be taken from the temporary table. This scheme uses the fewest resources, in case the program abandons the query before it fetches all the rows. Rows that are never fetched are usually not copied from the database, or are saved in a temporary table.

Specifying Where Values Go in Memory

Each value from the select list of the query or the output of the executed user-defined function must be returned into a memory location. You can specify these destinations in one of the following ways:

- Use the INTO clause of a SELECT statement.

- Use the INTO clause of an EXECUTE Function (or EXECUTE PROCEDURE) statement.
- Use the INTO clause of a FETCH statement.
- Use a system-descriptor area.
- Use an **sqlda** structure.

Using the INTO Clause

If you associate a SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement with a function cursor, the statement can contain an INTO clause to specify variables to receive the returned values. You can use this method only when you write the SELECT, EXECUTE FUNCTION, or EXECUTE PROCEDURE statement as part of the cursor declaration; see "DECLARE" on page 2-260. In this case, the FETCH statement cannot contain an INTO clause.

The following example uses the INTO clause of the SELECT statement to specify program variables in ESQL/C:

```
EXEC SQL declare ord_date cursor for
   select order_num, order_date, po_num
      into :o_num, :o_date, :o_po;
EXEC SQL open ord_date;
EXEC SQL fetch next ord_date;
```

If you prepare a SELECT statement, the SELECT *cannot* include the INTO clause so you must use the INTO clause of the FETCH statement.

When you create a SELECT statement dynamically, you cannot use an INTO clause because you cannot name host variables in a prepared statement.

If you are certain of the number and data type of values in the projection list, you can use an INTO clause in the FETCH statement. If user input generated the query, however, you might not be certain of the number and data type of values that are being selected. In this case, you must use either a system descriptor or else a pointer to an **sqlda** structure.

Using Indicator Variables

Use an indicator variable if the returned data might be null.

The *indicator_var* parameter is optional, but use an indicator variable if the possibility exists that the value of *output_var* is NULL.

If you specify the indicator variable without the INDICATOR keyword, you cannot put a blank space between *output_var* and *indicator_var*.

For information about rules for placing a prefix before the *indicator_var*, see the *IBM Informix ESQL/C Programmer's Manual*.

The host variable cannot be a DATETIME or INTERVAL data type.

When the INTO Clause of FETCH is Required

When SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) omits the INTO clause, you must specify a data destination when a row is fetched.

For example, to dynamically execute a SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement, the SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) cannot include its INTO clause in the PREPARE statement. Therefore, the FETCH statement must include an INTO clause to retrieve data into a set of variables. This method lets you store different rows in different memory locations.

You can fetch into a program-array element only by using an INTO clause in the FETCH statement. If you use a program array, you must list both the array name and a specific element of the array in *data_structure.* When you are declaring a cursor, do not refer to an array element within the SQL statement.

Tip: If you are certain of the number and data type of values in the select list of the Projection clause, you can use an INTO clause in the FETCH statement.

In the following ESQL/C example, a series of complete rows is fetched into a program array. The INTO clause of each FETCH statement specifies an array element as well as the array name:

```
EXEC SQL BEGIN DECLARE SECTION;
   char wanted_state[2];
   short int row_count = 0;
   struct customer_t{
   {
      int    c_no;
      char   fname[15];
      char   lname[15];
   } cust_rec[100];
EXEC SQL END DECLARE SECTION;

main()
{
   EXEC SQL connect to'stores_demo';
   printf("Enter 2-letter state code: ");
   scanf ("%s", wanted_state);
   EXEC SQL declare cust cursor for
      select * from customer where state = :wanted_state;
   EXEC SQL open cust;
   EXEC SQL fetch cust into :cust_rec[row_count];
   while (SQLCODE == 0)
   {
      printf("\n%s %s", cust_rec[row_count].fname,
         cust_rec[row_count].lname);
      row_count++;
      EXEC SQL fetch cust into :cust_rec[row_count];
   }
   printf ("\n");
   EXEC SQL close cust;
   EXEC SQL free cust;
}
```

Using a System-Descriptor Area (X/Open)

You can use a system-descriptor area to store output values when you do not know the number of return values or their data types that a SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement returns at runtime. A system-descriptor area describes the data type and memory location of one or more return values, and conforms to the X/Open standards.

The keywords USING SQL DESCRIPTOR introduce the name of the system-descriptor area into which you fetch the contents of a row or the return values of a user-defined function. You can then use the GET DESCRIPTOR statement to transfer the values that the FETCH statement returns from the system-descriptor area into host variables.

The following example shows a valid FETCH...USING SQL DESCRIPTOR statement:

```
EXEC SQL allocate descriptor 'desc';
   ...
EXEC SQL declare selcurs cursor for
   select * from customer where state = 'CA';
EXEC SQL describe selcurs using sql descriptor 'desc';
EXEC SQL open selcurs;
while (1)
   {
   EXEC SQL fetch selcurs using sql descriptor 'desc';
```

You can also use an **sqlda** structure to supply parameters dynamically.

Using sqlda Structures

You can use a pointer to an **sqlda** structure to stores output values when you do not know the number of values or their data types that a SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement returns.

This structure contains data descriptors that specify the data type and memory location for one selected value. The keywords USING DESCRIPTOR introduce the name of the pointer to the **sqlda** structure.

Tip: If you know the number and data types of all values in the select list, you can use an INTO clause in the FETCH statement. For more information, see “When the INTO Clause of FETCH is Required” on page 2-347.

To specify an sqlda structure as the location of parameters:

1. Declare an **sqlda** pointer variable.
2. Use the DESCRIBE statement to fill in the **sqlda** structure.
3. Allocate memory to hold the data values.
4. Use the USING DESCRIPTOR clause of FETCH to specify the **sqlda** structure as the location into which you fetch the returned values.

The following example shows a FETCH USING DESCRIPTOR statement:

```
struct sqlda *sqlda_ptr;
...
EXEC SQL declare selcurs2 cursor for
   select * from customer where state = 'CA';
EXEC SQL describe selcurs2 into sqlda_ptr;
...
EXEC SQL open selcurs2;
while (1)
   {
   EXEC SQL fetch selcurs2 using descriptor sqlda_ptr;
   ...
```

The **sqld** value specifies the number of output values that are described in occurrences of the **sqlvar** structures of the **sqlda** structure. This number must correspond to the number of values returned from the prepared statement.

Fetching a Row for Update

The FETCH statement does not ordinarily lock a row that is fetched. Thus, another process can modify (update or delete) the fetched row immediately after your program receives it. A fetched row is locked in the following cases:

- When you set the isolation level to Repeatable Read, each row that you fetch is locked with a read lock until the cursor closes or until the current transaction ends. Other programs can also read the locked rows.

- When you set the isolation level to Cursor Stability, the current row is locked.
- In an ANSI-compliant database, an isolation level of Repeatable Read is the default; you can set it to something else.
- When you are fetching through an update cursor (one that is declared FOR UPDATE), each row you fetch is locked with a promotable lock. Other programs can read the locked row, but no other program can place a promotable or write lock; therefore, the row is unchanged if another user tries to modify it using the WHERE CURRENT OF clause of an UPDATE or DELETE statement.

When you modify a row, the lock is upgraded to a write lock and remains until the cursor is closed or the transaction ends. If you do not modify the row, the behavior of the database server depends on the isolation level you have set. The database server releases the lock on an unchanged row as soon as another row is fetched, unless you are using Repeatable Read isolation. (See “SET ISOLATION” on page 2-575.)

Important: You can hold locks on additional rows even when Repeatable Read isolation is not in use or is unavailable. Update the row with unchanged data to hold it locked while your program is reading other rows. You must evaluate the effect of this technique on performance in the context of your application, and you must be aware of the increased potential for deadlock.

When you use explicit transactions, be sure that a row is both fetched and modified within a single transaction; that is, both the FETCH statement and the subsequent UPDATE or DELETE statement must fall between a BEGIN WORK statement and the next COMMIT WORK statement.

Fetching from a Collection Cursor (IDS)

A collection cursor allows you to access the individual elements of an ESQL/C collection variable. To declare a collection cursor, use the DECLARE statement and include the Collection-Derived-Table segment in the SELECT statement that you associate with the cursor. After you open the collection cursor with the OPEN statement, the cursor allows you to access the elements of the collection variable.

To fetch elements, one at a time, from a collection cursor, use the FETCH statement and the INTO clause. The FETCH statement identifies the collection cursor that is associated with the collection variable. The INTO clause identifies the host variable that holds the element value that is fetched from the collection cursor. The data type of the host variable in the INTO clause must match the element type of the collection.

Suppose you have a table called **children** with the following structure:

```
CREATE TABLE children
(
   age         SMALLINT,
   name         VARCHAR(30),
   fav_colors           SET(VARCHAR(20) NOT NULL),
)
```

The following ESQL/C code fragment shows how to fetch elements from the **child_colors** collection variable:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection child_colors;
   varchar one_favorite[21];
   char child_name[31] = "marybeth";
EXEC SQL END DECLARE SECTION;
EXEC SQL allocate collection :child_colors;
/* Get structure of fav_colors column for untyped
 * child_colors collection variable */
EXEC SQL select fav_colors into :child_colors
   from children
   where name = :child_name;
/* Declare select cursor for child_colors collection
 * variable */
EXEC SQL declare colors_curs cursor for
   select * from table(:child_colors);
EXEC SQL open colors_curs;
do
{
   EXEC SQL fetch colors_curs into :one_favorite;
   ...
} while (SQLCODE == 0)
EXEC SQL close colors_curs;
EXEC SQL free colors_curs;
EXEC SQL deallocate collection :child_colors;
```

After you fetch a collection element, you can modify the element with the UPDATE or DELETE statements. For more information, see the UPDATE and DELETE statements in this manual. You can also insert new elements into the collection variable with an INSERT statement. For more information, see the INSERT statement.

Checking the Result of FETCH

You can use the **SQLSTATE** variable to check the result of each FETCH statement. The database server sets the **SQLSTATE** variable after each SQL statement. If a row is returned successfully, the **SQLSTATE** variable contains the value `00000`. If no row is found, the database server sets the **SQLSTATE** code to `02000`, which indicates `no data found`, and the current row is unchanged. The following conditions set the **SQLSTATE** code to `02000`, indicating `no data found`:

- The active set contains no rows.
- You issue a FETCH NEXT statement when the cursor points to the last row in the active set or points past it.
- You issue a FETCH PRIOR or FETCH PREVIOUS statement when the cursor points to the first row in the active set.
- You issue a FETCH RELATIVE *n* statement when no *n*th row exists in the active set.
- You issue a FETCH ABSOLUTE *n* statement when no *n*th row exists in the active set.

The database server copies the **SQLSTATE** code from the **RETURNED_SQLSTATE** field of the system-diagnostics area. You can use the GET DIAGNOSTICS statement to examine the **RETURNED_SQLSTATE**field directly. The system-diagnostics area can also contain additional error information.

You can also use **SQLCODE** variable of the SQL Communications Area (**sqlca**) to determine the same results.

Related Information

Related statements: ALLOCATE DESCRIPTOR, CLOSE, DEALLOCATE DESCRIPTOR, DECLARE, DESCRIBE, GET DESCRIPTOR, OPEN, PREPARE, SET DEFERRED_PREPARE, and SET DESCRIPTOR

For a task-oriented discussion of the FETCH statement, see the *IBM Informix Guide to SQL: Tutorial*.

For more information about concepts that relate to the FETCH statement, see the *IBM Informix ESQL/C Programmer's Manual*.

FLUSH

Use the FLUSH statement to force rows that a PUT statement buffered to be written to the database.

Use this statement, which is an extension to the ANSI/ISO standard for SQL, with ESQL/C.

Syntax

```
>>──FLUSH──┬─cursor_id─────┬──────────────────────────────────────────────────><
           └─cursor_id_var─┘
```

Element	Description	Restrictions	Syntax
cursor_id	Name of a cursor	Must have been declared	"Identifier" on page 5-22
cursor_id_var	Host variable that holds the value of *cursor_id*	Must be a character data type	Language specific

Usage

The PUT statement adds a row to a buffer, whose content is written to the database when the buffer is full. Use the FLUSH statement to force the insertion when the buffer is not full.

If the program terminates without closing the cursor, the buffer is left unflushed. Rows placed into the buffer since the last flush are lost. Do not expect the end of the program to close the cursor and flush the buffer automatically. The following example shows a FLUSH statement that operates on a cursor called **icurs**:

```
FLUSH icurs
```

Error Checking FLUSH Statements

The SQL Communications Area (**sqlca**) structure contains information on the success of each FLUSH statement and the number of rows that are inserted successfully. The result of each FLUSH statement is described in the fields of the **sqlca**: **sqlca.sqlcode**, **SQLCODE**, and **sqlca.sqlerrd[2]**.

When you use data buffering with an insert cursor, you do not discover errors until the buffer is flushed. For example, an input value that is incompatible with the data type of the column for which it is intended is discovered only when the buffer is flushed. When an error is discovered, any rows in the buffer that are located after the error are *not* inserted; they are lost from memory.

The **SQLCODE** field is set either to an error code or to zero (0) if no error occurs. The third element of the **SQLERRD** array is set to the number of rows that are successfully inserted into the database:

- If a block of rows is successfully inserted into the database, **SQLCODE** is set to zero (0) and **SQLERRD** to the count of rows.
- If an error occurs while the FLUSH statement is inserting a block of rows, **SQLCODE** shows which error, and **SQLERRD** contains the number of rows that were successfully inserted. (Uninserted rows are discarded from the buffer.)

Tip: When you encounter an **SQLCODE** error, a corresponding **SQLSTATE** error value also exists. For information about how to get the message text, check the GET DIAGNOSTICS statement.

To count the number of rows actually inserted into the database as well as the number not yet inserted:

1. Prepare two integer variables, for example, **total** and **pending**.
2. When the cursor opens, set both variables to `0`.
3. Each time a PUT statement executes, increment both **total** and **pending**.
4. Whenever a FLUSH statement executes or the cursor is closed, subtract the third field of the **SQLERRD** array from **pending**.

Related Information

Related statements: CLOSE, DECLARE, OPEN, and PREPARE

For a task-oriented discussion of FLUSH, see the *IBM Informix Guide to SQL: Tutorial*.

For information about the **sqlca** structure, see the *IBM Informix ESQL/C Programmer's Manual*.

FREE

Use the FREE statement to release resources that are allocated to a prepared statement or to a cursor.

Use this statement, which is an extension to the ANSI/ISO standard for SQL, with ESQL/C.

Syntax

```
►►──FREE──┬─cursor_id──────────┬─────────────────────────────────────────►◄
          ├─cursor_id_var──────┤
          ├─statement_id───────┤
          └─statement_id_var───┘
```

Element	Description	Restrictions	Syntax
cursor_id	Name of a cursor	Must have been declared	"Identifier" on page 5-22
cursor_id_var	Host variable that holds the value of cursor_id	Must be a character data type	Language specific
statement_id	String that identifies an SQL statement	Must be defined in a previous PREPARE statement	"PREPARE" on page 2-433
statement_id_var	Host variable that identifies an SQL statement	Same restrictions as *statement_id*. Must be a character data type.	"PREPARE" on page 2-433

Usage

FREE releases the resources that the database server and application-development tool allocated for a prepared statement or for a declared cursor.

If you declared a cursor for a prepared statement, FREE *statement_id* (or *statement_id_var*) releases only the resources in the application development tool; the cursor can still be used. The resources in the database server are released only when you free the cursor.

If you prepared a statement (but did not declare a cursor for it), FREE *statement_id* (or FREE *statement_id_var*) releases the resources in both the application development tool and the database server.

After you free a statement, you cannot execute it or declare a cursor for it until you prepare it again.

The following ESQL/C example shows the sequence of statements that is used to free an implicitly prepared statement:

```
EXEC SQL prepare sel_stmt from 'select * from orders';
...
EXEC SQL free sel_stmt;
```

The following ESQL/C example shows the sequence of statements that are used to release the resources of an explicitly prepared statement. The first FREE statement in this example frees the cursor. The second FREE statement in this example frees the prepared statement.

```
sprintf(demoselect, "%s %s",
   "select * from customer ",
   "where customer_num between 100 and 200");
EXEC SQL prepare sel_stmt from :demoselect;
EXEC SQL declare sel_curs cursor for sel_stmt;
EXEC SQL open sel_curs;
...
EXEC SQL close sel_curs;
EXEC SQL free sel_curs;
EXEC SQL free sel_stmt;
```

If you declared a cursor for a prepared statement, freeing the cursor releases only the resources in the database server. To release the resources for the statement in the application-development tool, use FREE *statement_id* (or FREE *statement_id_var*).

If a cursor is not declared for a prepared statement, freeing it releases the resources in both the application-development tool and the database server.

After a cursor is freed, it cannot be opened until it is declared again. The cursor should be explicitly closed before it is freed.

For an example of a FREE statement that frees a cursor, see the previous example.

Related Information

Related statements: CLOSE, DECLARE, EXECUTE, EXECUTE IMMEDIATE, OPEN, PREPARE, and SET AUTOFREE

For a task-oriented discussion of the FREE statement, see the *IBM Informix Guide to SQL: Tutorial*.

GET DESCRIPTOR

Use the GET DESCRIPTOR statement to read from a system descriptor area.

Use this statement with ESQL/C.

Syntax

```
►►──GET DESCRIPTOR──┬─descriptor_var─┬────────────────────────────────────────────►
                    └─'descriptor ' ─┘

►──┬─total_items_var── =──COUNT──────────────────────────────────────────────┬──►◄
   │                                ┌─,──────────────────────────────┐       │
   │                                ▼                                │       │
   └─VALUE──┬─item_num_var─┬────────┤ Described Item Information ├──┴───────┘
            └─item_num─────┘
```

Described Item Information:

```
├──field_var── =──┬──┬─TYPE──────┬────────────────────────┬───────────────────┤
                  │  ├─LENGTH────┤                        │
                  │  ├─PRECISION─┤                        │
                  │  ├─SCALE─────┤                        │
                  │  ├─NULLABLE──┤                        │
                  │  ├─INDICATOR─┤                        │
                  │  ├─NAME──────┤                        │
                  │  ├─DATA──────┤                        │
                  │  ├─IDATA─────┤                        │
                  │  ├─ITYPE─────┤                        │
                  │  └─ILENGTH───┘                        │
                  │  (1)    (2)                           │
                  └──────────────┬─EXTYPEID──────────────┬┘
                                 ├─EXTYPENAME────────────┤
                                 ├─EXTYPEOWNERNAME───────┤
                                 ├─EXTYPELENGTH──────────┤
                                 ├─EXTYPEOWNERLENGTH─────┤
                                 ├─SOURCEID──────────────┤
                                 └─SOURCETYPE────────────┘
```

Notes:

1 Informix extension

2 Dynamic Server only

Element	Description	Restrictions	Syntax
descriptor	Quoted string that identifies a system-descriptor area (SDA)	System-descriptor area must already have been allocated	"Quoted String" on page 4-142
descriptor_var	Variable that stores *descriptor* value	Same restrictions as *descriptor*	Language specific
field_var	Host variable to receive the contents of a field from an SDA	Must be of type that can receive value of a specified SDA field	Language specific
item_num	Unsigned ordinal number of an item described in the SDA	0 ≤ *item_num* ≤ (number of item descriptors in the SDA)	"Literal Number" on page 4-137
item_num_ var	Host variable storing *item_num*	Must be an integer data type	Language specific
total_items_var	Host variable storing the number of items described in the SDA	Must be an integer data type	Language specific

Usage

Use the GET DESCRIPTOR statement to accomplish any of the following tasks:

- Determine how many items are described in a system-descriptor area.
- Determine the characteristics of each column or expression that is described in the system-descriptor area.
- Copy a value from the system-descriptor area into a host variable after a FETCH statement.

With Dynamic Server, you can use GET DESCRIPTOR after you describe EXECUTE FUNCTION, INSERT, SELECT, or UPDATE statements with the DESCRIBE ... USING SQL DESCRIPTOR statement.

With Extended Parallel Server, you can use GET DESCRIPTOR after you describe EXECUTE PROCEDURE, INSERT, or SELECT statements with the DESCRIBE ... USING SQL DESCRIPTOR statement.

The host variables that you reference in the GET DESCRIPTOR statement must be declared in the BEGIN DECLARE SECTION of a program.

If an error occurs during the assignment of a value to any specified host variable, the contents of the host variable are undefined.

Using the COUNT Keyword

Use the COUNT keyword to determine how many items are described in the system-descriptor area.

The following ESQL/C example shows how to use a GET DESCRIPTOR statement with a host variable to determine how many items are described in the system-descriptor area called **desc1**:

```
main()
{
EXEC SQL BEGIN DECLARE SECTION;
int h_count;
EXEC SQL END DECLARE SECTION;

EXEC SQL allocate descriptor 'desc1' with max 20;

/* This section of program would prepare a SELECT or INSERT
 * statement into the s_id statement id.
*/
EXEC SQL describe s_id using sql descriptor 'desc1';
EXEC SQL get descriptor 'desc1' :h_count = count;
...
}
```

Using the VALUE Clause

Use the VALUE clause to obtain information about a described column or expression or to retrieve values that the database server returns in a system descriptor area.

The *item_num* must be greater than zero (0) but not greater than the number of item descriptors that were specified when the system-descriptor area was allocated with the ALLOCATE DESCRIPTOR statement.

Using the VALUE Clause After a DESCRIBE: After you describe a SELECT, EXECUTE FUNCTION (or EXECUTE PROCEDURE), INSERT, or UPDATE statement, the characteristics of each column or expression in the select list of the SELECT statement, the characteristics of the values returned by the EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement, or the characteristics of each column in an INSERT or UPDATE statement are returned to the system-descriptor area. Each value in the system-descriptor area describes the characteristics of one returned column or expression.

The following ESQL/C example uses GET DESCRIPTOR to obtain data type information from the **demodesc** system-descriptor area:

```
EXEC SQL get descriptor 'demodesc' value :index
       :type = TYPE,
       :len = LENGTH,
       :name = NAME;
printf("Column %d: type = %d, len = %d, name = %s\n",
      index, type, len, name);
```

The value that the database server returns into the TYPE field is a defined integer. To evaluate the data type that is returned, test for a specific integer value. For additional information about integer data type values, see "Setting the TYPE or ITYPE Field" on page 2-556.

In X/Open mode, the X/Open code is returned to the TYPE field. You cannot mix the two modes because errors can result. For example, if a particular data type is not defined under X/Open mode but is defined for IBM Informix products, executing a GET DESCRIPTOR statement can result in an error.

In X/Open mode, a warning message appears if ILENGTH, IDATA, or ITYPE is used. It indicates that these fields are not standard X/Open fields for a system-descriptor area.

If the TYPE of a fetched value is DECIMAL or MONEY, the database server returns the precision and scale information for a column into the PRECISION and SCALE fields after a DESCRIBE statement is executed. If the TYPE is *not* DECIMAL or MONEY, the SCALE and PRECISION fields are undefined.

Using the VALUE Clause After a FETCH: Each time your program fetches a row, it must copy the fetched value into host variables so that the data can be used. To accomplish this task, use a GET DESCRIPTOR statement after each fetch of each value in the select list. If three values exist in the select list, you need to use three

GET DESCRIPTOR statements after each fetch (assuming you want to read all three values). The item numbers for each of the three GET DESCRIPTOR statements are 1, 2, and 3.

The following ESQL/C example shows how you can copy data from the DATA field into a host variable (**result**) after a fetch. For this example, it is predetermined that all returned values are the same data type:

```
EXEC SQL get descriptor 'demodesc' :desc_count = count;
.. .
EXEC SQL fetch democursor using sql descriptor 'demodesc';
for (i = 1; i <= desc_count; i++)
   {
   if (sqlca.sqlcode != 0) break;
   EXEC SQL get descriptor 'demodesc' value :i :result = DATA;
   printf("%s ", result);
   }
printf("\n");
```

Fetching a NULL Value: When you use GET DESCRIPTOR after a fetch, and the fetched value is NULL, the INDICATOR field is set to -1 to indicate the NULL value. The value of DATA is undefined if INDICATOR indicates a NULL value. The host variable into which DATA is copied has an unpredictable value.

Using LENGTH or ILENGTH

If your DATA or IDATA field contains a character string, you must specify a value for LENGTH. If you specify LENGTH=0, LENGTH is automatically set to the maximum length of the string. The DATA or IDATA field might contain a literal character string or a character string that is derived from a character variable of CHAR or VARCHAR data type. This provides a method to determine the length of a string in the DATA or IDATA field dynamically.

If a DESCRIBE statement precedes a GET DESCRIPTOR statement, LENGTH is automatically set to the maximum length of the character field that is specified in your table.

This information is identical for ILENGTH. Use ILENGTH when you create a dynamic program that does not comply with the X/Open standard.

Describing an Opaque-Type Column (IDS)

The DESCRIBE statement sets the following item-descriptor fields when the column to fetch has an opaque type as its data type:

- The EXTYPEID field stores the extended ID for the opaque type.
  This integer is the value in the corresponding **extended_id** column of the **sysxtdtypes** system catalog table.
- The EXTYPENAME field stores the name of the opaque type.
  This character value is the value in the **name** column of the row with the matching **extended_id** value in the **sysxtdtypes** system catalog table.
- The EXTYPELENGTH field stores the length of the opaque-type name.
  This integer is the length of the data type name (in bytes).
- The EXTYPEOWNERNAME field stores the name of the opaque-type owner.
  This character value is the value in the **owner** column of the row with the matching **extended_id** value in the **sysxtdtypes** system catalog table.
- The EXTYPEOWNERLENGTH field stores the length of the value in the EXTTYPEOWNERNAME field. This integer is the length, in bytes, of the name of the owner of the opaque type.

Use these field names with the GET DESCRIPTOR statement to obtain information about an opaque column.

Describing a Distinct-Type Column (IDS)

The DESCRIBE statement sets the following item-descriptor fields when the column to fetch has a distinct type as its data type:

- The SOURCEID field stores the extended identifier for the source data type.

  This integer has the value of the **source** column for the row of the **sysxtdtypes** system catalog table whose **extended_id** value matches that of the distinct data type. This field is set only if the source data type is an opaque data type.
- The SOURCETYPE field stores the data type constant for the source data type.

  This value is the data type constant (from the **sqltypes.h** file) for the data type of the source type for the DISTINCT data type. The codes for the SOURCETYPE field are listed in the description of the TYPE field in the SET DESCRIPTOR statement. (For more information, see "Setting the TYPE or ITYPE Field" on page 2-556.) This integer value must correspond to the value in the **type** column for the row of the **sysxtdtypes** system catalog table whose **extended_id** value matches that of the DISTINCT data type.

Use these field names with the GET DESCRIPTOR statement to obtain information about a distinct-type column.

Related Information

Related statements: ALLOCATE DESCRIPTOR, DEALLOCATE DESCRIPTOR, DECLARE, DESCRIBE, EXECUTE, FETCH, OPEN, PREPARE, PUT, and SET DESCRIPTOR

For more information on concepts that relate to the GET DESCRIPTOR statement, see the *IBM Informix ESQL/C Programmer's Manual*.

For more information on the **sysxtdtypes** system catalog table, see the *IBM Informix Guide to SQL: Reference*.

GET DIAGNOSTICS

Use the GET DIAGNOSTICS statement to return diagnostic information about the most recently executed SQL statement.

Use this statement with ESQL/C.

Syntax

```
                                               (1)
►►──GET DIAGNOSTICS──┬──┤ Statement Clause ├──────┬──────────────────────────►◄
                     │                         (2)│
                     └──┤ EXCEPTION Clause ├──────┘
```

Notes:

1 See "Statement Clause" on page 2-365

2 See "EXCEPTION Clause" on page 2-366

Usage

The GET DIAGNOSTICS statement retrieves specified status information that the database server records in a structure called the *diagnostics area*. Using GET DIAGNOSTICS does not change the contents of the diagnostics area.

The GET DIAGNOSTICS statement uses one of the following two clauses:

- The Statement clause returns count and overflow information about errors and warnings that the most recent SQL statement generates.
- The EXCEPTION clause provides specific information about errors and warnings that the most recent SQL statement generates.

Using the SQLSTATE Error Status Code

When an SQL statement executes, an error status code is automatically generated. This code represents `success`, `failure`, `warning`, or `no data found`. This error status code is stored in a built-in variable called SQLSTATE.

Class and Subclass Codes: The SQLSTATE status code is a five-character string that can contain only digits and uppercase letters.

The first two characters of the SQLSTATE status code indicate a class. The last three characters of the SQLSTATE code indicate a subclass. Figure 2-1 shows the structure of the SQLSTATE code. This example uses the value `08001`, where `08` is the class code and `001` is the subclass code. The value `08001` represents the error `unable to connect with database environment`.

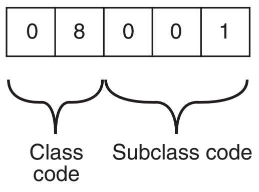


Figure 2-1. Structure of the SQLSTATE Code

The following table is a quick reference for interpreting class code values.

SQLSTATE Class Code Value	Outcome
00	Success
01	Success with warning
02	No data found
> 02	Error or warning

Support for the ANSI/ISO Standard for SQL: All status codes returned to the SQLSTATE variable are ANSI-compliant except in the following cases:

- SQLSTATE codes with a class code of `01` and a subclass code that begins with an `I` are Informix-specific warning messages.
- SQLSTATE codes with a class code of `IX` and any subclass code are Informix-specific error messages.
- SQLSTATE codes whose class code begins with a digit in the range 5 to 9 or with an uppercase letter in the range I to Z indicate conditions that are currently undefined by the ANSI/ISO standard for SQL. The only exception is that SQLSTATE codes whose class code is `IX` are Informix-specific error messages.

List of SQLSTATE Codes: This table describes the class codes, subclass codes, and the meaning of all valid warning and error codes associated with the SQLSTATE variable.

Class	Subclass	Meaning
00	000	Success
01	000	Success with warning
01	002	Disconnect error. Transaction rolled back
01	003	NULL value eliminated in set function
01	004	String data, right truncation
01	005	Insufficient item descriptor areas
01	006	Privilege not revoked
01	007	Privilege not granted
01	I01	Database has transactions
01	I03	ANSI-compliant database selected
01	I04	IBM Informix database server selected
01	I05	Float to decimal conversion was used
01	I06	Informix extension to ANSI-compliant syntax
01	I07	UPDATE or DELETE statement does not have a WHERE clause
01	I08	An ANSI keyword was used as a cursor name
01	I09	Cardinalities of the projection list and of the INTO list are not equal
01	I10	Database server running in secondary mode
01	I11	Dataskip is turned on
02	000	No data found
07	000	Dynamic SQL error
07	001	USING clause does not match dynamic parameters
07	002	USING clause does not match target specifications
07	003	Cursor specification cannot be executed
07	004	USING clause is required for dynamic parameters
07	005	Prepared statement is not a cursor specification
07	006	Restricted data type attribute violation
07	008	Invalid descriptor count
07	009	Invalid descriptor index

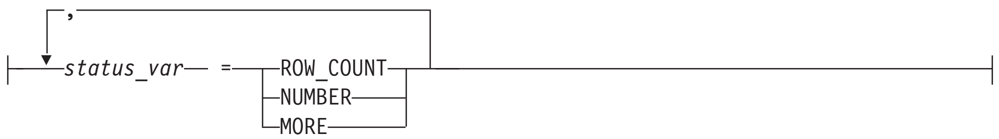
Class	Subclass	Meaning
08	000	Connection exception
08	001	Database server rejected the connection
08	002	Connection name in use
08	003	Connection does not exist
08	004	Client unable to establish connection
08	006	Transaction rolled back
08	007	Transaction state unknown
08	S01	Communication failure
0A	000	Feature not supported
0A	001	Multiple server transactions
21	000	Cardinality violation
21	S01	Insert value list does not match column list
21	S02	Degree of derived table does not match column list
22	000	Data exception
22	001	String data, right truncation
22	002	NULL value, no indicator parameter
22	003	Numeric value out of range
22	005	Error in assignment
22	027	Data exception trim error
22	012	Division by zero (0)
22	019	Invalid escape character
22	024	Unterminated string
22	025	Invalid escape sequence
23	000	Integrity constraint violation
24	000	Invalid cursor state
25	000	Invalid transaction state
2B	000	Dependent privilege descriptors still exist
2D	000	Invalid transaction termination
26	000	Invalid SQL statement identifier
2E	000	Invalid connection name
28	000	Invalid user-authorization specification
33	000	Invalid SQL descriptor name
34	000	Invalid cursor name
35	000	Invalid exception number
37	000	Syntax error or access violation in PREPARE or EXECUTE IMMEDIATE
3C	000	Duplicate cursor name
40	000	Transaction rollback
40	003	Statement completion unknown
42	000	Syntax error or access violation
S0	000	Invalid name
S0	001	Base table or view table already exists
S0	002	Base table not found
S0	011	Index already exists
S0	021	Column already exists
S1	001	Memory allocation failure
IX	000	Informix reserved error message

Using SQLSTATE in Applications: You can use a built-in variable, called SQLSTATE, which you do not have to declare in your program. SQLSTATE contains the status code, essential for error handling, which is generated every time your program executes an SQL statement. SQLSTATE is created automatically. You can examine the SQLSTATE variable to determine whether an SQL statement was successful. If the SQLSTATE variable indicates that the statement failed, you can execute a GET DIAGNOSTICS statement to obtain additional error information.

For an example of how to use an SQLSTATE variable in a program, see "Using GET DIAGNOSTICS for Error Checking" on page 2-369.

Statement Clause

Statement Clause:



Element	Description	Restrictions	Syntax
status_var	Host variable to receive status information about the most recent SQL statement for the specified status field name	Must match data type of the field	Language specific

When retrieving count and overflow information, GET DIAGNOSTICS can deposit the values of the three statement fields into a corresponding host variable. The host-variable data type must be the same as that of the requested field. The following keywords represent these three fields.

Field Name Keyword	Field Data Type	Field Contents	ESQL/C Host Variable Data Type
MORE	Character	Y or N	char[2]
NUMBER	Integer	1 to 35,000	int
ROW_COUNT	Integer	0 to 999,999,999	int

Using the MORE Keyword: Use the MORE keyword to determine if the most recently executed SQL statement resulted in the following actions by the database server:

- Stored all the exceptions that it detected in the diagnostics area

  If so, GET DIAGNOSTICS returns a value of N.
- Detected more exceptions than it stored in the diagnostics area

  If so, GET DIAGNOSTICS returns a value of `Y`. (The value of MORE is always `N`.)

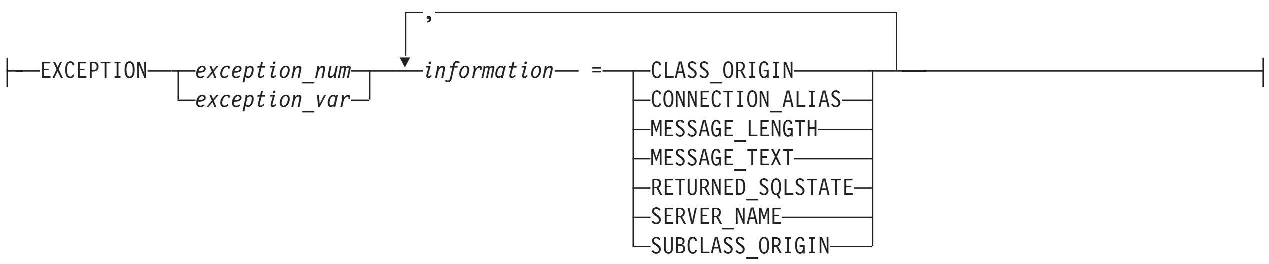
Using the ROW_COUNT Keyword: The ROW_COUNT keyword returns the number of rows the most recently executed DML statement processed. ROW_COUNT counts these rows:

- Inserted into a table
- Updated in a table
- Deleted from a table

Using the NUMBER Keyword: The NUMBER keyword returns the number of exceptions that the most recently executed SQL statement raised. The NUMBER field can hold a value from `1` to `35,000`, depending on how many exceptions are counted.

EXCEPTION Clause

Exception Clause:



Element	Description	Restrictions	Syntax
exception_num	Number of exceptions	Integer in range `1` to `35,000`	"Literal Number" on page 4-137
exception_var	Variable storing *exception_num*	Must be SMALLINT or INT	Language specific
information	Host variable to receive the value of a specified exception field	Data type must match that of the specified field	Language specific

The *exception_num* literal indicates one of the exception values from the number of exceptions that the NUMBER field in the Statement clause returns.

When retrieving exception information, GET DIAGNOSTICS writes the values of each of the seven fields into corresponding host variables. These fields are located in the diagnostics area and are derived from an exception raised by the most recent SQL statement.

The host-variable data type must be the same as that of the requested field. The following table describes the seven exception information fields.

Field Name Keyword	Field Data Type	Field Contents	ESQL/C Host Variable Data Type
RETURNED_SQLSTATE	Character	SQLSTATE value	char[6]
CLASS_ORIGIN	Character	String	char[255]
SUBCLASS_ORIGIN	Character	String	char[255]
MESSAGE_TEXT	Character	String	char[255]
MESSAGE_LENGTH	Integer	Numeric value	int
SERVER_NAME	Character	String	char[255]
CONNECTION_NAME	Character	String	char[255]

The application specifies the exception by number, using either an unsigned integer or an integer host variable (an exact numeric with a scale of 0). An exception with a value of 1 corresponds to the SQLSTATE value set by the most recent SQL statement other than GET DIAGNOSTICS. The association between other exception numbers and other exceptions raised by that SQL statement is undefined. Thus, no set order exists in which the diagnostic area can be filled with exception values. You always get at least one exception, even if the SQLSTATE value indicates success.

If an error occurs within the GET DIAGNOSTICS statement (that is, if an invalid exception number is requested), the Informix internal SQLCODE and SQLSTATE variables are set to the value of that exception. In addition, the GET DIAGNOSTICS fields are undefined.

Using the RETURNED_SQLSTATE Keyword: The RETURNED_SQLSTATE keyword returns the SQLSTATE value that describes the exception.

Using the CLASS_ORIGIN Keyword: Use the CLASS_ORIGIN keyword to retrieve the class portion of the RETURNED_SQLSTATE value. If the ISO standard for SQL defines the class, the value of CLASS_ORIGIN is equal to ISO 9075. Otherwise, the value returned by CLASS_ORIGIN is defined by Informix and cannot be ISO 9075. The terms ANSI SQL and ISO SQL are synonymous.

Using the SUBCLASS_ORIGIN Keyword: The SUBCLASS_ORIGIN keyword returns data on the RETURNED_SQLSTATE subclass. (This value is `ISO 9075` if the ISO standard defines the subclass.)

Using the MESSAGE_TEXT Keyword: The MESSAGE_TEXT keyword returns the message text of the exception (for example, an error message).

Using the MESSAGE_LENGTH Keyword: The MESSAGE_LENGTH keyword returns the length in bytes of the current message text string.

Using the SERVER_NAME Keyword: The SERVER_NAME keyword returns the the name of the database server associated with a CONNECT or DATABASE statement. GET DIAGNOSTICS updates the SERVER_NAME field when any of the following events occur:

- A CONNECT statement successfully executes.
- A SET CONNECTION statement successfully executes.
- A DISCONNECT statement successfully terminates the current connection.
- A DISCONNECT ALL statement fails.

The SERVER_NAME field is not updated, however, after these events:

- A CONNECT statement fails.
- A DISCONNECT statement fails (but this does not include the DISCONNECT ALL statement).
- A SET CONNECTION statement fails.

The SERVER_NAME field retains the value set in the previous SQL statement. If any of the preceding conditions occur on the first SQL statement that executes, the SERVER_NAME field is blank.

The Contents of the SERVER_NAME Field

The SERVER_NAME field contains different information after you execute the following statements.

Executed Statement	SERVER_NAME Field Contents
CONNECT	Contains the name of the database server to which

	you connect or fail to connect Field is blank if you do not have a current connection or if you make a default connection.
SET CONNECTION	Contains the name of the database server to which you switch or fail to switch
DISCONNECT	Contains the name of the database server from which you disconnect or fail to disconnect If you disconnect and then you execute a DISCONNECT statement for a connection that is not current, the SERVER_NAME field remains unchanged.
DISCONNECT ALL	Sets the field to blank if the statement executes successfully If the statement fails, SERVER_NAME contains the names of all the database servers from which you did not disconnect. (This information does not mean that the connection still exists.)

If CONNECT succeeds, SERVER_NAME is set to one of the following values:
- The **INFORMIXSERVER** value (if the connection is to a default database server; that is, if CONNECT specified no database server)
- The name of the database server (if the connection is to a specific database server)

The DATABASE Statement: When you execute a DATABASE statement, the SERVER_NAME field contains the name of the database server on which the database resides.

Using the CONNECTION_NAME Keyword: Use the CONNECTION_NAME keyword to return the name of the connection specified in your CONNECT or SET CONNECTION statement.

When the CONNECTION_NAME Keyword Is Updated: GET DIAGNOSTICS updates the CONNECTION_NAME field when the following situations occur:
- A CONNECT statement successfully executes.
- A SET CONNECTION statement successfully executes.
- A DISCONNECT statement successfully executes at the current connection.

  GET DIAGNOSTICS fills the CONNECTION_NAME field with blanks because no current connection exists.
- A DISCONNECT ALL statement fails.

When the CONNECTION_NAME Is Not Updated: The CONNECTION_NAME field is not updated in the following cases:
- A CONNECT statement fails.
- A DISCONNECT statement fails (but this does not include the DISCONNECT ALL statement).
- A SET CONNECTION statement fails.

The CONNECTION_NAME field retains the value set in the previous SQL statement. If any of the preceding conditions occurs on the first SQL statement that executes, the CONNECTION_NAME field is blank.

An implicit connection has no name. After a DATABASE statement successfully creates an implicit connection, the CONNECTION_NAME field is blank.

The Contents of the CONNECTION_NAME Field

The CONNECTION_NAME field contains different information after you execute the following statements.

Executed Statement	CONNECTION_NAME Field Contents
CONNECT	Contains connection name specified in the CONNECT statement, to which you connect or fail to connect The field is blank for no current connection or a default connection.
SET CONNECTION	Contains the connection name specified in the CONNECT statement, to which you switch or fail to switch
DISCONNECT	Contains the connection name specified in the CONNECT statement, from which you disconnect or fail to disconnect If you disconnect, and then execute a DISCONNECT statement for a connection that is not current, the CONNECTION_NAME field remains unchanged.
DISCONNECT ALL	Contains no information if the statement executes successfully If the statement does not execute successfully, the CONNECTION_NAME field contains the names of all the connections specified in your CONNECT statement from which you did not disconnect. This information does not mean, however, that the connection still exists.

If CONNECT is successful, CONNECTION_NAME takes one of these values:

- The name of the database environment as specified in the CONNECT statement if the CONNECT statement does not include the AS clause
- The name of the connection (the identifier that was declared after the AS keyword) if the CONNECT statement includes the AS clause

Using GET DIAGNOSTICS for Error Checking

GET DIAGNOSTICS returns values from various fields in the diagnostics area. For each field in the diagnostics area that you wish to access, you must supply a host variable of a compatible data type.

The following example illustrates how to use the GET DIAGNOSTICS statement to display error information. The example shows an ESQL/C error display routine called **disp_sqlstate_err( )**:

```
void disp_sqlstate_err()
{
int j;
EXEC SQL BEGIN DECLARE SECTION;
    int exception_count;
    char overflow[2];
    int exception_num=1;
    char class_id[255];
    char subclass_id[255];
    char message[255];
    int messlen;
    char sqlstate_code[6];
    int i;
EXEC SQL END DECLARE SECTION;
    printf("---------------------------------");
    printf("-------------------------\n");
    printf("SQLSTATE: %s\n",SQLSTATE);
    printf("SQLCODE: %d\n", SQLCODE);
    printf("\n");
    EXEC SQL get diagnostics :exception_count = NUMBER,
        :overflow = MORE;
    printf("EXCEPTIONS:  Number=%d\t", exception_count);
    printf("More? %s\n", overflow);
    for (i = 1; i <= exception_count; i++)
    {
        EXEC SQL get diagnostics  exception :i
            :sqlstate_code = RETURNED_SQLSTATE,
            :class_id = CLASS_ORIGIN, :subclass_id = SUBCLASS_ORIGIN,
            :message = MESSAGE_TEXT, :messlen = MESSAGE_LENGTH;
        printf("- - - - - - - - - - - - - - - - - - - - -\n");
        printf("EXCEPTION %d: SQLSTATE=%s\n", i, sqlstate_code);
        message[messlen-1] ='\0';
        printf("MESSAGE TEXT: %s\n", message);
        j = stleng(class_id);
        while((class_id[j] == '\0') ||
              (class_id[j] == ' '))
            j--;
        class_id[j+1] = '\0';
        printf("CLASS ORIGIN: %s\n",class_id);
        j = stleng(subclass_id);
        while((subclass_id[j] == '\0') ||
              (subclass_id[j] == ' '))
            j--;
        subclass_id[j+1] = '\0';
        printf("SUBCLASS ORIGIN: %s\n",subclass_id);
    }
    printf("---------------------------------");
    printf("-------------------------\n");
}
```

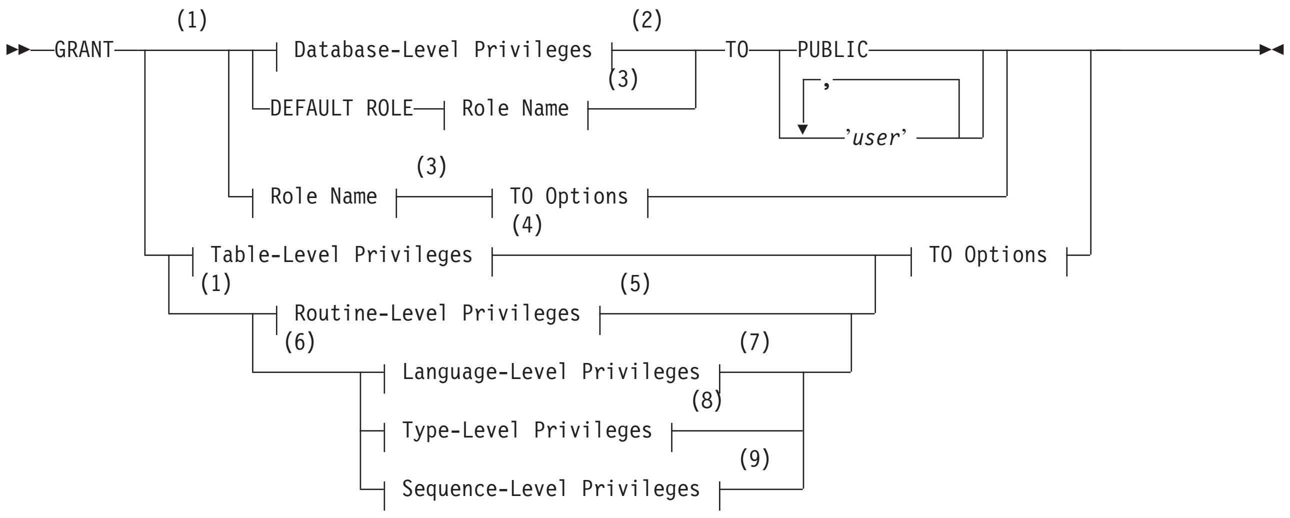
Related Information

For a task-oriented discussion of error handling and the SQLSTATE variable, see the *IBM Informix Guide to SQL: Tutorial*. For a discussion of concepts related to the GET DIAGNOSTICS statement and the SQLSTATE variable, see the *IBM Informix ESQL/C Programmer's Manual*.

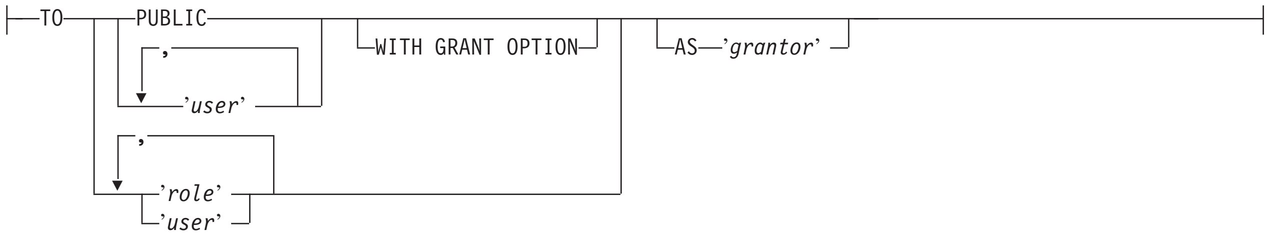
GRANT

The GRANT statement can assign privileges and roles to users of the database and to other roles.

Syntax



TO Options:



Notes:

1 Informix extension

2 See page 2-373

3 See page 2-383

4 See page 2-374

5 See page 2-380

6 Dynamic Server only

7 See page 2-382

8 See page 2-378

9 See page 2-382

Element	Description	Restrictions	Syntax
grantor	Authorization identifier of a user who can use REVOKE to cancel the effects of this GRANT statement. If AS clause is omitted, default is login name of user issuing this statement	Must be valid *user* name (not a *role* name)	Owner Name, p. 5-43
role	Name of an existing role to which you grant one or more access privileges, or to which you assign another role	Must exist in the database	Owner Name, p. 5-43
user	Authorization identifier of a user to whom you grant one or more access privileges, or to whom you assign a role	Same as for *grantor*	Owner Name, p. 5-43

Usage

The GRANT statement extends access privileges to other users that would normally accrue only to the DBA or to the creator of an object. Subsequent GRANT statements do not affect privileges that have already been granted to a user.

You can use the GRANT statement for operations like the following:

- Authorize others to use or administer a database that you create
- Allow others to view, alter, or drop a table, synonym, view or (for Dynamic Server only) a sequence object that you create
- Allow others to use a data type or the SPL language, or (for Dynamic Server only) to execute a user-defined routine (UDR) that you create
- Assign a role and its privileges to users, or to PUBLIC, or to another role
- Assign a default role to one or more users or to PUBLIC

You can grant privileges to a previously created role or to a built-in role. You can grant a role to PUBLIC, to individual users, or to another role.

If you enclose *grantor*, *role*, or *user* in quotation marks, the name is case sensitive and is stored exactly as you typed it. In an ANSI-compliant database, if you do not use quotation marks as delimiters, the name is stored in uppercase letters.

Privileges that you grant remain in effect until you cancel them with a REVOKE statement. Only the grantor of a privilege can revoke that privilege. The grantor is the person who issues the GRANT statement, unless the AS *grantor* clause transfers the right to revoke those privileges to another user.

Only the owner of an object or a user to whom privileges were explicitly granted with the WITH GRANT OPTION keywords can grant privileges on an object. Having DBA privileges is not sufficient. As DBA, however, you can grant a privilege on behalf of another user by using the AS *grantor* clause. For privileges on database objects whose owner is not a user recognized by the operating system (for example, user **informix**), the AS *grantor* clause is useful.

The keyword PUBLIC extends the specified privilege or role to all users. If you intend to restrict privileges that PUBLIC already holds to only a subset of users, you must first revoke those privileges from PUBLIC.

When database-level privileges conflict with table-level privileges, the more restrictive privileges take precedence.

To grant privileges on one or more fragments of a table that has been fragmented by expression, see "GRANT FRAGMENT" on page 2-388.

Database-Level Privileges

Database-Level Privileges:

```
├──┬─CONNECT──┬────────────────────────────────────────────────────┤
   ├─RESOURCE─┤
   └─DBA──────┘
```

When you create a database with the CREATE DATABASE statement, you are the owner and automatically receive all database-level privileges.

The database remains inaccessible to any other users until you, as DBA, grant database privileges to them.

As database owner, you also receive table-level privileges on all tables in the database automatically. For more information about table-level privileges, see "Table-Level Privileges" on page 2-374.

Recommendation: Only user **informix** can modify system catalog tables directly. Except as noted specifically in your database server documentation, however, do not use DML statements to insert, delete, or update rows of system catalog tables directly, because modifying data in these tables can destroy the integrity of the database.

Database access levels are, from lowest to highest, Connect, Resource, and DBA. Use the corresponding keyword to grant a level of access privilege.

Privilege	**Effect**
CONNECT	Lets you query and modify data You can modify the database schema if you own the database object that you intend to modify. Any user with the Connect privilege can perform the following operations: • Connect to the database with the CONNECT statement or another connection statement • Execute SELECT, INSERT, UPDATE, and DELETE statements, provided the user has the necessary table-level privileges • Create views, provided the user has the Select privilege on the underlying tables • Create synonyms • Create temporary tables and create indexes on the temporary tables • Alter or drop a table or an index, provided the user owns the table or index (or has Alter, Index, or References privileges on the table) • Grant privileges on a table or view, provided the user owns the table (or was given privileges on the table with the WITH GRANT OPTION keywords)

Privilege	Effect
RESOURCE	Lets you extend the structure of the database In addition to the capabilities of the Connect privilege, the holder of the Resource privilege can perform the following functions: • Create new tables • Create new indexes • Create new UDRs • Create new data types
DBA	Has all the capabilities of the Resource privilege and can perform the following additional operations: • Grant any database-level privilege, including the DBA privilege, to another user • Grant any table-level privilege to another user or to a role • Grant a role to a user or to another role • Revoke a privilege whose grantor you specify as the *revoker* in the AS clause of the REVOKE statement • Restrict the Execute privilege to DBAs when registering a UDR • Execute the SET SESSION AUTHORIZATION statement • Create any database object • Create tables, views, and indexes, designating another user as owner of these objects • Alter, drop, or rename database objects, regardless of who owns them • Execute the DROP DISTRIBUTIONS option of the UPDATE STATISTICS statement 3 • Execute DROP DATABASE and RENAME DATABASE statements

User **informix** has the privilege required to alter the tables of the system catalog, including the **systables** table.

The following example uses the PUBLIC keyword to grant the Connect privilege on the currently active database to all users:

```
GRANT CONNECT TO PUBLIC
```

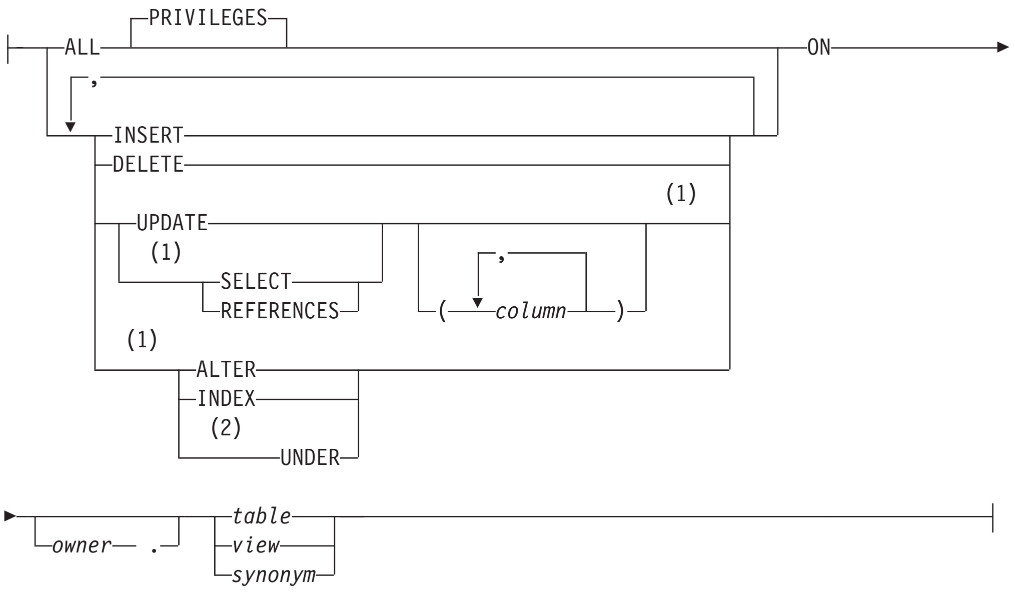
You cannot grant database-level privileges to a role. Only individual users or PUBLIC can hold database-level privileges.

Table-Level Privileges

When you create a table with the CREATE TABLE statement, you are the table owner and automatically receive all table-level privileges. You cannot transfer ownership to another user, but you can grant table-level privileges to another user or to a role. (See, however, “RENAME TABLE” on page 2-454, which can change both the name and the ownership of a table.)

A user with the database-level DBA privilege automatically receives all table-level privileges on every table in that database.

Table-Level Privileges:



Notes:

1 Informix extension

2 Dynamic Server only

Element	Description	Restrictions	Syntax
column	Column on which the References, Select, or Update privilege is granted. Default scope is all columns of *table*, *view*, or *synonym*.	Must be a column of the *table*, *view*, or *synonym*	Identifier, p. 5-22
owner	Name of the user who owns the *table*, *view*, or *synonym*	Must be a valid authorization identifier	Owner Name, p. 5-43
synonym, *table*, *view*	Synonym, table, or view on which privileges are granted. (This can be qualified by *owner*. name.)	Must exist in the current database	Identifier, p. 5-22

The GRANT statement can list one or more of the following keywords to specify the table privileges that you grant to the same users or roles.

Privilege	Effect
INSERT	Lets you insert rows
DELETE	Lets you delete rows
SELECT	Lets you access any column in SELECT statements. You can restrict the Select privilege to one or more columns by listing the columns.
UPDATE	Lets you access any column in UPDATE statements. You can restrict the Update privilege to one or more columns by listing the columns.
REFERENCES	Lets you define referential constraints on columns. You must have the Resource privilege to take advantage of the References privilege. (You can add, however, a referential constraint during an ALTER TABLE statement without holding the Resource privilege on the database.) You need only the References privilege to indicate cascading deletes. You do not need the Delete privilege to place cascading deletes on a table. You can restrict the References privilege to one or more columns by listing the columns.
INDEX	Lets you create permanent indexes. You must have the Resource privilege to use the Index privilege. (Any user with the Connect privilege can create an index on temporary tables.)
ALTER	Lets you add or delete columns, modify column data types, add or delete constraints, change the locking mode of the table from PAGE to ROW, or add or drop a corresponding ROW data type for your table. It also lets you enable or disable indexes, constraints and triggers, as described in "SET Database Object Mode" on page 2-539. You must have the Resource privilege to use the Alter privilege. In addition, you also need the Usage privilege for any user-defined data type affected by the ALTER TABLE statement.
UNDER	Lets you create subtables under a typed table (for IDS only)
ALL	Provides all privileges listed above. The PRIVILEGES keyword is optional.

You can narrow the scope of a Select, Update, or References privilege by specifying the columns to which the privilege applies.

Specify the keyword PUBLIC as *user* if you intend the GRANT statement to apply to all users.

Some simple examples that follow illustrate how to give table-level privileges with the GRANT statement.

The following statement grants the privilege to delete and select values in any column in the table **customer** to users **mary** and **john**. It also grants the Update privilege, but only for columns **customer_num**, **fname**, and **lname**:

```
GRANT DELETE, SELECT, UPDATE (customer_num, fname, lname)
   ON customer TO mary, john;
```

To grant the same privileges as those above to all authorized users, use the keyword PUBLIC as the following example shows:

```
GRANT DELETE, SELECT, UPDATE (customer_num, fname, lname)
   ON customer TO PUBLIC;
```

For a Dynamic Server database, suppose a user named **mary** has created a typed table named **tab1**. By default, only user **mary** can create subtables under the **tab1** table. If **mary** wants to grant the ability to create subtables under the **tab1** table to a user named **john**, **mary** must enter the following GRANT statement:

```
GRANT UNDER ON tab1 TO john
```

After receiving the Under privilege on table **tab1**, user **john** can create one or more subtables under **tab1**.

Effect of the ALL Keyword

The ALL keyword grants all possible table-level privileges to the specified user. If any or all of the table-level privileges do not exist for the grantor, the GRANT statement with the ALL keyword succeeds (in the sense of SQLCODE being set to zero, even if the possible privileges are an empty set for the grantor on the table). In this case, however, the following SQLSTATE warning is returned:

```
01007 - Privilege not granted.
```

For example, assume that user **ted** has the Select and Insert privileges on the **customer** table with the authority to grant those privileges to other users.

User **ted** wants to grant all table-level privileges to user **tania**. So user **ted** issues the following GRANT statement:

```
GRANT ALL ON customer TO tania;
```

This statement executes successfully but returns SQLSTATE code `01007` for the following reasons:

- The statement succeeds in granting the Select and Insert privileges to user **tania** because user **ted** has those privileges and the right to grant those privileges to other users.
- The other privileges implied by the ALL keyword were not grantable by user **ted** and, therefore, were not granted to user **tania**.

With Dynamic Server, if you grant all table-level privileges with the ALL keyword, the privileges includes the Under privilege only if the table is a typed table. The grant of ALL privileges does not include the Under privilege if the table is not based on a ROW type.

If the table owner grants ALL privileges on a traditional relational table and later changes that table to a typed table, the table owner must explicitly grant the Under privilege to allow other users to create subtables under it.

Table Reference

You grant table-level privileges directly by specifying the name or an existing synonym of a table or of a view, which you can qualify with the *owner* name.

Table Reference:

```
|──┬──────────┬──┬─view────┬──────────────────────────────────────|
   └─owner── .┘  ├─table───┤
                 └─synonym─┘
```

Element	Description	Restrictions	Syntax
owner	Name of the user who owns the *table*, *view*, or *synonym*	Must be a valid authorization identifier	Owner Name, p. 5-43
synonym, *table*, *view*	Synonym, table, or view on which privileges are granted	The *table*, *view*, or *synonym* must exist in the database	Database Object Name, p. 5-17

The object on which you grant privileges must reside in the current database.

In an ANSI-compliant database, if *owner* is not enclosed between quotation marks, the database stores the owner name in lowercase letters.

Privileges on Tables and Synonyms

In an ANSI-compliant database, if you create a table, only you, its owner, have any table-level privileges until you explicitly grant them to others.

When you create a table in a database that is *not* ANSI compliant, however, PUBLIC receives Select, Insert, Delete, Under, and Update privileges for that table and its synonyms. (The **NODEFDAC** environment variable, when set to `yes`, prevents PUBLIC from automatically receiving these table-level privileges.)

To allow access only to some users, or only on some columns in a database that is not ANSI compliant, you must explicitly revoke the privileges that PUBLIC receives by default, and then grant only the privileges that you intend. For example, this series of statements grants privileges on the entire **customer** table to users **john** and **mary**, but restricts PUBLIC access to the Select privilege on only four of the columns in that table:

```
REVOKE ALL ON customer FROM PUBLIC;
GRANT ALL ON customer TO john, mary;
GRANT SELECT (fname, lname, company, city) ON customer TO PUBLIC;
```

Privileges on a View

You must have at least the Select privilege on a table or columns to create a view on that table. For views that reference only tables in the current database, if the owner of a view loses the Select privilege on any base table underlying the view, the view is dropped.

You have the same privileges for the view that you have for the table or tables contributing data to the view. For example, if you create a view from a table to which you have only Select privileges, you can select data from your view but you cannot delete or update data. For information on how to create a view, see “CREATE VIEW” on page 2-247.

When you create a view, PUBLIC does not automatically receive any privileges for a view that you create. Only you have access to table data through that view. Even users who have privileges on the base table of the view do not automatically receive privileges for the view.

You can grant (or revoke) privileges on a view only if you are the owner of the underlying base tables, or if you received these privileges on the base table with the right to grant them (specified by the WITH GRANT OPTION keywords). You must explicitly grant those privileges within your authority, because PUBLIC does not automatically receive any privileges on a view when it is created.

The creator of a view can explicitly grant Select, Insert, Delete, and Update privileges for the view to other users or to a role. You cannot grant Index, Alter, Under, or References privileges on a view (nor can you specify the ALL keyword for views, because ALL confers Index, References, and Alter privileges).

Type-Level Privileges (IDS)

You can specify two privileges on data types that are not built-in data types:

- The Usage privilege on a user-defined data type

- The Under privilege on a named ROW type

Type-Level Privileges:

```
├──┬─USAGE ON TYPE──type_name──────┬──────────────────────────────────────┤
   └─UNDER ON TYPE──row_type_name──┘
```

Element	Description	Restrictions	Syntax
row_type_name	Named ROW type on which the Under privilege is granted	Named ROW data type must exist	Identifier, p. 5-22; Data Type, p. 4-18
type_name	User-defined type on which the Usage privilege is granted	User-defined data type must exist.	Identifier, p. 5-22; Data Type, p. 4-18

To see what privileges exist on user-defined data types, check the **sysxtdtypes** system catalog table for the *owner* of each UDT, and the **sysxtdtypeauth** system catalog table for any other users or roles that hold privileges on UDTs. See the *IBM Informix Guide to SQL: Reference* for information on the system catalog tables.

For all the *built-in data types*, however, these access privileges are automatically available to PUBLIC and cannot be revoked.

USAGE Privilege

You own any user-defined data type (UDT) that you create. As owner, you automatically receive the Usage privilege on that data type and can grant the Usage privilege to others so that they can reference the type name or data of that type in SQL statements. DBAs can also grant the Usage privilege for UDTs.

If you grant Usage privilege to a user (or to a role) that has Alter privileges, that grantee can add a column to a table that contains values of your UDT.

Without privileges from the GRANT statement, any user can issue SQL statements that reference built-in data types. In contrast, a user must receive an explicit Usage privilege from a GRANT statement to use a distinct data type, even if the distinct type is based on a built-in type.

For more information about user-defined types, see “CREATE OPAQUE TYPE” on page 2-136, “CREATE DISTINCT TYPE” on page 2-93, the discussion of data types in the *IBM Informix Guide to SQL: Reference* and the *IBM Informix Database Design and Implementation Guide*.

UNDER Privilege

You own any named ROW type that you create. If you want other users to be able to create subtypes under this named ROW type, you must grant to these users the Under privilege on your named ROW type.

For example, suppose that you create a ROW type named **rtype1**:

```
CREATE ROW TYPE rtype1 (cola INT, colb INT)
```

If you want another user named **kathy** to be able to create a subtype under this named ROW type, you must grant the Under privilege on this named ROW type to user **kathy**:

```
GRANT UNDER ON ROW TYPE rtype1 TO kathy
```

Now user **kathy** can create another ROW type under the **rtype1** ROW type, even though **kathy** is not the owner of the **rtype1** ROW type:

```
CREATE ROW TYPE rtype2 (colc INT, cold INT) UNDER rtype1
```

For more about named ROW types, see “CREATE ROW TYPE” on page 2-158, and the discussion of data types in the *IBM Informix Guide to SQL: Reference* and the *IBM Informix Database Design and Implementation Guide*.

Routine-Level Privileges

When you create a user-defined routine (UDR), you become owner of the UDR and you automatically receive the Execute privilege on that UDR.

The Execute privilege allows you to invoke the UDR with an EXECUTE FUNCTION or EXECUTE PROCEDURE statement, whichever is appropriate, or with a CALL statement in an SPL routine. The Execute privilege also allows you to use a user-defined function in an expression, as in this example:

```
SELECT * FROM table WHERE in_stock(partnum) < 20
```

Routine-Level Privileges:

```
├──GRANT ON──────────────────────────────────────────────────────────────►

►──┬─SPL_routine─────────────────────────────────────────────────┬────┤
   │ (1)                                                          │
   ├─────────┬─PROCEDURE─┬──routine──(──┬───────────────────────┬──)─┤
   │         ├─FUNCTION──┤              │                 (2)    │    │
   │         └─ROUTINE───┘              └─┤ Routine Parameter List ├─┘    │
   │                                           (3)                       │
   └─SPECIFIC──┬─ROUTINE───┬─┤ Specific Name ├────────────────────────────┘
               ├─FUNCTION──┤
               └─PROCEDURE─┘
```

Notes:

1 Dynamic Server only

2 See page 5-61

3 See page 5-68

Element	Description	Restrictions	Syntax
routine	A user-defined routine	Must exist	Database Object Name, p. 5-17
SPL_routine	An SPL routine	Must be unique in the database	Database Object Name, p. 5-17

Whether you must grant the Execute privilege explicitly depends on the following conditions:

- If you have DBA-level privileges, you can use the DBA keyword of CREATE FUNCTION or CREATE PROCEDURE to restrict the default Execute privilege to users with the DBA privilege. You must explicitly grant the Execute privilege on that UDR to users who do not have the DBA privilege.
- If you have the Resource database-level privilege but not the DBA privilege, you cannot use the DBA keyword when you create a UDR:
  - When you create a UDR in a database that is *not* ANSI compliant, PUBLIC can execute that UDR. You do not need to issue a GRANT statement for other users to receive the Execute privilege.

  - Setting the **NODEFDAC** environment variable to `yes` prevents PUBLIC from executing the UDR until you explicitly grant the Execute privilege.
- In an ANSI-compliant database, the creator of a UDR must explicitly grant the Execute privilege on the UDR for other users to be able to execute it.

In Dynamic Server, if two or more UDRs have the same name, use a keyword from this list to specify which of those UDRs a user list can execute.

Keyword	**UDR that the User Can Execute**
SPECIFIC	The UDR identified by *specific name*
FUNCTION	Any function with the specified *routine name* (and parameter types that match *routine parameter list,* if specified)
PROCEDURE	Any procedure with the specified *routine name (*and parameter types that match *routine parameter list,* if specified)
ROUTINE	Functions or procedures with the specified *routine name (*and parameter types that match *routine parameter list,* if specified)

If both a user-defined function and a user-defined procedure of Dynamic Server have the same name and the same list of parameter data types, you can grant the Execute privilege to both with the keyword ROUTINE.

To limit the Execute privilege to one routine among several that have the same identifier, use the FUNCTION, PROCEDURE, or SPECIFIC keyword.

To limit the Execute privilege to a UDR that accepts certain data types as arguments, include the routine parameter list or use the SPECIFIC keyword to introduce the specific name of a UDR.

In Dynamic Server, if an external function has a negator function, you must grant the Execute privilege on both the external function and its negator function before users can execute the external function.

A user must have the Usage privilege on a language to register a user-defined routine of Dynamic Server that is written in that language.

Langage-Level Privileges (IDS)

Dynamic Server also supports *language-level privileges*, which specify the programming languages of UDRs that users who have been granted Usage privileges for a given language can register in the database. This is the syntax of the USAGE ON LANGUAGE clause for specifying language-level privileges:

Language-Level Privileges:

```
|——USAGE ON LANGUAGE——SPL————————————————————————————————————————————————————|
```

In this release of Dynamic Server, only the SPL keyword is supported in the USAGE ON LANGUAGE clause.

When a user executes the CREATE FUNCTION or CREATE PROCEDURE statement to register a UDR that is written in SPL, the database server verifies that the user has the Usage privilege on the language in which the UDR is written. (In this release of Dynamic Server, the C language and the Java language do not require Usage privilege.)

For information on other privileges that these statements require, see "CREATE FUNCTION" on page 2-107 and "CREATE PROCEDURE" on page 2-145.

Usage Privilege in Stored Procedure Language

The Usage privilege on SPL is granted to PUBLIC by default. Only user **informix**, the DBA, or a user who was granted the Usage privilege WITH GRANT OPTION can grant the Usage privilege on SPL to another user.

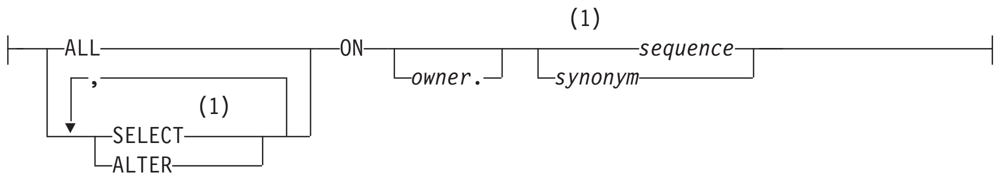
In the following example, assume that the default Usage privilege on SPL was revoked from PUBLIC and the DBA wants to grant the Usage privilege on SPL to the role named **developers**:

```
GRANT USAGE ON LANGUAGE SPL TO developers
```

Sequence-Level Privileges (IDS)

Although Dynamic Server implements sequence objects as tables, only a subset of table-level privileges (page 2-374) can be granted on a sequence. You can grant the Select or Alter privilege (or both) on a sequence:

Sequence-Level Privileges:



Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
owner	Owner of sequence (or owner of *synonym*)	Must be the owner	Owner Name, p. 5-43
sequence	Sequence on which to grant privileges	Must exist	Identifier, p. 5-22
synonym	Synonym for a sequence object	Must exist	Identifier, p. 5-22

The sequence object must exist in the current database. You can qualify the *sequence* or *synonym* identifier with a valid *owner* name, but the name of a remote *database* (or *database@server*) is not valid as a qualifier. You can include the WITH GRANT OPTION keywords when you grant ALTER, SELECT, or ALL to a user or to PUBLIC (but not to a role) as privileges on a sequence object.

Alter Privilege

You can grant the Alter privilege on a sequence to another user or to a role. The Alter privilege enables a specified user or role to modify the definition of a sequence with the ALTER SEQUENCE statement or to rename the sequence with the RENAME SEQUENCE statement.

Select Privilege

You can grant the Select privilege on a sequence to another user or to a role. The Select privilege enables a specified user or role to use *sequence*.CURRVAL and *sequence*.NEXTVAL expressions in SQL statements to read and to increment (respectively) the value of a sequence.

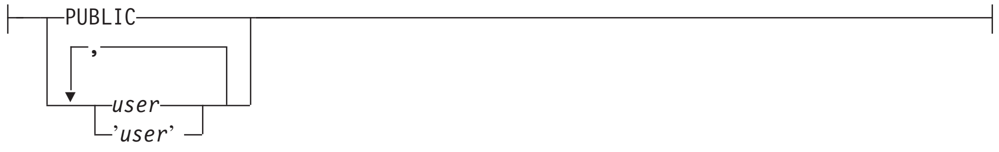
ALL Keyword

You can specify the ALL keyword to grant both Alter and Select privileges on a sequence object to another user or to a role, or to a list of users or roles.

The User List

You can grant privileges to an individual user or to a list of users. You can also specify the PUBLIC keyword to grant privileges to all users.

User List:



Element	Description	Restrictions	Syntax
user	Login name of a user to whom you are granting privilege or granting a role	Must be a valid authorization identifier	Owner Name, p. 5-43

The following example grants the Insert table-level privilege on **table1** to the user **mary** in a database that is not ANSI-compliant:

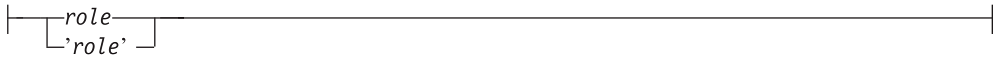
```
GRANT INSERT ON table1 TO mary;
```

In an ANSI-compliant database, if you do not include quotes as delimiters around *user*, the name of the user is stored in uppercase letters.

Role Name

You can use the GRANT statement to associate a list of one or more users (or all users, using the PUBLIC keyword) with a *role* name that can describe what they do. After you declare and grant a role, access privileges that you grant to that role are thereby granted to all users who are currently associated with that role.

Role Name:



Element	Description	Restrictions	Syntax
role	Role that is granted, or to which a privilege or another role is granted	Must exist. If enclosed between quotation marks, *role* is case sensitive.	Owner Name, p. 5-43

You can also grant an existing role to another role. This action gives whatever privileges the granted role possesses to all users who have the receiving role.

Granting a Role to a User or to Another Role

You must register a role in the database before the role can be used in a GRANT statement. For more information, see "CREATE ROLE" on page 2-155.

A DBA has the authority to grant a new role to another user. If a user receives a role WITH GRANT OPTION, that user can grant the role to other users or to another role. Users keep a role that was granted to them until the REVOKE statement breaks the association between their login names and the role name.

Important: The CREATE ROLE and GRANT statements do not activate the role. A non-default role has no effect until SET ROLE enables it. The grantor or the grantee of a role can issue the SET ROLE statement.

The following example shows the actions required to grant and activate the role **payables** to a group of employees who perform account payable functions. First the DBA creates role **payables**, then grants it to **maryf**.

```
CREATE ROLE payables;
GRANT payables TO maryf WITH GRANT OPTION;
```

The DBA or **maryf** can activate the role with the following statement:

```
SET ROLE payables;
```

User **maryf** has the WITH GRANT OPTION authorization to grant **payables** to other employees who pay accounts.

```
GRANT payables TO charly, gene, marvin, raoul;
```

If you grant privileges for one role to another role, the recipient role has the combined set of privileges that have been granted to both roles. The following example grants the role **petty_cash** to the role **payables**:

```
CREATE ROLE petty_cash;
SET ROLE petty_cash;
GRANT petty_cash TO payables;
```

After all of these statements excute successfully, if user **raoul** uses the SET ROLE statement to make **payables** his current role, then (aside from the effects of any REVOKE operations) he holds the following combined set of access privileges:

- The privileges granted to the **payables** role
- The privileges granted to the **petty_cash** role
- The privileges granted individually to **raoul**
- The privileges granted to PUBLIC

If you attempt to grant a role to yourself, either directly or indirectly, the database server generates an error.

The database server also generates an error if you include the WITH GRANT OPTION keywords in a GRANT statement that assigns a role to another role.

Granting a Privilege to a Role

You can grant table-level and routine-level privileges to a role if you have the authority to grant these same privileges to login names or to PUBLIC. A role cannot hold database-level privileges.

In Dynamic Server, you can also grant type-level privileges to a role.

The syntax is more restricted for granting privileges to a role than to a user:

- You can specify the AS *grantor* clause only in Dynamic Server.

  In this way, whoever has the role can revoke these same privileges. For more information, see "AS grantor Clause" on page 2-387.
- You cannot include the WITH GRANT OPTION clause.

  A role cannot, in turn, grant the same access privileges to another user.

This example grants Insert privilege on the **supplier** table to the role **payables**:

```
GRANT INSERT ON supplier TO payables;
```

Anyone who has been granted the **payables** role, and who successfully activates it by issuing the SET ROLE statement, can now insert rows into **supplier**.

Granting a Default Role

The DBA or the owner of the database (by default, user **informix**) can define a *default role* for one or more users or for PUBLIC with the GRANT DEFAULT ROLE statement. A default role is activated when the user connects to the database. The SET ROLE statement is not required to activate a default role.

Default roles are useful if users access databases through client applications that cannot modify access privileges nor set roles.

A default role can specify a set of access privileges to all the users who are assigned that role, as in the following example:

```
CREATE ROLE accounting
GRANT ALTER, INSERT, SELECT ON stock TO accounting
GRANT DEFAULT ROLE accounting TO mary, asok, vlad;
```

The last statement provides users **mary**, **asok**, and **vlad** with **accounting** as their default role. If any of these users connects to a database, that user activates whatever privileges the **accounting** role holds, in addition to any privileges that the user already possesses as an individual or as PUBLIC.

The role must already exist and the user must have the access privileges to set the role. If the role has not previously been granted to a user, it is granted as part of setting the default role.

If no default role is defined for a user nor for PUBLIC, then no role is set, and the existing privileges of the user are in effect.

The following example shows how the default role can be assigned to all users:

```
DATABASE hrdb;
CREATE ROLE emprole;
GRANT CONNECT TO PUBLIC;
GRANT SELECT ON emptab TO emprole;
GRANT emprole TO PUBLIC;
GRANT DEFAULT ROLE emprole TO PUBLIC;
```

Note: With Extended Parallel Server, using GRANT DEFAULT ROLE is an alternative to issuing the SET ROLE statement in the **sysdbopen( )** procedure. Default roles defined using the **sysdbopen( )** procedure, however, have precedence when a user establishes a connection.

Changing the default role for a user or for PUBLIC only affects new database connections. Existing connection continue to run under currently assigned roles. If one default role was granted to *user*, and another default role was granted to PUBLIC, the default role granted to *user* takes precedence at connection time.

A default role cannot be assigned to another role. Because roles are not defined across databases, the default role must be assigned for each database. No options besides the *user-list* are valid after the TO keyword in the GRANT DEFAULT ROLE statement. The database server issues an error if you attempt to include the AS *grantor* clause or the WITH GRANT OPTION clause.

Granting the EXTEND Role (IDS)

3 The Database Server Administrator (DBSA), by default user **informix**, can grant the built-in EXTEND role to one or more users or to PUBLIC with the GRANT EXTEND TO *user-list* statement. If the IFX_EXTEND_ROLE configuration parameter is set to ON, only users who hold the EXTEND role can create or drop UDRs that are written in C or Java, external languages that can support shared libraries. The SET ROLE statement is not required for the EXTEND role to have this effect; it is sufficient for a user to hold the EXTEND role without using SET ROLE to enable it. The following example grants this role to user **max**:

```
GRANT EXTEND TO 'max'
```

This statement enables user **max** to create or drop UDRs, without requiring **max** to issued the SET ROLE EXTEND statement. (Here the quotation marks preserve the lowercase letters in the authorization identifier **max**.)

In databases for which this security feature is not needed, the DBSA can disable this restriction on who can create or drop external UDRs by setting the IFX_EXTEND_ROLE configuration parameter to OFF in the ONCONFIG file. When IFX_EXTEND_ROLE is set to OFF, any user who holds the Resource privilege can create or drop external UDRs. See "Database-Level Privileges" on page 2-373 for information about the Resource privileges.

WITH GRANT OPTION Keywords

The WITH GRANT OPTION keywords convey the privilege or role to *user* with the right to grant the same privileges or role to other users. You create a chain of privileges that begins with you and extends to *user* as well as to whomever *user* subsequently conveys the right to grant privileges. If you include WITH GRANT OPTION, you can no longer control the dissemination of privileges.

If you revoke from *user* the privilege that you granted using the WITH GRANT OPTION keyword, you sever the chain of privileges. That is, when you revoke privileges from *user*, you automatically revoke the privileges of all users who received privileges from *user* or from the chain that *user* created (unless *user,* or the users who received privileges from *user*, were granted the same set of privileges by someone else).

The following examples illustrate this situation. You, as the owner of the table **items**, issue the following statements to grant access to user **mary**:

```
REVOKE ALL ON items FROM PUBLIC;
GRANT SELECT, UPDATE ON items TO mary WITH GRANT OPTION
```

User **mary** uses her privilege to grant users **cathy** and **paul** access to the table:

```
GRANT SELECT, UPDATE ON items TO cathy;
GRANT SELECT ON items TO paul
```

Later you revoke the access privileges for user **mary** on the **items** table:

```
REVOKE SELECT, UPDATE ON items FROM mary
```

This single statement effectively revokes all privileges on the **items** table from users **mary**, **cathy**, and **paul**. If you want to create a chain of privileges with another user as the source of the privilege, use the AS *grantor* clause.

The WITH GRANT OPTION keywords are valid only for users. They are not valid when you use GRANT to convey privileges or another role to a role.

AS grantor Clause

When you grant privileges, by default, you are the one who can revoke those privileges. The AS *grantor* clause lets you establish another user as the source of the privileges you are granting. When you use this clause, the login provided in the AS *grantor* clause replaces your login in the appropriate system catalog table. You can use this clause only if you have the DBA privilege on the database.

After you use this clause, only the specified *grantor* can REVOKE the effects of the current GRANT. Even a DBA cannot revoke a privilege unless that DBA is listed in the system catalog table as the source who granted the privilege.

The following example illustrates this situation. You are the DBA and you grant all privileges on the **items** table to user **tom** with the right to grant all privileges:

```
REVOKE ALL ON items FROM PUBLIC;
GRANT ALL ON items TO tom WITH GRANT OPTION
```

The following example illustrates a different situation. You also grant Select and Update privileges to user **jim**, but you specify that the grant is made as user **tom**. (The records of the database server show that user **tom** is the grantor of the grant in the **systabauth** system catalog table, rather than you.)

```
GRANT SELECT, UPDATE ON items TO jim AS tom
```

Later, you decide to revoke privileges on the **items** table from user **tom**, so you issue the following statement:

```
REVOKE ALL ON items FROM tom
```

If instead, however, you try to revoke privileges from user **jim** with a similar statement, the database server returns an error, as the next example shows:

```
REVOKE SELECT, UPDATE ON items FROM jim

580: Cannot revoke permission.
```

You receive an error because the database server record shows the original grantor as user **tom**, and you cannot revoke the privilege. Although you are the DBA, you cannot revoke a privilege that another user granted.

In Extended Parallel Server, the AS *grantor* clause is not valid in the GRANT ROLE statement or the GRANT DEFAULT ROLE statement.

In Dynamic Server, the AS *grantor* clause is not valid in the GRANT DEFAULT ROLE statement.

Related Information

Related statements: GRANT FRAGMENT, REVOKE, and REVOKE FRAGMENT

For information about roles, see the following statements: CREATE ROLE, DROP ROLE, and SET ROLE.

In the *IBM Informix Database Design and Implementation Guide*, see the discussion of privileges.

For a discussion of how to embed GRANT and REVOKE statements in programs, see the *IBM Informix Guide to SQL: Tutorial*.

GRANT FRAGMENT

Use the GRANT FRAGMENT statement to grant to one or more users or roles any or all of the Insert, Update, and Delete access privileges on individual fragments of a table that has been fragmented by expression.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
                                                 (1)
>>--GRANT FRAGMENT--| Fragment-Level Privileges |------ON--table---------------->


      .-,--------.
      V          |
>--(----fragment----)------------------------------------------------------------>

>--TO---+--PUBLIC-------------+--+--------------------+--+-----------------+-----><
        |  |  .-,--------.    |  |  '-WITH GRANT OPTION-'  '-AS--'grantor'--'
        |  '--V--'user'--+----'  |
        |   .-,--------.         |
        |   V          |         |
        '----'role'----+---------'
```

Notes:

1 See page 2-388

Element	Description	Restrictions	Syntax
3 *fragment*	Partition or dbspace that stores a fragment of table	Must exist; cannot be delimited by quotes	Identifier, p. 5-22
grantor	User who can revoke the privileges	Same as for *user*	Owner Name, p. 5-43
role	Role to receive privileges	Must exist in **sysusers**	Owner Name, p. 5-43
table	Fragmented table on which fragment privileges are granted	Must exist and must be fragmented by expression	Database Object Name, p. 5-17
user	User to whom privileges are to be granted	Must be a valid authorization identifier	Owner Name, p. 5-43

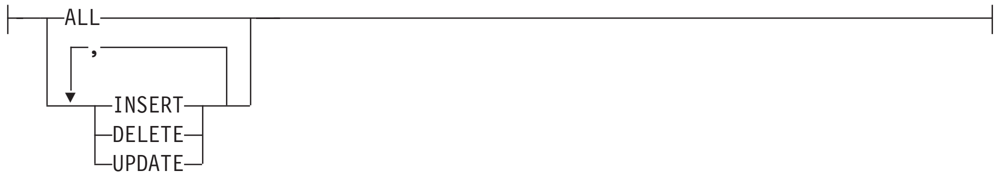
Usage

The GRANT FRAGMENT statement is a special case of the GRANT statement for assigning privileges on table fragments. GRANT FRAGMENT is valid only for tables that are fragmented according to an expression-based distribution scheme. For an explanation of this type of fragmentation strategy, see “Expression Distribution Scheme” on page 2-18.

Fragment-Level Privileges

The keyword or keywords that follow the FRAGMENT keyword specify *fragment-level privileges*, which are a logical subset of table-level privileges:

Fragment-Level Privileges:



These keywords correspond to the following fragment-level privileges:

Keyword	**Effect on Grantee**
ALL	Receives Insert, Delete, and Update privileges on the fragment
INSERT	Can insert rows into the fragment
DELETE	Can delete rows from the fragment
UPDATE	Can update rows in the fragment and in any columns.

Definition of Fragment-Level Authorization

In an ANSI-compliant database, the owner implicitly receives all table-level privileges on a newly created table, but no other users receive privileges.

A user who has table privileges on a fragmented table has the privileges implicitly on all fragments of the table. These privileges are not recorded in the **sysfragauth** system catalog table.

When a fragmented table is created in a database that is not ANSI compliant, the table owner implicitly receives all table-level privileges on the table, and other users (that is, PUBLIC) receive all fragment-level privileges by default. The privileges granted to PUBLIC are explicitly recorded in the **systabauth** system catalog table.

If you use the REVOKE statement to withdraw existing table-level privileges, however, you can then use the GRANT FRAGMENT statement to restore specified table-level privileges to users, roles, or PUBLIC on some subset of the fragments.

Whether or not the database is ANSI compliant, you can use the GRANT FRAGMENT statement to grant explicit Insert, Update, and Delete privileges on one or more fragments of a table that is fragmented by expression. The privileges that the GRANT FRAGMENT statement grants are explicitly recorded in the **sysfragauth** system catalog table.

The Insert, Update, and Delete privileges that are conferred on table fragments by the GRANT FRAGMENT statement are collectively known as *fragment-level privileges* or *fragment-level authority*.

Effect of Fragment-Level Authorization in Statement Validation

Fragment-level privilege enables users to execute INSERT, DELETE, and UPDATE data manipulation language (DML) statements on table fragments, even if the grantees lack Insert, Update, and Delete privileges on the table as a whole. Users who lack the table privileges can insert, delete, and update rows in authorized fragments because of the algorithm by which the database server validates DML statements. This algorithm consists of the following checks:

1. When a user executes an INSERT, DELETE, or UPDATE statement, the database server first checks whether the user has the table privileges necessary for the operation attempted. If the table privileges exist, the statement continues processing.
2. If the table privileges do not exist, the database server checks whether the table is fragmented by expression. If the table is not fragmented by expression, the database server returns an error to the user. This error indicates that the user does not have the privilege to execute the command.
3. If the table is fragmented by expression, the database server checks whether the user holds the fragment privileges necessary for the attempted operation. If the user holds the required fragment privileges, the database server continues to process the statement. If the fragment privileges do not exist, the database server returns an error to the user. This error indicates that the user does not have the privilege to execute the statement.

Duration of Fragment-Level Privileges

The duration of fragment-level privileges is tied to the duration of the fragmentation strategy for the table as a whole.

If you drop a fragmentation strategy by means of a DROP TABLE statement or by the INIT, DROP, or DETACH clauses of an ALTER FRAGMENT statement, you also drop any privileges that exist for the affected fragments. Similarly, if you drop a fragment or partition of a table, you also drop any privileges that exist for the fragment.

Tables that are created as a result of a DETACH or INIT clause of an ALTER FRAGMENT statement do not keep the privileges that the former fragment or fragments had when they were part of the fragmented table. Instead, such tables assume the default table privileges.

If a table on which fragment privileges are defined is changed to a table with a round-robin strategy or some other expression strategy, the fragment privileges are also dropped, and the table assumes the default table privileges.

Specifying Fragments

You can specify one fragment or a comma-separated list of fragments, with the name (or list of names) enclosed between parentheses that immediately follow the ON *table* specification. You cannot use quotation marks to delimit fragment names. 3
The database server issues an error if you include no fragment, or if no fragment of the specified table matches a fragment that you list.

Each *fragment* must be referenced by the name of the partition where it is stored. If you did not declare an explicit identifier when you created the partition, its name defaults to the name of the dbspace that contains the partition.

After a dbspace is renamed successfully by the onspaces utility, only the new name is valid. Dynamic Server automatically updates existing fragmentation strategies in the system catalog to substitute the new dbspace name, but you must specify the new name in GRANT FRAGMENT statement to reference a fragment whose default name is the name of a renamed dbspace.

The TO Clause

The list of one or more users or roles that follows the TO keyword identifies the grantees. You can specify the PUBLIC keyword to grant the specified fragment-level privileges to all users.

You cannot use GRANT FRAGMENT to grant fragment-level privileges to yourself, either directly or through roles.

If you enclose *user* or *role* in quotation marks, the name is case sensitive and is stored exactly as you typed it. In an ANSI-compliant database, if you do not use quotes around *user* or around *role*, the name is stored in uppercase letters.

The following statement grants the Insert, Update, and Delete privileges on the fragment of the **customer** table in **part1** to user **larry**:

```
GRANT FRAGMENT ALL ON customer (part1) TO larry
```

The following statement grants the Insert, Update, and Delete privileges on the fragments of the **customer** table in **part1** and **part2** to user **millie**:

```
GRANT FRAGMENT ALL ON customer (part1, part2) TO millie
```

To grant privileges on all fragments of a table to the same user or users, you can use the GRANT statement instead of the GRANT FRAGMENT statement. You can also use the GRANT FRAGMENT statement for this purpose.

Assume that the **customer** table is fragmented by expression into three fragments, and these fragments reside in the dbspaces named **part1**, **part2**, and **part3**. You can use either of the following statements to grant the Insert privilege on all fragments of the table to user **helen**:

```
GRANT FRAGMENT INSERT ON customer (part1, part2, part3) TO helen;

GRANT INSERT ON customer TO helen;
```

Granting Privileges to One User or a List of Users

You can grant fragment-level privileges to a single user or to a list of users.

The following statement grants the Insert, Update, and Delete privileges on the fragment of the **customer** table in **part3** to user **oswald**:

```
GRANT FRAGMENT ALL ON customer (part3) TO oswald
```

The following statement grants the Insert, Update, and Delete privileges on the fragment of the **customer** table in **part3** to users **jerome** and **hilda**:

```
GRANT FRAGMENT ALL ON customer (part3) TO jerome, hilda
```

Granting One Privilege or a List of Privileges

When you specify fragment-level privileges in a GRANT FRAGMENT statement, you can specify one privilege, a list of privileges, or all privileges.

The following statement grants the Update privilege on the fragment of the **customer** table in **part1** to user **ed**:

```
GRANT FRAGMENT UPDATE ON customer (part1) TO ed
```

The following statement grants the Update and Insert privileges on the fragment of the **customer** table in **part1** to user **susan**:

```
GRANT FRAGMENT UPDATE, INSERT ON customer (part1) TO susan
```

The following statement grants the Insert, Update, and Delete privileges on the fragment of the **customer** table in **part1** to user **harry**:

```
GRANT FRAGMENT ALL ON customer (part1) TO harry
```

WITH GRANT OPTION Clause

As in other GRANT statements, the WITH GRANT OPTION keywords specify that the grantee can grant the same fragment-level privileges to other users. WITH GRANT OPTION is not valid if the TO clause specifies a *role* as grantee. For additional information, see “WITH GRANT OPTION Keywords” on page 2-386.

The following statement grants the Update privilege on the fragment of the **customer** table in **part3** to user **george** and also gives george the right to grant the Update privilege on the same fragment to other users:

```
GRANT FRAGMENT UPDATE ON customer (part3) TO george WITH GRANT OPTION
```

AS grantor Clause

The AS *grantor* clause of the GRANT FRAGMENT statement can specify the grantor of the privilege. You can use this clause only if you have the DBA privilege on the database. hen you include the AS *grantor* clause, the database server lists the user or role who is specified as *grantor* as the grantor of the privilege in the **grantor** column of the **sysfragauth** system catalog table.

In the next example, the DBA grants the Delete privilege on the fragment of the **customer** table in **part3** to user **martha**, and uses the AS *grantor* clause to specify that user **jack** is listed in **sysfragauth** as the grantor of the privilege:

```
GRANT FRAGMENT DELETE ON customer (part3) TO martha AS jack
```

One effect of the AS *grantor* clause in the previous example is that user **jack** can execute the REVOKE FRAGMENT statement to cancel the Delete fragment-level privilege that **martha** holds, if this GRANT FRAGMENT statement were the only source of the fragment authority of **martha** on the **customer** rows in **part3**.

Omitting the AS grantor Clause

When GRANT FRAGMENT does not include the AS *grantor* clause, the user who issues the statement is the default grantor of the specified fragment privileges.

In the next example, the user grants the Update privilege on the fragment of the **customer** table in **part3** to user **fred**. Because this statement does not specify the AS *grantor* clause, the user who issues the statement is listed by default as the grantor of the privilege in the **sysfragauth** system catalog table.

```
GRANT FRAGMENT UPDATE ON customer (part3) TO fred
```

If you omit the AS *grantor* clause of GRANT FRAGMENT, or if you specify your own login name as the *grantor*, you can later use the REVOKE FRAGMENT statement to revoke the privilege that you granted to the specified user. For example, if you grant the Delete privilege on the fragment of the **customer** table in **part3** to user **martha** but specify user **jack** as the grantor of the privilege, user **jack** can revoke that privilege from user **martha**, but you cannot revoke that privilege from user **martha**.

The DBA, or the owner of the fragment, can use the AS clause of the REVOKE FRAGMENT statement to revoke privileges on the fragment.

Related Information

Related statements: GRANT and REVOKE FRAGMENT

For a discussion of fragment-level and table-level privileges, see the *IBM Informix Database Design and Implementation Guide*.

INFO

Use the INFO statement to display information about databases tables.

This statement is an extension to the ANSI/ISO standard for SQL. You can use this statement only with DB–Access.

Syntax

```
►►──INFO──┬─TABLES──────────────────────────────┬──────────────────────────►◄
          └──┬─┬─COLUMNS──┬─────┬─FOR──table──┘
             │ ├─INDEXES──┤     │
             │ └─STATUS───┘     │
             ├─┬─PRIVILEGES─┬───┤
             │ └─ACCESS─────┘   │
             └─┬─FRAGMENTS──┬───┘
               └─REFERENCES─┘
```

Element	Description	Restrictions	Syntax
table	Table about which you seek information	Must exist	"Database Object Name" on page 5-17

Usage

You can use the INFO statement with DB–Access to display information about database tables. C-style comments are not valid within the INFO statement.

Keywords of the INFO statement can display the following information.

INFO Keyword	**Information Displayed**
TABLES	Table names in the current database
COLUMNS	Column information for a specified table
INDEXES	Index information for a specified table
FRAGMENTS	Fragmentation strategy for a specified table
ACCESS *or* **PRIVILEGES**	Access privileges for a specified table. (The ACCESS and PRIVILEGES keywords are synonyms in this context.)
REFERENCES	References privileges for columns of a specified table
STATUS	Status information for a specified table

- **TABLES Keyword**

  Use TABLES to display a list of the tables in the current database, not including system catalog tables, in one of the following formats:
  - If you are the owner of the **cust_calls** table, it appears as **cust_calls**.
  - If you are *not* the owner of the **cust_calls** table, the name of the owner precedes the table name, such as **'june'.cust_calls**.
- **COLUMNS Keyword**

  Use COLUMNS to display the names and data types of the columns in a specified table, showing for each column whether NULL values are allowed.
- **INDEXES Keyword**

Use INDEXES to display the name, owner, and type of each index in a specified table, the clustered status, and listing the indexed columns.

- **FRAGMENTS Keyword**

  Use FRAGMENTS to display the names of dbspaces storing fragments of a table. If the table is fragmented with an expression-based distribution scheme, the INFO statement also shows the expressions.
- **ACCESS or PRIVILEGES Keyword**

  Use ACCESS or PRIVILEGES to display user-access privileges for a specified table. (These two keywords are synonyms in this context.)
- **REFERENCES Keyword**

  Use REFERENCES to display the References privilege for users for the columns of a specified table. For database-level privileges, use a SELECT statement to query the **sysusers** system catalog table.
- **STATUS Keyword**

  Use STATUS to display information about the owner, row length, number of rows and columns, creation date, and status of audit trails for a specified table.

An alternative to using the INFO statement of SQL is to use the **Info** command of the **SQL** menu or of the **Table** menu of DB–Access to display the same and additional information.

Related Information

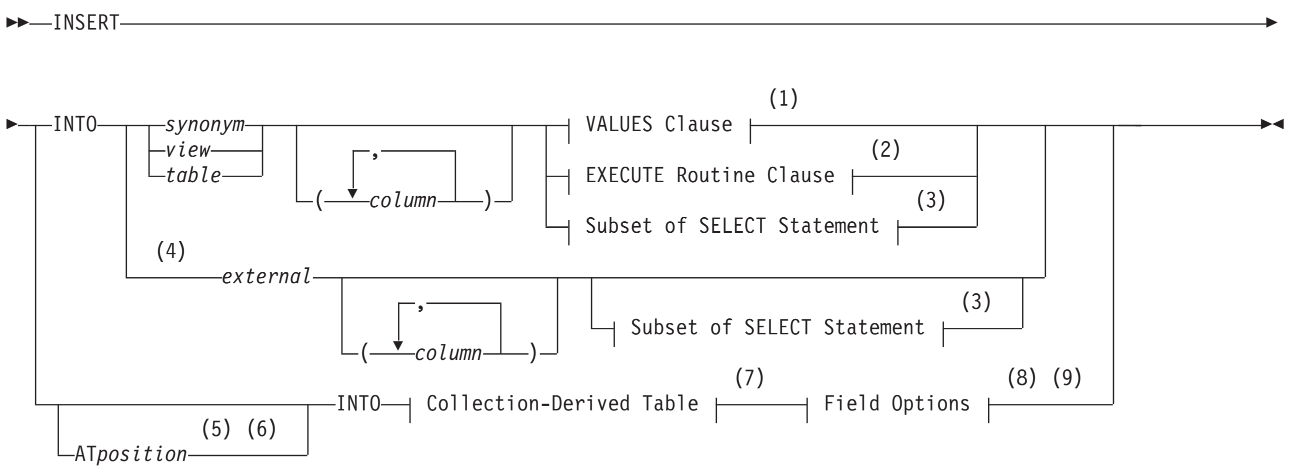
Related statements: GRANT and REVOKE

For a description of the **Info** option on the SQL menu or the **TABLE** menu in DB–Access, see the *IBM Informix DB–Access User's Guide*.

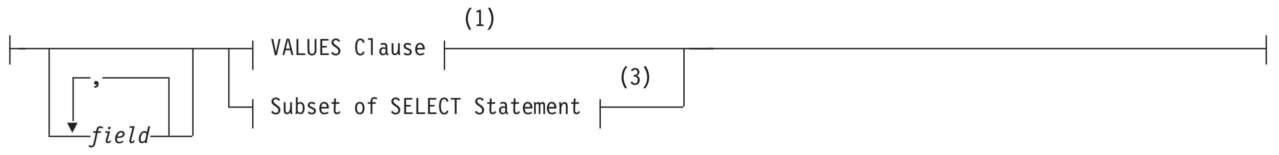
INSERT

Use the INSERT statement to insert one or more new rows into a table or view, or to insert one or more elements into an SPL or ESQL/C collection variable.

Syntax



Field Options:



Notes:

1 See "VALUES Clause" on page 2-398

2 See "Execute Routine Clause" on page 2-404

3 See "Subset of SELECT Statement" on page 2-403

4 Extended Parallel Server only

5 Stored Procedure Language only

6 ESQL/C only

7 See "Collection-Derived Table" on page 5-5

8 Informix extension

9 Dynamic Server only

Element	Description	Restrictions	Syntax
column	Column to receive new value	See "Specifying Columns" on page 2-396.	"Identifier" on page 5-22
external	External table into which to insert data	Must exist	"Database Object Name" on page 5-17
field	Field of a named or unnamed ROW data type	Must already be defined in the database	"Field Definition" on page 2-160
position	Position at which to insert an element of a LIST data type	Literal integer or an INT or SMALLINT type SPL variable.	"Literal Number" on page 4-137
synonym, table, view	Table, view, or synonym in which to insert data	Synonym or view and the table to which it points must exist	"Database Object Name" on page 5-17

Usage

To insert data into a table, you must either own the table or have the Insert privilege for the table. (see "GRANT" on page 2-371.) To insert data into a view, you must have the required Insert privilege, and the view must meet the requirements explained in "Inserting Rows Through a View" on page 2-397.

If the table or view has data integrity constraints, the inserted rows must meet the constraint criteria. If they do not, the database server returns an error. If the checking mode is set to IMMEDIATE, all specified constraints are checked at the end of each INSERT statement. If the checking mode is set to DEFERRED, all specified constraints are *not* checked until the transaction is committed.

Specifying Columns

If you do not explicitly specify one or more columns, data is inserted into columns using the column order that was established when the table was created or last altered. The column order is listed in the **syscolumns** system catalog table.

In ESQL/C, you can use the DESCRIBE statement with an INSERT statement to identify the column order and the data type of the columns in a table.

The number of columns specified in the INSERT INTO clause must equal the number of values supplied in the VALUES clause or by the SELECT statement, either implicitly or explicitly. If you specify a column list, the columns receive data in the order in which you list the columns. The first value following the VALUES keyword is inserted into the first column listed, the second value is inserted into the second column listed, and so on.

If you omit a column from the column list, and the column does not have a default value associated with it, the database server places a NULL value in the column when the INSERT statement is executed.

Using the AT Clause (ESQL/C, IDS, and SPL)

Use the AT clause to insert LIST elements at a specified position in a collection variable. By default, Dynamic Server adds a new element at the end of a LIST collection.

If you specify a position greater than the number of elements in the list, the database server adds the element to the end of the list. You must specify a position value of at least 1 because the first element in the list is at position 1.

The following SPL example inserts a value at a specific position in a list:

```
CREATE PROCEDURE test3()
   DEFINE a_list LIST(SMALLINT NOT NULL);
   SELECT list_col INTO a_list FROM table1 WHERE id = 201;
   INSERT AT 3 INTO TABLE(a_list) VALUES( 9 );
   UPDATE table1 VALUES list_col = a_list WHERE id = 201;
END PROCEDURE;
```

Suppose that before this INSERT, **a_list** contained the elements {1,8,4,5,2}. After this INSERT, **a_list** contains the elements {1,8,9,4,5,2}. The new element 9 was inserted at position 3 in the list. For more information on inserting values into collection variables, see "Collection-Derived Table" on page 5-5.

Inserting Rows Through a View

You can insert data through a *single-table* view if you have the Insert privilege on the view. To do this, the defining SELECT statement can select from only one table, and it cannot contain any of the following components:

- DISTINCT keyword
- GROUP BY clause
- Derived value (also referred to as a virtual column)
- Aggregate value

Columns in the underlying table that are unspecified in the view receive either a default value or a NULL value if no default is specified. If one of these columns has no default value, and a NULL value is not allowed, the INSERT fails.

You can use data-integrity constraints to prevent users from inserting values into the underlying table that do not fit the view-defining SELECT statement. For further information, see "WITH CHECK OPTION Keywords" on page 2-250.

With Dynamic Server, you can insert rows through a *single-table* or a *multiple-table* view if an INSTEAD OF trigger specifies valid INSERT operations in its Action clause. See "INSTEAD OF Triggers on Views (IDS)" on page 2-243 for information on how to create INSTEAD OF triggers that insert through views.

If several users are entering sensitive information into a single table, the built-in USER function can limit their view to only the specific rows that each user inserted. The following example contains a view and an INSERT statement that achieves this effect:

```
CREATE VIEW salary_view AS
   SELECT lname, fname, current_salary FROM salary WHERE entered_by = USER

INSERT INTO salary VALUES ('Smith', 'Pat', 75000, USER)
```

Inserting Rows with a Cursor

In ESQL/C, if you associate a cursor with an INSERT statement, you must use the OPEN, PUT, and CLOSE statements to carry out the INSERT operation. For databases that have transactions but are not ANSI-compliant, you must issue these statements within a transaction.

If you are using a cursor that is associated with an INSERT statement, the rows are buffered before they are written to the disk. The insert buffer is flushed under the following conditions:

- The buffer becomes full.
- A FLUSH statement executes.
- A CLOSE statement closes the cursor.

- In a database that is not ANSI-compliant, an OPEN statement implicitly closes and then reopens the cursor.
- A COMMIT WORK statement ends the transaction.

When the insert buffer is flushed, the client processor performs appropriate data conversion before it sends the rows to the database server. When the database server receives the buffer, it converts any user-defined data types and then begins to insert the rows one at a time into the database. If an error is encountered while the database server inserts the buffered rows into the database, any buffered rows that follow the last successfully inserted rows are discarded.

Inserting Rows into a Database Without Transactions

If you are inserting rows into a database with no transaction logging, you must take explicit action to restore inserted rows if the operation fails. For example, if INSERT fails after entering some rows, the successfully inserted rows remain in the table. You cannot recover automatically from a failed insert into a database for which no transaction log exists

Inserting Rows into a Database with Transactions

If you are inserting rows into a database and you are using explicit transactions, use the ROLLBACK WORK statement to undo the INSERT. If you do not execute BEGIN WORK before the INSERT, and the INSERT fails, the database server automatically rolls back any data modifications made since the beginning of the INSERT. If you are using an explicit transaction, and the INSERT fails, the database server automatically undoes the effects of the INSERT.

In an ANSI-compliant database, transactions are implicit, and all database modifications take place within a transaction. In this case, if an INSERT statement fails, use the ROLLBACK WORK statement to undo the insertions.

Tables that you create with the RAW logging type are never logged. Thus, raw tables are not recoverable, even if the database uses logging. For information about raw tables, refer to the *IBM Informix Guide to SQL: Reference*.

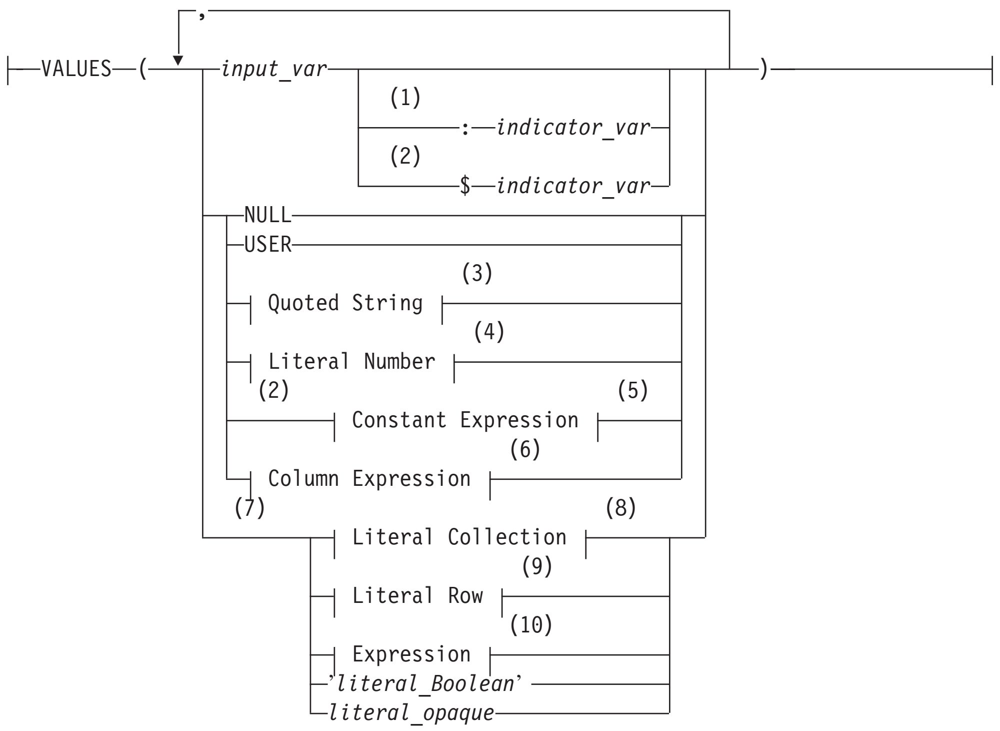
Rows that you insert with a transaction remain locked until the end of the transaction. The end of a transaction is either a COMMIT WORK statement, where all modifications are made to the database, or a ROLLBACK WORK statement, where none of the modifications are made to the database. If many rows are affected by a *single* INSERT statement, you can exceed the maximum number of simultaneous locks permitted. To prevent this situation, either insert fewer rows per transaction, or lock the page (or the entire table) before you execute the INSERT statement.

VALUES Clause

The VALUES clause can specify values to insert into one or more columns. When you use the VALUES clause, you can insert only one row at a time.

Each value that follows the VALUES keyword is assigned to the corresponding column listed in the INSERT INTO clause (or in column order, if a list of columns is not specified). If you are inserting a quoted string into a column, the maximum length that can be inserted without error is 256 bytes.

VALUES Clause:



Notes:

1 ESQL/C only

2 Informix extension

3 See “Quoted String” on page 4-142

4 See “Literal Number” on page 4-137

5 See “Constant Expressions” on page 4-53

6 See “Column Expressions” on page 4-44

7 Dynamic Server only

8 See “Literal Collection” on page 4-129

9 See “Literal Row” on page 4-139

10 See “Expression” on page 4-34

Element	Description	Restrictions	Syntax
indicator_var	Variable to show if SQL statement returns NULL to *input_var*	See the *IBM Informix ESQL/C Programmer's Manual*.	Language specific
input_var	Variable that holds value to insert. This can be a collection variable.	Can contain any value option of VALUES clause	Language specific
literal_opaque	Literal representation for an opaque data type	Must be recognized by the **input** support function of the opaque data type	See documentation of the opaque type.
literal_Boolean	Literal representation of a BOOLEAN value as a single character	Either `'t'` (TRUE) or `'f'` (FALSE)	“Quoted String” on page 4-142

In ESQL/C, if you use an *input_var* variable to specify the value, you can insert character strings longer than 256 bytes into a table.

For the keywords and the types of literal values that are valid in the VALUES clause, refer to "Constant Expressions" on page 4-53.

Considering Data Types

The value that the INSERT statement puts into a column does not need to be of the same data type as the column that receives it. These two data types, however, must be compatible. Two data types are *compatible* if the database server has some way to cast one data type to another. A *cast* is the mechanism by which the database server converts one data type to another.

The database server makes every effort to perform data conversion. If the data cannot be converted, the INSERT operation fails. Data conversion also fails if the target data type cannot hold the value that is specified. For example, you cannot insert the integer `123456` into a column defined as a SMALLINT data type because this data type cannot hold a number that large.

For a summary of the casting that the database server provides, see the *IBM Informix Guide to SQL: Reference*. For information on how to create a user-defined cast, see the CREATE CAST statement in this manual and *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Inserting Values into Serial Columns

You can insert consecutive numbers, explicit values, or explicit values that reset the value in a SERIAL or SERIAL8 column:

- To insert a consecutive serial value

  Specify a zero (0) for the serial column in the INSERT statement. In this case, the database server assigns the next highest value.
- To insert an explicit value

  Specify the nonzero value after first verifying that it does not duplicate one already in the table. If the serial column is uniquely indexed or has a unique constraint, and your value duplicates one already in the table, an error results. If the value is greater than the current maximum value, you will create a gap in the series.
- To create a gap in the series (that is, to reset the serial value)

  Specify a positive value that is greater than the current maximum value in the column.

  Alternatively, you can use the MODIFY clause of the ALTER TABLE statement to reset the next value of a serial column.

For more information, see "Altering the Next Serial Value" on page 2-55.

NULL values are not valid in serial columns.

In Dynamic Server, inserting a serial value into a table that is part of a table hierarchy updates all tables in the hierarchy that contain the serial counter with the value that you insert. You can express this value either as zero (0) for the next highest value, or as a specific positive integer.

Inserting Values into Opaque-Type Columns (IDS)

Dynamic Server supports INSERT operations that specify literal values of opaque data types as quoted strings in the VALUES clause. You can use this syntax to insert values of opaque UDTs into columns of tables in the local database, or into columns of tables in other databases of the local Dynamic Server instance.

Some opaque data types require special processing when they are inserted. For example, if an opaque data type contains spatial or multirepresentational data, it might provide a choice of how to store the data: inside the internal structure or, for large objects, in a smart large object.

This is accomplished by calling a user-defined support function called **assign( )**. When you execute INSERT on a table whose rows contains one of these opaque types, the database server automatically invokes the **assign( )** function for the type. The **assign( )** function can make the decision of how to store the data. For more information about the **assign( )** support function, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Inserting Values into Collection Columns (IDS)

You can use the VALUES clause to insert values into a collection column. For more information, see "Collection Constructors" on page 4-65.

For example, suppose you define the **tab1** table as follows:

```
CREATE TABLE tab1
(
   int1 INTEGER,
   list1 LIST(ROW(a INTEGER, b CHAR(5)) NOT NULL),
   dec1 DECIMAL(5,2)
)
```

The following INSERT statement inserts a row into **tab1**:

```
INSERT INTO tab1 VALUES
   (
   10,
   LIST{ROW(1,'abcde'),
      ROW(POW(3,3), '=27'),
      ROW(ROUND(ROOT(126)), '=11')},
   100
   )
```

The collection column, **list1**, in this example, has three elements. Each element is an unnamed row type with an INTEGER field and a CHAR(5) field. The first element is composed of two literal values, an integer (1) and a quoted string (`abcde`). The second and third elements also use a quoted string to indicate the second field, but specify the value for the first field with an expression.

Regardless of what method you use to insert values into a collection column, you cannot insert NULL elements into the column. Thus expressions that you use cannot evaluate to NULL. If the collection that you are attempting to insert contains a NULL element, the database server returns an error.

You can also use a collection variable to insert the values of one or more collection elements into a collection column. For more information, see "Collection-Derived Table" on page 5-5.

Inserting Values into ROW-Type Columns (IDS)

The VALUES clause to insert literal and nonliteral values in a named or unnamed ROW type column, as in the following example:

```
CREATE ROW TYPE address_t
(
   street CHAR(20),
   city CHAR(15),
   state CHAR(2),
   zipcode CHAR(9)
);
CREATE TABLE employee
(
   name ROW ( fname CHAR(20), lname CHAR(20)),
   address address_t
);
```

The next example inserts literal values in the **name** and **address** columns:

```
INSERT INTO employee VALUES
   (
      ROW('John', 'Williams'),
      ROW('103 Baker St', 'Tracy','CA', 94060)::address_t
   )
```

INSERT uses ROW constructors to generate values for the **name** column (an unnamed ROW data type) and the **address** column (a named ROW data type). When you specify a value for a named ROW data type, you must use the CAST AS keywords or the double colon (**::**) operator, with the name of the ROW data type, to cast the value to the named ROW data type.

For the syntax of ROW constructors, see "Constructor Expressions (IDS)" on page 4-63 in the Expression segment. For information on literal values for named ROW and unnamed ROW data types, see "Literal Row" on page 4-139.

When you use a ROW variable in the VALUES clause, the ROW variable must contain values for each field value. For more information, see "Inserting into a Row Variable (ESQL/C, IDS, SPL)" on page 2-405.

You can use ESQL/C host variables to insert *nonliteral* values in two ways:

- An entire ROW type into a column. Use a **row** variable in the VALUES clause to insert values for all fields in a ROW column at one time.
- Individual fields of a ROW type. To insert nonliteral values in a ROW-type column, insert the elements into a **row** variable and then specify the **collection** variable in the SET clause of an UPDATE statement.

Data Types in Distributed INSERT Operations (IDS)

In Dynamic Server, an INSERT (or any other SQL data-manipulation language statement) that accesses a database of another database server can only reference the built-in data types that are not opaque, DISTINCT, extended, nor large-object types. Cross-server DML operations cannot reference a column or expression of an opaque, DISTINCT, complex, large-object, nor user-defined data type (UDT).

Distributed operations that access other databases of the local Dynamic Server instance, however, can also access most *built-in opaque data types*, which are listed in "BOOLEAN and Other Built-In Opaque Data Types (IDS)" on page 4-19.

Inserts across databases of the local Dynamic Server instance can also reference UDTs, as well as DISTINCT types based on built-in data types, if all the UDTs and DISTINCT types are explicitly cast to built-in data types, and all the UDTs, DISTINCT types, and casts are defined in each of the participating databases.

Inserts cannot access the database of another database server unless both servers define TCP/IP connections in the DBSERVERNAME or DBSERVERALIAS configuration parameters. This applies to any communication between Dynamic Server instances, even if both database servers reside on the same computer.

Using Expressions in the VALUES Clause

With IBM Informix Dynamic Server, you can insert any type of expression except a column expression into a column. For example, you can insert built-in functions that return the current date, date and time, login name of the current user, or database server name where the current database resides.

The TODAY keyword returns the system date. The CURRENT keyword returns the system date and time. The USER keyword returns a string that contains the login account name of the current user. The SITENAME or DBSERVERNAME keyword returns the database server name where the current database resides. The following example uses built-in functions to insert data:

```
INSERT INTO cust_calls (customer_num, call_dtime, user_id,
                call_code, call_descr)
   VALUES (212, CURRENT, USER, 'L', '2 days')
```

For more information, see "Expression" on page 4-34.

Inserting NULL Values

When you execute the INSERT statement, the database server inserts a NULL value into any column for which you provide no value, as well as for all columns that have no default values and that are not listed explicitly. You also can specify the NULL keyword in the VALUES clause to indicate that a column should be assigned a NULL value.

The following example inserts values into three columns of the **orders** table:

```
INSERT INTO orders (orders_num, order_date, customer_num) VALUES (0, NULL, 123)
```

In this example, a NULL value is explicitly entered in the **order_date** column, and all other columns of the **orders** table that are *not* explicitly listed in the INSERT INTO clause are also filled with NULL values.

Truncated CHAR Values

In a database that is not ANSI-compliant, if you assign a value to a CHAR(*n*) column or variable and the length of that value exceeds *n* characters, the database server truncates the last characters without raising an error. For example, suppose that you define this table:

```
CREATE TABLE tab1 (col_one CHAR(2)
```

The database server truncates the data values in the following INSERT statements to `"jo"` and `"sa"` respectively, but does not return a warning:

```
INSERT INTO tab1 VALUES ("john");
INSERT INTO tab1 VALUES ("sally");
```

Thus, in a database that is not ANSI-compliant, the semantic integrity of data for a CHAR(*n*) column or variable is not enforced when the value inserted or updated exceeds the declared length *n*. (But in an ANSI-compliant database, the database server issues error -1279 when truncation of character data occurs.)

Subset of SELECT Statement

As indicated in the diagram for "INSERT" on page 2-395, not all clauses and options of the SELECT statement are available for you to use in an INSERT statement. The following SELECT clauses and options are not supported by Dynamic Server:

- FIRST and INTO TEMP
- ORDER BY and UNION

Extended Parallel Server supports the ORDER BY and UNION options, but not FIRST nor INTO TEMP in the INSERT statement.

In an ANSI-compliant database, if this statement has a WHERE clause that does not return rows, **sqlca** returns SQLNOTFOUND (100).

If an INSERT statement that is part of a multistatement prepared object inserts no rows, **sqlca** returns SQLNOTFOUND (100) for both ANSI-compliant databases and databases that are not ANSI-compliant. In databases that are not ANSI-compliant, **sqlca** returns zero (0) if no rows satisfy the WHERE clause.

In Dynamic Server, if you are inserting values into a supertable in a table hierarchy, the subquery can reference a subtable. If you are inserting values into a subtable in a table hierarchy, the subquery can reference the supertable if it references only the supertable. That is, the subquery must use the SELECT...FROM ONLY (*supertable*)...syntax.

Using External Tables (XPS)

In Extended Parallel Server, a SELECT statement that is a part of a LOAD or UNLOAD operation involving an external table is subject to these restrictions:

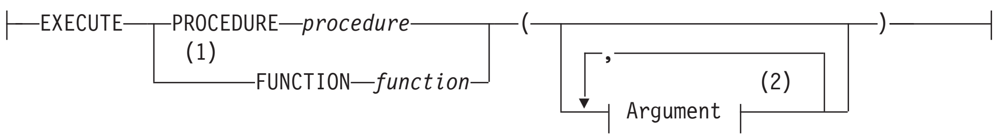
- Only one external table is allowed in the FROM clause.
- The SELECT subquery cannot contain an INTO clause, but it can include any valid SQL expression.

When you move data from a database into an external table, the SELECT statement must define all columns in the external table. The SELECT statement must not contain a FIRST, FOR UPDATE, INTO, INTO SCRATCH, or INTO TEMP clause. You can use an ORDER BY clause, however, to produce files that are ordered within themselves.

Execute Routine Clause

You can specify the EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement to insert values that a user-defined function returns.

Execute Routine Clause:



Notes:

1 Dynamic Server only

2 See “Arguments” on page 5-2

Element	Description	Restrictions	Syntax
function, *procedure*	User-defined function or procedure to insert the data	Must exist	“Database Object Name” on page 5-17

When you use a user-defined function to insert column values, the return values of the function must have a one-to-one correspondence with the listed columns. That is, each value that the function returns must be of the data type expected by the corresponding *column* in the column list.

For backward compatibility, Dynamic Server can use the EXECUTE PROCEDURE keywords to execute an SPL function that was created with the CREATE PROCEDURE statement.

If the called SPL routine scans or updates the target table of the INSERT statement, the database returns an error. That is, the SPL routine cannot select data from the table into which you are inserting rows.

If a called SPL routine contains certain SQL statements, the database server returns an error. For information on which SQL statements cannot be used in an SPL routine that is called within a data manipulation statement, see "Restrictions on SPL Routines in Data-Manipulation Statements" on page 5-71.

Number of Values Returned by SPL, C, and Java Functions

An SPL function can return one or more values. Make sure that the number of returned values matches the number of columns in the table or the number of columns in the column list of the INSERT statement. These columns must have data types that are compatible with the values that the SPL function returns.

An external function written in the C or Java language can only return *one* value. Make sure that you specify only one column in the column list of the INSERT statement. This column must have a compatible data type with the value that the external function returns. The external function can be an iterator function.

The following example shows how to insert data into a temporary table called **result_tmp** in order to output to a file the results of a user-defined function (**f_one**) that returns multiple rows:

```
CREATE TEMP TABLE result_tmp( ... );
INSERT INTO result_tmp EXECUTE FUNCTION f_one();
UNLOAD TO 'file' SELECT * FROM foo_tmp;
```

Inserting into a Row Variable (ESQL/C, IDS, SPL)

The INSERT statement does not support a row variable in the Collection-Derived-Table segment. You can use the UPDATE statement, however, to insert new field values into a row variable. For example, the following ESQL/C code fragment inserts a new row into the **rectangles** table (which "Inserting Values into ROW-Type Columns (IDS)" on page 2-401 defines):

```
EXEC SQL BEGIN DECLARE SECTION;
   row (x int, y int, length float, width float) myrect;
EXEC SQL END DECLARE SECTION;

...
EXEC SQL update table(:myrect)
   set x=7, y=3, length=6, width=2;
EXEC SQL insert into rectangles values (12, :myrect);
```

For more information, see "Updating a Row Variable (IDS, ESQL/C)" on page 2-647.

Using INSERT as a Dynamic Management Statement

In ESQL/C, you can use the INSERT statement to handle situations where you need to write code that can insert data whose structure is unknown at the time you compile. For more information, refer to the dynamic management section of the *IBM Informix ESQL/C Programmer's Manual*.

Related Information

Related statements: CLOSE, CREATE EXTERNAL TABLE (XPS), DECLARE, DESCRIBE, EXECUTE, FLUSH, FOREACH, OPEN, PREPARE, PUT, and SELECT

For a task-oriented discussion of inserting data into tables and for information on how to access row and collections with SPL variables, see the *IBM Informix Guide to SQL: Tutorial*.

For a discussion of the GLS aspects of the INSERT statement, see the *IBM Informix GLS User's Guide*.

For information on how to access row and collection values with ESQL/C host variables, see the chapter on complex data types in the *IBM Informix ESQL/C Programmer's Manual*.

LOAD

Use the LOAD statement to insert data from an operating-system file into an existing table or view.

This statement is an extension to the ANSI/ISO standard for SQL. You can use this statement only with DB–Access.

Syntax

```
>>──LOAD FROM──'filename' ──┬───────────────────────────┬──INSERT INTO──────────────►
                            └──DELIMITER──'delimiter' ──┘

►──┬─table───┬──┬──────────────────────┬─────────────────────────────────────────►◄
   ├─view────┤  │     ┌─,──────┐       │
   └─synonym─┘  │     ▼        │       │
                └─(────column──┴──)────┘
```

Element	Description	Restrictions	Syntax
column	Column to receive data values from *filename*	See "INSERT INTO Clause" on page 2-412.	"Identifier" on page 5-22
delimiter	Character to separate data values in each line of the load file. Default *delimiter* is the pipe (|) symbol.	See "DELIMITER Clause" on page 2-411.	"Quoted String" on page 4-142
filename	Path and filename of file to read. Default pathname is current directory	See "LOAD FROM File" on page 2-407.	Specific to operating system rules
synonym, *table*, *view*	Synonym for the table in which to insert data from *filename*	*Synonym* and *table* or *view* to which it points must exist	"Database Object Name" on page 5-17

Usage

The LOAD statement appends new rows to the table. It does not overwrite existing data. You cannot add a row that has the same key as an existing row.

C-style comments are not valid within the LOAD statement.

To use the LOAD statement, you must have Insert privileges for the table where you want to insert data. For information on database-level and table-level privileges, see the GRANT statement.

LOAD FROM File

The LOAD FROM file contains the data to be loaded into the specified table or view. The default pathname for the load file is the current directory.

You can use the file that the UNLOAD statement creates as the LOAD FROM file. (See "UNLOAD TO File" on page 2-630 for a description of how values of various data types are represented within the UNLOAD TO file.)

If you do not include a list of columns in the INSERT INTO clause, the fields in the file must match the columns that are specified for the table in number, order, and data type.

Each line of the file must have the same number of fields. You must define field lengths that are less than or equal to the length that is specified for the corresponding column. Specify only values that can convert to the data type of the corresponding column. The following table indicates how the database server expects you to represent the data types in the LOAD FROM file (when you use the default locale, U.S. English).

Type of Data	Input Format
blank	One or more blank characters between delimiters You can include leading blanks in fields that do not correspond to character columns.
BOOLEAN	A `t` or `T` indicates a TRUE value, and an `f` or `F` indicates a FALSE value.
COLLECTIONS	Collection must have its values surrounded by braces ({ }) and a field delimiter separating each element. For more information, see "Loading Complex Data Types (IDS)" on page 2-411.
DATE	Character string in the following format: *mm/dd/year* You must state the month as a two-digit number. You can use a two-digit number for the year if the year is in the 20th century. (You can specify another century algorithm with the **DBCENTURY** environment variable.) The value must be an actual date; for example, February 30 is illegal. You can use a different date format if you indicate this format with the **GL_DATE** or **DBDATE** environment variable. For more information about environment variables, see the *IBM Informix Guide to SQL: Reference* and the *IBM Informix GLS User's Guide*.
DECIMAL, MONEY, FLOAT	Value that can include a leading and/or trailing currency symbol and thousands and decimal separators Your locale files or the **DBMONEY** environment variable can specify a currency format.
NULL	Nothing between the delimiters
ROW types (named or unnamed)	ROW type must have its values surrounded by parentheses and a field delimiter that separates each element. For more information, see "Loading Complex Data Types (IDS)" on page 2-411.
Simple large objects (TEXT, BYTE)	TEXT and BYTE columns are loaded directly from the LOAD TO file. For more information, see "Loading Simple Large Objects" on page 2-410.
Smart large objects (CLOB, BLOB)	CLOB and BLOB columns are loaded from a separate operating-system file. The field for the CLOB or BLOB column in the LOAD FROM file contains the name of this separate file. For more information, see "Loading Smart Large Objects (IDS)" on page 2-410.
Time	Character string in *year-month-day hour:minute:second.fraction* format You cannot use data type keywords or qualifiers for DATETIME or INTERVAL values. The year must be a 4-digit number, and the month must be a 2-digit number. The **DBTIME** or **GL_DATETIME** environment variable can specify other formats.

Type of Data	Input Format
User-defined data formats (opaque types)	Associated opaque type must have an import support function defined if special processing is required to copy the data in the LOAD FROM file to the internal format of the opaque type. An import binary support function might also be required for data in binary format. The LOAD FROM file data must be in the format that the import or import binary support function expects. The associated opaque type must have an assign support function if special processing is required before writing the data in the database. See "Loading Opaque-Type Columns (IDS)" on page 2-411.

For more information on **DB*** environment variables, refer to the *IBM Informix Guide to SQL: Reference*. For more information on **GL*** environment variables, refer to the *IBM Informix GLS User's Guide*.

If you are using a nondefault locale, the formats of DATE, DATETIME, MONEY, and numeric column values in the LOAD FROM file must be compatible with the formats that the locale supports for these data types. For more information, see the *IBM Informix GLS User's Guide*.

The following example shows the contents of an input file named **new_custs**:

```
0|Jeffery|Padgett|Wheel Thrills|3450 El Camino|Suite 10|Palo Alto|CA|94306||
0|Linda|Lane|Palo Alto Bicycles|2344 University||Palo Alto|CA|94301|
    (415)323-6440
```

This data file conveys the following information:

- Indicates a serial field by specifying a zero (0)
- Uses the pipe (|), the default delimiter
- Assigns NULL values to the **phone** field for the first row and the **address2** field for the second row

  The NULL values are shown by two delimiters with nothing between them.

The following statement loads the values from the **new_custs** file into the **customer** table that **jason** owns:

```
LOAD FROM 'new_custs' INSERT INTO jason.customer
```

If you include any of the following special characters as part of the value of a field, you must precede the character with a backslash (\ ) escape symbol:

- Backslash
- Delimiter
- Newline character anywhere in the value of a VARCHAR or NVARCHAR column
- Newline character at end of a value for a TEXT value

Do not use the backslash character (\ ) as a field separator. It serves as an escape character to inform the LOAD statement that the next character is to be interpreted as part of the data, rather than as having special significance.

Fields that correspond to character columns can contain more characters than the defined maximum allows for the field. The extra characters are ignored.

If you are loading files that contain VARCHAR data types, note the following information:

- If you give the LOAD statement data in which the character fields (including VARCHAR) are longer than the column size, the excess characters are disregarded.
- Use the backslash (\ ) to escape embedded delimiter and backslash characters in all character fields, including VARCHAR.
- Do not use the following characters as delimiting characters in the LOAD FROM file: digits (0 to 9), the letters a to f, and A to F, the backslash (/) character, or the NEWLINE character.

Loading Simple Large Objects

The database server loads simple large objects (BYTE and TEXT columns) directly from the LOAD FROM file. Keep the following restrictions in mind when you load BYTE and TEXT data:

- You cannot have leading and trailing blanks in BYTE fields.
- Use the backslash (\ ) to escape the special significance of literal delimiter and backslash characters in TEXT fields.
- Data being loaded into a BYTE column must be in ASCII-hexadecimal form. BYTE columns cannot contain preceding blanks.
- Do not use the following characters as delimiting characters in the LOAD FROM file: digits (0 to 9), the letters a to f, and A to F, the backslash (/) character, or the NEWLINE character.

For loading TEXT columns in a non-default locale, the database server handles any required code-set conversions for the data. See also the *IBM Informix GLS User's Guide*.

If you are unloading files that contain BYTE or TEXT data types, objects smaller than 10 kilobytes are stored temporarily in memory. You can adjust the 10-kilobyte setting to a larger setting with the **DBBLOBBUF** environment variable. Simple large objects that are larger than the default or the setting of **DBBLOBBUF** are stored in a temporary file. For more information about the **DBBLOBBUF** environment variable, see the *IBM Informix Guide to SQL: Reference*.

Loading Smart Large Objects (IDS)

The database server loads smart large objects (BLOB and CLOB columns) from a separate operating-system file on the client computer. For information on the structure of this file, see "Unloading Smart Large Objects (IDS)" on page 2-632.

In a LOAD FROM file, a CLOB or BLOB column value appears as follows:

```
start_off,length,client_path
```

In this format, *start_off* is the starting offset (in hexadecimal) of the smart-large-object value within the client file, *length* is the length (in hexadecimal) of the BLOB or CLOB value, and *client_path* is the pathname for the client file. No blank spaces can appear between these values.

For example, to load a CLOB value that is 512 bytes long and is at offset 256 in the **/usr/apps/clob9ce7.318** file, the database server expects the CLOB value to appear as follows in the LOAD FROM file:

```
|100,200,/usr/apps/clob9ce7.318|
```

If the whole client file is to be loaded, a CLOB or BLOB column value appears as follows in the LOAD FROM file:

```
client_path
```

For example, to load a CLOB value that occupies the entire file **/usr/apps/clob9ce7.318**, the database server expects the CLOB value to appear as follows in the LOAD FROM file:

```
|/usr/apps/clob9ce7.318|
```

In DB-Access, the USING clause is valid within files executed from DB-Access. In interactive mode, DB-Access prompts you for a password, so the USING keyword and *validation_var* are not used.

For CLOB columns, the database server handles any required code-set conversions for the data. See also the *IBM Informix GLS User's Guide*.

Loading Complex Data Types (IDS)

In a LOAD FROM file, complex data types appear as follows:

- Collections are introduced with the appropriate constructor (SET, MULTISET, or LIST), and their elements are enclosed in braces ({ }) and separated with a comma, as follows:

  ```
  constructor{val1 , val2 , ... }
  ```

  For example, to load the SET values {`1, 3, 4`} into a column whose data type is SET(INTEGER NOT NULL), the corresponding field of the LOAD FROM file appears as:

  ```
  |SET{1 , 3 , 4}|
  ```

- Row types (named and unnamed) are introduced with the ROW constructor and their fields are enclosed with parentheses and separated with a comma, as follows:

  ```
  ROW(val1 , val2 , ... )
  ```

  For example, to load the ROW values (`1, 'abc'`), the corresponding field of the LOAD FROM file appears as:

  ```
  |ROW(1 , abc)|
  ```

Loading Opaque-Type Columns (IDS)

Some opaque data types require special processing when they are inserted. For example, if an opaque data type contains spatial or multirepresentational data, it might provide a choice of how to store the data: inside the internal structure or, for large objects, in a smart large object.

This processing is accomplished by calling a user-defined support function called **assign( )**. When you execute the LOAD statement on a table whose rows contain one of these opaque types, the database server automatically invokes the **assign( )** function for the type. The **assign( )** function can make the decision of how to store the data. For more information about the **assign( )** support function, see the *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

DELIMITER Clause

Use the DELIMITER clause to specify the delimiter that separates the data contained in each column in a row in the input file. You can specify TAB (CTRL-I) or a blank space (= ASCII 32) as the delimiter symbol. You cannot use the following items as the delimiter symbol:

- Backslash (\ )

- NEWLINE character (CTRL-J)
- Hexadecimal numbers (0 to 9, a to f, A to F)

If you omit this clause, the database server checks the **DBDELIMITER** environment variable. For information about how to set the **DBDELIMITER** environment variable, see the *IBM Informix Guide to SQL: Reference*.

If the **DBDELIMITER** environment variable has not been set, the default delimiter is the pipe (|).

The following example specifies the semicolon (;) as the delimiting character. The example uses Windows file-naming conventions.

```
LOAD FROM 'C:\data\loadfile' DELIMITER ';'
   INSERT INTO orders
```

INSERT INTO Clause

Use the INSERT INTO clause to specify the table, synonym, or view in which to load the new data. You must specify the column names only if one of the following conditions is true:

- You are not loading data into all columns.
- The input file does not match the default order of the columns (the order specified when the table was created).

The following example identifies the **price** and **discount** columns as the only columns in which to add data. The example uses Windows filenaming conventions.

```
LOAD FROM 'C:\tmp\prices' DELIMITER ','
   INSERT INTO norman.worktab(price,discount)
```

Related Information

Related statements: UNLOAD and INSERT

For a task-oriented discussion of the LOAD statement and other utilities for moving data, see the *IBM Informix Migration Guide*.

For a discussion of the GLS aspects of the LOAD statement, see the *IBM Informix GLS User's Guide*.

LOCK TABLE

Use the LOCK TABLE statement to control access to a table by other processes.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──LOCK TABLE──┬─table───┬──IN──┬─SHARE─────┬──MODE─────────────────────────><
                └─synonym─┘      └─EXCLUSIVE─┘
```

Element	Description	Restrictions	Syntax
synonym	Synonym for the table to be locked	Synonym and the table to which it points must exist	"Database Object Name" on page 5-17
table	Table to be locked	See first paragraph of Usage.	"Database Object Name" on page 5-17

Usage

You can use LOCK TABLE to lock a table if either of the following is true:
- You are the owner of the table.
- You have Select privilege on the table or on a column in the table, either from a direct grant or from a grant to PUBLIC.

The LOCK TABLE statement fails if the table is already locked in EXCLUSIVE mode by another process, or if you request an EXCLUSIVE lock while another user has locked the same table in SHARE mode.

The SHARE keyword locks a table in *shared mode*. Shared mode gives other processes *read* access to the table but denies *write* access. Other processes cannot update or delete data if a table is locked in shared mode.

The EXCLUSIVE keyword locks a table in *exclusive mode*. This mode denies other processes both read and write access to the table. Exclusive-mode locking automatically occurs during the ALTER INDEX, ALTER TABLE, CREATE INDEX, DROP INDEX, RENAME COLUMN, RENAME TABLE, START VIOLATIONS TABLE, STOP VIOLATIONS TABLE, and TRUNCATE statements.

Concurrent Access to Tables with Exclusive Locks

After the LOCK TABLE statement with the IN EXCLUSIVE MODE option executes successfully, no other user can obtain a lock on the specified table. When you attempt a DDL operation on that table, however, you might receive RSAM error -106 if the same table is being accessed by a concurrent session (for example, by opening a cursor). This error can also affect implicit locks that certain DDL statements place on tables automatically.

This is possible because table locks do not preclude table access. An exclusive lock prevents other users from obtaining a lock, but it cannot prevent them from opening the table for write operations that wait for the exclusive lock to be released, or for Dirty Read operations on the table. You can set the **IFX_DIRTY_WAIT** environment variable to specify that the DDL operation wait for a specified number of seconds for Dirty Read operations to commit or rollback.

Databases with Transactions

If your database was created with transactions, the LOCK TABLE statement succeeds only if it executes within a transaction. You must issue a BEGIN WORK statement before you can execute a LOCK TABLE statement.

Transactions are implicit in an ANSI-compliant database. The LOCK TABLE statement succeeds whenever the specified table is not already locked by another process.

The following guidelines apply to the use of the LOCK TABLE statement within transactions:

- You cannot lock system catalog tables.
- You cannot switch between shared and exclusive table locking within a transaction. For example, once you lock the table in shared mode, you cannot upgrade the lock mode to exclusive.
- If you issue a LOCK TABLE statement before you access a row in the table, and PDQ is not in effect, no row locks are set for the table. In this way, you can override row-level locking and avoid exceeding the maximum number of locks that are defined in the database server configuration. (But if PDQ is not in effect, you might run out of locks with error -134 unless the LOCKS parameter of your ONCONFIG file specifies a large enough number of locks.)
- All row and table locks release automatically after a transaction is completed. The UNLOCK TABLE statement fails in a database that uses transactions.
- The same user can explicitly use LOCK TABLE to lock up to 32 tables concurrently. (Use SET ISOLATION to specify an appropriate isolation level, such as Repeatable Read, if you need to lock rows from more than 32 tables during a single transaction.)

The following example shows how to change the locking mode of a table in a database that was created with transaction logging:

```
BEGIN WORK
LOCK TABLE orders IN EXCLUSIVE MODE
 ...
COMMIT WORK
BEGIN WORK
LOCK TABLE orders IN SHARE MODE
 ...
COMMIT WORK
```

Warning: It is recommended that you not use nonlogging tables in a transaction. If you need to use a nonlogging table in a transaction, either lock the table in exclusive mode or set the isolation level to Repeatable Read to prevent concurrency problems.

Databases Without Transactions

In a database that was created without transactions, table locks that were set by the LOCK TABLE statement are released after any of the following events:

- An UNLOCK TABLE statement executes.
- The user closes the database.
- The user exits the application.

To change the lock mode on a table, release the lock with the UNLOCK TABLE statement and then issue a new LOCK TABLE statement.

The following example shows how to change the lock mode of a table in a database that was created without transactions:

```
LOCK TABLE orders IN EXCLUSIVE MODE
   . . .
UNLOCK TABLE orders
   . . .
LOCK TABLE orders IN SHARE MODE
```

Locking Granularity

The default granularity for locking a table is at the *page* level, or whatever you specify (either PAGE or ROW) in the **IFX_TABLE_LOCKMODE** environment variable, or if that is not set, by setting DEF_TABLE_LOCKMODE in the ONCONFIG file. The LOCKMODE clause of the CREATE TABLE or ALTER TABLE statement can override the default locking granularity by specifying PAGE, ROW, or (for Extended Parallel Server only) TABLE for a specified table. The LOCK TABLE statement, however, always locks the entire table, overriding any other locking granularity specification for the table. For Extended Parallel Server, the LOCK MODE clause of the CREATE INDEX statement can specify COARSE or NORMAL locking granularity for an index.

In all of these contexts, the term ″lock mode″ means the *locking granularity*. In the context of the SET LOCK MODE statement, however, ″lock mode″ refers to the behavior of the database server when a process attempts to access a row or a table that another process has locked.

Related Information

Related statements: BEGIN WORK, COMMIT WORK, SAVE EXTERNAL DIRECTIVES, SET ISOLATION, SET LOCK MODE, and UNLOCK TABLE

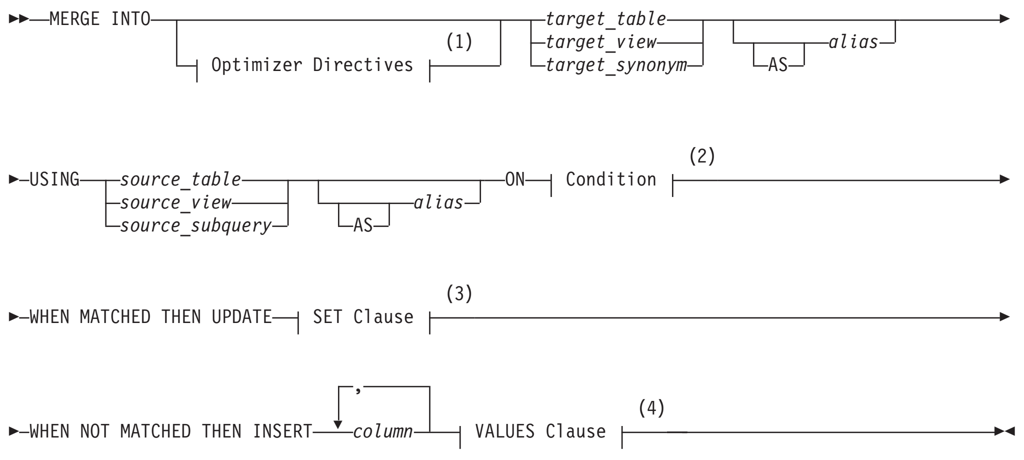
For a discussion of concurrency and locks, see the *IBM Informix Guide to SQL: Tutorial*.

MERGE

The MERGE statement provides an efficient way to merge two tables by combining UPDATE and INSERT operations into a single statement.

Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 See "Optimizer Directives" on page 5-34

2 See "Condition" on page 4-5

3 See "SET Clause" on page 2-639

4 See "VALUES Clause" on page 2-398

Element	Description	Restrictions	Syntax
alias	Temporary name that you declare here for the *target* table object or *source* table object	If potentially ambiguous, you must precede *alias* with the AS keyword	"Identifier" on page 5-22
column	Name of a column in the *target* table object in which to insert *source* data	Must exist in the *target* object	"Identifier" on page 5-22
source_table, *source_view*, *source_subquery*	Name of a table object (or the result of a query) that contains the data that you are relocating	Must exist	"Database Object Name" on page 5-17; SELECT, p. "SELECT" on page 2-479
target_table, *target_view*, *target_synonym*	Name or synonym of a table or updatable view in which to insert the *source* data	See "Target Table Restrictions" on page 2-417	"Database Object Name" on page 5-17

Usage

The MERGE statement enables you to merge data of a source table into a destination table, here called the *target table*. It provides an efficient way to update and insert the rows of the source table into the target table, based on search conditions that you specify within the statement.

The *target* object can be in a different database from the *source* object, but it must be a database managed by the currently running Extended Parallel Server instance. The *source* object, however, can be in a different database from the *target* object, and need not be a database managed by the current running Extended Parallel Server instance.

Rows in the *target* object that match the search conditions are updated; otherwise, new rows are inserted into the *target* object.

The MERGE statement combines some of the functionality of the UPDATE and INSERT statements into a single statement. The SET clause of this statement is identical to that of the UPDATE statement. For more information, see "SET Clause" on page 2-639.

The VALUES clause of the MERGE is similar to the INSERT statement, but only accepts column names and constant values, not expressions. For more information, see "VALUES Clause" on page 2-398.

The following example uses the transaction table **new_sale** to merge rows into the fact table **sale**, updating **sale_count** if there are already records in the **sale** table. If not, the rows are inserted into the **sale** table.

```
MERGE INTO sale USING new_sale AS n ON sale.cust_id = n.cust_id
   WHEN MATCHED THEN UPDATE SET sale.salecount = sale.salecount + n.salecount
   WHEN NOT MATCHED THEN INSERT (cust_id, salecount)
      VALUES    (n.cust_id,n.salecount);
```

If an error occurs while MERGE is executing, the entire statement is rolled back.

If the constraints checking mode for the target table is set to IMMEDIATE, then unique and referential constraints of the target object are checked after all the UPDATE and INSERT operations are complete. The NOT NULL and check constraints are checked during the UPDATE and INSERT operations. If the checking mode is set to DEFERRED, the constraints are not checked until after the transaction is committed.

Target Table Restrictions

The following restrictions apply to the target table of the MERGE statement. If any of the following conditions exist, MERGE returns an error.

- The target table of MERGE cannot have any violations tables defined
- The target table of MERGE cannot be an external table nor a remote table
- The target table of MERGE cannot be a system catalog table
- The target table of MERGE cannot be a static table nor a duplicated table
- The target table of MERGE cannot be a pseudo-table (a memory-resident object in a system database) nor a read-only view
- If an Update or Insert trigger is defined on the target table of MERGE, an error is issued. (Here MERGE does not act as a triggering event.)

Handling Duplicate Rows

While MERGE is executing, the same row in the target table cannot be updated more than once. Inserted rows are not updated by the MERGE statement. Using the previous example, if the **sale** table contains the two records shown at the left, then the **new_sale** table contains the three records shown at the right:

Records in ’sales’ Table			**Records in ’new_sales’ Table**	
cust_id	**sale_count**		**cust_id**	**sale_count**
Tom	129		Tom	20
Julie	230		Julie	3
			Julie	10

When merging **new_sale** into **sale** using the expression **sale.cust_id = new_sale.cust_id**, the MERGE statement returns an error, because it attempts to update one of the records in the source table more than once.

Related Information

Related statements: INSERT andUPDATE

MOVE TABLE

The MOVE TABLE statement moves the schema of a database table to another database of the same database server instance. Only Extended Parallel Server supports this syntax, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──MOVE TABLE──┬──────────┬──source_table──TO DATABASE──database──────────────>
                └─owner.───┘

>─┬──────────────────────────────────────────┬────────────────────────────────>
  └─RENAME──┬──────────────┬──new_table──────┘
            └─new_owner.───┘

                                                     ┌─RESTRICT─┐
>─┬──────────────────────────────────────────────┬──┼──────────┼──────────────><
  └─WITH──(──PRIVILEGES──┬───────────┬──)────────┘  └─CASCADE──┘
                         └─, ROLES───┘
```

Element	Description	Restrictions	Syntax
database	Name of the destination database	Must exist and must have the sane database server as the source database	"Database Name" on page 5-15
owner	Current table owner	Must be the owner of *source_table*	"Owner Name" on page 5-43
new_owner	Owner designated here for *new_table*	Must be a valid owner name in the destination *database*	"Owner Name" on page 5-43
new_table	Name declared here for relocated table	Must be unique among table, view, and synonym names in destination *database*	"Identifier" on page 5-22
source_table	Current table name	Must exist in the source database	"Identifier" on page 5-22

Usage

The MOVE TABLE statement provides a way to move a permanent table from one database to another on the same Extended Parallel Server instance. When the table is moved, many of its objects, including any indexes and fragmentation strategy, are preserved, but the data values in the table are not physically moved to the destination database. The database server transfers only the system catalog information describing *source_table* to the destination database. For this reason, the performance of MOVE TABLE depends on the time that is required to transfer the system catalog data, but not on the size of *source table*.

If indexes exist on *source table*, the data values of the index are not moved. Only the system catalog information is moved to the destination database. By default, all roles assigned to *source table* are dropped from the source database.

The destination table has, by default, restricted privileges. Only the owner of *source table* has privileges on *new table*. Also by default, all roles assigned to *source table* are dropped from *new table*. In the following basic example, the privileges of *source table* are not preserved in the destination database:

```
MOVE TABLE employee TO DATABASE payroll;
```

You can preserve the privileges and roles of the original table using the WITH clause. For more information, see "Preserving Table Privileges" on page 2-421.

Only users with DBA privileges on both the source and destination databases can use the MOVE TABLE statement.

The following types of tables cannot be moved using the MOVE TABLE statement:
- System catalog tables
- Temporary tables (TEMP or SCRATCH)
- Tables not currently in the database
- Active violations tables
- Tables appearing in the FROM clause of a GK index
- System database tables (tables in **sysmaster** and **sysutils**)

If the destination database already contains a table with the same name as *source table*, the MOVE TABLE statement fails with an error. Similarly, if any dependent objects of source table have names that already exist in the destination database, the MOVE TABLE statement fails and returns an error.

The source table can be either fragmented or non-fragmented. You must keep the dbspace and fragmentation schema in mind, however, because the data values of the destination table still reside in the same dbspace. MOVE TABLE does not provide a mechanism to move data from one dbspace to another.

The MOVE TABLE statement can only move tables between databases. Use the RENAME TABLE statement to move a table within the same database.

Considerations When Using the MOVE TABLE Statement

All user-defined indexes on *source table*, including detached and globally detached indexes, are preserved in the destination table. All system-generated indexes are dropped, except those whose constraints are preserved. For more information on constraints, see "Moving Tables with Constraints" on page 2-421.

By default, if any views exist that depend on *source table*, MOVE TABLE fails with an error. But if you specify CASCADE mode, then those views are dropped and MOVE TABLE succeeds. Remote views referring to *source table* are not checked. This functionality is similar to that of the DROP TABLE statement.

Like views, remote synonyms for *source table* are not checked. Any statement that refers to such synonyms after *source table* is moved returns an error message, indicating that the specified table does not exist.

Stored procedures referring to *source table* are not modified. If a stored procedure referencing *source table* is executed after the table is moved, an error is returned saying the table does not exist.

All triggers associated with the source table are dropped.

If the source table has duplicate tables defined, the duplicate tables are dropped when the table is moved.

All local synonyms of *source table* are dropped when the table is moved. This includes synonyms created on the views that are dependant on *source table*.

All column distributions of *source table* are preserved in the destination table. Entries for *source table* in the **sysdistrib** system catalog table are moved. This ensures that the destination table has the same statistics as the source table. For this reason, you do not need to run the UPDATE STATISTICS statement after moving a table.

A *source table* of the MOVE TABLE statement receives a new **tabid** as if it were a newly created table. This means that system-defined names of objects that are dependent on *source table* are also affected. User-defined object names are preserved after the table is moved.

Moving Tables with Constraints

The following table-level constraints are preserved in MOVE TABLE operations:

- UNIQUE
- NOT NULL
- CHECK
- PRIMARY KEY

All source table defaults are also preserved.

If you specify CASCADE mode, all referential constraints associated with *source table* are dropped when the MOVE TABLE statement executes. As part of this, all system-generated indexes for these constraints are also dropped. If an index has been explicitly created, however, it is preserved in the destination table.

By default, MOVE TABLE statement returns an error if any existing referential constraint references *source table*.

If a child table of *source table* has ON DELETE CASCADE set, the data of the child table is not affected, but its corresponding referential constraint is dropped. This behavior is the same as with the DROP TABLE statement.

By default, if *source table* is a parent table, then the MOVE TABLE statement fails. If *source table* is a child table, however, the MOVE TABLE operation succeeds.

Renaming the Table

If you want to designate a different identifier or owner for the destination table, you can specify the RENAME clause of MOVE TABLE. If the destination database already has that identifier registered for any table, view or synonym, MOVE TABLE fails and returns an error. Also, if the new owner specified in this clause is an existing role name in the destination database, MOVE TABLE fails and returns an error. The RENAME clause that also specifies a new owner name does not change owner of the table objects, such as indexes or constraints. MOVE TABLE maintains the original owners of those objects after the table has moved. That is, the RENAME clause renames only the table, and not its objects.

Preserving Table Privileges

By default, no privileges that users or roles hold on *source table* persist on the new table. You can preserve these privileges in the new table, however, by using the WITH (PRIVILEGES) and WITH (PRIVILEGES, ROLES) clauses.

The WITH (PRIVILEGES) Option: This clause moves all access privileges on *source table* to the destination table. All entries for *source table* in the **systabauth** and **syscolauth** system catalog tables are transferred to *new table* in the destination database. If these entries specify a role, however, the role is ignored, and is also dropped from the source database. The following MOVE TABLE example preserves the user privileges of *source table* and changes the owner of *new table*:

```
MOVE TABLE customer TO DATABASE sales RENAME mary.customer WITH (PRIVILEGES);
```

The WITH (PRIVILEGES, ROLES) Option: This clause specifies that all privileges on *source table* to be moved to *new table*, including any privileges of roles. All entries for *source table* in the **systabauth** and **syscolauth** system catalog tables are transferred to the destination table. The following example preserves both user and role privileges in *new table*:

```
MOVE TABLE mytab TO DATABASE newdb WITH (PRIVILEGES, ROLES);
```

The MOVE TABLE statement returns an error if there is a conflict between user names and role names in the source and destination databases. If any roles that are preserved in the destination table are not defined in the destination database, an error is returned. It is the responsibility of the DBA to ensure that role names and user names are correctly defined in the source and destination databases.

The RESTRICT and CASCADE Options

You can use one of the RESTRICT or CASCADE keywords to specify how the MOVE TABLE statement treats dependencies among database objects. If you include neither of these keywords, the default mode is RESTRICT.

Specifying CASCADE Mode: The CASCADE keyword of MOVE TABLE removes the following database objects, if they exist, that are related to *source table*:

- Referential constraints that are defined on the table
- Views that are defined on the table
- Any violations table or diagnostics table that is associated with the table

Specifying RESTRICT Mode: The RESTRICT keyword has no effect unless *source table* has one or more referential constraints or views defined on it, or unless a violations or diagnostics table is associated with it. If you explicitly specify RESTRICT (or equivalently, if you do not specify CASCADE, thereby making RESTRICT the default mode), the MOVE TABLE operation fails with an error if any of the following conditions are true for *source table*:

- One or more referential constraints are defined on the table
- One or more views are defined on the table
- A violations table or diagnostics table is associated with the table

Unlike the DROP TABLE statement, whose default mode is CASCADE, the RESTRICT mode is the default mode for the MOVE TABLE statement.

Physically Moving Data to Another Database

MOVE TABLE cannot be used if you need to physically move the table data from one database to another. In this case, you need to perform the following steps:

1. Use CREATE TABLE to create a new table, with an appropriate schema, in the destination database.
2. Use the INSERT INTO .... SELECT FROM statement to transfer the data from the source table to the destination table
3. Use the DROP TABLE statement to drop the original table.

You must also recreate any table objects, including indexes and fragmentation strategies, and verify that there is sufficient disk space to move the data.

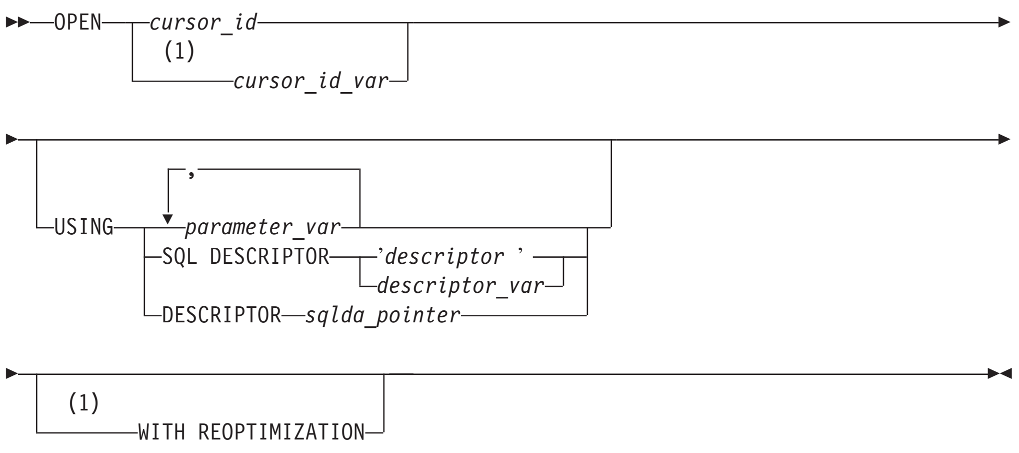
Related Information

Related statements: CREATE TABLE, DROP TABLE, INSERT, RENAME TABLE

OPEN

Use the OPEN statement to activate a cursor. Use this statement with ESQL/C.

Syntax



Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
cursor_id	Name of a cursor	Must have been declared	"Identifier" on page 5-22
cursor_id_var	Host variable = *cursor_id*	Must be a character data type	Language specific
descriptor	Name of a system-descriptor area	Must have been allocated	"Quoted String" on page 4-142
descriptor_var	Host variable that identifies the system-descriptor area	System-descriptor area must have been allocated	"Quoted String" on page 4-142
parameter_var	Host variable whose contents replace a question (?) mark placeholder in a prepared statement	Must be a character or collection data type	Language specific
sqlda_pointer	Pointer to **sqlda** structure defining data type and memory location of values to replace question (?) marks in a prepared statement	Cannot begin with a dollar ($) sign nor with a colon (:). You must use an **sqlda** structure with dynamic SQL statements.	"DESCRIBE" on page 2-281

Usage

A *cursor* is a database object that can contain an ordered set of values. The OPEN statement activates a cursor that the DECLARE statement created.

Cursor can be classified by their associated SQL statements:

- A *select cursor*: a cursor that is associated with a SELECT statement
- A *function cursor*: a cursor that is associated with the EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement
- An *insert cursor*: a cursor that is associated with the INSERT statement
- A *collection cursor*: in Dynamic Server, a select or insert cursor that operates on a collection variable.

The specific actions that the database server takes differ, depending on the statement with which the cursor is associated. When you associate one of the previous statements with a cursor directly (that is, you do not prepare the statement and associate the statement identifier with the cursor), the OPEN statement implicitly prepares the statement.

In an ANSI-compliant database, you receive an error code if you try to open a cursor that is already open.

Opening a Select Cursor

When you open either a select cursor or an update cursor that is created with the SELECT... FOR UPDATE syntax, the SELECT statement is passed to the database server with any values that are specified in the USING clause. The database server processes the query to the point of locating or constructing the first row of the active set. The following example illustrates a simple OPEN statement in ESQL/C:

```
EXEC SQL declare s_curs cursor for select * from orders;
EXEC SQL open s_curs;
```

Opening an Update Cursor Inside a Transaction

If you are working in a database with explicit transactions, you must open an update cursor within a transaction. This requirement is waived if you declared the cursor using the WITH HOLD option.

Opening a Function Cursor

When you open a function cursor, the EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement is passed to the database server with any values that are specified in the USING clause.

The values in the USING clause are passed as arguments to the user-defined function. This user-defined function must be declared to accept values. (If the statement was previously prepared, the statement was passed to the database server when it was prepared.) The database server executes the function to the point where it returns the first set of values.

The following example illustrates a simple OPEN statement in ESQL/C:

```
EXEC SQL declare s_curs cursor for
   execute function new_func(arg1,arg2)
   into :ret_val1, :ret_val2;
EXEC SQL open s_curs;
```

In Extended Parallel Server, to re-create this example, use the CREATE PROCEDURE statement instead of the CREATE FUNCTION statement.

Reopening a Select or Function Cursor

The database server evaluates the values that are named in the USING clause of the OPEN statement only when it opens the select or function cursor. While the cursor is open, subsequent changes to program variables in the USING clause do not change the active set of the cursor.

In a database that is ANSI-compliant, you receive an error code if you try to open a cursor that is already open.

In a database that is not ANSI-compliant, a subsequent OPEN statement closes the cursor and then reopens it. When the database server reopens the cursor, it creates a new active set, based on the current values of the variables in the USING clause. If the variables have changed since the previous OPEN statement, reopening the cursor can generate an entirely different active set.

Even if the values of the variables are unchanged, the values in the active set can be different, in the following situations:

- If the user-defined function takes a different execution path from the previous OPEN statement on a function cursor
- If data in the table was modified since the previous OPEN statement on a select cursor

The database server can process most queries dynamically, without pre-fetching all rows when it opens the select or function cursor. Therefore, if other users are modifying the table at the same time that the cursor is being processed, the active set might reflect the results of these actions.

For some queries, the database server evaluates the entire active set when it opens the cursor. These queries include those with the following features:

- Queries that require sorting: those with an ORDER BY clause or with the DISTINCT or UNIQUE keyword
- Queries that require hashing: those with a join or with the GROUP BY clause

For these queries, any changes that other users make to the table while the cursor is being processed are not reflected in the active set.

Errors Associated with Select and Function Cursors

Because the database server is seeing the query for the first time, it might detect errors. In this case, it does not actually return the first row of data, but it resets the **SQLCODE** variable and the **sqlca.sqlcode** field of the **sqlca**. The value is either negative or zero, as the following table describes.

Code Value	Significance
Negative	An error was detected in the SELECT statement
Zero	The SELECT statement is valid

If the SELECT, SELECT...FOR UPDATE, EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement is valid, but no rows match its criteria, the first FETCH statement returns a value of `100` (`SQLNOTFOUND`), meaning no rows were found.

Tip: When you encounter an **SQLCODE** error, a corresponding **SQLSTATE** error value also exists. For information about how to view the message text, refer to the GET DIAGNOSTICS statement.

Opening an Insert Cursor

When you open an insert cursor, the cursor passes the INSERT statement to the database server, which checks the validity of the keywords and column names. The database server also allocates memory for an insert buffer to hold new data. (See "DECLARE" on page 2-260.)

An OPEN statement for a cursor that is associated with an INSERT statement cannot include a USING clause.

Example of Opening an Insert Cursor: The following ESQL/C example illustrates an OPEN statement with an insert cursor:

```
EXEC SQL prepare s1 from
   'insert into manufact values ('npr', 'napier')';
EXEC SQL declare in_curs cursor for s1;
EXEC SQL open in_curs;
EXEC SQL put in_curs;
EXEC SQL close in_curs;
```

Reopening an Insert Cursor: When you reopen an insert cursor that is already open, you effectively flush the insert buffer; any rows that are stored in the insert buffer are written into the database table. The database server first closes the cursor, which causes the flush and then reopens the cursor. For information about how to check errors and count inserted rows, see “Error Checking” on page 2-447.

In an ANSI-compliant database, you receive an error code if you try to open a cursor that is already open.

Opening a Collection Cursor (IDS)

You can declare both select and insert cursors on collection variables. Such cursors are called *collection cursors*. You must use the OPEN statement to activate these cursors.

Use the name of a collection variable in the USING clause of the OPEN statement. For more information on the use of OPEN ... USING with a collection variable, see “Fetching from a Collection Cursor (IDS)” on page 2-350 and “Inserting into a Collection Cursor (IDS)” on page 2-445.

USING Clause

The USING clause is required when the cursor is associated with a prepared statement that includes question-mark (?) placeholders, as follows:

- A SELECT statement with input parameters in its WHERE clause
- An EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement with input parameters as arguments of its user-defined function
- An INSERT statement with input parameters in its VALUES clause

You can supply values for these parameters in one of the following ways:

- You can specify one or more host variables.
- You can specify a system-descriptor area.
- You can specify a pointer to an **sqlda** structure.

For more information, see “PREPARE” on page 2-433.

If you know the number of parameters to be supplied at runtime and their data types, you can define the parameters that are needed by the statement as host variables in your program. You pass parameters to the database server by opening the cursor with the USING keyword, followed by the names of the variables. These variables are matched with the SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement question-mark (?) parameters in a one-to-one correspondence, from left to right.

You cannot include indicator variables in the list of variable names. To use an indicator variable, you must include the SELECT or EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement as part of the DECLARE statement.

You must supply one host variable name for each placeholder. The data type of each variable must be compatible with the corresponding type that the prepared statement requires. The following ESQL/C code fragment opens a select cursor and specifies host variables in the USING clause:

```
sprintf (select_1, "%s %s %s %s %s",
   "SELECT o.order_num, sum(total price)",
   "FROM orders o, items i",
   "WHERE o.order_date > ? AND o.customer_num = ?",
   "AND o.order_num = i.order_num",
   "GROUP BY o.order_num");
EXEC SQL prepare statement_1 from :select_1;
EXEC SQL declare q_curs cursor for statement_1;
EXEC SQL open q_curs using :o_date, :o.customer_num;
```

The following example illustrates the USING clause of the OPEN statement with an EXECUTE FUNCTION statement in an ESQL/C code fragment:

```
stcopy ("EXECUTE FUNCTION one_func(?, ?)", exfunc_stmt);
EXEC SQL prepare exfunc_id from :exfunc_stmt;
EXEC SQL declare func_curs cursor for exfunc_id;
EXEC SQL open func_curs using :arg1, :arg2;
```

In Extended Parallel Server, to re-create this example use the CREATE PROCEDURE statement instead of the CREATE FUNCTION statement.

Specifying a System Descriptor Area

If you do not know the number of parameters to be supplied at runtime or their data types, you can associate input values from a system-descriptor area. A system-descriptor area describes the data type and memory location of one or more values to replace question-mark (?) placeholders.

A system-descriptor area conforms to the X/Open standards.

Use the SQL DESCRIPTOR keywords to introduce the name of a system descriptor area as the location of the parameters.

The COUNT field in the system-descriptor area corresponds to the number of dynamic parameters in the prepared statement. The value of COUNT must be less than or equal to the number of item descriptors that were specified when the system-descriptor area was allocated with the ALLOCATE DESCRIPTOR statement. You can obtain the value of a field with the GET DESCRIPTOR statement and set the value with the SET DESCRIPTOR statement.

The following example shows the OPEN ... USING SQL DESCRIPTOR statement:

```
EXEC SQL allocate descriptor 'desc1';
...
EXEC SQL open selcurs using sql descriptor 'desc1';
```

As the example indicates, the system descriptor area must be allocated before you reference it in the OPEN statement.

Specifying a Pointer to an sqlda Structure (ESQL/C)

If you do not know the number of parameters to be supplied at runtime, or their data types, you can associate input values from an **sqlda** structure. An **sqlda** structure lists the data type and memory location of one or more values to replace question-mark (?) placeholders.

Use the DESCRIPTOR keyword to introduce a pointer to the **sqlda** structure as the location of the parameters.

The **sqlda** value specifies the number of input values that are described in occurrences of **sqlvar**. This number must correspond to the number of dynamic parameters in the prepared statement.

Example of Specifying a Pointer to an sqlda Structure: The following example shows an OPEN ... USING DESCRIPTOR statement:

```
struct sqlda *sdp;
...
EXEC SQL open selcurs using descriptor sdp;
```

Using the WITH REOPTIMIZATION Option

Use the WITH REOPTIMIZATION keywords to reoptimize your query plan. When you prepare SELECT, EXECUTE FUNCTION, or EXECUTE PROCEDURE statements, the database server uses a query plan to optimize the query. If you later modify the data associated with the prepared statement, you can compromise the effectiveness of the query plan for that statement. In other words, if you change the data, you might deoptimize your query. To ensure optimization of your query, you can prepare the statement again, or open the cursor again using the WITH REOPTIMIZATION option.

You should generally use the WITH REOPTIMIZATION option, because it provides the following advantages over preparing a statement again:

- Rebuilds only the query plan, rather than the entire statement
- Uses fewer resources
- Reduces overhead
- Requires less time

The WITH REOPTIMIZATION option forces the database server to optimize the query-design plan before it processes the OPEN cursor statement.

The following example uses the WITH REOPTIMIZATION keywords:

```
EXEC SQL open selcurs using descriptor sdp with reoptimization;
```

Relationship Between OPEN and FREE

The database server allocates resources to prepared statements and open cursors. If you execute a FREE *statement_id* or FREE *statement_id_var* statement, you can still open the cursor associated with the freed statement ID. If you release resources with a FREE *cursor_id* or FREE *cursor_id_var* statement, however, you cannot use the cursor unless you declare the cursor again.

Similarly, if you use the SET AUTOFREE statement for one or more cursors, when the program closes the specific cursor, the database server automatically frees the cursor-related resources. In this case, you cannot use the cursor unless you declare the cursor again.

3 ## DDL Operations on Tables Referenced by Cursors

3 Various DDL statements can drop, rename, or alter the schema of a table that is
3 referenced directly (or indirectly, by the identifier of a prepared statement) in the
3 DECLARE statement that defines a cursor. Subsequent OPEN operations on the
3 cursor might fail with error -710, or might produce unexpected results.

3 Adding an index to a table that is referenced directly or indirectly in a DECLARE
3 statement can similarly invalidate the associated cursor. Subsequent OPEN
3 statements that specify the invalid cursor fail, even if they include the WITH
3 REOPTIMIZATION keywords. If an index is added to the table that is associated

3 with a cursor, you must prepare the statement again and declare the cursor again
3 before you can open the cursor. You cannot simply reopen a cursor that is based
3 on a prepared statement that is no longer valid.

Related Information

Related statements: ALLOCATE DESCRIPTOR, DEALLOCATE DESCRIPTOR, DESCRIBE, CLOSE, DECLARE, EXECUTE, FETCH, FLUSH, FREE, GET DESCRIPTOR, PREPARE, PUT, SET AUTOFREE, SET DEFERRED_PREPARE, and SET DESCRIPTOR

For a task-oriented discussion of the OPEN statement, see the *IBM Informix Guide to SQL: Tutorial*.

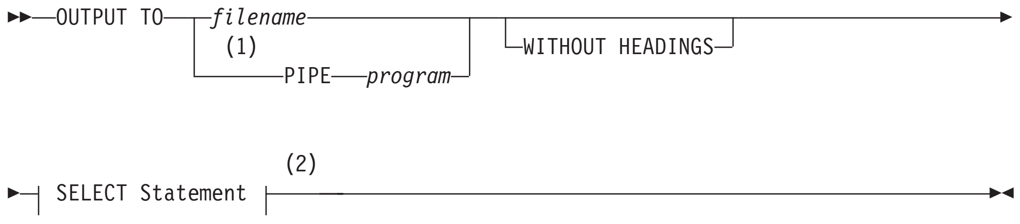
For more information on system-descriptor areas and the **sqlda** structure, refer to the *IBM Informix ESQL/C Programmer's Manual*.

OUTPUT

The OUTPUT statement writes query results in an operating-system file, or pipes query results to another program

This statement is an extension to the ANSI/ISO standard for SQL. You can use this statement only with DB–Access.

Syntax



Notes:

1 UNIX only

2 See “SELECT” on page 2-479

Element	Description	Restrictions	Syntax
filename	Path and filename where query results are written. The default path is the current directory.	Can specify a new or existing file. If the file exists, query results overwrite the current contents of the file.	Must conform to the rules of your operating system.
program	Name of a program to receive the query results as input	Program must exist, must be known to the operating system, and must be able to read the results of a query.	Must conform to the rules of your operating system.

Usage

You can use the OUTPUT statement to direct the results of a query to an operating-system file or to a program. You can also specify whether column headings should be omitted from the query output.

C-style comments are not valid within the OUTPUT statement.

Sending Query Results to a File

To send the results of a query to an operating-system file, specify the full pathname for the file. If the file already exists, the output overwrites the current contents.

The following examples show how to send the result of a query to an operating-system file. The example uses UNIX filenaming conventions.

```
OUTPUT TO /usr/april/query1
   SELECT * FROM cust_calls WHERE call_code = 'L'
```

Displaying Query Results Without Column Headings

To display the results of a query without column headings, use the WITHOUT HEADINGS keywords.

Sending Query Results to Another Program

In the UNIX environment, you can use the keyword PIPE to send the query results to another program, as the following example shows:

```
OUTPUT TO PIPE more
   SELECT customer_num, call_dtime, call_code
      FROM cust_calls
```

Related Information

Related statements: SELECT and UNLOAD

PREPARE

Use the PREPARE statement to parse, validate, and generate an execution plan for one or more SQL statements at runtime.

Use this statement with ESQL/C.

Syntax

```
►►──PREPARE──┬─statement_id─────┬──FROM──┬─' statement_text '─┬──────────────────────►◄
             └─statement_id_var─┘        └─statement_var──────┘
```

Element	Description	Restrictions	Syntax
statement_id	Identifier declared here for the prepared object	Must be unique in the database among names of cursors and prepared objects	"Identifier" on page 5-22
statement_id_var	Host variable storing *statement_id*	Must have been previously declared as a character data type	Language specific
statement_text	Text of the SQL statement(s) to prepare	See "Preparing Multiple SQL Statements" on page 2-439 and "Statement Text" on page 2-434.	"Quoted String" on page 4-142.
statement_var	Host variable storing the text of one or more SQL statements	Must be a character data type. Not valid if the SQL statement(s) contains the Collection-Derived-Table segment.	Language specific

Usage

The PREPARE statement enables your program to assemble the text of one or more SQL statements at runtime (creating a *prepared object*) and make it executable. This dynamic form of SQL is accomplished in three steps:

1. A PREPARE statement accepts statement text as input, either as a quoted string or stored within a character variable. Statement text can contain question-mark (?) placeholders to represent values that are to be defined when the statement is executed.
2. An EXECUTE or OPEN statement can supply the required input values and execute the prepared statement once or many times.
3. Resources allocated to the prepared statement can be released later using the FREE statement.

In Dynamic Server, the same collating order that is current when you create a prepared object is also used when that object is executed, even if the execution-time collation of the session (or of **DB_LOCALE**) is different.

Restrictions

The number of prepared objects in a single program is limited by available memory. These include statement identifiers declared in PREPARE statements (*statement_id* or *statement_id_var*) and declared cursors. To avoid exceeding the limit, use the FREE statement to release some statements or cursors.

The maximum length of a PREPARE statement is 64 kilobytes.

For restrictions on the statements in the character string, see "Restricted Statements in Single-Statement Prepares" on page 2-435 and "Restricted Statements in Multistatement Prepared Objects" on page 2-440.

Using a Statement Identifier

PREPARE sends the statement text to the database server, which analyzes the statement text. If the text contains no syntax errors, the database server translates it to an internal form. This translated statement is saved for later execution in a data structure that the PREPARE statement allocates. The name of the structure is the value that is assigned to the statement identifier in the PREPARE statement. Subsequent SQL statements can refer to the structure by using the same statement identifier that was used in the PREPARE statement.

A subsequent FREE statement releases the database server resources that were allocated to the statement. After you release these resources with FREE, you cannot use the statement identifier in a DECLARE statement or with the EXECUTE statement until you prepare the statement again.

Scope of Statement Identifiers

A program can consist of one or more source-code files. By default, the scope of reference of a statement identifier is global to the program. Therefore, a statement identifier that is prepared in one file can be referenced from another file.

In a multiple-file program, if you want to limit the scope of reference of a statement identifier to the file in which it is prepared, preprocess all the files with the -**local** command-line option.

Releasing a Statement Identifier

A statement identifier can represent only one SQL statement or series of statements at a time. A new PREPARE statement can specify an existing statement identifier if you want to bind the identifier to a different SQL statement text.

The PREPARE statement supports dynamic statement-identifier names, which allow you to prepare a statement identifier as an identifier or as a host variable of a data type that can contain a character string. The first example that follows shows a statement identifier that was specified as a host variable. The second specifies a statement identifier as a character string.

```
stcopy ("query2", stmtid);
EXEC SQL prepare :stmtid from 'select * from customer';

EXEC SQL prepare query2 from 'select * from customer';
```

The variable must be a character data type. In C, it must be declared as **`char`**.

Statement Text

The PREPARE statement can take statement text either as a quoted string or as text that is stored in a program variable. The following restrictions apply to the statement text:

- The text can contain only SQL statements. It cannot contain statements or comments from the host programming language.
- The text can contain comments preceded by a double hyphen (--), or that are enclosed in braces ({ }) or in C-style slash and asterisk (/* */) delimiters.

  These symbols introduce or enclose SQL comments. For more information on SQL comment symbols, see "How to Enter SQL Comments" on page 1-3.
- The text can contain either a single SQL statement or a series of statements that are separated by semicolon (;) symbols.

For a list of SQL statements that cannot be prepared, see "Restricted Statements in Single-Statement Prepares" on page 2-435. For more information on how to prepare multiple SQL statements, see "Preparing Multiple SQL Statements" on page 2-439.

- The text cannot include an embedded SQL statement prefix or terminator, such as a dollar sign ($) or the words EXEC SQL.
- Host-language variables are not recognized as such in prepared text.

  Therefore, you cannot prepare a SELECT (or EXECUTE FUNCTION or EXECUTE PROCEDURE) statement that includes an INTO clause, because the INTO clause requires a host-language variable.
- The only identifiers that you can use are names that are defined in the database, such as names of tables and columns. For more information on how to use identifiers in statement text, see "Preparing Statements with SQL Identifiers" on page 2-437.
- Use a question mark (?) as a placeholder to indicate where data is supplied when the statement executes, as in this ESQL/C example:

```
EXEC SQL prepare new_cust from
      'insert into customer(fname,lname) values(?,?)';
```

For more information on how to use question marks as placeholders, see "Preparing Statements That Receive Parameters" on page 2-437.

In Dynamic Server, if the prepared statement contains the Collection-Derived-Table segment or an ESQL/C collection variable, some additional limitations exist on how you can assemble the text for the PREPARE statement. For information about dynamic SQL, see the *IBM Informix ESQL/C Programmer's Manual*.

Preparing and Executing User-Defined Routines

The way to prepare a user-defined routine (UDR) depends on whether the UDR is a user-defined procedure or a user-defined function:

- To prepare a user-defined procedure, prepare the EXECUTE PROCEDURE statement that executes the procedure.

  To execute the prepared procedure, use the EXECUTE statement.
- To prepare a user-defined function, prepare the EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement that executes the function.

  You cannot include the INTO clause of EXECUTE FUNCTION (or EXECUTE PROCEDURE) in the PREPARE statement.

How to execute a prepared user-defined function depends on whether it returns only one group or multiple groups of values. Use the EXECUTE statement for user-defined functions that return only one group of values.

To execute user-defined functions that return more than one group of return values, you must associate the EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement with a cursor.

Restricted Statements in Single-Statement Prepares

In general, you can prepare any data manipulation language (DML) statement.

In Dynamic Server, you can prepare any single SQL statement except the following statements:

ALLOCATE COLLECTION
ALLOCATE DESCRIPTOR
ALLOCATE ROW
CLOSE
CONNECT
CREATE FUNCTION FROM
CREATE PROCEDURE FROM
CREATE ROUTINE FROM
DEALLOCATE COLLECTION
DEALLOCATE DESCRIPTOR
DEALLOCATE ROW
DECLARE
DESCRIBE
DISCONNECT
EXECUTE
EXECUTE IMMEDIATE
FETCH
FLUSH
FREE
GET DESCRIPTOR
GET DIAGNOSTICS
INFO
LOAD
OPEN
OUTPUT
PREPARE
PUT
SET AUTOFREE
SET CONNECTION
SET DEFERRED_PREPARE
SET DESCRIPTOR
UNLOAD
WHENEVER

In Extended Parallel Server, you can prepare any single SQL statement except the following statements:

ALLOCATE DESCRIPTOR
CLOSE
CONNECT
CREATE PROCEDURE FROM
DEALLOCATE DESCRIPTOR
DECLARE
DESCRIBE
DISCONNECT
EXECUTE
EXECUTE IMMEDIATE
FETCH
FLUSH
FREE
GET DESCRIPTOR
GET DIAGNOSTICS
INFO
LOAD
OPEN
OUTPUT
PREPARE
PUT
SET CONNECTION
SET DEFERRED_PREPARE
SET DESCRIPTOR
UNLOAD
WHENEVER

You can prepare a SELECT statement. If SELECT includes the INTO TEMP clause, you can execute the prepared statement with an EXECUTE statement. If it does not include the INTO TEMP clause, the statement returns rows of data. Use DECLARE, OPEN, and FETCH cursor statements to retrieve the rows.

A prepared SELECT statement can include a FOR UPDATE clause. This clause is used with the DECLARE statement to create an update cursor. The next example shows a SELECT statement with a FOR UPDATE clause in ESQL/C:

```
sprintf(up_query, "%s %s %s",
   "select * from customer ",
   "where customer_num between ? and ? ",
   "for update");
EXEC SQL prepare up_sel from :up_query;
EXEC SQL declare up_curs cursor for up_sel;
EXEC SQL open up_curs using :low_cust,:high_cust;
```

Preparing Statements When Parameters Are Known

In some prepared statements, all necessary information is known at the time the statement is prepared. The following example in ESQL/C shows two statements that were prepared from constant data:

```
sprintf(redo_st, "%s %s",
   "drop table workt1; ",
   "create table workt1 (wtk serial, wtv float)" );
EXEC SQL prepare redotab from :redo_st;
```

Preparing Statements That Receive Parameters

In some statements, parameters are unknown when the statement is prepared because a different value can be inserted each time the statement is executed. In these statements, you can use a question-mark (?) placeholder where a parameter must be supplied when the statement is executed.

The PREPARE statements in the following ESQL/C examples show some uses of question-mark (?) placeholders:

```
EXEC SQL prepare s3 from
   'select * from customer where state matches ?';
EXEC SQL prepare in1 from 'insert into manufact values (?,?,?)';
sprintf(up_query, "%s %s",
   "update customer set zipcode = ?"
   "where current of zip_cursor");
EXEC SQL prepare update2 from :up_query;
EXEC SQL prepare exfunc from
   'execute function func1 (?, ?)';
```

You can use a placeholder to defer evaluation of a value until runtime only for an expression, but not for an SQL identifier, except as noted in “Preparing Statements with SQL Identifiers” on page 2-437.

The following example of an ESQL/C code fragment prepares a statement from a variable that is named **demoquery**. The text in the variable includes one question-mark (?) placeholder. The prepared statement is associated with a cursor and, when the cursor is opened, the USING clause of the OPEN statement supplies a value for the placeholder:

```
EXEC SQL BEGIN DECLARE SECTION;
   char queryvalue [6];
   char demoquery  [80];
EXEC SQL END DECLARE SECTION;

EXEC SQL connect to 'stores_demo';
sprintf(demoquery, "%s %s",
      "select fname, lname from customer ",
      "where lname > ? ");
EXEC SQL prepare quid from :demoquery;
EXEC SQL declare democursor cursor for quid;
stcopy("C", queryvalue);
EXEC SQL open democursor using :queryvalue;
```

The USING clause is available in both OPEN statements that are associated with a cursor and EXECUTE statements (all other prepared statements).

You can use a question-mark (?) placeholder to represent the name of an ESQL/C or SPL collection variable.

Preparing Statements with SQL Identifiers

In general, you must specify SQL identifiers explicitly in the statement text when you prepare the statement. In a few special cases, however, you can use the question-mark (?) placeholder for an SQL identifier:

- For the database name in the DATABASE statement.

- For the dbspace name in the IN *dbspace* clause of the CREATE DATABASE statement.
- For the cursor name in statements that use cursor names.

Obtaining SQL Identifiers from User Input

If a prepared statement requires identifiers, but the identifiers are unknown when you write the prepared statement, you can construct a statement that receives SQL identifiers from user input.

The following ESQL/C example prompts the user for the name of a table and uses that name in a SELECT statement. Because this name is unknown until runtime, the number and data types of the table columns are also unknown. Therefore, the program cannot allocate host variables to receive data from each row in advance. Instead, this program fragment describes the statement into an **sqlda** descriptor and fetches each row with the descriptor. The fetch puts each row into memory locations that the program provides dynamically.

If a program retrieves all the rows in the active set, the FETCH statement would be placed in a loop that fetched each row. If the FETCH statement retrieves more than one data value (column), another loop exists after the FETCH, which performs some action on each data value:

```
#include <stdio.h>
EXEC SQL include sqlda;
EXEC SQL include sqltypes;
char *malloc( );

main()
{
   struct sqlda *demodesc;
   char tablename[19];
   int i;
EXEC SQL BEGIN DECLARE SECTION;
   char demoselect[200];
EXEC SQL END DECLARE SECTION;

/*  This program selects all the columns of a given tablename.
       The tablename is supplied interactively. */

EXEC SQL connect to 'stores_demo';
printf( "This program does a select * on a table\n" );
printf( "Enter table name: " );
scanf( "%s", tablename );
sprintf(demoselect, "select * from %s", tablename );

EXEC SQL prepare iid from :demoselect;
EXEC SQL describe iid into demodesc;

/* Print what describe returns */

for ( i = 0;  i < demodesc->sqld; i++ )
   prsqlda (demodesc->sqlvar + i);
/* Assign the data pointers. */

for ( i = 0;  i < demodesc->sqld; i++ )
   {
   switch (demodesc->sqlvar[i].sqltype & SQLTYPE)
      {
      case SQLCHAR:
         demodesc->sqlvar[i].sqltype = CCHARTYPE;
         /* make room for null terminator */
         demodesc->sqlvar[i].sqllen++;
         demodesc->sqlvar[i].sqldata =
            malloc( demodesc->sqlvar[i].sqllen );
         break;

      case SQLSMINT:    /* fall through */
      case SQLINT:      /* fall through */
      case SQLSERIAL:
         demodesc->sqlvar[i].sqltype = CINTTYPE;
         demodesc->sqlvar[i].sqldata =
            malloc( sizeof( int ) );
         break;
      /*  And so on for each type.  */
      }
   }

/* Declare and open cursor for select . */
EXEC SQL declare d_curs cursor for iid;
EXEC SQL open d_curs;

/* Fetch selected rows one at a time into demodesc. */
for( ; ; )
   {
   printf( "\n" );
   EXEC SQL fetch d_curs using descriptor demodesc;
   if ( sqlca.sqlcode != 0 )
       break;
   for ( i = 0;  i < demodesc->sqld; i++ )
      {
      switch (demodesc->sqlvar[i].sqltype)
         {
         case CCHARTYPE:
            printf( "%s: \"%s\n", demodesc->sqlvar[i].sqlname,
               demodesc->sqlvar[i].sqldata );
            break;
         case CINTTYPE:
            printf( "%s: %d\n", demodesc->sqlvar[i].sqlname,
               *((int *) demodesc->sqlvar[i].sqldata) );
            break;
         /* And so forth for each type... */
            }
      }
   }
EXEC SQL close d_curs;
EXEC SQL free d_curs;
/*  Free the data memory.  */

for ( i = 0;  i < demodesc->sqld; i++ )
   free( demodesc->sqlvar[i].sqldata );
free( demodesc );

printf ("Program Over.\n");
}

prsqlda(sp)
   struct sqlvar_struct *sp;

   {
   printf ("type = %d\n", sp->sqltype);
   printf ("len = %d\n", sp->sqllen);
   printf ("data = %lx\n", sp->sqldata);
   printf ("ind = %lx\n", sp->sqlind);
   printf ("name = %s\n", sp->sqlname);
   }
```

Preparing Multiple SQL Statements

You can execute several SQL statements as one action if you include them in the same PREPARE statement. Multistatement text is processed as a unit; actions are not treated sequentially. Therefore, multistatement text cannot include statements that depend on actions that occur in a previous statement in the text. For example, you cannot create a table and insert values into that table in the same prepared statement block.

If a statement in a multistatement prepare returns an error, the whole prepared statement stops executing. The database server does not execute any remaining statements. In most situations, compiled products return error-status information on the error, but do not indicate which statement in the text causes an error. You can use the **sqlca.sqlerrd[4]** field in the **sqlca** to find the offset of the errors.

In a multistatement prepare, if no rows are returned from a WHERE clause in the following statements, the database server returns `SQLNOTFOUND (100)`:

- UPDATE...WHERE...
- SELECT INTO TEMP...WHERE...
- INSERT INTO...WHERE...
- DELETE FROM...WHERE...

In the next example, four SQL statements are prepared into a single ESQL/C string called **query**. Individual statements are delimited with semicolons.

A single PREPARE statement can prepare the four statements for execution, and a single EXECUTE statement can execute the statements that are associated with the **qid** statement identifier:

```
sprintf (query,  "%s %s %s %s %s %s %s",
   "update account set balance = balance + ? ",
      "where acct_number = ?;",
   "update teller set balance = balance + ? ",
      "where teller_number = ?;",
   "update branch set balance = balance + ? ",
      "where branch_number = ?;",
   "insert into history values (?, ?);";
EXEC SQL prepare qid from :query;

EXEC SQL begin work;
EXEC SQL execute qid using
      :delta, :acct_number, :delta, :teller_number,
      :delta, :branch_number, :timestamp, :values;
EXEC SQL commit work;
```

Here the semicolons (;) are required as SQL statement-terminator symbols between each SQL statement in the text that **query** holds.

Restricted Statements in Multistatement Prepared Objects

In addition to the statements listed as exceptions in "Restricted Statements in Single-Statement Prepares" on page 2-435, you cannot use the following statements in the text of a multiple-statement prepared object:

CLOSE DATABASE	DROP DATABASE
CREATE DATABASE	RENAME DATABASE
DATABASE	SELECT (*with one exception*)

The following types of statements are also not valid in a multistatement prepare:

- Statements that can cause the current database to close during the execution of the multistatement sequence
- Statements that include references to TEXT or BYTE host variables

In general, you cannot use the SELECT statement in a multistatement prepare. The only form of the SELECT statement allowed in a multistatement prepare is a SELECT statement with an INTO temporary table clause.

Using Prepared Statements for Efficiency

To increase performance efficiency, you can use the PREPARE statement and an EXECUTE statement in a loop to eliminate overhead that redundant parsing and optimizing cause. For example, an UPDATE statement that is located within a WHILE loop is parsed each time the loop runs. If you prepare the UPDATE statement outside the loop, the statement is parsed only once, eliminating overhead and speeding statement execution. The following example shows how to prepare an ESQL/C statement to improve performance:

```
EXEC SQL BEGIN DECLARE SECTION;
   char disc_up[80];
   int cust_num;
EXEC SQL END DECLARE SECTION;
main()
{
   sprintf(disc_up, "%s %s","update customer ",
      "set discount = 0.1 where customer_num = ?");
   EXEC SQL prepare up1 from :disc_up;
   while (1)
      {
      printf("Enter customer number (or 0 to quit): ");
      scanf("%d", cust_num);
      if (cust_num == 0)
         break;
      EXEC SQL execute up1 using :cust_num;
      }
}
```

3 Like the SQL statement cache, prepared statements can reduce how often the same
3 query plan is reoptimized, thereby conserving resources in some contexts. The
3 section “Prepared Statements and the Statement Cache” on page 2-599 discusses
3 the use of prepared DML statements, cursors, and the SQL statement cache as
3 combined or alternative techniques for improving query performance.

3 DDL Operations on Tables Referenced in Prepared Objects

3 Various DDL statements can drop, rename, or alter the schema of a table that a
3 prepared object references, but subsequent attempts to execute the prepared object
3 might fail with error -710, or might produce unexpected results.

3 Adding an index to a table that a prepared statement references can similarly
3 invalidate the prepared statement. A subsequent OPEN statement fails if the cursor
3 refers to the invalid prepared statement, even if the OPEN statement includes the
3 WITH REOPTIMIZATION keywords. If an index is added after the statement was
3 prepared, you must prepare the statement again and declare the cursor again. You
3 cannot simply reopen the cursor if it is based on a prepared statement that is no
3 longer valid.

Related Statements

Related statements: CLOSE, DECLARE, DESCRIBE, EXECUTE, FREE, OPEN, SET AUTOFREE, and SET DEFERRED_PREPARE

For information about basic concepts that relate to the PREPARE statement, see the *IBM Informix Guide to SQL: Tutorial*.

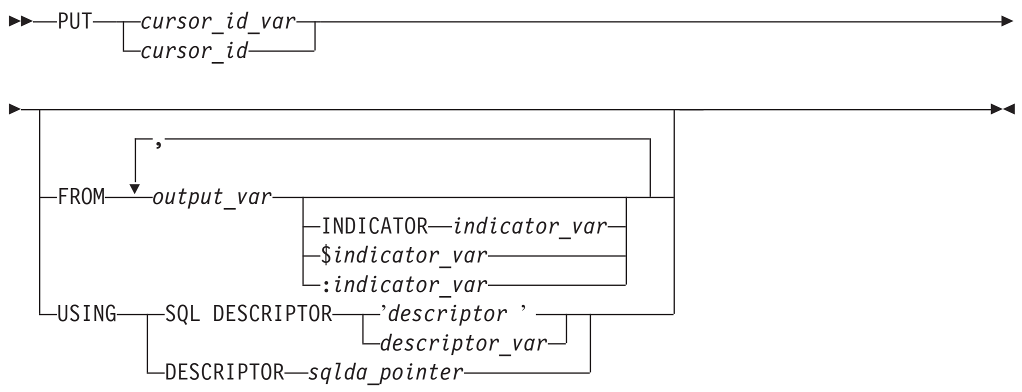
For information about more advanced concepts that relate to the PREPARE statement, see the *IBM Informix ESQL/C Programmer's Manual*.

PUT

Use the PUT statement to store a row in an insert buffer for later insertion into the database.

This statement is an extension to the ANSI/ISO standard for SQL. You can use this statement with ESQL/C.

Syntax



Element	Description	Restrictions	Syntax
cursor_id	Name of a cursor	Must be open	"Identifier" on page 5-22
cursor_id_var	Host variable = *cursor_id*	Must be a character type; cursor must be open	Language specific
descriptor	Name of a system-descriptor area	Must already be allocated	"Quoted String" on page 4-142
descriptor_var	Host-variable that contains *descriptor*	Must already be allocated	"Quoted String" on page 4-142
indicator_var	Host variable to receive a return code if corresponding *output_var* receives a NULL value	Cannot be a DATETIME or INTERVAL data type	Language specific
output_var	Host variable whose contents replace a question-mark (?) placeholder in a prepared INSERT statement	Must be a character data type	Language specific
sqlda_pointer	Pointer to an **sqlda** structure	First character cannot be the ($) or (:) symbol	"DESCRIBE" on page 2-281

Usage

PUT stores a row in an *insert buffer* that is created when the cursor is opened.

If the buffer has no room for the new row when the statement executes, the buffered rows are written to the database in a block, and the buffer is emptied. As a result, some PUT statement executions cause rows to be written to the database, and some do not. You can use the FLUSH statement to write buffered rows to the database without adding a new row. The CLOSE statement writes any remaining rows before it closes an insert cursor.

If the current database uses explicit transactions, you must execute a PUT statement within a transaction.

The following example uses a PUT statement in ESQL/C:

```
EXEC SQL prepare ins_mcode from
   'insert into manufact values(?,?)';
EXEC SQL declare mcode cursor for ins_mcode;
EXEC SQL open mcode;
EXEC SQL put mcode from :the_code, :the_name;
```

The PUT statement is not an X/Open SQL statement. Therefore, you get a warning message if you compile a PUT statement in X/Open mode.

Supplying Inserted Values

The values in the inserted row can come from one of the following sources:

- Constant values that are written into the INSERT statement
- Program variables that are named in the INSERT statement
- Program variables in the FROM clause of the PUT statement
- Values that are prepared in memory addressed by an **sqlda** structure or a system-descriptor area and then specified in the USING clause of the PUT statement

The system descriptor area or **sqlda** structure that *descriptor* or *sqlda_pointer* references must define a data type and memory location of each value that corresponds to a question-mark (?) placeholder in a prepared INSERT statement.

Using Constant Values in INSERT

The VALUES clause lists the values for the inserted columns. One or more of these values can be constants (that is, numbers or character strings).

When *all* the inserted values are constants, the PUT statement has a special effect. Instead of creating a row and putting it in the buffer, the PUT statement merely increments a counter. When you use a FLUSH or CLOSE statement to empty the buffer, one row and a repetition count are sent to the database server, which inserts that number of rows. In the following ESQL/C example, 99 empty customer records are inserted into the **customer** table. Because all values are constants, no disk output occurs until the cursor closes. (The constant zero for **customer_num** causes generation of a SERIAL value.) The following example inserts 99 empty customer records into the customer table:

```
int count;
EXEC SQL declare fill_c cursor for
   insert into customer(customer_num) values(0);
EXEC SQL open fill_c;
for (count = 1; count <= 99; ++count)
   EXEC SQL put fill_c;
EXEC SQL close fill_c;
```

Naming Program Variables in INSERT

When you associate the INSERT statement with a cursor (in the DECLARE statement), you create an insert cursor. In the INSERT statement, you can name program variables in the VALUES clause. When each PUT statement is executed, the contents of the program variables at that time are used to populate the row that is inserted into the buffer.

If you are creating an insert cursor (using DECLARE with INSERT), you must use only program variables in the VALUES clause. Variable names are not recognized in the context of a prepared statement; you associate a prepared statement with a cursor through its statement identifier.

The following ESQL/C example illustrates the use of an insert cursor. The code includes the following statements:

- The DECLARE statement associates a cursor called **ins_curs** with an INSERT statement that inserts data into the **customer** table.

  The VALUES clause specifies a data structure that is called **cust_rec**; the ESQL/C preprocessor converts **cust_rec** to a list of values, one for each component of the structure.
- The OPEN statement creates a buffer.
- A user-defined function (not defined within this example) obtains customer information from user input and stores it in **cust_rec**.
- The PUT statement composes a row from the current contents of the **cust_rec** structure and sends it to the row buffer.
- The CLOSE statement inserts into the **customer** table any rows that remain in the row buffer and closes the insert cursor:

```
int keep_going = 1;
EXEC SQL BEGIN DECLARE SECTION
   struct cust_row { /* fields of a row of customer table */ } cust_rec;
EXEC SQL END DECLARE SECTION
EXEC SQL declare ins_curs cursor for
      insert into customer values (:cust_row);
EXEC SQL open ins_curs;
while ( (sqlca.sqlcode == 0) && (keep_going) )


  {
keep_going = get_user_input(cust_rec); /* ask user for new customer */
   if (keep_going )                      /* user did supply customer info
*/
      {
      cust_rec.customer_num = 0;         /* request new serial value */
      EXEC SQL put ins_curs;
      }
   if (sqlca.sqlcode == 0)               /* no error from PUT */
      keep_going = (prompt_for_y_or_n("another new customer") =='Y')
   }
EXEC SQL close ins_curs;
```

Use an indicator variable if the data to be inserted might be NULL.

Naming Program Variables in PUT

When the INSERT statement is prepared (see “PREPARE” on page 2-433), you cannot use program variables in its VALUES clause, but you can represent values by a question-mark (?) placeholder. List the program variables in the FROM clause of the PUT statement to supply the missing values.

The following ESQL/C example lists host variables in a PUT statement:

```
char answer [1] = 'y';
EXEC SQL BEGIN DECLARE SECTION;
   char ins_comp[80];
   char u_company[20];
EXEC SQL END DECLARE SECTION;

main()
{
   EXEC SQL connect to 'stores_demo';
   EXEC SQL prepare ins_comp from
      'insert into customer (customer_num, company) values (0, ?)';
   EXEC SQL declare ins_curs cursor for ins_comp;
   EXEC SQL open ins_curs;

   while (1)
      {
      printf("\nEnter a customer: ");
```

```
         gets(u_company);
        EXEC SQL put ins_curs from :u_company;
        printf("Enter another customer (y/n) ? ");
        if (answer = getch() != 'y')
           break;
        }
     EXEC SQL close ins_curs;
     EXEC SQL disconnect all;
}
```

Indicator variables are optional, but you should use an indicator variable if the possibility exists that *output_var* might contain a NULL value. If you specify the indicator variable without the INDICATOR keyword, you cannot put a blank space between *output_var* and *indicator_var*.

Using the USING Clause

If you do not know the number of parameters to be supplied at runtime or their data types, you can associate input values from a system-descriptor area or an **sqlda** structure. Both of these descriptor structures describe the data type and memory location of one or more values to replace question-mark (?) placeholders.

Each time the PUT statement executes, the values that the descriptor structure describes are used to replace question-mark (?) placeholders in the INSERT statement. This process is similar to using a FROM clause with a list of variables, except that your program has full control over the memory location of the data values.

Specifying a System-Descriptor Area

The SQL DESCRIPTOR option specifies the name of a system-descriptor area.

The **COUNT** field in the system-descriptor area corresponds to the number of dynamic parameters in the prepared statement. The value of **COUNT** must be less than or equal to the number of item descriptors that were specified when the system-descriptor area was allocated with the ALLOCATE DESCRIPTOR statement. You can obtain the value of a field with the GET DESCRIPTOR statement and set the value with the SET DESCRIPTOR statement.

A system-descriptor area conforms to the X/Open standards.

The following ESQL/C example shows how to associate values from a system-descriptor area:

```
EXEC SQL allocate descriptor 'desc1';
...
EXEC SQL put selcurs using sql descriptor 'desc1';
```

Specifying an sqlda Structure

Use the **DESCRIPTOR** option to introduce the name of a pointer to an **sqlda** structure. The following ESQL/C example shows how to associate values from an **sqlda** structure:

```
EXEC SQL put selcurs using descriptor pointer2;
```

Inserting into a Collection Cursor (IDS)

A collection cursor allows you to access the individual elements of a collection variable. To declare a collection cursor, use the DECLARE statement and include the Collection-Derived-Table segment in the INSERT statement that you associate with the cursor. Once you open the collection cursor with the OPEN statement, the cursor can put elements in the collection variable.

To put elements, one at a time, into the insert cursor, use the PUT statement and the FROM clause. The PUT statement identifies the collection cursor that is associated with the collection variable. The FROM clause identifies the element value to be inserted into the cursor. The data type of any host variable in the FROM clause must match the element type of the collection.

Important: The collection variable stores the elements of the collection. However, it has no intrinsic connection with a database column. Once the collection variable contains the correct elements, you must then save the variable into the actual collection column with the INSERT or UPDATE statement.

Suppose you have a table called **children** with the following schema:

```
CREATE TABLE children
(
   age      SMALLINT,
   name     VARCHAR(30),
   fav_colors SET(VARCHAR(20)),
)
```

The following ESQL/C program fragment shows how to use an insert cursor to put elements into a collection variable called **child_colors**:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection child_colors;
   char *favorites[]
   (
      "blue",
      "purple",
      "green",
      "white",
      "gold",
      0
   );
   int a = 0;
   char child_name[21];
EXEC SQL END DECLARE SECTION;

EXEC SQL allocate collection :child_colors;

/* Get structure of fav_colors column for untyped
 * child_colors collection variable */
EXEC SQL select fav_colors into :child_colors
   from children where name = :child_name;
/* Declare insert cursor for child_colors collection
 * variable and open this cursor */
EXEC SQL declare colors_curs cursor for
   insert into table(:child_colors)
   values (?);
EXEC SQL open colors_curs;
/* Use PUT to gather the favorite-color values
 * into a cursor */
while (fav_colors[a])
{
   EXEC SQL put colors_curs from :favorites[:a];
   a++
   ...
}
/* Flush cursor contents to collection variable */
EXEC SQL flush colors_curs;
EXEC SQL update children set fav_colors = :child_colors;

EXEC SQL close colors_curs;
EXEC SQL deallocate collection :child_colors;
```

After the FLUSH statement executes, the collection variable, **child_colors**, contains the elements {"blue", "purple", "green", "white", "gold"}. The UPDATE statement at the end of this program fragment saves the new collection into the **fav_colors** column of the database. Without this UPDATE statement, the new collection would not be added to the collection column.

Writing Buffered Rows

To open an insert cursor, the OPEN statement creates an insert buffer. The PUT statement puts a row into this insert buffer. The buffered rows are inserted into the database table as a block only when necessary; this process is called *flushing the buffer*. The buffer is flushed after any of the following events:

- Buffer is too full to hold the new row at the start of a PUT statement.
- A FLUSH statement executes.
- A CLOSE statement closes the cursor.
- An OPEN statement specifies an already open cursor, closing it before reopening it. (This implicit CLOSE statement flushes the buffer.)
- A COMMIT WORK statement executes.
- Buffer contains BYTE or TEXT data (flushed after a single PUT statement).

If the program terminates without closing an insert cursor, the buffer remains unflushed. Rows that were inserted into the buffer since the last flush are lost. Do not rely on the end of the program to close the cursor and flush the buffer.

Error Checking

The **sqlca** structure contains information on the success of each PUT statement as well as information that lets you count the rows that were inserted. The result of each PUT statement is contained in the following fields of the **sqlca**: **sqlca.sqlcode**, **SQLCODE**, and **sqlca.sqlerrd[2]**.

Data buffering with an insert cursor means that errors are not discovered until the buffer is flushed. For example, an input value that is incompatible with the data type of the column for which it is intended is discovered only when the buffer is flushed. When an error is discovered, buffered rows that were not inserted before the error are *not* inserted; they are lost from memory.

The **SQLCODE** field is set to 0 if no error occurs; otherwise, it is set to an error code. The third element of the **sqlerrd** array is set to the number of rows that were successfully inserted into the database:

- If any row is put into the insert buffer, but *not* written to the database, **SQLCODE** and **sqlerrd** are set to 0 (**SQLCODE** because no error occurred, and **sqlerrd** because no rows were inserted).
- If a block of buffered rows is written to the database during the execution of a PUT statement, **SQLCODE** is set to 0 and **sqlerrd** is set to the number of rows that was successfully inserted into the database.
- If an error occurs while the buffered rows are written to the database, **SQLCODE** indicates the error, and **sqlerrd** contains the number of successfully inserted rows. (The uninserted rows are discarded from the buffer.)

Tip: When you encounter an **SQLCODE** error, a **SQLSTATE** error value also exists. See the GET DIAGNOSTICS statement for details of how to obtain the message text.

To count the number of pending and inserted rows in the database:

1. Prepare two integer variables (for example, **total** and **pending)**.
2. When the cursor is opened, set both variables to `0`.
3. Each time a PUT statement executes, increment both **total** and **pending**.
4. Whenever a PUT or FLUSH statement executes or the cursor closes, subtract the third field of the **SQLERRD** array from **pending**.

At any time, (**total** - **pending)** represents the number of rows actually inserted. If no statements fail, **pending** contains zero after the cursor is closed. If an error occurs during a PUT, FLUSH, or CLOSE statement, the value that remains in **pending** is the number of uninserted (discarded) rows.

Related Statements

Related statements: ALLOCATE DESCRIPTOR, CLOSE, DEALLOCATE DESCRIPTOR, FLUSH, DECLARE, GET DESCRIPTOR, OPEN, PREPARE, and SET DESCRIPTOR

For a task-oriented discussion of the PUT statement, see the *IBM Informix Guide to SQL: Tutorial*.

For more information about error checking, the system-descriptor area, and the **sqlda** structure, see the *IBM Informix ESQL/C Programmer's Manual*.

RENAME COLUMN

Use the RENAME COLUMN statement to change the name of a column.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>--RENAME COLUMN--+--------+--table--.--old_column--TO--new_column--------------><
                   '-owner.-'
```

Element	Description	Restrictions	Syntax
new_column	Name that you declare here to replace *old_column*	Must be unique among column names in *table*. See also “How Triggers Are Affected.”	Identifier, p. 5-22
old_column	Column to rename	Must exist within *table*	Identifier, p. 5-22
owner	Owner of the table	Must be the owner of *table*	Owner Name, p. 5-43
table	Table that contains *old_column*	Must exist in the current database	Identifier, p. 5-22

Usage

You can rename a column of a table if any of the following conditions are true:

- You own the table or have Alter privilege on the table.
- You have the DBA privilege on the database.

In Extended Parallel Server, you cannot rename the columns of a fragmented table if the table is fragmented by range. For more information, see “RANGE Method Clause (XPS)” on page 2-195.

How Views and Check Constraints Are Affected

If you rename a column that appears in a view, the text of the view definition in the **sysviews** system catalog table is updated to reflect the new column name. If you rename a column that appears in a check constraint, the text of the check constraint in the **syschecks** system catalog table is updated to reflect the new column name.

How Triggers Are Affected

If you rename a column that appears within the definition a trigger, it is replaced with the new name only in the following instances:

- When it appears as part of a correlation name inside the FOR EACH ROW action clause of a trigger
- When it appears as part of a correlation name in the INTO clause of an EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement
- When it appears as a triggering column in the UPDATE clause

When the trigger executes, if the database server encounters a column name that no longer exists in the table, an error is returned.

Example of RENAME COLUMN

The following example assigns the new name of **c_num** to the **customer_num** column in the **customer** table:

```
RENAME COLUMN customer.customer_num TO c_num
```

Related Information

Related statements: ALTER TABLE, CREATE TABLE, CREATE TRIGGER, CREATE VIEW, and RENAME TABLE

RENAME DATABASE

Use the RENAME DATABASE statement to change the name of a database.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──RENAME DATABASE──┬────────┬──old_database──TO──new_database──────────────────►◄
                     └─owner.─┘
```

Element	Description	Restrictions	Syntax
new_database	New name that you declare here for *old_database*	Must be unique among database names of the current database server; must not be opened by any user when this statement is issued	Database Name, p. 5-15
old_database	Name that *new_database* replaces	Must exist on current database server, but it cannot be the name of the current database	Database Name, p. 5-15
owner	Owner of *old_database*	Must be the owner of the database	Owner, p. 5-43

Usage

You can rename a database if either of the following is true:

- You created the database.
- You have the DBA privilege on the database.

The RENAME DATABASE statement fails with error -9874, however, if the specified database contains a virtual table or a virtual index.

You can only rename databases of the database server to which you are currently connected.

You cannot rename a database from inside an SPL routine.

Related Information

Related statement: CREATE DATABASE

For information on how to update the three-part names of JAR files after you rename the database, see the *J/Foundation Developer's Guide*.

RENAME INDEX

Use the RENAME INDEX statement to change the name of an existing index.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──RENAME INDEX──┬──────────┬──old_index──TO──new_index──────────────────────►◄
                  └─owner.───┘
```

Element	Description	Restrictions	Syntax
new_index	New name that you declare here for the index	Name must be unique to the database (or to the session, if *old_index* is on a temporary table)	Identifier, p. 5-22
old_index	Index name that *new_index* replaces	Must exist, but it cannot be any of the following: -- An index on a system catalog table -- A system-generated constraint index -- A Virtual-Index Interface (VII)	Identifier, p. 5-22
owner	Owner of index	Must be the owner of *old_index*	Owner Name, p. 5-43

Usage

You can rename an index if you are the owner of the index or have the DBA privilege on the database.

When you rename an index, the database server changes the index name in the **sysindexes**, **sysconstraints**, **sysobjstate**, and **sysfragments** system catalog tables. (But for an index on a temporary table, no system catalog tables are updated.)

Indexes on system catalog tables cannot be renamed. If you want to change the name of a system-generated index that implements a constraint, use the ALTER TABLE ... DROP CONSTRAINT statement to drop the constraint, and then use the ALTER TABLE ... ADD CONSTRAINT statement to define a new constraint that has the same definition as the constraint that you dropped, but for which you declare the new name.

SPL routines that use the renamed index are reoptimized on their next use after the index is renamed.

Related Information

Related statements: ALTER INDEX, CREATE INDEX, and DROP INDEX

For a discussion of SPL-routine reoptimization, see your *IBM Informix Performance Guide*.

RENAME SEQUENCE

Use the RENAME SEQUENCE statement to change the name of a sequence.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──RENAME SEQUENCE──┬──────────┬──old_sequence──TO──new_sequence──────────────►◄
                     └─owner.───┘
```

Element	Description	Restrictions	Syntax
new_sequence	New name that you declare here for an existing sequence	Must be unique among the names of sequences, tables, views, and synonyms in the database	Identifier, p. 5-22
old_sequence	Current name of a sequence	Must exist in the current database	Identifier, p. 5-22
owner	Owner of the sequence	Must be the owner of the sequence	Owner Name, p. 5-43

Usage

To rename a sequence, you must be the owner of the sequence, have the ALTER privilege on the sequence, or have the DBA privilege on the database.

You cannot use a synonym to specify the name of the sequence.

In a database that is not ANSI compliant, the name of *new_sequence* (or in an ANSI-compliant database, the combination of *owner***.***new_sequence*) must be unique among sequences, tables, views, and synonyms in the database.

Related Information

Related statements: ALTER SEQUENCE, CREATE SEQUENCE, DROP SEQUENCE, CREATE SYNONYM, DROP SYNONYM, GRANT, REVOKE, INSERT, UPDATE, and SELECT

For information about generating values from a sequence, see "NEXTVAL and CURRVAL Operators (IDS)" on page 4-61.

RENAME TABLE

Use the RENAME TABLE statement to change the name of a table.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──RENAME TABLE──┬────────┬──old_table──TO──┬──────────────────┬──new_table──────><
                  └─owner.─┘                 │ (1)              │
                                             └──────new_owner.──┘
```

Notes:

1 Extended Parallel Server only

Element	Description	Restrictions	Syntax
new_table	New name for *old_table*	Must be unique among the names of sequences, tables, views, and synonyms in the database	Identifier, p. 5-22
old_table	Name that *new_table* replaces	Must be the name (not the synonym) of a table that exists in the current database	Identifier, p. 5-22
owner	Current owner of the table	Must be the owner of the table.	Owner Name, p. 5-43
new_owner	New owner of the table (XPS only)	Must have DBA privilege on the database	Owner Name, p. 5-43

Usage

To rename a table, you must be the owner of the table, or have the ALTER privilege on the table, or have the DBA privilege on the database.

An error occurs if *old_table* is a synonym, rather than the name of a table.

The renamed table remains in the current database. You cannot use the RENAME TABLE statement to move a table from the current database to another database, nor to rename a table that resides in another database.

In Dynamic Server, you cannot change the table *owner* by renaming the table. An error occurs if you try to specify an *owner*. qualifier for the new name of the table.

In Extended Parallel Server, a user with DBA privilege on the database can change the owner of a table, if the table is local. Both the table name and owner can be changed by a single statement. The following example uses the RENAME TABLE statement to change the owner of a table:

```
RENAME TABLE tro.customer TO mike.customer
```

When the table owner is changed, you must specify both the old owner and new owner.

Important: When the owner of a table is changed, the existing privileges granted by the original owner are retained.

In Extended Parallel Server, you cannot rename a table that contains a dependent GK index.

In an ANSI-compliant database, if you are not the owner of *old_table*, you must specify *owner*.*old_table* as the old name of the table.

If *old_table* is referenced by a view in the current database, the view definition is updated in the **sysviews** system catalog table to reflect the new table name. For further information on the **sysviews** system catalog table, see the *IBM Informix Guide to SQL: Reference*.

If *old_table* is a triggering table, the database server takes these actions:

- Replaces the name of the table in the trigger definition but does *not* replace the table name where it appears inside any triggered actions
- Returns an error if the new table name is the same as a correlation name in the REFERENCING clause of the trigger definition

When the trigger executes, the database server returns an error if it encounters a table name for which no table exists.

You can reorganize the **items** table to move the **quantity** column from the fifth position to the third position by following these steps:

1. Create a new table, **new_table**, that contains the column **quantity** in the third position.
2. Fill the table with data from the current **items** table.
3. Drop the old **items** table.
4. Rename **new_table** with the name **items**.

The following example uses the RENAME TABLE statement as the last step:

```
CREATE TABLE new_table
   (
   item_num        SMALLINT,
   order_num        INTEGER,
   quantity        SMALLINT,
   stock_num        SMALLINT,
   manu_code        CHAR(3),
   total_price        MONEY(8)
   );
INSERT INTO new_table
   SELECT item_num, order_num, quantity, stock_num,
        manu_code, total_price    FROM items;
DROP TABLE items;
RENAME TABLE new_table TO items;
```

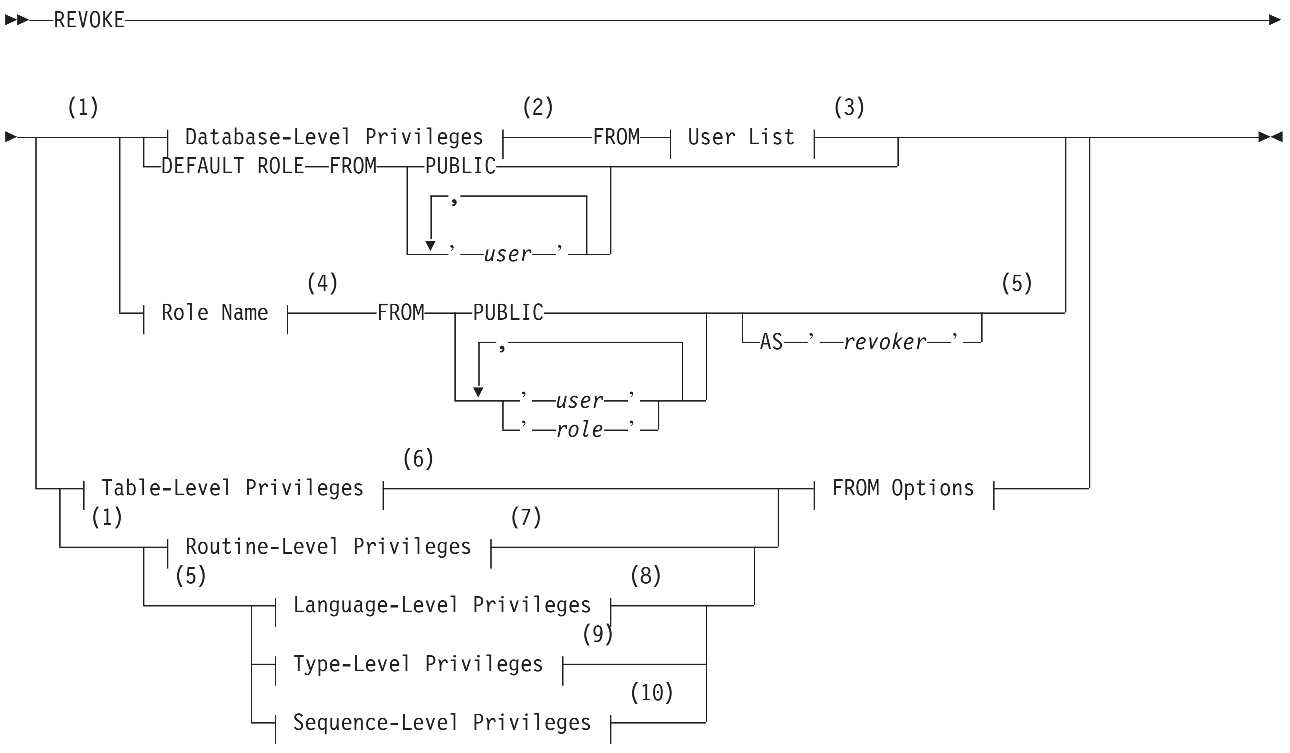
Related Information

Related statements: ALTER TABLE, CREATE TABLE, DROP TABLE, and RENAME COLUMN

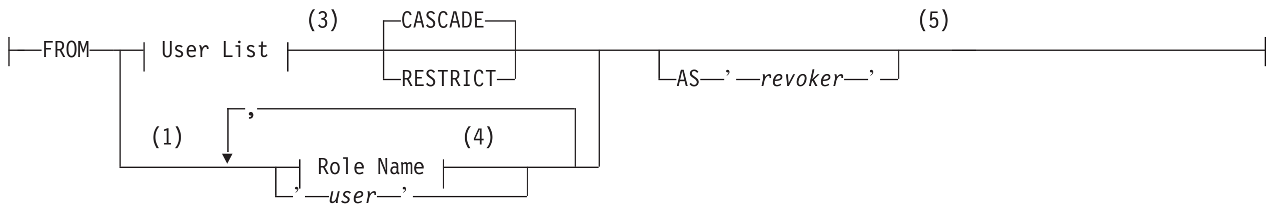
REVOKE

Use the REVOKE statement to cancel access privileges for PUBLIC, or for a list of users or roles, or to cancel a role for PUBLIC or for a list of users or roles.

Syntax



FROM Options:



Notes:

1 Informix extension

2 See page 2-457

3 See page 2-466

4 See page 2-466

5 Dynamic Server only

6 See page 2-459

7 See page 2-463

8 See page 2-464

9 See page 2-462

10 See page 2-465

Element	Description	Restrictions	Syntax
revoker	Authorization identifier of the grantor of the privileges to be revoked	Must be grantor of the specified privileges	Owner Name, p. 5-43
role	Role from which you revoke another role	Must exist	Owner Name, p. 5-43
user	User whose role (or default role) you cancel	Must exist	Owner Name, p. 5-43

Usage

To cancel privileges on one or more fragments of a table that has been fragmented by expression, see "REVOKE FRAGMENT" on page 2-471.

You can revoke privileges if any of the following conditions is true for the privileges that you are attempting to revoke on some database object:
- You granted them and did not designate another user as grantor.
- The GRANT statement specified you as grantor.
- You are revoking privileges from PUBLIC on an object that you own, and those privileges were granted by default when you created the object.
- You have database-level DBA privileges and you specify in the AS clause the name of a user who was grantor of the privilege.

The REVOKE statement can cancel any of the following access privileges or roles that a user, or PUBLIC, or a role currently holds:
- Privileges on the database (but a role cannot hold database-level privileges)
- Privileges on a table, synonym, view, or sequence object
- Privileges on a user-defined data type (UDT), a user-defined routine (UDR), or on the SPL language
- A non-default role, or the default role of PUBLIC or of a user.

You cannot revoke privileges from yourself. You cannot revoke *grantor* status from another user. To revoke a privilege that was granted to another user by the AS *grantor* clause of the GRANT statement, you must have the DBA privilege, and you must use the AS clause to specify that user as *revoker*.

If you enclose *revoker*, *role*, or *user* in quotation marks, the name is case sensitive and is stored exactly as you typed it. In an ANSI-compliant database, if you do not use quotation marks as delimiters, the name is stored in uppercase letters.

Database-Level Privileges

Database-Level Privileges:

```
|──┬─DBA──────┬──────────────────────────────────────────────────|
   ├─RESOURCE─┤
   └─CONNECT──┘
```

Three concentric layers of database-level privileges, Connect, Resource, and DBA, authorize increasing power over database access and control. Only a user with the DBA privilege can grant or revoke database-level privileges.

Because of the hierarchical organization of the privileges (as outlined in the privilege definitions that are described later in this section), if you revoke either the Resource or the Connect privilege from a user with the DBA privilege, the statement has no effect. If you revoke the DBA privilege from a user who has the DBA privilege, the user retains the Connect privilege on the database. To deny database access to a user with the DBA or Resource privilege, you must first revoke the DBA or the Resource privilege and then revoke the Connect privilege in a separate REVOKE statement.

Similarly, if you revoke the Connect privilege from a user who has the Resource privilege, the statement has no effect. If you revoke the Resource privilege from a user, the user retains the Connect privilege on the database.

Recommendation: Only user **informix** can modify system catalog tables directly. Except as noted specifically in your database server documentation, however, do not use DML statements to insert, delete, or update rows of system catalog tables directly, because modifying data in these tables can destroy the integrity of the database.

Only users or PUBLIC can hold database-level privileges. You cannot revoke these privileges from a role, because a role cannot hold database level privileges.

The following table lists the keyword for each database-level privilege.

Privilege	Effect
DBA	Has all the capabilities of the Resource privilege and can perform the following additional operations: • Grant any database-level privilege, including the DBA privilege, to another user. • Grant any table-level privilege to another user or to a role. • Grant a role to a user or to another role. • Revoke a privilege whose grantor you specify as the *revoker* in the AS clause of the REVOKE statement. • Restrict the Execute privilege to DBAs when registering a UDR. • Execute the SET SESSION AUTHORIZATION statement. • Create any database object. • Create tables, views, and indexes, designating another user as owner of these objects. • Alter, drop, or rename database objects, regardless of who owns it. • Execute the DROP DISTRIBUTIONS option of the UPDATE STATISTICS statement. 3 • Execute DROP DATABASE and RENAME DATABASE statements.
RESOURCE	Lets you extend the structure of the database. In addition to the capabilities of the Connect privilege, the holder of the Resource privilege can perform the following operations: • Create new tables. • Create new indexes. • Create new user-defined routines. • Create new data types.
CONNECT	If you have this privilege, you can query and modify data, and modify the database schema if you own the database object that you want to modify. A user holding the Connect privilege can perform the following operations: • Connect to the database with the CONNECT statement or another connection statement. • Execute SELECT, INSERT, UPDATE, and DELETE statements, provided that the user has the necessary table-level privileges. • Create views, provided that the user has the Select privilege on the underlying tables. • Create synonyms. • Create temporary tables and create indexes on temporary tables. • Alter or drop a table or an index, if the user owns the table or index (or has the Alter, Index, or References privilege on the table). • Grant privileges on a table, if the user owns the table (or was given privileges on the table with the WITH GRANT OPTION keyword).

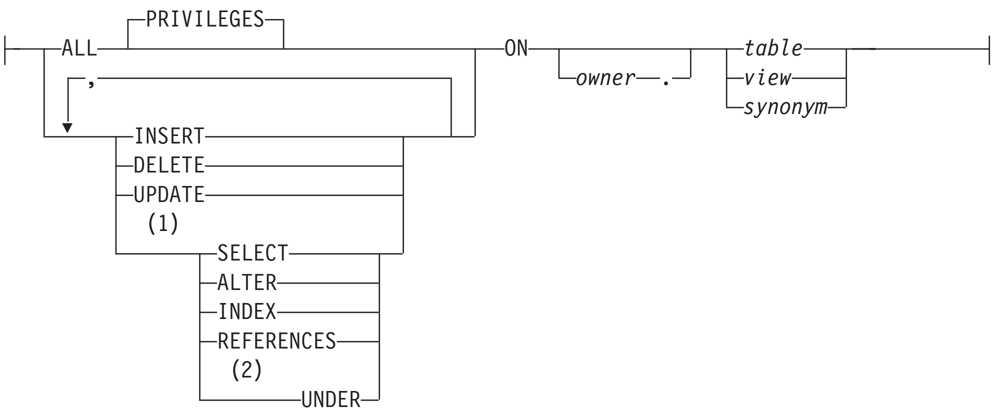
Table-Level Privileges

Table-level privileges, also called *table privileges*, specify which operations a user or role can perform on a table or view in the database. You can use a synonym to specify the table or view on which you grant or revoke table privileges.

Select, Update, and References privileges can be granted on a subset of the columns of a table or view, but can be revoked only for all columns. If Select privileges are revoked from a user for a table that is referenced in the SELECT statement defining a view that the same user owns, then that view is dropped, unless it also includes columns from tables in another database.

Use the following syntax to specifying which table-level privileges to revoke from one or more users or roles:

Table-Level Privileges:



Notes:

1 Informix extension

2 Dynamic Server only

Element	Description	Restrictions	Syntax
owner	Name of the user who owns the *table*, *view*, or *synonym*	Must be a valid authorization identifier	Owner Name, p. 5-43
synonym, table, view	Synonym, table, or view on which privileges are granted	Must exist in the current database	Identifier, p. 5-22

In one REVOKE statement, you can list one or more of the following keywords to specify the privileges on the specified table to be revoked from the users or roles.

Privilege	Effect after REVOKE
INSERT	User cannot insert rows.
DELETE	User cannot delete rows.
SELECT	User cannot display data retrieved by a SELECT statement.
UPDATE	User cannot change column values.
INDEX	User cannot create permanent indexes. You must have the Resource privilege to take advantage of the Index privilege. (But any user who has the Connect privilege can create indexes on temporary tables.)
ALTER	The holder cannot add or delete columns, modify column data types, add or delete constraints, change the locking mode of a table from PAGE to ROW, nor add or drop a corresponding named-ROW-type table. The user also cannot enable or disable indexes, constraints, nor triggers, as described in “SET Database Object Mode” on page 2-539.

Privilege	Effect after REVOKE
REFERENCES	User cannot reference columns in referential constraints. You must also have the Resource privilege on the database to take advantage of the References privilege on tables. (You can add, however, a referential constraint during an ALTER TABLE statement. without holding the Resource privilege on the database.) Revoking the References privilege disallows cascading DELETE operations.
UNDER (IDS)	User cannot create subtables under a typed table.
ALL	This removes all of the table privileges that are listed above. (Here the PRIVILEGES keyword is optional.)

See also "Table-Level Privileges" on page 2-374.

If a user receives the same privilege from two different grantors and one grantor revokes the privilege, the grantee still has the privilege until the second grantor also revokes the privilege. For example, if both you and a DBA grant the Update privilege on your table to **ted**, both you and the DBA must revoke the Update privilege to prevent **ted** from updating your table.

If user **ted** holds the same privileges through a role or as PUBLIC, however, this REVOKE operation does not prevent **ted** from exercising the Update privilege.

When to Use REVOKE Before GRANT

You can use combinations of REVOKE and GRANT to replace PUBLIC with specific users as grantees, and to remove table-level privileges on some columns.

Replacing PUBLIC with Specified Users: If a table owner grants a privilege to PUBLIC, the owner cannot revoke the same privilege from any specific user. For example, assume PUBLIC has default Select privileges on your **customer** table. Suppose that you issue the following statement in an attempt to exclude **ted** from accessing your table:

```
REVOKE ALL ON customer FROM ted
```

This statement results in ISAM error message 111, `No record found`, because the system catalog tables (**syscolauth** or **systabauth**) contain no table-level privilege entry for a user named **ted**. This REVOKE operation does not prevent **ted** from keeping all the table-level privileges given to PUBLIC on the **customer** table.

To restrict table-level privileges, first revoke the privileges with the PUBLIC keyword, then re-grant them to some appropriate list of users and roles. The following statements revoke the Index and Alter privileges from all users for the **customer** table, and then grant these privileges specifically to user **mary**:

```
REVOKE INDEX, ALTER ON customer FROM PUBLIC
GRANT INDEX, ALTER ON customer TO mary
```

Restricting Access to Specific Columns: Unlike GRANT, the REVOKE statement has no syntax to specify privileges on a subset of columns in a table. To revoke the Select, Update, or References privilege on a column from a user, you must revoke the privilege for all the columns of the table. To provide access to some of the columns on which you previously had granted privileges, issue a new GRANT statement to restore the appropriate privilege on specific columns.

The next example cancels Select privileges for PUBLIC on certain columns:

```
REVOKE SELECT ON customer FROM PUBLIC
GRANT SELECT (fname, lname, company, city) ON customer TO PUBLIC
```

In the next example, **mary** first receives the ability to reference four columns in **customer**, then the table owner restricts references to two columns:

```
GRANT REFERENCES (fname, lname, company, city) ON customer TO mary
REVOKE REFERENCES ON customer FROM mary
GRANT REFERENCES (company, city) ON customer TO mary
```

Effect of the ALL Keyword

The ALL keyword revokes all table-level privileges. If any or all of the table-level privileges do not exist for the revokee, REVOKE with the ALL keyword executes successfully but returns the following SQLSTATE code:

```
01006--Privilege not revoked
```

For example, assume that user **hal** has the Select and Insert privileges on the **customer** table. User **jocelyn** wants to revoke all seven table-level privileges from user **hal**. So user **jocelyn** issues the following REVOKE statement:

```
REVOKE ALL ON customer FROM hal
```

This statement executes successfully but returns SQLSTATE code 01006. The SQLSTATE warning is returned with a successful statement, as follows:

- The statement succeeds in revoking the Select and Insert privileges from user **hal** because user **hal** had those privileges.
- SQLSTATE code 01006 is returned because user **hal** lacked other privileges implied by the ALL keyword, so these privileges were not revoked.

The ALL keyword instructs the database server to revoke everything possible, including nothing. If the user from whom privileges are revoked has no privileges on the table, the REVOKE ALL statement still succeeds, because it revokes everything possible from the user (in this case, no privileges at all).

Effect of the ALL Keyword on UNDER Privilege (IDS): If you revoke ALL privileges on a typed table, the Under privilege is included in the privileges that are revoked. If you revoke ALL privileges on a table that is not based on a ROW type, the Under privilege is not included among the privileges that are revoked. (The Under privilege can be granted only on a typed table.)

Type-Level Privileges (IDS)

You can revoke two privileges on data types:

- The Usage privilege on a user-defined data type
- The Under privilege on a named ROW type

Type-Level Privileges:

```
|──┬─USAGE ON TYPE──type_name─┬──────────────────────────────────────|
   └─UNDER ON TYPE──row_type──┘
```

Element	Description	Restrictions	Syntax
row_type	Named ROW type for which to revoke Under privilege	Must exist	Data Type, p. 4-18
type_name	User-defined type for which to revoke Usage privilege	Must exist	Data Type, p. 4-18

Usage Privilege

Any user can reference a built-in data type in an SQL statement, but not a DISTINCT data type that is based on a built-in data type. The creator of a user-defined data type or a DBA must explicitly grant the Usage privilege on the UDT, including a DISTINCT data type based on a built-in data type.

REVOKE with the USAGE ON TYPE keywords removes the Usage privilege that you granted earlier to another user, to PUBLIC, or to a role.

Under Privilege

You own any named ROW data type that you create. If you want other users to be able to create subtypes under this named ROW type, you must grant these users the Under privilege on your named ROW type. If you later want to remove the ability of these users to create subtypes under the named ROW type, you must revoke the Under privilege from these users. A REVOKE statement with the UNDER ON TYPE keywords removes the Under privilege that you granted earlier to these users.

For example, suppose that you created a ROW type named **rtype1**:

```
CREATE ROW TYPE rtype1 (cola INT, colb INT)
```

If you want another user named **kathy** to be able to create a subtype under this named ROW type, you must grant the Under privilege on this named ROW type to user **kathy**:

```
GRANT UNDER ON TYPE rtype1 TO kathy
```

Now user **kathy** can create another ROW type under the **rtype1** ROW type even though **kathy** is not the owner of the **rtype1** ROW type:

```
CREATE ROW TYPE rtype2 (colc INT, cold INT) UNDER rtype1
```

If you later want to remove the ability of user **kathy** to create subtypes under the **rtype1** ROW type, enter the following statement:

```
REVOKE UNDER ON TYPE rtype1 FROM kathy
```

Routine-Level Privileges

If you revoke the Execute privilege on a UDR from a user, that user can no longer execute that UDR in any way. For details of how a user can execute a UDR, see “Routine-Level Privileges” on page 2-380.

Routine-Level Privileges:

```
|--EXECUTE ON------------------------------------------------------------->

>--+-SPL_routine-----------------------------------------------------+----|
   |  (1)                                                            |
   +----------+-PROCEDURE-+--routine--(--+------------------------+--)-+
   |          +-FUNCTION--+              |                    (2) |    |
   |          '-ROUTINE---'              '-| Routine Parameter List |-'    |
   |                                             (3)                    |
   '-SPECIFIC--+-ROUTINE---+--| Specific Name |-------------------------'
               +-FUNCTION--+
               '-PROCEDURE-'
```

Notes:

1 Dynamic Server only

2 See page 5-61

3 See page 5-68

Element	Description	Restrictions	Syntax
routine	A user-defined routine	Must exist	Database Object Name, p. 5-17
SPL_routine	An SPL routine	Must be unique in the database	Database Object Name, p. 5-17

In an ANSI-compliant database, the *owner* name must qualify the *routine* name, unless the user who issues the REVOKE statement is the owner of the routine.

In Dynamic Server, any negator function for which you grant the Execute privilege requires a separate, explicit, REVOKE statement.

When you create a UDR under any of the following circumstances, PUBLIC will not be granted Execute privilege by default. Therefore you must explicitly grant the Execute privilege before you can revoke it:

- You create the UDR in an ANSI-compliant database.
- You have DBA privilege and specify DBA after the CREATE keyword to restrict the Execute privilege to users with the DBA database-level privilege.
- The **NODEFDAC** environment variable is set to `yes` to prevent PUBLIC from receiving any privileges that are not explicitly granted.

But if you create a UDR with none of those conditions in effect, PUBLIC can execute your UDR without the GRANT EXECUTE statement. To limit who can executes your UDR, revoke Execute privilege FROM PUBLIC, and grant it to users (see “User List” on page 2-466) or roles (see “Role Name” on page 2-466).

In Dynamic Server, if two or more UDRs have the same name, use a keyword from this list to specify which of those UDRs a user list can no longer execute.

Keyword	UDR for Which Execution by the User is Prevented
SPECIFIC	The UDR identified by *specific name*
FUNCTION	Any function with the specified *routine name* (and parameter types that match *routine parameter list,* if specified)
PROCEDURE	Any procedure with the specified *routine name (*and parameter types that match *routine parameter list,* if specified)
ROUTINE	Functions or procedures with the specified *routine name (*and parameter types that match *routine parameter list,* if specified)

Language-Level Privileges (IDS)

A user must have the Usage privilege on SPL to register a UDR written in SPL.

Language-Level Privileges:

```
├──USAGE ON LANGUAGE──SPL──────────────────────────────────────────────┤
```

When a user registers a UDR that is written in SPL, Dynamic Server verifies that the user has the Usage privilege on the SPL language. If the user does not, the CREATE FUNCTION or CREATE PROCEDURE statement fails with an error. (The C language and the Java language do not require the Usage privilege.)

To revoke the Usage privilege on the SPL language from a user or role, issue a REVOKE statement that includes the USAGE ON LANGUAGE SPL keywords. If this statement succeeds, any user or role that you specify in the FROM clause can no longer register UDRs that are written in the specified language. For example, if you revoke the default Usage privilege on SPL from PUBLIC, the ability to create SPL routines is taken away from all users:

```
REVOKE USAGE ON LANGUAGE SPL FROM PUBLIC
```

You can issue a GRANT USAGE ON LANGUAGE statement to restore Usage privilege on SPL to a restricted group, such as to the role named **developers**:

```
GRANT USAGE ON LANGUAGE SPL TO developers
```

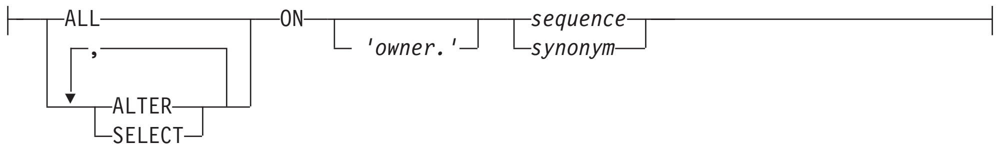
Sequence-Level Privileges (IDS)

Although Dynamic Server implements sequence objects as tables, only the following subset of the table privileges (as described in "Table-Level Privileges" on page 2-374) can be granted or revoked on a sequence:

- Select privilege
- Alter privilege

Use the following syntax to specify privileges to revoke on a sequence object:

Sequence-Level Privileges:



Element	Description	Restrictions	Syntax
owner	Owner of the sequence or of its synonym	Must be the owner	Owner Name, p. 5-43
sequence	Sequence on which to revoke privileges	Must exist	Identifier, p. 5-22
synonym	Synonym for a sequence object	Must point to a sequence	Identifier, p. 5-22

The sequence must reside in the current database. (You can qualify the *sequence* or *synonym* identifier with a valid *owner* name, but the name of a remote *database* (or *database@server*) is not valid as a qualifier.) Syntax to revoke sequence-level privileges is an extension to the ANSI/ISO standard for SQL.

Alter Privilege

You can revoke the Alter privilege on a sequence from another user or from a role. The Alter privilege enables a specified user or role to modify the definition of a sequence with the ALTER SEQUENCE statement or to rename the sequence with the RENAME SEQUENCE statement.

Select Privilege

You can revoke the Select privilege on a sequence from another user or from a role. Select privilege enables a user or role to use the *sequence*.**CURRVAL** and *sequence*.**NEXTVAL** in SQL statements to access and to increment the value of a sequence.

ALL Keyword

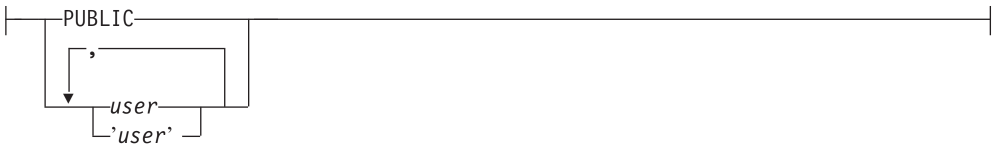
You can use the ALL keyword to revoke both Alter and Select privileges from another user or from a role.

User List

The authorization identifiers (or the PUBLIC keyword) that follow the FROM keyword of REVOKE specify who loses the revoked privileges or revoked roles. If you use the PUBLIC keyword as the user list, the REVOKE statement revokes the specified privileges or roles from PUBLIC, thereby revoking them from all users to whom the privileges or roles have not been explicitly granted, or who do not hold some other role through which they have received the role or privilege.

The *user list* can consist of the authorization identifier of a single user or of multiple users, separated by commas. If you use the PUBLIC keyword as the user list, the REVOKE statement revokes the specified privileges from all users.

User List:



Element	Description	Restrictions	Syntax
user	Login name of a user whose privilege or role you are revoking	Must be a valid authorization identifier	Owner Name, p. 5-43

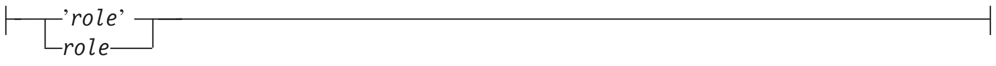
Spell the user names in the list exactly as they were spelled in the GRANT statement. You can optionally use quotes around each user name in the list to preserve the lettercase. In an ANSI-compliant database, if you do not use quotes to delimit *user*, the name of the user is stored in uppercase letters unless the **ANSIOWNER** environment variable was set to 1 before the database server was initialized.

When you specify login names, you can use the REVOKE statement and the GRANT statement to secure various types of database objects selectively. For examples, see "When to Use REVOKE Before GRANT" on page 2-461.

Role Name

Only the DBA or a user who was granted a role WITH GRANT OPTION can revoke a role or its privileges. Users cannot revoke roles from themselves.

Role Name:



Element	Description	Restrictions	Syntax
role	A role with one of these attributes: • Loses an existing privilege or role • Is lost by a user or by another role	Must exist. If enclosed between quotation marks, *role* is case sensitive.	Owner Name, p. 5-43

Immediately after the REVOKE keyword, the name of a *role* specifies a role to be revoked from the user list. After the FROM keyword, however, the name of a *role* specifies a role from which access privilege (or another role) is to be revoked. The same FROM clause can include both *user* and *role* names if no other REVOKE options conflict with the *user* or *role* specifications. Syntax to revoke privileges on a role or from a role are extensions to the ANSI/ISO standard for SQL.

When you include a *role* after the FROM keyword of the REVOKE statement, the specified privilege (or another role) is revoked from that role, but users who have that role retain any privileges or roles that were granted to them individually.

If you enclose *role* between quotation marks, the name is case sensitive and is stored exactly as you typed it. In an ANSI-compliant database, if you do not use quotation marks as delimiters, the *role* is stored in uppercase letters.

When you revoke a role that was granted to a user with the WITH GRANT OPTION keywords, you revoke both the role and the option to grant it.

The following examples show the effects of REVOKE *role*:

- Remove users or remove another role from inclusion in the specified role:
  ```
  REVOKE accounting FROM mary
  REVOKE payroll FROM accounting
  ```
- Remove one or more access privileges from a role:
  ```
  REVOKE UPDATE ON employee FROM accounting
  ```

When you revoke table-level privileges from a role, you cannot include the RESTRICT or CASCADE keywords.

Revoking a Default Role

The DBA or the owner of the database can define a *default role* for one or more users or for PUBLIC with the GRANT DEFAULT ROLE statement. Unlike a non-default role, which does not take effect until the SET ROLE statement activates the role, a default role takes effect automatically when the user connects to the database. The default role can specify a set of access privileges for all the users who are granted that default role. Conversely, the REVOKE DEFAULT ROLE statement cancels the specified *role* as the default role for the specified *user-list*, as in the following example:

```
REVOKE DEFAULT ROLE accounting FROM mary
```

This statement removes from user **mary** whatever privileges the default **accounting** role had conferred. If **mary** issues the SET ROLE DEFAULT statement, it has no effect until she is granted some new default role.

After you execute REVOKE DEFAULT ROLE specifying one or more users or PUBLIC, any privileges that those users held only through the default role are cancelled. (But this statement does not revoke any privileges that were granted to a user individually, or privileges that were granted to a user through another role, or privileges that PUBLIC holds.)

After REVOKE DEFAULT ROLE successfully cancels the default role of *user*, the default role of *user* becomes NULL, and the default role information is removed from the system catalog. (In this context, NULL and NONE are synonyms.)

No warning is issued if REVOKE DEFAULT ROLE specifies a user who has not been granted a default role.

No options besides the *user-list* are valid after the FROM keyword in the REVOKE DEFAULT ROLE statement.

Revoking the EXTEND Role (IDS)

The Database Server Administrator (DBSA), by default user **informix**, can grant the built-in EXTEND role to one or more users or to PUBLIC with the GRANT EXTEND TO *user-list* statement. Only users who have the EXTEND role can create or drop external UDRs that are written in the C or Java languages, both of which support shared libraries. (It is sufficient to hold the EXTEND role; it is not necessary to activate it with the SET ROLE statement for a user to be able to create and drop external UDRs.) Conversely, the REVOKE EXTEND FROM *user-list* statement cancels the EXTEND role of the specified users, preventing them from creating or dropping any external UDRs, as in the following example:

```
REVOKE EXTEND FROM 'max'
```

This statement prevents user **max** from creating or dropping external UDRs, even if **max** is the owner of a UDR that he subsequently attempts to drop.

In databases for which this security feature is not needed, the DBSA can disable this restriction on who can create or drop external UDRs by setting the IFX_EXTEND_ROLE configuration parameter to OFF in the ONCONFIG file. When IFX_EXTEND_ROLE is set to OFF, users with at least the Resource privilege on the database can create or drop external UDRs. See "Database-Level Privileges" on page 2-457 for information about the Resource privilege.

Revoking Privileges Granted WITH GRANT OPTION

If you revoke from *user* privileges or a role that you granted using the WITH GRANT OPTION keywords, you sever the chain of privileges granted by that *user*. Thus, when you revoke privileges from users or from a role, you also revoke the same privilege resulting from GRANT statements in the following contexts:

- Issued by your grantee
- Allowed because your grantee specified the WITH GRANT OPTION clause
- Allowed because subsequent grantees granted the same privilege or role using the WITH GRANT OPTION clause

The following examples illustrate this situation. You, as the owner of the table **items**, issue the following statements to grant access privileges to user **mary**:

```
REVOKE ALL ON items FROM PUBLIC
GRANT SELECT, UPDATE ON items TO mary WITH GRANT OPTION
```

User **mary** then uses her new privilege to grant users **cathy** and **paul** access to the **items** table:

```
GRANT SELECT, UPDATE ON items TO cathy
GRANT SELECT ON items TO paul
```

Later you revoke privileges on the **items** table from user **mary**:

```
REVOKE SELECT, UPDATE ON items FROM mary
```

This single statement effectively revokes all privileges on the **items** table from users **mary**, **cathy**, and **paul**.

The CASCADE keyword has the same effect as this default condition.

The AS Clause

Without the AS clause, the user who executes the REVOKE statement must be the grantor of the privilege that is being revoked. The DBA or the owner of the object can use the AS clause to specify another user (who must be the grantor of the privilege) as the revoker of the privileges. The AS clause provides the only mechanism by which privileges can be revoked on a database object whose *owner* is an authorization identifier, such as **informix**, that is not also a valid user account known to the operating system.

In Extended Parallel Server, the AS *revoker* clause is not valid in a REVOKE statement that cancels a *role*.

Effect of CASCADE Keyword on UNDER Privileges (IDS)

If you revoke the Under privilege on a typed table with the CASCADE option, the Under privilege is removed from the specified user, and any subtables created under the typed table by that user are dropped from the database.

If you revoke the Under privilege on a named ROW type with the CASCADE option when that data type is in use, the REVOKE fails. This exception to the default behavior of the CASCADE option occurs because the database server supports the DROP ROW TYPE statement with the RESTRICT keyword only.

For example, assume that user **jeff** creates a ROW type named **rtype1** and grants the Under privilege on that ROW type to user **mary**. User **mary** now creates a ROW type named **rtype2** under ROW type **rtype1** and grants the Under privilege on ROW type **rtype2** to user **andy.** Then user **andy** creates a ROW type named **rtype3** under ROW type **rtype2**.

If user **jeff** now tries to revoke the Under privilege on ROW type **rtype1** from user **mary** with the CASCADE option, the REVOKE statement fails, because ROW type **rtype2** is still in use by ROW type **rtype3**.

Controlling the Scope of REVOKE with the RESTRICT Option

The RESTRICT keyword causes the REVOKE statement to fail when any of the following dependencies exist:

- A view depends on a Select privilege that you are attempting to revoke.
- A foreign-key constraint depends on a References privilege that you attempt to revoke.
- You attempt to revoke a privilege from a user who subsequently granted this privilege to another user or to a role.

REVOKE does not fail if it specifies a user who has the right to grant the privilege to others but has not exercised that right. For example, assume that user **clara** specifies WITH GRANT OPTION when she grants the Select privilege on the **customer** table to user **ted**. Further assume that user **ted**, in turn, grants the Select privilege on the **customer** table to user **tania**. The following statement that **clara** issued has no effect, because **ted** has used his authority to grant the Select privilege:

```
REVOKE SELECT ON customer FROM ted RESTRICT
```

In contrast, if user **ted** does not grant the Select privilege to **tania** or to any other user, the same REVOKE statement succeeds. Even if **ted** does grant the Select privilege to another user, either of the following statements succeeds:

```
REVOKE SELECT ON customer FROM ted CASCADE
REVOKE SELECT ON customer FROM ted
```

Effect of Uncommitted Transactions

The REVOKE statement places an exclusive row lock on the entry in the **systables** system catalog table for the table on which privileges are revoked. This lock is not released until the transaction that contains the REVOKE statement terminates. When another transaction attempts to prepare a SELECT statement against this table while the first transaction is open, the concurrent transaction fails, because the systables row for the specified table remains exclusively locked. The attempt to prepare the SELECT statement cannot succeed until after the first transaction is either committed or rolled back.

Related Information

Related Statements: GRANT, GRANT FRAGMENT, and REVOKE FRAGMENT

For information about roles, see the following statements: CREATE ROLE, DROP ROLE, and SET ROLE.

For a discussion of privileges, see the *IBM Informix Database Design and Implementation Guide*.

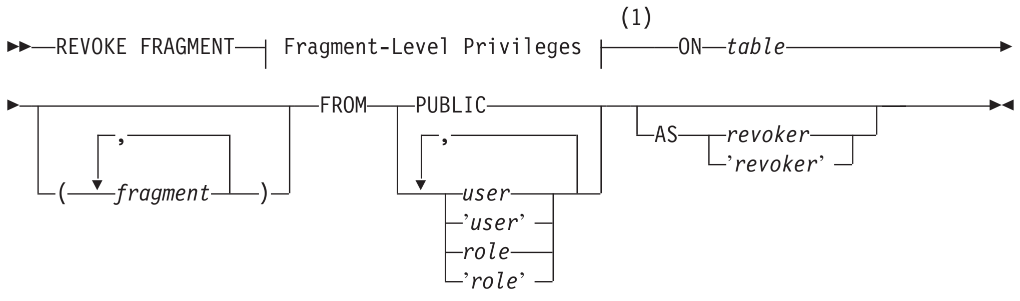
For a discussion of how to embed GRANT and REVOKE statements in programs, see the *IBM Informix Guide to SQL: Tutorial*.

REVOKE FRAGMENT

Use the REVOKE FRAGMENT statement to revoke from one or more users or roles the Insert, Update, or Delete fragment-level privileges that were granted on individual fragments of a table that has been fragmented by expression.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Notes:

1 See "Fragment-Level Privileges" on page 2-472

Element	Description	Restrictions	Syntax
fragment	Name of partition or dbspace that stores one fragment. Default is all fragments of *table*.	Must exist and must store a fragment of *table*	"Identifier" on page 5-22
revoker	User (who is not executing this statement) who was grantor of privileges to be revoked	Must be grantor of the fragment-level privileges	"Owner Name" on page 5-43
role	Role from whom privileges are to be revoked	Must exist in the database	"Owner Name" on page 5-43
table	Fragmented table whose fragment-level privileges are to be revoked	Must exist and must be fragmented by expression	"Database Object Name" on page 5-17
user	User from whom privileges are to be revoked	Must be a valid authorization identifier	"Owner Name" on page 5-43

Usage

The REVOKE FRAGMENT statement is a special case of the REVOKE statement for assigning privileges on table fragments. Use the REVOKE FRAGMENT statement to revoke the Insert, Update, or Delete privilege on one or more table fragments from one or more users or roles. The DBA can use this statement to revoke privileges on a fragment whose owner is another user.

The REVOKE FRAGMENT statement is valid only for tables that are fragmented by an expression-based distribution scheme. For an explanation of this fragmentation strategy, see "Expression Distribution Scheme" on page 2-18.

Specifying Fragments

If you specify no *fragment*, the privileges are revoked for all fragments of *table*. You can specify one fragment or a comma-separated list of fragments enclosed between parentheses that immediately follow the ON *table* specification.

Each *fragment* must be referenced by the name of the partition where it is stored. If you did not declare an explicit identifier when you created the partition, its name defaults to the name of the dbspace that contains the partition.

After a dbspace is renamed successfully by the onspaces utility, only the new name is valid. Dynamic Server automatically updates existing fragmentation strategies in the system catalog to substitute the new dbspace name, but you must specify the new name in REVOKE FRAGMENT statement to reference a fragment whose default name is the name of a renamed dbspace.

The FROM Clause

You can specify the PUBLIC keyword to revoke the specified fragment-level privileges from PUBLIC, thereby revoking the privileges from all users to whom the privileges have not been explicitly granted, or who do not hold a role through which they have received the privileges.

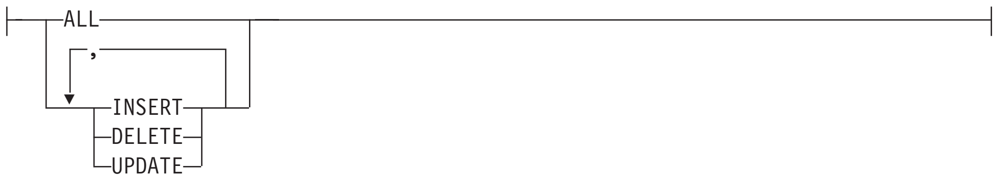
If you enclose *user* or *role* in quotation marks, the name is case sensitive and is stored exactly as you typed it. In an ANSI-compliant database, if you do not use quotes around *user* or around *role*, the name is stored in uppercase letters.

When you include a *role* in the FROM clause of REVOKE FRAGMENT, the specified fragment privilege is revoked from that role. Users who have that role, however, retain any fragment privileges they hold that were granted to them individually or to PUBLIC.

Fragment-Level Privileges

The keyword or keywords that follow the FRAGMENT keyword specify *fragment-level privileges*, which are a logical subset of table-level privileges:

Fragment-Level Privileges:



You can revoke fragment-level privileges individually or in combination. The following keywords specify the fragment-level privileges that you can revoke.

Keyword	Effect
INSERT	Prevents the user from inserting rows in the fragment
DELETE	Prevents the user from deleting rows in the fragment
UPDATE	Prevents the user from updating rows in the fragment
ALL	Cancels Insert, Delete, and Update privileges on a fragment

If you specify the ALL keyword in a REVOKE FRAGMENT statement, the specified users and roles lose all fragment-level privileges that they currently possess on the specified fragments. For example, assume that a user currently has the Update privilege on one fragment of a table. If you use the ALL keyword to revoke all current privileges on this fragment from this user, the user loses the Update privilege that he or she had on this fragment.

For the distinction between fragment-level and table-level privileges, see the sections Definition of Fragment-Level Authorization and “Effect of Fragment-Level Authorization in Statement Validation” on page 2-389.

The AS Clause

Without the AS clause, the user who executes the REVOKE statement must be a grantor of the privilege that is being revoked. The DBA or the owner of the fragment can use the AS clause to specify another user (who must be the grantor of the privilege) as the revoker of privileges on a fragment.

The AS clause provides the only mechanism by which privileges can be revoked on a fragment whose *owner* is an authorization identifier that is not a valid user account known to the operating system.

Examples of the REVOKE FRAGMENT Statement

Examples that follow are based on the **customer** table. They all assume that the **customer** table is fragmented by expression into three fragments that reside in partitions that are named **part1**, **part2**, and **part3**.

Revoking Privileges on One Fragment

The following statement revokes the Update privilege on the fragment of the **customer** table in **part1** from user **ed**:

```
REVOKE FRAGMENT UPDATE ON customer (part1) FROM ed
```

The following statement revokes the Update and Insert privileges on the fragment of the **customer** table in **part1** from user **susan**:

```
REVOKE FRAGMENT UPDATE, INSERT ON customer (part1) FROM susan
```

The following statement revokes all privileges currently granted to user **harry** on the fragment of the **customer** table in **part1**:

```
REVOKE FRAGMENT ALL ON customer (part1) FROM harry
```

Revoking Privileges on More Than One Fragment

The following statement revokes all privileges currently granted to user **millie** on the fragments of the **customer** table in **part1** and **part2**:

```
REVOKE FRAGMENT ALL ON customer (part1, part2) FROM millie
```

Revoking Privileges from More Than One User

The following statement revokes all privileges currently granted to users **jerome** and **hilda** on the fragment of the **customer** table in **part3**:

```
REVOKE FRAGMENT ALL ON customer (part3) FROM jerome, hilda
```

Revoking Privileges Without Specifying Fragments

The following statement revokes all current privileges from user **mel** on all fragments for which this user currently has privileges:

```
REVOKE FRAGMENT ALL ON customer FROM mel
```

Related Statements

Related statements: GRANT FRAGMENT and REVOKE

For a discussion of fragment-level and table-level privileges, see the section “Fragment-Level Privileges” on page 2-388. See also the *IBM Informix Database Design and Implementation Guide*.

ROLLBACK WORK

Use the ROLLBACK WORK statement to cancel a transaction deliberately and undo any changes that occurred since the beginning of the transaction. The ROLLBACK WORK statement restores the database to its state that existed before the transaction began.

Syntax

```
                  ┌─WORK─┐
►►──ROLLBACK──────┴──────┴──────────────────────────────────────────────►◄
```

Usage

The ROLLBACK WORK statement is valid only in databases that support transaction logging.

In a database that is not ANSI compliant, you start a transaction with the BEGIN WORK statement. You can end a transaction with the COMMIT WORK statement or cancel the transaction with a ROLLBACK WORK statement. The ROLLBACK WORK statement restores the database to the state that existed before the transaction began.

Use ROLLBACK WORK only at the end of a multistatement operation.

The ROLLBACK WORK statement releases all row and table locks that the cancelled transaction holds. If you issue a ROLLBACK WORK statement when no transaction is pending, an error occurs.

In an ANSI-compliant database, transactions are implicit. You do not need to mark the beginning of a transaction with a BEGIN WORK statement. You only need to mark the end of each transaction with a COMMIT WORK statement or cancel the transaction with a ROLLBACK WORK statement. If you issue a ROLLBACK WORK statement when no transaction is pending, the statement is accepted but has no effect.

In ESQL/C, the ROLLBACK WORK statement closes all open cursors except those that are declared as *hold cursors* (by including the WITH HOLD keywords). Hold cursors remain open after a transaction is committed or rolled back.

If you use the ROLLBACK WORK statement within an SPL routine that a WHENEVER statement calls, specify WHENEVER SQLERROR CONTINUE and WHENEVER SQLWARNING CONTINUE before the ROLLBACK WORK statement. This step prevents the program from looping if the ROLLBACK WORK statement encounters an error or a warning.

WORK Keyword

The WORK keyword is optional in a ROLLBACK WORK statement. The following two statements are equivalent:

```
ROLLBACK;

ROLLBACK WORK;
```

Related Statements

Related statements: BEGIN WORK and COMMIT WORK

For a discussion of transactions and ROLLBACK WORK, see the *IBM Informix Guide to SQL: Tutorial*.

SAVE EXTERNAL DIRECTIVES

Use the SAVE EXTERNAL DIRECTIVES statement to create external optimizer directives for a specified query, and save the directives in the database. These directives are applied automatically to subsequent instances of the same query.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
                                   ┌─,────────┐
                                   ▼          │
►►──SAVE EXTERNAL DIRECTIVES────directive─┴──┬─ACTIVE────┬──FOR──query──────────►◄
                                             ├─INACTIVE──┤
                                             └─TEST ONLY─┘
```

Element	Description	Restrictions	Syntax
directive	Optimizer directive valid for *query*	Must be valid for *query*	"Optimizer Directives" on page 5-34
query	Text of a valid SELECT statement	NULL string is not valid	"SELECT" on page 2-479

Usage

SAVE EXTERNAL DIRECTIVES associates one or more optimizer directives with a query, and stores a record of this association in the **sysdirectives** system catalog table, for subsequent use with queries that match the specified *query* string. This statement establishes an association between the list of optimizer directives and the text of a query, but it does not execute the specified *query*.

Only the DBA or user **informix** can execute SAVE EXTERNAL DIRECTIVES. Optimizer directives that it stores in the database are called *external directives*.

External Optimizer Directives

Like inline optimizer directives that are embedded within a query, external directives that SAVE EXTERNAL DIRECTIVES associates with the text of a query can improve performance in some queries for which the default behavior of the query optimizer is not satisfactory. Unlike inline directives, external directives can be applied without revising or recompiling existing applications.

Enabling External Directives for a Session

External directives are ignored if the EXT_DIRECTIVES parameter is set to 0 in the ONCONFIG file. In addition, the client system can disable this feature for its current session by setting the **IFX_EXTDIRECTIVES** environment variable to 0.

The following table shows whether external directives are disabled (OFF) or enabled (ON) for various combinations of valid **IFX_EXTDIRECTIVES** settings on the client system and valid EXT_DIRECTIVES settings on Dynamic Server:

	EXT_DIRECTIVES = 0	**EXT_DIRECTIVES = 1**	**EXT_DIRECTIVES = 2**
IFX_EXTDIRECTIVES Not Set	OFF	OFF	ON
IFX_EXTDIRECTIVES = **1**	OFF	ON	ON
IFX_EXTDIRECTIVES = **0**	OFF	OFF	OFF

If EXT_DIRECTIVES is set to 1 or 2 when the database server is initialized, then the server is enabled for external directives. Individual sessions can enable or disable external directives by setting **IFX_EXTDIRECTIVES**, as the table shows. Any settings other than 1 or 2 are interpreted as zero, disabling this feature.

When external directives are enabled, the status of individual external directives is specified by the ACTIVE, INACTIVE, or TEST ONLY keywords. (But only queries on which directives are effective can benefit from external directives.)

The directive Specification

Each *directive* specification in the SAVE EXTERNAL DIRECTIVES statement must follow the syntax of the Optimizer Directives segment, as described in "Optimizer Directives" on page 5-34. If you specify more than one directive, separate them by a comma (,) symbol, as in the following example:

```
SAVE EXTERNAL DIRECTIVES /*+ AVOID_INDEX (table1 index1)*/, /*+ FULL(table1) */
       ACTIVE FOR
           SELECT /*+ INDEX( table1 index1 ) */  col1, col2
               FROM table1, table2 WHERE table1.col1 = table2.col1
```

This example associates AVOID_INDEX and FULL directives with the specified query. The inline INDEX directive is ignored by the query optimizer when the external directives are applied to a query that matches the SELECT statement.

The ACTIVE, INACTIVE, and TEST ONLY Keywords

You must include one of the ACTIVE, INACTIVE, or TEST ONLY keyword options to enable, disable, or restrict the scope of external directives:

- If external directives are enabled, the ACTIVE keyword applies the list of directives to any subsequent query that matches the *query* string.
- The INACTIVE keyword causes Dynamic Server to ignore the directive. (It is associated with the query in **sysdirectives**, but it is dormant, with no effect.)
- If external directives are enabled, the TEST ONLY keywords apply the directives only to matching queries that the DBA or user **informix** executes. Queries by any other users cannot use TEST ONLY external directives.

An INACTIVE directive has no effect unless the DBA or user **informix** changes the **sysdirectives.active** system catalog column value from zero (INACTIVE) to one (ACTIVE) or two (TEST ONLY) for that directive. External directives do not have SQL identifiers, but the DBA can reference the **sysdirectives.id** column in an UPDATE statement to specify which external directive to update.

Alternatively, the DBA or user **informix** can delete an INACTIVE or TEST ONLY row from **sysdirectives** and use the SET EXTERNAL DIRECTIVES statement to redefine the deleted directive, but now specifying the ACTIVE keyword. This can give other users access to TEST ONLY directives that the DBA has validated.

The query Specification

The *query* specification that follows the FOR keyword in SAVE EXTERNAL DIRECTIVES must specify the syntax of a valid SELECT statement, as described in "SELECT" on page 2-479. If the *query* text also includes any inline optimizer directives, the inline directives are ignored when external directives are applied to the query.

When external directives are enabled and the **sysdirectives** system catalog table is not empty, the database server compares every query with the *query* text of every ACTIVE external directive, and for queries executed by the DBA or user **informix**, with every TEST ONLY external directive. If an external directive has been applied to a query, output from the SET EXPLAIN statement indicates “EXTERNAL DIRECTIVES IN EFFECT” for that query.

The purpose of external directives is to improve the performance of queries that match the *query* string, but the use of such directives can potentially slow other queries, if the query optimizer must compare the *query* strings of a large number of active external directives with the text of every SELECT statement. For this reason, IBM recommends that the DBA not allow the **sysdirectives** table to accumulate more than a few ACTIVE rows. (Another way to avoid unintended performance impact on other queries is to disable this feature.)

If more than one SET EXTERNAL DIRECTIVES statements associate active external directives with the same query, the effect is unpredictable, because the optimizer uses the first sysdirectives row whose *query* string matches the query.

Related Statements

For information about optimizer directives and their syntax, see the segment “Optimizer Directives” in “Optimizer Directives” on page 5-34.

For information about the **sysdirectives** table and the **IFX_EXTDIRECTIVES** environment variable, see the *IBM Informix Guide to SQL: Reference*.

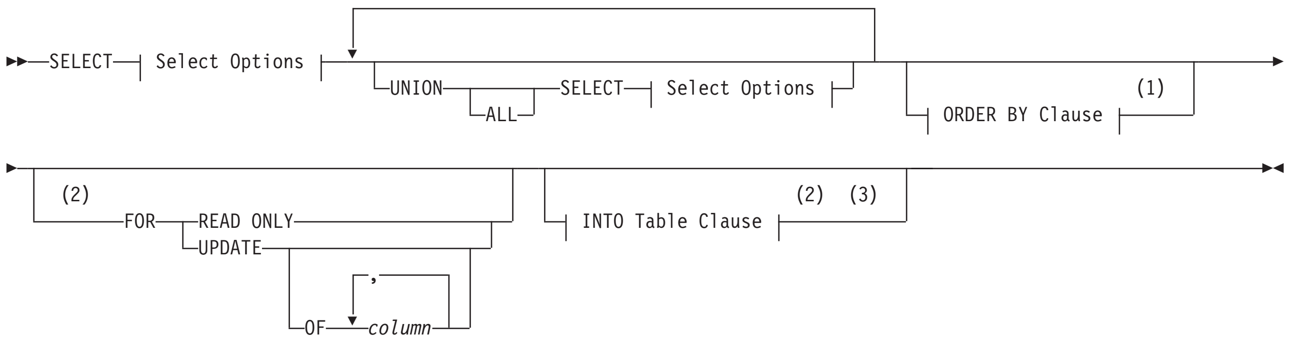
SELECT

3 Use the SELECT statement to retrieve values from a database or from an SPL or
3 ESQL/C collection variable. A SELECT operation is called a *query*.

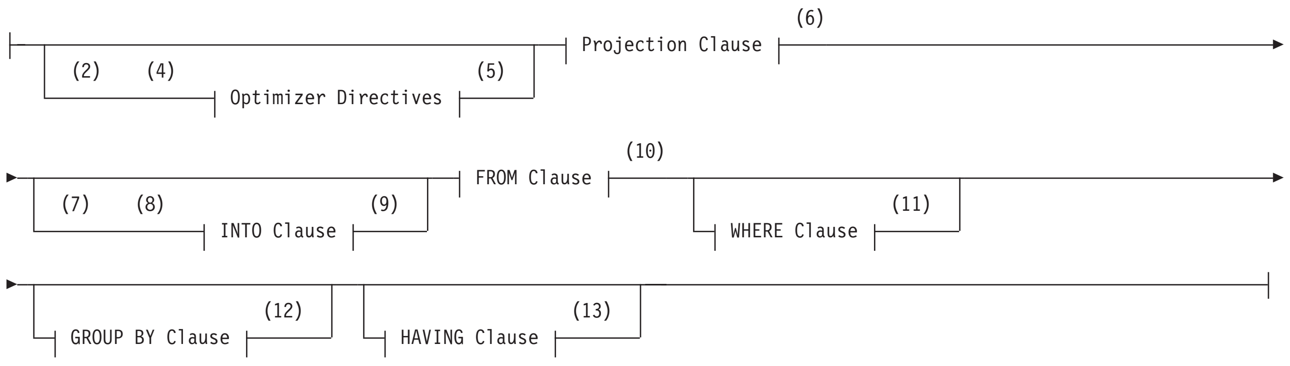
3 Rows or values that satisfy the specified search criteria of the query are called
3 *qualifying* rows or values. What the query retrieves to its calling context, after
3 applying any additional logical conditions, is called the *result set* of the query. This
3 result set can be empty.

3 You need the CONNECT privilege to execute a query, as well as the SELECT
3 privilege on the tables from which the query retrieves rows.

Syntax



Select Options:



Notes:

1 See "ORDER BY Clause" on page 2-515

2 Informix extension

3 See "INTO Table Clauses" on page 2-520

4 Dynamic Server only

5 See "Optimizer Directives" on page 5-34

6 See "Projection Clause" on page 2-481

7 ESQL/C only

8 Stored Procedure Language only

9 See “INTO Clause” on page 2-489

10 See “FROM Clause” on page 2-492

11 See “WHERE Clause” on page 2-507

12 See “GROUP BY Clause” on page 2-513

13 See “HAVING Clause” on page 2-514

Element	Description	Restrictions	Syntax
column	Name of a column that can be updated after a FETCH	Must be in a FROM clause *table*, but does not need to be in the select list of the Projection clause	“Identifier” on page 5-22

Usage

The SELECT statement can return data from tables in the current database, or in another database of the current database server, or in a database of another database server. Only the SELECT keyword, the Projection clause, and the FROM clause are required specifications.

The SELECT statement can include various basic clauses, which are identified in the following list.

Clause	Page	Effect
"Optimizer Directives" on page 5-34		Specifies how the query should be implemented
"Projection Clause"		Specifies a list of items to be read from the database
"INTO Clause" on page 2-489		Specifies variables to receive the result set
"FROM Clause" on page 2-492		Specifies the data sources of Projection clause items
"Using the ON Clause" on page 2-504		Specifies join conditions as pre-join filters
"WHERE Clause" on page 2-507		Sets conditions on qualifying rows and post-join filters
"GROUP BY Clause" on page 2-513		Combines groups of rows into summary results
"HAVING Clause" on page 2-514		Sets conditions on the summary results
"ORDER BY Clause" on page 2-515		Sorts qualifying rows according to column values
"FOR UPDATE Clause" on page 2-518		Enables updating of the result set after a FETCH
"Using the FOR READ ONLY Clause in Read-Only Mode" on page 2-520		Disables updating of the result set after a FETCH
"INTO TEMP Clause" on page 2-522		Puts the result set into a temporary table
"INTO EXTERNAL Clause (XPS)" on page 2-523		Stores the result set in an external table
"INTO SCRATCH Clause (XPS)" on page 2-524		Stores the result set in an unlogged temporary table
"UNION Operator" on page 2-524		Combines the result sets of two SELECT statements
"UNION Operator" on page 2-524		Same as UNION ALL, but discards duplicate rows

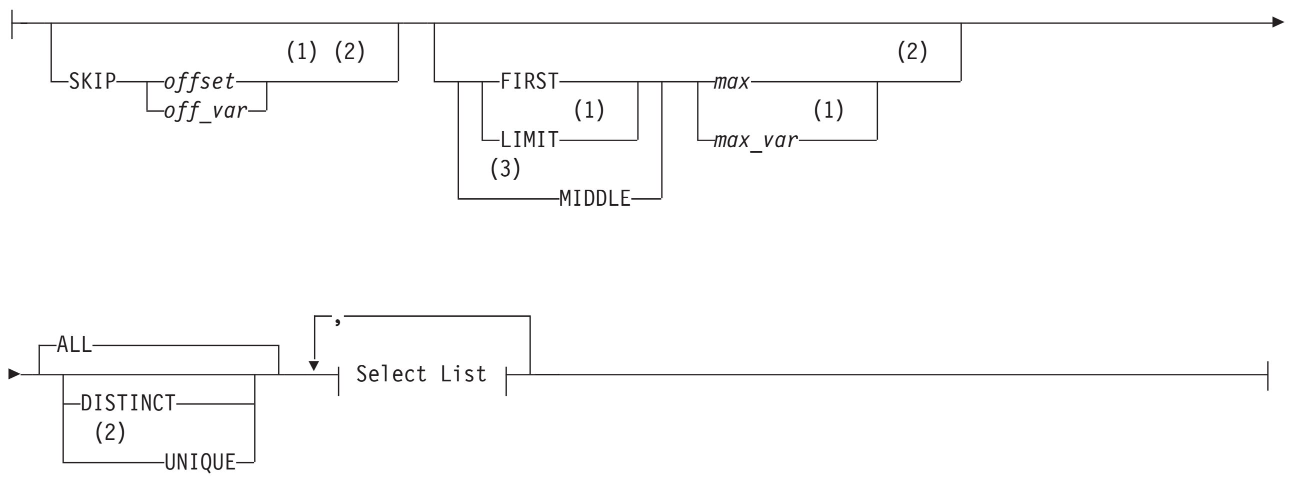
Sections that follow describe these clauses of the SELECT statement.

Projection Clause

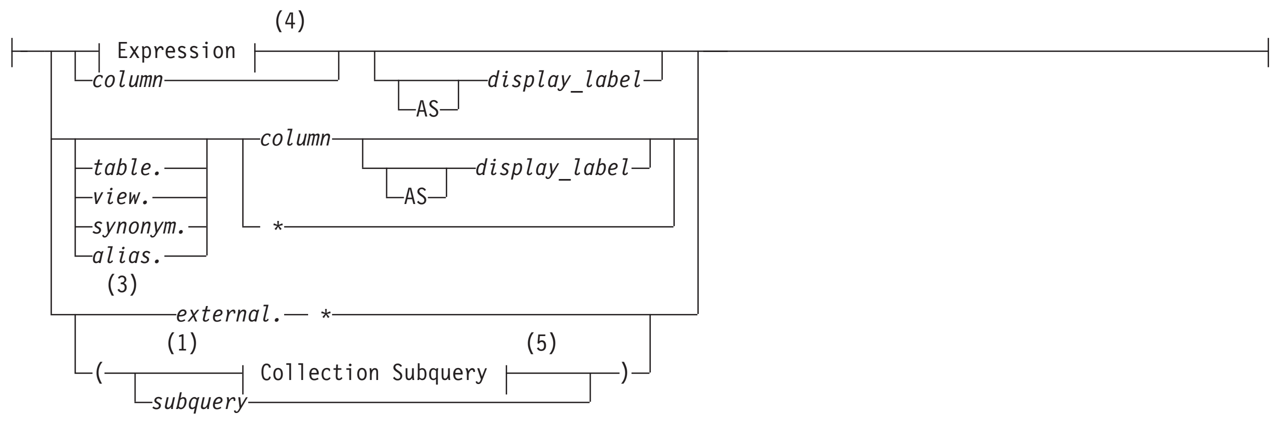
The Projection clause (sometimes called the *Select clause*) specifies a list of database objects or expressions to retrieve, and can set restrictions on qualifying rows. (The *select list* is sometimes also called the *projection list*.)

Projection Clause:

SELECT



Select List:



Notes:

1 Dynamic Server only

2 Informix extension

3 Extended Parallel Server only

4 See "Expression" on page 4-34

5 See "Collection Subquery" on page 4-3

Element	Description	Restrictions	Syntax
alias	Temporary *table* or *view* name. See "FROM Clause" on page 2-492.	Valid only if the FROM clause declares the *alias* for *table* or *view*	"Identifier" on page 5-22
column	Column from which to retrieve data	Must exist in a data source that the FROM clause references	"Identifier" on page 5-22
display _label	Temporary name declared here for a *column* or for an expression	See "Declaring a Display Label" on page 2-489	"Identifier" on page 5-22
external	External table from which to retrieve data	Must exist	"Database Object Name" on page 5-17
max	Integer (> 0) specifying maximum number of rows to return	If *max* > number of qualifying rows then all matching rows are returned	"Literal Number" on page 4-137
max_var	Host variable or local SPL variable storing the value of max	Same as *max*; valid in prepared objects and in SPL routines	Language dependent
offset	Integer (> 0) specifying how many qualifying rows to exclude before the first row of the result set	Cannot be negative. If *offset* > (number of qualifying rows), then no rows are returned	"Literal Number" on page 4-137
off_var	Host variable or local SPL variable storing the value of offset	Same as *offset*; valid in prepared objects and in user-defined routines	Language dependent
subquery	Embedded query	Cannot include the SKIP or FIRST clause nor the ORDER BY clause	"SELECT" on page 2-479
table, view, synonym	Name of a table, view, or synonym from which to retrieve data	The synonym and the table or view to which it points must exist	"Database Object Name" on page 5-17

The asterisk (*) specifies all columns in the *table* or *view* in their defined order. To retrieve all columns in another order, or a subset of columns, you must specify individual *column* names explicitly. A solitary asterisk (*) can be a valid Projection clause if the FROM clause specifies only a single data source.

The SKIP, FIRST, LIMIT, MIDDLE, DISTINCT, and UNIQUE specifications can restrict results to a subset of the qualifying rows, as sections that follow explain.

The Order of Qualifying Rows

To execute a query, the database server constructs a query plan and retrieves all qualifying rows that match the WHERE clause conditions. (Here a *row* refers to one set of values, as specified in the select list, from a single record in the table or joined tables that the FROM clause specifies.) If the query has no ORDER BY clause, the qualifying rows are sequenced in the order of their retrieval, which might vary with each execution; otherwise, their sequence follows the ORDER BY specification, as described in "ORDER BY Clause" on page 2-515.

Whether or not the query specifies ORDER BY can affect which qualifying rows are in the result set if the Projection clause includes any of the following options:

- the FIRST option
- the SKIP and LIMIT options (Dynamic Server only)
- the MIDDLE option (Extended Parallel Server only)

Using the SKIP Option (IDS)

The SKIP *offset* option specifies how many of the qualifying rows to exclude, for *offset* an integer in the SERIAL8 range, counting from the first qualifying row. The following example retrieves the values fom all rows except the first 10 rows:

```
SELECT SKIP 10 a, b FROM tab1;
```

You can also use a host variable to specify how many rows to exclude. In an SPL routine, you can use an input parameter or a local variable to provide this value.

When you use the SKIP option in a query with an ORDER BY clause, you can exclude the first *offset* rows that have the lowest values according to the ORDER BY criteria. You can also use SKIP to exclude rows with the highest values, if the ORDER BY clause includes the DESC keyword. For example, the following query returns all rows of the **orders** table, except for the fifty oldest orders:

```
SELECT SKIP 50 * FROM orders ORDER BY order_date
```

Here the result set is empty if there are fewer than 50 rows in the **orders** table. An *offset* = 0 is not invalid, but in that case the SKIP option does nothing.

You can also use the SKIP option to restrict the result sets of prepared SELECT statements, of UNION queries, in queries whose result set defines a collection-derived table, and in the events and actions of triggers.

You can use the SKIP and the FIRST options together to specify which and how many qualifying rows are in the result set, as illustrated by examples in the section "Using the SKIP Option with the FIRST Option (IDS)" on page 2-485.

The SKIP option is not valid in the following contexts:
- In the definition of a view
- In nested SELECT statements
- In subqueries.

Using the FIRST Option

The FIRST *max* option specifies that the result set includes no more than *max* rows (or exactly *max*, if *max* is not greater than the number of qualifying rows). Any additional rows that satisfy the selection criteria are not returned. The following example retrieves at most 10 rows from table **tab1**:

```
SELECT FIRST 10 a, b FROM tab1;
```

Dynamic Server can use a host variable or the value of an SPL input parameter in a local variable to specify *max*.

With an ORDER BY clause, you can retrieve the first *max* qualifying rows. For example, the following query finds the ten highest-paid employees:

```
SELECT FIRST 10 name, salary FROM emp ORDER BY salary DESC
```

You can use the FIRST option in a query whose result set defines a collection-derived table (CDT) within the FROM clause of another SELECT statement. The following query specifies a CDT that has no more than ten rows:

```
SELECT *
FROM TABLE(MULTISET(SELECT FIRST 10 * FROM employees
           ORDER BY employee_id)) vt(x,y), tab2
WHERE tab2.id = vt.x;
```

This example applies the FIRST option to the result of a UNION expression:

```
SELECT FIRST 10 a, b FROM tab1 UNION SELECT a, b FROM tab2
```

The FIRST option is not valid in any of the following contexts:
- In the definition of a view
- In nested SELECT statements

- In subqueries
- In a singleton SELECT (where *max* = 1) within an SPL routine
- Where embedded SELECT statements are used as expressions

The LIMIT Keyword (IDS)

For Dynamic Server, LIMIT is a keyword synonym for the FIRST keyword in the Projection clause. You cannot, however, substitute LIMIT for FIRST in other syntactic contexts where FIRST is valid, such as in the FETCH statement.

Extended Parallel Server does not support the LIMIT keyword, and it returns an error if FIRST is not immediately followed by a non-negative literal integer.

Using SKIP, FIRST, LIMIT, or MIDDLE as a Column Name

If no integer follows the FIRST keyword, the database server interprets FIRST as a column identifier. For example, if table **T** has columns **first**, **second**, and **third**, the following query would return data from the column named **first**:

```
SELECT first FROM T
```

The same considerations apply to the SKIP and LIMIT keywords of Dynamic Server, and to the MIDDLE keyword of Extended Parallel Server. If no literal integer nor integer variable follows the LIMIT keyword in the Projection clause, Dynamic Server interprets LIMIT as a column name. If no data source in the FROM clause has a column with that name, the query fails with an error.

Using the SKIP Option with the FIRST Option (IDS)

If a Projection clause with the SKIP *offset* option also includes FIRST or LIMIT, the result set begins with the row whose ordinal position is (*offset* + 1) in the set of qualifying rows, rather than with the first row. The row in position (*offset* + *max*) is the last row in the result set, unless there are fewer than (*offset* + *max*) qualifying rows. The following example ignores the first 50 rows from table **tab1**, but returns a result set of at most 10 rows, beginning with the fifty-first row:

```
SELECT SKIP 50 FIRST 10 a, b FROM tab1;
```

The next example uses in a query with SKIP and FIRST to insert no more than five rows from table **tab1** into table **tab2**, beginning with the eleventh row:

```
INSERT INTO tab2 SELECT SKIP 10 FIRST 5 * FROM tab1;
```

The following collection subquery returns only the eleventh through fifteenth qualifying rows as a collection-derived table, orders these five rows by the value in column **a**, and stores this result set in a temporary table.

```
SELECT * FROM TABLE (MULTISET (SELECT SKIP 10 FIRST 5 a FROM tab3
                     ORDER BY a)) INTO TEMP
```

The following INSERT statement includes a collection subquery whose results define a collection-derived table. The rows are ordered by the value in column **a**, and are inserted into table **tab1**.

```
INSERT INTO tab1 (a) SELECT * FROM TABLE (MULTISET (SELECT SKIP 10 FIRST 5 a
     FROM tab3 ORDER BY a));
```

Queries that combine the FIRST or LIMIT and SKIP options with the ORDER BY clause can impose a unique order on the qualifying rows, so successive queries that increment the *offset* value by the value of *max* can partition the qualifying rows into disjunct subsets of *max* rows. This can support web applications that require a fixed page size, without requiring cursor management.

You can use these features in distributed queries only if all of the participating database servers support the SKIP and FIRST options.

Using the MIDDLE Option (XPS)

The MIDDLE keyword, like the FIRST, can specify a maximum number of rows to retrieve that match conditions specified in the SELECT statement. The FIRST option returns the first *max* rows (for *max* substitute a number that you specify) that satisfy the selection criteria, but the MIDDLE option returns *max* rows from the middle of the set of qualifying rows.

The syntax and restrictions for this option are the same as those for the FIRST option. For more information, see "Using the FIRST Option" on page 2-484.

Allowing Duplicates

You can apply the ALL, UNIQUE, or DISTINCT keywords to indicate whether duplicate values are returned, if any exist. If you do not specify any of these keywords in the Projection clause, all qualifying rows are returned by default.

Keyword	**Effect**
ALL	Specifies that all qualifying rows are returned, regardless of whether duplicates exist. (This is the default specification.)
DISTINCT	Excludes duplicates of qualifying rows from the result set
UNIQUE	Excludes duplicate. (Here UNIQUE is a synonym for DISTINCT. This is an extension to the ANSI/ISO standard.)

For example, the next query returns all the unique ordered pairs of values from the **stock_num** and **manu_code** columns in rows of the **items** table. If several rows have the same pair of values, that pair appears only once in the result set:

```
SELECT DISTINCT stock_num, manu_code FROM items
```

You can specify DISTINCT or UNIQUE no more than once in each level of a query or subquery. The following example uses DISTINCT in both the query and in the subquery:

```
SELECT DISTINCT stock_num, manu_code FROM items
   WHERE order_num =    (SELECT DISTINCT order_num FROM orders
      WHERE customer_num = 120)
```

Data Types in Distributed Queries (IDS)

In Dynamic Server, a query that accesses tables in a database of another database server can only reference built-in data types that are not opaque, nor extended, nor large-object data types. Cross-server queries cannot reference a column or expression of an opaque, DISTINCT, or user-defined data type (UDT).

Distributed queries that access other databases of the local Dynamic Server instance, however, can also access most *built-in opaque data types*, which are listed in "BOOLEAN and Other Built-In Opaque Data Types (IDS)" on page 4-19.

Queries across databases of the local Dynamic Server instance can also reference UDTs, as well as DISTINCT types based on built-in data types, if all the UDTs and DISTINCT types are explicitly cast to built-in data types, and all the UDTs, DISTINCT types, and casts are defined in each of the participating databases.

3 A distributed query can use both the SKIP and FIRST options if all participating
3 servers support the SKIP option; otherwise the query fails with an error.

Queries cannot access a database of another database server unless both servers define TCP/IP connections in DBSERVERNAME or DBSERVERALIAS configuration parameters. This applies to any communication between Dynamic Server instances, even if both database servers reside on the same computer.

Expressions in the Select List

You can use any basic type of expression (column, constant, built-in function, aggregate function, and user-defined routine), or combination thereof, in the select list. The expression types are described in “Expression” on page 4-34. Sections that follow present examples of simple expression in the select list.

You can combine simple numeric expressions by connecting them with arithmetic operators for addition, subtraction, multiplication, and division. If you combine a column expression and an aggregate function, however, you must include the column expression in the GROUP BY clause. (See also “Relationship of GROUP BY and Projection Clauses” on page 2-513.)

In general, you cannot use variables (for example, host variables in an ESQL/C application) in the select list by themselves. A variable is valid in the select list, however, if an arithmetic or concatenation operator connects it to a constant.

In a FOREACH SELECT statement, you cannot use SPL variables in the select list, by themselves or with column names, when the tables in the FROM clause are remote tables. You can use SPL variables by themselves or with a constant in the select list only when the tables in the FROM clause are local tables.

In distributed queries of Dynamic Server, values in expressions (and returned by expressions) are restricted, as “Data Types in Distributed Queries (IDS)” on page 2-486 describes. Any UDRs used as expressions in other databases of the same Dynamic Server instance must be defined in each participating database.

The Boolean operator NOT is not valid in the Projection clause.

Selecting Columns: Column expressions are the most commonly used expressions in a SELECT statement. For a complete description of the syntax and use of column expressions, see “Column Expressions” on page 4-44. The following examples use column expressions in the Projection clause:

```
SELECT orders.order_num, items.price FROM orders, items
SELECT customer.customer_num ccnum, company FROM customer
SELECT catalog_num, stock_num, cat_advert [1,15] FROM catalog
SELECT lead_time - 2 UNITS DAY FROM manufact
```

Selecting Constants: If you include a constant expression in the select list, the same value is returned for each row that the query returns (except when the constant expression is **NEXTVAL**). For a complete description of the syntax and use of constant expressions, see “Constant Expressions” on page 4-53. Examples that follow show constant expressions within a select list:

```
SELECT 'The first name is', fname FROM customer
SELECT TODAY FROM cust_calls
SELECT SITENAME FROM systables WHERE tabid = 1
SELECT lead_time - 2 UNITS DAY FROM manufact
SELECT customer_num + LENGTH('string') from customer
```

Selecting Built-In Function Expressions: A built-in function expression uses a function that is evaluated for each row in the query. All built-in function expressions require arguments. This set of expressions contains the time functions and the length function when they are used with a column name as an argument. The following examples show built-in function expressions within the select list of the Projection clause:

```
SELECT EXTEND(res_dtime, YEAR TO SECOND) FROM cust_calls
SELECT LENGTH(fname) + LENGTH(lname) FROM customer
SELECT HEX(order_num) FROM orders
SELECT MONTH(order_date) FROM orders
```

Selecting Aggregate Function Expressions: An aggregate function returns one value for a set of queried rows. This value depends on the set of rows that the WHERE clause of the SELECT statement qualifies. In the absence of a WHERE clause, the aggregate functions take on values that depend on all the rows that the FROM clause forms. Examples that follow show aggregate functions in a select list:

```
SELECT SUM(total_price) FROM items WHERE order_num = 1013
SELECT COUNT(*) FROM orders WHERE order_num = 1001
SELECT MAX(LENGTH(fname) + LENGTH(lname)) FROM customer
```

Selecting User-Defined Function Expressions: User-defined functions extend the range of functions that are available to you and allow you to perform a subquery on each row that you select.

The following example calls the **get_orders( )** user-defined function for each **customer_num** and displays the returned value under the `n_orders` label:

```
SELECT customer_num, lname, get_orders(customer_num) n_orders
      FROM customer
```

If an SPL routine in a SELECT statement contains certain SQL statements, the database server returns an error. For information on which SQL statements cannot be used in an SPL routine that is called within a query, see “Restrictions on SPL Routines in Data-Manipulation Statements” on page 5-71.

For the complete syntax of user-defined function expressions, see “User-Defined Functions” on page 4-111.

Selecting Expressions That Use Arithmetic Operators: You can combine numeric expressions with arithmetic operators to make complex expressions. You cannot combine expressions that contain aggregate functions with column expressions. These examples show expressions that use arithmetic operators within a select list in the Projection clause:

```
SELECT stock_num, quantity*total_price FROM customer
SELECT price*2 doubleprice FROM items
SELECT count(*)+2 FROM customer
SELECT count(*)+LENGTH('ab') FROM customer
```

Selecting ROW Fields (IDS): You can select a specific field of a named or unnamed ROW type column with *row.field* notation, using a period (**.**) as a separator between the *row* and *field* names. For example, suppose you have the following table structure:

```
CREATE ROW TYPE one (a INTEGER, b FLOAT)
CREATE ROW TYPE two (c one, d CHAR(10))
CREATE ROW TYPE three (e CHAR(10), f two)

CREATE TABLE new_tab OF TYPE two
CREATE TABLE three_tab OF TYPE three
```

The following examples show expressions that are valid in the select list:

```
SELECT t.c FROM new_tab t
SELECT f.c.a FROM three_tab
SELECT f.d FROM three_tab
```

You can also enter an asterisk (*) in place of a field name to signify that all fields of the ROW-type column are to be selected.

For example, if the **my_tab** table has a ROW-type column named **rowcol** that contains four fields, the following SELECT statement retrieves all four fields of the **rowcol** column:

```
SELECT rowcol.* FROM my_tab
```

You can also retrieve all fields from a row-type column by specifying only the column name. This example has the same effect as the previous query:

```
SELECT rowcol FROM my_tab
```

You can use *row.field* notation not only with ROW-type columns but with expressions that evaluate to ROW-type values. For more information, see "Column Expressions" on page 4-44 in the Expression segment.

Declaring a Display Label

You can declare a display label for any column or column expression in the select list of the Projection clause. This temporary name is in scope only while the SELECT statement is executing.

In DB–Access, a display label appears as the heading for that column in the output of the SELECT statement.

In ESQL/C, the value of *display_label* is stored in the **sqlname** field of the **sqlda** structure. For more information on the **sqlda** structure, see the *IBM Informix ESQL/C Programmer's Manual*.

If your display label is an SQL keyword, use the AS keyword to clarify the syntax. For example, to use UNITS, YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, or FRACTION as display labels, use the AS keyword with the display label. The following statement uses AS with **minute** as a display label:

```
SELECT call_dtime AS minute FROM cust_calls
```

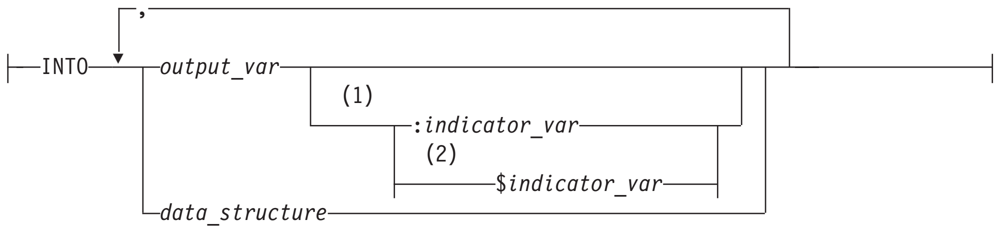
For the keywords of SQL, see Appendix A, "Reserved Words for IBM Informix Dynamic Server," on page A-1, or Appendix B, "Reserved Words for IBM Informix Extended Parallel Server," on page B-1.

If you are creating a temporary table, you must supply a display label for any columns that are not simple column expressions. The display label is used as the name of the column in the temporary table. If you are using the SELECT statement to define a view, do not use display labels. Specify the desired label names in the CREATE VIEW column list instead.

INTO Clause

Use the INTO clause in an SPL routine or an ESQL/C program to specify the program variables or host variables to receive data that SELECT retrieves.

INTO Clause:



Notes:

1 ESQL/C only

2 Informix extension

Element	Description	Restrictions	Syntax
data_ structure	Structure that was declared as a host variable	Data types of elements must be able to store the values that are being selected	Language specific
indicator_ var	Program variable to receive a return code if corresponding *output_var* receives a NULL value	Optional; use an indicator variable if the possibility exists that the value of the corresponding *output_var* is NULL	Language specific
output_ var	Program or host variable to receive value of the corresponding select list item. Can be a collection variable	Order of receiving variables must match the order of corresponding items in the select list of Projection clause	Language specific

The INTO clause specifies one or more variables that receive the values that the query returns. If it returns multiple values, they are assigned to the list of variables in the order in which you specify the variables.

If the SELECT statement stands alone (that is, it is not part of a DECLARE statement and does not use the INTO clause), it must be a singleton SELECT statement. A *singleton* SELECT statement returns only one row.

The number of receiving variables must be equal to the number of items in the select list of the Projection clause. The data type of each receiving variable should be compatible with the data type of the corresponding column or expression in the select list.

For the actions that the database server takes when the data type of the receiving variable does not match that of the selected item, see "Warnings in ESQL/C" on page 2-492.

The following example shows a singleton SELECT statement in ESQL/C:

```
EXEC SQL select fname, lname, company_name
   into :p_fname, :p_lname, :p_coname
   where customer_num = 101;
```

In an SPL routine, if a SELECT returns more than one row, you must use the FOREACH statement to access the rows individually. The INTO clause of the SELECT statement holds the fetched values. For more information, see "FOREACH" on page 3-20.

INTO Clause with Indicator Variables

If the possibility exists that a data value returned from the query is NULL, use an ESQL/C indicator variable in the INTO clause. For more information, see the *IBM Informix ESQL/C Programmer's Manual*.

INTO Clause with Cursors

If the SELECT statement returns more than one row, you must use a cursor in a FETCH statement to fetch the rows individually. You can put the INTO clause in the FETCH statement rather than in the SELECT statement, but you should not put it in both.

The following ESQL/C code examples show different ways you can use the INTO clause. As both examples show, first you must use the DECLARE statement to declare a cursor.

Using the INTO clause in the SELECT statement:

```
EXEC SQL declare q_curs cursor for
   select lname, company
      into :p_lname, :p_company
      from customer;
EXEC SQL open q_curs;
while (SQLCODE == 0)
   EXEC SQL fetch q_curs;
EXEC SQL close q_curs;
```

Using the INTO clause in the FETCH statement:

```
EXEC SQL declare q_curs cursor for
   select lname, company from customer;
EXEC SQL open q_curs;
while (SQLCODE == 0)
   EXEC SQL fetch q_curs into :p_lname, :p_company;
EXEC SQL close q_curs;
```

Preparing a SELECT ... INTO Query

In ESQL/C, you cannot prepare a query that has an INTO clause. You can prepare the query without the INTO clause, declare a cursor for the prepared query, open the cursor, and then use the FETCH statement with an INTO clause to fetch the cursor into the program variable.

Alternatively, you can declare a cursor for the query without first preparing the query and include the INTO clause in the query when you declare the cursor. Then open the cursor and fetch the cursor without using the INTO clause of the FETCH statement.

Using Array Variables with the INTO Clause

In ESQL/C, if you use a DECLARE statement with a SELECT statement that contains an INTO clause, and the variable is an array element, you can identify individual elements of the array with integer literals or variables. The value of the variable that is used as a subscript is determined when the cursor is declared; the subscript variable subsequently acts as a constant.

The following ESQL/C code example declares a cursor for a SELECT ... INTO statement using the variables **i** and **j** as subscripts for the array **a**. After you declare the cursor, the INTO clause of the SELECT statement is equivalent to `INTO a[5], a[2]`.

```
i = 5
j = 2
EXEC SQL declare c cursor for
   select order_num, po_num into :a[i], :a[j] from orders
      where order_num =1005 and po_num =2865
```

You can also use program variables in the FETCH statement to specify an element of a program array in the INTO clause. The program variables are evaluated at each fetch, rather than when you declare the cursor.

Error Checking

If the data type of the receiving variable does not match that of the selected item, the data type of the selected item is converted, if possible, to the data type of the variable. If the conversion is impossible, an error occurs, and a negative value is returned in the **status** variable, **sqlca.sqlcode,** or **SQLCODE**. In this case, the value in the program variable is unpredictable.

In an ANSI-compliant database, if the number of variables that are listed in the INTO clause differs from the number of items in the select list of the Projection clause, you receive an error.

Warnings in ESQL/C: In ESQL/C, if the number of variables listed in the INTO clause differs from the number of items in the Projection clause, a warning is returned in the **sqlwarn** structure: **sqlca.sqlwarn.sqlwarn3**. The actual number of variables that are transferred is the lesser of the two numbers. For information about the **sqlwarn** structure, see the *IBM Informix ESQL/C Programmer's Manual*.

FROM Clause

The FROM clause lists the table objects from which you are selecting the data.

FROM Clause:

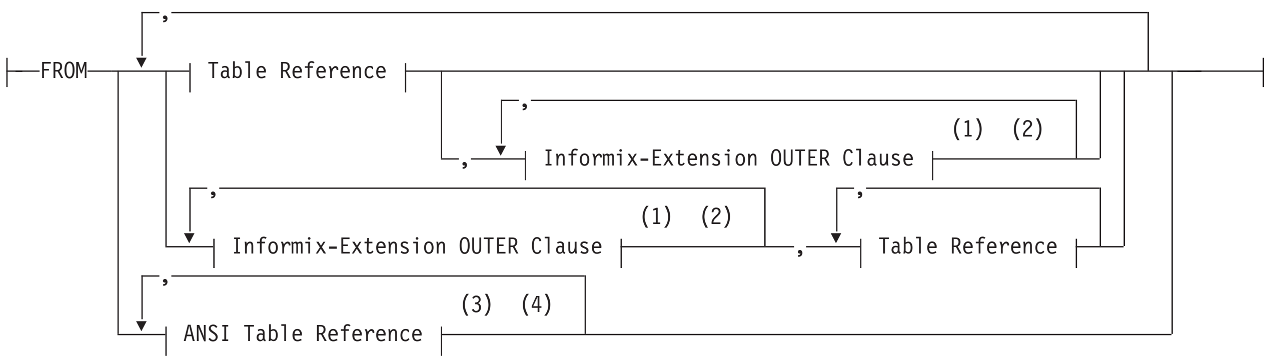
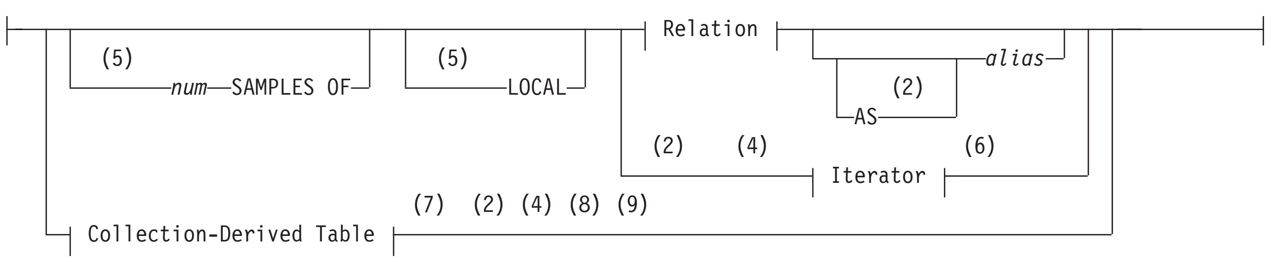


Table Reference:



Relation:

```
├──┬─table───────────────────┬──────────────────────────────────────────────────────┤
   ├─view────────────────────┤
   ├─synonym─────────────────┤
   │ (5)                     │
   ├───────external──────────┤
   │ (5)                     │
   ├───────(subquery)────────┤
   │ (4)                     │
   └───────ONLY──┬─(synonym)─┘
                 └─(table)───┘
```

Notes:

1 See "Informix-Extension Outer Joins" on page 2-506

2 Informix extension

3 See "ANSI Table Reference" on page 2-501

4 Dynamic Server only

5 Extended Parallel Server only

6 See "Iterator Functions (IDS)" on page 2-499

7 See "Collection-Derived Table" on page 5-5

8 Stored Procedure Language only

9 ESQL/C only

Element	Description	Restrictions	Syntax
alias	Temporary name for a table or view in this query	See "The AS Keyword" on page 2-494.	"Identifier" on page 5-22
external	External table from which to retrieve data	Must exist but cannot be the outer table in an outer join	"Database Object Name" on page 5-17
num	Number of rows to sample	Unsigned integer > 0	"Literal Number" on page 4-137
subquery	Specifies rows to be retrieved	Cannot be a correlated subquery	"SELECT" on page 2-479
synonym, table, view	Synonym for a table from which to retrieve data	Synonym and table or view to which it points must exist	"Database Object Name" on page 5-17

If the FROM clause specifies more than one data source, the query is called a *join*, because its result set can join rows from several table references. For more information about joins, see "Queries that Join Tables" on page 2-500.

Aliases for Tables or Views

You can declare an alias for a table or view in the FROM clause. If you do so, you must use the alias to refer to the table or view in other clauses of the SELECT statement. You can also use aliases to make the query shorter.

The following example shows typical uses of the FROM clause. The first query selects all the columns and rows from the **customer** table. The second query uses a join between the **customer** and **orders** table to select all the customers who have placed orders.

```
SELECT * FROM customer
SELECT fname, lname, order_num FROM customer, orders
   WHERE customer.customer_num = orders.customer_num
```

The next example is equivalent to the second query in the preceding example, but it declares aliases in the FROM clause and uses them in the WHERE clause:

```
SELECT fname, lname, order_num FROM customer c, orders o
   WHERE c.customer_num = o.customer_num
```

Aliases (sometimes called *correlation names*) are especially useful with a self-join. For more information about self-joins, see "Self-Joins" on page 2-512. In a self-join, you must list the table name twice in the FROM clause and declare a different alias for each of the two instances of table name.

The AS Keyword: If you use a potentially ambiguous word as an alias (or as a display label), you must begin its declaration with the keyword AS. This keyword is required if you use any of the keywords ORDER, FOR, AT, GROUP, HAVING, INTO, NOT, UNION, WHERE, WITH, CREATE, or GRANT as an alias for a table or view.

The database server would issue an error if the next example did not include the AS keyword to indicate that **not** is a display label, rather than an operator:

```
CREATE TABLE t1(a INT);
SELECT a AS not FROM t1
```

If you do not declare an alias for a collection-derived table, the database server assigns an implementation-dependent name to it.

Table Expressions (XPS)

The term *table expression* refers to the use of a view name, a table name, or uncorrelated subquery in the FROM clause. These can be simple or complex:

- Simple table expressions

  A *simple* table expression is one whose underlying query can be folded into the main query while preserving the correctness of the query result.
- Complex table expressions

  A *complex* table expression is one whose underlying query cannot be folded into the main query while preserving the correctness of the query result. The database server materializes such table expressions into a temporary table that is used in the main query.

In either case, the table expression is evaluated as a general SQL query and its results can be thought of as a logical table. This logical table and its columns can be used just like an ordinary base table, but it is not persistent. It exists only during the execution of the query that references it.

Table expressions have the same syntax as general SELECT statements, but with the same restrictions that apply to subqueries in other contexts. A table expression cannot include the following syntax elements:

- ORDER BY clause
- SELECT INTO clause

In addition, table expressions are not valid in the following contexts:

- CREATE TRIGGER statements
- CREATE GK INDEX statements

Queries and correlated subqueries are not supported in the FROM clause.

Apart from these restrictions, any valid SQL query can be a table expression. A table expression can be nested within another table expression, and can include tables and views in its definition. You can use table expressions in CREATE VIEW statements to define views.

Usability and Performance Considerations: Although equivalent functionality is available through views, subqueries as table expressions simplify the formulation of queries, make the syntax more flexible and intuitive, and support the ANSI/ISO standard for SQL.

Performance might be affected, however, if you use table expressions. It is advisable to use subqueries if you really do not need to use table expressions.

The following are examples of valid table expressions:

```
SELECT * FROM (SELECT * FROM t);

SELECT * FROM (SELECT * FROM t) AS s;

SELECT * FROM (SELECT * FROM t) AS s WHERE t.a = s.b;

SELECT * FROM (SELECT * FROM t) AS s, (SELECT * FROM u) AS v WHERE s.a = v.b;

SELECT * FROM (SELECT * FROM t WHERE t.a = 1) AS s,
OUTER
(SELECT * FROM u WHERE u.b = 2 GROUP BY 1) AS v WHERE s.a = v.b;
SELECT * FROM (SELECT a AS colA FROM t WHERE t.a = 1) AS s,
OUTER
(SELECT b AS colB FROM u WHERE u.b = 2 GROUP BY 1) AS v
   WHERE s.colA = v.colB;

CREATE VIEW vu AS SELECT * FROM (SELECT * FROM t);

SELECT * FROM ((SELECT * FROM t) AS r) AS s;
```

Restrictions on External Tables in Joins and Subqueries

In Extended Parallel Server, when you use external tables in joins or subqueries, the following restrictions apply:

- No more than one external table is valid in a query.
- The external table cannot be the outer table in an outer join.
- For subqueries that cannot be converted to joins, you can use an external table in the main query, but not the subquery.
- You cannot do a self-join on an external table.

For more information on subqueries, see your *IBM Informix Performance Guide*.

Application Partitioning: The LOCAL Keyword (XPS)

In Extended Parallel Server, the LOCAL table feature allows client applications to read data only from the *local* fragments of a table. In other words, it allows the application to read only the fragments that reside on the coserver to which the client is connected. This feature supports application partitioning. An application can connect to multiple coservers, execute a LOCAL read on each coserver, and assemble the final result on the client computer.

You qualify the name of a table with the LOCAL keyword to indicate that you want to retrieve rows from fragments only on the local coserver. The LOCAL keyword has no effect on data retrieved from nonfragmented tables.

When a query involves a join, you must plan carefully if you want to extract data that the client can aggregate. The simplest way to ensure that a join will retrieve data suitable for aggregation is to limit the number of LOCAL tables to one. The client can then aggregate data with respect to that table. The following example shows a query that returns data suitable for aggregation by the client:

```
SELECT x.col1, y.col2    FROM LOCAL     {can be aggregated by client}  {tab1 is
tab1 x, tab2 y    INTO TEMP t1          local}
WHERE x.col1 = y.col1;
```

The following example shows data that the client cannot aggregate:

```
SELECT x.col1, y.col2    FROM LOCAL tab1 x,  {client cannot aggregate}  {tab1 and
LOCAL tab2    INTO SCRATCH s4    WHERE       tab2 are local}
x.col1 = y.col1;
```

The client must submit exactly the same query to each coserver to retrieve data that can be aggregated.

Sampled Queries: The SAMPLES OF Keywords (XPS)

In Extended Parallel Server, *sampled queries* are supported. Sampled queries are queries that are based on *sampled tables*. A sampled table is the result of randomly selecting a specified number of rows from the table, rather than all rows that match the selection criteria.

You can use a sampled query to gather quickly an approximate profile of data within a large table. If you use a sufficiently large sample size, you can examine trends in the data by sampling the data instead of scanning all the data. In such cases, sampled queries can provide better performance than scanning the data. If the value specified for the sample size is greater than the number of rows in the table, the whole table is scanned.

To indicate that a table is to be sampled, specify the number of samples to return before the SAMPLES OF keywords of the FROM clause. You can run sampled queries against tables and synonyms, but not against views.

Sampled queries are not supported in the INSERT, DELETE, or UPDATE statements, nor in other SQL statements that can include a query.

A sampled query has at least one sampled table. You do not need to sample all tables in a sampled query. You can specify the SAMPLES OF option for some tables in the FROM clause but not specify it for other tables.

The sampling method is known as *sampling without replacement*. This means that a sampled row is not sampled again. The database server applies selection criteria *after* samples are selected. Thus, the selection criteria restrict the sample set, rather than the rows from which the sample is taken.

If a table is fragmented, the database server divides the specified number of samples among the fragments. The number of samples from a fragment is proportional to the ratio of the size of a fragment to the size of the table. In other words, the database server takes more samples from larger fragments.

Important: You must run UPDATE STATISTICS MEDIUM before you run the query with the SAMPLES OF option. If you do not run UPDATE

STATISTICS, the SAMPLES OF clause is ignored, and all data values are returned. For better results, run UPDATE STATISTICS MEDIUM before you run the query with the SAMPLES OF option.

The results of a sampled query contain a certain amount of deviation from a complete scan of all rows. You can reduce this expected error to an acceptable level by increasing the proportion of sampled rows to actual rows. When you use sampled queries in joins, the expected error increases dramatically; you must use larger samples in each table to retain an acceptable level of accuracy.

For example, you might want to generate a list of how many of each part is sold from the **parts_sold** table, which is known to contain approximately 100,000,000 rows.

The following query provides a sampling ratio of one percent and returns an approximate result:

```
SELECT part_number, COUNT(*) * 100 AS how_many
   FROM 1000000 SAMPLES OF parts_sold
   GROUP BY part_number;
```

The ONLY Keyword (IDS)

If the SELECT statement queries a supertable, rows from both the supertable and its subtables are returned. To query rows from the supertable only, you must include the ONLY keyword in the FROM clause, as in this example:

```
SELECT * FROM ONLY(super_tab)
```

Selecting from a Collection Variable (IDS)

The SELECT statement in conjunction with the Collection-Derived-Table segment allows you to select elements from a collection variable.

The Collection-Derived-Table segment identifies the collection variable from which to select the elements. (See “Collection-Derived Table” on page 5-5.)

Using Collection Variables with SELECT: To modify the contents of a column of a collection data type, you can use the SELECT statement with a collection variable in various ways:

- You can select the contents (if any) of a collection column into a collection variable.

  You can assign the data type of the column to a collection variable of type COLLECTION (that is, an untyped collection variable).
- You can select the contents from a collection variable to determine the data that you might want to update.
- You can select the contents from a collection variable INTO another variable in order to update certain collection elements.

  The INTO clause identifies the variable for the element value that is selected from the collection variable. The data type of the host variable in the INTO clause must be compatible with that of the corresponding collection element.
- You can use a collection cursor to select one or more elements from an ESQL/C collection variable.

  For more information, including restrictions on the SELECT statement, see “Associating a Cursor with a Prepared Statement” on page 2-271.
- You can use a collection cursor to select one or more elements from an SPL collection variable.

For more information, including restrictions on the SELECT statement, see "Using a SELECT ... INTO Statement" on page 3-21.

When one of the tables to be joined is a collection, the FROM clause cannot specify a join. This restriction applies when the collection variable holds your collection-derived table. See also "Collection-Derived Table" on page 5-5. and the INSERT, UPDATE, and DELETE statement descriptions in this chapter.

Selecting from a Row Variable (IDS, ESQL/C)

The SELECT statement can include the Collection-Derived-Table segment to select one or more fields from a **row** variable. The Collection-Derived-Table segment identifies the **row** variable from which to select the fields. For more information, see "Collection-Derived Table" on page 5-5.

To select fields:

1. Create a **row** variable in your ESQL/C program.
2. Optionally, fill the **row** variable with field values.

   You can select a ROW-type column into the **row** variable with the SELECT statement (without the Collection-Derived-Table segment). Alternatively, you can insert field values into the **row** variable with the UPDATE statement and the Collection-Derived-Table segment.
3. Select row fields from the **row** variable with the SELECT statement and the Collection-Derived-Table segment.
4. Once the **row** variable contains the correct field values, you can use the INSERT or UPDATE statement on a table or view name to save the contents of the **row** variable in a named or unnamed row column.

The INTO clause can specify a host variable to hold a field value selected from the **row** variable.

The type of the host variable must be compatible with that of the field. For example, this code fragment puts the **width** field value into the **rect_width** host variable.

```
EXEC SQL BEGIN DECLARE SECTION;
   ROW (x INT, y INT, length FLOAT, width FLOAT) myrect;
   double rect_width;
EXEC SQL END DECLARE SECTION;
...
EXEC SQL SELECT rect INTO :myrect FROM rectangles
   WHERE area = 200;
EXEC SQL SELECT width INTO :rect_width FROM table(:myrect);
```

The SELECT statement on a **row** variable has the following restrictions:

- No expressions are allowed in the select list of the Projection clause.
- ROW columns cannot be in a WHERE clause comparison condition.
- The Projection clause must be an asterisk (*) if the row-type contains fields of opaque, distinct, or built-in data types.
- Columns listed in the Projection clause can have only unqualified names. They cannot use the syntax *database@server:table.column.*
- The following clauses are not allowed: GROUP BY, HAVING, INTO TEMP, ORDER BY, and WHERE.
- The FROM clause has no provisions to do a join.

You can modify the **row** variable with the Collection-Derived-Table segment of the UPDATE statements. (The INSERT and DELETE statements do not support a **row** variable in the Collection-Derived-Table segment.)

The **row** variable stores the fields of the row. It has no intrinsic connection, however, with a database column. Once the **row** variable contains the correct field values, you must then save the variable into the ROW column with one of the following SQL statements:

- To update the ROW column in the table with the **row** variable, use an UPDATE statement on a table or view name and specify the **row** variable in the SET clause. For more information, see “Updating ROW-Type Columns (IDS)” on page 2-643.
- To insert a row into a ROW column, use the INSERT statement on a table or view and specify the **row** variable in the VALUES clause. See “Inserting Values into ROW-Type Columns (IDS)” on page 2-401.

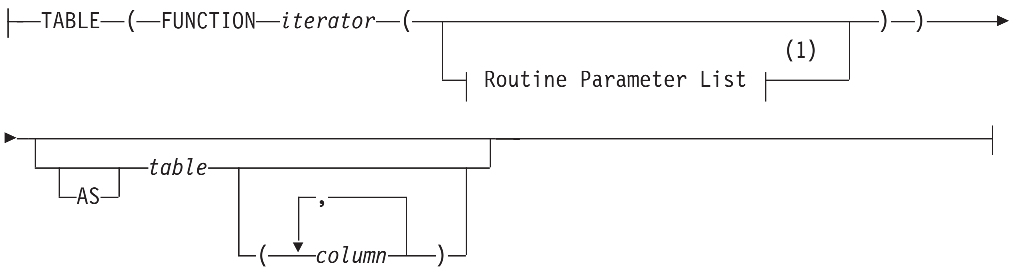
For examples of how to use SPL row variables, see the *IBM Informix Guide to SQL: Tutorial*. For information on using ESQL/C **row** variables, see the discussion of complex data types in the *IBM Informix ESQL/C Programmer's Manual*.

Iterator Functions (IDS)

The FROM clause can include a call to an iterator function to specify the source for a query. An *iterator function* is a user-defined function that returns to its calling SQL statement several times, each time returning a value.

You can query the returned result set of an iterator UDR using a virtual table interface. Use this syntax to invoke an iterator function in the FROM clause:

Iterator:



Notes:

1 See “Routine Parameter List” on page 5-61

Element	Description	Restrictions	Syntax
column	Name declared here for a virtual column in *table*	Must be unique among *column* names in *table*. Cannot include qualifiers	“Identifier” on page 5-22
iterator	Name of the iterator function	Must be registered in the database	“Identifier” on page 5-22
table	Name declared here for virtual table holding *iterator* result set	Cannot include qualifiers	“Identifier” on page 5-22

The *table* can only be referenced within the context of this query. After the SELECT statement terminates, the virtual table no longer exists.

The number of columns must match the number of values returned by the iterator. An external function can return no more than one value (but that can be of a collection data type). An SPL routine can return multiple values.

To reference the virtual *table* columns in other parts of the SELECT statement, for example, in the WHERE clause or HAVING clause, you must declare its name and the virtual column names in the FROM clause. You do not need to declare the *table* name or *column* names in the FROM clause if you use the asterisk notation in the Projection list of the SELECT clause:

```
SELECT * FROM ...
```

For more information and examples of using iterator functions in queries, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Queries that Join Tables

If the FROM clause specifies more than one table reference, the query can join rows from several tables. A *join condition* specifies a relationship between at least one column from each table to be joined. Because the columns in a join condition are being compared, they must have compatible data types.

The FROM clause of the SELECT statement can specify several types of joins.

FROM Clause Keyword	Corresponding Result Set
CROSS JOIN	Cartesian product (all possible pairs of rows)
INNER JOIN	Only rows from CROSS that satisfy the join condition
LEFT OUTER JOIN	Qualifying rows of one table, and all rows of another
RIGHT OUTER JOIN	Same as LEFT, but roles of the two tables are reversed
FULL OUTER JOIN	The union of all rows from an INNER join of the two tables, and of all rows of each table that have no match in the other table (using NULL values in the selected columns of the other table)

The last four categories are collectively called "Join Types" in the literature of the relational model; a CROSS JOIN ignores the specific data values in joined tables, returning every possible pair of rows, where one row is from each table.

In an inner (or simple) join, the result contains only the combination of rows that satisfy the join conditions. Outer joins preserve rows that otherwise would be discarded by inner joins. In an outer join, the result contains the combination of rows that satisfy the join conditions *and* the rows from the dominant table that would otherwise be discarded. The rows from the dominant table that do not have matching rows in the subordinate table contain NULL values in the columns selected from the subordinate table.

Dynamic Server supports the two different syntaxes for left outer joins:
- Informix-extension syntax
- ANSI-compliant syntax

Earlier versions of the database server supported only Informix-extension syntax for outer joins. Dynamic Server continues to support this legacy syntax, but using the ANSI-compliant syntax for joins provides greater flexibility in creating queries. In view definitions, however, the legacy syntax does not require materialized views, so it might offer performance advantages.

If you use ANSI-compliant syntax to specify a join in the FROM clause, you must also use ANSI-compliant syntax for all outer joins in the same query block. Thus, you cannot begin another outer join with only the OUTER keyword. The following query, for example, is not valid:

```
SELECT * FROM customer, OUTER orders RIGHT JOIN cust_calls
   ON (customer.customer_num = orders.customer_num)
   WHERE customer.customer_num = 104);
```

This returns an error because it attempts to combine the Informix-extension OUTER syntax with the ANSI-compliant RIGHT JOIN syntax for outer joins.

See the section "Informix-Extension Outer Joins" on page 2-506 for the Informix-extension syntax for LEFT OUTER joins.

ANSI-Compliant Joins (IDS)

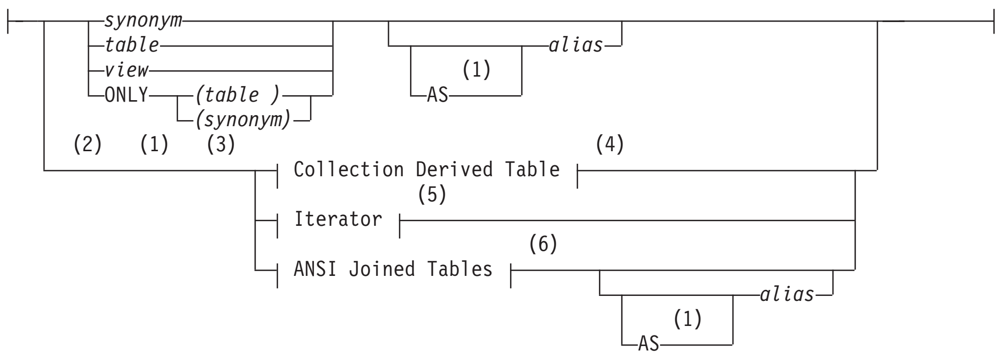
The ANSI-compliant syntax for joins supports these join specifications:

- To use a CROSS join, a LEFT OUTER, RIGHT OUTER, or FULL OUTER join, or an INNER (or simple) join, see "Creating an ANSI Join" on page 2-502 and "ANSI INNER Joins" on page 2-503.
- To use pre-join filters, see "Using the ON Clause" on page 2-504.
- To use one or more post-join filters in the WHERE clause, see "Specifying a Post-Join Filter" on page 2-505.
- To have the dominant or subordinate part of an outer join be the result set of another join, see "Using a Join as the Dominant or Subordinate Part of an Outer Join" on page 2-505.

Important: Use the ANSI-compliant syntax for joins when you create new queries in Dynamic Server. In Dynamic Server releases earlier than IDS 10.00.xC3, cross-server distributed queries with ANSI-compliant joins use query plans that are inefficient for this release. For any UDR older than IDS 10.00.xC3 that performs a cross-server ANSI-compliant join, use the UPDATE STATISTICS statement to replace the original query plan with a reoptimized plan.

ANSI Table Reference: This diagram shows the ANSI-compliant syntax for a table reference.

ANSI Table Reference:



Notes:

1 Informix extension

2 Stored Procedure Language only

3 ESQL/C only

4 See “Collection-Derived Table” on page 5-5

5 See “Iterator Functions (IDS)” on page 2-499

6 See “ANSI Joined Tables”

Element	Description	Restrictions	Syntax
alias	Temporary name for a table or view within the scope of the SELECT	See “The AS Keyword” on page 2-494.	“Identifier” on page 5-22
synonym, table, view	Source from which to retrieve data	The synonym and the table or view to which it points must exist	“Database Object Name” on page 5-17

Here the ONLY keyword is the same semantically as in the Informix-extension Table Reference segment, as described in “The ONLY Keyword (IDS)” on page 2-497.

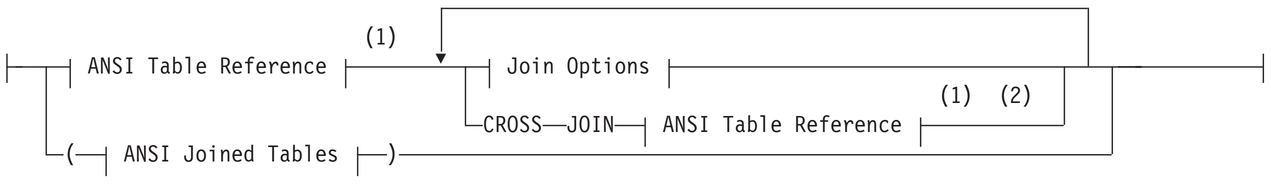
The AS keyword is optional when you declare an alias (also called a *correlation name*) for a table reference, as described in “The AS Keyword” on page 2-494, unless the alias conflicts with an SQL keyword.

Creating an ANSI Join: With ANSI-compliant joined table syntax, as shown in the following diagram, you can specify the INNER JOIN, CROSS JOIN, NATURAL JOIN, LEFT JOIN (or LEFT OUTER JOIN), RIGHT JOIN (and FULL OUTER JOIN keywords. The OUTER keyword is optional in ANSI-compliant outer joins.

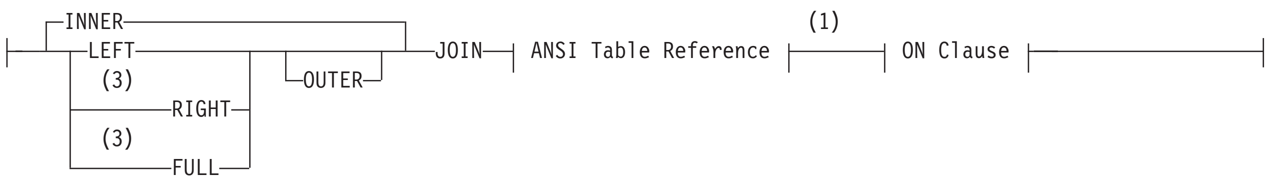
You must use the same form of join syntax (either Informix extension or ANSI-compliant) for all of the outer joins in the same query block. When you use the ANSI-compliant syntax, you must also specify the join condition in the ON clause, as described in “Using the ON Clause” on page 2-504.

ANSI Joined Tables: This is the ANSI-compliant syntax for specifying inner and outer joins.

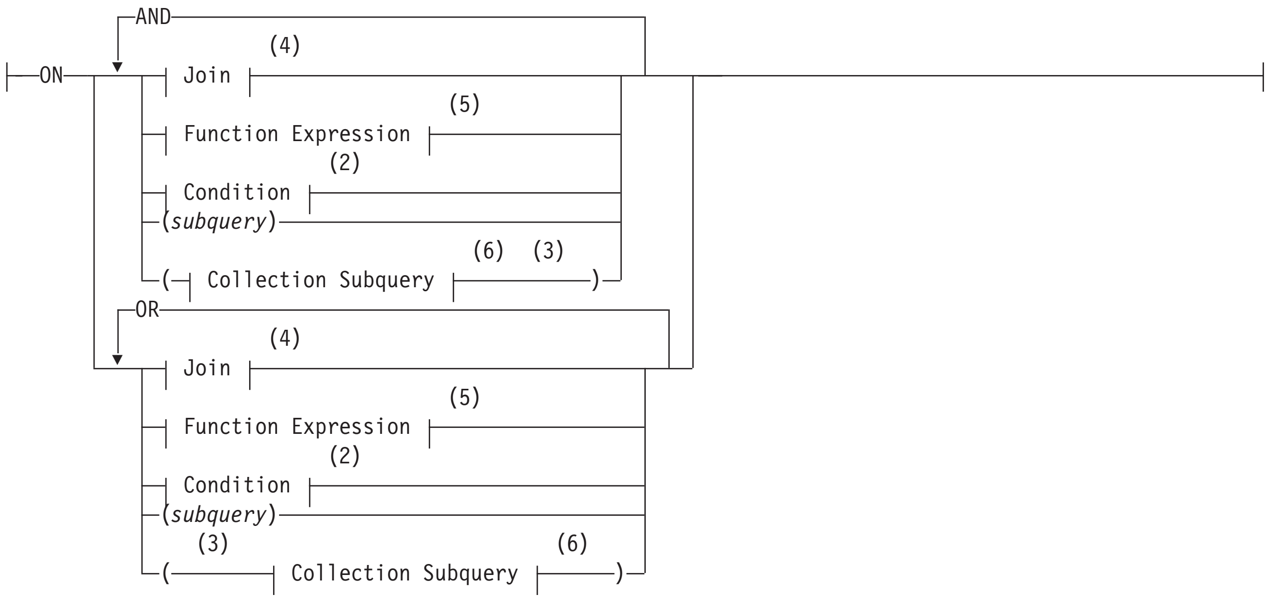
ANSI Joined Tables:



Join Options:



ON Clause:



Notes:

1 See "ANSI Table Reference" on page 2-501

2 See "Condition" on page 4-5

3 Dynamic Server only

4 See "Specifying a Join in the WHERE Clause" on page 2-511

5 See "Function Expressions" on page 4-68

6 See "Collection Subquery" on page 4-3

Element	Description	Restrictions	Syntax
subquery	Embedded query	Cannot contain the FIRST or the ORDER BY clause	"SELECT" on page 2-479

The ANSI-Joined Table segment must be enclosed between parentheses if it is immediately followed by another join specification. For example, the first of the following two queries returns an error; the second query is valid:

```
SELECT * FROM (T1 LEFT JOIN T2) CROSS JOIN T3 ON (T1.c1 = T2.c5)
      WHERE (T1.c1 < 100);    -- Ambiguous order of operations
SELECT * FROM (T1 LEFT JOIN T2 ON (T1.c1 = T2.c5)) CROSS JOIN T3
      WHERE (T1.c1 < 100);    -- Unambiguous order of operations
```

ANSI CROSS Joins: The CROSS keyword specifies the Cartesian product, returning all possible paired combinations that include one row from each of the joined tables.

ANSI INNER Joins: To create an inner (or simple) join using the ANSI-compliant syntax, specify the join with the JOIN or INNER JOIN keywords. If you specify only the JOIN keyword, the database server creates an implicit inner join by default. An inner join returns all the rows in a table that have one or more matching rows in the other table (or tables). The unmatched rows are discarded.

ANSI LEFT OUTER Joins: The LEFT keyword specifies a join that treats the first table reference as the dominant table in the join. In a left outer join, the subordinate part of the outer join appears to the right of the keyword that begins the outer join specification. The result set includes all the rows that an INNER join returns, plus all rows that would otherwise have been discarded from the dominant table.

ANSI RIGHT OUTER Joins: The RIGHT keyword specifies a join that treats the second table reference as the dominant table in the join. In a right outer join, the subordinate part of the outer join appears to the left of the keyword that begins the outer join specification. The result set includes all the rows that an INNER join returns, plus all rows that would otherwise have been discarded from the dominant table.

ANSI FULL OUTER Joins: The FULL keyword specifies a join in which the result set includes all the rows from the Cartesian product for which the join condition is true, plus all the rows from each table that do not match the join condition.

In an ANSI-compliant join that specifies the LEFT, RIGHT, or FULL keywords in the FROM clause, the OUTER keyword is optional.

Optimizer directives that you specify for an ANSI-compliant joined query are ignored, but are listed under Directives Not Followed in **sqlexplain.out**.

Using the ON Clause

Use the ON clause to specify the join condition and any expressions as optional join filters.

The following example from the **stores_demo** database illustrates how the join condition in the ON clause combines the **customer** and **orders** tables:

```
SELECT c.customer_num, c.company, c.phone, o.order_date
   FROM customer c LEFT JOIN orders o
      ON c.customer_num = o.customer_num
```

The following table shows part of the joined **customer** and **orders** tables.

customer_num	company	phone	order_date
101	All Sports Supplies	408-789-8075	05/21/1998
102	Sports Spot	415-822-1289	NULL
103	Phil’s Sports	415-328-4543	NULL
104	Play Ball!	415-368-1100	05/20/1998
—	—	—	—

In an outer join, the join filters (expressions) that you specify in the ON clause determine which rows of the subordinate table join to the dominant (or outer) table. The dominant table, by definition, returns all its rows in the joined table. That is, a join filter in the ON clause has no effect on the dominant table.

If the ON clause specifies a join filter on the dominant table, the database server joins only those dominant table rows that meet the criterion of the join filter to rows in the subordinate table. The joined result contains all rows from the dominant table. Rows in the dominant table that do not meet the criterion of the join filter are extended with NULL values for the subordinate columns.

The following example from the **stores_demo** database illustrates the effect of a join filter in the ON clause:

```
SELECT c.customer_num, c.company, c.phone, o.order_date
   FROM customer c LEFT JOIN orders o
      ON c.customer_num = o.customer_num
         AND c.company <> "All Sports Supplies"
```

The row that contains All Sports Supplies remains in the joined result.

customer_num	company	phone	order_date
101	All Sports Supplies	408-789-8075	NULL
102	Sports Spot	415-822-1289	NULL
103	Phil's Sports	415-328-4543	NULL
104	Play Ball!	415-368-1100	05/20/1998
—	—	—	—

Even though the order date for customer number 101 is 05/21/1998 in the **orders** table, the effect of placing the join filter (`c.company <> "All Sports Supplies"`) prevents this row in the dominant **customer** table from being joined to the subordinate **orders** table. Instead, a NULL value for **order_date** is extended to the row of All Sports Supplies.

Applying a join filter to a base table in the subordinate part of an outer join can improve performance. For more information, see your *IBM Informix Performance Guide*.

Specifying a Post-Join Filter: When you use the ON clause to specify the join, you can use the WHERE clause as a post-join filter. The database server applies the post-join filter of the WHERE clause to the results of the outer join.

The following example illustrates the use of a post-join filter. This query returns data from the **stores_demo** database. Suppose you want to determine which items in the catalog are not being ordered. The next query creates an outer join of the data from the **catalog** and **items** tables and then determines which catalog items from a specific manufacturer (HRO) have not sold:

```
SELECT c.catalog_num, c.stock_num, c.manu_code, i.quantity
FROM catalog c LEFT JOIN items i
   ON c.stock_num = i.stock_num AND c.manu_code = i.manu_code
   WHERE i.quantity IS NULL AND c.manu_code = "HRO"
```

The WHERE clause contains the post-join filter that locates the rows of HRO items in the catalog for which nothing has been sold.

When you apply a post-join filter to a base table in the dominant or subordinate part of an outer join, you might improve performance. For more information, see your *IBM Informix Performance Guide*.

Using a Join as the Dominant or Subordinate Part of an Outer Join: With the ANSI join syntax, you can nest joins. You can use a join as the dominant or subordinate part of an outer or inner join.

Suppose you want to modify the previous query (the post-join filter example) to get more information that will help you determine whether to continue carrying each unsold item in the catalog. You can modify the query to include information from the **stock** table so that you can see a short description of each unsold item with its cost:

```
SELECT c.catalog_num, c.stock_num, s.description, s.unit_price,
   s.unit_descr, c.manu_code, i.quantity
FROM (catalog c INNER JOIN stock s
   ON c.stock_num = s.stock_num
      AND c.manu_code = s.manu_code)
    LEFT JOIN items i
      ON c.stock_num = i.stock_num
         AND c.manu_code = i.manu_code
   WHERE i.quantity IS NULL
      AND c.manu_code = "HRO"
```

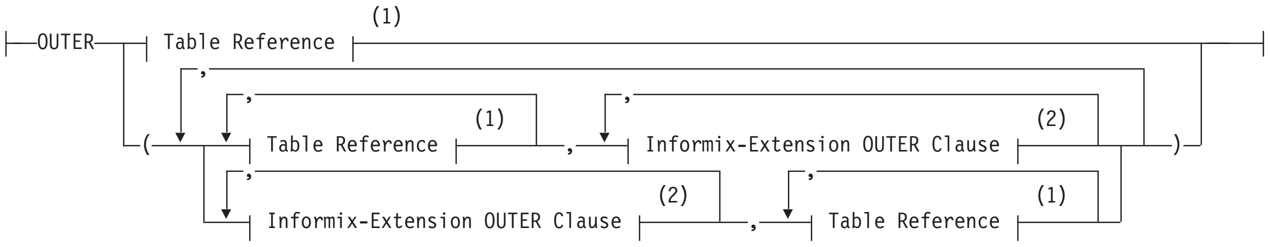
In this example, an inner join between the **catalog** and **stock** tables forms the dominant part of an outer join with the **items** table.

Additional Examples of Outer Joins: For additional examples of outer joins, see the *IBM Informix Guide to SQL: Tutorial*.

Informix-Extension Outer Joins

The Informix-extension syntax for outer joins begins with an implicit left outer join. That is, you begin an outer join with the OUTER keyword. This is the syntax of the Informix-extension OUTER clause.

Informix-Extension OUTER Clause:



OUTER
Table Reference (1)
(
,
Table Reference (1)
,
Informix-Extension OUTER Clause (2)
Informix-Extension OUTER Clause (2)
Table Reference (1)
)

Notes:

1 See “FROM Clause” on page 2-492

2 Informix extension

If you use this syntax for an outer join, you must use Informix-extension syntax for all outer joins in a single query block, and you must include the join condition in the WHERE clause. You cannot begin another outer join with the LEFT JOIN or the LEFT OUTER JOIN keywords.

This example uses the OUTER keyword to create an outer join that lists all customers and their orders, regardless of whether they have placed orders:

```
SELECT c.customer_num, c.lname, o.order_num FROM customer c,
   OUTER orders o WHERE c.customer_num = o.customer_num
```

This example returns all the rows from the **customer** table with the rows that match in the **orders** table. If no record for a customer appears in the **orders** table, the returned **order_num** column for that customer has a NULL value.

If you have a complex outer join, that is, the query has more than one outer join, you must either embed the additional outer join or joins in parentheses, as the syntax diagram shows, or establish join conditions, or relationships, between the dominant table and each subordinate table in the WHERE clause.

When an expression or a condition in the WHERE clause relates two subordinate tables, you must use parentheses around the joined tables in the FROM clause to enforce dominant-subordinate relationships, as in this example:

```
SELECT c.company, o.order_date, i.total_price, m.manu_name
   FROM customer c,
      OUTER (orders o, OUTER (items i, OUTER manufact m))
   WHERE c.customer_num = o.customer_num
      AND o.order_num = i.order_num
      AND i.manu_code = m.manu_code;
```

When you omit parentheses around the subordinate tables in the FROM clause, you must establish join conditions between the dominant table and each subordinate table in the WHERE clause. If a join condition is between two subordinate tables, the query will fail, but the following example successfully returns a result:

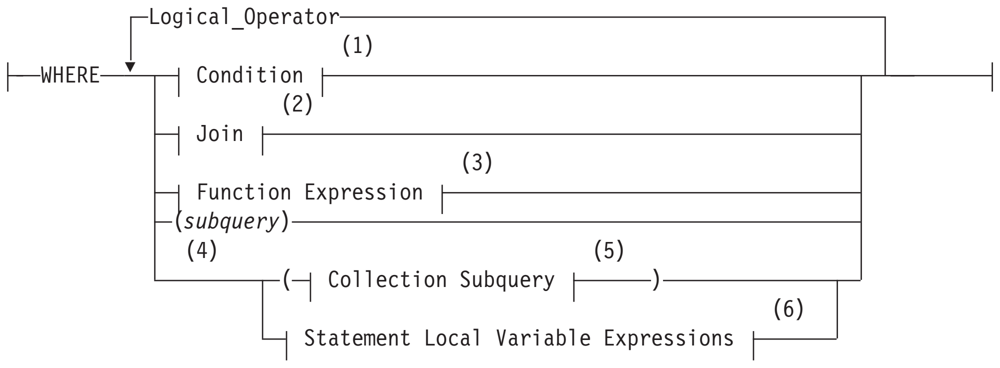
```
SELECT c.company, o.order_date, c2.call_descr
   FROM customer c, OUTER orders o, OUTER cust_calls c2
   WHERE c.customer_num = o.customer_num
      AND c.customer_num = c2.customer_num;
```

The *IBM Informix Guide to SQL: Tutorial* has examples of complex outer joins.

WHERE Clause

The WHERE clause can specify join conditions for Informix-extension joins, post-join filters for ANSI-compliant joins, and search criteria on data values.

WHERE Clause:



Notes:

1 See "Condition" on page 4-5

2 See "Specifying a Join in the WHERE Clause" on page 2-511

3 See "Function Expressions" on page 4-68

4 Dynamic Server only

5 See "Collection Subquery" on page 4-3

6 See "Statement-Local Variable Expressions (IDS)" on page 4-114

Element	Description	Restrictions	Syntax
Logical_ Operator	Combines two conditions	Valid options are *logical union* (= OR *or* OR NOT) or *logical intersection* (= AND *or* AND NOT)	"Conditions with AND or OR" on page 4-17
subquery	Embedded query	Cannot include the FIRST or ORDER BY keywords	"SELECT" on page 2-479

Using a Condition in the WHERE Clause

You can use these simple conditions or comparisons in the WHERE clause:

- Relational-operator condition
- IN or BETWEEN . . . AND
- IS NULL or IS NOT NULL
- LIKE or MATCHES

You also can use a SELECT statement within the WHERE clause; this is called a *subquery*. The following WHERE clause operators are valid in a subquery:

- IN or EXISTS
- ALL, ANY, or SOME

For more information, see "Condition" on page 4-5.

In the WHERE clause, an aggregate function is not valid unless it is part of a subquery or is on a correlated column originating from a parent query, and the WHERE clause is in a subquery within a HAVING clause.

Relational-Operator Condition: A relational-operator condition is satisfied if the expressions on each side of the operator fulfill the relation that the operator specifies. The following SELECT statements use the greater than (>) and equal (=) relational operators:

```
SELECT order_num FROM orders
   WHERE order_date > '6/04/98'
SELECT fname, lname, company
   FROM customer
   WHERE city[1,3] = 'San'
```

Quotes are required around 'San' because the substring is from a character column. See the "Relational-Operator Condition" on page 4-8.

IN Condition: The IN condition is satisfied when the expression to the left of the IN keyword is included in the list of values to the right of the keyword.

The following examples show the IN condition:

```
SELECT lname, fname, company FROM customer
   WHERE state IN ('CA','WA', 'NJ')
SELECT * FROM cust_calls
   WHERE user_id NOT IN (USER )
```

For more information, see the "IN Subquery" on page 4-14.

BETWEEN Condition: The BETWEEN condition is satisfied when the value to the left of BETWEEN is in the inclusive range of the two values on the right of BETWEEN. The first two queries in the following example use literal values after the BETWEEN keyword. The third query uses the built-in CURRENT function and a literal interval to search for dates between the current day and seven days earlier.

```
SELECT stock_num, manu_code FROM stock
   WHERE unit_price BETWEEN 125.00 AND 200.00
SELECT DISTINCT customer_num, stock_num, manu_code
   FROM orders, items
   WHERE order_date BETWEEN '6/1/97' AND '9/1/97'
SELECT * FROM cust_calls WHERE call_dtime
   BETWEEN (CURRENT - INTERVAL(7) DAY TO DAY) AND CURRENT
```

For more information, see the “BETWEEN Condition” on page 4-8.

IS NULL Condition: The IS NULL condition is satisfied if the column contains a NULL value. If you use the NOT option, the condition is satisfied when the column contains a value that is not NULL. The following example selects the order numbers and customer numbers for which the order has not been paid:

```
SELECT order_num, customer_num FROM orders
   WHERE paid_date IS NULL
```

For a complete description, see the “IS NULL Condition” on page 4-10.

LIKE or MATCHES Condition: The LIKE or MATCHES condition is satisfied if either of the following is true:

- The value of the column that precedes the LIKE or MATCHES keyword matches the pattern that the quoted string specifies. You can use wildcard characters in the string.
- The value of the column that precedes the LIKE or MATCHES keyword matches the pattern that is specified by the column that follows the LIKE or MATCHES keyword. The value of the column on the right serves as the matching pattern in the condition.

The following SELECT statement returns all rows in the **customer** table in which the **lname** column begins with the literal string `'Baxter'`. Because the string is a literal string, the condition is case sensitive.

```
SELECT * FROM customer WHERE lname LIKE 'Baxter%'
```

The next SELECT statement returns all rows in the **customer** table in which the value of the **lname** column matches the value of the **fname** column:

```
SELECT * FROM customer WHERE lname LIKE fname
```

The following examples use the LIKE condition with a wildcard. The first SELECT statement finds all stock items that are some kind of ball. The second SELECT statement finds all company names that contain a percent (%) sign. Backslash (\ ) is used as the default escape character for the percent (%) sign wildcard. The third SELECT statement uses the ESCAPE option with the LIKE condition to retrieve rows from the **customer** table in which the **company** column includes a percent (%) sign. The `z` is used as an escape character for the percent (%) sign:

```
SELECT stock_num, manu_code FROM stock
   WHERE description LIKE '%ball'
SELECT * FROM customer WHERE company LIKE '%\%%'
SELECT * FROM customer WHERE company LIKE '%z%%' ESCAPE 'z'
```

The following examples use MATCHES with a wildcard in SELECT statements. The first SELECT statement finds all stock items that are some kind of ball. The second SELECT statement finds all company names that contain an asterisk (*). The backslash (\ ) is used as the default escape character for a literal asterisk (*) character. The third statement uses the ESCAPE option with the MATCHES condition to retrieve rows from the **customer** table where the **company** column includes an asterisk (*). The z character is specified as an escape character for the asterisk (*) character:

```
SELECT stock_num, manu_code FROM stock
   WHERE description MATCHES '*ball'

SELECT * FROM customer WHERE company MATCHES '*\**'

SELECT * FROM customer WHERE company MATCHES '*z**' ESCAPE 'z'
```

See also the “LIKE and MATCHES Condition” on page 4-11.

IN Subquery: With the IN subquery, more than one row can be returned, but only one column can be returned.

This example shows the use of an IN subquery in a SELECT statement:

```
SELECT DISTINCT customer_num FROM orders
   WHERE order_num NOT IN
      (SELECT order_num FROM items
         WHERE stock_num = 1)
```

For additional information, see the “IN Condition” on page 4-9.

EXISTS Subquery: With the EXISTS subquery, one or more columns can be returned.

The following example of a SELECT statement with an EXISTS subquery returns the stock number and manufacturer code for every item that has never been ordered (and is therefore not listed in the **items** table).

It is appropriate to use an EXISTS subquery in this SELECT statement because you need the correlated subquery to test both **stock_num** and **manu_code** in the **items** table.

```
SELECT stock_num, manu_code FROM stock
   WHERE NOT EXISTS
      (SELECT stock_num, manu_code FROM items
         WHERE stock.stock_num = items.stock_num AND
            stock.manu_code = items.manu_code)
```

The preceding example would work equally well if you use a SELECT * in the subquery in place of the column names, because you are testing for the existence of a row or rows.

For additional information, see the “EXISTS Subquery” on page 4-14.

ALL, ANY, SOME Subqueries: The following examples return the order number of all orders that contain an item whose total price is greater than the total price of every item in order number 1023. The first SELECT uses the ALL subquery, and the second SELECT produces the same result by using the MAX aggregate function.

```
SELECT DISTINCT order_num FROM items
   WHERE total_price > ALL (SELECT total_price FROM items
        WHERE order_num = 1023)

SELECT DISTINCT order_num FROM items
   WHERE total_price > SELECT MAX(total_price) FROM items
        WHERE order_num = 1023)
```

The following SELECT statements return the order number of all orders that contain an item whose total price is greater than the total price of at least one of the items in order number 1023. The first SELECT statement uses the ANY keyword, and the second SELECT statement uses the MIN aggregate function:

```
SELECT DISTINCT order_num FROM items
   WHERE total_price > ANY (SELECT total_price FROM items
        WHERE order_num = 1023)

SELECT DISTINCT order_num FROM items
   WHERE total_price > (SELECT MIN(total_price) FROM items
      WHERE order_num = 1023)
```

You can omit the keywords ANY, ALL, or SOME in a subquery if the subquery returns exactly one value. If you omit ANY, ALL, or SOME, and the subquery returns more than one value, you receive an error. The subquery in the next example returns only one row, because it uses an aggregate function:

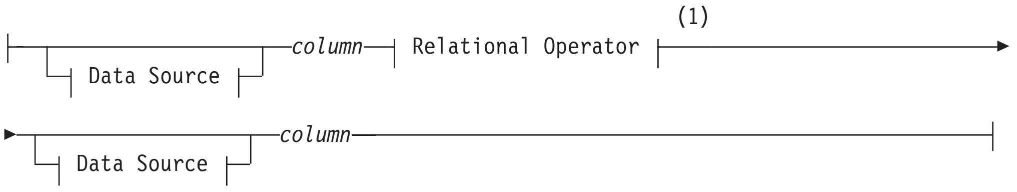
```
SELECT order_num FROM items
   WHERE stock_num = 9 AND quantity =
      (SELECT MAX(quantity) FROM items WHERE stock_num = 9)
```

See also "ALL, ANY, and SOME Subqueries" on page 4-15.

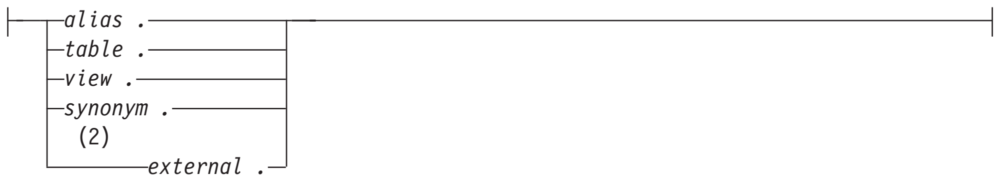
Specifying a Join in the WHERE Clause

You join two tables by creating a relationship in the WHERE clause between at least one column from one table and at least one column from another. The join creates a temporary composite table where each pair of rows (one from each table) that satisfies the join condition is linked to form a single row.

Join:



Data Source:



Notes:

1 See "Relational Operator" on page 4-146

2 Extended Parallel Server only

Element	Description	Restrictions	Syntax
alias	Temporary alternative name declared in the FROM clause for a table or view	See "Self-Joins" on page 2-512; "FROM Clause" on page 2-492	"Identifier" on page 5-22
column	Column of a table or view to be joined	Must exist in the table or view	"Identifier" on page 5-22
external	External table from which to retrieve data	External table must exist	"Database Object Name" on page 5-17
synonym, table, view	Name of a synonym, table, or view to be joined in the query	Synonym and the table or view to which it points must exist	"Database Object Name" on page 5-17

Rows from the tables or views are *joined* when there is a match between the values of specified columns. When the columns to be joined have the same name, you must qualify each column name with its data source.

Two-Table Joins: You can create two-table joins, multiple-table joins, self-joins, and outer joins (Informix-extension syntax). The following example shows a two-table join:

```
SELECT order_num, lname, fname FROM customer, orders
   WHERE customer.customer_num = orders.customer_num
```

Multiple-Table Joins: A multiple-table join is a join of more than two tables. Its structure is similar to the structure of a two-table join, except that you have a join condition for more than one pair of tables in the WHERE clause. When columns from different tables have the same name, you must qualify the column name with its associated table or table alias, as in *table.column*. For the full syntax of a table name, see "Database Object Name" on page 5-17.

The following multiple-table join yields the company name of the customer who ordered an item as well as its stock number and manufacturer code:

```
SELECT DISTINCT company, stock_num, manu_code
   FROM customer c, orders o, items i
   WHERE c.customer_num = o.customer_num
      AND o.order_num = i.order_num
```

Self-Joins: You can join a table to itself. To do so, you must list the table name twice in the FROM clause and assign it two different table aliases. Use the aliases to refer to each of the *two* tables in the WHERE clause. The next example is a self-join on the **stock** table. It finds pairs of stock items whose unit prices differ by a factor greater than 2.5. The letters `x` and `y` are each aliases for the **stock** table.

```
SELECT x.stock_num, x.manu_code, y.stock_num, y.manu_code
   FROM stock x, stock y WHERE x.unit_price > 2.5 * y.unit_price
```

Extended Parallel Server does not support self-joins with an external table.

Informix-Extension Outer Joins: The next outer join lists the company name of the customer and all associated order numbers, if the customer has placed an order. If not, the company name is still listed, and a NULL value is returned for the order number.

```
SELECT company, order_num FROM customer c, OUTER orders o
   WHERE c.customer_num = o.customer_num
```

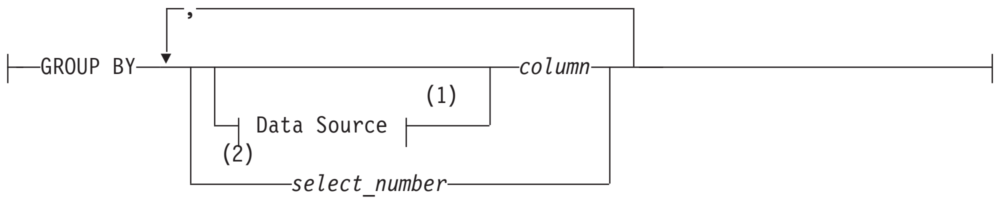
In Extended Parallel Server, you cannot use an external table as the outer table in an outer join.

For more information about outer joins, see the *IBM Informix Guide to SQL: Tutorial*.

GROUP BY Clause

Use the GROUP BY clause to produce a single row of results for each group. A *group* is a set of rows that have the same values for each column listed.

GROUP BY Clause:



Notes:

1 See "WHERE Clause" on page 2-507

2 Informix extension

Element	Description	Restrictions	Syntax
column	A column (or an expression) from the select list of the Projection clause	See "Relationship of GROUP BY and Projection Clauses"	"Identifier" on page 5-22
select _number	Integer specifying ordinal position of a column or expression in select list	See "Using Select Numbers" on page 2-514.	"Literal Number" on page 4-137

The SELECT statement with a GROUP BY clause returns a single row of results for each group of rows that have the same value in *column*, or that have the same value in the column or expression that the *select_number* specifies.

Relationship of GROUP BY and Projection Clauses

A GROUP BY clause restricts what the Projection clause can specify. If you use a GROUP BY clause, each *column* specified in the select list of the Projection clause must also be included in the GROUP BY clause.

If you use an aggregate function and one or more column expressions in the select list, you must put all the column names that are not used as part of an aggregate or time expression in the GROUP BY clause.

Constant expressions and BYTE or TEXT column expressions are not valid in the GROUP BY list.

If the select list includes a BYTE or TEXT column, you cannot use the GROUP BY clause. In addition, you cannot include a ROWID in a GROUP BY clause.

In Dynamic Server, if your select list includes a column of a user-defined data type, the column cannot be used in a GROUP BY clause unless the UDT can use the built-in bit-hashing function. Any UDT that cannot use the built-in bit-hashing function must be created with the CANNOTHASH modifier, which tells the database server that the UDT cannot be used in a GROUP BY clause.

The following example names one column that is not in an aggregate expression. The **total_price** column should not be in the GROUP BY list because it appears as the argument of an aggregate function. The COUNT and SUM aggregates are applied to each group, not to the whole query set.

```
SELECT order_num, COUNT(*), SUM(total_price)
   FROM items GROUP BY order_num
```

If a column stands alone in a column expression in the select list, you must use it in the GROUP BY clause. If a column is combined with another column by an arithmetic operator, you can choose to group by the individual columns or by the combined expression using the number.

NULL Values in the GROUP BY Clause

In a column listed in a GROUP BY clause, each row that contains a NULL value belongs to a single group. That is, all NULL values are grouped together.

Using Select Numbers

You can use one or more integers in the GROUP BY clause to stand for column expressions. In the next example, the first SELECT statement uses select numbers for **order_date** and **paid_date - order_date** in the GROUP BY clause. You can group only by a combined expression using the select numbers.

In the second SELECT statement, you cannot replace the 2 with the arithmetic expression **paid_date - order_date**:

```
SELECT order_date, COUNT(*), paid_date - order_date
   FROM orders GROUP BY 1, 3
SELECT order_date, paid_date - order_date
   FROM orders GROUP BY order_date, 2
```

HAVING Clause

Use the HAVING clause to apply one or more qualifying conditions to groups.

HAVING Clause:

```
                         (1)
├──HAVING──┤ Condition ├──────────────────────────────────────────────────┤
```

Notes:

1 See "Condition" on page 4-5

In the following examples, each condition compares one calculated property of the group with another calculated property of the group or with a constant. The first SELECT statement uses a HAVING clause that compares the calculated expression `COUNT(*)` with the constant 2. The query returns the average total price per item on all orders that have more than two items.

The second SELECT statement lists customers and the call months for customers who have made two or more calls in the same month:

```
SELECT order_num, AVG(total_price) FROM items
   GROUP BY order_num HAVING COUNT(*) > 2
SELECT customer_num, EXTEND (call_dtime, MONTH TO MONTH)
   FROM cust_calls GROUP BY 1, 2 HAVING COUNT(*) > 1
```

You can use the HAVING clause to place conditions on the GROUP BY column values as well as on calculated values. This example returns **cust_code** and **customer_num**, **call_dtime**, and groups them by **call_code** for all calls that have been received from customers with **customer_num** less than 120:

```
SELECT customer_num, EXTEND (call_dtime), call_code
   FROM cust_calls GROUP BY call_code, 2, 1
   HAVING customer_num < 120
```

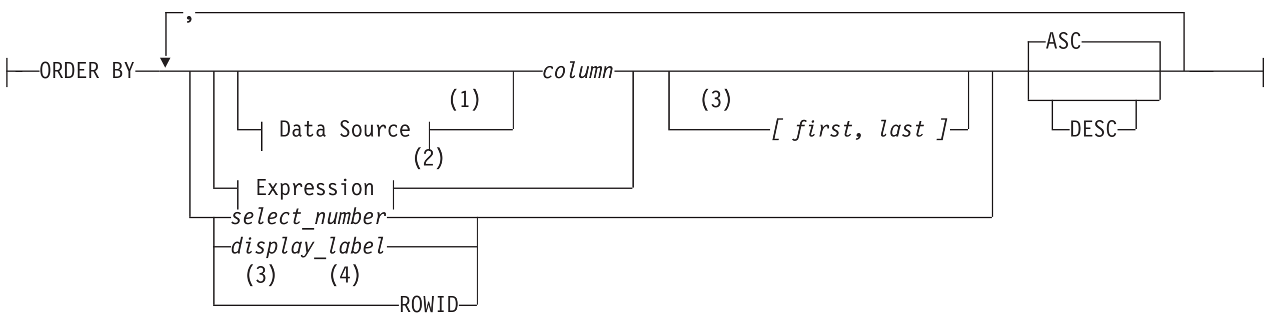
The HAVING clause generally complements a GROUP BY clause. If you omit the GROUP BY clause, the HAVING clause applies to all rows that satisfy the query, and all rows in the table make up a single group. The following example returns the average price of all the values in the table, as long as more than ten rows are in the table:

```
SELECT AVG(total_price) FROM items HAVING COUNT(*) > 10
```

ORDER BY Clause

The ORDER BY clause sorts query results by specified columns or expressions.

ORDER BY Clause:



Notes:

1 See "WHERE Clause" on page 2-507

2 See "Expression" on page 4-34

3 Informix extension

4 Dynamic Server only

Element	Description	Restrictions	Syntax
column	Sort rows by value in this column	Must also be in select list (Extended Parallel Server only).	"Identifier" on page 5-22
display_label	Temporary name for a column or for a column expression	Must be unique among labels declared in the Projection clause	"Identifier" on page 5-22
first, last	First and last byte in column substring to sort the result set	Integers; for BYTE, TEXT, and character data types only	"Literal Number" on page 4-137
select_ number	Ordinal position of a column in select list of the Projection clause	See "Using Select Numbers" on page 2-514.	"Literal Number" on page 4-137

The ORDER BY clause is not valid in queries within an SPL routine.

Ordering by a Column or by an Expression

For Extended Parallel Server, any *column* in the ORDER BY clause must also appear explicitly or by * notation in the select list of the Projection clause. To order query results by an expression, you must also declare a display label for the expression in the Projection clause, as in the following example, which declares the display label **span** for the difference between two columns:

```
SELECT paid_date - ship_date span, customer_num FROM orders
   ORDER BY span
```

Dynamic Server supports columns and expressions in the ORDER BY clause that do not appear in the select list of the Projection clause. You can omit a display label for the derived column in the select list and specify the derived column by means of a select number in the ORDER BY clause.

The select list of the Projection clause must include any column or expression that the ORDER BY clause specifies, however, if any of the following is true:
- The query includes the DISTINCT, UNIQUE, or UNION operator.
- The query includes the INTO TEMP *table* clause.
- The distributed query accesses a remote database whose server requires every column or expression in the ORDER BY clause to also appear in the select list of the Projection clause.
- An expression in the ORDER BY clause includes a display label for a column substring. (See the next section, "Ordering by a Substring" on page 2-516.)

The next query selects one column from the **orders** table and sorts the results by the value of another column. (With Extended Parallel Server, **order_date** must also appear in the Projection clause.) By default, the rows are listed in ascending order.

```
SELECT ship_date FROM orders ORDER BY order_date
```

You can order by an aggregate expression only if the query also has a GROUP BY clause. This query declares the display label **maxwgt** for an aggregate in the ORDER BY clause:

```
SELECT ship_charge, MAX(ship_weight) maxwgt
   FROM orders GROUP BY ship_charge ORDER BY maxwgt
```

If the current processing locale defines a localized collation, then NCHAR and NVARCHAR column values are sorted in that localized order.

3 In Dynamic Server, no *column* in the ORDER BY clause can be a collection type,
3 but a query whose result set defines a collection-derived table can include the
3 ORDER BY clause. For an example, see "Collection-Derived Table" on page 5-5.

You might improve the performance of some non-PDQ queries that use the ORDER BY clause to sort a large set of rows if you increase the setting of the DS_NONPDQ_QUERY_MEM configuration parameter.

Ordering by a Substring

You can order by a substring instead of by the entire length of a character, BYTE, or TEXT column, or of an expression returning a character string. The database server uses the substring to sort the result set. Define the substring by specifying integer subscripts (the *first* and *last* parameters), representing the starting and ending byte positions of the substring within the column value.

The following SELECT statement queries the **customer** table and specifies a column substring in the ORDER BY column. This instructs the database server to sort the query results by the portion of the **lname** column contained in the sixth through ninth bytes of the column value.

```
SELECT * from customee ORDER BY lname[6,9]
```

Assume that the value of **lname** in one row of the **customer** table is `Greenburg`. Because of the column substring in the ORDER BY clause, the database server determines the sort position of this row by using the value `burg`, rather than the complete column value `Greenburg`.

When ordering by an expression, you can specify substrings only for expressions that return a character data type. If you specify a column substring in the ORDER BY clause, the column must have one of the following data types: BYTE, CHAR, NCHAR, NVARCHAR, TEXT, or VARCHAR.

Dynamic Server can also support LVARCHAR column substrings in the ORDER BY clause, if the column is in a database of the local database server.

For information on the GLS aspects of using column substrings in the ORDER BY clause, see the *IBM Informix GLS User's Guide*.

Ascending and Descending Orders

You can use the ASC and DESC keywords to specify ascending (smallest value first) or descending (largest value first) order. The default order is ascending. For DATE and DATETIME data types, *smallest* means earliest in time and *largest* means latest in time. For character data types in the default locale, the order is the ASCII collating sequence, as listed in "Collating Order for U.S. English Data" on page 4-147.

For NCHAR or NVARCHAR data types, the localized collating order of the current session is used, if that is different from the code set order. For more information about collation, see "SET COLLATION" on page 2-531.

If you specify the ORDER BY clause, NULL values are ordered as less than values that are not NULL. Using the ASC order, a NULL value comes before any non-NULL value; using DESC order, the NULL comes last.

Nested Ordering

If you list more than one column in the ORDER BY clause, your query is ordered by a nested sort. The first level of sort is based on the first column; the second column determines the second level of sort. The following example of a nested sort selects all the rows in the **cust_calls** table and orders them by **call_code** and by **call_dtime** within **call_code**:

```
SELECT * FROM cust_calls ORDER BY call_code, call_dtime
```

Using Select Numbers

In place of column names, you can enter in the ORDER BY clause one or more integers that refer to the position of items listed in the select list of the Projection clause. You can also use a select number to sort by an expression.

The following example orders by the expression **paid_date - order_date** and **customer_num**, using select numbers in a nested sort:

```
SELECT order_num, customer_num, paid_date - order_date
   FROM orders
   ORDER BY 3, 2
```

Select numbers are required in the ORDER BY clause when SELECT statements are joined by the UNION or UNION ALL keywords, or when compatible columns in the same position have different names.

Ordering by Rowids

You can specify the ROWID keyword in the ORDER BY clause. This specifies the **rowid** column, a hidden column in nonfragmented tables and in fragmented tables that were created with the WITH ROWIDS clause. The **rowid** column contains a unique internal record number that is associated with a row in a table. (It is recommended, however, that you utilize primary keys as your access method, rather than exploiting the **rowid** column.)

The ORDER BY clause cannot specify the **rowid** column if the table from which you are selecting is a fragmented table that has no **rowid** column.

In Extended Parallel Server, you cannot specify the ROWID keyword in the ORDER BY clause unless you also included ROWID in the Projection clause.

In Dynamic Server, you do not need to include the ROWID keyword in the Projection clause when you specify ROWID in the ORDER BY clause.

For further information about **rowid** values and how to use the **rowid** column in column expressions, see "WITH ROWIDS Option (IDS)" on page 2-21 and "Using Rowids (IDS)" on page 4-48.

ORDER BY Clause with DECLARE

In ESQL/C, you cannot use a DECLARE statement with a FOR UPDATE clause to associate a cursor with a SELECT statement that has an ORDER BY clause.

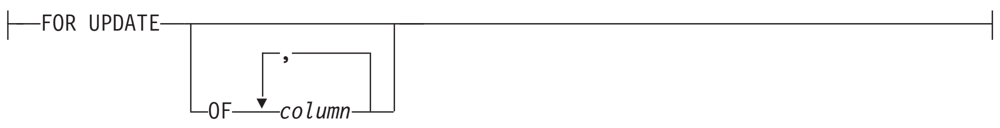
Placing Indexes on ORDER BY Columns

When you include an ORDER BY clause in a SELECT statement, you can improve the performance of the query by creating an index on the column or columns that the ORDER BY clause specifies. The database server uses the index that you placed on the ORDER BY columns to sort the query results in the most efficient manner. For more information on how to create indexes that correspond to the columns of an ORDER BY clause, see "Using the ASC and DESC Sort-Order Options" on page 2-121.

FOR UPDATE Clause

Use the FOR UPDATE clause when you intend to update the values returned by a prepared SELECT statement when the values are fetched. Preparing a SELECT statement that contains a FOR UPDATE clause is equivalent to preparing the SELECT statement without the FOR UPDATE clause and then declaring a FOR UPDATE cursor for the prepared statement.

FOR UPDATE Clause:



Element	Description	Restrictions	Syntax
column	Name of a column that can be updated after a FETCH	Must be in the FROM clause *table*, but it does not need to be in the select list of the Projection clause	"Identifier" on page 5-22

The FOR UPDATE keyword notifies the database server that updating is possible, causing it to use more stringent locking than it would with a select cursor. You cannot modify data through a cursor without this clause. You can specify which columns can be updated.

After you declare a cursor for a SELECT ... FOR UPDATE statement, you can update or delete the currently selected row using an UPDATE or DELETE statement with the WHERE CURRENT OF clause. The words CURRENT OF refer to the row that was most recently fetched; they replace the usual test expressions in the WHERE clause. To update rows with a specific value, your program might contain statements such as those in the following example:

```
EXEC SQL BEGIN DECLARE SECTION;
    char fname[ 16];
    char lname[ 16];
    EXEC SQL END DECLARE SECTION;
. . .
 EXEC SQL connect to 'stores_demo';
 /* select statement being prepared contains a for update clause */
 EXEC SQL prepare x from 'select fname, lname from customer for update';
 EXEC SQL declare xc cursor for x;

 for (;;)
   {
   EXEC SQL fetch xc into $fname, $lname;
   if (strncmp(SQLSTATE, '00', 2) != 0) break;
   printf("%d %s %s\n",cnum, fname, lname );
   if (cnum == 999)              --update rows with 999 customer_num
       EXEC SQL update customer set fname = 'rosey' where current of xc;
   }

 EXEC SQL close xc;
 EXEC SQL disconnect current;
```

A SELECT...FOR UPDATE statement, like an update cursor, allows you to perform updates that are not possible with the UPDATE statement alone, because both the decision to update and the values of the new data items can be based on the original contents of the row. The UPDATE statement cannot query the table that is being updated.

Syntax That is Incompatible with the FOR UPDATE Clause

A SELECT statement that uses a FOR UPDATE clause must conform to the following restrictions:

- The statement can select data from only one table.
- The statement cannot include any aggregate functions.
- The statement cannot include any of the following clauses or keywords: DISTINCT, FOR READ ONLY, GROUP BY, INTO SCRATCH, INTO TEMP, INTO EXTERNAL, ORDER BY, UNION, or UNIQUE.

For information on how to declare an update cursor for a SELECT statement that does not include a FOR UPDATE clause, see "Using the FOR UPDATE Option" on page 2-264.

FOR READ ONLY Clause

Use the FOR READ ONLY keywords to specify that the select cursor declared for the SELECT statement is a read-only cursor. A read-only cursor is a cursor that cannot modify data. This section provides the following information about the FOR READ ONLY clause:

- When you must use the FOR READ ONLY clause

- Syntax restrictions on a SELECT statement that uses a FOR READ ONLY clause

Using the FOR READ ONLY Clause in Read-Only Mode

Normally, you do not need to include the FOR READ ONLY clause in a SELECT statement. SELECT is a read-only operation by definition, so the FOR READ ONLY clause is usually unnecessary. In certain circumstances, however, you must include the FOR READ ONLY keywords in a SELECT statement.

If you have used the High-Performance Loader (HPL) in express mode to load data into the tables of an ANSI-compliant database, and you have not yet performed a level-0 backup of this data, the database is in read-only mode. When the database is in read-only mode, the database server rejects any attempts by a select cursor to access the data unless the SELECT or the DECLARE includes a FOR READ ONLY clause. This restriction remains in effect until the user has performed a level-0 backup of the data.

In an ANSI-compliant database, select cursors are update cursors by default. An update cursor is a cursor that can be used to modify data. These update cursors are incompatible with the read-only mode of the database. For example, this SELECT statement against the **customer_ansi** table fails:

```
EXEC SQL declare ansi_curs cursor for
   select * from customer_ansi;
```

The solution is to include the FOR READ ONLY clause in your select cursors. The read-only cursor that this clause specifies is compatible with the read-only mode of the database. For example, the following SELECT FOR READ ONLY statement against the **customer_ansi** table succeeds:

```
EXEC SQL declare ansi_read cursor for
   select * from customer_ansi for read only;
```

DB–Access executes all SELECT statements with select cursors, so you must specify FOR READ ONLY in all queries that access data in a read-only ANSI-compliant database. The FOR READ ONLY clause causes DB–Access to declare the cursor for the SELECT statement as a read-only cursor.

For more information on level-0 backups, see your *IBM Informix Backup and Restore Guide*. For more information on select cursors, read-only cursors, and update cursors, see “DECLARE” on page 2-260.

For more information on the express mode of the HPL of Dynamic Server, see the *IBM Informix High-Performance Loader User's Guide*.

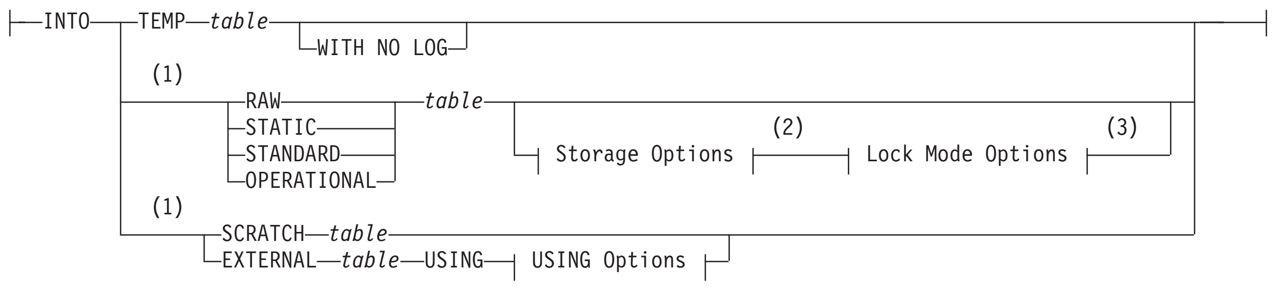
Syntax That Is Incompatible with the FOR READ ONLY Clause

If you attempt to include both the FOR READ ONLY clause and the FOR UPDATE clause in the same SELECT statement, the SELECT statement fails. For information on declaring a read-only cursor for a SELECT statement that does not include a FOR READ ONLY clause, see “DECLARE” on page 2-260.

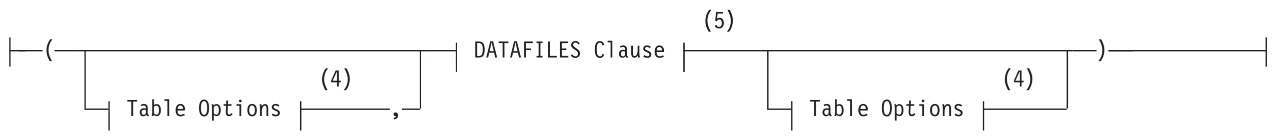
INTO Table Clauses

Use the INTO Table clauses to specify a temporary or external table to receive the data that the SELECT statement retrieves.

INTO Table Clauses:



USING Options:



Notes:

1 Extended Parallel Server only

2 See "Storage Options" on page 2-188

3 See "LOCK MODE Options" on page 2-203

4 See "Table Options" on page 2-523

5 See "DATAFILES Clause" on page 2-102

Element	Description	Restrictions	Syntax
table	Table to receive the results of the query	Must be unique among names of tables, views, and synonyms that you own in the current database	"Database Object Name" on page 5-17

You must have the Connect privilege on a database to create a temporary or external table in that database. The name of a temporary table need not be unique among the names of temporary tables of other users.

Column names in the temporary or external table must be specified in the Projection clause, where you must supply a display label for all expressions that are not simple column expressions. The display label becomes the column name in the temporary or external table. If you do not declare a display label for a column expression, the table uses the column name from the select list of the Projection clause.

The following INTO TEMP example creates the **pushdate** table with two columns, **customer_num** and **slowdate**:

```
SELECT customer_num, call_dtime + 5 UNITS DAY slowdate
   FROM cust_calls INTO TEMP pushdate
```

Results When No Rows are Returned

When you use an INTO Table clause combined with the WHERE clause, and no rows are returned, the SQLNOTFOUND value is `100` in ANSI-compliant databases and `0` in databases that are not ANSI compliant. If the SELECT INTO TEMP...WHERE... statement is a part of a multistatement PREPARE and no rows are returned, the SQLNOTFOUND value is `100` for both ANSI-compliant databases and databases that are not ANSI-compliant.

This release of Dynamic Server continues to process the remaining statements of a multistatement prepared object after encountering the SQLNOTFOUND value of 100. You can maintain the legacy behavior, however, of not executing the remaining prepared statements by setting the **IFX_MULTIPREPSTMT** environment variable to 1.

Restrictions with INTO Table Clauses in ESQL/C

In ESQL/C, do not use the INTO clause with an INTO *table* clause. If you do, no results are returned to the program variables and the **SQLCODE** variable is set to a negative value.

INTO TEMP Clause

The INTO TEMP clause creates a temporary table to hold the query results. The default initial and next extents for a temporary table are four pages. The temporary table must be accessible by the built-in RSAM access method of the database server; you cannot specify another access method.

If you use the same query results more than once, using a temporary table saves time. In addition, using an INTO TEMP clause often gives you clearer and more understandable SELECT statements.

Data values in a temporary table are static; they are not updated as changes are made to the tables that were used to build the temporary table. You can use the CREATE INDEX statement to create indexes on a temporary table.

A logged, temporary table exists until one of the following situations occurs:
- The application disconnects from the database.
- A DROP TABLE statement is issued on the temporary table.
- The database is closed.

For Dynamic Server, if your database does not have transaction logging, the temporary table behaves in the same way as a table created with the WITH NO LOG option.

3 If you specify more than one temporary dbspace in the **DBSPACETEMP**
3 environment variable (or if this is not set, in the DBSPACETEMP configuration
3 parameter), the INTO TEMP clause loads the rows of the results set of the query
3 into each of these dbspaces in round-robin fashion. For more information about the
3 storage location of temporary tables that queries with the INTO TEMP clause
3 create, see "Where Temporary Tables are Stored" on page 2-214.

Using SELECT INTO to Create a New Permanent Table

Using Extended Parallel Server, you can use the SELECT INTO statement to create a new permanent table based on the result set of a SELECT statement.

When using SELECT INTO to create a new table, you must specify its type. You can optionally specify storage and lock mode options for the new table.

The column names of the new permanent table are the names specified in the select list. If an "*" appears in the select list, it is expanded to all the columns of the corresponding tables or views in the SELECT statement.

All expressions other than simple column expressions must have a display label. This is used as the name of the column in the new table. If a column expression has no display label, the table uses the column name. If there are duplicate labels or column names in the select list, an error will be returned.

Using the WITH NO LOG Option

Use the WITH NO LOG option to reduce the overhead of transaction logging because operations on nonlogging temporary tables are not logged.

A nonlogging temporary table exists until one of the following events occurs:

- The application disconnects.
- A DROP TABLE statement is issued on the temporary table.

Because nonlogging temporary tables do not disappear when the database is closed, you can use a nonlogging temporary table to transfer data from one database to another while the application remains connected. The behavior of a temporary table that you create with the WITH NO LOG option of the INTO TEMP clause is the same as that of a scratch table.

For more information about temporary tables, see “CREATE Temporary TABLE” on page 2-209.

INTO EXTERNAL Clause (XPS)

The INTO EXTERNAL clause unloads query results into an external table, creating a default external table description that you can use when you subsequently reload the files. This combines the functionality of the CREATE EXTERNAL TABLE . . . SAMEAS and INSERT INTO . . . SELECT statements.

Table Options: The SELECT statement supports a subset of the CREATE EXTERNAL TABLE syntax for “Table Options” on page 2-103. Use the Table Options clause of the SELECT INTO EXTERNAL statement to specify the format of the unloaded data in the external table.

Table Options:

```
                  ┌─,──────────────────────────────────┐
   (1)            │          ┌─DELIMITED─┐             │
├──────────────── ▼ ┬─FORMAT──'─┴─INFORMIX──┴─'────────┬─┴──────────────────────────────────┤
                    │            ┌─ASCII──┐          │
                    ├─CODESET──'─┴─EBCDIC─┴─'────────┤
                    ├─DELIMITER──'field_delimiter ' ─┤
                    ├─RECORDEND──'record_delimiter ' ┤
                    └─ESCAPE─────────────────────────┘
```

Notes:

1 Extended Parallel Server only

Element	Description	Restrictions	Syntax
field_delimiter	Character to separate fields. Default is pipe (|) character	See “Specifying Delimiters” on page 2-524.	“Quoted String” on page 4-142
record_delimiter	Character to separate records	See “Specifying Delimiters” on page 2-524.	“Quoted String” on page 4-142

The following table describes the keywords that apply to unloading data. If you want to specify additional table options in the external-table description for the purpose of reloading the table later, see “Table Options” on page 2-103.

In the SELECT ... INTO EXTERNAL statement, you can specify all table options that are discussed in the CREATE EXTERNAL TABLE statement except the fixed-format option.

You can use the INTO EXTERNAL clause when the format type of the created data file is either delimited text (if you use the DELIMITED keyword) or text in Informix internal data format (if you use the INFORMIX keyword). You cannot use it for a fixed-format unload.

Keyword	**Effect**
CODESET	Specifies the type of code set. Options are EBCDIC or ASCII.
DELIMITER	Specifies the character that separates fields in a delimited text file
ESCAPE	Directs the database server to recognize ASCII special characters embedded in ASCII-text-based data files If you do not specify ESCAPE when you load data, the database server does not check the character fields in text data files for embedded special characters. If you do not specify ESCAPE when you unload data, the database server does not create embedded hexadecimal characters in text fields.
FORMAT	Specifies the format of the data in the data files
RECORDEND	Specifies the character that separates records in a delimited text file

Specifying Delimiters: If you do not set the **RECORDEND** environment variable, the default value for *record_delimiter* is the newline character (CTRL-J).

If you use a non-printing character as a delimiter, encode it as the octal representation of the ASCII character. For example, '\006' can represent CTRL-F.

For more information on external tables, see "CREATE EXTERNAL TABLE (XPS)" on page 2-98.

INTO SCRATCH Clause (XPS)

Extended Parallel Server supports the INTO Scratch clause. This can improve performance, because scratch tables are not logged. A scratch table does not support indexes or constraints. It persists until the application disconnects, or a DROP TABLE statement is issued on the temporary table.

Because scratch tables do not disappear when the database is closed, you can use a scratch table to transfer data from one database to another while the application remains connected. A scratch table is identical to a temporary table that is created with the WITH NO LOG option. For more information about scratch tables, see "CREATE Temporary TABLE" on page 2-209.

UNION Operator

Place the UNION operator between two SELECT statements to combine the queries into a single query. You can string several SELECT statements together using the UNION operator. Corresponding items do not need to have the same name. Omitting the ALL keyword excludes duplicate rows.

Restrictions on a Combined SELECT

Several restrictions apply on the queries that you can connect with a UNION operator, as the following list describes:

- In ESQL/C, you cannot use an INTO clause in a compound query unless exactly one row is returned, and you are not using a cursor. In this case, the INTO clause must be in the first SELECT statement.
- The number of items in the Projection clause of each query must be the same, and the corresponding items in each Projection clause must have compatible data types.
- The Projection clause of each query cannot specify BYTE or TEXT columns. (This restriction does not apply to UNION ALL operations.)
- If you use an ORDER BY clause, it must follow the last Projection clause, and you must refer to the item ordered by integer, not by identifier. Sorting takes place after the set operation is complete.

You can store the combined results of a UNION operator in a temporary table, but the INTO TEMP clause can appear only in the final SELECT statement.

Duplicate Rows in a Combined SELECT

If you use the UNION operator alone, the duplicate rows are removed from the complete set of rows. That is, if multiple rows contain identical values in each column, only one row is retained. If you use the UNION ALL operator, all the selected rows are returned (the duplicates are not removed).

The next example uses UNION ALL to join two SELECT statements without removing duplicates. The query returns a list of all the calls that were received during the first quarter of 1997 and the first quarter of 1998.

```
SELECT customer_num, call_code FROM cust_calls
   WHERE call_dtime BETWEEN
         DATETIME (1997-1-1) YEAR TO DAY
      AND DATETIME (1997-3-31) YEAR TO DAY
UNION ALL
SELECT customer_num, call_code FROM cust_calls
   WHERE call_dtime BETWEEN
         DATETIME (1998-1-1)YEAR TO DAY
      AND DATETIME (1998-3-31) YEAR TO DAY
```

If you want to remove duplicates, use the UNION operator without the keyword ALL in the query. In the preceding example, if the combination `101 B` were returned in both SELECT statements, a UNION operator would cause the combination to be listed once. (If you want to remove duplicates within each SELECT statement, use the DISTINCT keyword in the Projection clause, as described in “Projection Clause” on page 2-481.)

UNION in Subqueries

You can use the UNION and UNION ALL operators in subqueries of SELECT statements within the WHERE clause, the FROM clause, and in collection subqueries. In this release of Dynamic Server, however, subqueries that include UNION or UNION ALL are not supported in the following contexts:

- In the definition of a view
- In the event or in the Action clause of a trigger
- With the FOR UPDATE clause or with an Update cursor

- In a distributed query (accessing tables outside the local database)

For more information about collection subqueries, see "Collection Subquery" on page 4-3. For more information about the FOR UPDATE clause, see "FOR UPDATE Clause" on page 2-518.

In a combined subquery, the database server can resolve a column name only within the scope of its qualifying table reference. The following query, for example, returns an error:

```
SELECT * FROM t1 WHERE EXISTS
   (SELECT a FROM t2
   UNION
   SELECT b FROM t3 WHERE t3.c IN
      (SELECT t4.x FROM t4 WHERE t4.4 = t2.z))
```

Here **t2.z** in the innermost subquery cannot be resolved, because **z** occurs outside the scope of reference of the table reference **t2**. Only column references that belong to **t4**, **t3**, or **t1** can be resolved in the innermost subquery. The scope of a table reference extends downwards through subqueries, but not across the UNION operator to sibling SELECT statements.

Related Information

3 Because the SELECT statement is ″the Q in SQL,″ most features of the database
3 server directly or indirectly support SELECT operations, which are central to
3 relational and object-relational databases. (So this section is not comprehensive.)

For task-oriented discussions of the SELECT statement, see the *IBM Informix Guide to SQL: Tutorial*.

For a discussion of the GLS aspects of the SELECT statement, see the *IBM Informix GLS User's Guide*.

For information on how to access row and collection values with ESQL/C host variables, see the discussion of complex data types in the *IBM Informix ESQL/C Programmer's Manual*.

SET ALL_MUTABLES

Use the SET ALL_MUTABLES statement to specify the modifiability of all mutable environment variables in a user session.

Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──SET ALL_MUTABLES──TO──┬─MUTABLE───┬──────────────────────────────────────────►◄
                          └─IMMUTABLE─┘
```

Usage

By default, users can reset the values of some environment variables during a session to support their usage requirements. This capability can sometimes conflict, however, with the resource usage policy set by the DBA. By changing the mutability property of environment variables, a DBA can have more accurate control over resource allocation during a user session.

- SET ALL_MUTABLES TO MUTABLE causes all environment settings that have the mutability property to be modifiable during a user session.
- SET ALL_MUTABLES TO IMMUTABLE prevents modification of any environment settings that have the mutability property during a user session.

Settings of the following features frequently have the most impact on resource utilization within a user session, and have the mutability property defined:

- BOUND_IMPL_PDQ
- CLIENT_TZ
- COMPUTE_QUOTA
- DEFAULT TABLE_SPACE
- DEFAULT TABLE_TYPE
- IMPLICIT_PDQ
- MAXSCAN
- PDQPRIORITY
- TEMP_TAB_EXT_SIZE
- TEMP_TAB_NEXT_SIZE
- TMPSPACE_LIMIT

Users can reset the mutability of specific features by using the corresponding SET statement. For example, PDQPRIORITY can be made immutable by the SET PDQPRIORITY IMMUTABLE statement. SET DEFAULT TABLE_TYPE MUTABLE can change the default table type. SET ALL_MUTABLES can reset the mutability all of the above features in a single statement.

Typically, the mutability property is set by the DBA in a **sysdbopen** procedure to control the usage of resources. For a discussion of setting the mutability property in **sysdbopen** procedure, see *IBM Informix Performance Guide.*

The DBA can modify all variables, irrespective of their mutability setting. The command

```
onstat -g mut session_id
```

displays the current mutability settings for the specified session.

The command

```
onmode -q
```

can change the mutability of a specified variable associated with an existing session. See the *IBM Informix Administrator's Reference* for details of how to use the **onstat** and **onmode** utilities.

By default, all environment variables are MUTABLE.

Related Information

Related statements: SET Default Table Space, SET Default Table Type, SET ENVIRONMENT, and SET PDQPRIORITY

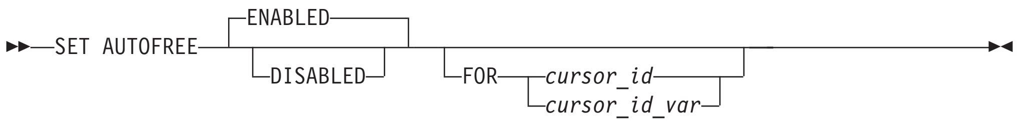
See also the section "Setting Environment Variables in SYSTEM Commands" on page 3-40, which describes how to use the SYSTEM statement of SPL to change the settings of environment variables for the current user session.

SET AUTOFREE

Use the SET AUTOFREE statement to instruct the database server to enable or disable a memory-management feature that can free the memory allocated for a cursor automatically, as soon as the cursor is closed.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. You can use this statement only with ESQL/C.

Syntax



Element	Description	Restrictions	Syntax
cursor_id	Name of a cursor for which Autofree is to be reset	Must already be declared within the program	Identifier, p. 5-22
cursor_ _id_var	Host variable that holds the value of *cursor_id*	Must store a *cursor_id* already declared in the program	Must conform to language-specific rules for names.

Usage

When the Autofree feature is enabled for a cursor, and the cursor is subsequently closed, you do not need to explicitly use the FREE statement to release the memory that the database server allocated for the cursor. If you issue SET AUTOFREE but specify no option, the default is ENABLED.

The SET AUTOFREE statement that enables the Autofree feature must appear before the OPEN statement that opens a cursor. The SET AUTOFREE statement does not affect the memory allocated to a cursor that is already open. After a cursor is Autofree enabled, you cannot open that cursor a second time.

Globally Affecting Cursors with SET AUTOFREE

If you include no FOR *cursor_id* or FOR *cursor_id_var* clause, then the scope of SET AUTOFREE is all subsequently-declared cursors in the program (or more precisely, all cursors declared before a subsequent SET AUTOFREE statement with no FOR clause globally resets the Autofree feature). This example enables the Autofree feature for all subsequent cursors in the program:

```
EXEC SQL set autofree;
```

The next example disables the Autofree feature for all subsequent cursors:

```
EXEC SQL set autofree disabled;
```

Using the FOR Clause to Specify a Specific Cursor

If you specify FOR *cursor _id* or FOR *cursor_id_var*, then SET AUTOFREE affects only the cursor that you specify after the FOR keyword.

This option allows you to override a global setting for all cursors. For example, if you issue a SET AUTOFREE ENABLED statement for all cursors in a program, you can issue a subsequent SET AUTOFREE DISABLED FOR statement to disable the Autofree feature for a specific cursor.

In the following example, the first statement enables the Autofree feature for all cursors, while the second statement disables the Autofree feature for the cursor named **x1**:

```
EXEC SQL set autofree enabled;
EXEC SQL set autofree disabled for x1;
```

Here the **x1** cursor must have been declared but not yet opened.

Associated and Detached Statements

When a cursor is automatically freed, its associated prepared statement (or associated statement) is also freed.

The term *associated statement* has a special meaning in the context of the Autofree feature. A cursor is associated with a prepared statement if it is the first cursor that you declare with the prepared statement, or if it is the first cursor that you declare with the statement after the statement is detached.

The term *detached statement* has a special meaning in the context of the Autofree feature. A prepared statement is detached if you do not declare a cursor with the statement, or if the cursor with which the statement is associated was freed.

If the Autofree feature is enabled for a cursor that has an associated prepared statement, and that cursor is closed, the database server frees the memory allocated to the prepared statement as well as the memory allocated for the cursor. Suppose that you enable the Autofree feature for the following cursor:

```
/*Cursor associated with a prepared statement */
EXEC SQL prepare sel_stmt 'select * from customer';
EXEC SQL declare sel_curs2 cursor for sel_stmt;
```

When the database server closes the **sel_curs2** cursor, it automatically performs the equivalent of the following FREE statements:

```
FREE sel_curs2;
FREE sel_stmt;
```

Because memory for the **sel_stmt** statement is freed automatically, you cannot declare a new cursor on it unless you prepare the statement again.

Closing Cursors Implicitly

A potential problem exists with cursors that have the Autofree feature enabled. In a database that is not ANSI-compliant, if you do not close a cursor explicitly and then open it again, the cursor is closed implicitly. This implicit closing of the cursor triggers the Autofree feature. The second time the cursor is opened, the database server generates an error message (`cursor not found`) because the cursor is already freed.

Related Information

Related statements: CLOSE, DECLARE, FETCH, FREE, OPEN, and PREPARE

For more information on the Autofree feature, see the *IBM Informix ESQL/C Programmer's Manual*.

SET COLLATION

Use the SET COLLATION statement to specify a new collating order for the session, superseding the default collation of the **DB_LOCALE** environment variable setting. SET NO COLLATION restores the default collation.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. You can use this statement with ESQL/C.

Syntax

```
►►──SET──┬─COLLATION──locale─┬─────────────────────────────────────────────────►◄
         └─NO COLLATION──────┘
```

Element	Description	Restrictions	Syntax
locale	Name of a locale whose collating order is to be used in this session	Must be the name of a locale that the database server can access	Quoted String, p. 4-142

Usage

As the *IBM Informix GLS User's Guide* explains, the database server uses locale files to specify the character set, the collating order, and other conventions of some natural language to display and manipulate character strings and other data values. The *collating order* of the database locale is the sequential order in which the database server sorts character strings.

If you set no value for **DB_LOCALE**, the default locale, based on United States English, is **en_us.8859-1** for UNIX, or Code Page 1252 for Windows systems. Otherwise, the database server uses the **DB_LOCALE** setting as its locale. SET COLLATION overrides the collating order of **DB_LOCALE** at runtime for all database servers previously accessed in the same session.

The new collating order remains in effect for the rest of the session, or until you issue another SET COLLATION statement. Other sessions are not affected, but database objects that you created with a non-default collation will use whatever collating order was in effect at their time of their creation.

By default, the collating order is the code-set order, but some locales also support a *locale-specific* order. In most contexts, only NCHAR and NVARCHAR data values can be sorted according to a locale-specific collating order.

Specifying a Collating Order with SET COLLATION

SET COLLATION replaces the current collating order with that of the specified *locale* for all database servers previously accessed in the current session. For example, this specifies the collating order of the German language:

```
EXEC SQL set collation "de_de.8859-1";
```

If the next action of a database server in this session sorted NCHAR or NVARCHAR values, this would follow the German collating order.

Suppose that, in the same session, the following SET NO COLLATION statement restores the **DB_LOCALE** setting for the collating order:

```
EXEC SQL set no collation;
```

After SET NO COLLATION executes, subsequent collation in the same session is based on the **DB_LOCALE** setting. Any database objects that you created using the German collating order, however, such as check constraints, indexes, prepared objects, triggers, or UDRs, will continue to apply German collation to NCHAR and NVARCHAR data types.

Restrictions on SET COLLATION

Although SET COLLATION enables you to change the collating order of the database server dynamically within a session, you should be aware of these limitations on the effects of the SET COLLATION statement.

- Only collation performed by the database server is affected. Client processes that sort data are not affected by SET COLLATION.
- Only the current session is affected. Other sessions are not affected directly by your SET COLLATION statements (but any database objects that you create will sort in their creation-time collating order).
- Changing the collating order does not change the code set. The database server always uses the code set specified by **DB_LOCALE**.
- Only NCHAR and NVARCHAR values sort in locale-specific order.

Because SET COLLATION changes only the collating order, rather than the current locale or code set, you cannot use this statement to insert character data from different locales, such as French and Japanese, into the same database. You must use Unicode if the database needs to store characters from two or more languages that require inherently different code sets. The database can store characters from the dissimilar character sets of more than one natural language only if you set **DB_LOCALE** to a Unicode locale when the database is created.

Collation Performed by Database Objects

Although the database reverts to the **DB_LOCALE** collating order after the session ends (or after you execute SET NO COLLATION), objects that you create using a non-default collation persist in the database. You can create, for example, multiple indexes on the same set of columns, called *multilingual indexes*, using different collating orders that SET COLLATION specifies.

Only one clustered index, however, can exist on a given set of columns.

Only one unique constraint or primary key can exist on a given set of columns, but you can create multiple unique indexes on the same set of columns, if each index has a different collation order.

The query optimizer ignores indexes that apply any collation other than the current session collation to NCHAR or NVARCHAR columns when calculating the cost of a query.

The collating order of an attached index must be the same as that of its table, and this must be the default collating order specified by **DB_LOCALE**.

The ALTER INDEX statement cannot change the collation of an index. Any previous SET COLLATION statement is ignored when ALTER INDEX executes.

When you compare values from CHAR columns with NCHAR columns, Dynamic Server casts the CHAR value to NCHAR, and then applies the current collation. Similarly, before comparing VARCHAR and NVARCHAR values, Dynamic Server first casts the VARCHAR values to NVARCHAR.

When synonyms are created for remote tables or views, the participating databases must have the same collating order. Existing synonyms, however, can be used in other databases that support SET COLLATION and the collating order of the synonym, regardless of the **DB_LOCALE** setting.

Check constraints, cursors, prepared objects, triggers, and SPL routines that sort NCHAR or NVARCHAR values use the collation that was in effect at the time of their creation, if this is different from the **DB_LOCALE** setting.

The effect on performance is sensitive to how many different collations are used when creating database objects that sort in a localized order.

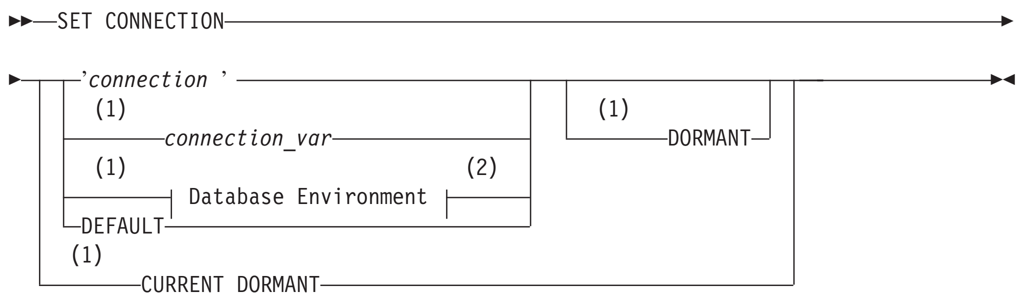
Related Information

For information on locales, see the *IBM Informix GLS User's Guide*.

SET CONNECTION

Use the SET CONNECTION statement to reestablish a connection between an application and a database environment and to make the connection current. You can also use this statement with the DORMANT option to put the current connection in a dormant state. Use this statement with ESQL/C.

Syntax



Notes:

1 Informix extension

2 See page 2-78

Element	Description	Restrictions	Syntax
connection	Name of the initial connection that the CONNECT statement made	The database must already exist	Quoted String, p. 4-142
connection_var	Host variable that contains the value of *connection*	Must be a character data type	Language specific

Usage

You can use SET CONNECTION to make a dormant connection current or to make the current connection dormant.

SET CONNECTION is not valid as a prepared statement.

Making a Dormant Connection the Current Connection

If you use the SET CONNECTION statement without the DORMANT option, *connection* must represent a dormant connection. A *dormant connection* is a connection that is established but is not current.

The SET CONNECTION statement, with no DORMANT option, makes the specified dormant connection the current one. The connection that the application specifies must be dormant. The connection that is current when the statement executes becomes dormant.

The SET CONNECTION statement in the following example makes connection `con1` the current connection and makes `con2` a dormant connection:

```
CONNECT TO 'stores_demo' AS 'con1'
...
CONNECT TO 'demo' AS 'con2'
...
SET CONNECTION 'con1'
```

A dormant connection has a *connection context* associated with it. When an application makes a dormant connection current, it reestablishes that connection to a database environment and restores its connection context. (For more information on connection context, see the CONNECT statement on page 2-75.) Reestablishing a connection is comparable to establishing the initial connection, except that it typically avoids authenticating the permissions for the user again, and it avoids reallocating resources associated with the initial connection. For example, the application does not need to reprepare any statements that have previously been prepared in the connection, nor does it need to redeclare any cursors.

Making a Current Connection the Dormant Connection

In the SET CONNECTION *connection* DORMANT statement, *connection* must represent the current connection. The SET CONNECTION statement with the DORMANT option makes the specified current connection a dormant connection. For example, the following SET CONNECTION statement makes connection `con1` dormant:

```
SET CONNECTION 'con1' DORMANT
```

The SET CONNECTION statement with the DORMANT option generates an error if you specify a connection that is already dormant. For example, if connection `con1` is current and connection `con2` is dormant, the following SET CONNECTION statement returns an error message:

```
SET CONNECTION 'con2' DORMANT
```

The following SET CONNECTION statement executes successfully:

```
SET CONNECTION 'con1' DORMANT
```

Dormant Connections in a Single-Threaded Environment

In a single-threaded ESQL/C application (one that does not use threads), the DORMANT option makes the current connection dormant. Using this option makes single-threaded ESQL/C applications upwardly compatible with thread-safe ESQL/C applications. A single-threaded environment, however, can have only one active connection while the program executes.

Dormant Connections in a Thread-Safe Environment

In a thread-safe ESQL/C application, the DORMANT option makes an active connection dormant. Another thread can now use the connection by issuing the SET CONNECTION statement without the DORMANT option. A thread-safe environment can have many threads (concurrent pieces of work performing particular tasks) in one ESQL/C application, and each thread can have one active connection.

An active connection is associated with a particular thread. Two threads cannot share the same active connection. Once a thread makes an active connection dormant, that connection is available to other threads. A dormant connection is still established but is not currently associated with any thread. For example, if the connection named `con1` is active in the thread named `thread_1`, the thread named `thread_2` cannot make connection `con1` its active connection until `thread_1` has made connection `con1` dormant.

The following code fragment from a thread-safe ESQL/C program shows how a particular thread within a thread-safe application makes a connection active, performs work on a table through this connection, and then makes the connection dormant so that other threads can use the connection:

```
thread_2()
{  /* Make con2 an active connection */
   EXEC SQL connect to 'db2' as 'con2';
   /*Do insert on table t2 in db2*/
   EXEC SQL insert into table t2 values(10);
   /* make con2 available to other threads */
   EXEC SQL set connection 'con2' dormant;
}
```

If a connection to a database environment was initiated using the CONNECT . . . WITH CONCURRENT TRANSACTION statement, any thread that subsequently connects to that database environment can use an ongoing transaction. In addition, if an open cursor is associated with such a connection, the cursor remains open when the connection is made dormant.

Threads within a thread-safe ESQL/C application can use the same cursor by making the associated connection current, even though only one thread can use the connection at any given time.

Identifying the Connection

If the application did not specify a connection name in the initial CONNECT statement, you must use a database environment (such as a database name or a database pathname) as the connection name. For example, the following SET CONNECTION statement uses a database environment for the connection name because the CONNECT statement does not use a connection name. For information about quoted strings that contain a database environment, see "Database Environment" on page 2-78.

```
CONNECT TO 'stores_demo'
...
CONNECT TO 'demo'
...
SET CONNECTION 'stores_demo'
```

If a connection to a database server was assigned a connection name, however, you must use the connection name to reconnect to the database server. An error is returned if you use a database environment rather than the connection name when a connection name exists.

DEFAULT Option

The DEFAULT option specifies the default connection for a SET CONNECTION statement. The default connection is one of the following connections:

- An explicit default connection (a connection established with the CONNECT TO DEFAULT statement)
- An implicit default connection (any connection established with the DATABASE or CREATE DATABASE statements)

Use SET CONNECTION without a DORMANT option to reestablish the default connection, or with that option to make the default connection dormant.

For more information, see "DEFAULT Option" on page 2-76 and "The Implicit Connection with DATABASE Statements" on page 2-76.

CURRENT Keyword

Use the CURRENT keyword with the DORMANT option of the SET CONNECTION statement as a shorthand form of identifying the current connection. The CURRENT keyword replaces the current connection name. If the current connection is `con1`, the following two statements are equivalent:

```
SET CONNECTION 'con1' DORMANT;

SET CONNECTION CURRENT DORMANT;
```

When a Transaction is Active

Without the DORMANT keyword, the SET CONNECTION statement implicitly puts the current connection in the dormant state.

When you issue a SET CONNECTION statement with the DORMANT keyword, the SET CONNECTION statement explicitly puts the current connection in the dormant state. In both cases, the statement can fail if a connection that becomes dormant has an uncommitted transaction. If the connection that becomes dormant has an uncommitted transaction, the following conditions apply:

- If the connection was established using the WITH CONCURRENT TRANSACTION clause of the CONNECT statement, SET CONNECTION succeeds and puts the connection in a dormant state.
- If the connection was not established by the WITH CONCURRENT TRANSACTION clause of the CONNECT statement, SET CONNECTION fails and cannot set the connection to a dormant state, and the transaction in the current connection continues to be active. The statement generates an error and the application must decide whether to commit or roll back the active transaction.

Related Information

Related statements: CONNECT, DISCONNECT, and DATABASE

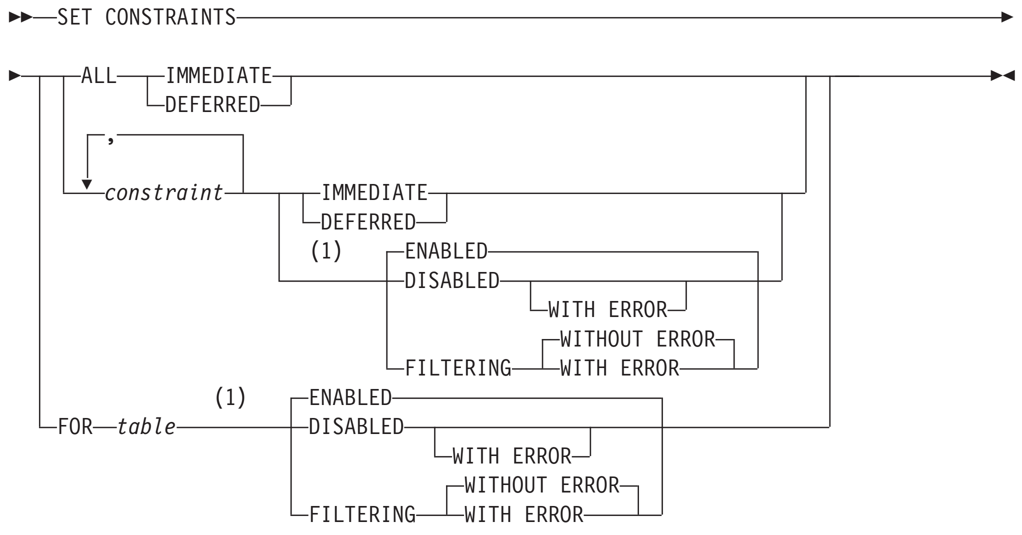
For a discussion of the SET CONNECTION statement and thread-safe applications, see the *IBM Informix ESQL/C Programmer's Manual*.

SET CONSTRAINTS

Use the SET CONSTRAINTS statements to specify how some or all of the constraints on a table are processed. Constraint-mode options include these:

- Whether constraints are checked at the statement level (IMMEDIATE) or at the transaction level (DEFERRED)
- Whether to enable or disable constraints
- Whether to change the filtering mode of constraints.

Syntax



Notes:

1 Informix extension and Dynamic Server only

Element	Description	Restrictions	Syntax
constraint	Constraint whose mode is to be reset	All constraints must exist and must all be defined on the same table	Database Object Name, p. 5-17
table	Table whose constraint mode is to be reset for all constraints	Table must exist in the database	Database Object Name, p. 5-17

Usage

The SET CONSTRAINTS keywords begin the SET Transaction Mode statement, which is described in “SET Transaction Mode” on page 2-606. Only Dynamic Server supports the SET Transaction Mode statement, which is an extension to the ANSI/ISO standard for SQL.

The SET CONSTRAINTS keywords can also begin a special case of the SET Database Object Mode statement, which is an extension to the ANSI/ISO standard for SQL. The SET Database Object Mode statement can also enable or disable a trigger or index, or change the filtering mode of a unique index. For the complete syntax and semantics of the SET INDEX statement, see “SET Database Object Mode” on page 2-539.

SET Database Object Mode

Use the SET Database Object Mode statement to change the filtering mode of constraints of unique indexes, or to enable or disable constraints, indexes, and triggers.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. To specify whether constraints are checked at the statement level or at the transaction level, see "SET Transaction Mode" on page 2-606.

Syntax

```
                                      (1)
>>--SET--+--| Object-List Format |------+-----------------------------------><
         |                     (2)      |
         '--| Table Format |------------'
```

Notes:

1 See page 2-540

2 See page 2-541

Usage

In the context of this statement, *database object* has the restricted meaning of an *index*, a *trigger*, or a *constraint*, rather than the more general meaning of this term that the description of the 5-17 segment defines in Chapter 5.

The scope of the SET Database Object Mode statement is restricted to constraints, indexes, or triggers in the local database to which the session is currently connected. After you change the mode of an object, the new mode is in effect for all sessions of that database, and persists until another SET Database Object Mode statement changes it again, or until the object is dropped from the database.

Only two object modes are available for triggers and for indexes that allow duplicate values:
- enabled
- disabled

For constraints and for unique indexes, you can also specify two additional modes:
- filtering without integrity-violation errors
- filtering with integrity-violation errors

At any given time, an object must be in exactly one of these modes. These modes, which are sometimes called *object states*, are described in the section "Definitions of Database Object Modes" on page 2-541.

The **sysobjstate** system catalog table lists all of the constraint, index, and trigger objects in the database, and the current mode of each object. For information on the **sysobjstate** table, see the *IBM Informix Guide to SQL: Reference*.

Privileges Required for Changing Database Object Modes

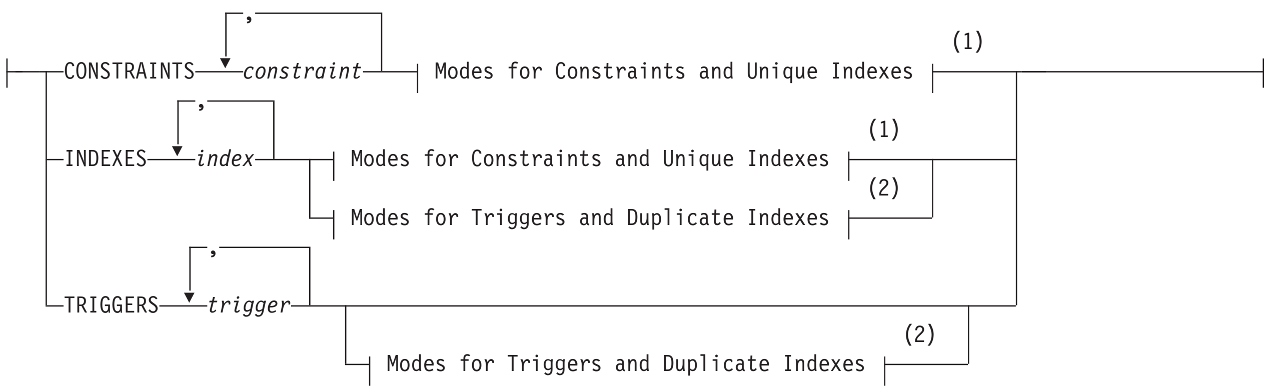
To change the mode of a constraint, index, or trigger, you must have the necessary access privileges. You must meet at least one of these requirements:

- You must have the DBA privilege on the database.
- You must be the owner of the table on which the database object is defined and you must also have the Resource privilege on the database.
- You must have the Alter privilege on the table on which the database object is defined and you must also have the Resource privilege on the database.

Object-List Format

Use the object-list format to change the mode for one or more constraint, index, or trigger.

Object-List Format:


CONSTRAINTS
,
constraint
Modes for Constraints and Unique Indexes
(1)
INDEXES
,
index
Modes for Constraints and Unique Indexes
(1)
Modes for Triggers and Duplicate Indexes
(2)
TRIGGERS
,
trigger
Modes for Triggers and Duplicate Indexes
(2)

Notes:

1 See page 2-541

2 See page 2-544

Element	Description	Restrictions	Syntax
constraint	Name of a constraint whose mode is to be set	Must be a local constraint, and all constraints in the list must be defined on the same table	Database Object Name, p. 5-17
index	Name of an index whose mode is to be set	Must be a local index, and all indexes in the list must be defined on the same table	Database Object Name, p. 5-17
trigger	Name of a trigger whose mode is to be set	Must be a local trigger, and all triggers in the list must be defined on the same table or view	Database Object Name, p. 5-17

For example, to change the mode of the unique index **unq_ssn** on the **cust_subset** table to filtering, enter the following statement:

```
SET INDEXES unq_ssn FILTERING
```

You can also use the object-list format to change the mode for a list of constraints, indexes, or triggers that are defined on the same table. Assume that four triggers are defined on the **cust_subset** table: **insert_trig**, **update_trig**, **delete_trig**, and **execute_trig**. Also assume that all four triggers are enabled. To disable all triggers except **execute_trig**, enter this statement:

```
SET TRIGGERS insert_trig, update_trig, delete_trig DISABLED
```

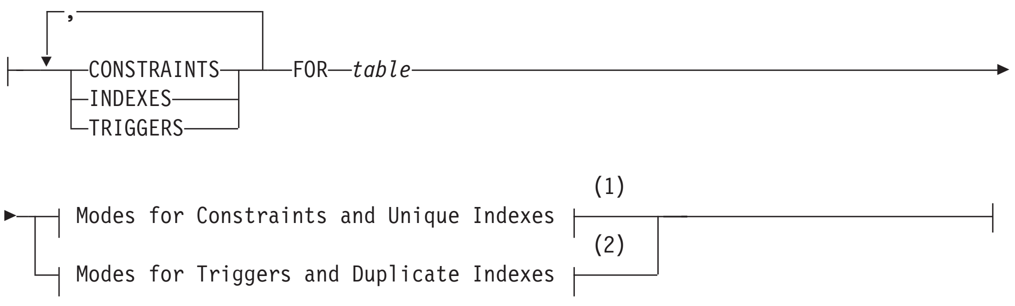
If **my_trig** is a disabled INSTEAD OF trigger on a view, the following statement enables that trigger:

```
SET TRIGGERS my_trig ENABLED
```

Table Format

Use the table format to change the mode of all database objects of a specified type that have been defined on the same table.

Table Format:


,
CONSTRAINTS
INDEXES
TRIGGERS
FOR
table
Modes for Constraints and Unique Indexes
(1)
Modes for Triggers and Duplicate Indexes
(2)

Notes:

1 See page 2-541

2 See page 2-544

Element	Description	Restrictions	Syntax
table	Table on which objects are defined	Must be a local table. Objects defined on a temporary table cannot be set to disabled or filtering modes.	Database Object Name, p. 5-17

This example disables all constraints defined on the **cust_subset** table:

```
SET CONSTRAINTS FOR cust_subset DISABLED
```

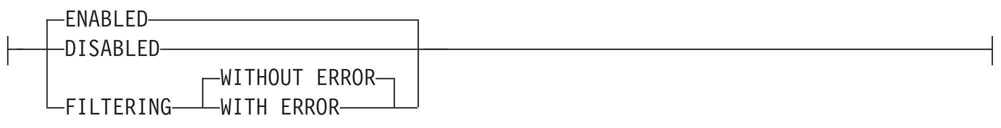
In table format, you can change the modes of more than one database object type with a single statement. For example, this enables all constraints, indexes, and triggers that are defined on the **cust_subset** table:

```
SET CONSTRAINTS, INDEXES, TRIGGERS FOR cust_subset ENABLED
```

Modes for Constraints and Unique Indexes

You can specify enabled or disabled mode for a constraint or a unique index.

Modes for Constraints and Unique Indexes:



If you specify no mode for a constraint in a CREATE TABLE, ALTER TABLE, or SET Database Object Mode statement, the constraint is enabled by default. If you do not specify the mode for an index in the CREATE INDEX or SET Database Object Mode statement, the index is enabled by default.

Definitions of Database Object Modes

You can use database object modes to control the effects of INSERT, DELETE, and UPDATE statements. Your choice of mode affects the tables whose data you are manipulating, the behavior of the database objects defined on those tables, and the behavior of the data manipulation statements themselves.

Enabled Mode

Constraints, indexes, and triggers are enabled by default. The CREATE TABLE, ALTER TABLE, CREATE INDEX, and CREATE TRIGGER statements create database objects in enabled mode, unless you specify another mode. When a database object is enabled, the database server recognizes the existence of the database object and takes the database object into consideration while it executes an INSERT, DELETE, or UPDATE statement (or for Select triggers, a SELECT statement). Thus, an enabled constraint is enforced, an enabled index updated, and an enabled trigger is executed when the trigger event takes place.

When you enable constraints and unique indexes, if a violating row exists, the data manipulation statement fails (that is, no rows are changed) and the database server returns an error message.

Disabled Mode

When a database object is disabled, the database server ignores it during the execution of an INSERT, DELETE, SELECT, or UPDATE statement. A disabled constraint is not enforced, a disabled index is not updated, and a disabled trigger is not executed when the trigger event takes place. When you disable constraints and unique indexes, any data manipulation statement that violates the restriction of the constraint or unique index succeeds (that is, the target row is changed), and the database server does not return an error message.

You can use the disabled mode to add a new constraint or new unique index to an existing table, even if some rows in the table do not satisfy the new integrity specification. Disabling can also be efficient in LOAD operations.

For information on adding a constraint, see “Adding a Constraint That Existing Rows Violate (IDS)” on page 2-56 in the ALTER TABLE statement. For information on adding a unique index, see Adding a Unique Index When Duplicate Values Exist in the Column in the CREATE INDEX statement.

Filtering Mode

When a constraint or unique index is in filtering mode, the INSERT, DELETE, or UPDATE statement succeeds, but the database server enforces the constraint or the unique-index requirement by writing any failed rows to the violations table associated with the target table. Diagnostic information about the constraint violation or unique-index violation is written to the diagnostics table associated with the target table.

In data manipulation operations, filtering mode has the following specific effects on INSERT, UPDATE, and DELETE statements:

- A constraint violation during an INSERT statement causes the database server to make a copy of the nonconforming record and write it to the violations table. The database server does not write the nonconforming record to the target table.

  If the INSERT statement is not a singleton INSERT, the rest of the insert operation proceeds with the next record.
- A constraint violation or unique-index violation during an UPDATE statement causes the database server to make a copy of the existing record that was to be updated and write it to the violations table. The database server also makes a copy of the new record and writes it to the violations table, but the actual record

is not updated in the target table. If the UPDATE statement is not a singleton update, the rest of the update operation proceeds with the next record.

- A constraint violation or unique-index violation during a DELETE statement causes the database server to make a copy of the record that was to be deleted and write it to the violations table. The database server does not delete the actual record in the target table. If the DELETE statement is not a singleton delete, the rest of the delete operation proceeds with the next record.

In all of these cases, the database server sends diagnostic information about each constraint violation or unique-index violation to the diagnostics table associated with the target table.

For information on the structure of the records that the database server writes to the violations and diagnostics tables, see “Structure of the Violations Table” on page 2-612 and “Structure of the Diagnostics Table (IDS)” on page 2-617.

Starting and Stopping the Violations and Diagnostics Tables: You must use the START VIOLATIONS TABLE statement to start the violations and diagnostics tables for the target table on which the database objects are defined, either before you set any database objects that are defined on the table to the filtering mode, or after you set database objects to filtering, but before any users issue INSERT, DELETE, or UPDATE statements.

If you want to stop the database server from filtering bad records to the violations table and sending diagnostic information about each bad record to the diagnostics table, you must issue a STOP VIOLATIONS TABLE statement.

For further information on these statements, see “START VIOLATIONS TABLE” on page 2-609 and “STOP VIOLATIONS TABLE” on page 2-622.

Error Options for Filtering Mode: When you set the mode of a constraint or unique index to filtering, you can specify one of two error options. These error options control whether the database server displays an integrity-violation error message when it encounters bad records during execution of data manipulation statements:

- The WITH ERROR option instructs the database server to return a referential integrity-violation error message after executing an INSERT, DELETE, or UPDATE statement in which one or more of the target rows causes a constraint violation or a unique-index violation.
- The WITHOUT ERROR option is the default. This option prevents the database server from issuing a referential integrity-violation error message to the user after an INSERT, DELETE, or UPDATE statement causes a constraint violation or a unique-index violation.

Effect of Filtering Mode on the Database: The net effect of the filtering mode is that the contents of the target table always satisfy all constraints on the table and any unique-index requirements on the table.

In addition, the database server does not lose any data values that violate a constraint or unique-index requirement, because non-conforming records are sent to the violations table, and diagnostic information about those records is sent to the diagnostics table.

Furthermore, when filtering mode is in effect, insert, delete, and update operations on the target table do not fail when the database server encounters bad records.

These operations succeed in adding all the good records to the target table. Thus, filtering mode is appropriate for large-scale batch updates of tables. The user can fix records that violate constraints and unique-index requirements after the fact. The user does not have to fix the bad records before the batch update or lose the bad records during the batch update.

Modes for Triggers and Duplicate Indexes

You can specify the modes for triggers or duplicate indexes.

Modes for Triggers and Duplicate Indexes:

```
    ┌─ENABLED──┐
├───┴─DISABLED─┴────────────────────────────────────────────────────────┤
```

If you specify no mode for an index or for a trigger when you create it or in a subsequent SET Database Object Mode statement, the object is enabled by default.

Related Information

Related statements: ALTER TABLE, CREATE TABLE, CREATE INDEX, CREATE TRIGGER, START VIOLATIONS TABLE, and STOP VIOLATIONS TABLE

For a discussion of object modes and violation detection and examples that show how database object modes work when users execute data manipulation statements on target tables or add new constraints and indexes to target tables, see the *IBM Informix Guide to SQL: Tutorial*.

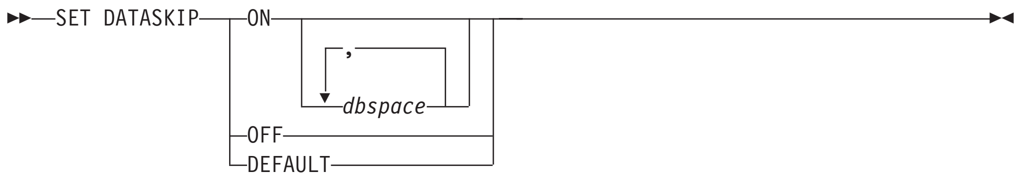
For information on the system catalog tables associated with the SET Database Object Mode statement, see the descriptions of the **sysobjstate** and **sysviolations** tables in the *IBM Informix Guide to SQL: Reference*.

SET DATASKIP

Use the SET DATASKIP statement to control whether the database server skips a dbspace that is unavailable during the processing of a transaction.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax



Element	Description	Restrictions	Syntax
dbspace	Name of the skipped dbspace	Must exist at time of execution	Identifier, p. 5-22

Usage

SET DATASKIP allows you to reset at runtime the Dataskip feature, which controls whether the database server skips a dbspace that is unavailable (for example, due to a media failure) in the course of processing a transaction.

In ESQL/C, the warning flag **sqlca.sqlwarn.sqlwarn6** is set to `W` if a dbspace is skipped. See also the *IBM Informix ESQL/C Programmer's Manual*.

In Dynamic Server, this statement applies only to tables that are fragmented across dbspaces or partitions. It does not apply to blobspaces nor to sbspaces.

Specifying SET DATASKIP ON without including a *dbspace* instructs the database server to skip any dbspaces in the fragmentation list that are unavailable. You can use the **onstat -d** or **-D** options to determine whether a dbspace is down.

When you specify SET DATASKIP ON *dbspace*, you are instructing the database server to skip the specified *dbspace* if it is unavailable.

If you specify SET DATASKIP OFF, the Dataskip feature is disabled. If you specify SET DATASKIP DEFAULT, the database server uses the setting for the Dataskip feature from the ONCONFIG file.

Circumstances When a Dbspace Cannot Be Skipped

The database server cannot skip a dbspace under certain conditions. The following list outlines those conditions:

- Referential constraint checking

  When you want to delete a parent row, the child rows must also be available for deletion, and must exist in an available fragment.

  When you want to insert a new child row, the parent row must be found in the available fragments.
- Updates

  When you perform an update that moves a record from one fragment to another, both fragments must be available.

- Inserts

  When you try to insert records in a expression-based fragmentation strategy and the dbspace is unavailable, an error is returned.

  When you try to insert records in a round-robin fragment-based strategy, and a dbspace is down, the database server inserts the rows into any available dbspace.

  When no dbspace is available, an error is returned.
- Indexing

  When you perform updates that affect the index, such as when you insert or delete rows, or update an indexed column, the index must be available.

  When you try to create an index, the dbspace you want to use must be available.
- Serial keys

  The first fragment is used to store the current serial-key value internally. This is not visible to you except when the first fragment becomes unavailable and a new serial key value is required, which can happen during INSERT statements.

Related Information

Related statement: SET ALL_MUTABLES

For additional information about the Dataskip feature, see your *IBM Informix Administrator's Guide*.

SET DEBUG FILE

Use the SET DEBUG FILE statement to identify the file that is to receive the runtime trace output of an SPL routine.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──SET DEBUG FILE TO──┬─'filename '───┬──┬─────────────┬──────────────────────────><
                       ├─filename_var──┤  └─WITH APPEND─┘
                       └─expression────┘
```

Element	Description	Restrictions	Syntax
expression	Expression that returns a filename	Must be a valid filename	Expression, p. 4-34
filename	Pathname of the file that contains the output of the TRACE statement	See "Using the WITH APPEND Option" on page 2-547	Quoted String, p. 4-142.
filename_var	Host variable storing *filename* string	Must be a character type	Language specific

Usage

This statement specifies the file to which the database server writes the output from the TRACE statement in the SPL routine Each time the TRACE statement is executed, the trace information is added to this output file.

Using the WITH APPEND Option

The output file that you specify in the SET DEBUG FILE statement can be a new file or existing file. If you specify an existing file, its current contents are deleted when you issue the SET DEBUG FILE TO statement. The first execution of a TRACE command sends trace output to the beginning of the file.

If you include the WITH APPEND option, the current contents of the file are preserved when you issue the SET DEBUG FILE statement. The first execution of a TRACE command adds the new trace output to the end of the file.

If you specify a new file in the SET DEBUG FILE TO statement, it makes no difference whether you include the WITH APPEND option. The first execution of a TRACE command sends trace output to the beginning of the new file whether you include or omit the WITH APPEND option.

Closing the Output File

To close the file that the SET DEBUG FILE TO statement opened, issue another SET DEBUG FILE TO statement with another filename. You can then read or edit the contents of the first file.

Redirecting Trace Output

You can use the SET DEBUG FILE TO statement outside an SPL routine to direct the trace output of the SPL routine to a file. You can also use this statement within an SPL routine to redirect its own output.

Location of the Output File

If you execute the SET DEBUG FILE statement with a simple filename on a local database, the output file is located in your current directory. If your current database is on a remote database server, the output file is located in your home directory on the remote database server. If you provide a full pathname for the debug file, the file is placed in the directory that you specify on the remote database server. If you do not have write permissions in the directory, you receive an error.

The following example sends the output of the SET DEBUG FILE TO statement to a file called **debug.out**:

```
SET DEBUG FILE TO 'debug' || '.out'
```

Related Information

Related statement: TRACE

For a task-oriented discussion of SPL routines, see the *IBM Informix Guide to SQL: Tutorial*.

SET Default Table Space

Use the SET Default Table Space statement to specify the default storage space used by subsequent statements in the same session that create tables. Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──SET──┬──────┬──TABLE_SPACE  TO──┬─dbs_list──┬──────────────────────────><
         └─TEMP─┘                   ├─DEFAULT───┤
                                    ├─IMMUTABLE─┤
                                    └─MUTABLE───┘
```

Element	Description	Restrictions	Syntax
dbs_list	A dbspace, dbslice, or a comma-separated list of dbspaces	Must exist	Identifier, p. 5-22

Usage

When the CREATE TABLE statement includes no fragmentation clause, the database server uses the dbspace of the current database as the default storage location. You can use the SET TABLE_SPACE statements to change the default to another dbslice or to a list of one or more dbspaces.

Similarly, you can use the SET TEMP TABLE_SPACE statement to change the default storage location for CREATE Temporary TABLE statements that do not include the Storage Options clause. This statement also sets the default dbspace for SELECT statements that include the INTO Table clause. These defaults persist for the rest of the current session, or until the next SET Default Table Space statement.

Specifying the TO DEFAULT option restores the default behavior.

The DBA can use the MUTABLE or IMMUTABLE keywords to enable (with MUTABLE) or prevent (with IMMUTABLE) changes by users to the default table space. The DBA typically sets the default table space in a **sysdbopen** procedure, and sets it to IMMUTABLE if the default should not be changed in a user session.

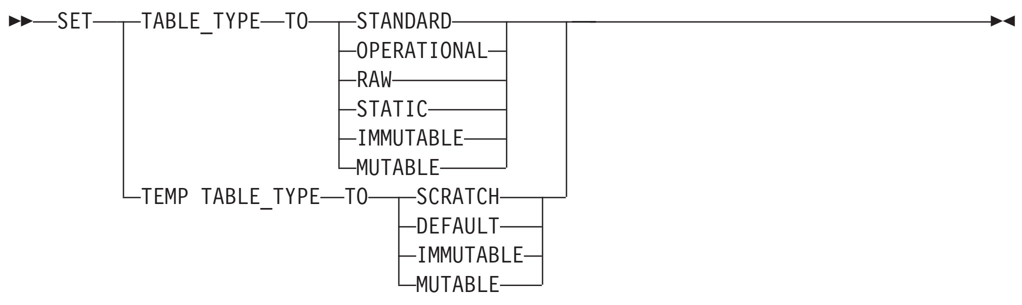
Related Information

Related statements: CREATE TABLE, CREATE Temporary TABLE, SET ALL_MUTABLES, SET Default Table Type.

SET Default Table Type

Use the SET Default Table Type statement to specify the default table type for tables (or temporary tables) that you subsequently create in the same session. Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Usage

If CREATE TABLE specifies no table type, the default table type is STANDARD. The SET TABLE_TYPE statement can change this default for subsequent CREATE TABLE statements in the current session. Similarly, you can use the SET TEMP TABLE_TYPE to change the default temporary table type.

These statements have no effect on tables for which you explicitly specify a table type in the statement that creates the new table or temporary table.

Because the CREATE Temporary TABLE statement requires an explicit table type, the SET TEMP TABLE_TYPE statement only affects SQL operations that create a temporary implicitly, such as in executing join operations, SELECT statements with the GROUP BY or ORDER BY clause, and index builds.

The effect of SET Default Table Type persists until the end of the session, or until you issue another SET Default Table Type statement to specify a new default table type.

The SET TABLE_TYPE TO STANDARD statement and the SET TEMP TABLE_TYPE TO DEFAULT statements restore the default behavior.

The DBA can use the keyword MUTABLE or IMMUTABLE to enable (with MUTABLE) or to prevent (with IMMUTABLE) changes by users to the default table type during a user session. The DBA typically sets the default table type in a **sysdbopen** procedure and specifies IMMUTABLE if it should not be changed during a user session.

Although the scope of these statements is the current session, they can be used to have a database-wide effect. The next example shows how to do this by using SPL routines to establish a default table type at connect time:

```
CREATE PROCEDURE public.sysdbopen()
   SET TABLE_TYPE TO RAW;
   SET TEMP TABLE_TYPE TO SCRATCH;
   SET TABLE_SPACE TO other_tables;
...
```

```
END PROCEDURE;

CREATE PROCEDURE helene.sysdbopen()
   EXECUTE PROCEDURE public.sysdbopen();
   SET ROLE marketing;
   SET TABLE_SPACE TO marketing_dbslice;
END PROCEDURE;
```

Related Information

Related statements: CREATE TABLE, CREATE TEMP TABLE, SET ALL_MUTABLES, SET Default Table Space.

For more information on table types that can be specified in the CREATE TABLE statement, see "CREATE TABLE" on page 2-171. For more information about temporary tables, see "CREATE Temporary TABLE" on page 2-209.

SET DEFERRED_PREPARE

Use the SET DEFERRED_PREPARE statement to control whether a client process postpones sending a PREPARE statement to the database server until the OPEN or EXECUTE statement is sent. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. You can use this statement only with ESQL/C.

Syntax

```
                           ┌─ENABLED──────┐
►►──SET DEFERRED_PREPARE───┤              ├──────────────────────────────────►◄
                           └──DISABLED────┘
```

Usage

By default, the SET DEFERRED_PREPARE statement causes the application program to delay sending the PREPARE statement to the database server until the OPEN or EXECUTE statement is executed. In effect, the PREPARE statement is bundled with the other statement so that one round-trip of messages, instead of two, is sent between the client and the server. This Deferred-Prepare feature can affect the following series of Dynamic SQL statement:

- PREPARE, DECLARE, OPEN statement blocks that operate with the FETCH or PUT statements
- PREPARE followed by the EXECUTE or EXECUTE IMMEDIATE statement

You can specify ENABLED or DISABLED options for SET DEFERRED_PREPARE.

If you specify no option, the default is ENABLED. The following example enables the Deferred-Prepare feature by default:

```
EXEC SQL set deferred_prepare;
```

The ENABLED option enables the Deferred-Prepare feature within the application. The following example explicitly specifies the ENABLED option:

```
EXEC SQL set deferred_prepare enabled;
```

After an application issues SET DEFERRED_PREPARE ENABLED, the Deferred-Prepare feature is enabled for subsequent PREPARE statements in the application. The application then exhibits the following behavior:

- The sequence PREPARE, DECLARE, OPEN sends the PREPARE statement to the database server with the OPEN statement. If the prepared statement has syntax errors, the database server does not return error messages to the application until the application declares a cursor for the prepared statement and opens the cursor.
- The sequence PREPARE, EXECUTE sends the PREPARE statement to the database server with the EXECUTE statement. If a prepared statement contains syntax errors, the database server does not return error messages to the application until the application attempts to execute the prepared statement.

If Deferred-Prepare is enabled in a PREPARE, DECLARE, OPEN statement block that contains a DESCRIBE statement, the DESCRIBE statement must follow the OPEN statement rather than the PREPARE statement. If the DESCRIBE follows PREPARE, the DESCRIBE statement results in an error.

Use the DISABLED option to disable the Deferred-Prepare feature within the application. The following example specifies the DISABLED option:

```
EXEC SQL set deferred_prepare disabled;
```

If you specify the DISABLED option, the application sends each PREPARE statement to the database server when the PREPARE statement is executed.

Example of SET DEFERRED_PREPARE

The following code fragment shows a SET DEFERRED_PREPARE statement with a PREPARE, EXECUTE statement block. In this case, the database server executes the PREPARE and EXECUTE statements all at once:

```
EXEC SQL BEGIN DECLARE SECTION;
   int a;
EXEC SQL END DECLARE SECTION;
EXEC SQL allocate descriptor 'desc';
EXEC SQL create database test;
EXEC SQL create table x (a int);

/* Enable Deferred-Prepare feature */
EXEC SQL set deferred_prepare enabled;
/* Prepare an INSERT statement */
EXEC SQL prepare ins_stmt from 'insert into x values(?)';
a = 2;
EXEC SQL EXECUTE ins_stmt using :a;
if (SQLCODE)
   printf("EXECUTE : SQLCODE is %d\n", SQLCODE);
```

Using Deferred-Prepare with OPTOFC

You can use the Deferred-Prepare and Open-Fetch-Close Optimization (OPTOFC) features in combination. The OPTOFC feature delays sending the OPEN message to the database server until the FETCH message is sent. The following situations occur if you enable the Deferred-Prepare and OPTOFC features at the same time:

- If the text of a prepared statement contains syntax errors, the error messages are not returned to the application until the first FETCH statement is executed.
- A DESCRIBE statement cannot be executed until after the FETCH statement.
- You must issue an ALLOCATE DESCRIPTOR statement before a DESCRIBE or GET DESCRIPTOR statement can be executed.

The database server performs an internal execution of a SET DESCRIPTOR statement which sets the TYPE, LENGTH, DATA, and other fields in the system descriptor area. You can specify a GET DESCRIPTOR statement after the FETCH statement to see the data that is returned.

Related Information

Related statements: DECLARE, DESCRIBE, EXECUTE, OPEN, and PREPARE

For a task-oriented discussion of the PREPARE statement and dynamic SQL, see the *IBM Informix Guide to SQL: Tutorial*.

For more information about concepts that relate to the SET DEFERRED_PREPARE statement, see the *IBM Informix ESQL/C Programmer's Manual*.

SET DESCRIPTOR

The SET DESCRIPTOR statement sets values in a system-descriptor area (SDA). Use this statement with ESQL/C.

Syntax

```
>>─SET DESCRIPTOR──┬─descriptor_var─┬──────────────────────────────────────►
                   └─'descriptor '──┘

►──┬─COUNT=──┬─total_items_var─┬───────────────────────────┬──────────────►◄
   │         └─total_items─────┘                           │
   │                           ┌─,──────────────────────┐  │
   │                           ▼                    (1) │  │
   └─VALUE──┬─item_num_var─┬──────┤ Item Descriptor ├───┴──┘
            └─item_num─────┘
```

Notes:

1 See page 2-555

Element	Description	Restrictions	Syntax
descriptor	String that identifies the SDA to which values are assigned	System-descriptor area (SDA) must be previously allocated	Quoted String, p. 4-142
descriptor_var	Host variable that stores *descriptor*	Same restrictions as *descriptor*	Language specific
item_num	Unsigned integer that specifies ordinal position of an item descriptor in the SDA	0 < *item_num* ≤ (number of item descriptors specified when SDA was allocated)	Literal Number, p. 4-137
item_num_var	Host variable that stores *item_num*	Same restrictions as *item_num*	Language specific
total_items	Unsigned integer that specifies how many items the SDA describes	Same restrictions as *item_num*	Literal Number, p. 4-137
total_items_var	Host variable that stores *total_items*	Same restrictions as *total_items*	Language specific

Usage

The SET DESCRIPTOR statement can be used after you have described SELECT, EXECUTE FUNCTION, EXECUTE PROCEDURE, ALLOCATE DESCRIPTOR, or INSERT statements with the DESCRIBE ... USING SQL DESCRIPTOR statement.

SET DESCRIPTOR can assign values to a system-descriptor area in these cases:
- To set the **COUNT** field of a system-descriptor area to match the number of items for which you are providing descriptions in the system-descriptor area
- To set the item descriptor for each value for which you are providing descriptions in the system-descriptor area
- To modify the contents of an item-descriptor field

If an error occurs during the assignment to any identified system-descriptor fields, the contents of all identified fields are set to `0` or NULL, depending on the data type of the variable.

Using the COUNT Clause

Use the COUNT clause to set the number of items that are to be used in the system-descriptor area. If you allocate a system-descriptor area with more items than you are using, you need to set the **COUNT** field to the number of items that you are actually using. The following example shows a fragment of an ESQL/C program:

```
EXEC SQL BEGIN DECLARE SECTION;
   int count;

EXEC SQL END DECLARE SECTION;

EXEC SQL allocate descriptor 'desc_100'; /*allocates for 100 items*/
   count = 2;
EXEC SQL set descriptor 'desc_100' count = :count;
```

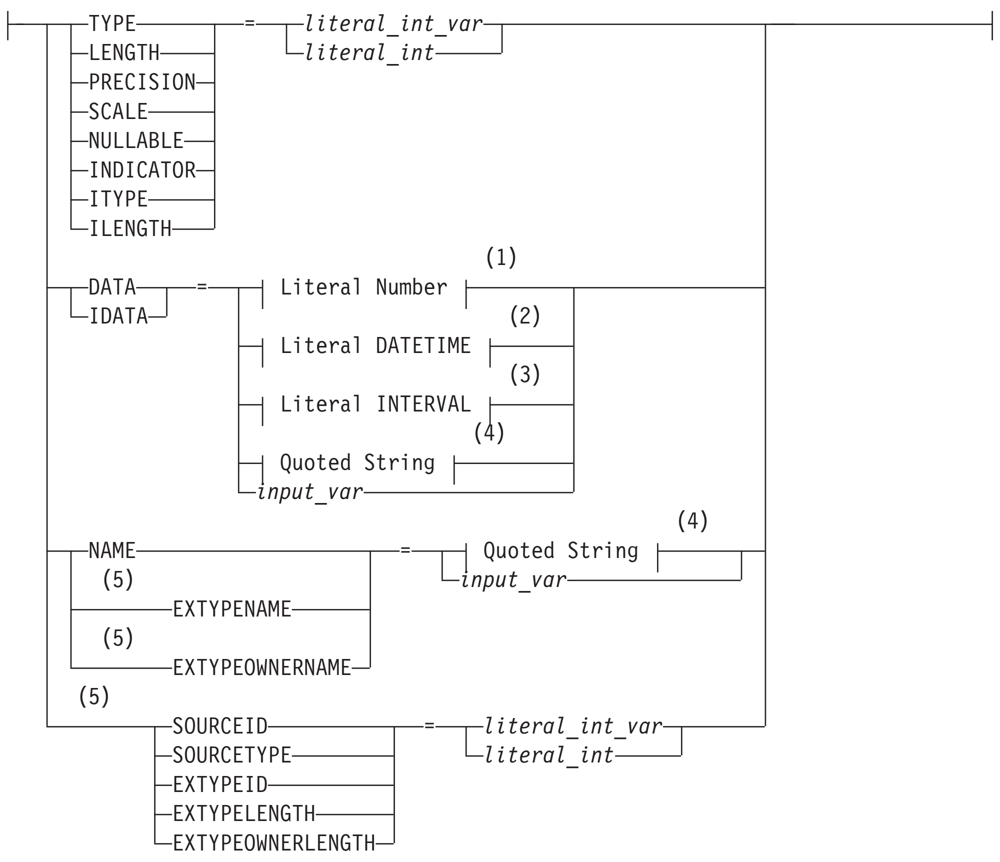
Using the VALUE Clause

Use the VALUE clause to assign values from host variables into fields of a system-descriptor area. You can assign values for items for which you are providing a description (such as parameters in a WHERE clause), or you can modify values for items after you use a DESCRIBE statement to fill the fields for an UPDATE or INSERT statement.

Item Descriptor

Use the Item Descriptor portion of the SET DESCRIPTOR statement to set value for an individual field in a system-descriptor area.

Item Descriptor:



Notes:

1 See page 4-137

2 See page 4-132

3 See page 4-135

4 See page 4-142

5 Dynamic Server only

Element	Description	Restrictions	Syntax
input_var	Host variable storing data for the specified item descriptor field	Must be appropriate for the specified field	Language-specific
literal_int	Integer value (> 0) assigned to the specified item descriptor field	Restrictions depend on the keyword to the left of = symbol	Literal Number, p. 4-137
literal_int_var	Variable having *literal_int* value	Same as for *literal_int*	Language-specific

For information on codes that are valid for the TYPE or ITYPE fields and their meanings, see "Setting the TYPE or ITYPE Field" on page 2-556.

For the restrictions that apply to other field types, see the individual headings for field types under "Using the VALUE Clause" on page 2-555.

Setting the TYPE or ITYPE Field

Use these integer values to set the value of **TYPE** or **ITYPE** for each item.

SQL Data Type	Integer Value	X-Open Integer Value	SQL Data Type	Integer Value	X-Open Integer Value
CHAR	0	1	MONEY	8	–
SMALLINT	1	4	DATETIME	10	–
INTEGER	2	5	BYTE	11	–
FLOAT	3	6	TEXT	12	–
SMALLFLOAT	4	–	VARCHAR	13	–
DECIMAL	5	3	INTERVAL	14	–
SERIAL	6	–	NCHAR	15	–
DATE	7	–	NVARCHAR	16	–

The following table lists integer values that represent additional data types available with Dynamic Server.

SQL Data Type	Integer Value	SQL Data Type	Integer Value
INT8	17	COLLECTION	23
SERIAL8	18	Varying-length OPAQUE type	40
SET	19	Fixed-length OPAQUE type	41
MULTISET	20	LVARCHAR (client-side only)	43
LIST	21	BOOLEAN	45
ROW	22		

The same **TYPE** constants can also appear in the **syscolumns.coltype** column in the system catalog; see *IBM Informix Guide to SQL: Reference*.

For code that is easier to maintain, use the predefined constants for these SQL data types instead of their actual integer values. These constants are defined in the **$INFORMIX/incl/public/sqltypes.h** header file. You cannot, however, use the actual constant name in the SET DESCRIPTOR statement. Instead, assign the constant to an integer host variable and specify the host variable in the SET DESCRIPTOR statement file.

The following example shows how you can set the **TYPE** field in ESQL/C:

```
main()
{
EXEC SQL BEGIN DECLARE SECTION;
   int itemno, type;
EXEC SQL END DECLARE SECTION;
...
EXEC SQL allocate descriptor 'desc1' with max 5;
...
type = SQLINT; itemno = 3;
EXEC SQL set descriptor 'desc1' value :itemno type = :type;
}
```

This information is identical for **ITYPE**. Use **ITYPE** when you create a dynamic program that does not comply with the X/Open standard.

Compiling Without the -xopen Option: If you compile without the **-xopen** option, the normal Informix SQL code is assigned for TYPE. You must be careful not to mix normal and X/Open modes, because errors can result. For example, if a data type is not defined under X/Open mode, but is defined under normal mode, executing a SET DESCRIPTOR statement can result in an error.

Setting the TYPE Field in X/Open Programs: In X/Open mode, you must use the X/Open set of integer codes for the data type in the **TYPE** field.

If you use the **ILENGTH**, **IDATA**, or **ITYPE** fields in a SET DESCRIPTOR statement, a warning message appears. The warning indicates that these fields are not standard X/Open fields for a system-descriptor area.

For code that is easier to maintain, use the predefined constants for these X/Open SQL data types instead of their actual integer value. These constants are defined in the **$INFORMIX/incl/public/sqlxtype.h** header file.

Using DECIMAL or MONEY Data Types: If you set the **TYPE** field for a DECIMAL or MONEY data type, and you want to use a scale or precision other than the default values, set the **SCALE** and **PRECISION** fields. You do not need to set the **LENGTH**field for a DECIMAL or MONEY item; the **LENGTH** field is set accordingly from the **SCALE** and **PRECISION** fields.

Using DATETIME or INTERVAL Data Types: If you set the **TYPE** field for a DATETIME or INTERVAL value, the **DATA** field can be a DATETIME or INTERVAL literal or a character string. If you use a character string, the **LENGTH** field must be the encoded qualifier value.

To determine the encoded qualifiers for a DATETIME or INTERVAL character string, use the datetime and interval macros in the **datetime.h** header file.

If you set **DATA** to a host variable of DATETIME or INTERVAL, you do not need to set **LENGTH** explicitly to the encoded qualifier integer.

Setting the DATA or IDATA Field

When you set the **DATA** or **IDATA** field, use the appropriate type of data (character string for CHAR or VARCHAR, integer for INTEGER, and so on).

If any value other than **DATA** is set, the value of **DATA** is undefined. You cannot set the **DATA** or **IDATA** field for an item without setting **TYPE** for that item. If you set the **TYPE** field for an item to a character type, you must also set the **LENGTH** field. If you do not set the **LENGTH** field for a character item, you receive an error.

Setting the LENGTH or ILENGTH Field

If your **DATA** or **IDATA** field contains a character string, you must specify a value for **LENGTH**. If you specify `LENGTH=0`, **LENGTH** is automatically set to the maximum length of the string. The **DATA** or **IDATA** field can contain a literal character string of up to 368-bytes, or a character string derived from a character variable of a CHAR or VARCHAR data type. This provides a method to determine dynamically the length of a string in the **DATA** or **IDATA**field.

If a DESCRIBE statement precedes a SET DESCRIPTOR statement, **LENGTH** is automatically set to the maximum length of the character field that is specified in your table.

This information is identical for **ILENGTH**. Use **ILENGTH** when you create a dynamic program that does not comply with the X/Open standard.

Setting the INDICATOR Field

If you want to put a NULL value into the system-descriptor area, set the **INDICATOR** field to `-1` and do not set the **DATA** field.

If you set the **INDICATOR** field to `0` to indicate that the data is not NULL, you must set the **DATA** field.

Setting Opaque-Type Fields (IDS)

The following item-descriptor fields provide information about a column that has an opaque type as its data type:

- The **EXTYPEID** field stores the extended identifier for the opaque type. This integer value must correspond to a value in the **extended_id** column of the **sysxtdtypes** system catalog table.
- The**EXTYPENAME** field stores the name of the opaque type. This character value must correspond to a value in the **name** column of the row with the matching **extended_id** value in the **sysxtdtypes** system catalog table.
- The **EXTYPELENGTH** field stores the length of the opaque-type name. This integer value is the length, in bytes, of the string in the **EXTYPENAME** field.
- The **EXTYPEOWNERNAME** field stores the name of the opaque-type owner. This character value must correspond to a value in the **owner** column of the row with the matching **extended_id** value in the **sysxtdtypes** system catalog table.
- The **EXTYPEOWNERLENGTH** field stores the length of the value in the **EXTTYPEOWNERNAME** field. This integer value is the length, in bytes, of the string in the **EXTYPEOWNERNAME** field.

For more information on the **sysxtdtypes** system catalog table, see the *IBM Informix Guide to SQL: Reference*.

Setting Distinct-Type Fields

The following item-descriptor fields provide information about a column that has a distinct type as its data type:

- The **SOURCEID** field stores the extended identifier for the source data type.

  Set this field if the source type of the distinct type is an opaque data type. This integer value must correspond to a value in the **source** column for the row of the **sysxtdtypes** system catalog table whose **extended_id** value matches that of the distinct type you are setting.
- The**SOURCETYPE** field stores the data type constant for the source data type.

  This value is the data type constant for the built-in data type that is the source type for the distinct type. The codes for the **SOURCETYPE** field are the same as those for the **TYPE** field (page 2-556). This integer value must correspond to the value in the **type** column for the row of the **sysxtdtypes** system catalog table whose **extended_id** value matches that of the distinct type you are setting.

For more information on the **sysxtdtypes** system catalog table, see the *IBM Informix Guide to SQL: Reference*.

Modifying Values Set by the DESCRIBE Statement

You can use a DESCRIBE statement to modify the contents of a system-descriptor area after it is set.

After you use DESCRIBE on a SELECT or an INSERT statement, you must check to determine whether the **TYPE** field is set to either 11 or 12 to indicate a TEXT or BYTE data type. If **TYPE** contains an 11 or a 12, you must use the SET DESCRIPTOR statement to reset **TYPE** to 116, which indicates FILE type.

Related Information

Related statements: ALLOCATE DESCRIPTOR, DEALLOCATE DESCRIPTOR, DECLARE, DESCRIBE, EXECUTE, FETCH, GET DESCRIPTOR, OPEN, PREPARE, and PUT

For more information on system-descriptor areas, refer to the *IBM Informix ESQL/C Programmer's Manual*.

SET ENCRYPTION PASSWORD

Use the SET ENCRYPTION PASSWORD statement to define or reset a *session password* for encryption and decryption of character, BLOB, or CLOB values. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. You can use this statement with ESQL/C.

Syntax

```
►►──SET ENCRYPTION PASSWORD──'password' ─┬──────────────────┬──────────────►◄
                                         └─WITH HINT──'hint'─┘
```

Element	Description	Restrictions	Syntax
hint	String that **GETHINT** returns from an encrypted argument	(0 byte) ≤ *hint* ≤ (32 bytes). Do not include the *password* in the *hint*.	Expression, p. 4-34
password	Password (or a multi-word phrase) for data encryption	(6 bytes) ≤ *password* ≤ (120 bytes). Do not specify your login password.	Expression, p. 4-34

Usage

The SET ENCRYPTION PASSWORD statement declares a *password* to support data confidentiality through built-in functions that use the Triple-DES or AES algorithms for encryption and decryption. These functions enable the database to store sensitive data in an encrypted format that prevents anyone who cannot provide the secret *password* from viewing, copying, or modifying encrypted data.

The *password* is not stored as plain text in the database, and is not accessible to the DBA. This security feature is independent of the Trusted Facility feature.

Important: By default, communication between client systems and Dynamic Server is in plain text. Unless the database is accessible only by a secure network, the DBA must enable the *encryption communication support module* (ENCCSM) to provide data encryption between the database server and any client system. Otherwise, an attacker might read the *password* and use it to access encrypted data.

If the network is not secure, all of the database servers in a distributed query need ENCCSM enabled, so that the *password* is not transmitted as plain text. For information about how to enable a communication support module (CSM), see your *IBM Informix Administrator's Guide*.

Operations on encrypted data tend to be slower than corresponding operations on plain text data, but use of this feature has no effect on unencrypted data.

The SET ENCRYPTION PASSWORD statements can be prepared, and EXECUTE IMMEDIATE can process a prepared SET ENCRYPTION PASSWORD statement.

Storage Requirements for Encryption

Use the **ENCRYPT_AES** or **ENCRYPT_TDES** built-in functions to encrypt data. Encrypted values of character data types are stored in BASE64 format (also called Radix-64). For character data, this requires significantly more storage than the corresponding unencrypted data. Omitting the *hint* can reduce encryption overhead by more than 50 bytes for each encrypted value. It is the responsibility of the user to make sufficient storage space available for encrypted values.

The following table lists the data types that can be encrypted, and built-in functions that you can use to encrypt and decrypt values of those data types:

Original Data Type	Encrypted Data Type	BASE64 Format	Decryption Function
CHAR	CHAR	Yes	**DECRYPT_CHAR**
NCHAR	NCHAR	Yes	**DECRYPT_CHAR**
VARCHAR	VARCHAR	Yes	**DECRYPT_CHAR**
NVARCHAR	NVARCHAR	Yes	**DECRYPT_CHAR**
LVARCHAR	LVARCHAR	Yes	**DECRYPT_CHAR**
BLOB	BLOB	No	**DECRYPT_BINARY**
CLOB	BLOB	No	**DECRYPT_CHAR**

If the encrypted VARCHAR (or NVARCHAR) value is longer than the 255 byte maximum size for those data types, the encryption function returns a CHAR (or NCHAR) value of sufficient size to store the encrypted value.

DECRYPT_BINARY and **DECRYPT_CHAR** both return the same value from encrypted CHAR, NCHAR, VARCHAR, NVARCHAR, or LVARCHAR values. No built-in encryption or decryption functions support BYTE or TEXT data types, but you can use BLOB data types to encrypt very large strings.

Warning: If the declared size of a database column in which you intend to store encrypted data is smaller than the encrypted data length, truncation occurs when you insert the encrypted data into the column. The truncated data cannot subsequently be decrypted, because the data length indicated in the header of the encrypted string does not match what the column stores.

To avoid truncation, make sure that any column that stored encrypted strings has sufficient length. (See the cross-reference in the next paragraph for details of how to calculate the length of an encrypted string.)

Besides the unencrypted data length, the storage required for encrypted data depends on the encoding format, on whether you specify a *hint*, and on the block size of the encryption function. For a formula to estimate the encrypted size, see "Calculating storage requirements for encrypted data" on page 4-82.

Specifying a Session Password and Hint

The required *password* specification can be quoted strings or other character expression that evaluates to a string whose length is at least 6 bytes but no more than 128 bytes. The optional *hint* can specify a string no longer than 32 bytes.

The password or *hint* can be a single word or several words. The *hint* should be a word or phrase that helps you to remember the *password*, but does not include the *password*. You can subsequently execute the built-in **GETHINT** function (with an encrypted value as its argument) to return the plain text of *hint*.

The following ESQL/C program fragment defines a routine that includes the SET ENCRYPTION PASSWORD statement and executes DML statements:

```
process_ssn( )
{
EXEC SQL BEGIN DECLARE SECTION;
char password[128];
char myhint[33];
char myid[16], myssn[16];
EXEC SQL END DECLARE SECTION;
. . .
EXEC SQL SET ENCRYPTION PASSWORD :password WITH HINT :myhint;
...
EXEC SQL INSERT INTO tab1 VALUES (':abcd', ENCRYPT_AES("111-22-3333")) ;
EXEC SQL SELECT Pid, DECRYPT(ssn, :password) INTO :myid, :myssn;
...
EXEC SQL SELECT GETHINT(ssn) INTO :myhint, WHERE id = :myid;
}
```

Levels of Encryption

You can use SET ENCRYPTION PASSWORD with encryption and decryption functions to support these granularities of encryption in the database.

- **Column-Level Encryption:** All values in a given column of a database table are encrypted using the same password, the same encryption algorithm, and the same encryption mode. (In this case, you can save disk space by storing the *hint* outside the encrypted column, rather than repeating it in every row.)
- **Cell-Level Encryption:** Values of a given column in different rows of the same database table are encrypted using different passwords, or different encryption algorithms, or different encryption modes. This technique is sometimes necessary to protect personal data. (*Row-column level* encryption and *set-column level* encryption are both synonyms for cell-level encryption.)

Protecting Passwords

Passwords and hints that you declare with SET ENCRYPTION PASSWORD are not stored as plain text in any table of the system catalog, which also maintains no record of which columns or tables contain encrypted data. To prevent other users from accessing the plain text of encrypted data or of a password, however, you must avoid actions that might compromise the secrecy of a password:

- Do not create a functional index using a decryption function. (This would store plain-text data in the database, defeating the purpose of encryption.)
- On a network that is not secure, always work with encrypted data, or use session encryption, because the SQL communication between client and server sends passwords, hints, and the data to be encrypted as plain text.
- Do not store passwords in a trigger or in a UDR that exposes the password to the public.
- Do not set the session password prior to creating any view, trigger, procedure, or UDR. Set the session password only when you use the object. Otherwise, the password might be visible in the schema to other users, and queries executed by other users might return unencrypted data.

Output from the SET EXPLAIN statement always displays the *password* and *hint* parameters as `XXXXX`, rather than displaying actual *password* or *hint* values.

Related Information

For more information about built-in functions for encrypting and decrypting data, see “Encryption and Decryption Functions” on page 4-79.

For information on setting the environment variable **INFORMIXCONCSMCFG**, refer to the *IBM Informix Guide to SQL: Reference*.

SET ENVIRONMENT

The SET ENVIRONMENT statement can specify options at runtime that affect subsequent queries submitted within the same routine. This is an extension to the ANSI/ISO standard for SQL. Only Dynamic Server supports the OPTCOMPIND option. All of the other options are valid only with Extended Parallel Server.

Syntax

```
►►──SET ENVIRONMENT─────────────────────────────────────────────────────────────►

      (1)
►──┬──────────────┬─BOUND_IMPL_PDQ──┬──┬─────────────┬─────────────────┬──────►◄
   │              ├─COMPUTE_QUOTA───┤  ├─ON──────────┤                 │
   │              ├─CLIENT_TZ───────┤  ├─OFF─────────┤                 │
   │              ├─IMPLICIT_PDQ────┤  ├─'value'─────┤                 │
   │              ├─MAXSCAN─────────┤  ├─DEFAULT─────┤                 │
   │              └─TMPSPACE_LIMIT──┘  ├─MUTABLE─────┤                 │
   │                                   └─IMMUTABLE───┘                 │
   │        (1)                                                        │
   └──┬─────────────┬─TEMP_TAB_EXT_SIZE──┬──┬──┬─DEFAULT─────────────┬──┘
      │             └─TEMP_TAB_NEXT_SIZE─┘  │  ├─'integer '──────────┤
      │              (2)                    │  │                (1)  │
      └─OPTCOMPIND──────────────────────────┘  └───┬─MUTABLE───┬─────┘
                                                   └─IMMUTABLE─┘
```

Notes:

1 Extended Parallel Server only

2 Dynamic Server only

Element	Description	Restrictions	Syntax
value	Value to set for the specified environment option, which this statement also enables	Must be valid for the specified environment option	Quoted String, p. 4-142
integer	The extent size for system-generated temporary tables, in kilobytes (XPS). The code 0, 1, or 2 to prioritize nested-loop joins as an optimizer strategy (IDS).	Same as for *value*	Quoted String, p. 4-142

Usage

SET ENVIRONMENT specifies environment options that manage resource use by the routine in which the statement is executed. For example, on Extended Parallel Server, the SET ENVIRONMENT IMPLICIT_PDQ ON statement enables automatic **PDQPRIORITY** allocation for queries submitted in the routine.

The OFF keyword disables the specified option.

The ON keyword enables the specified option.

The DEFAULT keyword sets the specified option to its default value.

The MUTABLE keyword makes the specified option modifiable during a user session.

The IMMUTABLE keyword prevents modification of the specified option during a user session.

The arguments that follow the option name depend on the syntax of the option. The option name and its ON, OFF, and DEFAULT keywords are not quoted and are not case sensitive. All other arguments must be enclosed between single (′) or double (″) quotation marks. If a quoted string is a valid argument for an environment option, the argument is case sensitive.

If you enter an undefined option name or an invalid *value* for a defined option, no error is returned. Undefined options are ignored, but they might produce unexpected results, if you intended some effect that a misspelled or unsupported option name cannot produce. The SET ENVIRONMENT statement can enable only the environment options that are described in sections that follow.

For information about the performance implications of the SET ENVIRONMENT options, refer to the *IBM Informix Performance Guide.*

BOUND_IMPL_PDQ Environment Option (XPS)

If IMPLICIT_PDQ is set to ON or to a value, use the BOUND_IMPL_PDQ environment option to specify that the allocated memory should be bounded by the current explicit **PDQPRIORITY** value or range. If IMPLICIT_PDQ is OFF, then BOUND_IMPL_PDQ is ignored. For example, you might execute the following statement to force the database server to use explicit **PDQPRIORITY** values as guidelines in allocating memory if the IMPLICIT_PDQ environment option has already been set:

```
SET ENVIRONMENT BOUND_IMPL_PDQ ON
```

If you set both IMPLICIT_PDQ and BOUND_IMPL_PDQ, then the explicit **PDQPRIORITY** value determines the upper limit of memory that can be allocated to a query. If **PDQPRIORITY** is specified as a range, the database server grants memory within the range specified.

For detailed information, see the *IBM Informix Performance Guide*.

CLIENT_TZ Environment Option (XPS)

Use the CLIENT_TZ environment option to set the timezone offset from GMT to use in the current session for evaluating the built-in CURRENT and TODAY functions. If you specify OFF or DEFAULT, values returned from CURRENT and TODAY use the timezone of the database server.

3 To specify a timezone offset, use the following format for the CLIENT_TZ *value*,
3 and enclose the *value* between a pair of single (′) or double (″) quotation marks:

```
►►──┬─ + ─┬──hour──:──minute─────────────────────────────────────────►◄
    └─ - ─┘
```

Element	Description	Restrictions	Syntax
hour	Number of hours in timezone offset from Greenwich Mean Time (GMT)	Must be an integer in the range -14 < *hour* <14	Literal Number, p. 4-137
minute	Additional minutes in timezone offset from Greenwich Mean Time (GMT)	Must be a 2-digit integer in the range 00 to 59 inclusive	Literal Number, p. 4-137

A positive (+) offset implies a time zone whose location is west of zero longitude (= GMT). A negative offset implies a time zone east of zero longitude. The following statement specifies an offset of five hours and fifteen minutes:

```
SET ENVIRONMENT CLIENT_TZ '+5:15'
```

If the statement in this statement executed successfully, then subsequent calls to the CURRENT function in the same session return a time-of-day value that is 5 hours and 15 minutes greater than the default value with no offset.

If a CLIENT_TZ value has been previously specified, the keyword ON tells the database server to use that value.

The CLIENT_TZ value that you specify in the SET ENVIRONMENT statement temporarily overrides any CLIENT_TZ setting of the **IBM_XPS_PARAMS** environment variable for the duration of the current session.

The **onstat -g ses** command can display the current CLIENT_TZ setting.

In a distributed transaction that you initiate from Extended Parallel Server, but in which remote Dynamic Server instances evaluate CURRENT or TODAY values, the CLIENT_TZ setting is ignored by Dynamic Server.

COMPUTE_QUOTA Environment Option (XPS)

Use the COMPUTE_QUOTA environment option to allow the optimizer to use only one CPU VP (virtual processor) on each coserver for each query operator instead of using all CPU VPs of each coserver.

To turn on this environment option, execute the following statement:

```
SET ENVIRONMENT COMPUTE_QUOTA ON
```

IMPLICIT_PDQ Environment Option (XPS)

Use the IMPLICIT_PDQ environment option to allow the database server to determine the amount of memory allocated to a query. Unless BOUND_IMPL_PDQ is also set, the database server ignores the current explicit setting of **PDQPRIORITY**. It does not allocate more memory, however, than is available when **PDQPRIORITY** is set to 100, as determined by MAX_PDQPRIORITY / 100 * DS_TOTAL_MEMORY.

This environment option is OFF by default.

If you set *value* between `1` and `100`, the database server scales its estimate by the specified value. If you set a low value, the amount of memory assigned to the query is reduced, which might increase the amount of query-operator overflow.

For example, to request the database server to determine memory allocations for queries and distribute memory among query operators according to their needs, enter the following statement:

```
SET ENVIRONMENT IMPLICIT_PDQ ON
```

To require the database server to use explicit **PDQPRIORITY** settings as the upper bound and optional lower bound of memory that it grants to a query, set the BOUND_IMPL_PDQ environment option.

MAXSCAN Environment Option (XPS)

Use the MAXSCAN environment option to change the default number of scan threads on each coserver. The default is three scan threads for each CPU VP. You might want to reduce the number of scan threads on a coserver if the GROUP, JOIN, and other operators above the scan are not producing rows quickly enough to keep the default number of scan threads busy.

For some queries, you might want to increase the number of scan threads on each coserver. For example, if each coserver has three CPU VPs, the database server can create nine scan threads on each coserver. To increase the number to four threads for each CPU VP, execute the following statement:

```
SET ENVIRONMENT MAXSCAN '12'
```

MAXSCAN is automatically set to 1 if the COMPUTE_QUOTA environment option is enabled or if the isolation level is set to Cursor Stability and the database server can use a pipe operator.

TMPSPACE_LIMIT Environment Option (XPS)

Use the TMPSPACE_LIMIT environment option to specify the amount of temporary space on each coserver that a query can use for query operator overflow. Temporary space limits do not affect the creation of temporary tables. The limits apply only to the query-operator overflow that occurs when a query cannot get enough memory to complete execution.

By default, TMPSPACE_LIMIT is OFF, and a query can use all available temporary space for operator overflow. If the DS_TOTAL_TMPSPACE configuration parameter is not set, then setting TMPSPACE_LIMIT has no effect.

If you enter a value between `'0'` and ’`100'` as an argument to the TMPSPACE_LIMIT option, the database server sets the temporary space quota to the percent of available temporary space that the **ONCONFIG** parameter DS_TOTAL_TMPSPACE, specifies.

- If the value is `100`, queries can use only the amount of temporary space on each coserver that DS_TOTAL_TMPSPACE specifies.
- If the value is `0`, query operators cannot overflow to temporary space.
- If you do not specify a value, a query can use all available temporary space on each coserver, as limited by DS_TOTAL_TMPSPACE, for query operator overflow.

To require queries to use only the amount of temporary space specified by the setting of DS_TOTAL_TMPSPACE on each coserver, execute this statement:

```
SET ENVIRONMENT TMPSPACE_LIMIT ON
```

To limit queries to 50 percent of DS_TOTAL_TMPSPACE on each coserver, execute the following statement:

```
SET ENVIRONMENT TMPSPACE_LIMIT "50";
```

TEMP_TAB_EXT_SIZE and TEMP_TAB_NEXT_SIZE Options (XPS)

Use the TEMP_TAB_EXT_SIZE and TEMP_TAB_NEXT_SIZE environment options to specify the number of kilobytes used as the first and next extent size for a system-generated temporary table.

The following example shows the syntax for setting the first and next extent size using these environment options:

```
SET ENVIRONMENT TEMP_TAB_EXT_SIZE '64'
SET ENVIRONMENT TEMP_TAB_NEXT_SIZE '128'
```

This example sets the first extent size of a generated temporary table to 64 and the next extent size to 128 kilobytes.

The minimum value of these options is four times the page size on your system. If you specify a size below the minimum, the server will default the page size to four pages. For flex inserts, the server will default to 32 pages or 128 kilobytes.

The maximum value for TEMP_TAB_EXT_SIZE and TEMP_TAB_NEXT_SIZE is the maximum value of a chunk size.

Use the DEFAULT keyword to reset the values of these environments options back to the system defaults.

Important: The database server calculates the extent sizes of temporary tables that it creates for hash tables and sorts. The SET ENVIRONMENT statement has no effect on extent sizes for these tables.

OPTCOMPIND Environment Option (IDS)

The OPTCOMPIND environment option can improve the performance of databases that are used for both decision support and online transaction processing. Use this option to specify join methods for the query optimizer to use in subsequent queries.

- If the value is `'0' then` queries will use a nested-loop join where possible, rather than a sort-merge join or a hash join.
- If the value is `'1'` and the transaction isolation level is not Repeatable Read, the optimizer behaves as in setting `'2'` as described next; for any other isolation level, it behaves as in setting `'0' above`.
- If the value is `'2'` then the query optimizer does not necessarily prefer nested-loop joins, but bases its decision entirely on the estimated cost, regardless of the transaction isolation mode.

For example, the following statement replaces whatever OPTCOMPIND setting was previously in effect with a purely cost-based optimizer strategy:

```
SET ENVIRONMENT OPTCOMPIND '2'
```

Use the DEFAULT keyword to restore the system default value, as described in the **OPTCOMPIND** section of the *IBM Informix Guide to SQL: Reference*.

For performance implications of the OPTCOMPIND option, see your *IBM Informix Performance Guide*.

Local Scope of SET ENVIRONMENT

The SET ENVIRONMENT variable provides a mechanism for temporarily resetting certain features of the environment dynamically at runtime. The scope of these changes is local to the routine that executes SET ENVIRONMENT, rather than the entire session.

Exceptions to this local scope are the **sysdbopen( )** and **sysdbclose( )** SPL routines of Extended Parallel Server, which can set the initial environment for a session. For more information on these built-in routines, see “Using sysbdopen( ) and sysdbclose( ) Stored Procedures (XPS)” on page 2-150.

Related Information

Related statements: SET ALL_MUTABLES, SET PDQPRIORITY

SET EXPLAIN

Use the SET EXPLAIN statement to display the query plan of optimizer, an estimate of the number of rows returned, and the relative cost of the query.

Syntax

```
>>--SET EXPLAIN--+--+-OFF-------------------+---------------------------+---------><
                 |  '-ON--+---------------+-'                           |
                 |        '-AVOID_EXECUTE-'                             |
                 |  (1)                                                 |
                 '---------FILE TO--+-'filename '-+--+-------------+----'
                                    +-filename_var+  '-WITH APPEND-'
                                    '-expr--------'
```

Notes:

1 Extended Parallel Server only

Element	Description	Restrictions	Syntax
expr	Expression that returns a *filename* specification	Must return a string satisfying the restrictions on *filename*	Expression, p. 4-34
filename	Path and filename of the file to receive the output. For the default, see "Location of the Output File" on page 2-547.	Must conform to operating- system rules. If an existing file, see "Using the WITH APPEND Option" on page 2-547.	Quoted String, p. 4-142
filename_var	Host variable that stores *filename*	Must be a character data type	Language specific

Usage

Output from a SET EXPLAIN ON statement is directed to the appropriate file until you issue a SET EXPLAIN OFF statement or until the program ends. If you do not enter a SET EXPLAIN statement, then the default behavior is OFF, and the database server does not generate measurements for queries.

The SET EXPLAIN statement executes during the database server optimization phase, which occurs when you initiate a query. For queries that are associated with a cursor, if the query is prepared and does not have host variables, optimization occurs when you prepare it. Otherwise, optimization occurs when you open the cursor.

The SET EXPLAIN statement provides various measurements of the work involved in performing a query.

Option	Effect
ON	Generates measurements for each subsequent query and writes the results to an output file in the current directory. If the file already exists, new output is appended to the existing file.
AVOID_EXECUTE	Prevents a SELECT, INSERT, UPDATE, or DELETE statement from executing while the database server prints the query plan to an output file
OFF	Terminates activity of the SET EXPLAIN statement,

	so that measurements for subsequent queries are no longer generated or written to the output file
FILE TO	Generates measurements for each subsequent query and allows you to specify the location for the explain output file. If the file already exists, new output overwrites the contents of the file unless you use the WITH APPEND option.

Using the AVOID_EXECUTE Option

The SET EXPLAIN ON AVOID_EXECUTE statement activates the Avoid Execute option for a session, or until the next SET EXPLAIN OFF (or ON) without AVOID_EXECUTE. The AVOID_EXECUTE keyword prevents DML statements from executing; instead, the database server prints the query plan to an output file. If you activate AVOID_EXECUTE for a query that contains a remote table, the query does not execute at either the local or remote site.

When AVOID_EXECUTE is set, the database server sends a warning message. If you are using DB-Access, it displays a text message

```
Warning! avoid_execute has been set
```

for any select, delete, update or insert query operations. From ESQL, the **sqlwarn.sqlwarn7** character is set to ’W’.

Use the SET EXPLAIN ON or the SET EXPLAIN OFF statement to turn off the AVOID_EXECUTE option. The SET EXPLAIN ON statement turns off the AVOID_EXECUTE option but continues to generate a query plan and writes the results to an output file.

If you issue the SET EXPLAIN ON AVOID_EXECUTE statement in an SPL routine, the SPL routine and any DDL statements still execute, but the DML statements inside the SPL routine do not execute. The database server prints the query plan of the SPL routine to an output file. To turn off this option, you must execute the SET EXPLAIN ON or the SET EXPLAIN OFF statement outside the SPL routine. If you execute the SET EXPLAIN ON AVOID_EXECUTE statement before you execute an SPL routine, the DML statements inside the SPL routine do not execute, and the database server does not print a query plan of the SPL routine to an output file.

Nonvariant functions in a query are still evaluated when AVOID_EXECUTE is in effect, because the database server calculates these functions before optimization.

For example, the **func( )** function is evaluated, even though the following SELECT statement is not executed:

```
SELECT * FROM orders WHERE func(10) > 5
```

For other performance implications of the AVOID_EXECUTE option, see your *IBM Informix Performance Guide*.

If you execute the SET EXPLAIN ON AVOID_EXECUTE statement before you open a cursor in an ESQL/C program, each FETCH operation returns the message that the row was not found. If you execute SET EXPLAIN ON AVOID_EXECUTE after an ESQL/C program opens a cursor, however, this statement has no effect on the cursor, which continues to return rows.

Using the FILE TO Option

When you execute a SET EXPLAIN FILE TO statement, explain output is implicitly turned on. The default filename for the output is **sqexplain.out** until changed by a SET EXPLAIN FILE TO statement. Once changed, the filename remains set until the end of the session or until changed by another SET EXPLAIN FILE TO statement.

The filename can be any valid combination of optional path and filename. If no path component is specified, the file is placed in your current directory. The permissions for the file are owned by the current user.

Using the WITH APPEND Option

The output file that you specify in the SET EXPLAIN statement can be a new file or an existing file.

If you specify an existing file, the current contents of the file are purged when you issue the SET EXPLAIN FILE TO statement. The first execution of a FILE TO command sends output to the beginning of the file.

If you include the WITH APPEND option, the current contents of the file are preserved when you issue the SET EXPLAIN FILE TO statement. The execution of a WITH APPEND command appends output to the end of the file.

If you specify a new file in the SET EXPLAIN FILE TO statement, it makes no difference whether you include the WITH APPEND option. The first execution of the command sends output to the beginning of the new file.

Default Name and Location of the Output File on UNIX

When you issue the SET EXPLAIN ON statement, the plan that the optimizer chooses for each subsequent query is written to the **sqexplain.out** file by default.

If the output file does not exist when you issue SET EXPLAIN ON, the database server creates the output file. If the output file already exists when you issue the SET EXPLAIN ON statement, subsequent output is appended to the file.

If the client application and the database server are on the same computer, the **sqexplain.out** file is stored in your current directory. If you are using a Version 5.x or earlier client application and the **sqexplain.out** file does not appear in the current directory, check your home directory for the file. When the current database is on another computer, the **sqexplain.out** file is stored in your home directory on the remote host.

Default Name and Location of the Output File on Windows

On Windows, SET EXPLAIN ON writes the plan that the optimizer chooses for each subsequent query to file **%INFORMIXDIR%\sqexpln\*username*.out** where *username* is the user login.

SET EXPLAIN Output

By examining the SET EXPLAIN output file, you can determine if steps can be taken to improve the performance of the query. The following table lists terms that can appear in the output file and their significance.

Term	Significance
Query	Displays the executed query and indicates whether SET OPTIMIZATION was set to HIGH or LOW. If you SET OPTIMIZATION to LOW, the output displays the following uppercase string as the first line: `QUERY:{LOW}` If you SET OPTIMIZATION to HIGH, the output of SET EXPLAIN displays the following uppercase string as the first line: `QUERY:`
Directives followed	Lists the directives set for the query If the syntax for a directive is incorrect, the query is processed without the directive. In that case, the output shows `DIRECTIVES NOT FOLLOWED` in addition to `DIRECTIVES FOLLOWED`. For more information on the directives specified after this term, see the “Optimizer Directives” on page 5-34 or “SET OPTIMIZATION” on page 2-584.
Estimated cost	An estimate of the amount of work for the query The optimizer uses an estimate to compare the cost of one path with another. The estimate is a number the optimizer assigns to the selected access method. This number does not translate directly into time and cannot be used to compare different queries. It can be used, however, to compare changes made for the same query. When data distributions are used, a query with a higher estimate generally takes longer to run than one with a smaller estimate. In the case of a query and a subquery, two estimated cost figures are returned; the query figure also contains the subquery cost. The subquery cost is shown only so you can see the cost that is associated with the subquery.
Estimated number of rows returned	An estimate of the number of rows to be returned This number is based on information in the system catalog tables.
Numbered list	The order in which tables are accessed, followed by the access method used (index path or sequential scan) When a query involves table inheritance, all the tables are listed under the supertable in the order in which they were accessed.
Index keys	The columns used as filters or indexes; the column name used for the index path or filter is indicated. The notation *(Key Only)* indicates that all the desired columns are part of the index key, so a key-only read of the index could be substituted for a read of the actual table. The *Lower Index Filter* shows the key value where the index read begins. If the filter condition contains more than one value, an *Upper Index Filter* is shown for the key value where the index read stops.
Join method	When the query involves a join between two tables, the join method the optimizer used (Nested Loop or Dynamic Hash) is shown at the bottom of the output for that query. When the query involves a dynamic join of two tables, if the output contains the words *Build Outer*, the hash table is built on the first table listed (called the build table). If the words *Build Outer* do not appear, the hash table is built on the second table listed.

If the query uses a collating order other than the default for the **DB_LOCALE** setting, then the **DB_LOCALE** setting and the name of the other locale that is the basis for the collation in the query (as specified by the SET COLLATION statement) are both included in the output file. Similarly, if an index is not used because of its collation, the output file indicates this.

Complete-Connection Level Settings

The SET EXPLAIN statement supports *complete-connection level* settings. This means that values in the local session environment at the time of connection are propagated to all new or resumed transactions. These can include the following types of transactions:

- transactions within the local database
- distributed transactions across databases of the same server instance
- distributed transactions across databases of two or more database server instances
- global transactions with XA-compliant data sources that are registered in the local database

If you change the SET EXPLAIN setting within a transaction, the new value is propagated back to the local environment and also to all subsequent new or resumed transactions.

Related Information

SET OPTIMIZATION, UPDATE STATISTICS

For a description of the EXPLAIN and AVOID_EXECUTE optimizer directives, see "Explain-Mode Directives" on page 5-40.

For discussions of SET EXPLAIN and of analyzing the output of the optimizer, see your *IBM Informix Performance Guide*.

SET INDEX

Use the SET INDEX statement to specify that one or more fragments of an index be resident in shared memory as long as possible. Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
>>──SET INDEX──index──┬─────────────────────────┬──┬─MEMORY_RESIDENT─┬─────────────><
                      │      ┌─,──────────┐     │  └─NON_RESIDENT────┘
                      │      ▼            │     │
                      └─(────dbspace──────┴──)──┘
```

Element	Description	Restrictions	Syntax
dbspace	Dbspace in which to store the fragment	Must exist	Identifier, p. 5-22
index	Index for which to change residency state	Must exist	Database Object Name, p. 5-17

Usage

This statement was formerly supported by Dynamic Server, but it is ignored in current releases. Beginning with Version 9.40, Dynamic Server determines the residency status of indexes and tables automatically.

The SET INDEX statement is a special case of the SET Residency statement. The SET Residency statement can also specify how long a table fragment remains resident in shared memory.

For the complete syntax and semantics of the SET INDEX statement, see “SET Residency” on page 2-590.

SET INDEXES

Use the SET INDEXES statement to enable or disable an index, or to change the filtering mode of a unique index.

Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL. Do not confuse the SET INDEXES statement with the SET INDEX statement.

Syntax

```
                    ┌─,─────┐
                    ▼       │
►►──SET INDEXES──┬───index──┴─┬──┬─┬─ENABLED──┬──────────────────────┬──────────►◄
                 └─FOR──table─┘  │ └─DISABLED─┘                      │
                                 │             ┌─WITHOUT ERROR─┐     │
                                 └─FILTERING───┴─WITH ERROR────┴─────┘
```

Element	Description	Restrictions	Syntax
table	Table whose indexes are all to be enabled, disabled, or changed in their filtering mode	Must exist	Database Object Name, p. 5-17
index	Index to be enabled, disabled, or changed in its filtering mode	Must exist	Database Object Name, p. 5-17

Usage

The SET INDEXES statement is a special case of the SET Database Object Mode statement. The SET Database Object Mode statement can also enable or disable a trigger or constraint or change the filtering mode of a constraint.

For the complete syntax and semantics of the SET INDEXES statement, see "SET Database Object Mode" on page 2-539.

SET ISOLATION

Use the SET ISOLATION statement to define the degree of concurrency among processes that attempt to access the same rows simultaneously. This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──SET ISOLATION──┬────┬──────────────────────────────────────────────────►
                   └─TO─┘

►──┬─REPEATABLE READ─────────────────────────────────────┬────────────►◄
   └─┬─COMMITTED READ──────────────┬─┬─────────────────────┬─┘
     ├─CURSOR STABILITY────────────┤ └─RETAIN UPDATE LOCKS─┘
     └─DIRTY READ─┬──────────────┬─┘
                  └─WITH WARNING─┘
```

Usage

The SET ISOLATION statement is an Informix extension to the ANSI SQL-92 standard. The SET ISOLATION statement can change the enduring isolation level for the session. If you want to set isolation levels through an ANSI-compliant statement, use the SET TRANSACTION statement instead. For a comparison of these two statements, see "SET TRANSACTION" on page 2-602.

The TO keyword is optional, and has no effect.

SET ISOLATION provides the same functionality as the ISO/ANSI-compliant SET TRANSACTION statement for isolation levels of DIRTY READ (called UNCOMMITTED in SET TRANSACTION), COMMITTED READ, and REPEATABLE READ (called SERIALIZABLE in SET TRANSACTION).

The database *isolation_level* affects read concurrency when rows are retrieved from the database. The isolation level specifies the phenomena that can occur during execution of concurrent SQL transactions. The following phenomena are possible:

- **Dirty Read**. SQL transaction T1 modifies a row. SQL transaction T2 then reads that row before T1 performs a COMMIT. If T1 then performs a ROLLBACK, T2 will have read a row that was never committed, and therefore can be considered never to have existed.
- **Non-Repeatable Read**. SQL transaction T1 reads a row. SQL transaction T2 then modifies or deletes that row and performs a COMMIT. If T1 then attempts to reread that row, T1 might receive the modified value or discover that the row has been deleted.
- **Phantom Row**. SQL transaction T1 reads the set of rows N that satisfy some search condition. SQL transaction T2 then executes SQL statements that generate one or more new rows that satisfy the search condition used by SQL transaction T1. If T1 then repeats the original read with the same search condition, T1 receives a different set of rows.

The database server uses shared locks to support different levels of isolation among processes attempting to access data.

The update or delete process always acquires an exclusive lock on the row that is being modified. The level of isolation does not interfere with rows that you are updating or deleting. If another process attempts to update or delete rows that you are reading with an isolation level of Repeatable Read, that process is denied access to those rows.

In ESQL/C, cursors that are open when SET ISOLATION executes might or might not use the new isolation level when rows are retrieved. Any isolation level that was set from the time the cursor was opened until the application fetches a row might be in effect. The database server might have read rows into internal buffers and internal temporary tables using the isolation level that was in effect at that time. To ensure consistency and reproducible results, close any open cursors before you execute the SET ISOLATION statement.

You can issue the SET ISOLATION statement from a client computer only after a database is opened.

Complete-Connection Level Settings

The SET ISOLATION statement supports *complete-connection level* settings. This means that values in the local session environment at the time of connection are propagated to all new or resumed transactions. These can include the following types of transactions:

- transactions within the local database,
- distributed transactions across databases of the same server instance,
- distributed transactions across databases of two or more database server instances,
- global transactions with XA-compliant data sources that are registered in the local database.

If you change the isolation level within a transaction, the new value is propagated back to the local environment and also to all subsequent new or resumed transactions.

Informix Isolation Levels

The following definitions explain the critical characteristics of each isolation level, from the lowest level of isolation to the highest.

Using the Dirty Read Option

Use the Dirty Read option to copy rows from the database whether or not there are locks on them. The program that fetches a row places no locks and it respects none. Dirty Read is the only isolation level available to databases that do not implement transaction logging.

This isolation level is most appropriate for static tables that are used for queries of tables where data is not being modified, because it provides no isolation. With Dirty Read, the program might return an uncommitted row that was inserted or modified within a transaction that has subsequently rolled back, or a *phantom row* that was not visible when you first read the query set, but that materializes in the query set before a subsequent read within the same transaction. (Only the Repeatable Read isolation level prevents access to phantom rows. Only Dirty Read provides access to uncommitted rows from concurrent transactions that might subsequently be rolled back.)

The optional WITH WARNING keywords instruct the database server to issue a warning when DML operations that use the Dirty Read isolation level might return an uncommitted row or a phantom row.

Using the Committed Read Option

Use the Committed Read option to guarantee that every retrieved row is committed in the table at the time that the row is retrieved. This option does not place a lock on the fetched row. Committed Read is the default level of isolation in a database with logging that is not ANSI compliant.

Committed Read is appropriate when each row is processed as an independent unit, without reference to other rows in the same table or in other tables.

Using the Cursor Stability Option

Use the Cursor Stability option to place a shared lock on the fetched row, which is released when you fetch another row or close the cursor. Another process can also place a shared lock on the same row, but no process can acquire an exclusive lock to modify data in the row. Such row stability is important when the program updates another table based on the data it reads from the row.

If you set the isolation level to Cursor Stability, but you are not using a transaction, the Cursor Stability acts like the Committed Read isolation level.

Using the Repeatable Read Option

Use the Repeatable Read option to place a shared lock on every row that is selected during the transaction. Another process can also place a shared lock on a selected row, but no other process can modify any selected row during your transaction, nor insert a row that meets the search criteria of your query during your transaction. If you repeat the query during the transaction, you reread the same information. The shared locks are released only when the transaction commits or rolls back. Repeatable Read is the default isolation level in an ANSI-compliant database.

Repeatable Read isolation places the largest number of locks and holds them the longest. Therefore, it is the level that reduces concurrency the most.

Default Isolation Levels

The default isolation level for a particular database is established when you create the database according to database type. The following list describes the default isolation level for each database type.

Isolation Level	**Database Type**
Dirty Read	Default level in a database without logging
Committed Read	Default level in a logged database that is not ANSI compliant
Repeatable Read	Default level in an ANSI-compliant database

The default level remains in effect until you issue a SET ISOLATION statement. After a SET ISOLATION statement executes, the new isolation level remains in effect until one of the following events occurs:

- You enter another SET ISOLATION statement.
- You open another database that has a default isolation level different from the level that your last SET ISOLATION statement specified.
- The program ends.

Using the RETAIN UPDATE LOCKS Option

Use the RETAIN UPDATE LOCKS option to affect the behavior of the database server when it handles a SELECT ... FOR UPDATE statement.

In a database with the isolation level set to Dirty Read, Committed Read, or Cursor Stability, the database server places an update lock on a fetched row of a SELECT ... FOR UPDATE statement. When you turn on the RETAIN UPDATE LOCKS option, the database server retains the update lock until the end of the transaction rather than releasing it at the next subsequent FETCH or when the cursor is closed. This option prevents other users from placing an exclusive lock on the updated row before the current user reaches the end of the transaction.

You can use this option to achieve the same locking effects but avoid the overhead of dummy updates or the repeatable read isolation level.

You can turn this option on or off at any time during the current session.

You can turn the option off by resetting the isolation level without using the RETAIN UPDATE LOCKS keywords.

For more information on update locks, see "Locking Considerations" on page 2-639.

Turning the Option Off In the Middle of a Transaction: If you set the RETAIN UPDATE LOCKS option to OFF after a transaction has begun, but before the transaction has been committed or rolled back, several update locks might still exist.

Switching OFF the feature does not directly release any update lock. When you turn this option off, the database server reverts to normal behavior for the three isolation levels. That is, a FETCH statement releases the update lock placed on a row by the immediately preceding FETCH statement, and a closed cursor releases the update lock on the current row.

Update locks placed by earlier FETCH statements are not released unless multiple update cursors are present within the same transaction. In this case, a subsequent FETCH could also release older update locks of other cursors.

Effects of Isolation Levels

You cannot set the database isolation level in a database that does not have logging. Every retrieval in such a database occurs as a Dirty Read.

The data retrieved from a BYTE or TEXT column can vary, depending on the database isolation level. Under Dirty Read or Committed Read levels of isolation, a process can read a BYTE or TEXT column that is either deleted (if the delete is not yet committed) or in the process of being deleted. Under these isolation levels, deleted data is readable under certain conditions. For information about these conditions, see the *IBM Informix Administrator's Guide*.

When you use DB–Access, as you use higher levels of isolation, lock conflicts occur more frequently. For example, if you use Cursor Stability, more lock conflicts occur than if you use Committed Read.

Using a scroll cursor in an ESQL/C transaction, you can force consistency between your temporary table and the database table either by setting the level to Repeatable Read or by locking the entire table during the transaction.

If you use a scroll cursor WITH HOLD in a transaction, you cannot force consistency between your temporary table and the database table. A table-level lock or locks that are set by Repeatable Read are released when the transaction is completed, but the scroll cursor with hold remains open beyond the end of the transaction. You can modify released rows as soon as the transaction ends, but retrieved data in the temporary table might be inconsistent with the actual data.

Attention: Do not use nonlogging tables within a transaction. If you need to use a nonlogging table within a transaction, either set the isolation level to Repeatable Read or else lock the table in Exclusive mode to prevent concurrency problems.

Related Information

Related statements: CREATE DATABASE, SET LOCK MODE, and SET TRANSACTION

For a discussion of how to set the database isolation level, see the *IBM Informix Guide to SQL: Tutorial*.

SET LOCK MODE

Use the SET LOCK MODE statement to define how the database server handles a process that tries to access a locked row or table.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──SET LOCK MODE TO──┬─NOT WAIT──────────┬──────────────────────────────────►◄
                      └─WAIT──┬─────────┬─┘
                              └─seconds─┘
```

Element	Description	Restrictions	Syntax
seconds	Maximum number of seconds that a process waits for a lock to be released before issuing an error	Valid only if shorter than system default	Literal Number, p. 4-137

Usage

This statement can direct the response of the database server in the following ways when a process tries to access a locked row or table.

Lock Mode	**Effect**
NOT WAIT	Database server ends the operation immediately and returns an error code. This condition is the default.
WAIT	Database server suspends the process until the lock releases.
WAIT *seconds*	Database server suspends the process until the lock releases or until the waiting period ends. If the lock remains after the waiting period, the operation ends and an error code is returned.

In the following example, the user specifies that if the process requests a locked row, the operation should end immediately and an error code should be returned:

```
SET LOCK MODE TO NOT WAIT
```

In the following example, the user specifies that the process should be suspended until the lock is released:

```
SET LOCK MODE TO WAIT
```

The next example sets an upper limit of 17 seconds on the length of any wait:

```
SET LOCK MODE TO WAIT 17
```

WAIT Clause

The WAIT clause causes the database server to suspend the process until the lock is released or until a specified number of seconds have passed without the lock being released.

The database server protects against the possibility of a deadlock when you request the WAIT option. Before the database server suspends a process, it checks whether suspending the process could create a deadlock. If the database server discovers that a deadlock could occur, it ends the operation (overruling your instruction to wait) and returns an error code. In the case of either a suspected or actual deadlock, the database server returns an error.

Cautiously use the unlimited waiting period that was created when you specify the WAIT option without *seconds*. If you do not specify an upper limit, and the process that placed the lock somehow fails to release it, suspended processes could wait indefinitely. Because a true deadlock situation does not exist, the database server does not take corrective action.

In a network environment, the DBA uses the ONCONFIG parameter DEADLOCK_TIMEOUT to establish a default value for *seconds*. If you use a SET LOCK MODE statement to set an upper limit, your value applies only when your waiting period is shorter than the system default.

Complete-Connection Level Settings

The SET LOCK MODE statement supports *complete-connection level* settings. This means that values in the local session environment at the time of connection are propagated to all new or resumed transactions. These can include the following types of transactions:

- transactions within the local database,
- distributed transactions across databases of the same server instance,
- distributed transactions across databases of two or more database server instances,
- global transactions with XA-compliant data sources that are registered in the local database.

If you change the lock mode setting within a transaction, the new value is propagated back to the local environment and also to all subsequent new or resumed transactions.

Releases of Dynamic Server earlier than 9.40.UC8, the SET LOCK MODE statement did not support complete-connection level settings. The process waited for the specified number of seconds only if you acquired locks within the current database server and a remote database server within the same transaction.

Related Information

Related statements: LOCK TABLE, SET ISOLATION, SET TRANSACTION, and UNLOCK TABLE

For a description of the two distinct meanings of the term *lock mode* in this manual, see the section “Locking Granularity” on page 2-415.

For a discussion of how to set the lock mode behavior of the database server, see the *IBM Informix Guide to SQL: Tutorial*.

SET LOG

Use the SET LOG statement to change your database logging mode from buffered transaction logging to unbuffered transaction logging or vice versa.

This statement is an extension to the ANSI/ISO standard for SQL. Unlike most extensions, the SET LOG statement is not valid in an ANSI-compliant database.

Syntax

```
►►──SET──┬──────────┬──LOG──────────────────────────────────────────►◄
         └─BUFFERED─┘
```

Usage

You activate transaction logging when you create a database or add logging to an existing database. These transaction logs can be buffered or unbuffered.

Buffered logging is a type of logging that holds transactions in a memory buffer until the buffer is full, regardless of when the transaction is committed or rolled back. The database server provides this option to speed up operations by reducing the number of disk writes.

Attention: You gain a marginal increase in efficiency with buffered logging, but you incur some risk. In the event of a system failure, the database server cannot recover any completed transactions in the memory buffer that were not written to disk.

The SET LOG statement in the following example changes the transaction logging mode to buffered logging:

```
SET BUFFERED LOG
```

Unbuffered logging is a type of logging that does not hold transactions in a memory buffer. As soon as a transaction ends, the database server writes the transaction to disk. If a system failure occurs when you are using unbuffered logging, you recover all completed transactions, but not those still in the buffer. The default condition for transaction logs is unbuffered logging.

The SET LOG statement in the following example changes the transaction logging mode to unbuffered logging:

```
SET LOG
```

The SET LOG statement redefines the mode for the current session only. The default mode, which the database administrator sets with the **ondblog** utility, remains unchanged.

The buffering option does not affect retrievals from external tables. For distributed queries, a database with logging can retrieve only from databases with logging, but it makes no difference whether the databases use buffered or unbuffered logging.

An ANSI-compliant database cannot use buffered logging.

You cannot change the logging mode of ANSI-compliant databases. If you created a database with the WITH LOG MODE ANSI keywords, you cannot later use the SET LOG statement to change the logging mode to buffered or unbuffered transaction logging.

Related Information

Related statement: CREATE DATABASE

SET OPTIMIZATION

Use the SET OPTIMIZATION statement to specify how much time the optimizer spends developing a query plan or specifying optimization goals.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──SET OPTIMIZATION──┬──┬─HIGH─┬──────────┬──────────────────────────────►◄
                      │  └─LOW──┘          │
                      │  (1)               │
                      └─────────┬─FIRST_ROWS─┬─┘
                                └─ALL_ROWS───┘
```

Notes:

1 Dynamic Server only

Usage

You can execute a SET OPTIMIZATION statement at any time. The specified optimization level carries across databases on the current database server. The option that you specify remains in effect until you issue another SET OPTIMIZATION statement or until the program ends. The default database server optimization level for the amount of time that the query optimizer spends determining the query plan is HIGH.

On Dynamic Server, the default optimization goal is ALL_ROWS. Although you can set only one option at a time, you can issue two SET OPTIMIZATION statements: one that specifies the time the optimizer spends to determine the query plan and one that specifies the optimization goal of the query.

HIGH and LOW Options

The HIGH and LOW options determine how much time the query optimizer spends to determine the query plan:

- HIGH

  This option directs the optimizer to use a sophisticated, cost-based algorithm that examines all reasonable query-plan choices and selects the best overall alternative.

  For large joins, this algorithm can incur more overhead than you desire. In extreme cases, you can run out of memory.

- LOW

  This option directs the optimizer to use a less sophisticated, but faster, optimization algorithm. This algorithm eliminates unlikely join strategies during the early stages of optimization and reduces the time and resources spent during optimization.

  When you specify a low level of optimization, the database server might not select the optimal strategy because the strategy was eliminated from consideration during the early stages of the algorithm.

FIRST_ROWS and ALL_ROWS Options (IDS)

The FIRST_ROWS and ALL_ROWS options relate to the optimization goal of the query:

- FIRST_ROWS

This option directs the optimizer to choose the query plan that returns the first result record as soon as possible.

- ALL_ROWS

  This option directs the optimizer to choose the query plan that returns all the records as quickly as possible.

You can also specify the optimization goal of a specific query with the optimization-goal directive. For more information, see “Optimizer Directives” on page 5-34.

Optimizing SPL Routines

For SPL routines that remain unchanged or change only slightly, you might want to set the SET OPTIMIZATION statement to HIGH when you create the SPL routine. This step stores the best query plans for the SPL routine. Then execute a SET OPTIMIZATION LOW statement before you execute the SPL routine. The SPL routine then uses the optimal query plans and runs at the more cost-effective rate.

Examples

The following example shows optimization across a network. The **central** database (on the **midstate** database server) is to have LOW optimization; the **western** database (on the **rockies** database server) is to have HIGH optimization.

```
CONNECT TO 'central@midstate';
SET OPTIMIZATION LOW;
SELECT * FROM customer;
CLOSE DATABASE;
CONNECT TO 'western@rockies';
SET OPTIMIZATION HIGH;
SELECT * FROM customer;
CLOSE DATABASE;
CONNECT TO 'wyoming@rockies';
SELECT * FROM customer;
```

The **wyoming** database is to have HIGH optimization because it resides on the same database server as the **western** database. The code does not need to re-specify the optimization level for the **wyoming** database because the **wyoming** database resides on the **rockies** database server like the **western** database.

The following example directs the Dynamic Server optimizer to use the most time to determine a query plan, and to then return the first rows of the result as soon as possible:

```
SET OPTIMIZATION LOW;
SET OPTIMIZATION FIRST_ROWS;
SELECT lname, fname, bonus
FROM sales_emp, sales
WHERE sales.empid = sales_emp.empid AND bonus > 5,000
ORDER BY bonus DESC
```

Related Information

Related statements: SET EXPLAIN, SET ENVIRONMENT, and UPDATE STATISTICS

For information on other methods by which you can alter the query plan of the Dynamic Server optimizer, see “Optimizer Directives” on page 5-34.

For more information on how to optimize queries, see your *IBM Informix Performance Guide*.

SET PDQPRIORITY

The SET PDQPRIORITY statement allows an application to set the query priority level dynamically within a routine.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
▶▶──SET PDQPRIORITY──┬─DEFAULT──────────────────────────┬──────────────────────────▶◀
                     ├─LOW──────────────────────────────┤
                     │  (1)                             │
                     ├────────OFF───────────────────────┤
                     ├─HIGH─────────────────────────────┤
                     ├─resources────────────────────────┤
                     │  (2)                             │
                     └────────┬─LOW──low──HIGH──high─┬──┘
                              ├─MUTABLE──────────────┤
                              └─IMMUTABLE────────────┘
```

Notes:

1 Dynamic Server only

2 Extended Parallel Server only

Element	Description	Restrictions	Syntax
high	Integer value that specifies the desired resource allocation	Must be in the range 1 to 100, and not less than the *low* value	Literal Number, p. 4-137
low	Integer that specifies the minimum resource allocation	Must be in the range 1 to 100, and not greater than the *high* value	Literal Number, p. 4-137
resources	Integer that specifies the query priority level and the percent of resources to process the query	Can range from -1 to 100. See also "Allocating Database Server Resources" on page 2-587.	Literal Number, p. 4-137

Usage

The SET PDQPRIORITY statement overrides the **PDQPRIORITY** environment variable (but has lower precedence than the MAX_PDQPRIORITY configuration parameter). The scope of SET PDQPRIORITY is local to the routine, and does not affect other routines within the same session.

The SET PDQPRIORITY statement is not supported in SPL routines.

In Dynamic Server, set PDQ priority to a value less than the quotient of 100 divided by the maximum number of prepared statements. For example, if two prepared statements are active, you should set the PDQ priority to less than 50.

In Extended Parallel Server, you can use SET PDQPRIORITY to set PDQ priority at runtime to a value greater than 0 when you need more memory for operations such as sorts, forming groups, and index builds. For guidelines on which values to use, see your *IBM Informix Performance Guide*.

For example, assume that the DBA sets the MAX_PDQPRIORITY parameter to 50. Then a user enters the following SET PDQPRIORITY statement to set the query priority level to 80 percent of resources:

```
SET PDQPRIORITY 80
```

When it processes the query, the database server uses the MAX_PDQPRIORITY value to factor the query priority level set by the user. The database server silently processes the query with a priority level of `40`. This priority level represents 50 percent of the 80 percent of resources that the user specifies.

The following keywords are supported by the SET PDQPRIORITY statement.

Keyword	Effect
DEFAULT	Uses the setting of the **PDQPRIORITY** environment variable
LOW	Data values are fetched from fragmented tables in parallel. (In Dynamic Server, when you specify LOW, the database server uses no other forms of parallelism.)
OFF	PDQ is turned off (Dynamic Server only). The database server uses no parallelism. OFF is the default if you use neither the **PDQPRIORITY** environment variable nor the SET PDQPRIORITY statement.
HIGH	The database server determines an appropriate **PDQPRIORITY** value, based on factors that include the number of available processors, the fragmentation of the tables being queried, the complexity of the query, and others. IBM reserves the right to change the performance behavior of queries when HIGH is specified in future releases.
MUTABLE	**PDQPRIORITY** can be changed in a user session by the user.
IMMUTABLE	**PDQPRIORITY** cannot be changed in a user session.

The DBA typically specifies the MUTABLE or IMMUTABLE setting, which only Extended Parallel Server supports, in a **sysdbopen( )** procedure.

Only Extended Parallel Server supports the HIGH and LOW keywords in the same statement, each followed by a value, to specify a range of resource levels. For more information, see “Using a Range of Values” on page 2-588.

Allocating Database Server Resources

You can specify an integer in the range from `-1` to `100` to indicate a query priority level as the percent of database server resources to process the query. Resources include the amount of memory and the number of processors. The higher the number you specify, the more resources the database server uses.

Use of more resources usually indicates better performance for a given query. Using excessive resources, however, can cause contention for resources and remove resources from other queries, so that degraded performance results. With the *resources* option, the following values are numeric equivalents of the keywords that indicate query priority level.

Value	Equivalent Keyword-Priority Level
`-1`	DEFAULT
`0`	OFF (Dynamic Server only)
`1`	LOW

For Dynamic Server, the following statements are equivalent. The first statement uses the keyword LOW to establish a low query-priority level. The second uses a value of 1 in the *resources* parameter to establish a low query-priority level.

```
SET PDQPRIORITY LOW;

SET PDQPRIORITY 1;
```

Using a Range of Values

In Extended Parallel Server, when you specify a range of values in SET PDQPRIORITY, you allow the Resource Grant Manager (RGM) some discretion in allocating resources.

The *high* value in the range is the desired resource allocation, while the *low* value is the minimum acceptable resource allocation for the query. If the *low* value exceeds the available system resources, the RGM blocks the query. Otherwise, the RGM chooses the largest PDQ priority in the specified range that does not exceed available resources.

Related Information

For information about configuration parameters and about the Resource Grant Manager, see your *IBM Informix Administrator's Guide* and your *IBM Informix Performance Guide*.

For information about the **PDQPRIORITY** environment variable, see the *IBM Informix Guide to SQL: Reference*.

SET PLOAD FILE

Use the SET PLOAD FILE statement to prepare a log file for a session of loading or unloading data from or to an external table. The log file records summary statistics about each load or unload job. The log file also lists any reject files created during a load job. Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──SET PLOAD FILE TO──filename──┬─────────────┬──────────────────────────────►◄
                                 └─WITH APPEND─┘
```

Element	Description	Restrictions	Syntax
filename	Name of the log file. If you specify no *filename*, then log information is written to **/dev/null**.	If the file cannot be opened for writing, an error results	Platform-dependent

Usage

The WITH APPEND option allows you to append new log information to the existing log file.

Each time a session closes, the log file for that session also closes. If you issue more than one SET PLOAD FILE statement within a session, each new statement closes a previously opened log file and opens a new log file.

If you invoke a SET PLOAD FILE statement with a simple filename on a local database, the output file is located in your current directory. If your current database is on a remote database server, then the output file is located in your home directory on the remote database server, on the coserver where the initial connection was made. If you provide a full pathname for the file, it is placed in the directory and file specified on the remote server.

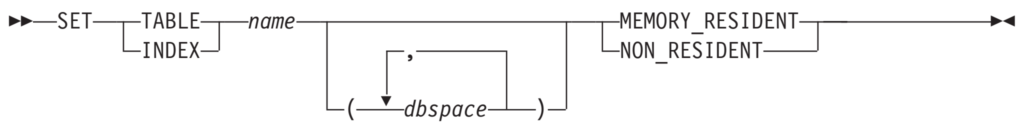
Related Information

Related statement: CREATE EXTERNAL TABLE (XPS)

SET Residency

Use the SET Residency statement to specify that one or more fragments of a table or index be resident in shared memory as long as possible. Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax



Element	Description	Restrictions	Syntax
dbspace	The dbspace where fragment resides	The dbspace must exist	Identifier, p. 5-22
name	Table or index for which the residency state will be changed	Table or index must exist	Database Object Name, p. 5-17

Usage

This statement was formerly supported by Dynamic Server, but it is ignored in current releases. Beginning with Version 9.40, Dynamic Server determines the residency status of indexes and tables automatically.

The SET Residency statement allows you to specify the tables, indexes, and data fragments that you want to remain in the buffer as long as possible. When a free buffer is requested, pages that are declared with the MEMORY_RESIDENT keyword are considered last for page replacement.

The default state is nonresident. The residency state is persistent while the database server is up. That is, each time the database server is started, you must specify the database objects that you want to remain in shared memory.

After a table, index, or data fragment is set to MEMORY_RESIDENT, the residency state remains in effect until one of the following events occurs:

- You use SET Residency to set the database object to NON_RESIDENT.
- The database object is dropped.
- The database server is taken offline.

Only user **informix** can set or change the residency state of a database object.

Residency and the Changing Status of Fragments

If new fragments are added to a resident table, the fragments are not marked automatically as resident. You must issue the SET Residency statement for each new fragment or reissue the statement for the entire table.

Similarly, if a resident fragment is detached from a table, the residency state of the fragment remains unchanged. If you want the residency state to change to nonresident, you must issue the SET Residency statement to declare the specific fragment (or the entire table) as nonresident.

Examples

The next example shows how to set the residency status of an entire table:

```
SET TABLE tab1 MEMORY_RESIDENT
```

For fragmented tables or indexes, you can specify residency for individual fragments as the following example shows:

```
SET INDEX index1 (dbspace1, dbspace2) MEMORY_RESIDENT;
SET TABLE tab1 (dbspace1) NON_RESIDENT
```

This example specifies that the **tab1** fragment in **dbspace1** is not to remain in shared memory while the **index1** fragments in **dbspace1** and **dbspace2** are to remain in shared memory as long as possible.

Related Information

Related statement: ALTER FRAGMENT

For information on how to monitor the residency status of tables, indexes, and fragments, refer to your *IBM Informix Administrator's Guide*.

SET ROLE

Use the SET ROLE statement to enable the privileges of a role. This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►─SET ROLE──┬─┬─role───┬─┬──────────────────────────────────────────►◄
             │ └─'role'─┘ │
             └─NULL───────┘
              ├─NONE────┤
              └─DEFAULT─┘
```

Element	Description	Restrictions	Syntax
role	Name of a role to be enabled	Must already exist in the database. If enclosed between quotation marks, *role* is case sensitive.	Owner Name, p. 5-43;

Usage

Any user who is granted a role can enable the role by using the SET ROLE statement. You can only enable one role at a time. If you execute the SET ROLE statement after a role is already set, the new role replaces the old role.

All users are assigned their DEFAULT role as granted by the DBA using GRANT DEFAULT ROLE statement for the database instance. If no default role exists for the user in the current database, role NULL or NONE is assigned by default. In this context, NULL and NONE are synonyms. Roles NULL and NONE can have no privileges. To set your role to NULL or NONE disables your current role.

When you use SET ROLE to enable a role, you gain the privileges of the role, in addition to the privileges of PUBLIC and your own privileges. If a role is granted to another role that has been assigned to you, you gain the privileges of both roles, in addition to any privileges of PUBLIC and your own privileges.

After SET ROLE executes successfully, the specified role remains effective until the current database is closed or the user executes another SET ROLE statement. Only the user, however, not the role, retains ownership of any database objects, such as tables, that were created during the session.

A role is in scope only within the current database. You cannot use privileges that you acquire from a role to access data in another database. For example, if you have privileges from a role in the database named **acctg**, and you execute a distributed query over the databases named **acctg** and **inventory**, your query cannot access the data in the **inventory** database unless you were also granted appropriate privileges in the **inventory** database.

If your database supports explicit transactions, you must issue the SET ROLE statement outside a transaction. If your database is ANSI-compliant, SET ROLE must be the first statement of a new transaction. If the SET ROLE statement is executed while a transaction is active, an error occurs. For more information about SQL statements that initiate an implicit transaction, see "SET SESSION AUTHORIZATION and Transactions" on page 2-596.

If the SET ROLE statement is executed as a part of a trigger or SPL routine, and the owner of the trigger or SPL routine was granted the role with the WITH GRANT OPTION, the role is enabled even if you are not granted the role. For example, this code fragment sets a role and then relinquishes it after a query:

```
EXEC SQL set role engineer;
EXEC SQL select fname, lname, project
      INTO :efname, :elname, :eproject FROM projects
      WHERE project_num > 100 AND lname = 'Larkin';
printf ("%s is working on %s\n", efname, eproject);
EXEC SQL set role NULL;
```

Setting the Default Role

The DBA or the owner of the database can issue the GRANT DEFAULT ROLE statement to assign an existing role as the *default role* to a specified list of users or to PUBLIC. Unlike a non-default role, the default role takes effect automatically when the user connects to the database, and does not require the SET ROLE statement to enable it. Each of the three statements in next example respectively performs one of the following operations on a role:

- Declares a role called **Engineer**
- Assigns Select privileges on a the **locomotives** table to the **Engineer** role
- Defines **Engineer** as the default role for the user **jgould**.

```
EXEC SQL CREATE ROLE 'Engineer';
EXEC SQL GRANT SELECT ON locomotives TO 'Engineer'.
EXEC SQL GRANT DEFAULT ROLE 'Engineer' TO jgould.
```

If **jgould** subsequently uses the SET ROLE statement to enable some other role, then by executing the following statement, **jgould** replaces that role with **Engineer** as the current role:

```
SET ROLE DEFAULT;
```

If you have no default role, SET ROLE DEFAULT makes NONE your current role, leaving only the privileges that have been granted explicitly to your *username* or to PUBLIC. After GRANT DEFAULT ROLE changes your default role to a new default role, executing SET ROLE DEFAULT restores your most recently granted default role, even if this role was not your default role when you connected to the database.

If one default role is granted to PUBLIC, but a different role is granted as the default role to an individual user, the individually-granted default role takes precedence if that user issues SET ROLE DEFAULT or connects to the database.

Related Information

Related statements: CREATE ROLE, DROP ROLE, GRANT, and REVOKE

For a discussion of how to use roles, see the *IBM Informix Guide to SQL: Tutorial*.

SET SCHEDULE LEVEL

The SET SCHEDULE LEVEL statement specifies the scheduling level of a query when queries are waiting to be processed. Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──SET SCHEDULE LEVEL──level──────────────────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
level	Integer value that specifies the scheduling priority of a query	Must be between 1 and 100. If the value falls outside the range of 1 and 100, the database server uses the default value of 50.	Literal Number, p. 4-137

Usage

The highest priority level is 100. That is, a query at level 100 is more important than a query at level 1. In general, the Resource Grant Manager (RGM) processes a query with a higher scheduling level before a query with a lower scheduling level. The exact behavior of the RGM is also influenced by the setting of the DS_ADM_POLICY configuration parameter.

Related Information

Related statement: SET PDQPRIORITY

For information about the Resource Grant Manager, see your *IBM Informix Administrator's Guide*.

For information about the DS_ADM_POLICY configuration parameter, see your *IBM Informix Administrator's Reference*.

SET SESSION AUTHORIZATION

The SET SESSION AUTHORIZATION statement lets you change the user name under which database operations are performed in the current session. Only Dynamic Server supports this statement.

Syntax

```
►►──SET SESSION AUTHORIZATION TO──'user'──────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
user	User name by which database operations will be performed in the current session	Must be a valid user name. Delimiters (′) are optional	Owner Name, p. 5-43

Usage

This statement allows a user with the DBA privilege to bypass the privileges that protect database objects. You can use this statement to gain access to a table and adopt the identity of a table owner to grant access privileges. You must obtain the DBA privilege before you start a session in which you use this statement. Otherwise, this statement returns an error.

The new identity remains in effect in the current database until you execute SET SESSION AUTHORIZATION again, or until you close the current database. When you use this statement, the specified *user* must have the Connect privilege on the current database. In addition the DBA cannot set the new authorization identifier to PUBLIC, nor to any existing role in the current database.

Setting a session to another user causes a change in a user name in the current active database server. The specified *user*, as far as this database server process is concerned, is completely dispossessed of any privileges while accessing the database server through some administrative utility. Additionally, the new session *user* is not able to initiate any administrative operation (execute a utility, for example) by virtue of the acquired identity.

After the SET SESSION AUTHORIZATION statement successfully executes, any role enabled by a previous user is relinquished. You must use the SET ROLE statement if you wish to assume a role that has been granted to the specified *user*. The database server does not enable the default role of *user* automatically.

After SET SESSION AUTHORIZATION successfully executes, the database server puts any owner-privileged UDRs that the DBA created while using the new authorization identifier in RESTRICTED mode, which can affect access privileges during operations of the UDR on objects in remote databases. For more information on RESTRICTED mode, see the **sysprocedures** system catalog table in the *IBM Informix Guide to SQL: Reference*.

When you assume the identity of another user by executing the SET SESSION AUTHORIZATION statement, you can perform operations in the current database only. You cannot perform an operation on a database object outside the current database, such as a remote table. In addition, you cannot execute a DROP DATABASE or RENAME DATABASE statement, even if the database is owned by the real or effective user.

You can use this statement either to obtain access to the data directly or to grant the database-level or table-level privileges needed for the database operation to proceed. The following example shows how to use the SET SESSION AUTHORIZATION statement to obtain table-level privileges:

```
SET SESSION AUTHORIZATION TO 'cathl';
GRANT ALL ON customer TO mary;
SET SESSION AUTHORIZATION TO 'mary';
UPDATE customer SET fname = 'Carl' WHERE lname = 'Pauli';
```

If you enclose *user* in quotation marks, the name is case sensitive and is stored exactly as you typed it. In an ANSI-compliant database, if you do not use quotation marks as delimiters, the name is stored in uppercase letters.

SET SESSION AUTHORIZATION and Transactions

If your database is not ANSI compliant, you must issue the SET SESSION AUTHORIZATION statement outside a transaction. If you issue the statement within a transaction, you receive an error message.

In an ANSI-compliant database, you can execute the SET SESSION AUTHORIZATION statement only if you have not executed a statement that initiates an implicit transaction (for example, CREATE TABLE or SELECT). Statements that do not initiate an implicit transaction are statements that do not acquire locks or log data (for example, SET EXPLAIN and SET ISOLATION). You can execute the SET SESSION AUTHORIZATION statement immediately after a DATABASE statement or a COMMIT WORK statement.

Related Information

Related statements: CONNECT, DATABASE, GRANT, and SET ROLE

SET STATEMENT CACHE

Use the SET STATEMENT CACHE statement to turn caching on or off for the current session. Only Dynamic Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──SET STATEMENT CACHE──┬─ON──┬─────────────────────────────────────────►◄
                         └─OFF─┘
```

Usage

You can use the SET STATEMENT CACHE statement to turn caching in the SQL statement cache ON or OFF for the current session. The statement cache stores in a buffer identical statements that are repeatedly executed in a session. Only data manipulation language (DML) statements (DELETE, INSERT, UPDATE, or SELECT) can be stored in the statement cache.

This mechanism allows qualifying statements to bypass the optimization stage and parsing stage, and avoid recompiling, which can reduce memory consumption and can improve query processing time.

Precedence and Default Behavior

SET STATEMENT CACHE takes precedence over the **STMT_CACHE** environment variable and the STMT_CACHE configuration parameter. You must enable the SQL statement cache, however, either by setting the STMT_CACHE configuration parameter or by using the **onmode** utility, before the SET STATEMENT CACHE statement can execute successfully.

When you issue a SET STATEMENT CACHE ON statement, the SQL statement cache remains in effect until you issue a SET STATEMENT CACHE OFF statement or until the program ends. If you do not use SET STATEMENT CACHE, the default behavior depends on the setting of the **STMT_CACHE** environment variable or the STMT_CACHE configuration parameter.

Turning the Cache ON

Use the ON option to enable the SQL statement cache. When the SQL statement cache is enabled, each statement that you execute passes through the SQL statement cache to determine if a matching cache entry is present. If so, the database server uses the cached entry to execute the statement.

If the statement has no matching entry, the database server tests to see if it qualifies for entry into the cache. For the conditions a statement must meet to enter into the cache, see "Statement Qualification" on page 2-598.

Restrictions on Matching Entries in the SQL Statement Cache: When the database server considers whether or not a statement is identical to a statement in the SQL statement cache, the following items must match:

- Lettercase
- Comments
- White space
- Optimization settings
  - SET OPTIMIZATION statement options

  - Optimizer directives
  - The SET ENVIRONMENT OPTCOMPIND statement options or settings of the **OPTCOMPIND** environment variable, or of the OPTCOMPIND configuration parameter in the ONCONFIG file. (If conflicting settings exist for the same query, this is the descending order of precedence.)
- Parallelism settings
  - SET PDQPRIORITY statement options or settings of the **PDQPRIORITY** environment variable
- Query text strings
- Literals

If an SQL statement is semantically equivalent to a statement in the SQL statement cache but has different literals, the statement is not considered identical and qualifies for entry into the cache. For example, the following SELECT statements are not identical:

```
SELECT col1, col2 FROM tab1 WHERE col1=3;

SELECT col1, col2 FROM tab1 WHERE col1=5;
```

In this example, both statements are entered into the SQL statement cache.

Host-variable names, however, are insignificant. For example, the following select statements are considered identical:

```
SELECT * FROM tab1 WHERE x = :x AND y = :y;

SELECT * FROM tab1 WHERE x = :p AND y = :q;
```

In the previous example, although the host names are different, the statements qualify, because the case, query text strings, and white space match. Performance does not improve, however, because each statement has already been parsed and optimized by the PREPARE statement.

Turning the Cache OFF

The OFF option disables the SQL statement cache. When you turn caching OFF for your session, no SQL statement cache code is executed for that session.

The SQL statement cache is designed to save memory in environments where identical queries are executed repeatedly and schema changes are infrequent. If this is not the case, you might want to turn the SQL statement cache off to avoid the overhead of caching. For example, if you have little cache cohesion, that is, when relatively few matches but many new entries into the cache exist, the cache management overhead is high. In this case, turn the SQL statement cache off.

If you know that you are executing many statements that do not qualify for the SQL statement cache, you might want to disable it and avoid the overhead of testing to see if each DML statement qualifies for insertion into the cache.

Statement Qualification

A statement that can be cached in the SQL statement cache (and consequently, one that can match a statement that already appears in the SQL statement cache) must meet all of the following conditions:

- It must be a SELECT, INSERT, UPDATE, or DELETE statement.
- It must contain only non-opaque built-in data types (excluding BLOB, BOOLEAN, BYTE, CLOB, LVARCHAR, and TEXT).

- It must contain only built-in operators.
- It cannot contain user-defined routines.
- It cannot contain temporary or remote tables.
- It cannot contain subqueries in the Projection list.
- It cannot be part of a multistatement PREPARE.
- It cannot have user-privilege restrictions on target columns.
- In an ANSI-compliant database, it must contain fully qualified object names.
- It cannot require re-optimization.

3 Requiring Re-Execution Before Cache Insertion

A qualified SQL statement is fully inserted into the SQL statement cache only after
the database server counts a configurable number of references (which are
3 sometimes called ″hits″) to that statement. For the default value of zero, a qualified
3 DML statement does not need to be re-executed before it is cached.

Using the STMT_CACHE_HITS configuration parameter, however, the database
3 administrator (DBA) can specify that qualified DML statements must be executed a
minimum number of times before they are inserted into the statement cache. By
3 setting this to a value of one (or to a larger value), the DBA excludes one-time-only
ad hoc queries from full insertion into the SQL statement cache, thereby lowering
cache-management overhead.

Enabling or Disabling Insertions After Size Exceeds Configured Limit

The DBA can prevent the insertion of additional qualified SQL statements into the statement cache when the cache size reaches its configured size (as specified by the STMT_CACHE_SIZE configuration parameter) by setting the configuration parameter STMT_CACHE_NOLIMIT to zero.

3 Prepared Statements and the Statement Cache

3 Prepared statements are inherently cached for a single session. That is, if a
3 prepared statement is executed many times (or if a single cursor is opened many
3 times), the same prepared query plan is used by that session. If a session prepares
3 a statement and then executes it many times, its performance is essentially
3 unaffected by using the SQL statement cache, because the statement is optimized
3 just once, during the PREPARE statement.

3 If other sessions also prepare that same statement, however, or if the first session
3 prepares the statement several times, then the statement cache usually provides a
3 direct performance benefit, because the database server only calculates the query
3 plan once. Of course, the original session might gain a (small) benefit from the
3 statement cache, even if it prepares the statement only once, because other sessions
3 use less memory, and the database server does less work for the other sessions.

Related Information

For information on optimization settings, see “SAVE EXTERNAL DIRECTIVES” on page 2-476, “SET OPTIMIZATION” on page 2-584, and “Optimizer Directives” on page 5-34.

For information about the **STMT_CACHE** environment variable, see the *IBM Informix Guide to SQL: Reference*.

For more information about STMT_CACHE, STMT_CACHE_NUMPOOL, STMT_CACHE_HITS, and other configuration parameters that affect the statement cache, as well as cache-related command-line options of the **onmode** utility, see your *IBM Informix Administrator's Reference*.

For more information on the performance implications of this feature, on when and how to use the SQL statement cache, on how to monitor the cache with the **onstat** options, and on how to tune the configuration parameters, see your *IBM Informix Performance Guide*.

SET TABLE

Use the SET TABLE statement to specify that one or more fragments of a table be resident in shared memory as long as possible. Only Extended Parallel Server supports this statement, which is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──SET TABLE──table──┬──────────────────────┬──┬─MEMORY_RESIDENT─┬──────────────►◄
                      │      ┌─,────────┐    │  └─NON_RESIDENT────┘
                      │      ▼          │    │
                      └─(────dbspace────┴─)──┘
```

Element	Description	Restrictions	Syntax
dbspace	Name of the dbspace in which the fragment resides	Must exist.	Identifier, p. 5-22;
table	Name of the table for which you want to change the residency state	Must exist	Database Object Name, p. 5-17

Usage

This statement was formerly supported by Dynamic Server, but it is ignored in current releases. Beginning with Version 9.40, Dynamic Server determines the residency status of indexes and tables automatically. In Extended Parallel Server, however, you can use this statement to specify the residency status of table fragments.

The SET TABLE statement is a special case of the SET Residency statement. The SET Residency statement can also specify how long an index fragment remains resident in shared memory.

For the complete syntax and semantics of the SET TABLE statement, see “SET Residency” on page 2-590.

SET TRANSACTION

Use the SET TRANSACTION statement to define the isolation level and to specify whether the access mode of a transaction is read-only or read-write.

Syntax

```
                           ┌,──────────────────────────────────────────────────┐
                           │   (1)                                              │
►►──SET TRANSACTION────────▼─┬────────┬─READ WRITE─┬──────────────────────────┬─┴──────►◄
                             │        └─READ ONLY──┘                          │
                             │   (1)                                          │
                             └────────ISOLATION LEVEL──┬─READ COMMITTED───┬───┘
                                                       ├─REPEATABLE READ──┤
                                                       ├─SERIALIZABLE─────┤
                                                       └─READ UNCOMMITTED─┘
```

Notes:

1 Use path no more than once

Usage

SET TRANSACTION is valid only in databases with transaction logging. You can issue a this statement from a client computer only after a database is opened. The database isolation level affects concurrency among processes that attempt to access the same rows simultaneously from the database. The database server uses shared locks to support different levels of isolation among processes that are attempting to read data, as the following list shows:

- Read Uncommitted
- Read Committed
- (ANSI) Repeatable Read
- Serializable

The update or delete process always acquires an exclusive lock on the row that is being modified. The level of isolation does not interfere with such rows, but the access mode does affect whether you can update or delete rows.

If another process attempts to update or delete rows that you are reading with an isolation level of Serializable or (ANSI) Repeatable Read, that process will be denied access to those rows.

Comparing SET TRANSACTION with SET ISOLATION

The SET TRANSACTION statement complies with ANSI SQL-92. This statement is similar to the Informix SET ISOLATION statement; however, the SET ISOLATION statement is not ANSI compliant and does not provide access modes. In fact, the isolation levels that you can set with the SET TRANSACTION statement are almost parallel to the isolation levels that you can set with the SET ISOLATION statement, as the following table shows.

SET TRANSACTION Isolation Level	SET ISOLATION Isolation Level
Read Uncommitted	Dirty Read
Read Committed	Committed Read
[*Not supported*]	Cursor Stability
(ANSI) Repeatable Read	(Informix) Repeatable Read
Serializable	(Informix) Repeatable Read

Another difference between SET TRANSACTION and SET ISOLATION is the behavior of the isolation levels within transactions. You can issue SET TRANSACTION only once for a transaction. Any cursors that are opened during that transaction are guaranteed that isolation level (or access mode, if you are defining an access mode). With SET ISOLATION, after a transaction is started, you can change the isolation level more than once within the transaction.

The following examples illustrate this difference in the behavior of the SET ISOLATION and SET TRANSACTION statements:

```
EXEC SQL BEGIN WORK;
EXEC SQL SET ISOLATION TO DIRTY READ;
EXEC SQL SELECT ... ;
EXEC SQL SET ISOLATION TO REPEATABLE READ;
EXEC SQL INSERT ... ;
EXEC SQL COMMIT WORK;    -- Executes without error
```

Compare the previous example to these SET TRANSACTION statements:

```
EXEC SQL BEGIN WORK;
EXEC SQL SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
EXEC SQL SELECT ... ;
EXEC SQL SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
   -- Produces error 876: Cannot issue SET TRANSACTION
   -- in an active transaction.
```

A additional difference between SET ISOLATION and SET TRANSACTION is the duration of isolation levels. Because SET ISOLATION supports complete-connection level settings, the isolation level specified by SET ISOLATION remains in effect until another SET ISOLATION statement is issued. The isolation level set by SET TRANSACTION only remains in effect until the transaction terminates. Then the isolation level is reset to the default for the database type.

Informix Isolation Levels

The following definitions explain the critical characteristics of each isolation level, from the lowest level of isolation to the highest.

Using the Read Uncommitted Option: Use the Read Uncommitted option to copy rows from the database whether or not locks are present on them. The program that fetches a row places no locks and it respects none. Read Uncommitted is the only isolation level available to databases that do not have transactions.

This isolation level is most appropriate in queries of static tables whose data is not being modified, because it provides no isolation. With Read Uncommitted, the program might return an uncommitted row that was inserted or modified within a transaction that was subsequently rolled back.

Using the Read Committed Option: Use the Read Committed option to guarantee that every retrieved row is committed in the table at the time that the row is retrieved. This option does not place a lock on the fetched row. Read Committed is the default level of isolation in a database with logging that is not ANSI compliant.

Read Committed is appropriate when each row of data is processed as an independent unit, without reference to other rows in the same or other tables.

Using the Repeatable Read and Serializable Options: The Informix implementation of Repeatable Read and of Serializable are equivalent. The Serializable (or Repeatable Read) option places a shared lock on every row that is selected during the transaction.

Another process can also place a shared lock on a selected row, but no other process can modify any selected row during your transaction or insert a row that meets the search criteria of your query during your transaction.

A *phantom row* is a row that was not visible when you first read the query set, but that materializes in a subsequent read of the query set in the same transaction. Only this isolation level prevents access to a phantom row.

If you repeat the query during the transaction, you reread the same data. The shared locks are released only when the transaction is committed or rolled back. Serializable is the default isolation level in an ANSI-compliant database. Serializable isolation places the largest number of locks and holds them the longest. Therefore, it is the level that reduces concurrency the most.

Default Isolation Levels

The default isolation level is established when you create the database.

Informix Name	ANSI Name	When This Is the Default Level of Isolation
Dirty Read	Read Uncommitted	Database without transaction logging
Committed Read	Read Committed	Databases with logging that are not ANSI-compliant
Repeatable Read	Serializable	ANSI-compliant databases

The default isolation level remains in effect until you issue a SET TRANSACTION statement within a transaction. After a COMMIT WORK statement completes the transaction or a ROLLBACK WORK statement cancels the transaction, the isolation level is reset to the default.

Access Modes

Access modes affect read and write concurrency for rows within transactions. Use access modes to control data modification. SET TRANSACTION can specify that a transaction is read-only or read-write. By default, transactions are read-write. When you specify a read-only transaction, certain limitations apply. Read-only transactions cannot perform the following actions:

- Insert, delete, or update rows of a table.
- Create, alter, or drop any database object such as schemas, tables, temporary tables, indexes, or SPL routines.
- Grant or revoke access privileges.
- Update statistics.
- Rename columns or tables.

You can execute SPL routines in a read-only transaction as long as the SPL routine does not try to perform any restricted statement.

Effects of Isolation Levels

You cannot set the database isolation level in a database that does not have logging. Every retrieval in such a database occurs as a Read Uncommitted.

The data that is obtained during retrieval of BYTE or TEXT data can vary, depending on the database isolation levels. Under Read Uncommitted or Read Committed isolation levels, a process is permitted to read a BYTE or TEXT column that is either deleted (if the delete is not yet committed) or in the process of being deleted. Under these isolation levels, an application can read a deleted BYTE or TEXT column when certain conditions exist. For information about these conditions, see the *IBM Informix Administrator's Guide*.

In ESQL/C, if you use a scroll cursor in a transaction, you can force consistency between your temporary table and the database table either by setting the isolation level to Serializable or by locking the entire table. A scroll cursor with hold, however, cannot guarantee the same consistency between the two tables. Table-level locks set by Serializable are released when the transaction is completed, but the scroll cursor with hold remains open beyond the end of the transaction. You can modify released rows as soon as the transaction ends, so the retrieved data in the temporary table might be inconsistent with the actual data.

Warning: Do not use nonlogging tables within a transaction. If you need to use a nonlogging table within a transaction, either set the isolation level to Repeatable Read or lock the table in exclusive mode to prevent concurrency problems.

Related Information

Related statements: CREATE DATABASE, SET ISOLATION, and SET LOCK MODE

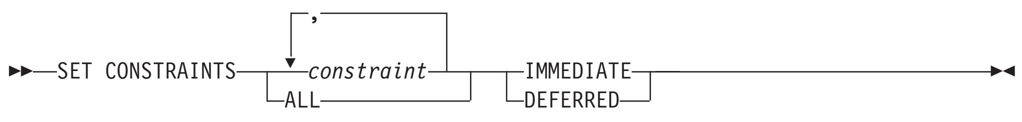
For a discussion of isolation levels and concurrency issues, see the *IBM Informix Guide to SQL: Tutorial*.

SET Transaction Mode

Use the SET Transaction Mode statement to specify whether constraints are checked at the statement level or at the transaction level during the current transaction.

In Dynamic Server, to enable or disable constraints, or to change their filtering mode, see "SET Database Object Mode" on page 2-539.

Syntax



Element	Description	Restrictions	Syntax
constraint	Constraint whose transaction mode is to be changed	All constraints must exist in the same database, which must support logging	Database Object Name, p. 5-17

Usage

This statement is valid only in a database with transaction logging, and its effect is limited to the transaction in which it is executed.

Use the IMMEDIATE keyword to set the transaction mode of constraints to statement-level checking. IMMEDIATE is the default transaction mode of constraints when they are created.

Use the DEFERRED keyword to set the transaction mode to transaction-level checking. You cannot change the transaction mode of a constraint to DEFERRED unless the constraint is currently enabled.

Statement-Level Checking

When you set the transaction mode to IMMEDIATE, statement-level checking is turned on, and all specified constraints are checked at the end of each INSERT, UPDATE, or DELETE statement. If a constraint violation occurs, the statement is not executed.

Transaction-Level Checking

When you set the transaction mode of constraints to DEFERRED, statement-level checking is turned off, and all (or the specified) constraints are not checked until the transaction is committed. If a constraint violation occurs while the transaction is being committed, the transaction is rolled back.

Tip: If you defer checking a primary-key constraint, checking the not-NULL constraint for that column or set of columns is also deferred.

Duration of Transaction Modes

The duration of the transaction mode that the SET Transaction Mode statement specifies is the transaction in which the SET Transaction Mode statement is executed. You cannot execute this statement outside a transaction. Once a

COMMIT WORK or ROLLBACK WORK statement is successfully completed, the transaction mode of all constraints reverts to IMMEDIATE.

To switch from transaction-level checking to statement-level checking, you can use the SET Transaction Mode statement to set the transaction mode to IMMEDIATE, or you can use a COMMIT WORK or ROLLBACK WORK statement to terminate your transaction.

Specifying All Constraints or a List of Constraints

You can specify all constraints in the database in the SET Transaction Mode statement, or you can specify a single constraint, or list of constraints.

If you specify the ALL keyword, the SET Transaction Mode statement sets the transaction mode for all constraints in the database. If any statement in the transaction requires that any constraint on any table in the database be checked, the database server performs the checks at the statement level or the transaction level, depending on the setting that you specify in the SET Transaction Mode statement.

If you specify a single constraint name or a list of constraints, the SET Transaction Mode statement sets the transaction mode for the specified constraints only. If any statement in the transaction requires checking of a constraint that you did not specify in the SET Transaction Mode statement, that constraint is checked at the statement level regardless of the setting that you specified in the SET Transaction Mode statement for other constraints.

When you specify a list of constraints, the constraints do not need to be defined on the same table, but they must exist in the same database.

Specifying Remote Constraints

You can set the transaction mode of local constraints or remote constraints. That is, the constraints that are specified in the SET Transaction Mode statement can be constraints that are defined on local tables or constraints that are defined on remote tables.

Examples of Setting the Transaction Mode for Constraints

The following example shows how to defer checking constraints within a transaction until the transaction is complete. The SET Transaction Mode statement in the example specifies that any constraints on any tables in the database are not checked until the COMMIT WORK statement is encountered.

```
BEGIN WORK
SET CONSTRAINTS ALL DEFERRED
...
COMMIT WORK
```

The following example specifies that a list of constraints is not checked until the transaction is complete:

```
BEGIN WORK
SET CONSTRAINTS update_const, insert_const DEFERRED
...
COMMIT WORK
```

Related Information

Related statements: ALTER TABLE and CREATE TABLE

SET TRIGGERS

Use the SET TRIGGERS statement to enable or disable all or some of the triggers on a table, or all or some of the INSTEAD OF triggers on a view.

Syntax

```
                     ┌─,───────┐
                     ▼         │           ┌─ENABLED──┐
►►──SET TRIGGERS──┬──trigger───┴──────┬──┬─┴──────────┴─┬──────────────────►◄
                  └─FOR──┬─table─┬────┘  └──DISABLED────┘
                         └─view──┘
```

Element	Description	Restrictions	Syntax
table	Table whose triggers are all to be enabled or disabled	Must exist	Database Object Name, p. 5-17
trigger	Trigger to be enabled or disabled	Must exist	Database Object Name, p. 5-17
view	View whose INSTEAD OF triggers are all to be enabled or disabled	Must exist	Database Object Name, p. 5-17

Usage

The SET TRIGGERS statement is a special case of the SET Database Object Mode statement. The SET Database Object Mode statement can also enable or disable an index or a constraint, or change the filtering mode of a unique index or of a constraint.

For the complete syntax and semantics of the SET TRIGGERS statement, see "SET Database Object Mode" on page 2-539.

START VIOLATIONS TABLE

Use the START VIOLATIONS TABLE statement to create a violations table and (for Dynamic Server only) a diagnostics table for a specified target table.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──START VIOLATIONS TABLE FOR──table──────────────────────────────────────►

►──┬──────────────────────────────────────────────────┬────────────────────►
   │                  (1)                             │
   └─USING─┬────────────────violations───────────────┤
           │      (2)                               │
           └────────────violations──,──diagnostics──┘

►──┬──────────────────────────────────────┬────────────────────────────────►◄
   │  (2)                                 │
   ├──────────MAX ROWS──num_rows──────────┤
   │  (1)                                 │
   └──────────MAX VIOLATIONS──num_rows────┘
```

Notes:

1 Extended Parallel Server only

2 Dynamic Server only

Element	Description	Restrictions	Syntax
diagnostics	Declares the name of a diagnostics table to be associated with the target *table*. Default name is **table_dia**.	Must be unique among names of tables, views, sequences, and synonyms	Database Object Name, p. 5-17
num_rows	Maximum number of rows database server (IDS) or any single coserver (XPS) can insert into *violations* when a single statement is executed on *table*	Must be an integer in range from 1 to the maximum value of the INTEGER data type	Literal Number, p. 4-137
table	Target table for which *violations* and (for Dynamic Server only) *diagnostics* are to be created	If USING clause is omitted, no more than 124 bytes	Database Object Name, p. 5-17
violations	Violations table to be associated with *table.* Default name is ***table*_vio**.	Same restrictions as *diagnostics*	Database Object Name, p. 5-17

Usage

The database server associates the *violations* table (and for Dynamic Server only) the *diagnostics* table) with the *target* table that you specify after the FOR keyword by recording the relationship among the three tables in the **sysviolations** system catalog table. In Extended Parallel Server, the START VIOLATIONS TABLE statement creates a violations table, but no diagnostics table is created.

A target table must satisfy these requirements:

- It cannot be external to the database.
- It cannot already be associated with a violations or diagnostics table.
- It cannot be a system catalog table.

The START VIOLATIONS TABLE statement creates the special violations table that holds nonconforming rows that fail to satisfy constraints and unique indexes during insert, update, and delete operations on target tables. This statement also creates the special diagnostics table that contains information about the integrity violations that each row causes in the violations table.

Relationship to SET Database Object Mode Statement

The START VIOLATIONS TABLE statement is closely related to the SET Database Object Mode statement. If you use SET Database Object Mode to set the constraints or unique indexes defined on a table to the FILTERING mode, without also using START VIOLATIONS TABLE, any rows that violate a constraint or unique-index requirement in data manipulation operations are not filtered out to a violations table. Instead you receive an error message that indicates that you must start a violations table for the target table.

Similarly, if you use the SET Database Object Mode statement to set a disabled constraint or disabled unique index to the ENABLED or FILTERING mode, but you do not use START VIOLATIONS TABLE for the table on which the database objects are defined, any rows that do not satisfy the constraint or unique-index requirement are not filtered out to a violations table.

In these cases, to identify the rows that do not satisfy the constraint or unique-index requirement, issue the START VIOLATIONS TABLE statement to start the violations and diagnostics tables. Do this before you use the SET Database Object Mode statement to set the database objects to the ENABLED or FILTERING database object mode.

Extended Parallel Server does not support the SET Database Object Mode feature, and the concept of database object modes does not exist. Once you use the START VIOLATIONS TABLE statement to create a violations table and associate it with a target table, the existence of this violations table causes all violations of constraints and unique-index requirements by insert, delete, and update operations to be recorded in the violations table.

In other words, once you issue a START VIOLATIONS TABLE statement, all constraints and unique indexes in a database on Extended Parallel Server behave like filtering-mode constraints and filtering-mode unique indexes in a database on Dynamic Server. For an explanation of filtering-mode constraints and filtering-mode unique indexes, see “Filtering Mode” on page 2-542.

Effect on Concurrent Transactions

If the database has transaction logging, you must issue START VIOLATIONS TABLE in isolation. That is, no other transaction can be in progress on a target table when you issue START VIOLATIONS TABLE on that table within a transaction. Any transactions that start on the target table after the first transaction has issued the START VIOLATIONS TABLE statement will behave the same way as the first transaction with respect to the violations and diagnostics tables. That is, any constraint and unique-index violations by these subsequent transactions will be recorded in the violations and diagnostics tables.

For example, if transaction A operates on table **tab1** and issues a START VIOLATIONS TABLE statement on table **tab1**, the database server starts a violations table named **tab1_vio** and filters any constraint or unique-index violations on table **tab1** by transaction A to table **tab1_vio**. If transactions B and C start on table **tab1** after transaction A has issued the START VIOLATIONS TABLE statement, the database server also filters any constraint and unique-index violations by transactions B and C to table **tab1_vio**.

The result is that all three transactions do not receive error messages about constraint and unique-index violations, even though transactions B and C do not expect this behavior. For example, if transaction B issues an INSERT or UPDATE statement that violates a check constraint on table **tab1**, the database server does not issue a constraint violation error to transaction B. Instead, the database server filters the nonconforming row (also called a ″bad row″) to the violations table without notifying transaction B that a data-integrity violation occurred.

You can prevent this situation from arising in Dynamic Server by specifying WITH ERRORS when you specify the FILTERING mode in a SET Database Object Mode, CREATE TABLE, ALTER TABLE, or CREATE INDEX statement. When multiple transactions operate on a table and the WITH ERRORS option is in effect, any transaction that violates a constraint or unique-index requirement on a target table receives a data-integrity error message.

In Extended Parallel Server, once a transaction issues a START VIOLATIONS TABLE statement, you have no way to make the database server issue data-integrity violation messages to that transaction or to any other transactions that subsequently start on the same target table.

Stopping the Violations and Diagnostics Tables

After you use START VIOLATIONS TABLE to create an association between a target table and the violations and diagnostics tables, the only way to drop the association between the target table and the violations and diagnostics tables is to issue a STOP VIOLATIONS TABLE statement for the target table. For more information, see “STOP VIOLATIONS TABLE” on page 2-622.

USING Clause

You can use the USING clause to declare explicit names for the violations table and (for Dynamic Server) the diagnostics table.

If you omit the USING clause, the database server assigns names to the violation table and (for Dynamic Server) the diagnostics table. The system-assigned name of the violations table consists of the name of the target table followed by the string `_vio`. The name that Dynamic Server assigns to the diagnostics table consists of the name of the target table followed by the string `_dia`.

If you omit the USING clause, the maximum length of the name of the target table is 124 bytes.

Using the MAX ROWS Clause (IDS)

The MAX ROWS clause specifies the maximum number of rows that the database server can insert into the diagnostics table when a single statement is executed on the target table. If you omit the MAX ROWS clause, no upper limit is imposed on the number of rows that can be inserted into the diagnostics table when a single statement is executed on the target table.

Using the MAX VIOLATIONS Clause (XPS)

Use the MAX VIOLATIONS clause to specify the maximum number of rows that any single coserver can insert into the violations table when a single statement is executed on the target table. Each coserver where the violations table resides has this limit. The first coserver to reach this limit raises an error and causes the statement to fail. If you omit the MAX VIOLATIONS clause, no upper limit exists on the number of rows that can be inserted into the violations table when a single statement is executed on the target table.

Specifying the Maximum Number of Rows in the Diagnostics Table (IDS)

The following statement starts violations and diagnostics tables for the target table named **orders**. The MAX ROWS clause specifies the maximum number of rows that can be inserted into the diagnostics table when a single statement, such as an INSERT statement, is executed on the target table.

```
START VIOLATIONS TABLE FOR orders MAX ROWS 50000
```

Specifying the Maximum Number of Rows in the Violations Table (XPS)

The following statement starts a violations table for the target table named **orders**. The MAX VIOLATIONS clause specifies the maximum number of rows that any single coserver can insert into the violations table when a single statement, such as an INSERT statement, is executed on the target table.

```
START VIOLATIONS TABLE FOR orders MAX VIOLATIONS 50000
```

Privileges Required for Starting Violations Tables

To start a violations and (for Dynamic Server) a diagnostics table for a target table, you must meet one of the following requirements:

- You must have the DBA privilege on the database.
- You must be the owner of the target table and have the Resource privilege on the database.
- You must have the Alter privilege on the target table and the Resource privilege on the database.

Structure of the Violations Table

When you issue START VIOLATIONS TABLE for a target table, the violations table that the statement creates has a predefined structure. This structure consists of the columns of the target table and three additional columns.

The following table shows the schema of the violations table.

Column Name	Data Type	Column Description	
Same columns (in the same order) that appear in the target table	Same types as corresponding columns in the target table.	The violations table has the same schema as the target table, so that rows violating constraints or a unique-index during insert, update, and delete operations can be filtered to the violations table.	
informix_tupleid	SERIAL	Unique serial code for the nonconforming row	
informix_optype	CHAR(1)	The type of operation that caused this bad row. This column can have the following values:	
		I =	Insert
		D =	Delete
		O =	Update (with original values in this row)
		N =	Update (with new values in this row)
		S =	SET Database Object Mode (IDS only)
informix_recowner	CHAR(32)	User who issued the statement that created this nonconforming row	

Serial columns in the target table are converted to integer data types in the violations table.

Users can examine these nonconforming rows in the violations table, analyze the related rows that contain diagnostic information in the diagnostics table, and take corrective actions.

Examples of START VIOLATIONS TABLE Statements

The following examples show different ways to execute the START VIOLATIONS TABLE statement.

Violations and Diagnostics Tables with Default Names: The following statement starts violations and diagnostics tables for the target table named **cust_subset**. The violations table is named **cust_subset_vio** by default, and the diagnostics table is named **cust_subset_dia** by default.

```
START VIOLATIONS TABLE FOR cust_subset
```

Violations and Diagnostics Tables with Explicit Names: The following statement starts a violations and diagnostics table for the target table named **items**. The USING clause assigns explicit names to the violations and diagnostics tables. The violations table is to be named **exceptions**, and the diagnostics table is to be named **reasons**.

```
START VIOLATIONS TABLE FOR items USING exceptions, reasons
```

Relationships Among the Target, Violations, and Diagnostics Tables

Users can take advantage of the relationships among the target, violations, and diagnostics tables to obtain diagnostic information about rows that cause data-integrity violations during INSERT, DELETE, and UPDATE statements. Each row of the violations table has at least one corresponding row in the diagnostics table.

- One row in the violations table is a copy of any row in the target table for which a data-integrity violation was detected. A row in the diagnostics table contains information about the nature of the data-integrity violation caused by the nonconforming row in the violations table.
- One row in the violations table has a unique serial identifier in the **informix_tupleid** column. A row in the diagnostics table has the same serial identifier in its **informix_tupleid** column.

A given row in the violations table can have more than one corresponding row in the diagnostics table. The multiple rows in the diagnostics table all have the same serial identifier in their **informix_tupleid** column so that they are all linked to the same row in the violations table. Multiple rows can exist in the diagnostics table for the same row in the violations table because a nonconforming row in the violations table can cause more than one data-integrity violation.

For example, the same nonconforming row can violate a unique index for one column, a not-NULL constraint for another column, and a check constraint for a third column. In this case, the diagnostics table contains three rows for the single nonconforming row in the violations table. Each of these diagnostic rows identifies a different data-integrity violation that the nonconforming row in the violations table caused.

By joining the violations and diagnostics tables, the DBA or target-table owner can obtain diagnostic information about any or all nonconforming rows in the violations table. SELECT statements can perform these joins interactively, or you can write a program to perform them within transactions.

Initial Privileges on the Violations Table

When you issue the START VIOLATIONS TABLE statement to create the violations table, the database server uses the set of privileges granted on the target table as a basis for granting privileges on the violations table. The database server follows different rules, however, when it grants each type of privilege.

The following table summarizes the circumstances under which the database server grants each type of privilege on the violations table.

Privilege	**Condition for Granting the Privilege**
Alter	Alter privilege is not granted on the violations table. (Users cannot alter violations tables.)
Index	User has Index privilege on the violations table if the user has the Index privilege on the target table. The user cannot create a globally detached index on the violations table even if the user has the Index privilege on the violations table (XPS only).
Insert	User has the Insert privilege on the violations table if the user has the Insert, Delete, or Update privilege on any column of the target table.
Delete	User has the Delete privilege on the violations table if the user has the Insert, Delete, or Update privilege on any column of the target table.
Select	User has the Select privilege on the **informix_tupleid**, **informix_optype**, and **informix_recowner** columns of the violations table if the user has the Select privilege on any column of the target table. User has the Select privilege on any other column of the violations table if the user has the Select privilege on the same column in the target table.
Update	User has the Update privilege on the **informix_tupleid**, **informix_optype**, and **informix_recowner** columns of the violations table if the user has the Update privilege on any column of the target table. (Even with the Update privilege on the **informix_tupleid** column, however, the user cannot update this SERIAL column.) User has the Update privilege on any other violations table column if the user has the Update privilege on the same column in the target table.
References	The References privilege is not granted on the violations table. (Users cannot add referential constraints to violations tables.)

The following rules apply to ownership of the violations table and privileges on the violations table:

- When the violations table is created, the owner of the target table becomes the owner of the violations table.
- The owner of the violations table automatically receives all table-level privileges on the violations table, including the Alter and References privileges. The

database server, however, prevents the owner of the violations table from altering the violations table or adding a referential constraint to the violations table.

- You can use the GRANT and REVOKE statements to modify the initial set of privileges on the violations table.
- When you issue an INSERT, DELETE, or UPDATE statement on a target table that has a filtering-mode unique index or constraint defined on it, you must have the Insert privilege on the violations and diagnostics tables.

  If you do not have the Insert privilege on the violations and diagnostics tables, the database server executes the INSERT, DELETE, or UPDATE statement on the target table provided that you have the necessary privileges on the target table. The database server does not return an error concerning the lack of Insert privilege on the violations and diagnostics tables unless an integrity violation is detected during execution of the INSERT, DELETE, or UPDATE statement.

  Similarly, when you issue a SET Database Object Mode statement to set a disabled constraint or disabled unique index to the enabled or filtering mode, and a violations table and diagnostics table exist for the target table, you must have the Insert privilege on the violations and diagnostics tables.

  If you do not have the Insert privilege on the violations and diagnostics tables, the database server executes the SET Database Object Mode statement if you have the necessary privileges on the target table. The database server does not return an error concerning the lack of Insert privilege on the violations and diagnostics tables, unless an integrity violation is detected during the execution of the SET Database Object Mode statement.
- The grantor of the initial set of privileges on the violations table is the same as the grantor of the privileges on the target table.

  For example, if user **henry** was granted the Insert privilege on the target table by both user **jill** and user **albert**, then the Insert privilege on the violations table is granted to **henry** both by **jill** and by **albert**.
- After the violations table is started, revoking a privilege on the target table from a user does not automatically revoke the same privilege on the violations table from that user. Instead, you must explicitly revoke the privilege on the violations table from the user.
- If you have fragment-level privileges on the target table, you have the corresponding fragment-level privileges on the violations table.

Example of Privileges on the Violations Table

The following example illustrates how the initial set of privileges on a violations table is derived from the current set of privileges on the target table. Assume that a table named **cust_subset** consists of the following columns: **ssn** (customer Social Security number), **fname** (customer first name), **lname** (customer last name), and **city** (city in which the customer lives).

The following set of privileges exists on the **cust_subset** table:

- User **barbara** has the Insert and Index privileges on the table. She also has the Select privilege on the **ssn** and **lname** columns.
- User **carrie** has the Update privilege on the **city** column. She also has the Select privilege on the **ssn** column.
- User **danny** has the Alter privilege on the table.

Now user **alvin** starts a violations table named **cust_subset_viols** and a diagnostics table named **cust_subset_diags** for the **cust_subset** table:

```
START VIOLATIONS TABLE FOR cust_subset
   USING cust_subset_viols, cust_subset_diags
```

The database server grants the following set of initial privileges on the **cust_subset_viols** violations table:

- User **alvin** is the owner of the violations table, so he has all table-level privileges on the table.
- User **barbara** has the Insert, Delete, and Index privileges on the table.

  User **barbara** has the Select privilege on five columns of the violations table: the **ssn**, the **lname**, the **informix_tupleid**, the **informix_optype**, and the **informix_recowner** columns.
- User **carrie** has Insert and Delete privileges on the violations table.

  User **carrie** has the Update privilege on four columns of the violations table: the **city**, the **informix_tupleid**, the **informix_optype**, and the **informix_recowner** columns. She cannot, however, update the **informix_tupleid** column (because this is a SERIAL column).

  User **carrie** has the Select privilege on four columns of the violations table: the **ssn** column, the **informix_tupleid** column, the **informix_optype** column, and the **informix_recowner** column.
- User **danny** has no privileges on the violations table.

Using the Violations Table

The following rules concern the structure and use of the violations table:

- Every pair of update rows in the violations table has the same value in the **informix_tupleid** column to indicate that both rows refer to the same row in the target table.
- If the target table has columns named **informix_tupleid**, **informix_optype**, or **informix_recowner**, the database server attempts to generate alternative names for these columns in the violations table by appending a digit to the end of the column name (for example, **informix_tupleid1**). If this fails, an error is returned, and no violations table is started for the target table.
- When a table functions as a violations table, it cannot have triggers or constraints defined on it.
- When a table functions as a violations table, users can create indexes on it, even though the existence of an index affects performance. Unique indexes on the violations table cannot be set to FILTERING database object mode.
- If a target table has a violations and diagnostics table associated with it, dropping the target table in cascade mode (the default mode) causes the violations and diagnostics tables to be dropped also. If the target table is dropped in the restricted mode, the DROP TABLE operation fails (because the violations and diagnostics tables exist).
- After a violations table is started for a target table, ALTER TABLE cannot add, modify, or drop columns of the violations, diagnostics, or target tables. Before you can alter any of these tables, you must issue a STOP VIOLATIONS TABLE statement for the target table.
- The database server does not clear out the contents of the violations table before or after it uses the violations table during an INSERT, UPDATE, DELETE, or SET Database Object Mode operation.
- If a target table has a filtering-mode constraint or unique index defined on it and a violations table associated with it, users cannot insert into the target table by selecting from the violations table. Before you insert rows into the target table by selecting from the violations table, you must take one of the following steps:

- You can set the constraint or unique index to DISABLED mode.
- You can issue STOP VIOLATIONS TABLE for the target table.

If it is inconvenient to take either of these steps, but you intend to copy records from the violations table into the target table, a third option is to select from the violations table into a temporary table and then insert the contents of the temporary table into the target table.

- If the target table that is specified in the START VIOLATIONS TABLE statement is fragmented, the violations table has the same fragmentation strategy as the target table. Each fragment of the violations table is stored in the same dbspace partition as the corresponding fragment of the target table.
- Once a violations table is started for a target table, you cannot use the ALTER FRAGMENT statement to alter the fragmentation strategy of the target table or the violations table.
- If the target table specified in the START VIOLATIONS TABLE statement is not fragmented, the database server places the violations table in the same dbspace as the target table.
- If the target table has BYTE or TEXT columns, BYTE or TEXT data values in the violations table are created in the same blobspace that stores the BYTE or TEXT data in the target table.

Example of a Violations Table

To start a violations and diagnostics table for the target table named **customer** in the demonstration database, enter the following statement:

```
START VIOLATIONS TABLE FOR customer
```

Because you include no USING clause, the violations table is named **customer_vio** by default. The **customer_vio** table includes these columns:

customer_num	**company**	**city**	**zipcode**	**informix_tupleid**
fname	**address1**	**state**	**phone**	**informix_optype**
lname	**address2**			**informix_recowner**

The **customer_vio** table has the same table definition as the **customer** table except that the **customer_vio** table has three additional columns that contain information about the operation that caused the nonconforming row.

Structure of the Diagnostics Table (IDS)

When you issue a START VIOLATIONS TABLE statement for a target table, the diagnostics table that the statement creates has a predefined structure. This structure is independent of the structure of the target table.

The following table shows the schema of the diagnostics table.

Column Name	Data Type	Description
informix_tupleid	INTEGER	Implicitly refers to **informix_tupleid** column values in the violations table This relationship, however, is not declared as a foreign-key to primary-key relationship.
objtype	CHAR(1)	Identifies the type of violation This column can have the following values:
		C = Constraint violation
		I = Unique-index violation
objowner	CHAR(32)	Identifies the owner of the constraint or index for which an integrity violation was detected
objname	VARCHAR(128, 0)	Contains the name of the constraint or index for which an integrity violation was detected

Initial Privileges on the Diagnostics Table

When the START VIOLATIONS TABLE statement creates the diagnostics table, the set of privileges granted on the target table are a basis for granting privileges on the diagnostics table. The database server follows different rules, however, when it grants each type of privilege.

The following table explains the circumstances under which the database server grants each privilege on the diagnostics table.

Privilege	Condition for Granting the Privilege
Insert	User has the Insert privilege on the diagnostics table if the user has the Insert, Delete, or Update privilege on any column of the target table.
Delete	User has the Delete privilege on the diagnostics table if the user has the Insert, Delete, or Update privilege on any column of the target table.
Select	User has the Select privilege on the diagnostics table if the user has the Select privilege on any column in the target table.
Update	User has the Update privilege on the diagnostics table if the user has the Update privilege on any column in the target table.
Index	User has the Index privilege on the diagnostics table if the user has the Index privilege on the target table.
Alter	Alter privilege is not granted on the diagnostics table. (Users cannot alter diagnostics tables.)
References	References privilege is not granted on the diagnostics table. (Users cannot add referential constraints to diagnostics tables.)

The following rules concern privileges on the diagnostics table:

- When the diagnostics table is created, the owner of the target table becomes the owner of the diagnostics table.
- The owner of the diagnostics table automatically receives all table-level privileges on the diagnostics table, including the Alter and References privileges.

The database server, however, prevents the owner of the diagnostics table from altering the diagnostics table or adding a referential constraint to the diagnostics table.

- You can use the GRANT and REVOKE statements to modify the initial set of privileges on the diagnostics table.
- For INSERT, DELETE, or UPDATE operations on a target table that has a filtering-mode unique index or constraint defined on it, you must have the Insert privilege on the violations and diagnostics tables.

  If you do not have the Insert privilege on the violations and diagnostics tables, the database server executes the INSERT, DELETE, or UPDATE statement on the target table, provided you have the necessary privileges on the target table. The database server does not return an error concerning the lack of Insert privilege on the violations and diagnostics tables unless an integrity violation is detected during execution of the INSERT, DELETE, or UPDATE statement.

  Similarly, when you issue a SET Database Object Mode statement to set a disabled constraint or disabled unique index to the enabled or filtering mode, and a violations table and diagnostics table exist for the target table, you must have the Insert privilege on the violations and diagnostics tables.

  If you do not have the Insert privilege on the violations and diagnostics tables, the database server executes the SET Database Object Mode statement, provided you have the necessary privileges on the target table. The database server does not return an error concerning the lack of Insert privilege on the violations and diagnostics tables unless an integrity violation is detected during the execution of the SET Database Object Mode statement.
- The grantor of the initial set of privileges on the diagnostics table is the same as the grantor of the privileges on the target table. For example, if the user **jenny** was granted the Insert privilege on the target table by both the user **wayne** and the user **laurie**, both user **wayne** and user **laurie** grant the Insert privilege on the diagnostics table to user **jenny**.
- Once a diagnostics table is started for a target table, revoking a privilege on the target table from a user does not automatically revoke the same privilege on the diagnostics table from that user. Instead you must explicitly revoke the privilege on the diagnostics table from the user.
- If you have fragment-level privileges on the target table, you have the corresponding table-level privileges on the diagnostics table.

The next example illustrates how the initial set of privileges on a diagnostics table is derived from the current privileges on the target table. Assume that you have a table called **cust_subset** that holds **customer data.** This table consists of the following columns: **ssn** (social security number), **fname** (first name), **lname** (last name), and **city** (city in which the customer lives). The following set of privileges exists on the **cust_subset** table:

- User **alvin** is the owner of the table.
- User **barbara** has the Insert and Index privileges on the table. She also has the Select privilege on the **ssn** and **lname** columns.
- User **danny** has the Alter privilege on the table.
- User **carrie** has the Update privilege on the **city** column. She also has the Select privilege on the **ssn** column.

Now user **alvin** starts a violations table named **cust_subset_viols** and a diagnostics table named **cust_subset_diags** for the **cust_subset** table:

```
START VIOLATIONS TABLE FOR cust_subset
   USING cust_subset_viols, cust_subset_diags
```

The database server grants the following set of initial privileges on the **cust_subset_diags** diagnostics table:

- User **alvin** is the owner of the diagnostics table, so he has all table-level privileges on the table.
- User **barbara** has the Insert, Delete, Select, and Index privileges on the diagnostics table.
- User **carrie** has the Insert, Delete, Select, and Update privileges on the diagnostics table.
- User **danny** has no privileges on the diagnostics table.

Using the Diagnostics Table

For information on the relationship between the diagnostics table and the violations table, see "Relationships Among the Target, Violations, and Diagnostics Tables" on page 2-613.

The following issues concern the structure and use of the diagnostics table:

- The MAX ROWS clause of the START VIOLATIONS TABLE statement sets a limit on the number of rows that can be inserted into the diagnostics table when you execute a single statement, such as an INSERT or SET Database Object Mode statement, on the target table.
- The MAX ROWS clause limits the number of rows only for operations in which the table functions as a diagnostics table.
- When a table functions as a diagnostics table, it cannot have triggers or constraints defined on it.
- When a table functions as a diagnostics table, users can create indexes on the table, but the existence of an index affects performance. You cannot set unique indexes on a diagnostics table to FILTERING database object mode.
- If a target table has a violations and diagnostics table associated with it, dropping the target table in cascade mode (the default mode) causes the violations and diagnostics tables to be dropped also.
- If the target table is dropped in restricted mode, the DROP TABLE operation fails (because the violations and diagnostics tables exist).
- Once a violations table is started for a target table, you cannot use the ALTER TABLE statement to add, modify, or drop columns in the target table, violations table, or diagnostics table. Before you can alter any of these tables, you must issue a STOP VIOLATIONS TABLE statement for the target table.
- The database server does not clear out the contents of the diagnostics table before or after it uses the diagnostics table during an Insert, Update, Delete, or Set operation.
- If the target table that is specified in the START VIOLATIONS TABLE statement is fragmented, the diagnostics table is fragmented with a round-robin strategy over the same dbspaces in which the target table is fragmented.

To start a violations and diagnostics table for the target table named **stock** in the demonstration database, enter the following statement:

```
START VIOLATIONS TABLE FOR stock
```

Because your START VIOLATIONS TABLE statement does not include a USING clause, the diagnostics table is named **stock_dia** by default. The **stock_dia** table includes the following columns:

informix_tupleid	**objowner**
objtype	**objname**

This list of columns shows an important difference between the diagnostics table and violations table for a target table. Whereas the violations table has a matching column for every column in the target table, the columns of the diagnostics table do not match any columns in the target table. The diagnostics table created by any START VIOLATIONS TABLE statement always has the same columns with the same column names and data types.

Related Information

Related statements: CREATE INDEX, CREATE TABLE, SET Database Object Mode, and STOP VIOLATIONS TABLE

For a discussion of object modes and violation detection, see the *IBM Informix Guide to SQL: Tutorial*.

STOP VIOLATIONS TABLE

Use the STOP VIOLATIONS TABLE statement to drop the association between a target table and its violations table (and for Dynamic Server only, its diagnostics table). This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──STOP VIOLATIONS TABLE FOR──table──────────────────────────────────────►◄
```

Element	Description	Restrictions	Syntax
table	Name of a target table whose association with the violations and diagnostics table is to be dropped. No default value exists.	Must be a local table that has an associated violations table and (for IDS) a diagnostics table	Database Object Name, p. 5-17

Usage

The STOP VIOLATIONS TABLE statement drops the association between the target table and the violations table (and for Dynamic Server, the diagnostics table). After you issue this statement, the former violations and diagnostics tables continue to exist, but they no longer function as violations and diagnostics tables for the target table. They now have the status of regular database tables instead of violations and diagnostics tables for the target table. You must issue the DROP TABLE statement to drop these two tables explicitly.

When DML operations (INSERT, DELETE, or UPDATE) cause data-integrity violations for rows of the target table, the nonconforming rows are no longer filtered to the former violations table, and diagnostic information about the data-integrity violations is not placed in the former diagnostics table.

In Extended Parallel Server, the diagnostics table does not exist. The STOP VIOLATIONS TABLE statement drops the association between the target table and the violations table.

Example of Stopping a Violations and Diagnostics Table

Assume that a target table named **cust_subset** has an associated violations table named **cust_subset_vio** and (for Dynamic Server) an associated diagnostics table named **cust_subset_dia**. To drop the association between the target table and the violations and diagnostics tables, enter the following statement:

```
STOP VIOLATIONS TABLE FOR cust_subset
```

Example of Dropping a Violations and Diagnostics Table

After you execute the STOP VIOLATIONS TABLE statement in the preceding example, the **cust_subset_vio** and (for Dynamic Server) the **cust_subset_dia** tables continue to exist, but they are no longer associated with the **cust_subset** table. Instead they now have the status of regular database tables. To drop these two tables, enter the following statements:

```
DROP TABLE cust_subset_vio;
DROP TABLE cust_subset_dia;
```

Privileges Required for Stopping a Violations Table

To stop a violations table (and for Dynamic Server, a diagnostics table) for a given target table, you must meet one of the following requirements:

- You must have the DBA privilege on the database.
- You must be the owner of the target table and have the Resource privilege on the database.
- You must have the Alter privilege on the target table and the Resource privilege on the database.

Related Information

Related statements: SET Database Object Mode and START VIOLATIONS TABLE

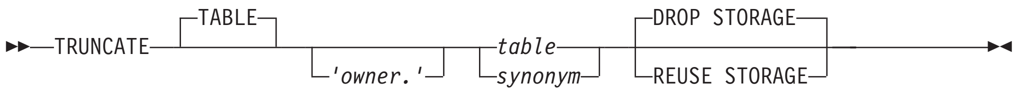
For a discussion of database object modes and violation detection, see the *IBM Informix Guide to SQL: Tutorial*.

TRUNCATE (IDS)

Use the TRUNCATE statement to quickly delete all rows from a local table and free the associated storage space. You can optionally reserve the space for the same table and its indexes. Only Dynamic Server supports this implementation of the TRUNCATE statement, which is an extension to the ANSI/ISO standard for SQL.

Extended Parallel Server supports a different implementation of TRUNCATE, as the section TRUNCATE (XPS) on page 2-628describes.

Syntax



Element	Description	Restrictions	Syntax
owner	Owner of *table* or *synonym*	See **Usage** notes.	Owner Name, p. 5-43
synonym	Synonym for the table from which to remove all data	Must exist, and **USETABLENAME** must not be set	Identifier, p. 5-22
table	Name of table from which to remove all data and all B-tree structures of its indexes	Must exist in the database	Identifier, p. 5-22

Usage

The TRUNCATE statement rapidly deletes from a local table all active data rows and the B-tree structures of indexes on the table. You have the option of releasing the storage space that was occupied by the rows and index extents, or of reusing the same space when the table is subsequently repopulated with new rows.

To execute the TRUNCATE statement, you must be the owner of the table, or else hold DBA access privilege on the database. You must also hold Delete privilege on the table. If an enabled Delete trigger is defined on the table, the Alter privilege is also required, even though TRUNCATE does not activate triggers.

Although it requires the Delete privilege, TRUNCATE is a data definition language (DDL) statement. Like other DDL statements, TRUNCATE cannot operate on any table outside the database to which you are connected, nor on a table that a concurrent session is reading in Dirty Read isolation mode.

Dynamic Server always logs the TRUNCATE operation, even for a non-logging table. In databases that support transaction logging, only the COMMIT WORK or ROLLBACK WORK statement of SQL is valid after the TRUNCATE statement within the same transaction.

When you rollback a TRUNCATE statement, no rows are removed from the table, and the storage extents that hold the rows and index partitions continue to be allocated to the table. Only databases with transaction logging can support the ROLLBACK WORK statement.

After the TRUNCATE statement successfully executes, Dynamic Server automatically updates the statistics and distributions for the table and for its indexes in the system catalog to show no rows in the table nor in its dbspace partitions. It is not necessary to run the UPDATE STATISTICS statement immediately after you commit the TRUNCATE statement.

If the table that the TRUNCATE statement specifies is a typed table, a successful TRUNCATE operation removes all the rows and B-tree structures from that table and from all its subtables within the table hierarchy.

The TRUNCATE statement does not reset the serial value of SERIAL or SERIAL8 columns. To reset the counter of a serial column, you must do so explicitly by using the MODIFY clause of the ALTER TABLE statement, either before or after you execute the TRUNCATE statement.

The TABLE Keyword

The TABLE keyword has no effect on this statement, but it can be included to make your code more legible for human readers. Both of the following statements have the same effect, deleting all rows and any related index data from the **customer** table:

```
TRUNCATE TABLE customer

TRUNCATE customer
```

The Table Specification

You must specify the name or synonym of a table in the local database to which you are currently connected. If the **USETABLENAME** environment variable is set, you must use the name of the table, rather than a synonym. The table can be of type STANDARD, RAW, or TEMP, but you cannot specify the name or synonym of a view. (Categories of tables that are not valid with TRUNCATE are listed in the section “Restrictions” on page 2-627.)

In a database that is ANSI-compliant, you must specify the *owner* qualifier if you are not the owner of the *table* or *synonym*.

After the TRUNCATE statement begins execution, Dynamic Server attempts to place an exclusive lock on the specified table, to prevent other sessions from locking the table until the TRUNCATE statement is committed or rolled back. Exclusive locks are also applied to any dependent tables of the truncated table within a table hierarchy.

While concurrent sessions that use the Dirty Read isolation level are reading the table, however, the TRUNCATE statement fails with an RSAM -106 error. To reduce this risk, you can set the **IFX_DIRTY_WAIT** environment variable to specify that the TRUNCATE operation wait for a specified number of seconds for Dirty Read operations to commit or rollback.

The Storage Specification

By default, all of the partition extents that had been allocated to the specified table and to its indexes are released after TRUNCATE successfully executes, but you can include the DROP STORAGE keywords to achieve the same result, making the storage space available for other database objects. The first extent size remains the same as it was before the TRUNCATE operation released the storage.

Alternatively, if it is your intention to keep the same storage space allocated to the same table for subsequently loaded data, specify the REUSE STORAGE keywords to prevent the space from being deallocated. The REUSE STORAGE option of TRUNCATE can make storage management more efficient in applications where the same table is periodically emptied and reloaded with new rows.

Whether you specify DROP STORAGE or REUSE STORAGE, any out-of-row data values are released for all rows of the table when the TRUNCATE transaction is committed. Storage occupied by any BLOB or CLOB values that become unreferenced in the TRUNCATE transaction is also released.

The AM_TRUNCATE Purpose Function

Dynamic Server provides built-in **am_truncate** purpose functions for its primary access methods that support TRUNCATE operations on columns of permanent and temporary tables. It also provides a built-in **am_truncate** purpose function for its secondary access method for TRUNCATE operations on B-tree indexes.

For the TRUNCATE statement to work correctly in a virtual table interface (VTI) table requires a valid **am_truncate** purpose function in the primary access method for the data type of the VTI table. To register a new primary access method in the database, use the CREATE PRIMARY ACCESS statement of SQL:

```
CREATE PRIMARY ACCESS_METHOD vti(
  AM_GETNEXT  = vti_getnext
  AM_TRUNCATE = vti_truncate
  ...);
```

You can also use the ALTER ACCESS_METHOD statement to add a valid **am_truncate** purpose function to an existing access method that has no **am_truncate** purpose function:

```
ALTER ACCESS_METHOD abc (
  ADD AM_TRUNCATE = abc_truncate);
```

In these examples, the **vti_truncate** and **abc_truncate** functions must be routines that support the functionality of the AM_TRUNCATE purpose option keyword, and that were previously registered in the database by the CREATE FUNCTION or CREATE ROUTINE statement.

Performance Advantages of TRUNCATE

The TRUNCATE statement is not equivalent to DROP TABLE. After TRUNCATE successfully executes, the specified *table* and all its columns and indexes are still registered in the database, but with no rows of data. In information management applications that require replacing all of the records in a table after some time interval, TRUNCATE requires fewer updates to the system catalog than the equivalent DROP TABLE, CREATE TABLE, and any additional DDL statements to redefine any synonyms, views, constraints, triggers, privileges, fragmentation schemes, and other attributes and associated database objects of the table.

In contexts where no existing rows of a table are needed, the TRUNCATE statement is typically far more efficient than using the DELETE statement with no WHERE clause to empty the table, because TRUNCATE requires fewer resources and less logging overhead than DELETE:

- DELETE FROM *table* deletes each row as a separately logged operation. If indexes exist on the table, each index must be updated when a row is deleted, and this update is also logged for each row. If an enabled Delete trigger is defined on the table, its triggered actions must also be executed and logged.
- TRUNCATE *table* performs the removal of all rows and of the B-tree structures of every index on the table as a single operation, and writes a single entry in the logical log when the transaction that includes TRUNCATE is committed or rolled back. The triggered action of any enabled trigger is ignored.

These performance advantages of TRUNCATE over DELETE are reduced when the table has one or more columns with the following attributes:

- Any simple large object data types stored in blobspaces
- Any BLOB, CLOB, complex, or user-defined types stored in sbspaces
- Any opaque types for which a **destroy** support function is defined.

Each of these features require the database server to read each row of the table, substantially reducing the speed of TRUNCATE.

If a table includes one or more UDTs for which you have registered an **am_truncate( )** purpose function, then the performance difference between TRUNCATE and DELETE would reflect the relative costs of invoking the **am_truncate** interface once for TRUNCATE versus invoking the **destroy** support function for each row.

As listed in the next section, certain conditions cause TRUNCATE to fail with an error. Some of these conditions have no effect on DELETE operations, so in those cases you can remove all rows more efficiently with a DELETE statement, as in the following operation on the **customer** table:

```
DELETE customer;
```

The FROM keyword that immediately follows DELETE can be omitted, as in this example, only if the **DELIMIDENT** environment variable is set.

Restrictions

The TRUNCATE statement fails if any of the following conditions exist:

- The user does not have Delete privilege on the table.
- The table has an enabled Delete trigger, but the user lacks the Alter privilege.
- The specified table or synonym does not exist in the local database.
- The specified synonym does not reference a table in the local database.
- The statement specifies a synonym for a local table, but the **USETABLENAME** environment variable is set.
- The statement specifies the name of a view or a synonym for a view.
- The table is a system catalog table or a system-monitoring interface (SMI) table.
- An R-tree index is defined on the table.
- The table is a virtual table (or has a virtual-index interface) for which no valid **am_truncate** access method exists in the database.
- An Enterprise Replication replicate is defined on the table.
- A shared or exclusive lock on the table already exists.
- One or more cursors are open on the table.
- A concurrent session with Dirty Read isolation level is reading the table.
- Another table, with at least one row, has an enabled foreign-key constraint on the specified table. (An enabled foreign key constraint of another table that has no rows, however, has no effect on a TRUNCATE operation.)

Related Information

DELETE, DROP TABLE

TRUNCATE (XPS)

Use the TRUNCATE statement for quick removal of all rows from a table and all corresponding index data. Only Extended Parallel Server supports this implementation of the TRUNCATE statement, which is an extension to the ANSI/ISO standard for SQL.

Dynamic Server supports a different implementation of TRUNCATE, as described in the section TRUNCATE (IDS) on page 2-624.

Syntax

```
                         ┌─TABLE─┐
►►──TRUNCATE─┬──────┬────┴───────┴──┬────────┬──table──────────────────────────►◄
             └─ONLY─┘               └─owner.─┘
```

Element	Description	Restrictions	Syntax
table	Name of table from which to remove all data	Must exist	Database Object Name, p. 5-17

Usage

You must be the owner of the table or have DBA privilege to use this statement.

The TRUNCATE statement does not automatically reset the serial value of a column. To reset the serial value of a column, you must do so explicitly, either before or after you run the TRUNCATE statement.

TRUNCATE is not equivalent to DROP TABLE. After TRUNCATE successfully executes, the specified *table* (and all its columns, and any synonyms, views, constraints, indexes, triggers, and access privileges) still exists in the database schema, but with no rows of data.

Restrictions

The TRUNCATE statement fails if any of the following conditions exist:

- One or more cursors are open on the table.
- Referential constraints exist on the table and any of the referencing tables has at least one row.
- A shared or exclusive lock on the table already exists.
- The statement references a view.
- The statement references any of the following types of tables:
  - An external table
  - A system catalog table
  - A violations table
- The statement is issued within a transaction.

Using the ONLY and TABLE Keywords

For Extended Parallel Server, the TABLE keyword and the ONLY keyword have no effect on this statement, but they can be included to make your code more legible for human readers. All of the following statements have the same effect, deleting all rows and any related index data from the **customer** table:

```
TRUNCATE ONLY TABLE customer
```

```
TRUNCATE TABLE customer
```

```
TRUNCATE ONLY customer
```

```
TRUNCATE customer
```

After the TRUNCATE Statement Executes

Information about the success of this statement appears in the logical-log files. For information about logical-log files, see your *IBM Informix Administrator's Guide*.

If the table was fragmented, after the statement executes, each fragment has a space allocated for it that is the same size as that of the first extent size. The fragment size of any indexes also corresponds to the size of the first extents.

Because the TRUNCATE statement does not alter the schema, the database server does not automatically update statistics. After you use this statement, you might want to issue an UPDATE STATISTICS statement on the table.

When You Might Use the TRUNCATE Statement

TRUNCATE performs similar operations to those that you can perform with the DELETE statement or with a combination of DROP TABLE and CREATE TABLE.

Using TRUNCATE can be faster than removing all rows from a table with the DELETE statement, because it does not activate any DELETE triggers. In addition, when you use TRUNCATE, the database server creates one log entry for the entire TRUNCATE statement, rather than one for each deleted row.

You might also use this statement instead of dropping a table and then re-creating it. When you drop and re-create a table, you must re-grant any access privileges that you want to preserve on the table. In addition, you must re-create any indexes, constraints, and triggers that were defined on the table. The TRUNCATE statement leaves these database objects and privileges intact.

Related Information

Related statements: DELETE and DROP TABLE

UNLOAD

Use UNLOAD to write the rows retrieved by a SELECT statement to an operating-system file. Use UNLOAD only with DB–Access

UNLOAD is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──UNLOAD TO──'filename' ──┬──────────────────────────┬──────────────────────────►
                            └─DELIMITER──'delimiter' ──┘


                  (1)
►──┬─┤ SELECT Statement ├──┬──────────────────────────────────────────────────────►◄
   └─variable──────────────┘
```

Notes:

1 See page 2-479

Element	Description	Restrictions	Syntax
delimiter	Quoted string to specify the field delimiter character in *filename* file	See "DELIMITER Clause" on page 2-633	Quoted String, p. 4-142
filename	Operating-system file to receive the rows. Default pathname is the current directory.	See "UNLOAD TO File" on page 2-630.	Quoted String, p. 4-142
variable	Host variable that contains the text of a valid SELECT statement	Must have been declared as a character data type	Language- specific

Usage

UNLOAD copies to a file the rows retrieved by a query. You must have the Select privilege on all columns specified in the SELECT statement. For information on database-level and table-level privileges, see "GRANT" on page 2-371.

You can specify a literal SELECT statement or a character variable that contains the text of a SELECT statement. (See "SELECT" on page 2-479.)

The following example unloads rows whose value of **customer.customer_num** is greater than or equal to 138, and writes them to a file named **cust_file**:

```
UNLOAD TO 'cust_file' DELIMITER '!'
   SELECT * FROM customer WHERE customer_num> = 138
```

The resulting output file, **cust_file**, contains two rows of data values:

```
138!Jeffery!Padgett!Wheel Thrills!3450 El Camino!Suite 10!Palo Alto!CA!94306!!
139!Linda!Lane!Palo Alto Bicycles!2344 University!!Palo Alto!CA!94301!
    (415)323-5400
```

UNLOAD TO File

The UNLOAD TO file, as specified by the *filename* parameter, receives the retrieved rows. You can use an UNLOAD TO file as input to a LOAD statement.

In the default locale, data values have these formats in the UNLOAD TO file.

Data Type	Output Format
BOOLEAN	BOOLEAN values appear as either t for TRUE or f for FALSE.
Character	If a character field contains the delimiter, IBM Informix products automatically escape it with a backslash (\ ) to prevent interpretation as a special character. (If you use a LOAD statement to insert the rows into a table, backslash escape characters are automatically stripped.)
Collections	A collection is unloaded with its values between braces ({ }) and a delimiter between each element. For more information, see "Unloading Complex Types (IDS)" on page 2-633.
DATE	DATE values are represented as *mm/dd/yyyy* (or the default format for the database locale), where *mm* is the month (January = 1, and so on), *dd* is the day, and *yyyy* is the year. If you have set the **GL_DATE** or **DBDATE** environment variable, the UNLOAD statement uses the specified date format for DATE values.
DATETIME, INTERVAL	Literal DATETIME and INTERVAL values appear as digits and delimiters, without keyword qualifiers, in the default format *yyyy-mm-dd hh:mi:ss.fff*. Time units outside the declared precision are omitted. If the **GL_DATETIME** or **DBTIME** environment variable is set, DATETIME values appear in the specified format.
DECIMAL, MONEY	Values are unloaded with no leading currency symbol. In the default locale, comma (,) is the *thousands* separator and period (.) is the decimal separator. If **DBMONEY** is set, UNLOAD uses its specified separators and currency format for MONEY values.
NULL	NULL appears as two delimiters with no characters between them.
Number	Values appear as literals, with no leading blanks. INTEGER, INT8, or SMALLINT zero appear as `0`, and MONEY, FLOAT, SMALLFLOAT, or DECIMAL zero appears as `0.0`.
ROW types (named and unnamed)	A ROW type is unloaded with its values enclosed between parentheses and a field delimiter separating each element. For more information, see "Unloading Complex Types (IDS)" on page 2-633.
Simple large objects (TEXT, BYTE)	TEXT and BYTE columns are unloaded directly into the UNLOAD TO file. BYTE values appear in ASCII hexadecimal form, with no added whitespace or newline characters. For more information, see "Unloading Simple Large Objects" on page 2-632.
Smart large objects (CLOB, BLOB)	CLOB and BLOB columns are unloaded into a separate operating-system file on the client computer. The CLOB or BLOB field in the UNLOAD TO file contains the name of this file. For more information, see "Unloading Smart Large Objects (IDS)" on page 2-632.
User-defined data types (opaque types)	Opaque types must have an **export( )** support function defined. They need special processing to copy data from the internal format of the opaque data type to the UNLOAD TO file format. An export binary support function might also be required for data in binary format. The data in the UNLOAD TO file would correspond to the format that the **export( )** or **exportbinary( )** support function returns.

For more information on **DB*** environment variables, refer to the *IBM Informix Guide to SQL: Reference*. For more information on **GL*** environment variables, refer to the *IBM Informix GLS User's Guide*.

In a nondefault locale, DATE, DATETIME, MONEY, and numeric column values have formats that the locale supports for these data types. For more information, see the *IBM Informix GLS User's Guide*.

Unloading Character Columns

In unloading files that contain VARCHAR or NVARCHAR columns, trailing blanks are retained in VARCHAR, LVARCHAR, or NVARCHAR fields. Trailing blanks are discarded when CHAR or NCHAR columns are unloaded.

For CHAR, VARCHAR, NCHAR, and NVARCHAR columns, an empty string (a data string of zero length, containing no characters) appears in the UNLOAD TO file as the four bytes "|\ |" (delimiter, backslash, blank space, delimiter).

Some earlier releases of Informix database servers used "||" (consecutive delimiters) to represent the empty string in LOAD and UNLOAD operations. In this release, however, "||" only represents NULL values in CHAR, VARCHAR, LVARCHAR, NCHAR, and NVARCHAR columns.

Unloading Simple Large Objects

The database server writes BYTE and TEXT values directly into the UNLOAD TO file. BYTE values are written in hexadecimal dump format with no added blank spaces or new line characters. The logical length of an UNLOAD TO file containing BYTE data can therefore be long and difficult to print or edit.

If you are unloading files that contain simple-large-object data types, do not use characters that can appear in BYTE or TEXT values as delimiters in the UNLOAD TO file. See also the section "DELIMITER Clause" on page 2-633.

The database server handles any required code-set conversions for TEXT data. For more information, see the *IBM Informix GLS User's Guide*.

If you are unloading files that contain simple-large-object data types, objects smaller than 10 kilobytes are stored temporarily in memory. You can adjust the 10-kilobyte setting to a larger setting with the **DBBLOBBUF** environment variable. BYTE or TEXT values larger than the default or the **DBBLOBBUF** setting are stored in a temporary file. For additional information about **DBBLOBBUF**, see the *IBM Informix Guide to SQL: Reference*.

Unloading Smart Large Objects (IDS)

The database server unloads smart large objects (BLOB and CLOB columns) into a separate operating-system file on the client computer, in the same directory as the UNLOAD TO file. The file has a name in one of these formats:

- For a BLOB value: `blob########`
- For a CLOB value: `clob########`

In the preceding formats, the pound (#) symbols represent the digits of the unique hexadecimal smart-large-object identifier. The database server uses the hexadecimal ID for the first smart large object in the file. The maximum number of digits for a smart-large-object identifier is 17. Most smart large objects, however, would have an identifier with fewer digits.

When the database server unloads the first smart large object, it creates the appropriate BLOB or CLOB client file with the hexadecimal identifier of the smart large object. If additional smart-large-object values are present, the database server creates another BLOB or CLOB client file whose filename contains the hexadecimal identifier of the next smart large object to unload.

In an UNLOAD TO file, a BLOB or CLOB column value appears as follows:

```
start_off,length,client_path
```

In this format, *start_off* is the starting offset (in hexadecimal format) of the smart-large-object value within the client file, *length* is the length (in hexadecimal) of the BLOB or CLOB value, and *client_path* is the pathname for the client file. No blank spaces can appear between these values. If a CLOB value is 512 bytes long and is at offset 256 in the **/usr/apps/clob9ce7.318** file, for example, then the CLOB value appears as follows in the UNLOAD TO file:

```
|100,200,/usr/apps/clob9ce7.318|
```

If a BLOB or CLOB column value occupies an entire client file, the CLOB or BLOB column value appears as follows in the UNLOAD TO file:

```
client_path
```

For example, if a CLOB value occupies the entire file **/usr/apps/clob9ce7.318**, the CLOB value appears as follows in the UNLOAD TO file:

```
|/usr/apps/clob9ce7.318|
```

For locales that support multibyte code sets, be sure that the declared size (in bytes) of any column that receives character data is large enough to store the entire data string. For some locales, this can require up to 4 times the number of logical characters in the longest data string.

The database server handles any required code-set conversions for CLOB data. For more information, see the *IBM Informix GLS User's Guide*.

Unloading Complex Types (IDS)

In an UNLOAD TO file, values of complex data types appear as follows:

- Collections are introduced with the appropriate constructor (MULTISET, LIST, SET), with their comma-separated elements enclosed in braces ({ }):

  ```
  constructor{val1 , val2 , ... }
  ```

  For example, to unload the SET values {1, 3, 4} from a column of the SET (INTEGER NOT NULL) data type, the corresponding field of the UNLOAD TO file appears as follows:

  ```
  |SET{1 , 3 , 4}|
  ```

- ROW types (named and unnamed) are introduced by the ROW constructor and have their fields enclosed between parentheses and comma-separated:

  ```
  ROW(val1 , val2 , ... )
  ```

  For example, to unload the ROW values (`1, 'abc'`), the corresponding field of the UNLOAD TO file appears as follows:

  ```
  |ROW(1 , abc)|
  ```

DELIMITER Clause

Use the DELIMITER clause to specify the delimiter that separates the data contained in each column in a row in the output file. If you omit this clause, then DB–Access checks the setting of the **DBDELIMITER** environment variable. If **DBDELIMITER** has not been set, the default delimiter is the pipe (|) symbol. You can specify `TAB` (`CTRL-I`) or a blank space (ASCII 32) as the delimiter symbol, but the following characters are not valid in any locale as delimiter symbols:

- Backslash (\ )
- Newline character (`CTRL-J`)
- Hexadecimal digits (`0` to `9`, `a` to `f`, `A` to `F`)

The backslash (\ ) is not a valid field separator or record delimiter because it is the default escape character, indicating that the next character is a literal character in the data, rather than a special character.

The following statement specifies the semicolon (;) as the delimiter:

```
UNLOAD TO 'cust.out' DELIMITER ';'
   SELECT fname, lname, company, city FROM customer
```

C-style comment indicators (/* . . . */) are not valid for comments in the LOAD or UNLOAD statements. Use double hyphen (`--`) or braces ({ ... }) instead.

Related Information

Related statements: LOAD and SELECT

For information about how to set environment variables, see the *IBM Informix Guide to SQL: Reference*.

For a discussion of the GLS aspects of the UNLOAD statement, see the *IBM Informix GLS User's Guide*.

For a task-oriented discussion of the UNLOAD statement and other utilities for moving data, see the *IBM Informix Migration Guide*.

UNLOCK TABLE

Use the UNLOCK TABLE statement in a database that does not use implicit transactions to unlock a table that you previously locked with the LOCK TABLE statement. The UNLOCK TABLE statement is not valid within a transaction.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

```
►►──UNLOCK TABLE──┬─table───┬──────────────────────────────────────────────►◄
                  └─synonym─┘
```

Element	Description	Restrictions	Syntax
synonym	Synonym for a table to unlock	The synonym and the table to which it points must exist	Database Object Name, p. 5-17
table	Table to unlock	Must be in a database without transactions and must be a table that you previously locked	Database Object Name, p. 5-17

Usage

You can lock a table if you own the table or if you have the Select privilege on the table, either from a direct grant to yourself or from a grant to **public**. You can only unlock a table that you locked. You cannot unlock a table that another process locked. Only one lock can apply to a table at a time.

You must specify the name or synonym of the table that you are unlocking. Do not specify the name of a view, or a synonym for a view.

To change the lock mode of a table in a database without transactions, use the UNLOCK TABLE statement to unlock the table, then issue a new LOCK TABLE statement. The following example shows how to change the lock mode of a table in a database that was created without transactions:

```
LOCK TABLE items IN EXCLUSIVE MODE
...
UNLOCK TABLE items
...
LOCK TABLE items IN SHARE MODE
```

The UNLOCK TABLE statement fails if it is issued within a transaction. Table locks set within a transaction are released automatically when the transaction completes.

If you are using an ANSI-compliant database, do not issue an UNLOCK TABLE statement. The UNLOCK TABLE statement fails if it is issued within a transaction, and a transaction is always in effect in an ANSI-compliant database.

Related Information

Related statements: BEGIN WORK, COMMIT WORK, LOCK TABLE, and ROLLBACK WORK

For a discussion of concurrency and locks, see the *IBM Informix Guide to SQL: Tutorial*.

UPDATE

Use the UPDATE statement to change the values in one or more columns of one or more existing rows in a table or view.

With Dynamic Server, you can also use this statement to change the values in one or more elements in an ESQL/C collection variable.

Syntax

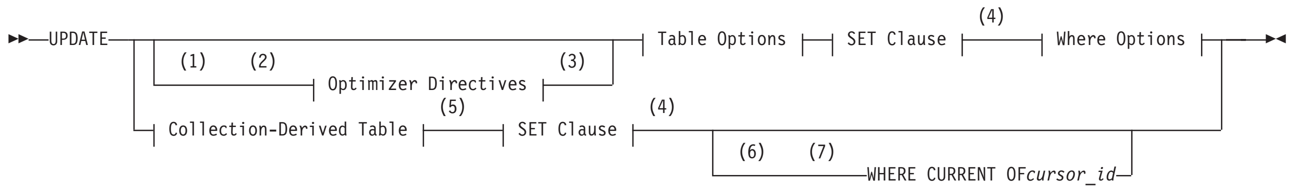
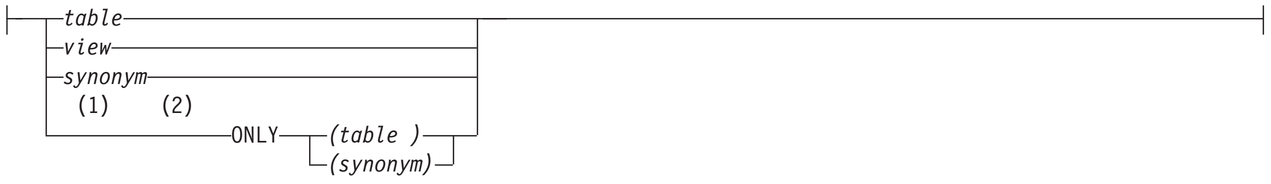
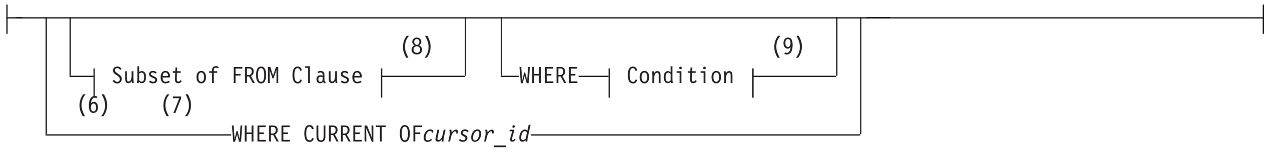


Table Options:



Where Options:



Notes:

1	Informix extension
2	Dynamic Server only
3	See page 5-34
4	See page 2-639
5	See page 5-5
6	ESQL/C only
7	Stored Procedure Language only
8	See page 2-645
9	See page 4-5

Element	Description	Restrictions	Syntax
cursor_id	Name of a cursor whose current row is to be updated	You cannot update a row that includes aggregates	Identifier, p. 5-22
synonym, table, view	Synonym, table, or view that contains the rows to be updated	The *synonym* and the table or view to which it points must exist	Database Object Name, p. 5-17

Usage

Use the UPDATE statement to update any of the following types of objects:

- A row in a table: a single row, a group of rows, or all rows in a table
- For Dynamic Server, an element in a collection variable
- An ESQL/C **row** variable: a field or all fields

For information on how to update elements of a collection variable, see "Collection-Derived Table" on page 5-5. Sections that follow in this description of the UPDATE statement describe how to update a row in a table.

You must either own the table or have the Update privilege for the table; see "GRANT" on page 2-371. To update data in a view, you must have the Update privilege, and the view must meet the requirements that are explained in "Updating Rows Through a View" on page 2-638.

The cursor (as defined in the SELECT ... FOR UPDATE portion of a DECLARE statement) can contain only column names. If you omit the WHERE clause, all rows of the target table are updated.

If you are using effective checking and the checking mode is set to IMMEDIATE, all specified constraints are checked at the end of each UPDATE statement. If the checking mode is set to DEFERRED, all specified constraints are *not* checked until the transaction is committed.

In Extended Parallel Server, if UPDATE is constructed in such a way that a single row might be updated more than once, the database server returns an error. If the new value is the same in every update, however, the database server allows the update to take place without reporting an error.

In DB-Access, if you omit the WHERE clause and are in interactive mode, DB–Access does not run the UPDATE statement until you confirm that you want to change all rows. If the statement is in a command file, however, and you are running at the command line, the statement executes immediately.

Using the ONLY Keyword (IDS)

If you use the UPDATE statement to update rows of a supertable, rows from its subtables can also be updated. To update rows from the supertable only, use the ONLY keyword prior to the table name, as this example shows:

```
UPDATE ONLY(am_studies_super)
WHERE advisor = "johnson"
SET advisor = "camarillo"
```

Note: If you use the UPDATE statement on a supertable without the ONLY keyword and without a WHERE clause, all rows of the supertable and its subtables are updated. You cannot use the ONLY keyword if you plan to use the WHERE CURRENT OF clause to update the current row of the active set of a cursor.

Updating Rows Through a View

You can update data through a *single-table* view if you have the Update privilege on the view (see “GRANT” on page 2-371). For a view to be updatable, the query that defines the view must not contain any of the following items:

- Columns in the projection list that are aggregate values
- Columns in the projection list that use the UNIQUE or DISTINCT keyword
- A GROUP BY clause
- A UNION operator

In addition, if a view is built on a table that has a derived value for a column, that column cannot be updated through the view. Other columns in the view, however, can be updated. In an updatable view, you can update the values in the underlying table by inserting values into the view.

You can use data-integrity constraints to prevent users from updating values in the underlying table when the update values do not fit the SELECT statement that defined the view. For more information, see “WITH CHECK OPTION Keywords” on page 2-250.

Because duplicate rows can occur in a view even if its base table has unique rows, be careful when you update a table through a view. For example, if a view is defined on the **items** table and contains only the **order_num** and **total_price** columns, and if two items from the same order have the same total price, the view contains duplicate rows. In this case, if you update one of the two duplicate **total_price** values, you have no way to know which item price is updated.

Important: If you are using a view with a check option, you cannot update rows in a remote table.

For Dynamic Server, an alternative to directly modifying data values in a view with the UPDATE statement is to create an INSTEAD OF trigger on the view. For more information, see “INSTEAD OF Triggers on Views (IDS)” on page 2-243.

Updating Rows in a Database Without Transactions

If you are updating rows in a database without transactions, you must take explicit action to restore updated rows. For example, if the UPDATE statement fails after updating some rows, the successfully updated rows remain in the table. You cannot automatically recover from a failed update.

Updating Rows in a Database with Transactions

If you are updating rows in a database with transactions, and you are using transactions, you can undo the update using the ROLLBACK WORK statement. If you do not execute a BEGIN WORK statement before the update, and the update fails, the database server automatically rolls back any database modifications made since the beginning of the update.

You can create temporary tables with the WITH NO LOG option. These tables are never logged and are not recoverable.

Tables that you create with the RAW logging type are never logged. Thus, RAW tables are not recoverable, even if the database uses logging. For information about RAW tables, refer to the *IBM Informix Guide to SQL: Reference*.

In an ANSI-compliant database, transactions are implicit, and all database modifications take place within a transaction. In this case, if an UPDATE statement fails, you can use ROLLBACK WORK to undo the update.

If you are within an explicit transaction, and the update fails, the database server automatically undoes the effects of the update.

Locking Considerations

When a row is selected with the intent to update, the update process acquires an update lock. Update locks permit other processes to read, or *share*, a row that is about to be updated, but they do not allow those processes to update or delete it. Just before the update occurs, the update process *promotes* the shared lock to an exclusive lock. An exclusive lock prevents other processes from reading or modifying the contents of the row until the lock is released.

An update process can acquire an update lock on a row or on a page that has a shared lock from another process, but you cannot promote the update lock from shared to exclusive (and the update cannot occur) until the other process releases its lock.

If the number of rows that a single update affects is large, you can exceed the limits placed on the maximum number of simultaneous locks. If this occurs, you can reduce the number of transactions per UPDATE statement, or you can lock the page or the entire table before you execute the statement.

SET Clause

Use the SET clause to identify the columns to update and assign values to each column. The clause supports the following formats:

- A single-column format, which pairs each column with a single expression
- A multiple-column format, which associates a list of multiple columns with the values returned by one or more expressions

SET Clause:

```
                                (1)
|--SET--+-| Single-Column Format |----------+-----------------------------|
        | (2)                         (3)  |
        '---------| Multiple-Column Format |-'
```

Notes:

1 See page 2-639

2 Informix extension

3 See page 2-641

Single-Column Format

Use the single-column format to pair one column with a single expression.

Single-Column Format:

```
    ┌─,──────────────────────────────────┐
    ▼                                    │
├───column── =──┬─expression─────────────┬┴──────────────────────────────────┤
                ├─(──singleton_select──)─┤
                ├─NULL───────────────────┤
                │  (1)                   │
                └──────────collection_var┘
```

Notes:

1 Dynamic Server only

Element	Description	Restrictions	Syntax
column	Column to be updated	Cannot be a serial data type	Identifier, p. 5-22
collection_var	Host or program variable	Must be declared as a collection data type	Language specific
expression	Returns a value for *column*	Cannot contain aggregate functions	Expression, p. 4-34
singleton _select	Subquery that returns exactly one row	Returned subquery values must have a 1-to-1 correspondence with *column* list	SELECT, p. 2-479

You can use this syntax to update a column that has a ROW data type.

You can include any number of "single *column* = single *expression*" terms. The *expression* can be an SQL subquery (enclosed between parentheses) that returns a single row, provided that the corresponding *column* is of a data type that can store the value (or the set of values) from the row that the subquery returns.

To specify values of a ROW-type column in a SET clause, see "Updating ROW-Type Columns (IDS)" on page 2-643. The following examples illustrate the single-column format of the SET clause.

```
UPDATE customer
   SET address1 = '1111 Alder Court', city = 'Palo Alto',
      zipcode = '94301' WHERE customer_num = 103;

UPDATE stock
   SET unit_price = unit_price * 1.07;
```

Using a Subquery to Update a Column

You can update a column with the value that a subquery returns.

```
UPDATE orders
   SET ship_charge =
      (SELECT SUM(total_price) * .07 FROM items
         WHERE orders.order_num = items.order_num)
      WHERE orders.order_num = 1001
```

In Dynamic Server, if you are updating a supertable in a table hierarchy, the SET clause cannot include a subquery that references a subtable. If you are updating a subtable in a table hierarchy, a subquery in the SET clause can reference the supertable if it references only the supertable. That is, the subquery must use the SELECT...FROM ONLY (*supertable*) syntax.

Updating a Column to NULL

Use the NULL keyword to modify a column value when you use the UPDATE statement. For example, for a customer whose previous address required two address lines but now requires only one, you would use the following entry:

```
UPDATE customer
   SET address1 = '123 New Street',
   SET address2 = null,
   city = 'Palo Alto',
   zipcode = '94303'
   WHERE customer_num = 134
```

Updating the Same Column Twice

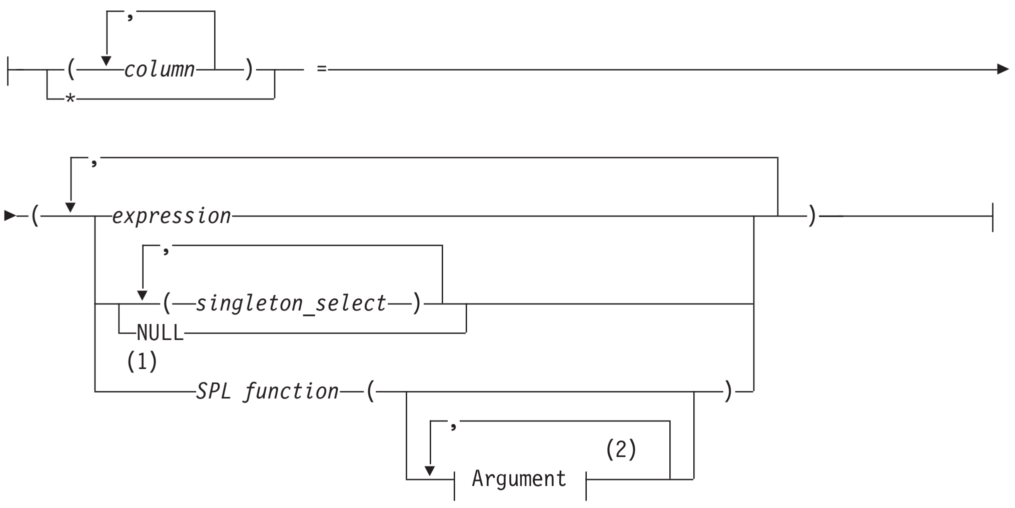
You can specify the same column more than once in the SET clause. If you do so, the column is set to the last value that you specified for the column. In the next example, the **fname** column appears twice in the SET clause. For the row where the customer number is `101`, the user sets **fname** first to `gary` and then to `harry`. After the UPDATE statement executes, the value of **fname** is `harry`.

```
UPDATE customer
   SET fname = "gary", fname = "harry"
      WHERE customer_num = 101
```

Multiple-Column Format

Use the multiple-column format of the SET clause to list multiple columns and set them equal to corresponding expressions.

Multiple-Column Format:



Notes:

1 Extended Parallel Server only

2 See page 5-2

Element	Description	Restrictions	Syntax
column	Name of a column to be updated	Cannot have a serial or ROW type. The number of *column* names must equal the number of values returned to the right of the = sign.	Identifier, p. 5-22
expression	Expression that returns a value for a *column*	Cannot include aggregate functions	Expression, p. 4-34
singleton_ select	Subquery that returns exactly one row	Values that the subquery returns must correspond to columns in the *column* list	SELECT, p. 2-479
SPL function	SPL routine that returns one or more values	Returned values must have a 1-to-1 correspondence to columns in *the column* list	Identifier, p. 5-22

The multiple-column format of the SET clause offers the following options for listing a set of columns that you intend to update:

- Explicitly list each column, placing commas between columns and enclosing the set of columns between parentheses.
- Implicitly list all columns in the table by using an asterisk (*).

You must list each expression explicitly, placing comma (,) separators between expressions and enclosing the set of expressions between parentheses. The number of columns must equal the number of values returned by the expression list, unless the expression list includes an SQL subquery.

The following examples show the multiple-column format of the SET clause:

```
UPDATE customer
   SET (fname, lname) = ('John', 'Doe') WHERE customer_num = 101

UPDATE manufact
   SET * = ('HNT', 'Hunter') WHERE manu_code = 'ANZ'
```

Using a Subquery to Update Column Values

The expression list can include one or more subqueries. Each must return a single row containing one or more values. The number of columns that the SET clause explicitly or implicitly specifies must equal the number of values returned by the expression (or expression list) that follows the equal (=) sign.

The subquery must be enclosed between parentheses. These parentheses are nested within the parentheses that immediately follow the equal (=) sign. If the expression list includes multiple subqueries, each subquery must be enclosed between parentheses, with a comma (,) separating successive subqueries:

```
UPDATE ... SET ... = ((subqueryA),(subqueryB), ... (subqueryN))
```

The following examples show the use of subqueries in the SET clause:

```
UPDATE items
   SET (stock_num, manu_code, quantity) =
      ( (SELECT stock_num, manu_code FROM stock
         WHERE description = 'baseball'), 2)
   WHERE item_num = 1 AND order_num = 1001

UPDATE table1
   SET (col1, col2, col3) =
      ((SELECT MIN (ship_charge), MAX (ship_charge) FROM orders), '07/01/1997')
   WHERE col4 = 1001
```

In Dynamic Server, if you are updating a supertable in a table hierarchy, the SET clause cannot include a subquery that references one of its subtables. If you are updating a subtable in a table hierarchy, a subquery in the SET clause can reference the supertable if it references only the supertable. That is, the subquery must use the SELECT... FROM ONLY (*supertable*) syntax.

Using an SPL Function to Update Column Values (XPS)

When you use an SPL function to update column values, the returned values of the function must have a one-to-one correspondence with the listed columns. That is, each value that the SPL function returns must be of the data type expected by the corresponding column in the column list.

If the called SPL routine contains certain SQL statements, a runtime error occurs. For information on which SQL statements cannot be used in an SPL routine that is called in a data-manipulation statement, see "Restrictions on SPL Routines in

Data-Manipulation Statements" on page 5-71. In the next example, the SPL function **p2( )** updates the **i2** and **c2** columns of the **t2** table:

```
CREATE PROCEDURE p2() RETURNING int, char(20);
   RETURN 3, 'three';
END PROCEDURE;
UPDATE t2 SET (i2, c2) = (p2()) WHERE i2 = 2;
```

In Extended Parallel Server, you create an SPL function with the CREATE PROCEDURE statement. The CREATE FUNCTION statement is not available.

Updating ROW-Type Columns (IDS)

Use the SET clause to update a named or unnamed ROW-type column. For example, suppose you define the following named ROW type and a table that contains columns of both named and unnamed ROW types:

```
CREATE ROW TYPE address_t
(
   street CHAR(20), city CHAR(15), state CHAR(2)
);
CREATE TABLE empinfo
(
   emp_id INT
   name ROW ( fname CHAR(20), lname CHAR(20)),
   address address_t
);
```

To update an unnamed ROW type, specify the ROW constructor before the parenthesized list of field values.

The following statement updates the **name** column (an unnamed ROW type) of the **empinfo** table:

```
UPDATE empinfo SET name = ROW('John','Williams') WHERE emp_id =455
```

To update a named ROW type, specify the ROW constructor before the list (in parentheses) of field values, and use the cast (**::**) operator to cast the ROW value as a named ROW type. The following statement updates the **address** column (a named ROW type) of the **empinfo** table:

```
UPDATE empinfo
SET address = ROW('103 Baker St','Tracy','CA')::address_t
WHERE emp_id = 3568
```

For more information on the syntax for ROW constructors, see "Constructor Expressions (IDS)" on page 4-63. See also "Literal Row" on page 4-139.

The ROW-column SET clause can only support literal values for fields. To use an ESQL/C variable to specify a field value, you must select the ROW data into a **row** variable, use host variables for the individual field values, then update the ROW column with the **row** variable. For more information, see "Updating a Row Variable (IDS, ESQL/C)" on page 2-647.

You can use ESQL/C host variables to insert *non-literal* values as:

- An entire row type into a column

  Use a **row** variable as a variable name in the SET clause to update all fields in a ROW column at one time.
- Individual fields of a ROW type

  To insert non-literal values into a ROW-type column, you can first update the elements in a **row** variable and then specify the **collection** variable in the SET clause of an UPDATE statement.

When you use a **row** variable in the SET clause, the **row** variable must contain values for each field value. For information on how to insert values into a **row** variable, see "Updating a Row Variable (IDS, ESQL/C)" on page 2-647.

You can use the UPDATE statement to modify only some of the fields in a row:

- Specify the field names with field projection for all fields whose values remain unchanged.

  For example, the following UPDATE statement changes only the **street** and **city** fields of the **address** column of the **empinfo** table:

  ```
  UPDATE empinfo
  SET address = ROW('23 Elm St', 'Sacramento',
                address.state)
     WHERE emp_id = 433
  ```

  The **address.state** field remains unchanged.
- Select the row into an ESQL/C **row** variable and update the desired fields.

  For more information, see "Updating a Row Variable (IDS, ESQL/C)" on page 2-647.

Updating Collection Columns (IDS)

You can use the SET clause to update values in a collection column. For more information, see "Collection Constructors" on page 4-65.

A collection variable can update a collection-type column. With a collection variable, you can insert one or more individual elements of a collection. For more information, see "Collection-Derived Table" on page 5-5.

For example, suppose you define the **tab1** table as follows:

```
CREATE TABLE tab1
(
   int1 INTEGER,
   list1 LIST(ROW(a INTEGER, b CHAR(5)) NOT NULL),
   dec1 DECIMAL(5,2)
)
```

The following UPDATE statement updates a row in **tab1**:

```
UPDATE tab1
   SET list1 = LIST{ROW(2, 'zyxwv'),
      ROW(POW(2,6), '=64'),
      ROW(ROUND(ROOT(146)), '=12')},
   where int1 = 10
```

Collection column **list1** in this example has three elements. Each element is an unnamed ROW type with an INTEGER field and a CHAR(5) field. The first element includes two literal values: an integer (`2`) and a quoted string (`'zyxwv'`).

The second and third elements also use a quoted string to indicate the value for the second field. They each designate the value for the first field with an expression, however, rather than with a literal value.

Updating Values in Opaque-Type Columns (IDS)

Some opaque data types require special processing when they are updated. For example, if an opaque data type contains spatial or multirepresentational data, it might provide a choice of how to store the data: inside the internal structure or, for large objects, in a smart large object.

This processing is accomplished by calling a user-defined support function called **assign( )**. When you execute UPDATE on a table whose rows contain one of these opaque types, the database server automatically invokes the **assign( )** function for the type. This function can make the decision of how to store the data. For more information about the **assign( )** support function, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Data Types in Distributed UPDATE Operations (IDS)

In Dynamic Server, an UPDATE (or any other SQL data-manipulation language statement) that accesses a database of another database server can only reference the built-in data types that are not opaque, DISTINCT, extended, nor large-object types. Cross-server DML operations cannot reference a column or expression of an opaque, DISTINCT, complex, large-object, nor user-defined data type (UDT).

Distributed operations that access other databases of the local Dynamic Server instance, however, can also access most *built-in opaque data types*, which are listed in "BOOLEAN and Other Built-In Opaque Data Types (IDS)" on page 4-19.

Updates across databases of the local Dynamic Server instance can also reference UDTs, as well as DISTINCT types based on built-in data types, if all the UDTs and DISTINCT types are explicitly cast to built-in data types, and all the UDTs, DISTINCT types, and casts are defined in each of the participating databases.

Updates cannot access the database of another database server unless both servers define TCP/IP connections in DBSERVERNAME or DBSERVERALIAS configuration parameters. This applies to any communication between Dynamic Server instances, even if both database servers reside on the same computer.

Subset of FROM Clause

You can use a join to determine which column values to update by specifying a FROM clause. Columns from any table in the FROM clause can appear in the WHERE clause to provide values for the columns and rows to update. For example, in the following UPDATE statement, a FROM clause introduces tables to be joined in the WHERE clause:

```
UPDATE tab1 SET tab1.a = tab2.a FROM tab1, tab2, tab3
   WHERE tab1.b = tab2.b AND tab2.c =tab3.c
```

UPDATE supports only a subset of the syntax listed in "FROM Clause" on page 2-492. You cannot include the LOCAL or the SAMPLES OF keywords if you are using Extended Parallel Server.

WHERE Clause

The WHERE clause lets you specify search criteria to limit the rows to be updated. If you omit the WHERE clause, every row in the table is updated. For more information, see the "WHERE Clause" on page 2-507.

The next example uses WHERE and FROM clauses to update three columns (**state**, **zipcode**, and **phone**) in each row of the **customer** table that has a corresponding entry in a table of new addresses called **new_address**:

```
UPDATE customer
   SET (state, zipcode, phone) =
      ((SELECT state, zipcode, phone FROM new_address N
         WHERE N.cust_num = customer.customer_num))
      WHERE customer_num IN
         (SELECT cust_num FROM new_address)
```

SQLSTATE Values When Updating an ANSI-Compliant Database

If you update a table in an ANSI-compliant database with an UPDATE statement that contains the WHERE clause and no rows are found, the database server issues a warning.

You can detect this warning condition in either of the following ways:

- The GET DIAGNOSTICS statement sets the **RETURNED_SQLSTATE** field to the value `02000`. In an SQL API application, the **SQLSTATE** variable contains this same value.
- In an SQL API application, the **sqlca.sqlcode** and **SQLCODE** variables contain the value `100`.

The database server also sets **SQLSTATE** and **SQLCODE** to these values if the UPDATE ... WHERE statement is part of a multistatement PREPARE and the database server returns no rows.

SQLSTATE Values When Updating a Non-ANSI Database

In a database that is not ANSI compliant, the database server does not return a warning when it finds no matching rows for the WHERE clause of an UPDATE statement. The **SQLSTATE** code is `00000` and the **SQLCODE** code is zero (`0`). If the UPDATE ... WHERE statement is part of a multistatement PREPARE, however, and no rows are returned, the database server issues a warning, and sets **SQLSTATE** to `02000` and sets **SQLCODE** to `100`.

Using the WHERE CURRENT OF Clause (ESQL/C, SPL)

Use the WHERE CURRENT OF clause to update the current row of the active set of a cursor in the current element of a collection cursor.

The UPDATE statement does not advance the cursor to the next row, so the current row position remains unchanged.

For table hierarchies of Dynamic Server, you cannot use this clause if you are selecting from only one table in a table hierarchy. That is, you cannot use this option if you use the ONLY keyword.

To use the WHERE CURRENT OF keywords, you must have previously used the DECLARE statement to define the *cursor* with the FOR UPDATE option.

If the DECLARE statement that created the cursor specified one or more columns in the FOR UPDATE clause, you are restricted to updating only those columns in a subsequent UPDATE ... WHERE CURRENT OF statement. The advantage to specifying columns in the FOR UPDATE clause of a DECLARE statement is speed. The database server can usually perform updates more quickly if columns are specified in the DECLARE statement.

Before you can use the CURRENT OF keywords, you must declare a cursor with the FOREACH statement.

Note: An update cursor can perform updates that are not possible with the UPDATE statement.

The following ESQL/C example illustrates the CURRENT OF form of the WHERE clause. In this example, updates are performed on a range of customers who receive 10-percent discounts (assume that a new column, **discount**, is added to the **customer** table). The UPDATE statement is prepared outside the WHILE loop to ensure that parsing is done only once.

```
char answer [1] = 'y';
EXEC SQL BEGIN DECLARE SECTION;
   char fname[32],lname[32];
   int low,high;
EXEC SQL END DECLARE SECTION;
main()
{
   EXEC SQL connect to 'stores_demo';
   EXEC SQL prepare sel_stmt from
      'select fname, lname from customer \
       where cust_num between ? and ? for update';
EXEC SQL declare x cursor for sel_stmt;
   printf("\nEnter lower limit customer number: ");
   scanf("%d", &low);
   printf("\nEnter upper limit customer number: ");
   scanf("%d", &high);
   EXEC SQL open x using :low, :high;
   EXEC SQL prepare u from
      'update customer set discount = 0.1  where current of x';
   while (1)
      {
      EXEC SQL fetch x into :fname, :lname;
       if ( SQLCODE == SQLNOTFOUND) break;
       }
   printf("\nUpdate %.10s %.10s (y/n)?", fname, lname);
   if (answer = getch() == 'y')
      EXEC SQL execute u;
   EXEC SQL close x;
}
```

Updating a Row Variable (IDS, ESQL/C)

The UPDATE statement with the Collection-Derived-Table segment allows you to update fields in a **row** variable. The Collection-Derived-Table segment identifies the **row** variable in which to update the fields. For more information, see "Collection-Derived Table" on page 5-5.

To update fields:

1. Create a **row** variable in your ESQL/C program.
2. Optionally, select a ROW-type column into the **row** variable with the SELECT statement (without the Collection-Derived-Table segment).
3. Update fields of the **row** variable with the UPDATE statement and the Collection-Derived-Table segment.
4. After the **row** variable contains the correct fields, you then use the UPDATE or INSERT statement on a table or view name to save the **row** variable in the ROW column (named or unnamed).

The UPDATE statement and the Collection-Derived-Table segment allow you to update a field or a group of fields in the **row** variable. Specify the new field values in the SET clause. For example, the following UPDATE changes the **x** and **y** fields in the **myrect** ESQL/C **row** variable:

```
EXEC SQL BEGIN DECLARE SECTION;
   row (x int, y int, length float, width float) myrect;
EXEC SQL END DECLARE SECTION;
. . .
EXEC SQL select into :myrect from rectangles where area = 64;
EXEC SQL update table(:myrect) set x=3, y=4;
```

Suppose that after the SELECT statement, the **myrect2** variable has the values `x=0`, `y=0`, `length=8`, and `width=8`. After the UPDATE statement, the **myrect2** variable has field values of `x=3`, `y=4`, `length=8`, and `width=8`. You cannot use a **row** variable in the Collection-Derived-Table segment of an INSERT statement.

You can, however, use the UPDATE statement and the Collection-Derived-Table segment to insert new field values into a **row** host variable, if you specify a value for every field in the row.

For example, the following code fragment inserts new field values into the **row** variable **myrect** and then inserts this **row** variable into the database:

```
EXEC SQL update table(:myrect)
   set x=3, y=4, length=12, width=6;
EXEC SQL insert into rectangles
   values (72, :myrect);
```

If the **row** variable is an untyped variable, you must use a SELECT statement *before* the UPDATE so that ESQL/C can determine the data types of the fields. An UPDATE of fields in a **row** variable cannot include a WHERE clause.

The **row** variable can store the field values of the row, but it has no intrinsic connection with a database column. Once the **row** variable contains the correct field values, you must then save the variable into the ROW column with one of the following SQL statements:

- To update the ROW column in the table with contents of the **row** variable, use an UPDATE statement on a table or view name and specify the **row** variable in the SET clause. (For more information, see "Updating ROW-Type Columns (IDS)" on page 2-643.)
- To insert a **row** into a column, use the INSERT statement on a table or view name and specify the **row** variable in the VALUES clause. (For more information, see "Inserting Values into ROW-Type Columns (IDS)" on page 2-401.)

For examples of SPL ROW variables, see the *IBM Informix Guide to SQL: Tutorial*. For more information on using ESQL/C **row** variables, see the discussion of complex data types in the *IBM Informix ESQL/C Programmer's Manual*.

Related Information

Related statements: DECLARE, INSERT, OPEN, SELECT, and FOREACH

For a task-oriented discussion of the UPDATE statement, see the *IBM Informix Guide to SQL: Tutorial*.

For a discussion of the GLS aspects of the UPDATE statement, see the *IBM Informix GLS User's Guide*.

For information on how to access row and collections with ESQL/C host variables, see the discussion of complex data types in the *IBM Informix ESQL/C Programmer's Manual*.

UPDATE STATISTICS

Use the UPDATE STATISTICS statement to perform any of the following tasks:

- Calculate the distribution of column values.
- Update system catalog tables that the database server uses to optimize queries.
- Force reoptimization of SPL routines.
- Convert existing indexes when you upgrade the database server.

This statement is an extension to the ANSI/ISO standard for SQL.

Syntax

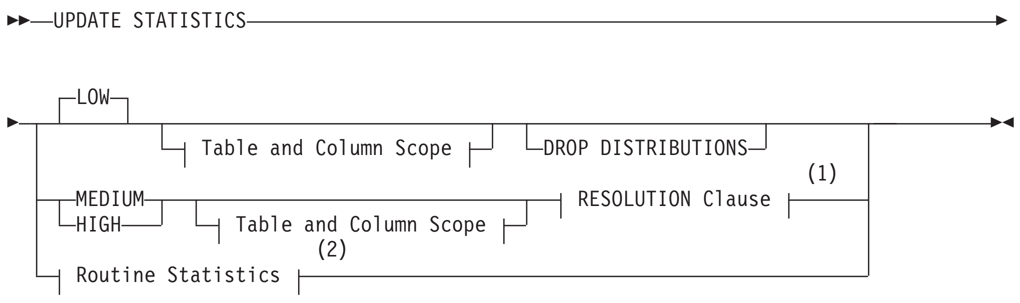
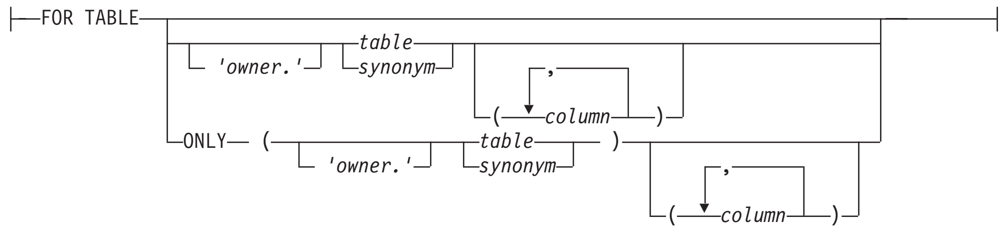


Table and Column Scope:



Notes:

1 See "Resolution Clause" on page 2-654

2 See "Routine Statistics" on page 2-655

Element	Description	Restrictions	Syntax
column	A column in *table* or *synonym*	Must exist. With MEDIUM or HIGH keywords, *column* cannot be of BYTE or TEXT data type	"Identifier" on page 5-22
synonym	Synonym for a table whose statistics are to be updated	The *synonym* and the table to which it points must exist in the current database	"Database Object Name" on page 5-17
table	Table for which statistics are to be updated	Must exist in the current database or be a temporary table created in the current session	"Database Object Name" on page 5-17

Usage

Use the UPDATE STATISTICS statement to update system catalog information that the query optimizer uses for operations on objects in the local database.

You cannot, however, update the statistics for a table or the query plan of a UDR that is external to the current database. That is, the database server ignores remote database objects when executing the UPDATE STATISTICS statement.

Scope of UPDATE STATISTICS

If you include no Table and Column Scope clause and no Resolution clause, then statistics are updated for every table and SPL routine in the current database, including the system catalog tables. Similarly, if you include a clause that begins with the FOR keyword, but do not specify the name of any table or SPL routine, the database server recalculates distributions for all tables, including temporary tables, or reoptimizes the query plans of all SPL routines in the current database.

If you use the FOR TABLE keywords without also specifying a table name, the database server calculates distributions on all of the tables in the current database, and on all of the temporary tables in your session.

In databases of Extended Parallel Server, the UPDATE STATISTICS statement does not update, maintain, or collect statistics on indexes, and it does not update the **syscolumns** or **sysindexes** tables. References to indexes or to the **syscolumns** or **sysindexes** system catalog tables in sections that follow do not apply to Extended Parallel Server.

Updating Statistics for Tables

Although a change to the database might make information in the **systables**, **syscolumns**, **sysindexes**, and **sysdistrib** system catalog tables obsolete, the database server does not automatically update those tables. Issue an UPDATE STATISTICS statement in the following situations to ensure that the stored distribution information reflects the state of the database:

- You perform extensive modifications to a table.
- An application changes the distribution of column values.

  UPDATE STATISTICS reoptimizes queries on the modified objects.
- You upgrade a database for use with a newer database server.

  The UPDATE STATISTICS statement converts the old indexes to conform to the newer database server index format and implicitly drops the old indexes.

  You can convert the indexes table by table or for the entire database at one time. Follow the conversion guidelines in the *IBM Informix Migration Guide*.

If your application makes many modifications to the data in a particular table, update the system catalog for that table routinely with UPDATE STATISTICS to improve query efficiency. The term *many modifications* is relative to the resolution of the distributions. If the data modifications have little effect on the distribution of column values, you do not need to execute UPDATE STATISTICS.

Using the ONLY Keyword (IDS)

Use the ONLY keyword to collect data for one table in a hierarchy of typed tables. If you do not specify the ONLY keyword and the table that you specify has subtables, the database server creates distributions for that table and every table under it in the hierarchy.

For example, assume your database has the typed table hierarchy that appears in Figure 2-2, which shows a supertable named **employee** that has a subtable named **sales_rep**. The **sales_rep** table, in turn, has a subtable named **us_sales_rep.**

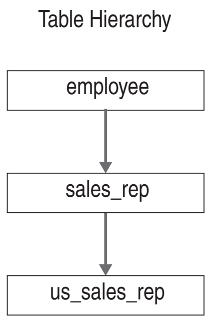


Figure 2-2. Example of Typed Table Hierarchy

When the following statement executes, the database server generates statistics on both the **sales_rep** and **us_sales_rep** tables:

```
UPDATE STATISTICS FOR TABLE sales_rep
```

In contrast, the following example generates statistical data for each column in table **sales_rep** but does not act on tables **employee** or **us_sales_rep**:

```
UPDATE STATISTICS FOR TABLE ONLY (sales_rep)
```

Because neither of the previous examples specified the level at which to update the statistical data, the database server uses the LOW mode by default.

3 Updating Statistics for Columns

3 The Table and Column Scope specification can also include the names of one or
3 more columns for which you want distributions calculated. For example, this
3 statement calculates the distributions for three columns of the **orders** table:

3
```
UPDATE STATISTICS FOR TABLE orders (order_num, customer_num, ship_date)
```

3 If you include no *column* name in the FOR TABLE clause, then distributions are
3 calculated for all columns of the specified *table*, using to the LOW, MEDIUM, or
3 HIGH mode and the RESOLUTION percentage that you request. .

3 Distributions are not calculated for BYTE or TEXT columns. See also "Updating
3 Statistics for Columns of User-Defined Types (IDS)" on page 2-652 for UPDATE
3 STATISTICS restrictions on columns that store UDTs.

Examining Index Pages

In Dynamic Server, when you execute the UPDATE STATISTICS statement in any mode, the database server reads through index pages to:

- Compute statistics for the query optimizer
- Locate pages that have the delete flag marked as 1

If pages are found with the delete flag marked as 1, the corresponding keys are removed from the B-tree cleaner list.

This operation is particularly useful if a system failure causes the B-tree cleaner list (which exists in shared memory) to be lost. To remove the B-tree items that have been marked as deleted but are not yet removed from the B-tree, run the UPDATE STATISTICS statement. For information on the B-tree cleaner list, see your *IBM Informix Administrator's Guide*.

Updating Statistics for Columns of User-Defined Types (IDS)

To collect statistics for a column of a user-defined data type, you must specify either medium or high mode. When you execute UPDATE STATISTICS, the database server does not collect values for the **colmin** and **colmax** columns of the **syscolumns** table for columns that hold user-defined data types.

To drop statistics for a column that holds one of these data types, you must execute UPDATE STATISTICS in the LOW mode with the DROP DISTRIBUTIONS option. When you use this option, the database server removes the row in the **sysdistrib** system catalog table that corresponds to the **tableid** and **column**. In addition, the database server removes any large objects that might have been created for storing the statistics information.

Requirements

UPDATE STATISTICS collects statistics for opaque data types only if you have defined user-defined routines for **statcollect( )**, **statprint( )**, and the selectivity functions. You must have Usage privilege on these routines.

In some cases, UPDATE STATISTICS also requires an sbspace as specified by the SYSSBSPACENAME configuration parameter. For information about how to provide statistical data for a column, refer to the *IBM Informix DataBlade API Programmer's Guide*. For information about SYSSBSPACENAME, refer to your *IBM Informix Administrator's Reference*.

Using the LOW Mode Option

Use the LOW option to generate and update some of the relevant statistical data regarding table, row, and page count statistics in the **systables** system catalog table. If you do not specify any mode, the LOW mode is the default.

In Dynamic Server, the LOW mode also generates and updates some index and column statistics for specified columns in the **syscolumns** and the **sysindexes** system catalog tables.

The LOW mode generates the least amount of information about the column. If you want the UPDATE STATISTICS statement to do minimal work, specify a column that is not part of an index. The **colmax** and **colmin** values in **syscolumns** are not updated unless there is an index on the column.

The following example updates statistics on the **customer_num** column of the **customer** table:

```
UPDATE STATISTICS LOW FOR TABLE customer (customer_num)
```

Because the LOW mode option does not update data in the **sysdistrib** system catalog table, all distributions associated with the **customer** table remain intact, even those that already exist on the **customer_num** column.

Using the DROP DISTRIBUTIONS Option

Use the DROP DISTRIBUTIONS option to force the removal of distribution information from the **sysdistrib** system catalog table.

When you specify the DROP DISTRIBUTIONS option, the database server removes the existing distribution data for the column or columns that you specify. If you do not specify any columns, the database server removes all the distribution data for that table.

You must have the DBA privilege or be owner of the table to use this option.

The following example shows how to remove distributions for the **customer_num** column in the **customer** table:

```
UPDATE STATISTICS LOW
   FOR TABLE customer (customer_num) DROP DISTRIBUTIONS
```

As the example shows, you drop the distribution data at the same time you update the statistical data that the low mode option generates.

Using the MEDIUM Mode Option

Use the MEDIUM mode option to update the same statistics that you can perform with the LOW mode option and also generate statistics about the distribution of data values for each specified column. The database server places distribution information in the **sysdistrib** system catalog table.

If you use the MEDIUM mode option, the database server scans tables at least once and takes longer to execute on a given table than the LOW mode option.

When you use the MEDIUM mode option, the data for the distributions is obtained by sampling a percentage of data rows, using a statistical confidence level that you specify, or else a default confidence level of 95 percent.

Because the MEDIUM sample size is usually much smaller than the actual number of rows, this mode executes more quickly than the HIGH mode.

Because the distribution is obtained by sampling, the results can vary, because different samples of rows might produce different distribution results. If the results vary significantly, you can lower the resolution percent or increase the confidence level to obtain more consistent results.

If you specify no RESOLUTION clause, the default average percentage of the sample in each bin is `2.5`, dividing the range into 40 intervals. If you do not specify a value for *confidence_level*, the default level is `0.95`. This value can be roughly interpreted to mean that 95 times out of 100, the estimate is not statistically different from what would be obtained from high distributions.

You must have the DBA privilege or be the owner of the table to create medium distributions. For more on the MEDIUM and HIGH mode options, see the "Resolution Clause" on page 2-654.

Using the HIGH Mode Option

Use the HIGH mode option to update the same statistics that you can perform with the LOW mode option and also generate statistics about the distribution of data values for each specified column. The database server places distribution information in the **sysdistrib** system catalog table.

If you do not specify a RESOLUTION clause, the default percentage of data distributed to every bin is `0.5`, partitioning the range of values for each column into 200 intervals.

The constructed distribution is exact. Because more information is gathered, this mode executes more slowly than LOW or MEDIUM modes. If you use the HIGH mode option of update statistics, the database server can take considerable time to gather the information across the database, particularly a database with large tables. The HIGH keyword might scan each table several times (for each column). To minimize processing time, specify a table name and column names within that table.

You must have the DBA privilege or be the owner of the table to create HIGH distributions. For more information on the MEDIUM and HIGH mode options, see the “Resolution Clause” on page 2-654.

Resolution Clause

Use the Resolution clause to adjust the size of the distribution bin, designate whether or not to avoid calculating data on indexes, and with the MEDIUM mode, to adjust the confidence level.

RESOLUTION Clause:

```
|──┬─| RESOLUTION Clause for MEDIUM Mode |─┬──────────────────────────|
   └─| RESOLUTION Clause for HIGH Mode |───┘
```

RESOLUTION Clause for MEDIUM Mode:

```
|──RESOLUTION──percent──┬──────────────────┬──┬─────────────────────────┬──────|
                        └─confidence_level─┘  │ (1)                     │
                                              └────────DISTRIBUTIONS ONLY─┘
```

RESOLUTION Clause for HIGH Mode:

```
|──RESOLUTION──percent──┬─────────────────────────┬───────────────────────|
                        │ (1)                     │
                        └────────DISTRIBUTIONS ONLY─┘
```

Notes:

1 Dynamic Server only

Element	Description	Restrictions	Syntax
confidence_level	Estimated fraction of the time that sampling in MEDIUM mode should produce same results as the exact HIGH mode. Default level is 0.95.	Must be within the range from 0.80 (minimum) to 0.99 (maximum)	“Literal Number” on page 4-137
percent	Percentage of sample in each bin of distribution Default is 2.5 for MEDIUM and 0.5 for HIGH.	Minimum resolution is 1/*nrows*, for *nrows* the number of rows in the table	“Literal Number” on page 4-137

A *distribution* is a mapping of the data in a column into a set of column values, ordered by magnitude or by collation. The range of these sample values is partitioned into disjunct intervals, called *bins*, each containing an approximately equal portion of the sample of column values. For example, if one bin holds 2 percent of the data, 50 such intervals hold the entire sample.

Some statistical texts call these bins *equivalence categories*. Each contains a subset of the range of the data values that are sampled from the column.

The optimizer estimates the effect of a WHERE clause by examining, for each column included in the WHERE clause, the proportionate occurrence of data values contained in the column.

You cannot create distributions for BYTE or TEXT columns. If you include a BYTE or TEXT column in an UPDATE STATISTICS statement that specifies medium or high distributions, no distributions are created for those columns. Distributions are constructed for other columns in the list, however, and the statement does not return an error.

Columns of the VARCHAR data type do not use overflow bins, even when multiple bins are being used for duplicate values.

The amount of space that the **DBUPSPACE** environment variable specifies determines the number of times the database server scans the designated table to construct a distribution.

Using the DISTRIBUTIONS ONLY Option to Suppress Index Information

In Dynamic Server, when you specify the DISTRIBUTIONS ONLY option, you do not update index information. This option does not affect existing index information.

Use this option to avoid the examination of index information that can consume considerable processing time.

This option does not affect the recalculation of information on tables, such as the number of pages used, the number of rows, and fragment information. UPDATE STATISTICS needs this information to construct accurate column distributions and requires little time and system resources to collect it.

Routine Statistics

3 Before the database server executes a new SPL routine the first time, it optimizes
3 the statements in the SPL routine. Optimization makes the code depend on the
3 structure of tables referenced by the routine. If a table schema changes after the
3 routine is optimized, but before it is executed, the routine can fail with an error.

To avoid this error after DDL operations, or to reoptimize SPL routines after table distributions might have been modified by DML operations, you can use the Routine Statistics segment of UPDATE STATISTICS to update the optimized execution plans for SPL routines in the **sysprocplan** system catalog table.

Routine Statistics:

```
├──FOR──┬─PROCEDURE──┬──────────┬───────────────────────────────────────────┬──────────┤
        │            └─routine──┘                                           │
        │  (1)                                                              │
        ├──────────┬─PROCEDURE─┬──┬────────────────────────────────────────┬─┤
        │          ├─FUNCTION──┤  └─routine──(──┬──────────────────────┬─)─┘ │
        │          └─ROUTINE───┘                │                 (2)  │     │
        │                                       └─┤ Routine Parameter List ├─┘  │
        │                           (3)                                     │
        └─SPECIFIC──┬─PROCEDURE─┬─┤ Specific Name ├─────────────────────────┘
                    ├─FUNCTION──┤
                    └─ROUTINE───┘
```

Notes:

1 Dynamic Server only

2 See "Routine Parameter List" on page 5-61

3 See "Specific Name" on page 5-68

Element	Description	Restrictions	Syntax
routine	Name declared for a SPL routine in a CREATE FUNCTION or CREATE PROCEDURE statement	Must reside in the database. In ANSI-compliant databases, qualify *routine* with *owner* if you are not *owner*.	"Database Object Name" on page 5-17

The following table explains the keywords of the Routine Statistics segment.

Keyword	**Which Execution Plan is Reoptimized**
SPECIFIC	The plan for the SPL routine called *specific name*
FUNCTION	The plan for any SPL function with the specified name (and with parameter types that match *routine parameter list,* if supplied)
PROCEDURE	The plan for any SPL procedure with the specified name (and parameter types that match *routine parameter list,* if supplied)
ROUTINE	The plan for SPL functions and procedures with the specified name (and parameter types that match *routine parameter list*, if supplied)

If you specify no *routine*, the execution plans are reoptimized for all SPL routines in the current database.

3 The database server keeps a list of tables that the SPL routine references explicitly.
3 Whenever an explicitly referenced table is modified, the database server
3 reoptimizes the procedure the next time the procedure is executed.

The **sysprocplan** system catalog table stores execution plans for SPL routines. Two actions can update the **sysprocplan** system catalog table:

- Execution of an SPL routine that uses a modified table
- The UPDATE STATISTICS statement

If you change a table that an SPL routine references, you can run UPDATE STATISTICS to reoptimize the procedures that reference the table, rather than waiting until the next time an SPL routine that uses the table executes. (If a table that an SPL routine references is dropped, however, running UPDATE STATISTICS cannot prevent the SPL routine from failing with an error.)

3 Altered Tables that are Referenced Indirectly in SPL Routines

3 If the SPL routine depends on a table that is referenced only indirectly, however,
3 the database server cannot detect the need to reoptimize the procedure after that
3 table is modified. For example, a table can be referenced indirectly if the SPL
3 routine invokes a trigger. If the schema of a table that is referenced by the trigger
3 (but not directly by the SPL routine) is changed, the database server does not
3 know that it should reoptimize the SPL routine before running it. When the
3 procedure is run after the table has been changed, error -710 can occur.

3 Each SPL routine is optimized the first time that it is run (not when it is created).
3 This behavior means that an SPL routine might succeed the first time it is run but
3 fail later under virtually identical circumstances, if the schema of an indirectly
3 referenced table has been changed. The failure of an SPL routine can also be
3 intermittent, because failure during one execution forces an internal warning to
3 reoptimize the procedure before the next execution.

3 You can use either of two methods to recover from this error:

- 3 Issue UPDATE STATISTICS to force reoptimization of the routine.
- 3 Rerun the routine.

3 To prevent this error, you can force reoptimization of the SPL routine. To force
3 reoptimization, execute the following statement:

```
3 UPDATE STATISTICS FOR PROCEDURE routine
```

3 You can add this statement to your program in either of the following ways:

- 3 Issue UPDATE STATISTICS after each statement that changes the mode of an
  3 object.
- 3 Issue UPDATE STATISTICS before each invocation of the SPL routine

3 For efficiency, you can put the UPDATE STATISTICS statement with the action that
3 occurs less frequently in the program (change of object mode or execution of the
3 procedure). In most cases, the action that occurs less frequently in the program is
3 the change of object mode.

3 When you follow this method of recovering from this error, you must execute
3 UPDATE STATISTICS for each procedure that indirectly references the altered
3 tables unless the procedure also references the tables explicitly.

3 You can also recover from error -710 after an indirectly referenced table is altered
3 simply by re-executing the SPL routine. The first time that the stored procedure
3 fails, the database server marks the procedure as in need of reoptimization. The
3 next time that you run the procedure, the database server reoptimizes the
3 procedure before running it. Running the SPL routine twice, however, might be
3 neither practical nor safe. A safer choice is to use the UPDATE STATISTICS
3 statement to force reoptimization of the procedure.

Updating Statistics When You Upgrade the Database Server (IDS)

When you upgrade a database to use with a newer database server, you can use the UPDATE STATISTICS statement to convert the indexes to the form that the newer database server uses. You can choose to convert the indexes one table at a time or for the entire database at one time. Follow the conversion guidelines that are outlined in the *IBM Informix Migration Guide*.

When you use the UPDATE STATISTICS statement to convert the indexes to use with a newer database server, the indexes are implicitly dropped and re-created. The only time that an UPDATE STATISTICS statement causes table indexes to be implicitly dropped and re-created is when you upgrade a database for use with a newer database server.

Performance

The more specific you make the list of objects that UPDATE STATISTICS examines, the faster it completes execution. Limiting the number of columns distributed speeds the update. Similarly, precision affects the speed of the update. If all other keywords are the same, LOW works fastest, but HIGH examines the most data.

Related Statements

Related statements: SET EXPLAIN and SET OPTIMIZATION

For a discussion of the performance implications of UPDATE STATISTICS, see your *IBM Informix Performance Guide*.

For a discussion of how to use the **dbschema** utility to view distributions created with UPDATE STATISTICS, see the *IBM Informix Migration Guide*.

WHENEVER

Use the WHENEVER statement to trap exceptions that occur during the execution of SQL statements. Use this statement only with ESQL/C.

Syntax

```
>>──WHENEVER──┬─SQLERROR─────────────┬──┬─CONTINUE──────────────────────────┬──────────><
              ├─NOT FOUND────────────┤  ├─┬─GOTO──┬──┬─:label──────────┬────┤
              │  (1)                 │  │ └─GO TO─┘  │  (1)            │    │
              ├───────────SQLWARNING─┤  │            └─────────label───┘    │
              │  (1)                 │  ├─CALL──routine─────────────────────┤
              └───────────ERROR──────┘  └─STOP──────────────────────────────┘
```

Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
label	Statement label to which program control transfers when an exception occurs	Must exist in the same source-code module.	Language-specific
routine	Name of a user-defined routine (UDR) to be invoked when an exception occurs	No arguments; UDR must exist at compile time.	"Database Object Name" on page 5-17

Usage

The WHENEVER statement is equivalent to placing an exception-checking routine after every SQL statement. The following table summarizes the types of exceptions for which you can check with the WHENEVER statement.

Type of Exception	WHENEVER Keyword	For More Information
Errors	SQLERROR *or* ERROR	"SQLERROR Keyword" on page 2-661
Warnings	"SQLWARNING Keyword" on page 2-661	
Not Found *or* End of Data	"NOT FOUND Keywords" on page 2-661	

Programs that do not use the WHENEVER statement do not automatically abort when an exception occurs. Such programs must explicitly check for exceptions and take whatever corrective action their logic specifies. If you do not check for exceptions, the program simply continues running. If errors occur, however, the program might not perform its intended purpose.

The first keyword that follows WHENEVER specifies some type of exceptional condition; the last part of the statement specifies some action to take when the exception is encountered (or no action, if CONTINUE is specified). The following table summarizes possible actions that WHENEVER can specify.

Type of Action	WHENEVER Keyword	For More Information
Continue program execution	“CONTINUE Keyword” on page 2-661	
Stop program execution	“STOP Keyword” on page 2-662	
Transfer control to a specified label	GOTO GO TO	“GOTO Keyword” on page 2-662
Transfer control to a UDR	“CALL Clause” on page 2-662	

The Scope of WHENEVER

WHENEVER is a preprocessor directive, rather than an executable statement. The ESQL/C preprocessor, not the database server, handles the interpretation of the WHENEVER statement. When the preprocessor encounters a WHENEVER statement in an ESQL/C source file, it inserts appropriate code into the preprocessed code after each SQL statement, based on the exception and the action that WHENEVER specifies. The scope of the WHENEVER statement begins where the statement appears in the source module and remains in effect until the preprocessor encounters one or the other of the following things while sequentially processing the source module:

- The next WHENEVER statement with the same condition (SQLERROR, SQLWARNING, or NOT FOUND) in the same source module
- The end of the source module

The following ESQL/C example program has three WHENEVER statements, two of which are WHENEVER SQLERROR statements. Line 4 uses STOP with SQLERROR to override the default CONTINUE action for errors.

Line 8 specifies the CONTINUE keyword to return the handling of errors to the default behavior. For all SQL statements between lines 4 and 8, the preprocessor inserts code that checks for errors and halts program execution if an error occurs. Therefore, any errors that the INSERT statement on line 6 generates cause the program to stop.

After line 8, the preprocessor does not insert code to check for errors after SQL statements. Therefore, any errors that the INSERT statement (line 10), the SELECT statement (line 11), and DISCONNECT statement (line 12) generate are ignored. The SELECT statement, however, does not stop program execution if it does not locate any rows; the WHENEVER statement on line 7 tells the program to continue if such an exception occurs:

```
1   main()
2   {
3   EXEC SQL connect to 'test';
4   EXEC SQL WHENEVER SQLERROR STOP;
5   printf("\n\nGoing to try first insert\n\n");
6   EXEC SQL insert into test_color values ('green');
7   EXEC SQL WHENEVER NOT FOUND CONTINUE;
8   EXEC SQL WHENEVER SQLERROR CONTINUE;
9   printf("\n\nGoing to try second insert\n\n");
10   EXEC SQL insert into test_color values ('blue');
11   EXEC SQL select paint_type from paint where color='red';
12   EXEC SQL disconnect all;
13   printf("\n\nProgram over\n\n");
14   }
```

SQLERROR Keyword

If you use the SQLERROR keyword, any SQL statement that encounters an error is handled as the WHENEVER SQLERROR statement directs. If an error occurs, the **sqlcode** variable (**sqlca.sqlcode**, **SQLCODE**) is set to a value less than zero (`0`) and the SQLSTATE variable is set to a class code with a value greater than `02`.

The next example terminates program execution if an SQL error is detected:

```
WHENEVER SQLERROR STOP
```

If you do not include any WHENEVER SQLERROR statements in a program, the default action for WHENEVER SQLERROR is CONTINUE.

ERROR Keyword

Within the WHENEVER statement (and only in this context), the keyword ERROR is a synonym for the SQLERROR keyword.

SQLWARNING Keyword

If you use the SQLWARNING keyword, any SQL statement that generates a warning is handled as the WHENEVER SQLWARNING statement directs. If a warning occurs, the first field (**sqlca.sqlwarn.sqlwarn0**) of the warning structure in SQLCA is set to `W`, and the SQLSTATE variable is set to a class code of `01`.

Besides the first field of the warning structure, a warning also sets an additional field to `W`. The field that is set indicates what type of warning occurred.

The next statement causes execution to stop if a warning condition exists:

```
WHENEVER SQLWARNING STOP
```

If you do not use any WHENEVER SQLWARNING statements in a program, the default action for WHENEVER SQLWARNING is CONTINUE.

NOT FOUND Keywords

If you use the NOT FOUND keywords, exception handling for SELECT and FETCH statements (including implicit SELECT and FETCH statements in FOREACH and UNLOAD statements) is treated differently from other SQL statements. The NOT FOUND keyword checks for the following cases:

- The **End of Data** condition: a FETCH statement that attempts to get a row beyond the first or last row in the active set
- The **Not Found** condition: a SELECT statement that returns no rows

In each case, the **sqlcode** variable is set to `100`, and the SQLSTATE variable has a class code of `02`. For the name of the **sqlcode** variable in each IBM Informix product, see the table in "SQLERROR Keyword" on page 2-661.

The following statement calls the **no_rows( )** function each time the NOT FOUND condition exists:

```
WHENEVER NOT FOUND CALL no_rows
```

If you do not use any WHENEVER NOT FOUND statements in a program, the default action for WHENEVER NOT FOUND is CONTINUE.

CONTINUE Keyword

Use the CONTINUE keyword to instruct the program to ignore the exception and to continue execution at the next statement after the SQL statement. The default action for all exceptions is CONTINUE. You can use this keyword to turn off a previously specified action for an exceptional condition.

STOP Keyword

Use the STOP keyword to instruct the program to stop execution when the specified exception occurs. The following statement halts execution of an ESQL/C program each time that an SQL statement generates a warning:

```
EXEC SQL WHENEVER SQLWARNING STOP;
```

GOTO Keyword

Use the GOTO clause to transfer control to the statement that the label identifies when a specified exception occurs. The GOTO and GO TO keywords are ANSI-compliant syntax for this feature of embedded SQL languages like ESQL/C. The following ESQL/C code fragment shows a WHENEVER statement that transfers control to the label **missing** each time that the NOT FOUND condition occurs:

```
query_data()
   ...
   EXEC SQL WHENEVER NOT FOUND GO TO missing;

   ...
   EXEC SQL fetch lname into :lname;
   ...
   missing:
      printf("No Customers Found\n");
```

Within the scope of the WHENEVER GOTO statement, you must define the labeled statement in *each* routine that contains SQL statements. If your program contains more than one user-defined function, you might need to include the labeled statement and its code in *each* function.

If the preprocessor encounters an SQL statement within the scope of a WHENEVER ... GOTO statement, but within a routine that does not have the specified label, the preprocessor tries to insert the code associated with the labeled statement, but generates an error when it cannot find the label.

To correct this error, either put a labeled statement with the same label name in each UDR, or issue another WHENEVER statement to reset the error condition, or use the CALL clause to call a separate function.

CALL Clause

Use the CALL clause to transfer program control to the specified UDR when the specified type of exception occurs. Do not include parentheses after the UDR name. The following WHENEVER statement causes the program to call the **error_recovery()** function if the program detects an error:

```
EXEC SQL WHENEVER SQLERROR CALL error_recovery;
```

When the UDR returns, execution resumes at the next statement after the line that is causing the error. If you want to halt execution when an error occurs, include statements that terminate the program as part of the specified UDR.

Observe the following restrictions on the specified routine:

- The UDR cannot accept arguments nor can it return values. If it needs external information, use global variables or the WHENEVER ... GOTO option to transfer program control to a label that calls the UDR.

- You cannot specify the name of an SPL routine in the CALL clause. To call an SPL routine, use the CALL clause to invoke a UDR that contains the EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement.
- Make sure that all functions within the scope of WHENEVER ... CALL statements can find a declaration of the specified function.

Related Statements

Related statements: EXECUTE FUNCTION, EXECUTE PROCEDURE, and FETCH

For discussions on exception handling and error checking, see the *IBM Informix ESQL/C Programmer's Manual*.

Chapter 3. SPL Statements

In This Chapter

You can use Stored Procedure Language (SPL) statements to write SPL routines (formerly referred to as *stored procedures*), and you can store these routines in the database as user-defined routines (UDRs). SPL routines are effective tools for controlling SQL activity. This chapter contains descriptions of the SPL statements. The description of each statement includes the following information:

- A brief introduction that explains the effect of the statement
- A syntax diagram that shows how to enter the statement correctly
- A syntax table that explains each input parameter in the syntax diagram
- Rules of usage, including examples that illustrate these rules

If a statement is composed of multiple clauses, the statement description provides information about each clause.

For an overview of the SPL language and task-oriented information about creating and using SPL routines, see the *IBM Informix Guide to SQL: Tutorial*.

In Extended Parallel Server, to create an SPL function you must use the CREATE PROCEDURE statement or the CREATE PROCEDURE FROM statement. Extended Parallel Server does not support the CREATE FUNCTION statement nor the CREATE FUNCTION FROM statement.

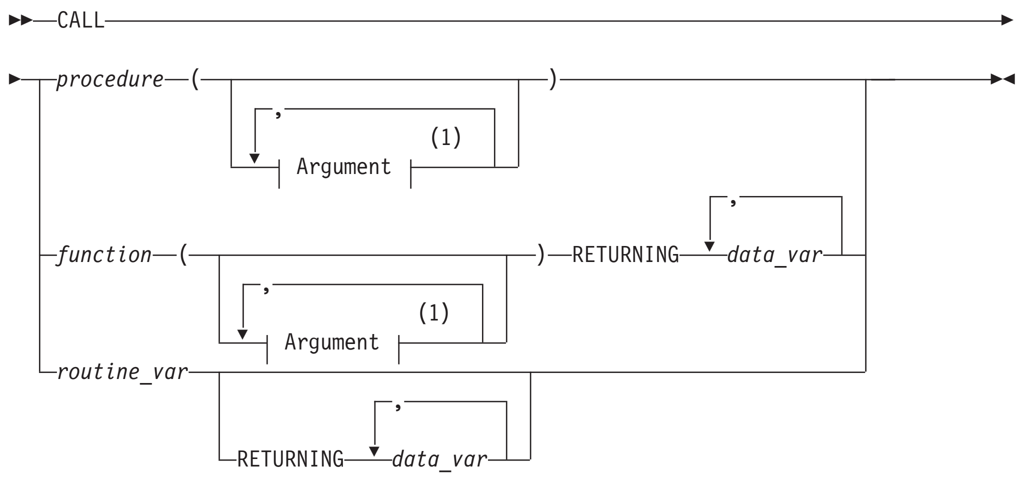
In Dynamic Server, for backward compatibility, you can create an SPL function with the CREATE PROCEDURE or CREATE PROCEDURE FROM statement. For external functions, you must use the CREATE FUNCTION or CREATE FUNCTION FROM statement. It is recommended that you use the CREATE FUNCTION or CREATE FUNCTION FROM statement when you create new user-defined functions.

The SPL language does not support dynamic SQL. You cannot include any of the SQL statements that Chapter 1, “Overview of SQL Syntax” classifies as “Dynamic Management Statements” within an SPL routine.

CALL

Use the CALL statement to execute a user-defined routine (UDR) from within an SPL routine.

Syntax



Notes:

1 See "Arguments" on page 5-2

Element	Description	Restrictions	Syntax
data_var	Variable to receive the values *function* returns	The data type of *data_var* must be appropriate for the returned value	"Identifier" on page 5-22
function, *procedure*	User-defined function or procedure	The function or procedure must exist	"Database Object Name" on page 5-17
routine_var	Variable that contains the name of a UDR	Must be a character data type that contains the non-NULL name of an existing UDR	"Identifier" on page 5-22

Usage

The CALL statement invokes a UDR. The CALL statement is identical in behavior to the EXECUTE PROCEDURE and EXECUTE FUNCTION statements, but you can only use CALL from within an SPL routine.

You can use CALL in an ESQL/C program or with DB–Access, but only if the statement is in an SPL routine that the program or DB–Access executed.

If you CALL a user-defined *function*, you must specify a RETURNING clause.

Specifying Arguments

If a CALL statement contains more arguments than the UDR expects, you receive an error.

If CALL specifies fewer arguments than the UDR expects, the arguments are said to be missing. The database server initializes missing arguments to their corresponding default values. (See "CREATE PROCEDURE" on page 2-145 and "CREATE FUNCTION" on page 2-107.) This initialization occurs before the first executable statement in the body of the UDR. If missing arguments do not have default values, they are initialized to the value of UNDEFINED. An attempt to use any variable of UNDEFINED value results in an error.

In each UDR call, you have the option of specifying parameter names for the arguments you pass to the UDR. Each of the following examples are valid for a UDR that expects character arguments named `t`, `n`, and `d`, in that order:

```
CALL add_col (t='customer', n = 'newint', d ='integer');
CALL  add_col('customer','newint','integer');
```

The syntax is described in more detail in “Arguments” on page 5-2.

Receiving Input from the Called UDR

The RETURNING clause specifies the variable that receives values that a called function returns.

The following example shows two UDR calls:

```
CREATE PROCEDURE not_much()
   DEFINE i, j, k INT;
   CALL no_args (10,20);
   CALL yes_args (5) RETURNING i, j, k;
END PROCEDURE
```

The first routine call (**no_args**) expects no returned values. The second routine call is to a function (**yes_args**), which expects three returned values. The **not_much()** procedure declares three integer variables (**i**, **j**, and **k**) to receive the returned values from **yes_args**.

CASE

Use the CASE statement when you need to take one of many branches depending on the value of an SPL variable or a simple expression. The CASE statement is a fast alternative to the IF statement.

Only Extended Parallel Server supports the CASE statement.

Syntax

```
>>──CASE──value_expr─────────────────────────────────────────────────────────>

                            (1)
>──┬─ELSE──┤ Statement Block ├─────────────────────────────────────┬─────────>
   │  ┌──────────────────────────────────────────┐                │
   │  ▼                                      (1) │                │
   └──WHEN──constant_expr──THEN──┤ Statement Block ├──┬─────────────────────┬─┘
                                                      │                 (1) │
                                                      └─ELSE──┤ Statement Block ├─┘

>─END CASE──────────────────────────────────────────────────────────────────><
```

Notes:

1 See "Statement Block" on page 5-69

Element	Description	Restrictions	Syntax
constant_expr	Expression that specifies a literal value	Can be a literal number, quoted string, literal datetime, or literal interval. The data type must be compatible with the data type of *value_expr*.	"Constant Expressions" on page 4-53
value_expr	Expression that returns a value	An SPL variable or any other type of expression that returns a value	"Expression" on page 4-34

Usage

You can use the CASE statement to create a set of conditional branches within an SPL routine. The WHEN and the ELSE clauses are optional, but you must include at least one of them. If you specify no WHEN and no ELSE clause, you receive a syntax error.

3 Do not confuse the CASE statement with CASE expressions of SQL. (For Extended
3 Parallel Server, CASE expressions support the same keywords as the CASE
3 statement, but use different syntax and semantics to evaluate *conditions* that you
3 specify and return a single value or NULL, as described in "CASE Expressions" on
3 page 4-49.)

How the Database Server Executes a CASE Statement

The database server executes the CASE statement in the following way:

- The database server evaluates the *value_expr* parameter.
- If the resulting value matches a literal value specified in the *constant_expr* parameter of a WHEN clause, the database server executes the statement block that follows the THEN keyword in that WHEN clause.
- If the value resulting from the evaluation of the *value_expr* parameter matches the *constant_expr* parameter in more than one WHEN clause, the database server executes the statement block that follows the THEN keyword in the first matching WHEN clause in the CASE statement.

- After the database server executes the statement block that follows the THEN keyword, it executes the statement that follows the CASE statement in the SPL routine.
- If the value of the *value_expr* parameter does not match the literal value specified in the *constant_expr* parameter of any WHEN clause, and if the CASE statement includes an ELSE clause, the database server executes the statement block that follows the ELSE keyword.
- If the value of the *value_expr* parameter does not match the literal value specified in the *constant_expr* parameter of any WHEN clause, and if the CASE statement does not include an ELSE clause, the database server executes the statement that follows the CASE statement in the SPL routine.
- If the CASE statement includes an ELSE clause but not a WHEN clause, the database server executes the statement block that follows the ELSE keyword.

The statement block that follows the THEN or ELSE keywords can include any SQL statement or SPL statement that is valid in the statement block of an SPL routine. For more information, see “Statement Block” on page 5-69.

Computation of the Value Expression in CASE

The database server computes the value of the *value_expr* parameter only one time. It computes this value at the start of execution of the CASE statement. If the value expression specified in the *value_expr* parameter contains SPL variables and the values of these variables change subsequently in one of the statement blocks within the CASE statement, the database server does not recompute the value of the *value_expr* parameter. So a change in the value of any variables contained in the *value_expr* parameter has no effect on the branch taken by the CASE statement.

Example of CASE Statement

In the following example, the CASE statement initializes one of a set of SPL variables (named **j**, **k**, **l**, and **m**) to the value of an SPL variable named **x**, depending on the value of another SPL variable named **i**:

```
CASE i
   WHEN 1 THEN LET j = x;
   WHEN 2 THEN LET k = x;
   WHEN 3 THEN LET l = x;
   WHEN 4 THEN LET m = x;
   ELSE
      RAISE EXCEPTION 100; --illegal value
END CASE
```

Related Statements

IF

CONTINUE

Use the CONTINUE statement to start the next iteration of the innermost FOR, WHILE, or FOREACH loop.

Syntax

```
>>──CONTINUE──┬─FOR─────┬──;──────────────────────────────────────────><
              ├─WHILE───┤
              └─FOREACH─┘
```

Usage

When control of execution passes to a CONTINUE statement, the SPL routine skips the rest of the statements in the innermost loop of the indicated type. Execution continues at the top of the loop with the next iteration.

In the following example, the **loop_skip** function inserts values 3 through 15 into the table **testtable**. The function also returns values 3 through 9 and 13 through 15 in the process. The function does not return the value 11 because it encounters the CONTINUE FOR statement. The CONTINUE FOR statement causes the function to skip the RETURN WITH RESUME statement:

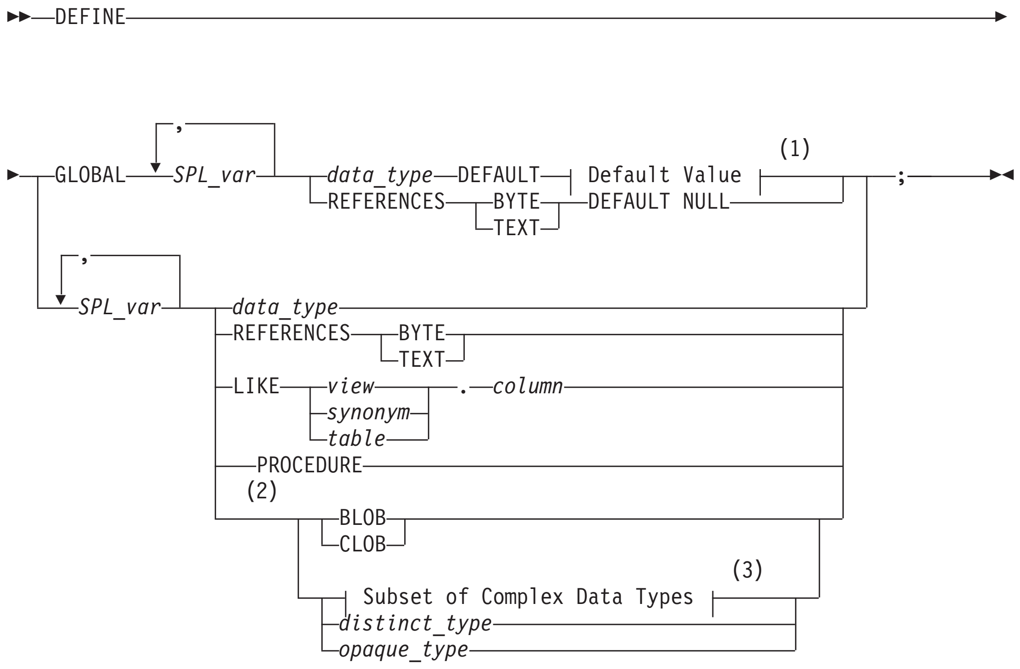
```
CREATE FUNCTION loop_skip()
   RETURNING INT;
   DEFINE i INT;
   ...
   FOR i IN (3 TO 15 STEP 2)
      INSERT INTO testtable values(i, null, null);
      IF i = 11
         CONTINUE FOR;
      END IF;
      RETURN i WITH RESUME;
   END FOR;

END FUNCTION;
```

Just as with EXIT ("EXIT" on page 3-16), the FOR, WHILE, or FOREACH keyword must immediately follow CONTINUE to specify the type of loop. The CONTINUE statement generates errors if it cannot find the specified loop.

DEFINE

Use the DEFINE statement to declare local variables that an SPL routine uses, or to declare global variables that can be shared by several SPL routines.

Syntax



Notes:

1 See 3-9

2 Dynamic Server only

3 See “Subset of Complex Data Types (IDS)” on page 3-12

Element	Description	Restrictions	Syntax
column	Column name	Must already exist in the *table* or *view*	“Data Type” on page 4-18
data_type	Type of *SPL_var*	See “Declaring Global Variables” on page 3-8.	“Data Type” on page 4-18
distinct_type	A distinct type	Must already be defined in the database	“Identifier” on page 5-22
opaque_type	An opaque type	Must already be defined in the database	“Identifier” on page 5-22
SPL_var	New SPL variable	Must be unique within statement block	“Identifier” on page 5-22
synonym, *table*, *view*	Name of a table, view, or synonym	Synonym and the table or view to which it points must exist when DEFINE is issued	“Database Object Name” on page 5-17

Usage

The DEFINE statement is not an executable statement. The DEFINE statement must appear after the routine header and before any other statements. If you declare a local variable (by using DEFINE without the GLOBAL keyword), its scope of reference is the statement block in which it is defined. You can use the variable within the statement block. Another variable outside the statement block with a different definition can have the same name.

A variable with the GLOBAL keyword is global in scope and is available outside the statement block and to other SPL routines. Global variables can be any built-in data type except SERIAL, SERIAL8, TEXT, BYTE, CLOB, or BLOB. Local variables can be any built-in data type except SERIAL, SERIAL8, TEXT, or BYTE. If *column* is of the SERIAL or SERIAL8 data type, declare an INT or INT8 variable (respectively) to store its value.

Referencing TEXT and BYTE Variables

The REFERENCES keyword lets you use BYTE and TEXT variables. These do not contain the actual data but are pointers to the data. The REFERENCES keyword indicates that the SPL variable is just a pointer. You can use BYTE and TEXT variables exactly as you would use any other variable in SPL.

Redeclaration or Redefinition

If you define the same variable twice in the same statement block, you receive an error. You can redefine a variable within a nested block, in which case it temporarily hides the outer declaration. This example produces an error:

```
CREATE PROCEDURE example1()
   DEFINE n INT; DEFINE j INT;
   DEFINE n CHAR (1);    -- redefinition produces an error
```

Redeclaration is valid in the following example. Within the nested statement block, **n** is a character variable. Outside the block, **n** is an integer variable.

```
CREATE PROCEDURE example2()
   DEFINE n INT; DEFINE j INT;
   ...
   BEGIN
   DEFINE n CHAR (1);    -- character n masks global integer variable
   ...
END
```

Declaring Global Variables

Use the following syntax for declaring global variables:

```
                    ┌─,──────┐
                    ▼        │
►►──DEFINE──GLOBAL────SPL_var┴─────────────────────────────────────────────►

                                                (1)
►──┬─data_type──DEFAULT──┤ Default Value ├──────────┬──;──────────────────►◄
   └─REFERENCES──┬─BYTE─┬──DEFAULT NULL─────────────┘
                 └─TEXT─┘
```

Notes:

1 See 3-9

Element	Description	Restrictions	Syntax
data_type	Type of *SPL_var*	See "Declaring Global Variables" on page 3-8.	"Data Type" on page 4-18
SPL_var	New SPL variable	Must be unique within statement block	"Identifier" on page 5-22

The GLOBAL keyword indicates that the variables that follow have a scope of reference that includes all SPL routines that run in a given DB-Access or SQL API session. The data types of these variables must match the data types of variables in the *global environment*. The global environment is the memory that is used by all the SPL routines that run in a given DB-Access or SQL API session. The values of global variables are stored in memory.

SPL routines that are running in the current session share global variables. Because the database server does not save global variables in the database, the global variables do not remain when the current session closes.

The first declaration of a global variable establishes the variable in the global environment; subsequent global declarations simply bind the variable to the global environment and establish the value of the variable at that point.

The following example shows two SPL procedures, **proc1** and **proc2**; each has defined the global variable **gl_out**:

- SPL procedure **proc1**

```
CREATE PROCEDURE proc1()
   ...
   DEFINE GLOBAL gl_out INT DEFAULT 13;
   ...
   LET gl_out = gl_out + 1;
END PROCEDURE;
```

- SPL procedure **proc2**

```
CREATE PROCEDURE proc2()
   ...
   DEFINE GLOBAL gl_out INT DEFAULT 23;
   DEFINE tmp INT;
   ...
   LET tmp = gl_out
END PROCEDURE;
```

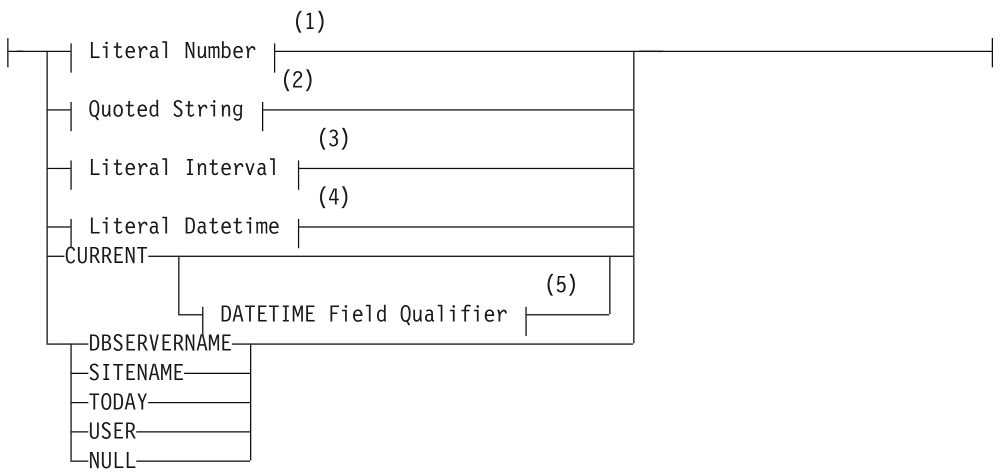
If **proc1** is called first, **gl_out** is set to 13 and then incremented to 14. If **proc2** is then called, it sees that **gl_out** is already defined, so the default value of 23 is not applied. Then, **proc2** assigns the existing value of 14 to **tmp**. If **proc2** had been called first, **gl_out** would have been set to 23, and 23 would have been assigned to **tmp**. Later calls to **proc1** would not apply the default of 13.

Databases of different database server instances do not share global variables, but all the databases of the same database server instance can share global SPL variables in a single session. The database server and any application development tools, however, do not share global variables.

Default Value

Global variables can have literal, NULL, or system constant default values.

Default Value:



Notes:

1 See "Literal Number" on page 4-137

2 See "Quoted String" on page 4-142

3 See "Literal INTERVAL" on page 4-135

4 See "Literal DATETIME" on page 4-132

5 See "DATETIME Field Qualifier" on page 4-32

If you specify a default value, the global variable is initialized with the specified value.

CURRENT

CURRENT is a valid default only for a DATETIME variable. If the YEAR TO FRACTION is its declared precision, no qualifier is needed. Otherwise, you must specify the same DATETIME qualifier when CURRENT is the default, as in the following example of a DATETIME variable:

```
DEFINE GLOBAL d_var DATETIME YEAR TO MONTH
     DEFAULT CURRENT YEAR TO MONTH;
```

USER

If you use the value that USER returns as the default, the variable must be defined as a CHAR, VARCHAR, NCHAR, or NVARCHAR data type. It is recommended that the length of the variable be at least 32 bytes. You risk getting an error message during INSERT and ALTER TABLE operations if the length of the variable is too small to store the default value.

TODAY

If you use TODAY as the default, the variable must be a DATE value. (See "Constant Expressions" on page 4-53 for descriptions of TODAY and of the other system constants that can appear in the Default Value clause.)

BYTE and TEXT

The only default value valid for a BYTE or TEXT variable is NULL. The following example defines a TEXT global variable that is called **l_blob**:

```
CREATE PROCEDURE use_text()
   DEFINE i INT;
   DEFINE GLOBAL l_blob REFERENCES TEXT DEFAULT NULL;
   ...
END PROCEDURE
```

Here the REFERENCES keyword is required, because the DEFINE statement cannot declare a BYTE or TEXT data type directly; the **l_blob** variable is a pointer to a TEXT value that is stored in the global environment.

SITENAME or DBSERVERNAME

If you use the SITENAME or DBSERVERNAME keyword as the default, the variable must be a CHAR, VARCHAR, NCHAR, NVARCHAR, or LVARCHAR data type. Its default value is the name of the database server at runtime. It is recommended that the size of the variable be at least 128 bytes long. You risk getting an error message during INSERT and ALTER TABLE operations if the length of the variable is too small to store the default value.

The following example uses the SITENAME keyword to specify a default value. This example also initializes a global BYTE variable to NULL:

```
CREATE PROCEDURE gl_def()
   DEFINE GLOBAL gl_site CHAR(200) DEFAULT SITENAME;
   DEFINE GLOBAL gl_byte REFERENCES BYTE DEFAULT NULL;
   ...
END PROCEDURE
```

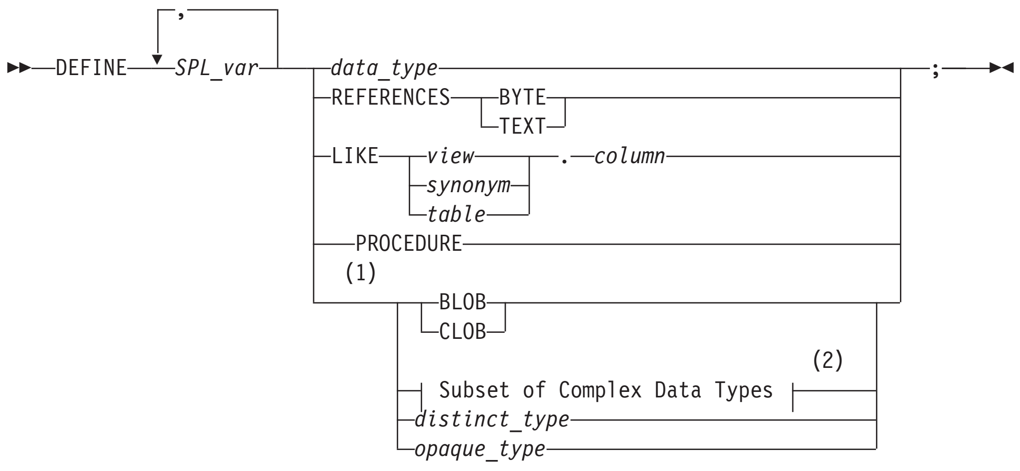
Declaring Local Variables

A *local variable* has as its scope of reference the routine in which it is declared. If you omit the GLOBAL keyword, any variables declared in the DEFINE statement are local variables, and are not visible in other SPL routines.

For this reason, different SPL routines that declare local variables of the same name can run without conflict in the same DB-Access or SQL API session.

If a local variable and a global variable have the same name, the global variable is not visible within the SPL routine where the local variable is declared. (In all other SPL routines, only the global variable is in scope.)

The following DEFINE statement syntax is for declaring local variables:



Notes:

1 Dynamic Server only

2 See "Subset of Complex Data Types (IDS)"

Element	Description	Restrictions	Syntax
column	Column name	Must already exist in the *table* or *view*	"Identifier" on page 5-22;
data_type	Type of *SPL_var*	Cannot be SERIAL, SERIAL8, TEXT, nor BYTE	"Data Type" on page 4-18
distinct_type	A distinct type	Must already be defined in the database	"Identifier" on page 5-22
opaque_type	An opaque type	Must already be defined in the database	"Identifier" on page 5-22
SPL_var	New SPL variable	Must be unique within statement block	"Identifier" on page 5-22;
synonym, *table*, *view*	Name of a table, view, or synonym	Synonym and the table or view to which it points must already exist when the statement is issued	"Database Object Name" on page 5-17

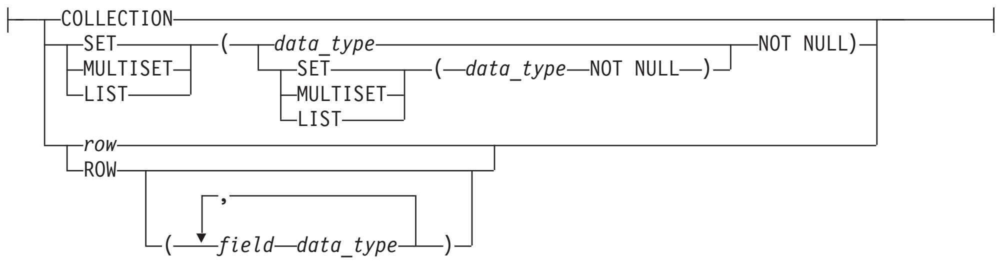
Local variables do not support default values. The following example shows some typical definitions of local variables:

```
CREATE PROCEDURE def_ex()
   DEFINE i INT;
   DEFINE word CHAR(15);
   DEFINE b_day DATE;
   DEFINE c_name LIKE customer.fname;
   DEFINE b_text REFERENCES TEXT;
END PROCEDURE
```

Subset of Complex Data Types (IDS)

You can use the following syntax to declare an SPL variable as a typed or generic collection, or as a named, unnamed, or generic ROW data type.

Complex Data Types (Subset):



Element	Description	Restrictions	Syntax
data_type	Type of elements of a collection or of fields of an unnamed ROW type	Must match the data type of the values that the variable will store. Cannot be SERIAL, SERIAL8, TEXT, BYTE, CLOB, or BLOB.	"Data Type" on page 4-18
field	Field of unnamed ROW	Must exist in the database	"Identifier" on page 5-22
row	Named ROW data type	Must exist in the database	"Identifier" on page 5-22

Declaring Collection Variables (IDS)

A local variable of type COLLECTION, SET, MULTISET, or LIST can hold a collection of values fetched from the database. You cannot define a collection variable as global (with the GLOBAL keyword) or with a default value.

A variable declared with the keyword COLLECTION is an untyped (or generic) collection variable that can hold a collection of any data type.

A variable declared as type SET, MULTISET, or LIST is a *typed collection variable*. It can hold a collection of its specified data type only.

You must use the NOT NULL keywords when you define the elements of a typed collection variable, as in the following examples:

```
DEFINE a SET ( INT NOT NULL );

DEFINE b MULTISET ( ROW ( b1 INT,
                   b2 CHAR(50)
                 ) NOT NULL );

DEFINE c LIST( SET( INTEGER NOT NULL ) NOT NULL );
```

With variable **c**, both the INTEGER values in the SET and the SET values in the LIST are defined as NOT NULL.

You can define collection variables with nested complex types to hold matching nested complex type data. Any type or depth of nesting is allowed. You can nest **ROW** types within collection types, collection types within **ROW** types, collection types within collection types, **ROW** types within collection and **ROW** types, and so on.

If you declare a variable as COLLECTION type, the variable acquires varying data type declarations if it is reassigned within the same statement block, as in the following example:

```
DEFINE a COLLECTION;
LET a = setB;
...
LET a = listC;
```

In this example, **varA** is a generic collection variable that changes its data type to the data type of the currently assigned collection. The first LET statement makes **varA** a SET variable. The second LET statement makes **varA** a LIST variable.

Declaring ROW Variables (IDS)

ROW variables hold data from named or unnamed ROW types. You can define a generic ROW variable, a named ROW variable, or an unnamed ROW variable.

A generic ROW variable, defined with the ROW keyword, can hold data from any ROW type. A named ROW variable holds data from the named ROW type that you specified in the declaration of the variable.

The following statements show examples of generic ROW variables and named ROW variables:

```
DEFINE d ROW;              -- generic ROW variable

DEFINE rectv rectangle_t;   -- named ROW variable
```

A named ROW variable holds named ROW types of the same type in the declaration of the variable.

To define a variable that will hold data stored in an unnamed ROW type, use the ROW keyword followed by the fields of the ROW type, as in:

```
DEFINE area ROW ( x int, y char(10) );
```

Unnamed ROW types are type-checked only by structural equivalence. Two unnamed ROW types are considered equivalent if they have the same number of fields, and if the fields have the same type definitions. Therefore, you could fetch either of the following ROW types into the variable **area** defined above:

```
ROW ( a int, b char(10) )
ROW ( area int, name char(10) )
```

ROW variables can have fields, just as ROW types have fields. To assign a value to a field of a ROW variable, use the qualifier notation *variableName.fieldName*, followed by an expression, as in the following example:

```
CREATE ROW TYPE rectangle_t (start point_t, length real, width real);

DEFINE r rectangle_t;
      -- Define a variable of a named ROW type
LET r.length = 45.5;
      -- Assign a value to a field of the variable
```

When you assign a value to a ROW variable, you can use any valid expression.

Declaring Opaque-Type Variables (IDS)

Opaque-type variables hold data retrieved from opaque data types, which you create with the CREATE OPAQUE TYPE statement. An opaque-type variable can only hold data of the same opaque type on which it is defined. The following example defines a variable of the opaque type **point**, which holds the **x** and **y** coordinates of a two-dimensional point:

```
DEFINE b point;
```

Declaring Variables LIKE Columns

If you use the LIKE clause, the database server assigns the variable the same data type as a specified column in a table, synonym, or view.

The data types of variables that are defined as database columns are resolved at runtime; therefore, *column* and *table* do not need to exist at compile time.

You can use the LIKE keyword to declare that a variable is like a serial column. This declares an INTEGER variable if the column is of the SERIAL data type, or an INT8 variable if the column is of the SERIAL8 data type. For example, if the column **serialcol** in the **mytab** table has the SERIAL data type, you can create the following SPL function:

```
CREATE FUNCTION func1()
DEFINE local_var LIKE mytab.serialcol;
RETURN;
END FUNCTION;
```

The variable **local_var** is treated as an INTEGER variable.

Declaring Variables as the PROCEDURE Type

The PROCEDURE keyword indicates that in the current scope, the variable is a call to a UDR.

The DEFINE statement does not support a FUNCTION keyword. Use the PROCEDURE keyword, whether you are calling a user-defined procedure or a user-defined function.

Declaring a variable as PROCEDURE type indicates that in the current statement scope, the variable is not a call to a built-in function. For example, the following statement defines **length** as an SPL routine, not as the built-in LENGTH function:

```
DEFINE length PROCEDURE;
...
LET x = length (a,b,c)
```

This definition disables the built-in LENGTH function within the scope of the statement block. You would use such a definition if you had already created a user-defined routine with the name **length**.

If you create an SPL routine with the same name as an aggregate function (SUM, MAX, MIN, AVG, COUNT) or with the name **extend**, you must qualify the routine name with the owner name.

Declaring Variables for BYTE and TEXT Data

The keyword REFERENCES indicates that the variable does not contain a BYTE or TEXT value but is a pointer to the BYTE or TEXT value. Use the variable as though it holds the data.

The following example defines a local BYTE variable:

```
CREATE PROCEDURE use_byte()
   DEFINE i INT;
   DEFINE l_byte REFERENCES BYTE;
END PROCEDURE --use_byte
```

If you pass a variable of BYTE or TEXT data type to an SPL routine, the data is passed to the database server and stored in the root dbspace or dbspaces that the **DBSPACETEMP** environment variable specifies, if it is set. You do not need to know the location or name of the file that holds the data. BYTE or TEXT manipulation requires only the name of the BYTE or TEXT variable as it is defined in the routine.

EXIT

The EXIT statement terminates execution of a FOR, WHILE, or FOREACH loop.

Syntax

```
►►──EXIT──┬─FOR─────┬──;───────────────────────────────────────────────────────►◄
          ├─WHILE───┤
          └─FOREACH─┘
```

Usage

The EXIT statement marks the end of a FOR, WHILE, or FOREACH statement, causing the innermost loop of the specified type (FOR, WHILE, or FOREACH) to terminate. Execution resumes at the first statement outside the loop.

The FOR, WHILE, or FOREACH keyword must immediately follow EXIT. If the database server cannot find the specified loop, the EXIT statement fails. If EXIT is used outside any FOR, WHILE, or FOREACH loop, it generates errors.

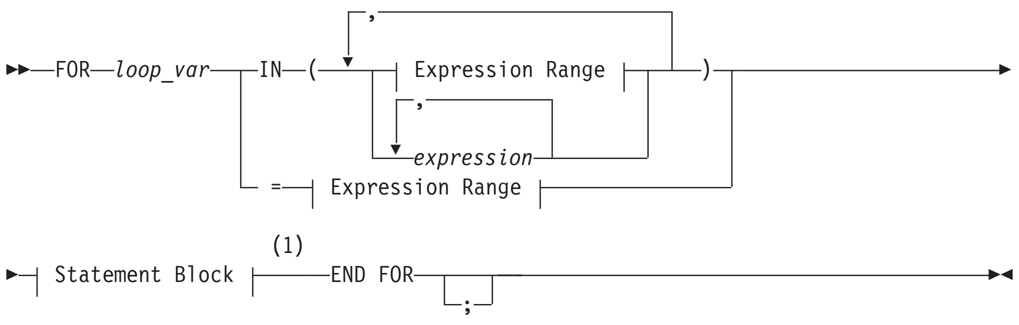
The following example uses an EXIT FOR statement. In the FOR loop, when `j` becomes `6`, the IF condition `i = 5` in the WHILE loop is true. The FOR loop stops executing, and the SPL procedure continues at the next statement outside the FOR loop (in this case, the END PROCEDURE statement). In this example, the procedure ends when `j` equals `6`:

```
CREATE PROCEDURE ex_cont_ex()
   DEFINE i,s,j, INT;
   FOR j = 1 TO 20
      IF j > 10 THEN
         CONTINUE FOR;
      END IF
      LET i,s = j,0;
      WHILE i > 0
         LET i = i -1;
         IF i = 5 THEN
            EXIT FOR;
         END IF
      END WHILE
   END FOR
END PROCEDURE
```

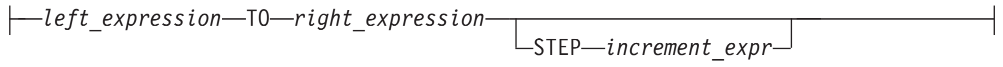
FOR

Use the FOR statement to initiate a controlled (definite) loop when you want to guarantee termination of the loop. The FOR statement uses expressions or range operators to specify a finite number of iterations for a loop.

Syntax



Expression Range:



Notes:

1 See "Statement Block" on page 5-69

Element	Description	Restrictions	Syntax
expression	Value to compare with *loop_var*	Must match *loop_var* data type	"Expression" on page 4-34
increment_expr	Positive or negative value by which *loop_var* is incremented	Must return an integer. Cannot return `0`.	"Expression" on page 4-34
left_expression	Starting expression of a range	Value must match SMALLINT or INT data type of *loop_var*	"Expression" on page 4-34
loop_var	Variable that determines how many times the loop executes	Must be defined and in scope within this statement block	"Identifier" on page 5-22
right_expression	Ending expression in the range	Same as for *left_expression*	"Expression" on page 4-34

Usage

The database server evaluates all expressions before the FOR statement executes. If one or more of the expressions are variables whose values change during the loop, the change has no effect on the iterations of the loop.

You can use the output from a SELECT statement as the *expression*.

The FOR loop terminates when *loop_var* is equal to the values of each element in the expression list or range in succession, or when it encounters an EXIT FOR statement. An error is issued, however, if an assignment within the body of the FOR statement attempts to modify the value of *loop_var*.

The size of *right_expression* relative to *left_expression* determines if the range is stepped through by positive or negative increments.

Using the TO Keyword to Define a Range

The TO keyword implies a range operator. The range is defined by *left_expression* and *right_expression*, and the STEP *increment_expr* option implicitly sets the number of increments. If you use the TO keyword, *loop_var* must be an INT or SMALLINT data type.

The next examples shows two equivalent FOR statements. Each uses the TO keyword to define a range. The first uses the IN keyword, and the second uses an equal sign (=). Each statement causes the loop to execute five times:

```
FOR index_var IN (12 TO 21 STEP 2)
   -- statement block
END FOR

FOR index_var = 12 TO 21 STEP 2
   -- statement block
END FOR
```

If you omit the STEP option, the database server gives *increment_expr* the value of -1 if *right_expression* is less than *left_expression*, or +1 if *right_expression* is more than *left_expression*. If *increment_expr* is specified, it must be negative if *right_expression* is less than *left_expression*, or positive if *right expression* is more than *left_expression*.

The two statements in the following example are equivalent. In the first statement, the STEP increment is explicit. In the second statement, the STEP increment is implicitly 1:

```
FOR index IN (12 TO 21 STEP 1)
   -- statement block
END FOR

FOR index = 12 TO 21
   -- statement block
END FOR
```

The database server initializes the value of *loop_var* to the value of *left_expression*. In subsequent iterations, the server adds *increment_expr* to the value of *loop_var* and checks *increment_expr* to determine whether the value of *loop_var* is still between *left_expression* and *right_expression*. If so, the next iteration occurs. Otherwise, an exit from the loop takes place. Or, if you specify another range, the variable takes on the value of the first element in the next range.

Specifying Two or More Ranges in a Single FOR Statement: The following example shows a statement that traverses a loop forward and backward and uses different increment values for each direction:

```
FOR index_var IN (15 to 21 STEP 2, 21 to 15 STEP -3)
   -- statement body
END FOR
```

Using an Expression List as the Range

The database server initializes the value of *loop_var* to the value of the first expression specified. In subsequent iterations, *loop_var* takes on the value of the next expression. When the database server has evaluated the last expression in the list and used it, the loop stops.

The expressions in the IN list do not need to be numeric values, as long as you do not use range operators in the IN list. The following example uses a character expression list:

```
FOR c IN ('hello', (SELECT name FROM t), 'world', v1, v2)
   INSERT INTO t VALUES (c);
END FOR
```

The following FOR statement shows the use of a numeric expression list:

```
FOR index IN (15,16,17,18,19,20,21)
   -- statement block
END FOR
```

Mixing Range and Expression Lists in the Same FOR Statement

If *loop_var* is an INT or SMALLINT value, you can mix ranges and expression lists in the same FOR statement. The following example shows a mixture that uses an integer variable. Values in the expression list include the value that is returned from a SELECT statement, a sum of an integer variable and a constant, the values that are returned from an SPL function named **p_get_int**, and integer constants:

```
CREATE PROCEDURE for_ex ()
   DEFINE i, j INT;
   LET j = 10;
   FOR i IN (1 TO 20, (SELECT c1 FROM tab WHERE id = 1),
         j+20 to j-20, p_get_int(99),98,90 to 80 step -2)
      INSERT INTO tab VALUES (i);
   END FOR
END PROCEDURE
```

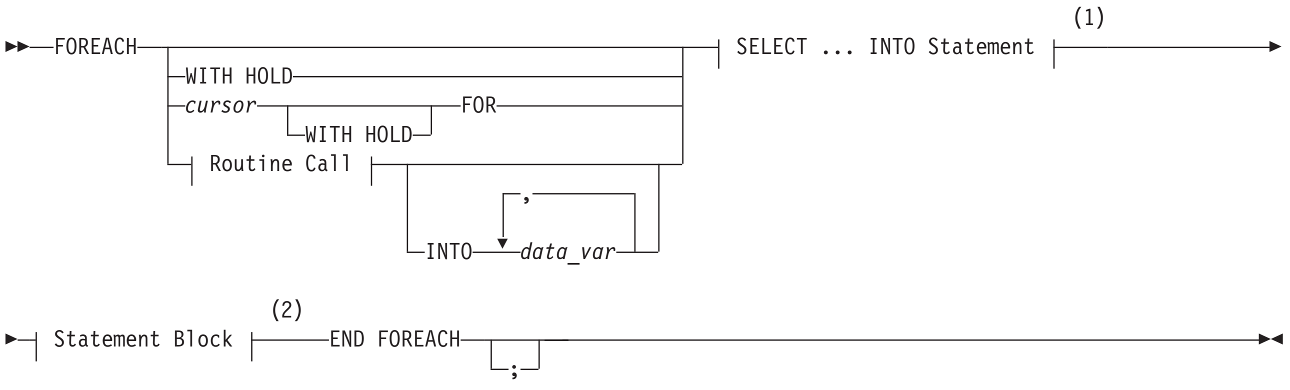
Related Statements

FOREACH, WHILE

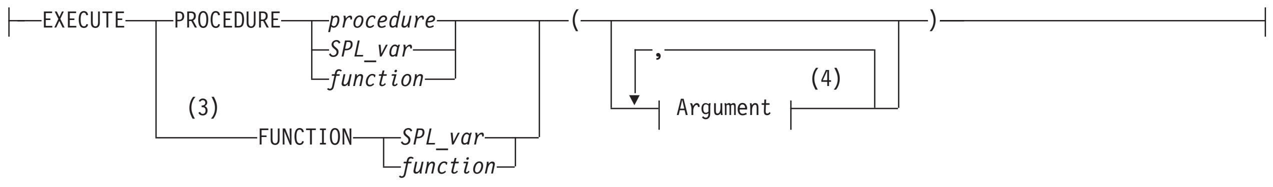
FOREACH

Use a FOREACH loop to select and manipulate more than one row.

Syntax



Routine Call:



Notes:

1 See "Using a SELECT ... INTO Statement" on page 3-21

2 See "Statement Block" on page 5-69

3 Dynamic Server only

4 See "Arguments" on page 5-2

Element	Description	Restrictions	Syntax
cursor	Identifier that you supply as a name for this FOREACH loop	Each cursor name within a routine must be unique	"Identifier" on page 5-22
data_var	SPL variable in the calling routine that receives the returned values	Data type of *data_var* must be appropriate for returned value	"Identifier" on page 5-22
function, procedure	SPL function or procedure to execute	Function or procedure must exist	"Database Object Name" on page 5-17
SPL_var	SPL variable that contains the name of a routine to execute	Must be a CHAR, VARCHAR, NCHAR, or NVARCHAR type	"Identifier" on page 5-22

Usage

A FOREACH loop is the procedural equivalent of using a cursor. To execute a FOREACH statement, the database server takes these actions:

1. It declares and implicitly opens a cursor.
2. It obtains the first row from the query contained within the FOREACH loop, or else the first set of values from the called routine.

3. It assigns to each variable in the variable list the value of the corresponding value from the active set that the SELECT statement or the called routine creates.
4. It executes the statement block.
5. It fetches the next row from the SELECT statement or called routine on each iteration, and it repeats steps 3 and 4.
6. It terminates the loop when it finds no more rows that satisfy the SELECT statement or called routine. It closes the implicit cursor when the loop terminates.

Because the statement block can contain additional FOREACH statements, cursors can be nested. No limit exists on the number of nested cursors.

An SPL routine that returns more than one row, collection element, or set of values is called a *cursor function*. An SPL routine that returns only one row or value is a *noncursor function*.

This SPL procedure illustrates FOREACH statements with a SELECT ... INTO clause, with an explicitly named cursor, and with a procedure call:

```
CREATE PROCEDURE foreach_ex()
   DEFINE i, j INT;
   FOREACH SELECT c1 INTO i FROM tab ORDER BY 1
      INSERT INTO tab2 VALUES (i);
   END FOREACH
   FOREACH cur1 FOR SELECT c2, c3 INTO i, j FROM tab
      IF j > 100 THEN
         DELETE FROM tab WHERE CURRENT OF cur1;
         CONTINUE FOREACH;
      END IF
      UPDATE tab SET c2 = c2 + 10 WHERE CURRENT OF cur1;
   END FOREACH
   FOREACH EXECUTE PROCEDURE bar(10,20) INTO i
      INSERT INTO tab2 VALUES (i);
   END FOREACH
END PROCEDURE; -- foreach_ex
```

A select cursor is closed when any of the following situations occur:

- The cursor returns no further rows.
- The cursor is a select cursor without a HOLD specification, and a transaction completes using COMMIT or ROLLBACK statements.
- An EXIT statement executes, which transfers control out of the FOREACH statement.
- An exception occurs that is not trapped inside the body of the FOREACH statement. (See “ON EXCEPTION” on page 3-31.)
- A cursor in the calling routine that is executing this cursor routine (within a FOREACH loop) closes for any reason.

Using a SELECT ... INTO Statement

As indicated in the diagram for “FOREACH” on page 3-20, not all clauses and options of the SELECT statement are available for you to use in a FOREACH statement. The SELECT statement in the FOREACH statement must include the INTO clause. It can also include UNION and ORDER BY clauses, but it cannot use the INTO TEMP clause. For a complete description of SELECT syntax and usage, see “SELECT” on page 2-479. The data type and count of each variable in the variable list must match each value that the SELECT ... INTO statement returns.

Using Hold Cursors

The WITH HOLD keywords specify that the cursor should remain open when a transaction closes (by being committed or by being rolled back).

Updating or Deleting Rows Identified by Cursor Name

Specify a *cursor* name in the FOREACH statement if you intend to use the WHERE CURRENT OF *cursor* clause in UPDATE or DELETE statements that operate on the current row of *cursor* within the FOREACH loop. Although you cannot include the FOR UPDATE keywords in the SELECT ... INTO segment of the FOREACH statement, the cursor behaves like a FOR UPDATE cursor.

For a discussion of locking, see the section on "Locking with an Update Cursor" on page 2-265. For a discussion of isolation levels, see the description of "SET ISOLATION" on page 2-575.

Using Collection Variables (IDS)

The FOREACH statement allows you to declare a cursor for an SPL collection variable. Such a cursor is called a *collection cursor*. Use a collection variable to access the elements of a collection (SET, MULTISET, LIST) column. Use a cursor when you want to access one or more elements in a collection variable.

Restrictions: When you use a collection cursor to fetch individual elements from a collection variable, the FOREACH statement has the following restrictions:

- It cannot contain the WITH HOLD keywords.
- It must contain a restricted SELECT statement in the FOREACH loop.

In addition, the SELECT statement that you associate with the collection cursor has the following restrictions:

- Its general structure is SELECT... INTO ... FROM TABLE. The statement selects one element at a time from a collection variable specified after the TABLE keyword into another variable called an *element variable*.
- It cannot contain an expression in the projection list.
- It cannot include the following clauses or options: WHERE, GROUP BY, ORDER BY, HAVING, INTO TEMP, and WITH REOPTIMIZATION.
- The data type of the element variable must be the same as the element type of the collection.
- The data type of the element variable can be any opaque, distinct, or collection data type, or any built-in data type except SERIAL, SERIAL8, TEXT, BYTE, CLOB, or BLOB.
- If the collection contains opaque, distinct, built-in, or collection types, the projection list must be an asterisk (*) symbol.
- If the collection contains ROW types, the projection list can be a list of one or more field names.

Examples: The following excerpt from an SPL routine shows how to fill a collection variable and then how to use a cursor to access individual elements:

```
DEFINE a SMALLINT;
DEFINE b SET(SMALLINT NOT NULL);
SELECT numbers INTO b FROM table1 WHERE id = 207;
FOREACH cursor1 FOR
   SELECT * INTO a FROM TABLE(b);
...
END FOREACH;
```

In this example, the SELECT statement selects one element at a time from the collection variable **b** into the element variable **a**. The projection list is an asterisk, because the collection variable **b** contains a collection of built-in types. The variable **b** is used with the TABLE keyword as a Collection-Derived Table. For more information, see “Collection-Derived Table” on page 5-5.

The next example also shows how to fill a collection variable and then how to use a cursor to access individual elements. This example, however, uses a list of ROW-type fields in its projection list:

```
DEFINE employees employee_t;
DEFINE n VARCHAR(30);
DEFINE s INTEGER;

SELECT emp_list into employees FROM dept_table
   WHERE dept_no = 1057;
FOREACH cursor1 FOR
   SELECT name,salary
      INTO n,s FROM TABLE( employees ) AS e;
...
END FOREACH;
```

Here the collection variable **employees** contains a collection of ROW types. Each ROW type contains the fields **name** and **salary**. The collection query selects one name and salary combination at a time, placing **name** into **n** and **salary** into **s**. The AS keyword declares **e** as an alias for the collection-derived table **employees**. The alias exists as long as the SELECT statement executes.

Modifying Elements in a Collection Variable: To update an element of a collection within an SPL routine, you must first declare a cursor with the FOREACH statement.

Then, within the FOREACH loop, select elements one at a time from the collection variable, using the collection variable as a collection-derived table in a SELECT query.

When the cursor is positioned on the element to be updated, you can use the WHERE CURRENT OF clause, as follows:

- The UPDATE statement with the WHERE CURRENT OF clause updates the value in the current element of the collection variable.
- The DELETE statement with the WHERE CURRENT OF clause deletes the current element from the collection variable.

Calling a UDR in the FOREACH Loop

In general, use these guidelines for calling another UDR from an SPL routine:

- To call a user-defined procedure, use EXECUTE PROCEDURE *procedure name*.
- To call a user-defined function, use EXECUTE FUNCTION *function name* (or EXECUTE PROCEDURE *function name* if the user-defined function was created with the CREATE PROCEDURE statement).

In Extended Parallel Server, you must use EXECUTE PROCEDURE. Extended Parallel Server does not support the EXECUTE FUNCTION statement.

In Dynamic Server, if you use EXECUTE PROCEDURE, the database server looks first for a user-defined procedure of the name you specify. If it finds the procedure, the database server executes it. If it does not find the procedure, it looks for a user-defined function of the same name to execute. If the database server finds neither a function nor a procedure, it issues an error message. If you use EXECUTE FUNCTION, the database server looks for a user-defined function of the name you specify. If it does not find a function of that name, the database server issues an error message.

An SPL function can return zero (0) or more values or rows.

The data type and count of each variable in the variable list must match each value that the function returns.

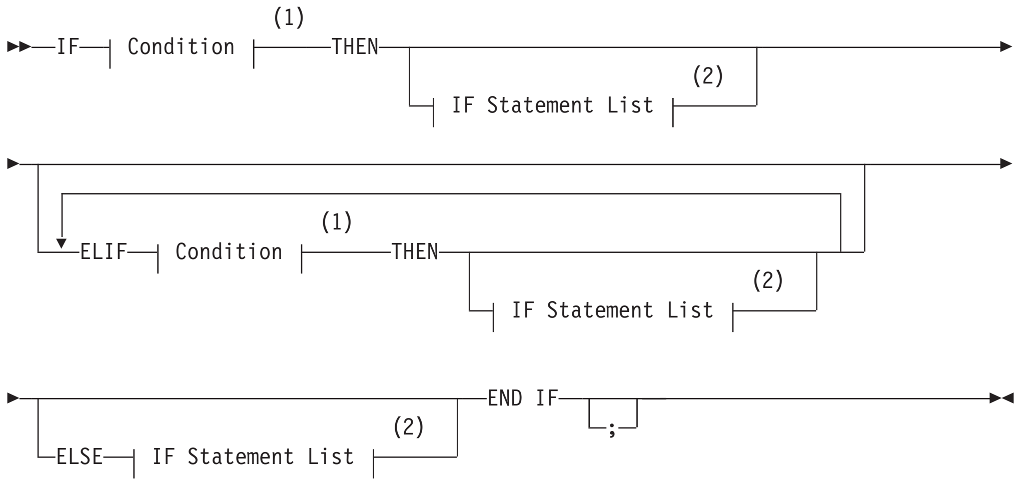
Related Statements

FOR, WHILE

IF

Use the IF statement to create a logical branch within an SPL routine.

Syntax



Notes:

1 See "Condition" on page 4-5

2 See "IF Statement List" on page 3-26

Usage

The database server processes the IF statement by the following steps:

1. If the condition that follows the IF keyword is true, any statements that follow the first THEN keyword of the IF statement execute, and the IF statement terminates.
2. If the result of the initial IF condition is false, but an ELIF clause exists, the database server evaluates the condition that follows the ELIF keyword.
3. If the result of the ELIF condition is true, any statements that follow the THEN keyword of the ELIF clause execute, and the IF statement terminates.
4. If the result of the condition in the first ELIF clause is also false, but one or more additional ELIF clauses exist, the database server evaluates the condition in the next ELIF clause, and proceeds as in the previous step if it is true. If it is false, the database server evaluates the condition in successive ELIF clauses, until it finds a condition that is true, in which case it executes the statement list that follows the THEN keyword of that ELIF clause, and the IF statement terminates.
5. If no condition in the IF statement is true, but the ELSE clause exists, statements that follow the ELSE keyword execute, and the IF statement terminates.
6. If none of the conditions in the IF statement are true, and no ELSE clause exists, the IF statement terminates without executing any statement list.

ELIF Clause

Use the ELIF clause to specify one or more additional conditions to evaluate. If the IF condition is false, the ELIF condition is evaluated. If the ELIF condition is true, the statements that follow the THEN keyword in the ELIF clause execute.

3 If no statement follows the THEN keyword of the ELIF clause when the ELIF
3 condition is true, program control passes from the IF statement to the next statement.

ELSE Clause

The ELSE clause executes if no true previous condition exists in the IF clause or any of the ELIF clauses.

In the following example, the SPL function uses an IF statement with both an ELIF clause and an ELSE clause. The IF statement compares two strings.

The function displays 1 to indicate that the first string comes before the second string alphabetically, or -1 if the first string comes after the second string alphabetically. If the strings are the same, a zero (0) is returned.

```
CREATE FUNCTION str_compare (str1 CHAR(20), str2 CHAR(20))
   RETURNING INT;
   DEFINE result INT;
   IF str1 > str2 THEN
      LET result =1;
   ELIF str2 > str1 THEN
      LET result = -1;
   ELSE
      LET result = 0;
   END IF
   RETURN result;
END FUNCTION -- str_compare
```

Conditions in an IF Statement

Just as in the WHILE statement, if any expression in the *condition* evaluates to NULL, then the condition cannot be true, unless you are explicitly testing for NULL using the IS NULL operator. The following rules summarize NULL values in conditions:

1. If the expression **x** evaluates to NULL, then **x** is not true by definition. Furthermore, NOT (**x**) is also not true .
2. IS NULL is the only operator that can return true for **x**. That is, **x** IS NULL is true, and **x** IS NOT NULL is not true.

If an expression in the condition has an UNKNOWN value from an uninitialized SPL variable, the statement terminates and raises an exception.

IF Statement List

IF Statement List:

```
                                    (1)
├──┬─BEGIN──┤ Statement Block ├──────────END─┬──────────────────────────────────┤
   │                                 (2)     │
   ├──┤ Subset of SPL Statements ├───────────┤
   │                                 (3)     │
   └──┤ Subset of SQL Statements ├──────────;┘
```

Notes:

1 See “Statement Block” on page 5-69

2 See “Subset of SPL Statements Allowed in the IF Statement List”

3 See “SQL Statements Not Valid in an IF Statement”

Subset of SPL Statements Allowed in the IF Statement List

You can use any of the following SPL statements in the IF statement list.

CALL	FOREACH	RETURN
CONTINUE	IF	SYSTEM
EXIT	LET	TRACE
FOR	RAISE EXCEPTION	WHILE

The “Subset of SPL Statements” syntax diagram for the IF Statement List refers to the SPL statements that are listed in the preceding table.

SQL Statements Not Valid in an IF Statement

The “Subset of SQL Statements” element in the syntax diagram for the IF Statement List refers to all SQL statements, except for the following SQL statements, which are not valid in the IF statement list.

ALLOCATE DESCRIPTOR	LOAD
CLOSE DATABASE	OPEN
CONNECT	OUTPUT
CREATE DATABASE	PREPARE
CREATE PROCEDURE	PUT
DATABASE	SET CONNECTION
DEALLOCATE DESCRIPTOR	SET DESCRIPTOR
DECLARE	UNLOAD
DESCRIBE	WHENEVER
DISCONNECT	FREE
EXECUTE	GET DESCRIPTOR
EXECUTE IMMEDIATE	GET DIAGNOSTICS
FETCH	INFO
FLUSH	

Many of these statements are prohibited by the more general rule that the dynamic management statements of SQL are not valid within an SPL routine.

You can use a SELECT statement only if you use the INTO TEMP clause to store the result set of the SELECT statement in a temporary table.

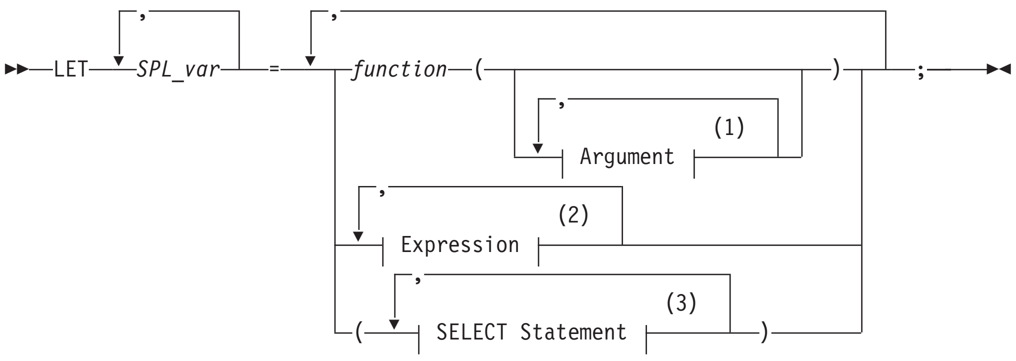
Related Statements

CASE, WHILE

LET

Use the LET statement to assign values to variables or to call a user-defined SPL routine and assign the returned value or values to SPL variables.

Syntax



Notes:

1 See "Arguments" on page 5-2

2 See "Expression" on page 4-34

3 See "SELECT" on page 2-479

Element	Description	Restrictions	Syntax
function	SPL function to be invoked	Must exist in the database	"Database Object Name" on page 5-17
SPL_var	SPL variable to receive a value that the *function*, expression, or query returns	Must be defined and in scope within the statement block	"Identifier" on page 5-22;

Usage

The LET statement can assign a value returned by an expression, function, or query to an SPL variable. At runtime, the value to be assigned is calculated first. The resulting value is cast to the data type of *SPL_var*, if possible, and the assignment occurs. If conversion is not possible, an error occurs, and the value of the variable remains undefined. (A LET operation that assigns a single value to a single SPL variable is called a *simple assignment*.)

A *compound assignment* assigns multiple expressions to multiple SPL variables. The data types of expressions in the expression list do not need to match the data types of the corresponding variables in the variable list, because the database server automatically converts the data types. (For a detailed discussion of casting, see the *IBM Informix Guide to SQL: Reference*.)

In multiple-assignment operations, the number of variables to the left of the equal (=) sign must match the number of values returned by the functions, expressions, and queries listed on the right of the equal (=) sign. The following example shows several LET statements that assign values to SPL variables:

```
LET a   = c + d ;
LET a,b = c,d ;
LET expire_dt = end_dt + 7 UNITS DAY;
LET name = 'Brunhilda';
LET sname = DBSERVERNAME;
LET this_day = TODAY;
```

You cannot use multiple values to the right of the equal (=) sign to operate on other values. For example, the following statement is not valid:

```
LET a,b = (c,d) + (10,15); -- INVALID EXPRESSION
```

Using a SELECT Statement in a LET Statement

The examples in this section use a SELECT statement in a LET statement. You can use a SELECT statement to assign values to one or more variables on the left side of the equals (=) operator, as the following example shows:

```
LET a,b = (SELECT c1,c2 FROM t WHERE id = 1);
LET a,b,c = (SELECT c1,c2 FROM t WHERE id = 1), 15;
```

You cannot use a SELECT statement to make multiple values operate on other values. The following example is invalid:

```
LET a,b = (SELECT c1,c2 FROM t) + (10,15); -- INVALID CODE
```

Because a LET statement is equivalent to a SELECT ... INTO statement, the two statements in the following example have the same results: `a=c` and `b=d`:

```
CREATE PROCEDURE proof()
   DEFINE a, b, c, d INT;
   LET a,b = (SELECT c1,c2 FROM t WHERE id = 1);
   SELECT c1, c2 INTO c, d FROM t WHERE id = 1
END PROCEDURE
```

If the SELECT statement returns more than one row, you must enclose the SELECT statement in a FOREACH loop.

For a description of SELECT syntax and usage, see “SELECT” on page 2-479.

Calling a Function in a LET Statement

You can call a user-defined function in a LET statement and assign the returned values to an SPL variable that receives the values that the function returns.

An SPL function can return multiple values (that is, values from multiple columns in the same row) into a list of variable names. In other words, the function can have multiple values in its RETURN statement and the LET statement can have multiple variables to receive the returned values.

When you call the function, you must specify all the necessary arguments to the function unless the arguments of the function have default values. If you specify the name of one of the parameters in the called function with syntax such as **name = ’smith’**, you must name all of the parameters.

An SPL function that selects and returns more than one row must be enclosed in a FOREACH loop.

The following two examples show valid LET statements:

```
LET a, b, c = func1(name = 'grok', age = 17);
LET a, b, c = 7, func2('orange', 'green');
```

The following LET statement is not valid because it tries to add the output of two functions and then assign the sum to two variables, **a** and **b**.

```
LET a, b = func1() + func2(); -- INVALID CODE
```

You can easily split this LET statement into two valid LET statements:

```
LET a = (func1() + func2());
LET b = a;                  -- VALID CODE
```

A function called in a LET statement can have an argument of COLLECTION, SET, MULTISET, or LIST. You can assign the value that the function returns to a variable, for example:

```
LET d = function1(collection1);
LET a = function2(set1);
```

In the first statement, the SPL function **function1** accepts **collection1** (that is, any collection data type) as an argument and returns its value to the variable **d**. In the second statement, the SPL function **function2** accepts **set1** as an argument and returns a value to the variable **a**.

ON EXCEPTION

Use the ON EXCEPTION statement to specify actions to be taken for any error, or for a list of one or more specified errors, during execution of a statement block.

Syntax

```
>>──ON EXCEPTION──┬───────────────────────────────┬──────────────────────────>
                  │         ┌─,───────────┐       │
                  │         ▼             │       │
                  └─IN──(───error_number──┴──)────┘

                                                                 (1)
>──┬────────────────────────────────────────────┬──┤ Statement Block ├────────>
   └─SET──SQL_error_var──┬───────────────────────┤
                         ├─,──ISAM_error_var─────┤
                         └─,──error_data_var─────┘

>─END EXCEPTION──┬─────────────┬──┬───┬───────────────────────────────────────><
                 └─WITH RESUME─┘  └─;─┘
```

Notes:

1 See "Statement Block" on page 5-69

Element	Description	Restrictions	Syntax
error_data_var	SPL variable to receive a string returned by an SQL error or by a user-defined exception	Must be a character type to receive the error information. Must be valid in current statement block.	"Identifier" on page 5-22
error_number	SQL error number or a number defined by a RAISE EXCEPTION statement that is to be trapped	Must be of integer type. Must be valid in current statement block.	"Literal Number" on page 4-137
ISAM_error_var	SPL variable that receives the ISAM error number of the exception raised	Same as for *error_number*	"Identifier" on page 5-22
SQL_error_var	SPL variable that receives the SQL error number of the exception raised	Same as for *ISAM_error_var*	"Identifier" on page 5-22

Usage

The ON EXCEPTION statement, together with the RAISE EXCEPTION statement, provides an error-trapping and error-recovery mechanism for SPL. ON EXCEPTION can specify the errors that you want to trap as the SPL routine executes, and specifies the action to take if the error occurs within the statement block. ON EXCEPTION can specify an error number list in the IN clause, or can include no IN clause. If the IN clause is omitted, then all errors are trapped.

A statement block can include more than one ON EXCEPTION statement. The exceptions that are trapped can be either system-defined or user-defined.

The scope of an ON EXCEPTION statement is the statement block that follows the ON EXCEPTION statement, and all the statement blocks that are nested within that statement block.

When an exception is trapped, the error status is cleared.

If you specify a variable to receive an ISAM error, but no accompanying ISAM error exists, a zero (0) is assigned to the variable. If you specify a variable to receive the error text, but none exists, the variable stores an empty string.

ON EXCEPTION has no effect within a UDR that is called by a trigger.

Placement of the ON EXCEPTION Statement

The ON EXCEPTION statement is a declarative statement, not an executable statement. For this reason, ON EXCEPTION must precede any executable statement and must follow any DEFINE statement within an SPL routine.

The following example shows the correct placement of an ON EXCEPTION statement. Function **add_salesperson( )** inserts a set of values into a table. If the table does not exist, it is created, and the values are inserted. The function also returns the total number of rows in the table after the insert occurs:

```
CREATE FUNCTION add_salesperson(last CHAR(15), first CHAR(15))
   RETURNING INT;
   DEFINE x INT;
   ON EXCEPTION IN (-206) -- If no table was found, create one
      CREATE TABLE emp_list
          (lname CHAR(15),fname CHAR(15), tele CHAR(12));
      INSERT INTO emp_list VALUES -- and insert values
          (last, first, '800-555-1234');
   END EXCEPTION WITH RESUME;
   INSERT INTO emp_list VALUES (last, first, '800-555-1234');
   SELECT count(*) INTO x FROM emp_list;
   RETURN x;
END FUNCTION;
```

When an error occurs, the database server searches for the last ON EXCEPTION statement that traps the error code. If the database server finds no pertinent ON EXCEPTION statement, the error code passes back to the calling context (the SPL routine, application, or interactive user), and execution terminates.

In the previous example, the minus sign (-) is required in the IN clause that specifies error -206; most error codes are negative integers.

The next example uses two ON EXCEPTION statements with the same error number so that error code 691 can be trapped in two levels of nesting. All of the DELETE statements except the one that is marked { 6 } are within the scope of the first ON EXCEPTION statement. The DELETE statements that are marked { 1 } and { 2 } are within the scope of the inner ON EXCEPTION statement:

```
CREATE PROCEDURE delete_cust (cnum INT)
   ON EXCEPTION  IN (-691)    -- children exist
      BEGIN -- Begin-end so no other DELETEs get caught in here.
         ON EXCEPTION IN (-691)
            DELETE FROM another_child WHERE num = cnum;   { 1 }
            DELETE FROM orders WHERE customer_num = cnum; { 2 }
         END EXCEPTION -- for error -691
         DELETE FROM orders WHERE customer_num = cnum;    { 3 }
      END
      DELETE FROM cust_calls WHERE customer_num = cnum;   { 4 }
      DELETE FROM customer WHERE customer_num = cnum;     { 5 }
   END EXCEPTION
   DELETE FROM customer WHERE customer_num = cnum;        { 6 }
END PROCEDURE
```

Using the IN Clause to Trap Specific Exceptions

An error is trapped if the SQL error code or the ISAM error code matches an exception code in the list of error numbers. The search through the list of errors begins from the left and stops with the first match. You can use a combination of an ON EXCEPTION statement without an IN clause and one or more ON EXCEPTION statements with an IN clause. When an error occurs, the database server searches for the last declaration of the ON EXCEPTION statement that traps the particular error code.

```
CREATE PROCEDURE ex_test()
   DEFINE error_num INT;
   ...
   ON EXCEPTION SET error_num
   -- action C
   END EXCEPTION
   ON EXCEPTION IN (-300)
   -- action B
   END EXCEPTION
   ON EXCEPTION IN (-210, -211, -212) SET error_num
   -- action A
   END EXCEPTION
```

A summary of the sequence of statements in the previous example would be:

1. Test for an error.
2. If error `-210`, `-211`, or `-212` occurs, take action `A`.
3. If error `-300` occurs, take action `B`.
4. If any other error occurs, take action `C`.

Receiving Error Information in the SET Clause

If you use the SET clause, when an exception occurs, the SQL error code and (optionally) the ISAM error code are inserted into the variables that are specified in the SET clause. If you provide an *error_data_var*, any error text that the database server returns is put into the *error_data_var*. Error text includes information such as the offending table or column name.

Forcing Continuation of the Routine

The first example in "Placement of the ON EXCEPTION Statement" on page 3-32 uses the WITH RESUME keyword to indicate that after the statement block in the ON EXCEPTION statement executes, execution is to continue at the `LET x = SELECT COUNT(*) FROM emp_list` statement, which is the line following the line that raised the error. For this function, the result is that the count of salespeople names occurs even if the error occurred.

Continuing Execution After an Exception Occurs

If you omit the WITH RESUME keywords, the next statement that executes after an exception occurs depends on the placement of the ON EXCEPTION statement, as the following scenarios describe:

- If the ON EXCEPTION statement is inside a statement block with a BEGIN and an END keyword, execution resumes with the first statement (if any) after that BEGIN ... END block. That is, it resumes after the scope of the ON EXCEPTION statement.
- If the ON EXCEPTION statement is inside a loop (FOR, WHILE, FOREACH), the rest of the loop is skipped, and execution resumes with the next iteration of the loop.

- If no statement or block, but only the SPL routine, contains the ON EXCEPTION statement, the routine executes a RETURN statement with no arguments, returning a successful status and no values.

To prevent an infinite loop, if an error occurs during execution of the statement block, then the search for another ON EXCEPTION statement to trap the error does not include the current ON EXCEPTION statement.

Related Statements

RAISE EXCEPTION

RAISE EXCEPTION

Use the RAISE EXCEPTION statement to simulate the generation of an error.

Syntax

```
►►──RAISE EXCEPTION──SQL_error_var──┬─────────────────────────────────────┬──;──────────►◄
                                    └─,──ISAM_error──┬──────────────────┬─┘
                                                     └─,──error_text────┘
```

Element	Description	Restrictions	Syntax
error_text	SPL variable or expression that contains the error message text	Must be a character data type and be valid in the statement block	"Identifier" on page 5-22; "Expression" on page 4-34
ISAM_error	SPL variable or expression that represents an ISAM error number. The default is `0`.	Must return a value in SMALLINT range. You can specify a unary minus sign before error number.	"Identifier" on page 5-22; "Expression" on page 4-34
SQL_error	SPL variable or expression that represents an SQL error number	Same as for *ISAM_error*	"Identifier" on page 5-22; "Expression" on page 4-34

Usage

Use the RAISE EXCEPTION statement to simulate an error or to generate an error with a custom message. An ON EXCEPTION statement can trap the generated error.

If you omit *ISAM_error*, the database server sets the ISAM error code to zero (`0`) when the exception is raised. If you want to specify *error_text* but not specify a value for *ISAM_error*, specify zero (`0`) as the value of *ISAM_error*.

The RAISE EXCEPTION statement can raise either system-generated exceptions or user-generated exceptions. For example, the following statement raises the error number `-208` and inserts the text `a missing file` into the variable of the system-generated error message:

```
RAISE EXCEPTION -208, 0, 'a missing file';
```

Here the minus (-) symbol is required after the EXCEPTION keyword for error -208; most error codes are negative integers.

The special error number `-746` allows you to produce a customized message. For example, the following statement raises the error number `-746` and returns the quoted text:

```
RAISE EXCEPTION -746, 0, 'You broke the rules';
```

Special Error Numbers

In the following example, a negative value for **`alpha`** raises exception `-746` and provides a specific message that describes the problem. The code should contain an ON EXCEPTION statement that traps for an exception of `-746.`

```
FOREACH SELECT c1 INTO alpha FROM sometable
IF alpha < 0 THEN
RAISE EXCEPTION -746, 0, 'a < 0 found' -- emergency exit
END IF
END FOREACH
```

When the SPL routine executes and the IF condition is met, the database server returns the following error:

```
-746: a < 0 found.
```

For more information about the scope and compatibility of exceptions, see "ON EXCEPTION" on page 3-31.

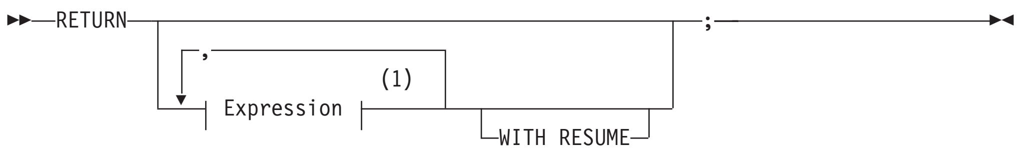
Related Statements

ON EXCEPTION

RETURN

Use the RETURN statement to specify what values (if any) the SPL function returns to the calling context.

Syntax



Notes:

1 See "Expression" on page 4-34

Usage

In Dynamic Server, for backward compatibility, you can use the RETURN statement inside a CREATE PROCEDURE statement to create an SPL function. By only using RETURN in CREATE FUNCTION statements, however, you can maintain the convention of using CREATE FUNCTION to define routines that return a value, and CREATE PROCEDURE for other routines.

All RETURN statements in the SPL function must be consistent with the RETURNING clause of the CREATE FUNCTION (or CREATE PROCEDURE) statement that defines the function. Any RETURN list of expressions must match in cardinality (and be of data types compatible with) the ordered list of data types in the RETURNING clause of the function definition.

Alternatively, however, the RETURN statement can specify no expressions, even if the RETURNING clause lists one or more data types. In this case, a RETURN statement that specifies no expression is equivalent to returning the expected number of NULL values to the calling context. A RETURN statement without any expressions exits only if the SPL function is declared as not returning any values. Otherwise it returns NULL values.

The following SPL function has two valid RETURN statements:

```
CREATE FUNCTION two_returns (stockno INT)  RETURNING CHAR (15);
   DEFINE des CHAR(15);
   ON EXCEPTION (-272)     -- if user does not have select privilege
      RETURN;                        -- return no values.
   END EXCEPTION;
   SELECT DISTINCT descript INTO des FROM stock
      WHERE stocknum = stockno;
   RETURN des;
END FUNCTION
```

A program that calls the function in the previous example should test whether no values are returned and act accordingly.

WITH RESUME Keyword

If you use the WITH RESUME keyword, after the RETURN statement executes, the next invocation of the SPL function (upon the next FETCH or FOREACH statement) starts from the statement that follows the RETURN statement. Any function that executes a RETURN WITH RESUME statement must be invoked within a FOREACH loop, or else in the FROM clause of a query. If an SPL routine executes a RETURN WITH RESUME statement, a FETCH statement in an ESQL/C application can call the SPL routine.

The following example shows a cursor function that another UDR can call. After the RETURN WITH RESUME statement returns each value to the calling UDR or program, the next line of **series** executes the next time **series** is called. If the variable **backwards** equals zero (0), no value is returned to the calling UDR or program, and execution of **series** stops:

```
CREATE FUNCTION series (limit INT, backwards INT) RETURNING INT;
   DEFINE i INT;
   FOR i IN (1 TO limit)
      RETURN i WITH RESUME;
   END FOR
   IF backwards = 0 THEN
      RETURN;
   END IF
   FOR i IN (limit TO 1 STEP -1)
      RETURN i WITH RESUME;
   END FOR
END FUNCTION -- series
```

Returning Values from Another Database (IDS)

If an SPL function includes the RETURN statement to return one or more values from another database of the local database server, the parameters and returned values must be of built-in data types. UDRs can also return DISTINCT types whose base types are built-in types, or can be UDTs, but you must explicitly cast the DISTINCT types and UDTs to built-in types. All the UDRs, DISTINCT types, UDTs, and casts must also be defined in all of the participating databases.

Only built-in data types can be returned from tables of other database servers.

External Functions and Iterator Functions (IDS): In an SPL program, you can use a C or Java language external function as an expression in a RETURN statement, provided that the external function is not an iterator function. An *iterator function* is an external function that returns one or more rows of data (and therefore requires a cursor to execute).

SPL iterator functions must include the RETURN WITH RESUME statement. For information about using an iterator function with a virtual table interface in the FROM clause of a query, see “Iterator Functions (IDS)” on page 2-499.

SYSTEM

Use the SYSTEM statement to issue an operating-system command from within an SPL routine.

Syntax

```
►►──SYSTEM──┬─expression─┬──;───────────────────────────────────────►◄
            └─SPL_var────┘
```

Element	Description	Restrictions	Syntax
expression	Evaluates to a user-executable operating-system command	You cannot specify that the command run in the background	Operating-system dependent
SPL_var	SPL variable containing a command	Must be of a character data type	"Identifier" on page 5-22;

Usage

If the specified *expression* is not a character expression, it is converted to a character expression and passed to the operating system for execution.

The command that SYSTEM specifies cannot run in the background. The database server waits for the operating system to complete execution of the command before it continues to the next statement in the SPL routine. The SPL routine cannot use any returned values from the command.

If the operating-system command fails (that is, returns a nonzero status for the command), an exception is raised that contains the returned operating-system status as the ISAM error code and an appropriate SQL error code.

A rollback does not terminate a system call, so a suspended transaction can wait indefinitely for the call to return. For instructions on recovery from a deadlock during a long transaction rollback, see the *IBM Informix Administrator's Guide*.

The dynamic log feature of Dynamic Server automatically adds log files until the long transaction completes or rolls back successfully.

In DBA- and owner-privileged SPL routines that contain SYSTEM statements, the command runs with the access privileges of the user who executes the routine.

Executing the SYSTEM Statement on UNIX

The SYSTEM statement in the following example of an SPL routine causes the UNIX operating system to send a mail message to the system administrator:

```
CREATE PROCEDURE sensitive_update()
   ...
   LET mailcall = 'mail headhoncho < alert';
   -- code to execute if user tries to execute a specified
   -- command, then sends email to system administrator
   SYSTEM mailcall;
   ...
END PROCEDURE; -- sensitive_update
```

You can use a double-pipe symbol (||) to concatenate expressions with a SYSTEM statement, as the following example shows:

```
CREATE PROCEDURE sensitive_update2()
   DEFINE user1 char(15);
   DEFINE user2 char(15);
   LET user1 = 'joe';
   LET user2 = 'mary';
   ...
   -- code to execute if user tries to execute a specified
   -- command, then sends email to system administrator
   SYSTEM 'mail -s violation' ||user1 || ' ' || user2
               || '< violation_file';
   ...
END PROCEDURE; --sensitive_update2
```

Executing the SYSTEM Statement on Windows

On Windows systems, any SYSTEM statements in an SPL routine are executed only if the current user who is executing the SPL routine has logged on with a password. The database server must have the password and login name of the user in order to execute a command on behalf of that user.

The first SYSTEM statement in the following example of an SPL routine causes Windows to send an error message to a temporary file and to put the message in a system log that is sorted alphabetically. The second SYSTEM statement causes the operating system to delete the temporary file:

```
CREATE PROCEDURE test_proc()
   ...
   SYSTEM 'type errormess101 > %tmp%tmpfile.txt |
         sort >> %SystemRoot%systemlog.txt';
   SYSTEM 'del %tmp%tmpfile.txt';
   ...
END PROCEDURE; --test_proc
```

The expressions that follow the SYSTEM statements in this example contain variables **%tmp%** and **%SystemRoot%** that are defined by Windows.

Setting Environment Variables in SYSTEM Commands

When the operating-system command that SYSTEM specifies is executed, no guarantee exists that any environment variables that the user application sets are passed to the operating system. If you set an environment variable in a SYSTEM command, the setting is only valid during that SYSTEM command.

To avoid this potential problem, the following method is recommended to ensure that any environment variables that the user application requires are carried forward to the operating system.

To Change Environment Settings for an Operating System Command:

1. Create a shell script (on UNIX systems) or a batch file (on Windows platforms) that sets up the desired environment and then executes the operating system command.
2. Use the SYSTEM command to execute the shell script or batch file.

This solution has an additional advantage: if you subsequently need to change the environment, you can modify the shell script or the batch file without needing to recompile the SPL routine.

For information about operating system commands that set environment variables, see the *IBM Informix Guide to SQL: Reference*.

TRACE

Use the TRACE statement to control the generation of debugging output.

Syntax

```
►►──TRACE──┬─ON────────────────┬──;──────────────────────────────────►◄
           ├─OFF───────────────┤
           ├─PROCEDURE─────────┤
           │              (1)  │
           └─┤ Expression ├────┘
```

Notes:

1 See “Expression” on page 4-34

Usage

The TRACE statement generates output that is sent to the file that the SET DEBUG FILE TO statement specifies. Tracing writes to the debug file the current values of the following program objects:

- SPL variables
- Routine arguments
- Return values
- SQL error codes
- ISAM error codes

The output of each executed TRACE statement appears on a separate line.

If you use the TRACE statement before you specify a DEBUG file to contain the output, an error is generated.

Any routine that the SPL routine calls inherits the trace state. That is, a called routine (on the same database server) assumes the same trace state (ON, OFF, or PROCEDURE) as the calling routine. The called routine can set its own trace state, but that state is not passed back to the calling routine.

A routine that is executed on a remote database server does not inherit the trace state.

TRACE ON

If you specify the keyword ON, all statements are traced. The values of variables (in expressions or otherwise) are printed before they are used. To turn tracing ON implies tracing both routine calls and statements in the body of the routine.

TRACE OFF

If you specify the keyword OFF, all tracing is turned off.

TRACE PROCEDURE

If you specify the keyword PROCEDURE, only the routine calls and return values, but not the body of the routine, are traced.

The TRACE statement supports no ROUTINE or FUNCTION keywords. Use the TRACE PROCEDURE keywords when the SPL routine that you trace is a function.

Displaying Expressions

You can use the TRACE statement with a quoted string or an expression to display values or comments in the output file. If the expression is not a literal expression, the expression is evaluated before it is written to the output file.

You can use the TRACE statement with an expression even if you used a TRACE OFF statement earlier in a routine. You must first, however, use the SET DEBUG statement to establish a trace output file.

The next example uses a TRACE statement with an expression after using a TRACE OFF statement. The example uses UNIX file naming conventions:

```
CREATE PROCEDURE tracing ()
   DEFINE i INT;
BEGIN
   ON EXCEPTION IN (1)
   END EXCEPTION; -- do nothing
   SET DEBUG FILE TO '/tmp/foo.trace';
   TRACE OFF;
   TRACE 'Forloop starts';
   FOR i IN (1 TO 1000)
      BEGIN
         TRACE 'FOREACH starts';
         FOREACH SELECT...INTO a FROM t
            IF <some condition> THEN
               RAISE EXCEPTION 1    -- emergency exit
            END IF
         END FOREACH                -- return some value
      END
   END FOR                          -- do something
END;
END PROCEDURE
```

Example Showing Different Forms of TRACE

The following example shows several different forms of the TRACE statement. The example uses Windows file naming conventions:

```
CREATE PROCEDURE testproc()
   DEFINE i INT;
   SET DEBUG FILE TO 'C:\tmp\test.trace';
   TRACE OFF;
   TRACE 'Entering foo';
   TRACE PROCEDURE;
   LET i = test2();

   TRACE ON;
   LET i = i + 1;

   TRACE OFF;
   TRACE 'i+1 = ' || i+1;
   TRACE 'Exiting testproc';

   SET DEBUG FILE TO 'C:\tmp\test2.trace';

END PROCEDURE
```

Looking at the Traced Output

To see the traced output, use a text editor or similar utility to display or read the contents of the file.

WHILE

Use the WHILE statement to establish a loop with variable end conditions.

Syntax

```
                          (1)                        (2)
►►──WHILE──┤ Condition ├──────┤ Statement Block ├──────END WHILE──┬───┬──────────►◄
                                                                  └─;─┘
```

Notes:

1 See "Condition" on page 4-5

2 See "Statement Block" on page 5-69

Usage

The *condition* is evaluated before the *statement block* first runs and before each subsequent iteration. Iterations continue as long as the *condition* remains true. The loop terminates when the *condition* evaluates to not true.

If any expression within the *condition* evaluates to NULL, the *condition* becomes not true unless you are explicitly testing for NULL with the IS NULL operator.

If an expression within the *condition* has an UNKNOWN value because it references uninitialized SPL variables, an immediate error results. In this case, the loop terminates, raising an exception.

Example of WHILE Loops in an SPL Routine

The following example illustrates the use of WHILE loops in an SPL routine. In the SPL procedure, **simp_while**, the first WHILE loop executes a DELETE statement. The second WHILE loop executes an INSERT statement and increments the value of an SPL variable.

```
CREATE PROCEDURE simp_while()
   DEFINE i INT;
   WHILE EXISTS (SELECT fname FROM customer
       WHERE customer_num > 400)
      DELETE FROM customer WHERE id_2 = 2;
   END WHILE;
   LET i = 1;
   WHILE i < 10
      INSERT INTO tab_2 VALUES (i);
      LET i = i + 1;
   END WHILE;
END PROCEDURE
```

Chapter 4. Data Types and Expressions

In This Chapter

This chapter describes the data types and expressions that Dynamic Server and Extended Parallel Server support. These fundamental syntax segments can appear in data definition language (DDL) and data manipulation language (DML) statements, and in other types of SQL statements. Some SPL statements can also specify data types or expressions. You can use these features of a relational or object-relational database in various contexts, such as to define the schema of a table, to specify the signature and arguments of a routine, or to represent or calculate specific data values.

Scope of Segment Descriptions

The description of each segment includes the following information:

- A brief introduction that explains the effect of the segment
- A syntax diagram that shows how to enter the segment correctly
- A table that explains the terms in the syntax diagram for which you must substitute names, values, or other specific information
- Rules of usage, typically including examples that illustrate these rules

If a segment consists of multiple parts, the segment description provides similar information about each part. Some descriptions conclude with references to related information in this manual and in other manuals.

Use of Segment Descriptions

The syntax diagram within each segment description is not a stand-alone diagram. Rather, it is a subdiagram of the syntax of the SQL statements (in Chapter 2) or of SPL statements (in Chapter 3) that can include the segment.

SQL or SPL syntax descriptions can refer to segment descriptions in two ways:

- A *subdiagram reference* in a syntax diagram can list a segment name and the page in this manual where the segment description begins.

- The **Syntax** column of the table that immediately follows a syntax diagram can list a segment name and the page where the segment description begins.

If the syntax diagram for a statement includes a reference to a segment, turn to that segment description to see the complete syntax for the segment.

For example, if you want to write a CREATE VIEW statement that includes a *database* and *database server* qualifiers of the *view* name, first look up the syntax diagram for the CREATE VIEW statement in Chapter 2. The table beneath that diagram refers to the Database Object Name segment for the syntax of *view.* Then use the Database Object Name segment syntax to enter a valid CREATE VIEW statement that also specifies the *database* and *database server* name for the view (and for Extended Parallel Server, the *coserver* identifier). In the following example, the CREATE VIEW statement defines a view called **name_only** in the **sales** database on the **boston** database server:

```
CREATE VIEW sales@boston:name_only AS
      SELECT customer_num, fname, lname FROM customer;
```

Besides the Data Types and Expressions syntax segments that this chapter documents, Chapter 5 provides additional syntax segments that are referenced in the syntax diagrams of this manual.

Collection Subquery

You can use a Collection Subquery to create a MULTISET collection from the results of a subquery. Only Dynamic Server supports this syntax, which is an extension to the ANSI/ISO standard for SQL.

Syntax

Collection Subquery:

```
   (1)
├───────MULTISET──(──┬─subquery──────────────────────┬─)──────────────────────┤
                     └─SELECT ITEM──singleton_select─┘
```

Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
singleton _select	Subquery returning exactly one row	Subquery cannot repeat the SELECT keyword, nor include the ORDER BY clause	SELECT, p. 2-479
subquery	Embedded query	Cannot contain the ORDER BY clause	SELECT, p. 2-479

Usage

The MULTISET and SELECT ITEM keywords have the following significance:

- MULTISET specifies a collection of elements that can contain duplicate values, but that has no specific order of elements.
- SELECT ITEM supports only one expression in the projection list. You cannot repeat the SELECT keyword in the singleton subquery.

You can use a collection subquery in the following contexts:

- The Projection clause and WHERE clause of the SELECT statement
- The VALUES clause of the INSERT statement
- The SET clause of the UPDATE statement
- Wherever you can use a collection expression (that is, any expression that evaluates to a single collection)
- As an argument passed to a user-defined routine

The following restrictions apply to a collection subquery:

- The Projection clause cannot contain duplicate column (field) names.
- It cannot contain aliases for table names. (But it can use aliases for column (field) names, as in some of the examples that follow.)
- It is read-only.
- It cannot be opened twice.
- It cannot contain NULL values.
- It cannot contain syntax that attempts to seek within the subquery.

A collection subquery returns a multiset of unnamed ROW data types. The fields of this ROW type are elements in the projection list of the subquery. Examples that follow access the tables and the ROW types that these statements define:

```
CREATE ROW TYPE rt1 (a INT);
CREATE ROW TYPE rt2 (x int, y rt1);
CREATE TABLE tab1 (col1 rt1, col2 rt2);
CREATE TABLE tab2 OF TYPE rt1;
CREATE TABLE tab3 (a ROW(x INT));
```

The following examples of collection subqueries return the MULTISET collections that are listed to the right of the subquery.

Collection Subquery	Resulting Collections
MULTISET (SELECT * FROM tab1)...	MULTISET(ROW(col1 rt1, col2 rt2))
MULTISET (SELECT col2.y FROM tab1)...	MULTISET(ROW(y rt1))
MULTISET (SELECT * FROM tab2)...	MULTISET(ROW(a int))
MULTISET(SELECT p FROM tab2 p)...	MULTISET(ROW(p rt1))
MULTISET (SELECT * FROM tab3)...	MULTISET(ROW(a ROW(x int)))

The following is another collection subquery:

```
SELECT f(MULTISET(SELECT * FROM tab1 WHERE tab1.x = t.y))
   FROM t WHERE t.name = 'john doe';
```

The following collection subquery includes the UNION operator:

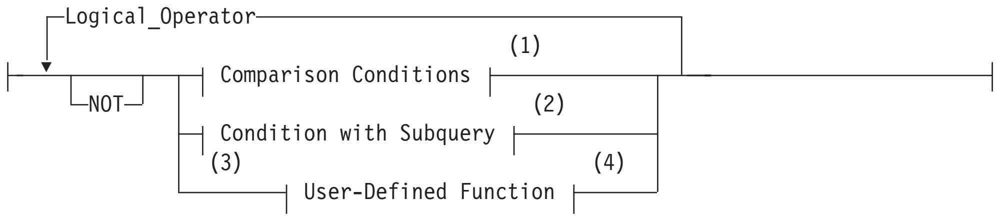
```
SELECT f(MULTISET(SELECT id FROM tab1
UNION
SELECT id FROM tab2 WHERE tab2.id2 = tab3.id3)) FROM tab3;
```

Condition

Use a condition to test whether data meets certain qualifications. Use this segment wherever you see a reference to a condition in a syntax diagram.

Syntax

Condition:



Notes:

1 See page 4-6

2 See page 4-13

3 Dynamic Server only

4 See page 4-111

Element	Description	Restrictions	Syntax
Logical _Operator	Combines two conditions	Valid options are OR (= *logical union*) *or* AND (= *logical intersection*)	Condition with AND or OR, p. 4-17

Usage

A *condition* is a search criterion, optionally connected by the logical operators AND or OR. Conditions can be classified into the following categories:

- Comparison conditions (also called filters or Boolean expressions)
- Conditions within a subquery
- User-defined functions (Dynamic Server only)

A condition can contain an aggregate function only if it is used in the HAVING clause of a SELECT statement or in the HAVING clause of a subquery.

No aggregate function can appear in a condition in the WHERE clause of a DELETE, SELECT, or UPDATE statement unless both of the following are `TRUE`:

- Aggregate is on a correlated column originating from a parent query.
- The WHERE clause appears in a subquery within a HAVING clause.

In Dynamic Server, user-defined functions are not valid as conditions in the following contexts:

- In the HAVING clause of a SELECT statement
- In the definition of a check constraint

SPL routines are not valid as conditions in the following contexts:

- In the definition of a check constraint
- In the ON clause of a SELECT statement

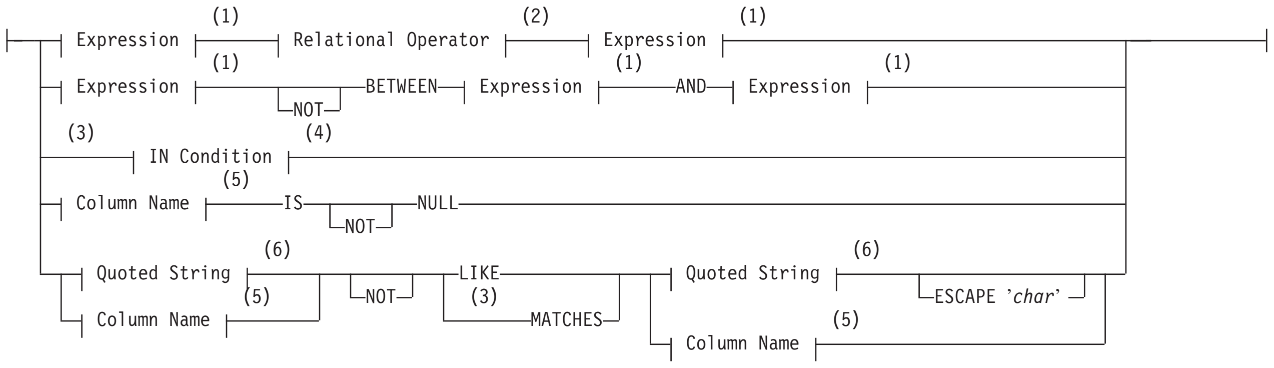
- In the WHERE clause of a DELETE, SELECT, or UPDATE statement

External routines are not valid as conditions in the following contexts:
- In the definition of a check constraint
- In the ON clause of a SELECT statement
- In the WHERE clause of a DELETE, SELECT, or UPDATE statement
- In the WHEN clause of CREATE TRIGGER
- In the IF, CASE, or WHILE statements of SPL

Comparison Conditions (Boolean Expressions)

Five kinds of comparison conditions exist: Relational Operator, BETWEEN, IN, IS NULL, and LIKE and MATCHES. Comparison conditions are often called *Boolean expressions* because they return a `TRUE` or `FALSE` result. Their syntax is summarized in this diagram and explained in the sections that follow.

Comparison Conditions:



Notes:

1 See page 4-34

2 See page 4-146

3 Informix extension

4 See page 4-9

5 See page 4-7

6 See page 4-142

Element	Description	Restrictions	Syntax
char	An ASCII character to be the nondefault escape character in the quoted string. Single (′) and double (″) quotation marks are not valid as *char*.	See "ESCAPE with LIKE" on page 4-12 and "ESCAPE with MATCHES" on page 4-13.	Quoted String, p. 4-142

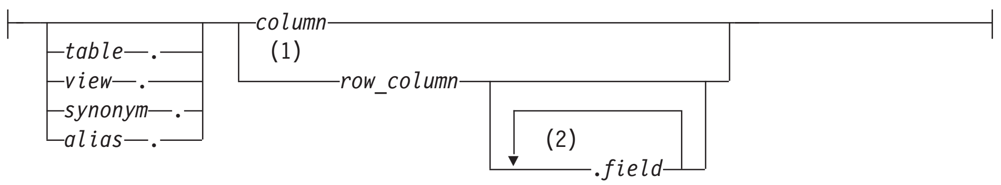
The following sections describe the different types of comparison conditions:
- "Relational-Operator Condition" on page 4-8
- "BETWEEN Condition" on page 4-8
- "IN Condition" on page 4-9
- "IS NULL Condition" on page 4-10
- "LIKE and MATCHES Condition" on page 4-11.

For a discussion of comparison conditions in the context of the SELECT statement, see “Using a Condition in the WHERE Clause” on page 2-508.

Warning: A literal *date* or *DATETIME* value in a comparison condition should specify 4 digits for the year. When you specify a 4-digit year, the **DBCENTURY** environment variable has no effect on the result. When you specify a 2-digit year, **DBCENTURY** can affect how the database server interprets the comparison condition, which might not work as you intended. For more information, see the *IBM Informix Guide to SQL: Reference*.

Column Name

Column Name:



Notes:

1 Dynamic Server only

2 Repeat no more than three times

Element	Description	Restrictions	Syntax
alias	Temporary alternative name for table or view	Must be defined in the FROM clause of the SELECT statement	Identifier, p. 5-22
column	Name of a column	Must exist in the specified table	Identifier, p. 5-22
field	A field to compare in a ROW type column	Must be a component of *row-column name* or *field name* (for nested rows)	Identifier, p. 5-22
row_column	A column of type ROW	Must be an existing named ROW type or unnamed ROW type	Identifier, p. 5-22
synonym, *table*, *view*	Name of a synonym, table, or view	The *synonym* and the table or view to which it points must exist in the database	Database Object Name, p. 5-17

For more information on the meaning of the *column* name in these conditions, see the “IS NULL Condition” on page 4-10 and the “LIKE and MATCHES Condition” on page 4-11.

Quotation Marks in Conditions

When you compare a column expression with a constant expression in any comparison condition, observe the following rules:

- If the column has a numeric data type, do not enclose the constant expression between quotation marks.
- If the column has a character data type, enclose the constant expression between quotation marks.
- If the column has a time data type, enclose the constant expression between quotation marks.

Otherwise, you might get unexpected results.

The following example shows the correct use of quotation marks in comparison conditions. Here the **ship_instruct** column has a character data type, the **order_date** column has a date data type, and the **ship_weight** column has a numeric data type.

```
SELECT * FROM orders
   WHERE ship_instruct = 'express'
   AND order_date > '05/01/98'
   AND ship_weight < 30
```

Relational-Operator Condition

The following examples show some relational-operator conditions:

```
city[1,3] = 'San'

o.order_date > '6/12/98'

WEEKDAY(paid_date) = WEEKDAY(CURRENT- (31 UNITS DAY))

YEAR(ship_date) < YEAR (TODAY)

quantity <= 3

customer_num <> 105

customer_num != 105
```

If an expression within the *condition* has an UNKNOWN value because it references an uninitialized variable, the database server raises an exception.

If any expression within the *condition* evaluates to NULL, the *condition* cannot be true, unless you are explicitly testing for NULL by using the IS NULL operator. For example, if the **paid_date** column has a NULL value, then neither of the following statements can retrieve that row:

```
SELECT customer_num, order_date FROM orders
   WHERE paid_date = ''

SELECT customer_num, order_date FROM orders
   WHERE NOT (paid_date !='')
```

The IS NULL operator tests for a NULL value, as the next example shows. The IS NULL operator is described in “IS NULL Condition” on page 4-10.

```
SELECT customer_num, order_date FROM orders
   WHERE paid_date IS NULL
```

BETWEEN Condition

For a BETWEEN test to be `TRUE`, the value of the expression on the left of the BETWEEN keyword must be in the inclusive range of the values of the two expressions on the right of the BETWEEN keyword.

NULL values do not satisfy the condition, and you cannot use NULL for either expression that defines the range.

The following examples show some BETWEEN conditions:

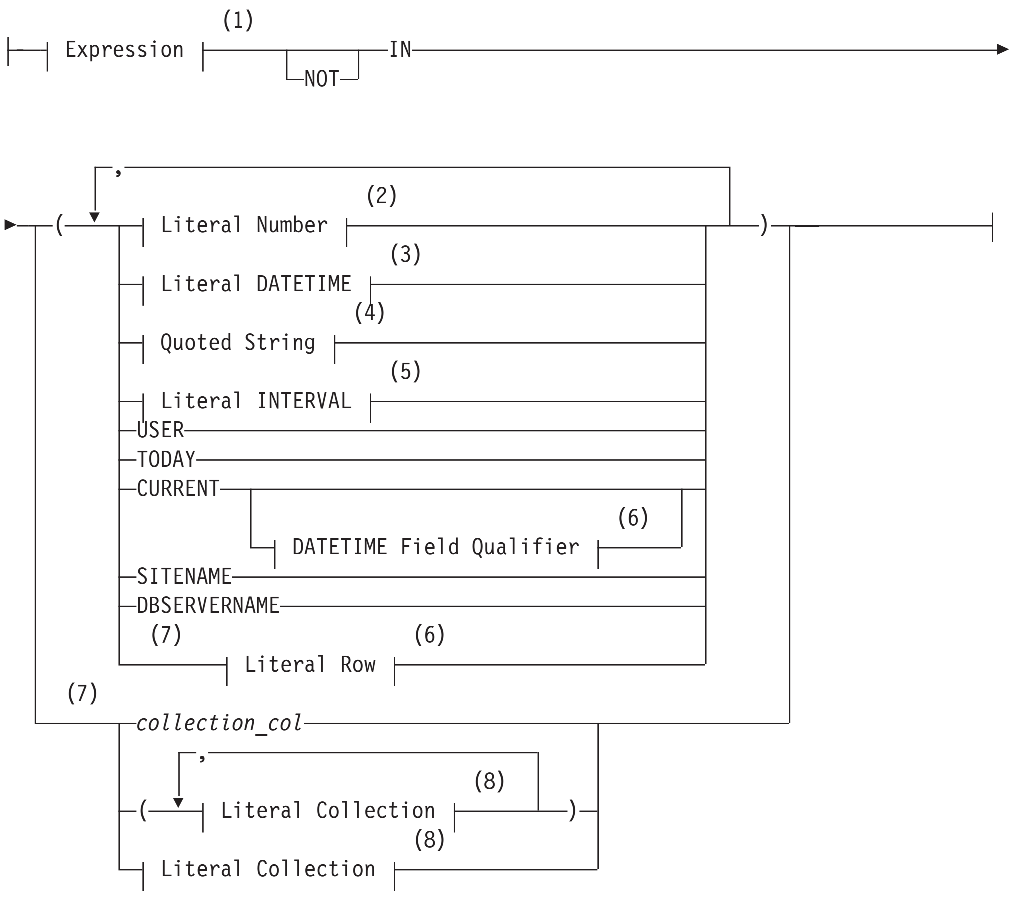
```
order_date BETWEEN '6/1/97' and '9/7/97'

zipcode NOT BETWEEN '94100' and '94199'

EXTEND(call_dtime, DAY TO DAY) BETWEEN
   (CURRENT - INTERVAL(7) DAY TO DAY) AND CURRENT
```

```
lead_time BETWEEN INTERVAL (1) DAY TO DAY
   AND INTERVAL (4) DAY TO DAY

unit_price BETWEEN loprice AND hiprice
```

IN Condition

The IN condition is satisfied when the expression to the left of the keyword IN is included in the list of items.

IN Condition:



Notes:

1 See page 4-34

2 See page 4-137

3 See page 4-132

4 See page 4-142

5 See page 4-135

6 See page 4-32

7 Dynamic Server only

8 See page 4-139

Element	Description	Restrictions	Syntax
collection_col	Name of a collection column that is used in an IN condition	The column must exist in the specified table	Identifier, p. 5-22

If you specify the NOT operator, the IN condition is TRUE when the expression is not in the list of items. NULL values do not satisfy the IN condition.

The following examples show some IN conditions:

```
WHERE state IN ('CA', 'WA', 'OR')
WHERE manu_code IN ('HRO', 'HSK')
WHERE user_id NOT IN (USER)
WHERE order_date NOT IN (TODAY)
```

In ESQL/C, the built-in TODAY function is evaluated at execution time. The built-in CURRENT function is evaluated when a cursor opens or when the query executes, if it is a singleton SELECT statement.

The built-in USER function is case sensitive; for example, it interprets **minnie** and **Minnie** as different values.

Using the IN Operator with Collection Data Types (IDS): You can use the IN operator to determine if an element is contained in a collection. The collection can be a simple or nested collection. (In a *nested* collection type, the element type of the collection is also a collection type.) When you use IN to search for an element of a collection, the expression to the left or right of the IN keyword cannot contain a BYTE or TEXT data type.

Suppose you create the following table that contains two collection columns:

```
CREATE TABLE tab_coll
(
set_num SET(INT NOT NULL),
list_name LIST(SET(CHAR(10) NOT NULL) NOT NULL)
);
```

The following partial examples show how you might use the IN operator for search conditions on the collection columns of the **tab_coll** table:

```
WHERE 5 IN set_num
WHERE 5.0::INT IN set_num
WHERE "5" NOT IN set_num
WHERE set_num IN ("SET{1,2,3}", "SET{7,8,9}")
WHERE "SET{'john', 'sally', 'bill'}" IN list_name
WHERE list_name IN ("LIST{""SET{'bill','usha'}"",
                  ""SET{'ann' 'moshi'}""}",
               "LIST{""SET{'bob','ramesh'}"",
                  ""SET{'bomani' 'ann'}""}")
```

In general, when you use the IN operator on a collection data type, the database server checks whether the value on the left of the IN operator is an element in the set of values on the right of the IN operator.

IS NULL Condition

The IS NULL condition is satisfied if the column contains a NULL value. If you use the IS NOT NULL operator, the condition is satisfied when the column contains a value that is not NULL. This example shows an IS NULL condition:

```
WHERE paid_date IS NULL
```

Conditions that use the IS NULL operator are exceptions to the usual rule that SQL expressions in which an operator has a NULL operand return `FALSE`.

LIKE and MATCHES Condition

A LIKE or MATCHES condition tests for matching character strings. The condition is `TRUE`, or satisfied, when either of the following tests is `TRUE`:

- The value of the column on the left matches the pattern that the quoted string specifies. You can use wildcard characters in the string. NULL values do not satisfy the condition.
- The value of the column on the left matches the pattern that the column on the right specifies. The value of the column on the right serves as the matching pattern in the condition.

You can use the single quote (′) only with the quoted string to match a literal quote; you cannot use the ESCAPE clause. You can use the quote character as the escape character in matching any other pattern if you write it as `''''`.

Important: You cannot specify a ROW-type column in a LIKE or MATCHES condition. A ROW-type column is a column that is declared as a named or unnamed ROW type.

NOT Operator: The NOT operator makes the search condition successful when the column on the left has a value that is not NULL and that does not match the pattern that the quoted string specifies.

For example, the following conditions exclude all rows that begin with the characters `Baxter` in the **lname** column:

```
WHERE lname NOT LIKE 'Baxter%'
WHERE lname NOT MATCHES 'Baxter*'
```

LIKE Operator: The LIKE operator supports these wildcard characters in the quoted string.

Wildcard	Effect
%	Matches zero or more characters
_	Matches any single character
\	Removes the special significance of the next character (to match a literal `%` or _ or \ by specifying `\%` or `\_` or `\\`)

Using the backslash (\ ) symbol as the default escape character is an Informix extension to the ANSI/ISO-standard for SQL.

In an ANSI-compliant database, you can only use an escape character to escape a percent sign (%), an underscore (_), or the escape character itself.

The following condition tests for the string `tennis`, alone or in a longer string, such as `tennis ball` or `table tennis paddle`:

```
WHERE description LIKE '%tennis%'
```

The next example tests for **description** rows containing an underscore. Here backslash (\ ) is necessary because underscore (_) is a wildcard character.

```
WHERE description LIKE '%\_%'
```

The LIKE operator has an associated operator function called **like( )**. You can define a **like( )** function to handle your own user-defined data types. See also *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

MATCHES Operator: The MATCHES operator supports wildcard characters in the quoted string.

Wildcard	Effect
*	Matches any string of zero or more characters
?	Matches any single character
[. . .]	Matches any of the enclosed characters, including ranges, as in [a-z]. Characters within the brackets cannot be escaped.
^	As first character within the brackets, matches any character that is not listed. Thus, [^abc] matches any character except a, b, or c.
\	Removes the special significance of the next character (to match a literal \ or any other wildcard by specifying \\ or* or \? and so forth)

The following condition tests for the string `tennis`, alone or within a longer string, such as `tennis ball` or `table tennis paddle`:

```
WHERE description MATCHES '*tennis*'
```

The following condition is `TRUE` for the names `Frank` and `frank`:

```
WHERE fname MATCHES '[Ff]rank'
```

The following condition is `TRUE` for any name that begins with either `F` or `f`:

```
WHERE fname MATCHES '[Ff]*'
```

The next condition is `TRUE` for any name that ends with the letters `a`, `b`, `c`, or `d`:

```
WHERE fname MATCHES '*[a-d]'
```

MATCHES has an associated **matches( )** operator function. You can define a **matches( )** function for your own user-defined data types. For more information, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

If **DB_LOCALE** or SET COLLATION specifies a nondefault locale supporting a localized collation, and you specify a range for the MATCHES operator using bracket ([. . .]) symbols, the database server uses the localized collating order, instead of code-set order, to interpret the range and to compare values that have CHAR, CHARACTER VARYING, LVARCHAR, NCHAR, NVARCHAR, and VARCHAR data types.

This behavior is an exception to the usual rule that only NCHAR and NVARCHAR data types can be compared in a localized collating order. For more information on the GLS aspects of conditions that include the MATCHES or LIKE operators, see the *IBM Informix GLS User's Guide*.

ESCAPE with LIKE: The ESCAPE clause can specify a nondefault escape character. For example, if you specify `z` in the ESCAPE clause, then a quoted string operand that included `z_` is interpreted as including a literal underscore (_) character, rather than _ as a wildcard. Similarly, `z%` is interpreted as a literal percent (%) sign, rather than % as a wildcard. Finally, the characters `zz` in a string would be interpreted as single literal z. The following statement retrieves rows from the **customer** table in which the **company** column includes a literal underscore character:

```
SELECT * FROM customer WHERE company LIKE '%z_%' ESCAPE 'z'
```

You can also use a host variable that contains a single character. The next statement uses a host variable to specify an escape character:

```
EXEC SQL BEGIN DECLARE SECTION;
   char escp='z';
   char fname[20];
EXEC SQL END DECLARE SECTION;
EXEC SQL select fname from customer
   into :fname where company like '%z_%' escape :escp;
```

ESCAPE with MATCHES: The ESCAPE clause can specify a nondefault escape character. Use this as you would the backslash to include a question mark (?), an asterisk (*), a caret (^), or a left ([ ) or right ( ]) bracket as a literal character within the quoted string, to prevent them from being interpreted as special characters. If you choose to use z as the escape character, the characters z? in a string stand for a literal question mark (?). Similarly, the characters z* stand for a literal asterisk (*). Finally, the characters zz in the string stand for the single character z.

The following example retrieves rows from the **customer** table in which the value of the **company** column includes the question mark (?):

```
SELECT * FROM customer WHERE company MATCHES '*z?*' ESCAPE 'z'
```

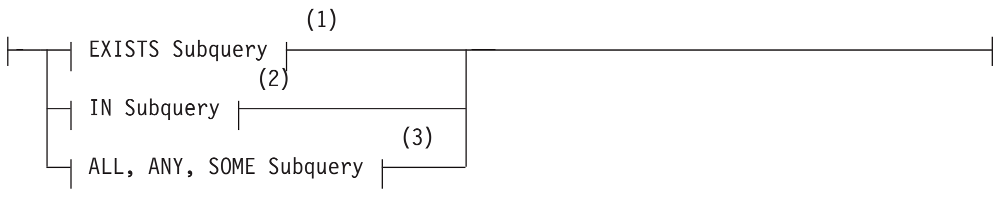
Stand-Alone Condition

A stand-alone condition can be any expression that is not explicitly listed in the syntax for the comparison condition. Such an expression is valid as a condition only if it returns a BOOLEAN value. For example, the following example returns a value of the BOOLEAN data type:

```
funcname(x)
```

Condition with Subquery

Condition with Subquery:



Notes:

1 See page 4-14

2 See page 4-14

3 See page 4-15

You can include a SELECT statement within a condition; this combination is called a *subquery*. You can use a subquery in a SELECT statement to perform the following functions:

- Compare an expression to the result of another query.

- Determine if an expression is included in the results of another query.
- Ask whether another query selects any rows.

The subquery can depend on the current row that the outer SELECT statement is evaluating; in this case, the subquery is called a *correlated subquery*.

The following sections describe subquery conditions and their syntax. For a discussion of types of subquery conditions in the context of the SELECT statement, see "Using a Condition in the WHERE Clause" on page 2-508.

A subquery can return a single value, no value, or a set of values, depending on its context. If a subquery returns a value, it must select only a single column. If the subquery simply checks whether a row (or rows) exists, it can select any number of rows and columns.

A subquery cannot contain BYTE or TEXT data types, nor can it contain an ORDER BY clause. For a complete description of SELECT syntax and usage, see "SELECT" on page 2-479.

IN Subquery

IN Subquery:

```
                    (1)
├──┤ Expression ├──────────┬─────┬──IN──(──subquery──)──────────────────────────┤
                           └─NOT─┘
```

Notes:

1   See page 4-34

Element	Description	Restrictions	Syntax
subquery	Embedded query	Cannot contain the FIRST nor the ORDER BY clause	SELECT, p. 2-479

An IN subquery condition is `TRUE` if the value of the expression matches one or more of the values from the subquery. (The subquery must return only one row, but it can return more than one column.) The keyword IN is equivalent to the =ANY specification. The keywords NOT IN are equivalent to the !=ALL specification. See the "ALL, ANY, and SOME Subqueries" on page 4-15.

The following example of an IN subquery finds the order numbers for orders that do not include baseball gloves (`stock_num = 1`):

```
WHERE order_num NOT IN
   (SELECT order_num FROM items WHERE stock_num = 1)
```

Because the IN subquery tests for the presence of rows, duplicate rows in the subquery results do not affect the results of the main query. Therefore, the UNIQUE or DISTINCT keyword in the subquery has no effect on the query results, although not testing duplicates can improve query performance.

EXISTS Subquery

EXISTS Subquery:

```
├──┬─────┬──EXISTS──(──subquery──)──────────────────────────────────────┤
   └─NOT─┘
```

Element	Description	Restrictions	Syntax
subquery	Embedded query	Cannot contain the FIRST nor the ORDER BY clause	SELECT, p. 2-479

An EXISTS subquery condition evaluates to `TRUE` if the subquery returns a row. With an EXISTS subquery, one or more columns can be returned. The subquery always contains a reference to a column of the table in the main query. If you use an aggregate function in an EXISTS subquery that includes no HAVING clause, at least one row is always returned.

The following example of a SELECT statement with an EXISTS subquery returns the stock number and manufacturer code for every item that has never been ordered (and is therefore not listed in the **items** table). You can appropriately use an EXISTS subquery in this SELECT statement because you use the subquery to test both **stock_num** and **manu_code** in **items**.

```
SELECT stock_num, manu_code FROM stock
   WHERE NOT EXISTS (SELECT stock_num, manu_code FROM items
      WHERE stock.stock_num = items.stock_num AND
      stock.manu_code = items.manu_code)
```

The preceding example works equally well if you use SELECT * in the subquery in place of the column names, because the existence of the entire row is tested; specific column values are not tested.

ALL, ANY, and SOME Subqueries

ALL, ANY, SOME Subquery:

```
                  (1)                          (2)
├──┤ Expression ├──────┤ Relational Operator ├──────┬──────┬──(──subquery──)──────┤
                                                    ├─ALL──┤
                                                    ├─ANY──┤
                                                    └─SOME─┘
```

Notes:

1 See page 4-34

2 See page 4-146

Element	Description	Restrictions	Syntax
subquery	Embedded query	Cannot contain the FIRST or the ORDER BY clause	SELECT, p. 2-479

Use the ALL, ANY, and SOME keywords to specify what makes the condition `TRUE` or `FALSE`. A search condition that is `TRUE` when the ANY keyword is used might not be `TRUE` when the ALL keyword is used, and vice versa.

Using the ALL Keyword: The ALL keyword specifies that the search condition is `TRUE` if the comparison is `TRUE` for every value that the subquery returns. If the subquery returns no value, the condition is `TRUE`.

In the following example, the first condition tests whether each **total_price** is greater than the total price of every item in order number 1023. The second condition uses the **MAX** aggregate function to produce the same results.

```
total_price > ALL (SELECT total_price FROM items
                WHERE order_num = 1023)

total_price > (SELECT MAX(total_price) FROM items
                WHERE order_num = 1023)
```

Using the NOT keyword with an ALL subquery tests whether an expression is not TRUE for at least one element that the subquery returns. For example, the following condition is TRUE when the expression **total_price** is not greater than all the selected values. That is, it is TRUE when **total_price** is not greater than the highest total price in order number 1023.

```
NOT total_price > ALL (SELECT total_price FROM items
                  WHERE order_num = 1023)
```

Using the ANY or SOME Keywords: The ANY keyword denotes that the search condition is TRUE if the comparison is TRUE for at least one of the values that is returned. If the subquery returns no value, the search condition is FALSE. The SOME keyword is a synonym for ANY.

The following conditions are TRUE when the total price is greater than the total price of at least one of the items in order number 1023. The first condition uses the ANY keyword; the second uses the MIN aggregate function:

```
total_price > ANY (SELECT total_price FROM items
               WHERE order_num = 1023)

total_price > (SELECT MIN(total_price) FROM items
               WHERE order_num = 1023)
```

Using the NOT keyword with an ANY subquery tests whether an expression is not TRUE for all elements that the subquery returns. For example, the following condition is TRUE when the expression **total_price** is not greater than any selected value. That is, it is TRUE when **total_price** is greater than none of the total prices in order number 1023.

```
NOT total_price > ANY (SELECT total_price FROM items
                  WHERE order_num = 1023)
```

Omitting the ANY, ALL, or SOME Keywords: You can omit the keywords ANY, ALL, or SOME in a subquery if you know that the subquery will return exactly one value. If you omit the ANY, ALL, or SOME keywords, and the subquery returns more than one value, you receive an error. The subquery in the following example returns only one row because it uses an aggregate function:

```
SELECT order_num FROM items
   WHERE stock_num = 9 AND quantity =
      (SELECT MAX(quantity) FROM items WHERE stock_num = 9)
```

NOT Operator

If you preface a condition with the keyword NOT, the test is TRUE only if the condition that NOT qualifies is FALSE. If the condition that NOT qualifies has a NULL or an UNKNOWN value, the NOT operator has no effect.

The following truth table shows the effect of NOT. Here T represents a TRUE condition, F represents a FALSE condition, and a question mark (?) represents an UNKNOWN condition. (An UNKNOWN value can occur when an operand is NULL).

NOT	
T	F
?	?
F	T

The left column shows the value of the operand of the NOT operator, and the right column shows the returned value after NOT is applied to the operand.

Conditions with AND or OR

You can combine simple conditions with the logical operators AND or OR to form complex conditions. The following SELECT statements contain examples of complex conditions in their WHERE clauses:

```
SELECT customer_num, order_date FROM orders
   WHERE paid_date > '1/1/97' OR paid_date IS NULL;
SELECT order_num, total_price FROM items
   WHERE total_price > 200.00 AND manu_code LIKE 'H%';
SELECT lname, customer_num FROM customer
   WHERE zipcode BETWEEN '93500' AND '95700'
   OR state NOT IN ('CA', 'WA', 'OR')
```

The following truth tables show the effect of the AND and OR operators. The letter T represents a `TRUE` condition, F represents a `FALSE` condition, and the question mark (?) represents an `UNKNOWN` value. An `UNKNOWN` value can occur when part of an expression that uses a logical operator is NULL.

OR	T	?	F
T	T	T	T
?	T	?	?
F	T	?	F

AND	T	?	F
T	T	?	F
?	?	?	F
F	F	F	F

The marginal values at the left represent the first operand, and values in the top row represent the second operand. Values within each 3x3 matrix show the returned value after the operator is applied to those operands.

If the Boolean expression evaluates to `UNKNOWN`, the condition is not satisfied.

Consider the following example within a WHERE clause:

```
WHERE ship_charge/ship_weight < 5
   AND order_num = 1023
```

The row where **order_num** = 1023 is the row where **ship_weight** is NULL. Because **ship_weight** is NULL, **ship_charge**/**ship_weight** is also NULL; therefore, the truth value of **ship_charge**/**ship_weight** < 5 is `UNKNOWN`. Because **order_num** = 1023 is `TRUE`, the AND table states that the truth value of the entire condition is `UNKNOWN`. Consequently, that row is not chosen. If the condition used an OR in place of the AND, the condition would be `TRUE`.

Related Information

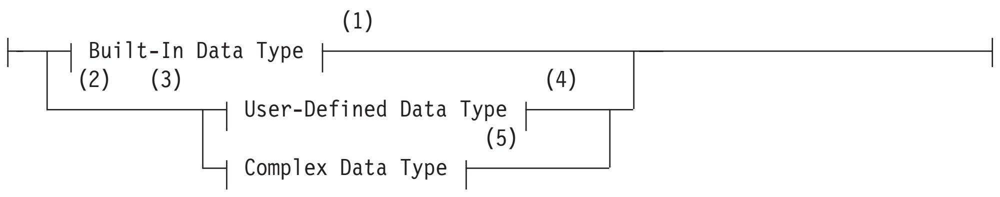
For discussions of comparison conditions in the SELECT statement and of conditions with a subquery, see the *IBM Informix Guide to SQL: Tutorial*. For information on the GLS aspects of conditions, see the *IBM Informix GLS User's Guide*.

Data Type

The Data Type segment specifies the data type of a column, a routine parameter, or a value returned by an expression or by a cast. Use this segment whenever you see a reference to a data type in a syntax diagram.

Syntax

Data Type:



Notes:

1 See "Built-In Data Types"

2 Informix extension

3 Dynamic Server only

4 See "User-Defined Data Type (IDS)" on page 4-27

5 See "Complex Data Type (IDS)" on page 4-28

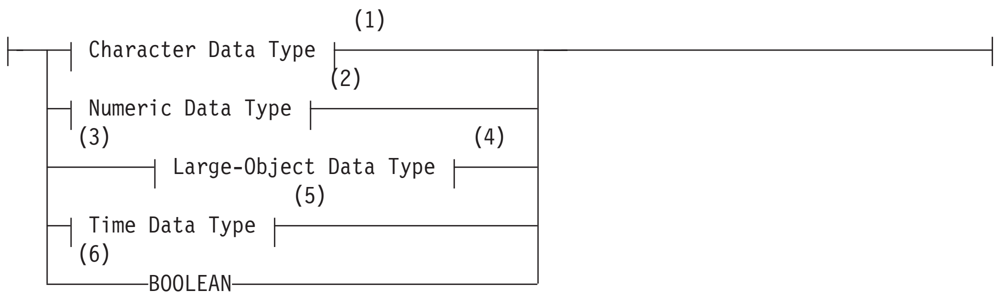
Usage

Sections that follow summarize these data types. For more information, see the chapter about data types in the *IBM Informix Guide to SQL: Reference*.

Built-In Data Types

Built-in data types are data types that are defined by the database server.

Built-In Data Type:



Notes:

1 See "Character Data Types" on page 4-19

2 See "Numeric Data Types" on page 4-21

3 Informix extension

4 See "Large-Object Data Types" on page 4-25

5 See "Time Data Types" on page 4-27

6 Dynamic Server only

These are "built into the database server" in the sense that the information and support functions required to interpret and transfer these data types is part of the database server software, which supports *character*, *numeric*, *large-object*, and *time* categories of built-in data types. These are described in sections that follow.

BOOLEAN and Other Built-In Opaque Data Types (IDS)

Dynamic Server also supports the BOOLEAN data type, which is a *built-in opaque data type* that can store `true`, `false`, or NULL values. The symbol `t` represents a literal BOOLEAN `true`, and `f` represents a literal BOOLEAN `false`.

Like other built-in opaque data types, BOOLEAN column values cannot be retrieved by a distributed query (nor modified by INSERT, DELETE, or UPDATE operations on a remote database) unless all of the tables that the DML operation accesses are in databases of the local Dynamic Server instance.

Values of BOOLEAN and other built-in opaque data types can be returned from a remote database by a UDR only if both of the following conditions are true:

- the UDR is defined in all participating databases, and
- all of the databases are databases of the local Dynamic Server instance.

Other built-in opaque data types of Dynamic Server include BLOB, CLOB, LVARCHAR, IFX_LO_SPEC, IFX_LO_STAT, INDEXKEYARRAY, POINTER, RTNPARAMTYPES, SELFUNCARGS, STAT, CLIENTBINVAL, and XID data types. The first three types are discussed in subsequent sections of this chapter.

Dynamic Server also supports the built-in opaque data types LOLIST, IMPEX, IMPEXBIN, and SENDRECV. These types cannot, however, be accessed in a remote database by DML operations, nor returned from a remote database by a UDR, because these data types do not have the required support functions.

Character Data Types

Character Data Type:

```
                         ┌─(── 1──)───┐
├──┬──┬─CHAR───────────┬─┴─(──size──)─┴──────────────────┬────────────────────────────┤
   │  ├─CHARACTER──────┤                                 │
   │  │  (1)           │                                 │
   │  └─────────NCHAR──┘                                 │
   │    (1)                          ┌─, 0──────────┐    │
   ├──┬─────────NVARCHAR────┬─(max───┴─,──reserve────┴──)─┤
   │  ├─VARCHAR─────────────┤                            │
   │  └─CHARACTER VARYING───┘                            │
   │   (2)             ┌─(──2048──)─┐                    │
   └──────────LVARCHAR─┴─(──max──)──┴────────────────────┘
```

Notes:

1 Localized Collation

2 Dynamic Server only

Element	Description	Restrictions	Syntax
max	Maximum size in bytes. For VARCHAR, this is required. LVARCHAR default is 2048	VARCHAR: Integer; 1 ≤ *max* ≤ 255 (or 1 ≤ *max* ≤ 254, if indexed) LVARCHAR: 1 ≤ *max* ≤ 32,739	"Literal Number" on page 4-137
reserve	Bytes reserved. Default is 0.	Integer; 0 ≤ *reserve* ≤ *max*	"Literal Number" on page 4-137
size	Size in bytes. Default is 1.	Integer; 1 ≤ *size* ≤ 32,767	"Literal Number" on page 4-137

The database server issues an error if the data type declaration includes empty parentheses, such as LVARCHAR( ). To declare a CHAR or LVARCHAR data type of the default length, simply omit any **(***size***)** or **(***max***)** specification. The CREATE TABLE statement of Dynamic Server accepts VARCHAR and NVARCHAR column declarations that have no **(***max***)** nor **(***max*, *reserve***)** specifications, using (1, 0) as the **(***max*, *reserve***)** defaults for the column.

The following table summarizes the built-in character data types.

Data Type	Description
CHAR	Stores single-byte or multibyte text strings of fixed length (up to 32,767 bytes); supports code-set order in collation of text data. Default size is 1 byte.
CHARACTER	Synonym for CHAR
CHARACTER VARYING	ANSI-compliant synonym for VARCHAR
LVARCHAR (IDS)	Stores single-byte or multibyte text strings of varying length (up to 32,739 bytes). The size of other columns in the same table can further reduce this upper limit. Default size is 2,048 bytes.
NCHAR	Stores single-byte or multibyte text strings of fixed length (up to 32,767 bytes); supports localized collation of text data.
NVARCHAR	Stores single-byte or multibyte text strings of varying length (up to 255 bytes); supports localized collation of text data.
VARCHAR	Stores single-byte or multibyte text strings of varying length (up to 255 bytes); supports code-set order collation of text data.

Single-Byte and Multi-Byte Characters and Locales: All built-in character data types can support single- and multibyte characters in the code set that the **DBLOCALE** setting specifies. Locales for most European and Middle Eastern languages support only single-byte code sets, but some East Asian locales (and the **UTF-8** Unicode locale) support multibyte characters.

The TEXT and CLOB data types also support single-byte or multibyte character data, but most built-in functions for manipulating character strings do not support TEXT nor CLOB data. For more information, see "Large-Object Data Types" on page 4-25.

Fixed- and Varying-Length Character Data Types: The database server supports storage of fixed-length and varying-length character data. A *fixed-length* column requires the defined number of bytes regardless of the actual size of the data. The CHAR data type is of fixed-length. For example, a CHAR(25) column requires 25 bytes of storage for all values, so the string `"This is a text string"` uses 25 bytes of storage.

A *varying-length* column size can be the number of bytes occupied by its data. NVARCHAR, VARCHAR, and (for Dynamic Server only) the LVARCHAR data types are varying-length character data types. For example, a VARCHAR(25) column reserves up to 25 bytes of storage for the column value, but the character string `"This is a text string"` uses only 21 bytes of the reserved 25 bytes. The VARCHAR data type can store up to 255 bytes of data.

The LVARCHAR type of Dynamic Server can store up to 32,739 bytes of text. LVARCHAR is a built-in opaque data type. Like other opaque types, it cannot be accessed in a database of a non-local Dynamic Server instance by a distributed query or by other DML operations, nor can LVARCHAR values be returned from a database of another database server by UDRs. For information on accessing LVARCHAR values in other databases of the local server, however, see "BOOLEAN and Other Built-In Opaque Data Types (IDS)" on page 4-19.

A single table cannot be created with more than approximately 195 LVARCHAR columns. (This restriction applies to all varying-length and ROW data types.)

Light scans are not supported on tables that include LVARCHAR columns.

NCHAR and NVARCHAR Data Types: The character data types CHAR, LVARCHAR, and VARCHAR support code-set order collation of data. The database server collates text data in columns of these types by the order that their characters are defined in the code set.

To accommodate locale-specific order of characters, you can use the NCHAR and NVARCHAR data types. The NCHAR data type is the fixed-length character data type that supports localized collation. The NVARCHAR data type is the varying-length character data type that can store up to 255 bytes of text data and supports localized collation. A single table cannot be created with more than approximately 195 NVARCHAR or VARCHAR columns.

Dynamic Server does not support light scans on tables that have NVARCHAR columns.

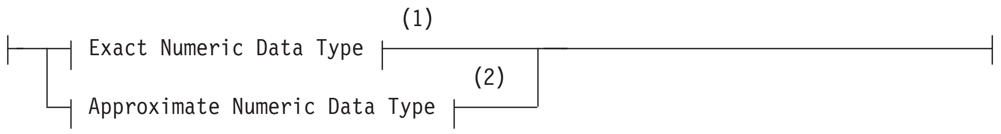
In Dynamic Server, if you specify no parameters in CREATE TABLE or ALTER TABLE statements that declare VARCHAR or NVARCHAR columns, then the new columns default to a max size of 1 byte and a reserve size of zero.

For more information, see the *IBM Informix GLS User's Guide*.

Numeric Data Types

Numeric data types allow the database server to store numbers such as integers and real numbers in a column.

Numeric Data Type:



Notes:

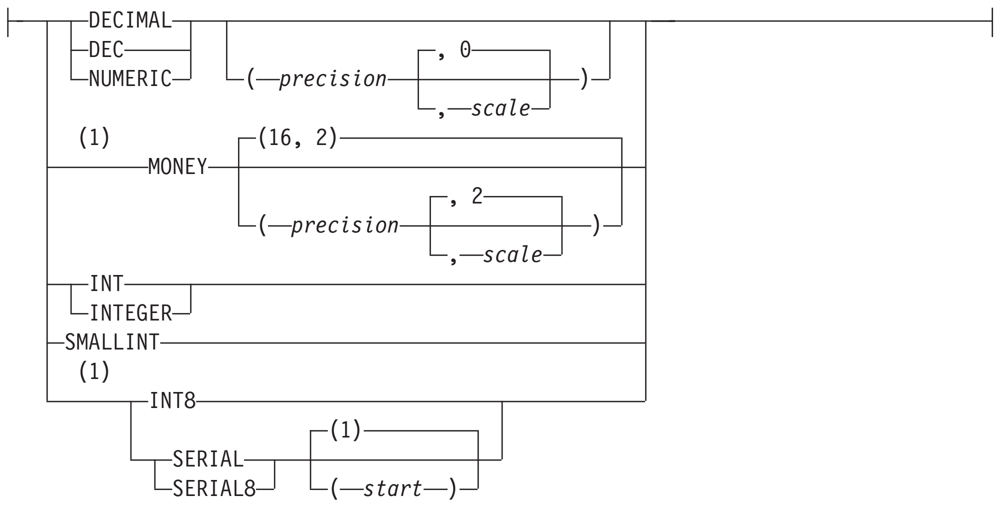
1 See "Exact Numeric Data Types" on page 4-22

2 See "Approximate Numeric Data Types" on page 4-23

The values of numbers are stored either as *exact numeric* data types or as *approximate numeric* data types.

Exact Numeric Data Types: An *exact numeric* data type stores numbers of a specified precision and scale.

Exact Numeric Data Type:



Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
precision	Significant digits	Must be an integer; 1 ≤ *precision* ≤ 32	"Literal Number" on page 4-137
scale	Digits in fractional part	Must be an integer; 1 ≤ *scale* ≤ *precision*	"Literal Number" on page 4-137
start	Integer starting value	For SERIAL: 1 ≤ *start* ≤ 2,147,483,64; For SERIAL8: 1 ≤ *start* ≤ 9,223,372,036,854,775,807	"Literal Number" on page 4-137

The *precision* of a data type is the number of digits that the data type stores. The *scale* is the number of digits to the right of the decimal separator.

The following table summarizes the exact numeric data types available.

Data Type	Description
DEC(*p,s*)	Synonym for DECIMAL(*p,s*)
DECIMAL(*p,s*)	Stores fixed-point decimal values of real numbers, with up to 30 significant digits in the fractional part, or up to 32 significant digits to the left of the decimal point.
INT	Synonym for INTEGER
INTEGER	Stores a 4-byte integer value. These values can be in the range from -((2**31)-1) to (2**31)-1 (the range -2,147,483,647 to 2,147,483,647).
INT8	Stores an 8-byte integer value. These values can be in the range from -((2**63)-1) to (2**63)-1 (the range -9,223,372,036,854,775,807 to 9,223,372,036,854,775,807).
MONEY(*p,s*)	Stores fixed-point currency values. These values have same internal data format as a fixed-point DECIMAL(p,s) value.
NUMERIC(*p,s*)	ANSI-compliant synonym for DECIMAL(*p,s*)
SERIAL	Stores a 4-byte positive integer that the database server generates. Values can range from 1 to (2**31)-1 (that is, from 1 to 2,147,483,647).
SERIAL8	Stores an 8-byte positive integer value that the database server generates. Values can range from 1 to (2**63)-1 (that is, from 1 to 9,223,372,036,854,775,807).
SMALLINT	Stores a 2-byte integer value. These values can be in the range from -((2**15)-1) to (2**15)-1 (that is, from -32,767 to 32,767).

DECIMAL(p,s) Data Types: The first DECIMAL(*p, s*) parameter (*p*) specifies the *precision* (the total number of digits) and the second (*s*) parameter specifies the *scale* (the number of digits in the fractional part). If you provide only one parameter, an ANSI-compliant database interprets it as the precision of a fixed-point number and the default scale is 0. If you specify no parameters, and the database is ANSI-compliant, then by default the precision is 16 and the scale is 0.

If the database is not ANSI-compliant, and you specify fewer than 2 parameters, you declare a floating-point DECIMAL, which is not an exact number data type. (See instead the section “Approximate Numeric Data Types” on page 4-23.)

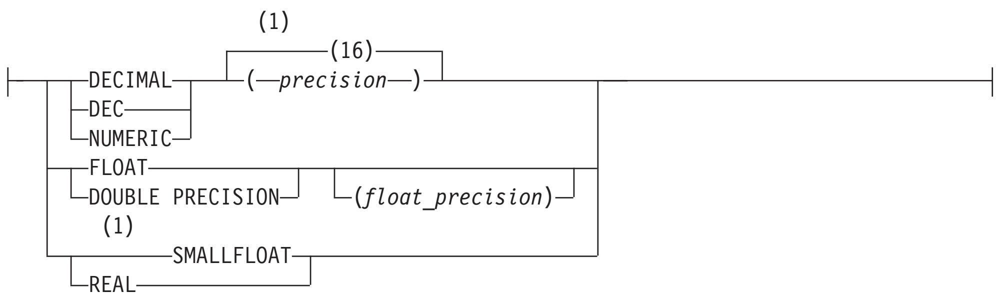
DECIMAL(*p, s*) values are stored internally with the first byte representing a sign bit and a 7-bit exponent in excess-65 format. The other bytes express the mantissa as base-100 digits. This implies that DECIMAL(32,s) data types store only *s*-1 decimal digits to the right of the decimal point, if *s* is an odd number.

SERIAL and SERIAL8 Data Types: If you want to insert an explicit value into a SERIAL or SERIAL8 column, you can use any nonzero number. You cannot, however, start or reset the value of a SERIAL or SERIAL8 column with a negative number. (For details of an alternative feature of Dynamic Server for generating integer values, see “CREATE SEQUENCE” on page 2-165.)

A SERIAL or SERIAL8 column is not unique unless you set a unique index on the column. (The index can also be in the form of a primary key or unique constraint.) With such an index, values in SERIAL or SERIAL8 columns are guaranteed to be unique, but successive values are not necessarily contiguous.

Approximate Numeric Data Types: An *approximate numeric* data type represents numeric values approximately.

Approximate Numeric Data Type:



Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
float_precision	The *float_precision* is ignored, but is ANSI/ISO compliant.	Must be a positive integer. Specified value has no effect.	"Literal Number" on page 4-137
precision	Significant digits. Default is 16.	An integer; 1 ≤ *precision* ≤ 32	"Literal Number" on page 4-137

Use approximate numeric data types for very large and very small numbers that can tolerate some degree of rounding during arithmetic operations.

The following table summarizes the built-in approximate numeric data types.

Data Type	Description
DEC(*p*)	Synonym for DECIMAL(p)
DECIMAL(*p*)	Stores floating-point decimal values in the approximate range from 1.0E-130 to 9.99E+126 The *p* parameter specifies the precision. If no precision is specified, the default is 16. This floating-point data type is available as an approximate numeric type only in a database that is not ANSI-compliant. In an ANSI-compliant database, DECIMAL(*p*) is implemented as a fixed-point DECIMAL; see "Exact Numeric Data Types" on page 4-22.
DOUBLE PRECISION	ANSI-compliant synonym for FLOAT. The *float_precision* term is not valid when you use this synonym in data type declarations.
FLOAT	Stores double-precision floating-point numbers with up to 16 significant digits. The *float-precision* parameter is accepted in data-type declarations for compliance with the ANSI/ISO standard for SQL, but this parameter has no effect on the actual precision of values that the database server stores.
NUMERIC(*p*)	ANSI-compliant synonym for DECIMAL(*p*) In an ANSI-compliant database, this is implemented as an exact numeric type, with the specified precision and a scale of zero, rather than an approximate numeric (floating-point) data type.
REAL	ANSI-compliant synonym for SMALLFLOAT
SMALLFLOAT	Stores single-precision floating-point numbers with approximately 8 significant digits

The built-in number data types of Informix database servers support real numbers. They cannot directly store imaginary or complex numbers.

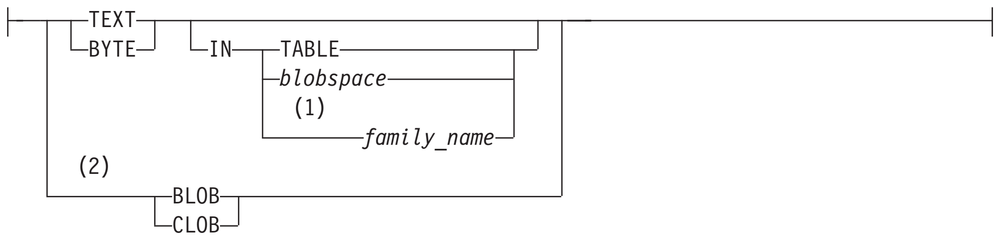
In Dynamic Server, you must create a user-defined data type for applications that support values that can have an imaginary part.

No more than nine arguments to an external UDR can be DECIMAL data types of SQL that the UDR declares as BigDecimal data types of the Java language.

Large-Object Data Types

Large-object data types can store extremely large column values, such as images and documents, independently of the column.

Large-Object Data Type:



Notes:

1 Optical Subsystem only

2 Dynamic Server only

Element	Description	Restrictions	Syntax
blobspace	Name of an existing blobspace	Must exist	"Identifier" on page 5-22
family_name	Family name or variable in the optical family	Must exist	"Quoted String" on page 4-142.

The large object data types can be classified in two categories:
- Simple large objects: TEXT and BYTE
- Smart large objects: CLOB and BLOB

Simple-Large-Object Data Types: These are the simple-large-object data types:

Data Type	Description
TEXT	Stores text data of up to 2^{31} bytes
BYTE	Stores any digitized data of up to 2^{31} bytes

These data types are not recoverable. Do not supply a BYTE value where TEXT is expected. No built-in cast supports BYTE to TEXT data-type conversion.

You cannot create a table with more than approximately 195 BYTE or TEXT columns. (This restriction applies to all varying-length and ROW data types.)

Storing BYTE and TEXT Data: A simple-large-object data type can store text or binary data in blobspaces or in tables. The database server can access a BYTE or

TEXT value in one piece. When you specify a BYTE or TEXT data type, you can specify the location in which it is stored. You can store data with the table or in a separate blobspace.

In Dynamic Server, if you are creating a named ROW data type that has a BYTE or TEXT field, you cannot use the IN clause to specify a separate storage space.

The following example shows how blobspaces and dbspaces are specified. The user creates the **resume** table. The data values are stored in the **employ** dbspace. The data in the **vita** column is stored with the table, but the data associated with the **photo** column is stored in a blobspace named **photo_space**.

```
CREATE TABLE resume
   (
   fname        CHAR(15),
   lname        CHAR(15),
   phone        CHAR(18),
   recd_date    DATETIME YEAR TO HOUR,
   contact_date DATETIME YEAR TO HOUR,
   comments     VARCHAR(250, 100),
   vita         TEXT IN TABLE,
   photo        BYTE IN photo_space
   )
   IN employ
```

Smart-Large-Object Data Types (IDS): A smart-large-object data type stores text or binary data in sbspaces. The database server can provide random access to a smart-large-object value. That is, it can access any portion of the smart-large-object value. These data types are recoverable. The following table summarizes the smart-large-object data types that Dynamic Server supports.

Data Type	Description
BLOB	Stores binary data of up to 4 terabytes (4*2^{40} bytes)
CLOB	Stores text data of up to 4 terabytes (4*2^{40} bytes)

Both of these are built-in opaque data types. Like other opaque types, they cannot be accessed in a database of a non-local database server by a distributed query or by other DML operations, nor can they be returned from a database of another database server by a UDR. For information on accessing BLOB or CLOB values in other databases of the local server, however, see "BOOLEAN and Other Built-In Opaque Data Types (IDS)" on page 4-19.

Smart large object data types are not parallelizable. The PDQ feature of Dynamic Serve has no effect on operations that load or unload BLOB or CLOB values, or that process them in queries or in other DML operations.

For more information about these "smart blob" data types, see the *IBM Informix Guide to SQL: Reference*.

For information on how to create blobspaces, see your *IBM Informix Administrator's Guide*.

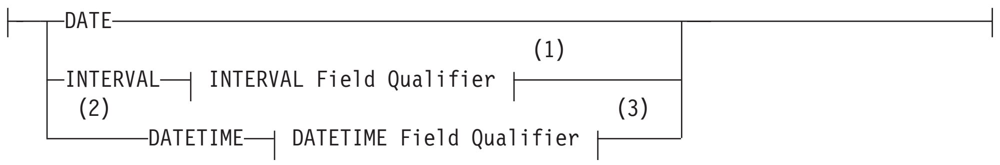
For information about optical families, see the *IBM Informix Optical Subsystem Guide*.

For information about the built-in functions that you can use to import, export, and copy smart large objects, see "Smart-Large-Object Functions (IDS)" on page 4-91 and the *IBM Informix Guide to SQL: Tutorial*.

Time Data Types

The time data types allow the database server to store calendar dates, points in time, and intervals of time.

Time Data Types:



Notes:

1 See "INTERVAL Field Qualifier" on page 4-127

2 Informix extension

3 See "DATETIME Field Qualifier" on page 4-32

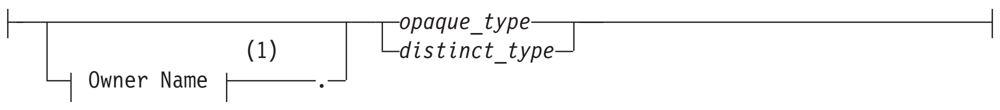
The following table summarizes the built-in time data types.

Data Type	Description
DATE	Stores a date value as a Julian date in the range from January 1 of the year 1 up to December 31, *9999*.
DATETIME	Stores a point-in-time date (*year*, *month*, *day*) and time-of-day (*hour*, *minute*, *second*, and *fraction* of second), in the range of years 1 to 9999. Also supports contiguous subsets of these time units.
INTERVAL	Stores spans of time, in *years* and/or *months*, or in smaller time units (*days, hours*, *minutes*, *seconds*, and/or *fractions* of second), with up to 9 digits of precision in the largest time unit, if this is not FRACTION. Also supports contiguous subsets of these time units.

User-Defined Data Type (IDS)

A user-defined data type is one that a user defines for the database server. Dynamic Server supports two categories of user-defined data types, namely *distinct data types* and *opaque data types*. This is the declaration syntax for user-defined data types:

User-Defined Data Type:



Notes:

1 See "Owner Name" on page 5-43

Element	Description	Restrictions	Syntax
distinct_type	Distinct data type with same structure as an existing data type	Must be unique among data type names in the database	"Identifier" on page 5-22
opaque_type	Name of the opaque data type	Must be unique among data type names in the database	"Identifier" on page 5-22

In this manual, *user-defined data type* is usually abbreviated as UDT.

Distinct Data Types

A distinct data type is a user-defined data type that is based on an existing built-in type, opaque type, named row type, or distinct type. To create a distinct type, you must use the CREATE DISTINCT TYPE statement. (For more information, see“CREATE DISTINCT TYPE” on page 2-93.)

DISTINCT column values cannot be retrieved by a distributed query (nor modified by INSERT, DELETE, or UPDATE operations on a remote database) unless the base type is a built-in data type, and all of the tables that the DML operation accesses are in databases of the local Dynamic Server instance.

Values of a DISTINCT data type can be returned from a remote database by a UDR only if all of the following conditions are true:

- the DISTINCT type is defined on a built-in data type
- the DISTINCT type can be explicitly cast to a built-in data type
- the DISTINCT type, its explicit cast to a built-in type, and the UDR are defined in all participating databases, and
- all of the databases are databases of the local Dynamic Server instance.

Opaque Data Types

An opaque data type is a user-defined data type that can be used in the same way as a built-in data type. To create an opaque type, you must use the CREATE OPAQUE TYPE statement. Because an opaque type is encapsulated, you create support functions to access the individual components of an opaque type. The internal storage details of the type are hidden or opaque.

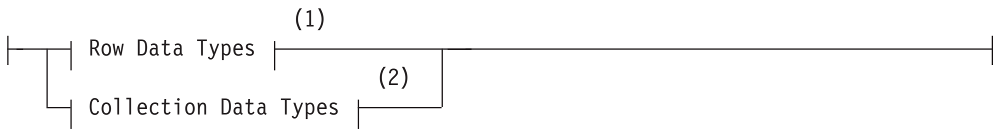
For more information about how to create an opaque data type and its support functions, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Because of the maximum row size limit of 32,767 bytes, when you create a new table, no more than approximately 195 columns can be varying-length opaque or distinct user-defined data types. (The same restriction applies to BYTE, TEXT, VARCHAR, LVARCHAR, NVARCHAR, and ROW columns. See “ROW Data Types” on page 4-29 for additional information about ROW data types.)

Complex Data Type (IDS)

Complex data types are ROW types or COLLECTION types that you create from built-in types, opaque types, distinct types, or other complex types.

Complex Data Type:



Notes:

1 See “CREATE ROW TYPE” on page 2-158

2 See “Collection Data Types” on page 4-30

A single complex data type can include multiple components. When you create a complex type, you define the components of the complex type. Unlike an opaque type, however, a complex type is not encapsulated. You can use SQL to access the individual components of a complex data type. The individual components of a complex data type are called *elements*.

Dynamic Server supports the following categories of complex data types:
- ROW data types: Named ROW types and unnamed ROW types
- COLLECTION data types: SET, MULTISET, and LIST

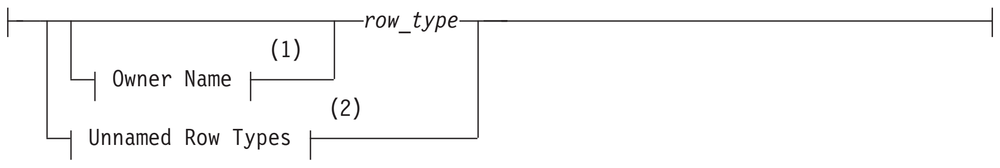
The elements of a COLLECTION data type must all be of the same data type. You can use the keyword COLLECTION in SPL data type declarations to specify an untyped collection variable. NULL values are not supported in elements of COLLECTION data types.

The elements of a ROW data type can be of different data types, but the pattern of data types from the first to the last element cannot vary for a given ROW data type. NULL values are supported in elements of ROW data types, unless you specify otherwise in the data type declaration or in a constraint.

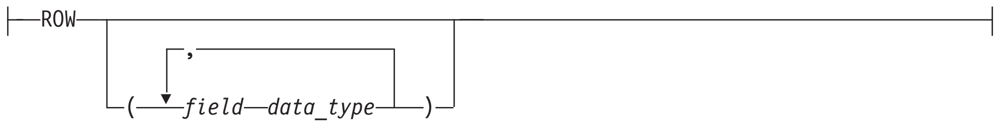
ROW Data Types

This is the syntax to define a column as a named or unnamed ROW type.

Row Data Types:



Unnamed Row Types:



Notes:

1 See "Owner Name" on page 5-43

2 See "CREATE ROW TYPE" on page 2-158

Element	Description	Restrictions	Syntax
data_type	Data type of *field*	Any data type except BYTE or TEXT	"Data Type" on page 4-18
field	Name of a field within *row_type*	Must be unique among fields of the same ROW type	"Identifier" on page 5-22
row_type	Some ROW data type defined by CREATE ROW TYPE statement	ROW type must exist in the database	"Identifier" on page 5-22; "Data Type" on page 4-18

You can assign a named ROW type to a table, to a column, or to an SPL variable. A named ROW type that you use to create a typed table or to define a column must already exist. For information on how to create a named ROW data type, see "CREATE ROW TYPE" on page 2-158.

To specify a named ROW data type in an ANSI-compliant database, you must qualify the *row_type* with its *owner* name, if you are not the owner of *row_type*.

An unnamed ROW data type is identified by its structure, which specifies fields that you create with its ROW constructor. You can define a column or an SPL variable as an unnamed ROW data type. For the syntax to specify values for an unnamed ROW type, see "ROW Constructors" on page 4-64.

Collection Data Types

This diagram shows the syntax to define a column or of an SPL variable as a collection data type. (A table can include no more than 97 columns of collection data types.) For the syntax to specify values of collection elements, see "Collection Constructors" on page 4-65.

Collection Data Type:

```
|--+-COLLECTION--------------------------------------------------------------------+--|
   '-+-SET------+--(--+-data_type----------------------------------+--NOT NULL)-'
     +-MULTISET-+     '-+-SET------+--(--data_type-- NOT NULL--)-'
     '-LIST-----'       +-MULTISET-+
                        '-LIST-----'
```

Element	Description	Restrictions	Syntax
data_type	Data type of each of the elements of the collection	Can be any data type except TEXT, BYTE, SERIAL, or SERIAL8	"Data Type" on page 4-18

A SET is an unordered collection of elements, each of which has a unique value. Define a column as a SET data type when you want to store collections whose elements contain no duplicate values and have no associated order.

A MULTISET is an unordered collection of elements in which elements can have duplicate values. You can define a column as a MULTISET collection type when you want to store collections whose elements might not be unique and have no specific order associated with them.

A LIST is an ordered collection of elements that can include duplicate elements. A LIST differs from a MULTISET in that each element in a LIST collection has an ordinal position in the collection. You can define a column as a LIST collection type when you want to store collections whose elements might not be unique but have a specific order associated with them.

The keyword COLLECTION can be used in SPL data type declarations to specify an untyped collection variable.

Defining the Element Type: The element type can be any data type except TEXT, BYTE, SERIAL, or SERIAL8. You can nest collection types, using elements of a collection type.

Every element must be of the same type. For example, if the element type of a collection data type is INTEGER, every element must be of type INTEGER.

An exception to this restriction occurs if the database server determines that some elements of a collection of character strings are VARCHAR data types (whose length is limited to 255 or fewer bytes) but other elements are longer than 255 bytes. In this case, the collection constructor can assign a CHAR(*n*) data type to all elements, for *n* the length in bytes of the longest element. If this is undesirable, you can cast the collection to LVARCHAR, to prevent padding extra length in elements of the collection, as in this example:

```
LIST {'first character string longer than 255 bytes . . . ',
   'second character string longer than 255 bytes . . . ',
   'another character string'} ::LIST (LVARCHAR NOT NULL)
```

See "Collection Constructors" on page 4-65 for additional information.

If the element type of a collection is an unnamed ROW type, the unnamed ROW type cannot contain fields that hold unnamed ROW types. That is, a collection cannot contain nested unnamed ROW data types.

The elements of a collection cannot be NULL. When you define a column as a collection data type, you must use the NOT NULL keywords to specify that the elements of the collection cannot be NULL.

Privileges on a collection data type are those of the database column. You cannot specify privileges on individual elements of a collection.

Related Information

For more information about choosing a data type for your database, see the *IBM Informix Database Design and Implementation Guide*.

For more information about the specific qualities of individual data types, see the chapter on data types in the *IBM Informix Guide to SQL: Reference*.

For more information about data types for storing character data in multibyte locales, see the discussion of the NCHAR and NVARCHAR data types and the GLS aspects of other character data types in the *IBM Informix GLS User's Guide*.

DATETIME Field Qualifier

Use a DATETIME Field Qualifier to specify the largest and smallest unit of time in a DATETIME column or value. Use this segment whenever you see a reference to a DATETIME Field Qualifier in a syntax diagram.

Syntax

DATETIME Field Qualifier:

```
├──┬─YEAR────┬─TO YEAR──────────────────┬──┬────────────────────────────────┤
   │         ├─TO MONTH─────────────────┤  │
   │         ├─TO DAY───────────────────┤  │
   │         ├─TO HOUR──────────────────┤  │
   │         ├─TO MINUTE────────────────┤  │
   │         ├─TO SECOND────────────────┤  │
   │         └─TO FRACTION─┬─────────┬──┘  │
   │                       └─(─scale─)─┘   │
   ├─MONTH─────┬─TO MONTH─────────────────┬─┤
   │           ├─TO DAY───────────────────┤ │
   │           ├─TO HOUR──────────────────┤ │
   │           ├─TO MINUTE────────────────┤ │
   │           ├─TO SECOND────────────────┤ │
   │           └─TO FRACTION─┬─────────┬─)┘ │
   │                         └─(─scale─)─┘  │
   ├─DAY─────┬─TO DAY─────────────────┬─────┤
   │         ├─TO HOUR────────────────┤     │
   │         ├─TO MINUTE──────────────┤     │
   │         ├─TO SECOND──────────────┤     │
   │         └─TO FRACTION─┬─────────┬┘     │
   │                       └─(─scale─)─┘    │
   ├─HOUR────┬─TO HOUR──────────────────┬───┤
   │         ├─TO MINUTE────────────────┤   │
   │         ├─TO SECOND────────────────┤   │
   │         └─TO FRACTION─┬─────────┬──┘   │
   │                       └─(─scale─)─┘    │
   ├─MINUTE─────┬─TO MINUTE─────────────────┬┤
   │            ├─TO SECOND─────────────────┤│
   │            └─TO FRACTION─┬─────────┬───┘│
   │                          └─(─scale─)─┘  │
   ├─SECOND─────┬─TO SECOND─────────────────┬┤
   │            └─TO FRACTION─┬─────────┬───┘│
   │                          └─(─scale─)─┘  │
   └─FRACTION───TO FRACTION─┬─────────┬──────┘
                            └─(─scale─)─┘
```

Element	Description	Restrictions	Syntax
scale	Fraction of a second. Default is 3.	Integer (1 ≤ *scale* ≤ 5)	"Literal Number" on page 4-137

Usage

This segment specifies the precision and scale of a DATETIME data type.

Specify, as the first keyword, the largest time unit that the DATETIME column will store. After the keyword TO, specify the smallest unit as the last keyword. These can be the same keyword. If they are different, the qualifier implies that any intermediate time units between the first and last are also recorded by the DATETIME data type.

The keywords can specify the following time units for the DATETIME column.

Unit of Time	Description
YEAR	Specifies a year, in the range from A.D. 1 to 9999
MONTH	Specifies a month, in the range from 1 (January) to 12 (December)
DAY	Specifies a day, in the range from 1 to 28, 29, 30, or 31 (depending on the specific month)
HOUR	Specifies an hour, in the range from 0 (midnight) to 23
MINUTE	Specifies a minute, in the range from 0 to 59
SECOND	Specifies a second, in the range from 0 to 59
FRACTION	Specifies a fraction of a second, with up to five decimal places The default scale is three digits (thousandth of a second).

Unlike INTERVAL qualifiers, DATETIME qualifiers cannot specify nondefault precision (except for FRACTION, when FRACTION is the smallest unit in the qualifier). Some examples of DATETIME qualifiers follow:

```
YEAR TO MINUTE             MONTH TO MONTH
DAY TO FRACTION(4)         MONTH TO DAY
```

An error results if the first keyword represents a smaller time unit than the last, or if you use the plural form of a keyword (such as MINUTES).

Operations on DATETIME values that do not include YEAR in their qualifier use values from the system clock-calendar to supply any additional precision. If the first term in the qualifier is DAY, and the current month has fewer than 31 days, unexpected results can occur.

Related Information

For an explanation of the DATETIME Field Qualifier, see the discussion of the DATETIME data type in the *IBM Informix Guide to SQL: Reference*.

For important differences between the syntax of DATETIME and INTERVAL field qualifiers, see "INTERVAL Field Qualifier" on page 4-127.

Expression

Data values in SQL statements must be represented as expressions. An *expression* is a specification, which can include operators, operands, and parentheses, that the database server can evaluate to one or more values, or to a reference to some database object.

Expressions can refer to values already in a table of the database, or to values derived from such data, but some expressions (such as TODAY, USER, or literal values) can return values that are independent of the database. You can use expressions to specify values in data-manipulation statements, to define fragmentation strategies, and in other contexts. Use the Expression segment whenever you see a reference to an expression in a syntax diagram.

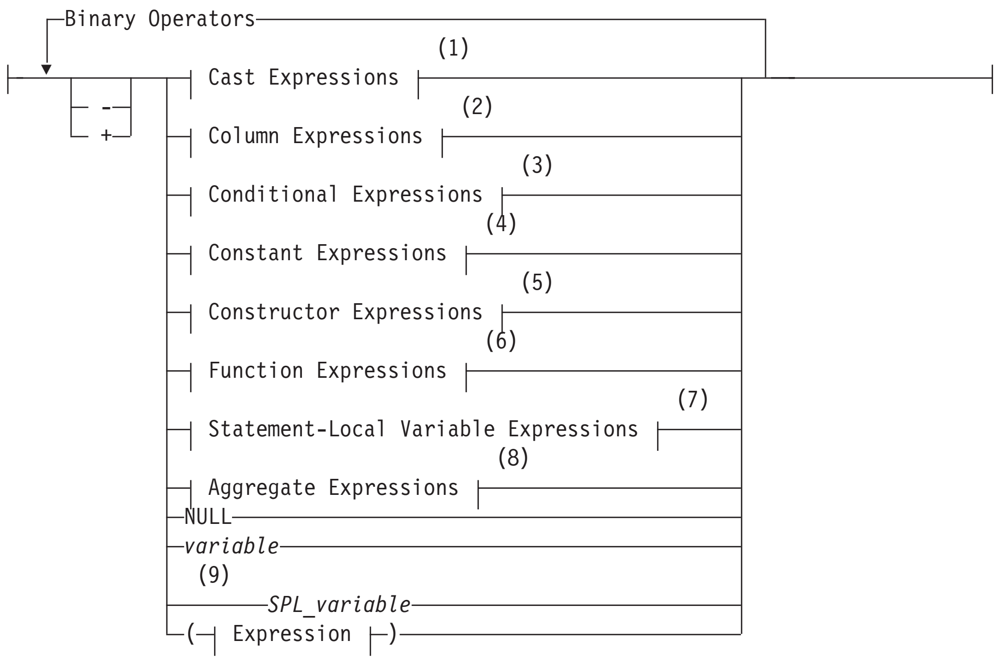
In most contexts, however, you are restricted to expressions whose returned value is of some specific data type, or of a data type that can be converted by the database server to some required data type.

For an alphabetical listing of the built-in operators and functions that are described in this segment, see "List of Expressions" on page 4-36.

Syntax

The sections that follow describe SQL expressions, which are specifications that return one or more values or references to database objects. IBM Informix database servers support the following categories of expressions:

SQL Expressions:



Binary Operators:

```
├──┬─ +──┬──────────────────────────────────────────────────────────────┤
   ├─ -──┤
   ├─ *──┤
   ├─ /──┤
   └─ ||─┘
```

Notes:

1 See page 4-42
2 See page 4-44
3 See page 4-49
4 See page 4-53
5 See page 4-63
6 See page 4-68
7 See page 4-114
8 See page 4-116
9 Stored Procedure Language only

Element	Description	Restrictions	Syntax
SPL_variable	In an SPL routine, a variable that contains some expression type that the syntax diagram shows	Must conform to the rules for expressions of that type	Identifier, p. 5-22
variable	Host or program variable that contains some expression type that the syntax diagram shows	Must conform to the rules for expressions of that type	Language-specific rules for names

Usage

The following table lists the types of SQL expressions, as identified in the diagram for "Expression" on page 4-34, and describes what each type returns.

Expression Type	Description
Aggregate functions	Returns values from built-in or from user-defined aggregates
Arithmetic operators	Supports arithmetic operations on one (unary operators) or two (binary operators) numeric operands
Concatenation operator	Concatenates two string values
Cast operators	Explicit casts from one data type to another
Column expressions	Full or partial column values
Conditional expressions	Returns values that depend on conditional tests
Constant expressions	Literal values in data manipulation (DML) statements
Constructor expressions	Dynamically creates values for complex data types
Function expressions	Returns values from built-in or user-defined functions
Statement-Local-Variable expressions	Specifies how you can use a defined statement-local variable (SLV) elsewhere in an SQL statement

You can also use host variables or SPL variables as expressions. For a complete list with page references to this chapter, see the following "List of Expressions."

List of Expressions

Each category of SQL expression includes many individual expressions. The following table lists all the SQL expressions (and some operators) in alphabetical order. The columns in this table have the following meanings:

- **Name** gives the name of each expression.
- **Description** gives a short description of each expression.
- **Syntax** lists the page that shows the syntax of the expression.
- **Usage** shows the page that describes the usage of the expression.

Each expression listed in the following table is supported on all database servers unless otherwise noted. When an expression is not supported on all database servers, the **Name** column notes in parentheses the database server or servers that do support the expression.

Name	Description	Syntax	Usage
ABS function	Returns absolute value of a numeric argument	p. 4-69	p. 4-70
ACOS function	Returns the arc cosine of a numeric argument	p. 4-100	p. 4-101
Addition (+) operator	Returns the sum of two numeric operands	p. 4-34	p. 4-40
ASIN function	Returns the arc sine of a numeric argument	p. 4-100	p. 4-101
ATAN function	Returns the arc tangent of numeric argument	p. 4-100	p. 4-102
ATAN2 function	Computes the angular component of the polar coordinates (*r*, q) associated with (*x, y*)	p. 4-100	p. 4-102
AVG function	Returns the mean of a set of numeric values	p. 4-116	p. 4-118
CARDINALITY function (IDS)	Returns the number of elements in a collection data type (SET, MULTISET, or LIST)	p. 4-72	p. 4-72
CASE expression	Returns a value that depends on which of several conditional tests evaluates to true	p. 4-49	p. 4-49
CAST expression (IDS)	Converts an expression to a specified data type	p. 4-42	p. 4-42
Cast (**::**) operator	See "Double-colon (::) cast operator"	p. 4-42	p. 4-42
CHARACTER_LENGTH function	See CHAR_LENGTH function. (In multibyte locales, this replaces the LENGTH function.)	p. 4-89	p. 4-90
CHAR_LENGTH function	Returns count of logical characters in a string	p. 4-89	p. 4-90
Column expression	Complete or partial column value from a table	p. 4-44	p. 4-44
Concatenation (||) operator	Concatenates the results of two expressions	p. 4-34	p. 4-41
Constant expression	Expression with a literal, fixed, or variant value	p. 4-53	p. 4-53
COS function	Returns the cosine of a radian expression	p. 4-100	p. 4-101
COUNT (as a set of functions)	Functions that return frequency counts Each form of the COUNT function is listed below.	p. 4-116	p. 4-119
COUNT (ALL *column*) function	See COUNT (*column*) function.	p. 4-116	p. 4-120
COUNT (*column*) function	Returns the number of non-NULL values in a specified column	p. 4-116	p. 4-120
COUNT DISTINCT function	Returns the number of unique non-NULL values in a specified column	p. 4-116	p. 4-119
COUNT UNIQUE function	See COUNT DISTINCT function.	p. 4-116	p. 4-119

Name	Description	Syntax	Usage
COUNT (*) function	Returns the cardinality of the set of rows that satisfy a query	p. 4-116	p. 4-119
CURRENT operator	Returns the current time as a DATETIME value that consists of the date and the time of day	p. 4-53	p. 4-58
CURRENT_ROLE operator	Returns the currently enabled role of the user	p. 4-53	p. 4-56
sequence.CURRVAL (IDS)	Returns the current value of specified *sequence*	p. 4-53	p. 4-61
DATE function	Converts a nondate argument to a DATE value	p. 4-96	p. 4-97
DAY function	Returns the day of the month as an integer	p. 4-96	p. 4-98
DBINFO (as a set of functions)	Provides a set of functions for retrieving different types of database information. To invoke each function, specify the appropriate DBINFO option. Each option is listed below.	p. 4-72	p. 4-73
DBINFO (’coserverid’ string followed by *table***.** *column* and the ’currentrow’ string) (XPS)	Returns the coserver ID of the coserver where each row of a specified table is located	p. 4-72	p. 4-78
DBINFO (’coserverid’ string with no other arguments) (XPS)	Returns the coserver ID of the coserver to which the user who entered the query is connected	p. 4-72	p. 4-78
DBINFO (’dbhostname’ option)	Returns the hostname of the database server to which a client application is connected	p. 4-72	p. 4-76
DBINFO (’dbspace’ string followed by *table.column* and the ’currentrow’ string) (XPS)	Returns the name of the dbspace where each row of a specified table is located	p. 4-72	p. 4-79
DBINFO (’dbspace’ string followed by a tblspace number)	Returns the name of a dbspace corresponding to a tblspace number	p. 4-72	p. 4-74
DBINFO (’serial8’ option)	Returns most recently inserted SERIAL8 value	p. 4-72	p. 4-77
DBINFO (’sessionid’ option)	Returns the session ID of the current session	p. 4-72	p. 4-75
DBINFO (’sqlca.sqlerrd1’ option)	Returns the last serial value inserted in a table	p. 4-72	p. 4-74
DBINFO (’sqlca.sqlerrd2’ option)	Returns the number of rows processed by DML statements, and by EXECUTE PROCEDURE and EXECUTE FUNCTION statements	p. 4-72	p. 4-75
DBINFO (’version’ option)	Returns exact version of the database server to which a client application is connected	p. 4-72	p. 4-76
DBSERVERNAME function	Returns the name of the database server	p. 4-53	p. 4-57
DECODE function	Evaluates one or more expression pairs and compares the *when* expression in each pair with a specified value expression	p. 4-52	p. 4-52
DECRYPT_CHAR function (IDS)	Returns a plain-text string or CLOB after processing an encrypted argument	p. 4-79	p. 4-84
DECRYPT_BINARY function (IDS)	Returns a plain-text BLOB data value after processing an encrypted BLOB argument	p. 4-79	p. 4-85
DEFAULT_ROLE operator	Returns the default role of the current user	p. 4-53	p. 4-56
Division (/) operator	Returns the quotient of two numeric operands	p. 4-34	p. 4-40
Double-colon (::) cast operator (IDS)	Converts the value of an expression to a specified data type	p. 4-42	p. 4-42
Double-pipe (||) concatenation operator	Returns a string that joins one string operand to another string operand	p. 4-34	p. 4-41

Name	Description	Syntax	Usage
ENCRYPT_AES function (IDS)	Returns an encrypted string or BLOB after processing a plain-text string, BLOB, or CLOB	p. 4-79	p. 4-86
ENCRYPT_TDES function (IDS)	Returns an encrypted string or BLOB after processing a plain-text string, BLOB, or CLOB	p. 4-79	p. 4-86
EXP function	Returns the exponent of a numeric expression	p. 4-87	p. 4-87
EXTEND function	Resets precision of DATETIME or DATE value	p. 4-96	p. 4-98
FILETOBLOB function (IDS)	Creates a BLOB value from data stored in a specified operating-system file	p. 4-91	p. 4-91
FILETOCLOB function (IDS)	Creates a CLOB value from data stored in a specified operating-system file	p. 4-91	p. 4-91
GETHINT function (IDS)	Returns a plain-text hint string after processing an encrypted data-string argument	p. 4-79	p. 4-87
HEX function	Returns the hexadecimal encoding of a base-10 integer argument	p. 4-88	p. 4-88
Host variable	See Variable.	p. 4-34	p. 4-34
IFX_ALLOW_NEWLINE function	Sets a newline session mode that allows or disallows newline characters in quoted strings	p. 4-111	p. 4-111
IFX_REPLACE_MODULE function (IDS)	Replaces a loaded shared-object file with a new version that has a different name or location	p. 4-90	p. 4-90
INITCAP function	Converts a string argument to a string in which only the initial letter of each word is uppercase	p. 4-109	p. 4-110
LENGTH function	Returns the number of bytes in a character column, not including any trailing blank spaces	p. 4-89	p. 4-89
LIST collection constructor (IDS)	Constructor for collections whose elements are ordered and can contain duplicate values	p. 4-65	p. 4-65
Literal BOOLEAN	Literal representation of a BOOLEAN value	p. 4-53	p. 4-53
Literal collection (IDS)	Represents elements in a collection data type	p. 4-53	p. 4-63
Literal DATETIME	Represents a DATETIME value	p. 4-53	p. 4-60
Literal INTERVAL	Represents an INTERVAL value	p. 4-53	p. 4-60
Literal number	Represents a numeric value	p. 4-53	p. 4-55
Literal opaque type (IDS)	Represents an opaque data type	p. 4-53	p. 4-53
Literal row (IDS)	Represents the elements in a ROW data type	p. 4-53	p. 4-63
LOCOPY function (IDS)	Creates a copy of a smart large object	p. 4-91	p. 4-95
LOGN function	Returns the natural log of a numeric argument	p. 4-87	p. 4-88
LOG10 function	Returns the base-10 logarithm of an argument	p. 4-87	p. 4-88
LOTOFILE function (IDS)	Copies a BLOB or CLOB value to a file	p. 4-91	p. 4-93
LOWER function	Converts uppercase letters to lowercase	p. 4-109	p. 4-110
LPAD function	Returns a string that is left-padded by a specified number of pad characters	p. 4-107	p. 4-107
MAX function	Returns the largest in a specified set of values	p. 4-116	p. 4-122
MDY function	Returns a DATE value from integer arguments	p. 4-96	p. 4-99
MIN function	Returns the smallest in a specified set of values	p. 4-116	p. 4-122
MOD function	Returns the modulus (the integer-division remainder value) from two numeric arguments	p. 4-69	p. 4-70

Name	Description	Syntax	Usage
MONTH function	Returns the month value from a DATE or DATETIME argument	p. 4-96	p. 4-98
Multiplication (*) operator	Returns the product of two numeric operands	p. 4-34	p. 4-40
MULTISET collection constructor (IDS)	Constructor for a non-ordered collection of elements that can contain duplicate value	p. 4-65	p. 4-65
sequence.NEXTVAL (IDS)	Increments the value of the specified *sequence*	p. 4-53	p. 4-61
NULL keyword	Unknown, missing, or logically undefined value	p. 4-66	p. 4-67
NVL function	Returns the value of a not-NULL argument, or a specified value if the argument is NULL	p. 4-52	p. 4-52
OCTET_LENGTH function	Returns the number of bytes in a character column, including any trailing blank spaces	p. 4-89	p. 4-90
POW function	Raises a base value to a specified power	p. 4-69	p. 4-70
Procedure-call expression	See user-defined function.	p. 4-111	p. 4-111
Program variable	See variable.	p. 4-34	p. 4-34
Quoted string	Literal character string	p. 4-53	p. 4-55
RANGE function	Returns the range of a specified set of values	p. 4-116	p. 4-122
REPLACE function	Replaces specified characters in a source string	p. 4-107	p. 4-107
ROOT function	Returns the root value of a numeric argument	p. 4-69	p. 4-70
ROUND function	Returns the rounded value of an argument	p. 4-69	p. 4-71
ROW constructor (IDS)	Constructor for a named ROW data type	p. 4-63	p. 4-64
RPAD function	Returns a string that is right-padded by a specified number of pad characters	p. 4-108	p. 4-108
SET collection constructor (IDS)	Constructor for an unordered collection of elements in which each value is unique	p. 4-65	p. 4-65
SIN function	Returns the sine of a radian expression	p. 4-100	p. 4-101
SITENAME function	See DBSERVERNAME function.	p. 4-53	p. 4-57
SPL routine expression	See ″User-defined functions″	p. 4-111	p. 4-111
SPL variable	SPL variable that stores an expression	p. 4-34	p. 4-34
SQRT function	Returns the square root of a numeric argument	p. 4-69	p. 4-71
Statement-Local-Variable expression	A statement-local variable (SLV) whose scope is restricted to the same SQL statement	p. 4-113	p. 4-114
STDEV function	Returns the standard deviation of a data set	p. 4-116	p. 4-123
SUBSTR function	Returns a substring of a string argument	p. 4-105	p. 4-105
SUBSTRING function	Returns a substring of a source string	p. 4-104	p. 4-104
Substring ([x, *y*]) operator	Returns a substring of a string operand	p. 4-44	p. 2-508
Subtraction (-) operator	Returns the difference between two numbers	p. 4-34	p. 4-40
SUM function	Returns the sum of a specified set of values	p. 4-116	p. 4-122
TAN function	Returns the tangent of a radian expression	p. 4-100	p. 4-101
TO_CHAR function	Converts a DATE or DATETIME to a string	p. 4-96	p. 4-99
TO_DATE function	Converts a string to a DATETIME value	p. 4-96	p. 4-100
TODAY operator	Returns the current system date	p. 4-53	p. 4-57
TRIM function	Drops pad characters from a string argument	p. 4-102	p. 4-102
TRUNC function	Returns a truncated numeric value	p. 4-69	p. 4-71

Name	Description	Syntax	Usage
Unary minus (-) sign	Specifies a negative (< 0) numeric value	p. 4-34	p. 4-40
Unary plus (+) sign	Specifies a positive (> 0) numeric value .	p. 4-34	p. 4-40
UNITS operator	Convert an integer to an INTERVAL value	p. 4-53	p. 4-60
UPPER function	Converts lowercase letters to uppercase	p. 4-109	p. 4-110
User-defined aggregate (IDS)	Aggregate that you define (as opposed to built-in aggregates that Dynamic Server provides)	p. 4-125	p. 4-125
User-defined function	Function that you write (as opposed to built-in functions that the database server provides)	p. 4-111	p. 4-111
USER operator	Returns the login name of the current user	p. 4-53	p. 4-55
Variable	Host or program variable that stores a value	p. 4-34	p. 4-34
VARIANCE function	Returns the variance for a set of values	p. 4-116	p. 4-123
WEEKDAY function	Returns an integer code for the day of the week	p. 4-96	p. 4-98
YEAR function	Returns a 4-digit integer representing a year	p. 4-96	p. 4-98
* symbol	See ″Multiplication (*) operator″	p. 4-34	p. 4-40
+ symbol	See ″Addition″ and ″Unary plus (+) sign″	p. 4-34	p. 4-40
- symbol	See ″Subtraction″ and ″Unary minus (-) sign″	p. 4-34	p. 4-40
/ symbol	See ″Division operator″	p. 4-34	p. 4-40
:: symbols	See ″Double-colon (::) cast operator″	p. 4-42	p. 4-42
|| symbol	See ″Double-pipe (||) concatenation operator″	p. 4-34	p. 4-41
[*first*, *last*] symbols	See ″Substring operator″	p. 4-34	p. 4-40

Sections that follow describe the syntax and usage of each expression that appears in the preceding table.

Arithmetic Operators

Binary arithmetic operators can combine expressions that return numbers.

Arithmetic Operation	Arithmetic Operator	Operator Function	Arithmetic Operation	Arithmetic Operator	Operator Function
Addition	+	**plus( )**	Multiplication	*	**times( )**
Subtraction	–	**minus( )**	Division	/	**divide( )**

The following examples use binary arithmetic operators:

```
quantity * total_price
price * 2
COUNT(*) + 2
```

If you combine a DATETIME value with one or more INTERVAL values, all the fields of the INTERVAL value must be present in the DATETIME value; no implicit EXTEND function is performed. In addition, you cannot use YEAR to MONTH intervals with DAY to SECOND intervals. For additional information about binary arithmetic operators, see the *IBM Informix Guide to SQL: Reference*.

The binary arithmetic operators have associated operator functions, as the preceding table shows. Connecting two expressions with a binary operator is equivalent to invoking the associated operator function on the expressions. For example, the following two statements both select the product of the **total_price** column and 2. In the first statement, the * operator implicitly invokes the **times( )** function.

```
SELECT (total_price * 2) FROM items
   WHERE order_num = 1001
SELECT times(total_price, 2) FROM items
   WHERE order_num = 1001
```

You cannot use arithmetic operators to combine expressions that use aggregate functions with column expressions.

The database server provides the operator functions associated with the relational operators for all built-in data types. You can define new versions of these operator functions to handle your own user-defined data types.

For more information, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

The database server also supports the following unary arithmetic operators.

Sign of Number	Unary Arithmetic Operator	Operator Function
Positive	+	**positive( )**
Negative	–	**negate( )**

The unary arithmetic operators have the associated operator functions that the preceding table shows. You can define new versions of these functions to handle your own user-defined data types. For more information on this topic, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

If any value that participates in an arithmetic expression is NULL, the value of the entire expression is NULL, as the following example shows:

```
SELECT order_num, ship_charge/ship_weight FROM orders
   WHERE order_num = 1023
```

If either **ship_charge** or **ship_weight** is NULL, the value returned for the expression **ship_charge**/**ship_weight** is also NULL. If the NULL expression **ship_charge**/**ship_weight** is used in a condition, its truth value cannot be TRUE, and the condition is not satisfied (unless the NULL expression is an operand of the **IS NULL** operator).

Concatenation Operator

You can use the concatenation operator (||) to concatenate two expressions. These examples show some possible concatenated-expression combinations.

- The first example concatenates the **zipcode** column to the first three letters of the **lname** column.
- The second example concatenates the suffix **.dbg** to the contents of a host variable called **file_variable**.
- The third example concatenates the value that the **TODAY** operator returns to the string `Date`.

```
lname[1,3] || zipcode

:file_variable || '.dbg'

'Date:' || TODAY
```

You cannot use the concatenation operator in an embedded-language-only statement. The ESQL/C-only statements of SQL appear in the following list:

ALLOCATE COLLECTION	EXECUTE IMMEDIATE
ALLOCATE DESCRIPTOR	FETCH
ALLOCATE ROW	FLUSH
CLOSE	FREE
CREATE FUNCTION FROM	GET DESCRIPTOR
CREATE PROCEDURE FROM	GET DIAGNOSTICS
CREATE ROUTINE FROM	OPEN
DEALLOCATE COLLECTION	PREPARE
DEALLOCATE DESCRIPTOR	PUT
DEALLOCATE ROW	SET AUTOFREE
DECLARE	SET CONNECTION
DESCRIBE	SET DESCRIPTOR
DESCRIBE INPUT	WHENEVER
EXECUTE	

You can use the concatenation operator in a SELECT, INSERT, EXECUTE FUNCTION, or EXECUTE PROCEDURE statement within the DECLARE statement.

You can use the concatenation operator in the SQL statement or statements in the PREPARE statement.

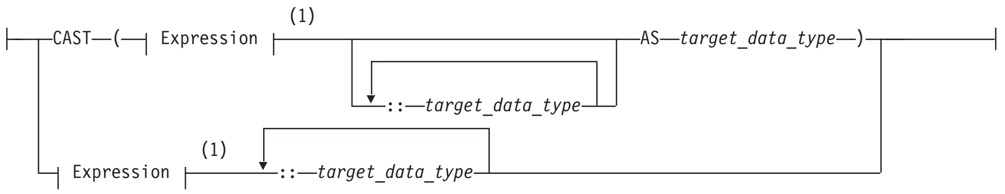
The concatenation operator (||) has an associated operator function called **concat( )**. You can define a **concat( )** function to handle your own string-based user-defined data types. For more information, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Cast Expressions (IDS)

You can use the CAST AS keywords or the double-colon cast operator (**::**) to cast an expression to another data type. Both the operator and the keywords invoke a cast from the data type of the expression to the target data type.

To invoke an explicit cast, you can use either the cast operator or the CAST AS keywords. If you use the cast operator or the CAST AS keywords, but no explicit or implicit cast was defined to perform the conversion between two data types, the statement returns an error.

Cast Expressions:



Notes:

1 See page 4-34

Element	Description	Restrictions	Syntax
target_data_type	Data type returned by cast	See "Rules for the Target Data Type"	Data Type, p. 4-18

Rules for the Target Data Type

The following rules restrict the *target data type* in cast expressions:

- The target data type must be either a built-in type, a user-defined type, or a named row type in the database.
- The target data type cannot be an unnamed row or a collection type.
- The target data type can be a BLOB data type under the following conditions:
  - The source expression (the expression to be cast to another data type) is a BYTE data type.
  - The source expression is a user-defined type and the user has defined a cast from the user-defined type to the BLOB type.
- The target data type can be a CLOB type under these conditions:
  - The source expression is a TEXT data type.
  - The source expression is a user-defined type and the user has defined a cast from the user-defined type to the CLOB type.
- You cannot cast a BLOB data type to a BYTE data type.
- You cannot cast a CLOB data type to a TEXT data type.
- An explicit or implicit cast must exist that can convert the data type of the source expression to the target data type.

Examples of Cast Expressions

The following examples show two different ways to convert the sum of *x* and *y* to a user-defined data type, **user_type**. The two methods produce identical results. Both require the existence of an explicit or implicit cast from the type returned by `(x + y)` to the user-defined type:

```
CAST ((x + y) AS user_type)
(x + y)::user_type
```

The following examples show two different ways of finding the integer equivalent of the expression **expr**. Both require the existence of an implicit or explicit cast from the data type of **expr** to the INTEGER data type:

```
CAST (expr AS INTEGER)
expr::INTEGER
```

In the following example, the user casts a BYTE column to the BLOB type and copies the BLOB data to an operating-system file:

```
SELECT LOTOFILE(mybytecol::blob, 'fname', 'client')
   FROM mytab
   WHERE pkey = 12345
```

In the following example, the user casts a TEXT column to a CLOB value and then updates a CLOB column in the same table to have the CLOB value derived from the TEXT column:

```
UPDATE newtab SET myclobcol = mytextcol::clob
```

The Keyword NULL in Cast Expressions

Cast expressions can appear in the projection list, including expressions of the form NULL**::***datatype*, where *datatype* is any data type known to the database:

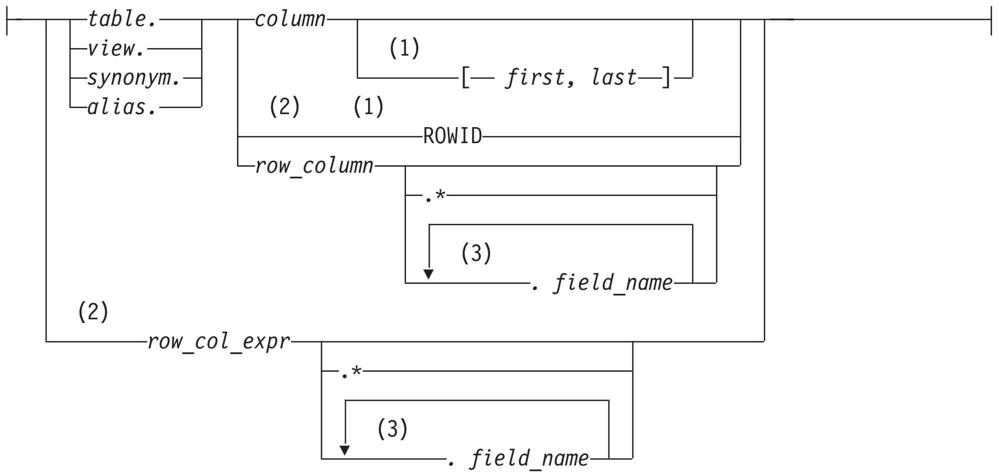
```
SELECT newtable.col0, null::int FROM newtable;
```

The keyword NULL has a global scope of reference within expressions. In SQL, the keyword NULL is the only syntactic mechanism for accessing a NULL value. Any attempt to redefine or restrict the global scope of the keyword NULL (for example, declaring an SPL variable called **null**) disables any cast expression that involves a NULL value. Make sure that the keyword NULL receives its global scope in all expression contexts.

Column Expressions

A *column expression* specifies a data value in a column in the database, or a substring of the value, or (for Dynamic Server only) a field within a ROW-type column. This is the syntax for column expressions.

Column Expressions:



Notes:

1 Informix extension

2 Dynamic Server only

3 Use path no more than three times

Element	Description	Restrictions	Syntax
alias	Temporary alternative name for a table or view, declared in the FROM clause of a query	Restrictions depend on the clause of the SELECT statement in which *alias* occurs	Identifier, p. 5-22
column	Name of a column	Restrictions depend on the SQL statement where *column* occurs	Identifier, p. 5-22
field_name	Name of a ROW field in the ROW column or ROW-column expression	Must be a member of the row that *row-column name* or *row_col_expr* or *field name* (for nested rows) specifies	Identifier, p. 5-22
first, last	Integers indicating positions of first and last characters within *column*	The *column* must be of type CHAR, VARCHAR, NCHAR, NVARCHAR, BYTE, or TEXT, and 0 < *first* ≤ *last*	Literal Number, p. 4-137
row_col_expr	Expression that returns ROW-type values	Must return a ROW data type	Expression, p. 4-34
row_column	Name of a ROW-type column	Must be a named ROW data type or an unnamed ROW data type	Identifier, p. 5-22
synonym, table, view	Table, view, or synonym (for the table or view) that contains *column*	Synonym and the table or view to which it points must exist	Database Object Name, p. 5-17

The following examples show column expressions:

```
company

items.price

cat_advert [1,15]
```

You must qualify the *column* name with a *table* name or *alias* whenever it is necessary to distinguish between columns that have the same name but are in different tables. The SELECT statements that the following example shows use **customer_num** from the **customer** and **orders** tables. The first example precedes the column names with table names. The second example precedes the column names with table aliases.

```
SELECT * FROM customer, orders
   WHERE customer.customer_num = orders.customer_num;

SELECT * FROM customer c, orders o
   WHERE c.customer_num = o.customer_num;
```

Using Dot Notation

Dot notation (sometimes called the *membership operator*) allows you to qualify an SQL identifier with another SQL identifier of which it is a component. You separate the identifiers with the period (**.**) symbol. For example, you can qualify a column name with any of the following SQL identifiers:

- Table name: *table_name***.***column_name*
- View name: *view_name***.***column_name*
- Synonym name: *syn_name***.***column_name*

These forms of dot notation are called *column projections*.

You can also use dot notation to directly access the fields of a named or unnamed ROW column, as in the following example:

```
row-column name.field name
```

This use of dot notation is called a *field projection*. For example, suppose you have a column called **rect** with the following definition:

```
CREATE TABLE rectangles
(
   area float,
   rect ROW(x int, y int, length float, width float)
);
```

The following SELECT statement uses dot notation to access field **length** of the **rect** column:

```
SELECT rect.length FROM rectangles
   WHERE area = 64;
```

Selecting All Fields of a Column with Asterisk Notation: If you want to select all fields of a column that has a ROW type, you can specify the column name without dot notation. For example, you can select all fields of the **rect** column as follows:

```
SELECT rect FROM rectangles
   WHERE area = 64;
```

You can also use asterisk (*****) notation to project all the fields of a column that has a ROW data type. For example, if you want to use asterisk notation to select all fields of the **rect** column, you can enter the following statement:

```
SELECT rect.* FROM rectangles
   WHERE area = 64;
```

Asterisk notation is easier than specifying each field of the **rect** column individually:

```
SELECT rect.x, rect.y, rect.length, rect.width
   FROM rectangles
      WHERE area = 64;
```

Asterisk notation is valid only in the projection list of a SELECT statement. It can specify all fields of a ROW-type column or the data that a ROW-column expression returns.

Asterisk notation is not necessary with ROW-type columns because you can specify the column name alone to project all of its fields. Asterisk notation is quite helpful, however, with ROW-type expressions such as subqueries and user-defined functions that return ROW-type values. For more information, see “Using Dot Notation with Row-Type Expressions” on page 4-47.

You can use asterisk notation with columns and expressions of ROW data types in the projection list of a SELECT statement only. You cannot use asterisk notation with columns and expressions of ROW type in any other clause of a SELECT statement.

Selecting Nested Fields: When the ROW type that defines a column itself contains other ROW types, the column contains nested fields. Use dot notation to access these nested fields within a column.

For example, assume that the **address** column of the **employee** table contains the fields: **street**, **city**, **state**, and **zip**. In addition, the **zip** field contains the nested fields: **z_code** and **z_suffix**. A query on the **zip** field returns values for the **z_code** and **z_suffix** fields. You can specify, however, that a query returns only specific nested fields. The following example shows how to use dot notation to construct a SELECT statement that returns rows for the **z_code** field of the **address** column only:

```
SELECT address.zip.z_code
   FROM employee;
```

Rules of Precedence: The database server uses the following precedence rules to interpret dot notation:

1. schema *name_a* . table *name_b* . column *name_c* . field *name_d*
2. table *name_a* . column *name_b* . field *name_c* . field *name_d*
3. column *name_a* . field *name_b* . field *name_c* . field *name_d*

When the meaning of an identifier is ambiguous, the database server uses precedence rules to determine which database object the identifier specifies. Consider the following two tables:

```
CREATE TABLE b (c ROW(d INTEGER, e CHAR(2));
CREATE TABLE c (d INTEGER);
```

In the following SELECT statement, the expression **c.d** references column **d** of table **c** (rather than field **d** of column **c** in table **b**) because a table identifier has a higher precedence than a column identifier:

```
SELECT *
   FROM b,c
      WHERE c.d = 10;
```

For more information about precedence rules and how to use dot notation with ROW columns, see the *IBM Informix Guide to SQL: Tutorial*.

Using Dot Notation with Row-Type Expressions: Besides specifying a column of a ROW data type, you can also use dot notation with any expression that evaluates to a ROW type. In an INSERT statement, for example, you can use dot notation in a subquery that returns a single row of values. Assume that you created a ROW type named **row_t**:

```
CREATE ROW TYPE row_t (part_id INT, amt INT);
```

Also assume that you created a typed table named **tab1** that is based on the **row_t** ROW type:

```
CREATE TABLE tab1 OF TYPE row_t;
```

Assume also that you inserted the following values into table **tab1**:

```
INSERT INTO tab1 VALUES (ROW(1,7));
INSERT INTO tab1 VALUES (ROW(2,10));
```

Finally, assume that you created another table named **tab2**:

```
CREATE TABLE tab2 (colx INT);
```

Now you can use dot notation to insert the value from only the **part_id** column of table **tab1** into the **tab2** table:

```
INSERT INTO tab2
   VALUES ((SELECT t FROM tab1 t
      WHERE part_id = 1).part_id);
```

The asterisk form of dot notation is not necessary when you want to select all fields of a ROW-type column because you can specify the column name alone to select all of its fields. The asterisk form of dot notation can be quite helpful, however, when you use a subquery, as in the preceding example, or when you call a user-defined function to return ROW-type values.

Suppose that a user-defined function named **new_row** returns ROW-type values, and you want to call this function to insert the ROW-type values into a table. Asterisk notation makes it easy to specify that all the ROW-type values that the **new_row( )** function returns are to be inserted into the table:

```
INSERT INTO mytab2 SELECT new_row (mycol).* FROM mytab1;
```

References to the fields of a ROW-type column or a ROW-type expression are not allowed in fragment expressions. A fragment expression is an expression that defines a table fragment or an index fragment in SQL statements like CREATE TABLE, CREATE INDEX, and ALTER FRAGMENT.

Using Subscripts on Character Columns

You can use subscripts on CHAR, VARCHAR, NCHAR, NVARCHAR, LVARCHAR, BYTE, and TEXT columns. The subscripts indicate the starting and ending character positions in the expression. Together the column subscripts define a *column substring* as the portion of the column that is contained in the expression.

For example, if a value in the **lname** column of the **customer** table is `Greenburg`, the following expression evaluates to `burg`:

```
lname[6,9]
```

A conditional expression can include a column expression that uses the substring operator ([*first*, *last*]), as in the following example:

```
SELECT lname FROM customer WHERE phone[5,7] = '356';
```

Here the quotes are required, to prevent the database server from applying a numeric filter to the digits in the criterion value.

For information on the GLS aspects of column subscripts and substrings, see the *IBM Informix GLS User's Guide*.

Using Rowids (IDS)

In Dynamic Server, you can use the **rowid** column that is associated with a table row as a property of the row. The **rowid** column is essentially a hidden column in nonfragmented tables and in fragmented tables that were created with the WITH ROWIDS clause. The **rowid** column is unique for each row, but it is not necessarily sequential. It is recommended, however, that you use primary keys as an access method rather than exploiting the **rowid** column.

The following examples use the ROWID keyword in a SELECT statement:

```
SELECT *, ROWID FROM customer;

SELECT fname, ROWID FROM customer ORDER BY ROWID;

SELECT HEX(rowid) FROM customer WHERE customer_num = 106;
```

The last example shows how to get the page number (the first six digits after 0x) and the slot number (the last two digits) of the location of your row.

You cannot use the ROWID keyword in the select list of the Projection clause of a query that contains an aggregate function.

Using Smart Large Objects (IDS)

The SELECT, UPDATE, and INSERT statements do not manipulate the values of smart large objects directly. Instead, they use a *handle value*, which is a type of pointer, to access the BLOB or CLOB value, as follows:

- The SELECT statement returns a handle value to the BLOB or CLOB value that the projection list specifies. SELECT does not return the actual data for the BLOB or CLOB column that the projection list specifies. Instead, it returns a handle value to the column data.
- The INSERT and UPDATE statements do not send the actual data for the BLOB or CLOB column to the database server. Instead, they accept a handle value to this data as the value to be inserted or updated.

To access the data of a smart-large-object column, you must use one of the following application programming interfaces (APIs):

- From within an IBM Informix ESQL/C program, use the ESQL/C library functions that access smart large objects. For more information, see the *IBM Informix ESQL/C Programmer's Manual*.
- From within a C program such as a DataBlade module, use the Client and Server API. For more information, see your *IBM Informix DataBlade Developer's Kit User's Guide*.

You cannot use the name of a smart-large-object column in expressions that involve arithmetic operators. For example, operations such as addition or subtraction on the smart-large-object handle value have no meaning.

When you select a smart-large-object column, you can assign the handle value to any number of columns: all columns with the same handle value share the CLOB or BLOB value. This storage arrangement reduces the amount of disk space that the CLOB or BLOB value, but when several columns share the same smart-large-object value, the following conditions result:

- The chance of lock contention on a CLOB or BLOB column increases. If two columns share the same smart-large-object value, the data might be locked by either column that needs to access it.
- The CLOB or BLOB value can be updated from a number of points.

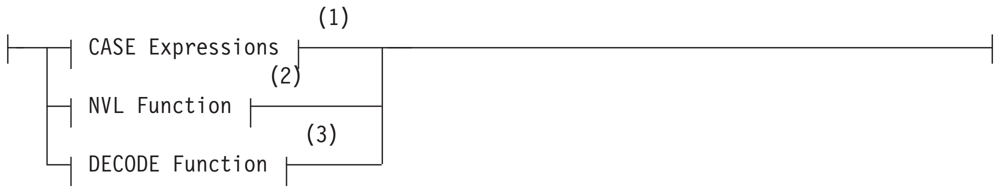
To remove these constraints, you can create separate copies of the BLOB or CLOB data for each column that needs to access it. You can use the **LOCOPY** function to create a copy of an existing smart large object.

You can also use the built-in functions **LOTOFILE**, **FILETOCLOB**, and **FILETOBLOB** to access smart-large-object values, as described in "Smart-Large-Object Functions (IDS)" on page 4-91. For more information on the BLOB and CLOB data types, see the *IBM Informix Guide to SQL: Reference*.

Conditional Expressions

Conditional expressions return values that depend on the outcome of conditional tests. This diagram shows the syntax for Conditional Expressions.

Conditional Expressions:



Notes:

1 See page 4-49

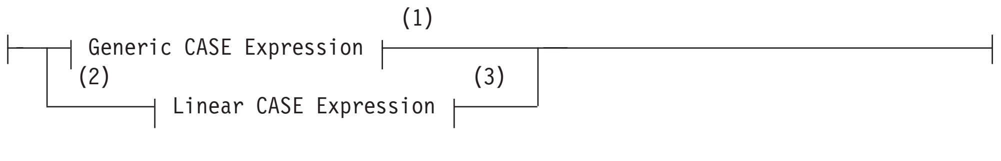
2 See page 4-52

3 See page 4-52

CASE Expressions

The CASE expression allows an SQL statement such as the SELECT statement to return one of several possible results, depending on which of several condition evaluates to true. The CASE expression has two forms: generic CASE expressions and linear CASE expressions.

CASE Expressions:



Notes:

1 See page 4-50

2 Dynamic Server only

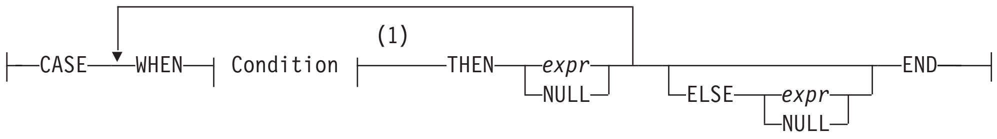
3 See page 4-51

You must include at least one WHEN clause in the CASE expression. Subsequent WHEN clauses and the ELSE clause are optional. You can use a generic or linear CASE expression wherever you can use a column expression in an SQL statement (for example, in the Projection clause a SELECT statement).

Expressions in the search condition or the result value expression can contain subqueries, and you can nest a CASE expression in another CASE expression. When a CASE expression appears in an aggregate expression, you cannot use aggregate functions in the CASE expression.

Generic CASE Expressions: A generic CASE expression tests for a true condition in a WHEN clause. If it finds a true condition, it returns the result specified in the THEN clause.

Generic CASE Expression:



Notes:

1 See page 4-5

Element	Description	Restrictions	Syntax
expr	Expression that returns some data type	Data type of *expr* in a THEN clause must be compatible with data types of expressions in other THEN clauses	Expression, p. 4-34

The database server processes the WHEN clauses in the order that they appear in the statement. If the search condition of a WHEN clause evaluates to TRUE, the database server uses the value of the corresponding THEN expression as the result, and stops processing the CASE expression.

If no WHEN condition evaluates to TRUE, the database server uses the ELSE expression as the overall result. If no WHEN condition evaluates to TRUE, and no ELSE clause was specified, the returned CASE expression value is NULL. You can use the IS NULL condition to handle NULL results. For information on how to handle NULL values, see "IS NULL Condition" on page 4-10.

The next example shows a generic CASE expression in the Projection clause.

In this example, the user retrieves the name and address of each customer as well as a calculated number that is based on the number of problems that exist for that customer:

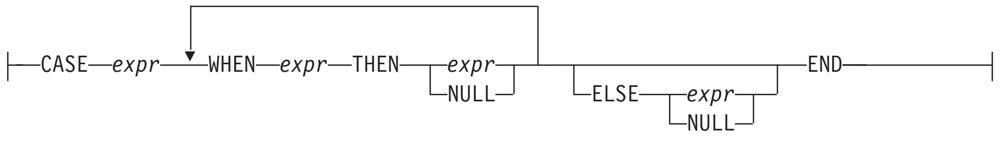
```
SELECT cust_name,
   CASE
   WHEN number_of_problems = 0
      THEN 100
   WHEN number_of_problems > 0 AND number_of_problems < 4
      THEN number_of_problems * 500
   WHEN number_of_problems >= 4 and number_of_problems <= 9
      THEN number_of_problems * 400
   ELSE
```

```
      (number_of_problems * 300) + 250
   END,
   cust_address
FROM custtab
```

In a generic CASE expression, all the results should be of the same data type, or they should evaluate to a common compatible data type. If the results in all the WHEN clauses are not of the same data type, or if they do not evaluate to values of mutually compatible types, an error occurs.

Linear CASE Expressions (IDS): A linear CASE expression compares the value of the expression that follows the CASE keyword with an expression in a WHEN clause.

Linear CASE Expression:



Element	Description	Restrictions	Syntax
expr	Expression that returns a value of some data type	Data type of *expr* that follows the WHEN keyword must be compatible with data type of the expression that follows the CASE keyword. Data type of *expr* in the THEN clause must be compatible with data types of expressions in other THEN clauses.	Expression, p. 4-34

The database server evaluates the expression that follows the CASE keyword, and then processes the WHEN clauses sequentially. If an expression after the WHEN keyword returns the same value as the expression that follows the CASE keyword, the database server uses the value of the expression that follows the THEN keyword as the overall result of the CASE expression. Then the database server stops processing the CASE expression.

If none of the WHEN expressions return the same value as the expression that follows the CASE keyword, the database server uses the expression of the ELSE clause as the overall result of the CASE expression (or, if no ELSE clause was specified, the returned value of the CASE expression is NULL).

The next example shows a linear CASE expression in the projection list of the Projection clause of a SELECT statement. For each movie in a table of movie titles, the query returns the title, the cost, and the type of the movie. The statement uses a CASE expression to derive the type of each movie:

```
SELECT title, CASE movie_type
      WHEN 1 THEN 'HORROR'
      WHEN 2 THEN 'COMEDY'
      WHEN 3 THEN 'ROMANCE'
      WHEN 4 THEN 'WESTERN'
      ELSE 'UNCLASSIFIED'
   END,
   our_cost FROM movie_titles
```

In linear CASE expressions, the data types of WHEN clause expressions must be compatible with that of the expression that follows the CASE keyword.

NVL Function

The **NVL** expression returns different results, depending on whether its first argument evaluates to NULL.

NVL Function:

```
├──NVL──(──expr1──,──expr2──)────────────────────────────────────────┤
```

Element	Description	Restrictions	Syntax
expr1 *expr2*	Expressions that return values of a compatible data type	Cannot be a host variable or a BYTE or TEXT data type	Expression, p. 4-34

NVL evaluates *expression1*. If *expression1* is not NULL, then **NVL** returns the value of *expression1*. If *expression1* is NULL, **NVL** returns the value of *expression2*. The expressions *expression1* and *expression2* can be of any data type, as long as they can be cast to a common compatible data type.

Suppose that the **addr** column of the **employees** table has NULL values in some rows, and the user wants to be able to print the label `Address unknown` for these rows. The user enters the following SELECT statement to display the label `Address unknown` when the **addr** column has a NULL value:

```
SELECT fname, NVL (addr, 'Address unknown') AS address
   FROM employees
```

DECODE Function

The **DECODE** expression is similar to the CASE expression in that it can print different results depending on the values found in a specified column.

DECODE Function:

```
                         ┌─,──────────────────────────┐
                         ▼                            │  ┌─,──NULL──────┐
├──DECODE──(──expr──,────when_expr──,──┬─then_expr─┬──┴──┼──────────────┼──)──────┤
                                       └─NULL──────┘     └─,──else_expr─┘
```

Element	Description	Restrictions	Syntax
expr, else_expr, then_expr, when_expr	Expressions whose values and data types can be evaluated	Data types of *when_expr* and *expr* must be compatible, as must *then_expr* and *else_expr*. Value of *when_expr* cannot be a NULL.	Expression, p. 4-34

The expressions *expr*, *when_expr*, and *then_expr* are required. **DECODE** evaluates *expr* and compares it to *when_expr*. If the value of *when_expr* matches the value of *expr*, then **DECODE** returns *then_expr*.

The expressions *when_expr* and *then_expr* are an expression pair, and you can specify any number of expression pairs in the **DECODE** function. In all cases, **DECODE** compares the first member of the pair against *expr* and returns the second member of the pair if the first member matches *expr*.

If no expression matches *expr*, **DECODE** returns *else_expr*. If no expression matches *expr* and you specified no *else_expr*, then **DECODE** returns NULL.

You can specify any data type for the arguments, but two restrictions exist:

- All instances of *when_expr* must have the same data type, or a common compatible type must exist. All instances of *when_expr* must also have the same (or a compatible) data type as *expr*.
- All instances of *then_expr* must have the same data type, or a common compatible type must exist. All instances of *then_expr* must also have the same (or a compatible) data type as *else_expr*.

Suppose that a user wants to convert descriptive values in the **evaluation** column of the **students** table to numeric values in the output. The following table shows the contents of the **students** table.

firstname	evaluation	firstname	evaluation
Edward	Great	Mary	Good
Joe	Not done	Jim	Poor

The user now enters a query with the **DECODE** function to convert the descriptive values in the **evaluation** column to numeric equivalents:

```
SELECT firstname, DECODE(evaluation,
   'Poor', 0,
   'Fair', 25,
   'Good', 50,
   'Very Good', 75,
   'Great', 100,
   -1) as grade
FROM students
```

The following table shows the output of this SELECT statement.

firstname	evaluation	firstname	evaluation
Edward	100	Mary	50
Joe	-1	Jim	0

Constant Expressions

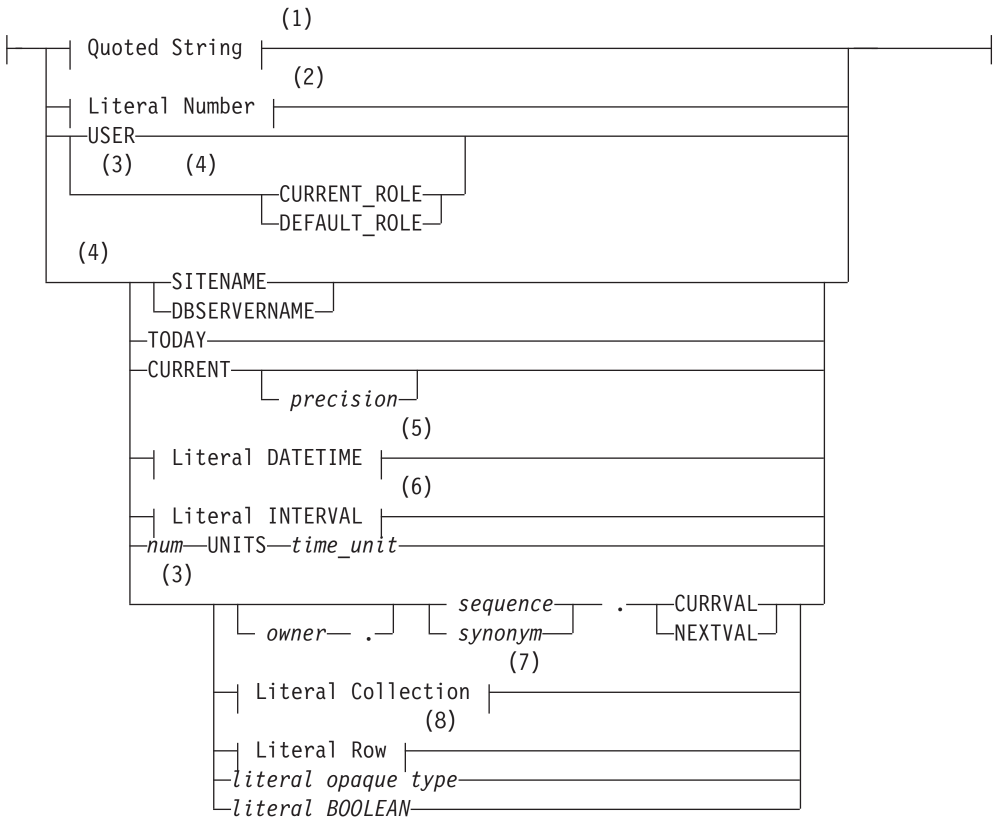
Certain expressions that return a fixed value are called *constant expressions*. Among these are the following operators (or *system constants*) whose returned values are determined at runtime:

- **CURRENT** returns the current time and date, from the system clock.
- **CURRENT_ROLE** returns the name of the role, if any, whose privileges are enabled for the current user.
- **DEFAULT_ROLE** returns the name of the role, if any, that is the default role for the current user.
- **DBSERVERNAME** returns the name of the current database server.
- **SITENAME** is a synonym for **DBSERVERNAME.**
- **TODAY** returns the current calendar date, from the system clock.
- **USER** returns the login name (also called the *authorization identifier*) of the current user.

Besides these operators, the term *constant expression* can also refer to a quoted string, to a literal value, or to the **UNITS** operator with its operands.

The Constant Expression segment has the following syntax.

Constant Expressions:



Notes:

1 See page 4-142

2 See page 4-137

3 Dynamic Server only

4 Informix extension

5 See page 4-132

6 See page 4-135

7 See page 4-129

8 See page 4-139

Element	Description	Restrictions	Syntax
literal Boolean	Literal representation of a BOOLEAN value	Must be either *t* (TRUE) or *f* (FALSE)	Quoted string, p. 4-142
literal opaque type	Literal representation of value of an opaque data type	Must be recognized by the input support function of opaque type	Defined by UDT developer
num	How many of specified time units. See "UNITS Operator" on page 4-60.	If *num* is not an integer, the fractional part is truncated	Literal Number, p. 4-137
owner	Name of the owner of sequence	Must own sequence	Owner, p. 5-43
precision	Precision of the returned DATETIME expression	None, but see Syntax reference in next column for valid syntax	DATETIME Qualifier, p. 4-32
sequence	Name of a sequence	Must exist in current database	Identifier, p. 5-22
synonym	Synonym for the name of a sequence	Must exist in current database	Identifier, p. 5-22
time_unit	Keyword to specify time unit: YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, *or* FRACTION	Must be one of the keywords at left. Case insensitive but cannot be enclosed within quotes	See the **Restrictions** column.

Quoted String

The following examples show quoted strings as expressions:

```
SELECT 'The first name is ', fname FROM customer

INSERT INTO manufact VALUES ('SPS', 'SuperSport')

UPDATE cust_calls SET res_dtime = '1997-1-1 10:45'
   WHERE customer_num = 120 AND call_code = 'B'
```

For more information, see "Quoted String" on page 4-142.

Literal Number

The following examples show literal numbers as expressions:

```
INSERT INTO items VALUES (4, 35, 52, 'HRO', 12, 4.00)

INSERT INTO acreage VALUES (4, 5.2e4)

SELECT unit_price + 5 FROM stock

SELECT -1 * balance FROM accounts
```

For more information, see "Literal Number" on page 4-137.

USER Operator

The **USER** operator returns a string containing the login name (also called the authorization identifier) of the current user who is running the process.

The following statements show how you might use the **USER** operator:

```
INSERT INTO cust_calls VALUES
   (221,CURRENT,USER,'B','Decimal point off', NULL, NULL)

SELECT * FROM cust_calls WHERE user_id = USER

UPDATE cust_calls SET user_id = USER WHERE customer_num = 220
```

The **USER** operator does not change the lettercase of a user ID. If you use **USER** in an expression and the current user is **Robertm**, the **USER** operator returns **Robertm**, not **robertm** or **ROBERTM**.

If you specify **USER** as a default column value, *column* must be of type CHAR, VARCHAR, NCHAR, NVARCHAR, or (in Dynamic Server) LVARCHAR.

If you specify **USER** as the default value for a column, the size of *column* should not be less than 32 bytes. You risk getting an error during operations such as INSERT or ALTER TABLE if the column length is too small to store the default value.

In an ANSI-compliant database, if you do not enclose the *owner* name in quotes, the name of the table owner is stored as uppercase letters. If you use the **USER** operator as part of a condition, you must be sure that the way the *user* name is stored matches what the **USER** operator returns with respect to lettercase.

CURRENT_ROLE Operator

The **CURRENT_ROLE** operator returns a string that contains the name of the currently enabled role of the user who is running the session. This *role* was either set in the session explicitly, using the SET ROLE statement, or else implicitly as a default role when the current user connected to the database. If the user holds no role, or if no role that was granted to the user is currently enabled, **CURRENT_ROLE** returns a NULL value. If the user has been granted no role individually, but a default role has been granted to PUBLIC, and this default role has been explicitly or implicitly enabled, **CURRENT_ROLE** returns the name of this default role.

The next statements show how you might use the **CURRENT_ROLE** operator:

```
select CURRENT_ROLE from systables where tabid = 1;)
```

The **CURRENT_ROLE** operator does not change the lettercase of the identifier of a role. If you use **CURRENT_ROLE** in an expression and your current role is **Czarina**, the **CURRENT_ROLE** operator returns **Czarina**, not **czarina**.

If you specify **CURRENT_ROLE** as the default value for a column, the column must have a CHAR, VARCHAR, LVARCHAR, NCHAR, or NVARCHAR data type. Because the name of a role is an authorization identifier, truncation might occur if the column length is less than 32 bytes.

DEFAULT_ROLE Operator

The **DEFAULT_ROLE** operator evaluates to a string that contains the name of the default role that has been granted to the user who is running the session. This default role need not be currently enabled, but it must not have been revoked since the most recent GRANT DEFAULT ROLE statement that referenced the user or PUBLIC in the TO clause.

If has no default role is explicitly defined for the current user, but PUBLIC has a default role, **DEFAULT_ROLE** returns the default role of PUBLIC.

If the user has no default role, or if the default role that was most recently granted to the user explicitly, or as PUBLIC, was subsequently revoked by the REVOKE DEFAULT ROLE statement, **DEFAULT_ROLE** returns a NULL value. If the user has been granted no default role individually, but a default role has been granted to PUBLIC, the **DEFAULT_ROLE** operator returns the name of this default role. If no default role is currently defined for the user nor for PUBLIC, however, **DEFAULT_ROLE** returns NULL.

The SET ROLE statement has no effect on the **DEFAULT_ROLE** operator, but any access privileges of the default role are not necessarily available to the user if SET ROLE has activated some other role, or if SET ROLE specified NULL or NONE as the current role of the user.

The next statements show how you might use the **DEFAULT_ROLE** operator:

```
select DEFAULT_ROLE from systables where tabid = 1;)
```

DEFAULT_ROLE does not change the lettercase of the identifier of a role.

If you specify **DEFAULT_ROLE** as the default value for a column, the column must have a CHAR, VARCHAR, LVARCHAR, NCHAR, or NVARCHAR data type. Because the name of a role is an authorization identifier, truncation might occur if the column width is less than 32 bytes. (See "Owner Name" on page 5-43 for the syntax of authorization identifiers.)

DBSERVERNAME and SITENAME Operators

The **DBSERVERNAME** operator returns the database server name, as defined in the ONCONFIG file for the installation where the current database resides, or as specified in the **INFORMIXSERVER** environment variable. The two operators, **DBSERVERNAME** and **SITENAME**, are synonymous. You can use the **DBSERVERNAME** operator to determine the location of a table, to put information into a table, or to extract information from a table. You can insert **DBSERVERNAME** into a simple character field or use it as a default value for a column.

If you specify **DBSERVERNAME** as a default column value, the column must have a CHAR, VARCHAR, LVARCHAR, NCHAR, or NVARCHAR data type.

If you specify **DBSERVERNAME** or **SITENAME** as the default value for a column, the size of the column should be at least 128 bytes long. You risk getting an error message during INSERT and ALTER TABLE operations if the length of the column is too small to store the default value.

In the following example, the first statement returns the name of the database server where the **customer** table resides. Because the query is not restricted with a WHERE clause, it returns **DBSERVERNAME** for every row in the table. If you add the DISTINCT keyword to the SELECT clause, the query returns **DBSERVERNAME** once. The second statement adds a row that contains the current site name to a table. The third statement returns all the rows that have the site name of the current system in **site_col**. The last statement changes the company name in the **customer** table to the current system name:

```
SELECT DBSERVERNAME FROM customer

INSERT INTO host_tab VALUES ('1', DBSERVERNAME)

SELECT * FROM host_tab WHERE site_col = DBSERVERNAME

UPDATE customer SET company = DBSERVERNAME
    WHERE customer_num = 120
```

TODAY Operator

Use the **TODAY** operator to return the system date as a DATE data type. If you specify **TODAY** as a default column value, the column must be a DATE column.

The following examples show how you might use the **TODAY** operator in an INSERT, UPDATE, or SELECT statement:

```
UPDATE orders (order_date) SET order_date = TODAY
    WHERE order_num = 1005

INSERT INTO orders VALUES
   (0, TODAY, 120, NULL, N, '1AUE217', NULL, NULL, NULL, NULL)

SELECT * FROM orders WHERE ship_date = TODAY
```

For Extended Parallel Server, the value returned by **TODAY** defaults to the date from the system clock-calendar, but you can specify instead the date from some other time zone. You can specify a time zone by using the SET ENVIRONMENT CLIENT_TZ statement of SQL (or by setting the **IBM_XPS_PARAMS** environment variable) to specify an offset from Greenwich Mean Time (GMT).

For code examples of setting non-default time zones, see “CURRENT Operator” on page 4-58. For information on how to set **IBM_XPS_PARAMS**, see the chapter on environment variables in the *IBM Informix Guide to SQL: Reference*.

CURRENT Operator

The **CURRENT** operator returns a DATETIME value with the date and time of day, showing the current instant.

If you do not specify a DATETIME qualifier, the default qualifier is YEAR TO FRACTION(3). The USEOSTIME configuration parameter specifies whether or not the database server uses subsecond precision when it obtains the current time from the operating system. For more information on the USEOSTIME configuration parameter, see your *IBM Informix Administrator's Reference*.

You can use **CURRENT** in any context where a literal DATETIME is valid. See “Literal DATETIME” on page 4-132). If you specify **CURRENT** as the default value for a column, it must be a DATETIME column and the qualifier of **CURRENT** must match the column qualifier, as the following example shows:

```
CREATE TABLE new_acct (col1 int, col2 DATETIME YEAR TO DAY
   DEFAULT CURRENT YEAR TO DAY)
```

If you use the **CURRENT** operator in more than once in a single statement, identical values might be returned by each instance of CURRENT. You cannot rely on **CURRENT** to return distinct values each time it executes.

The returned value is based on the system clock and is fixed when any SQL statement starts. For example, any call to **CURRENT** from inside the SPL function that an EXECUTE FUNCTION (or EXECUTE PROCEDURE) statement invokes returns the value of the system clock when the SPL function starts.

CURRENT is always evaluated in the database server where the current database is located. If the current database is in a remote database server, the returned value is from the remote host.

SQL is not a procedural language, and **CURRENT** might not execute in the lexical order of its position in a statement. You should not use **CURRENT** to mark the start, the end, nor a specific point in the execution of an SQL statement.

If your platform does not provide a system call that returns the current time with subsecond precision, **CURRENT** returns a zero for the FRACTION field.

In the following example, the first statement uses **CURRENT** in a WHERE condition. The second statement uses **CURRENT** as an argument to the **DAY** function. The last query selects rows whose **call_dtime** value is within a range from the beginning of 1997 to the current instant:

```
DELETE FROM cust_calls WHERE res_dtime < CURRENT YEAR TO MINUTE

SELECT * FROM orders WHERE DAY(ord_date) < DAY(CURRENT)

SELECT * FROM cust_calls WHERE call_dtime
   BETWEEN '1997-1-1 00:00:00' AND CURRENT
```

For more information, see “DATETIME Field Qualifier” on page 4-32.

Non-default Time Zones for CURRENT or TODAY (XPS)

For Extended Parallel Server, the time and date returned by **CURRENT** (like the date returned by **TODAY**) defaults to the value from the system clock-calendar, but you can specify instead that **CURRENT** return the time and date from some other time zone. You can specify a time zone by using the SET ENVIRONMENT CLIENT_TZ statement of SQL (or by setting the **IBM_XPS_PARAMS** environment variable) to specify an offset from Greenwich Mean Time (GMT).

Suppose that a table in an Extended Parallel Server instance has this schema:

```
create table testtab (intcol integer,
      dtcol            date,
      datecol          datetime year to second);
```

Assume also that the **IBM_XPS_PARAMS** setting for CLIENT_TZ has the value +1, that the server time zone is at GMT+4 hours, that the current server date is 2005-05-15, and the current server time is 1:10:39. If the system clocks for client and server are both based on the same value for GMT, this implies a client time zone of GMT+1 hour, or 3 hours earlier than the time zone of the server.

Now you enter the following SQL statements:

```
INSERT INTO testtab VALUES (1, TODAY, CURRENT);
SELECT * FROM testtab WHERE intcol = 1;
```

The query returns 1 (from column **intcol**) and the following **TODAY** and **CURRENT** values:

```
2005-05-15          01:10:39.000 05/15/2005
```

Now assume that the client issues the following statements:

```
SET ENVIRONMENT CLIENT_TZ "-06:30"
INSERT INTO testtab VALUES (3, TODAY, CURRENT);
SELECT * FROM testtab WHERE intcol = 2;
```

The query returns 2 (from column **intcol**) and the following **TODAY** and **CURRENT** values:

```
   2005-05-14     14:40:39 05/14/2005
```

This value is 10.5 hours earlier than the result from the first example.

Note that values that have been stored into a database table are not affected by the CLIENT_TZ specification, as the following example illustrates. The CLIENT_TZ setting is used only when evaluating the **CURRENT** and **TODAY** operators as specific DATETIME and DATE values.

```
SET ENVIRONMENT CLIENT_TZ ON
SELECT * FROM testtab WHERE intcol = 1;
```

The query returns 1 (from column **intcol**) and the following **TODAY** and **CURRENT** values:

```
2005-05-15     01:10:39 05/15/2005
```

It is also important to note that the INSERT statements above do not evaluate to the time on the client system. Instead, they are based on the time of the database server, as offset to the time zone of the client system. These two times might differ, if the server and client system clocks are not synchronized correctly.

Literal DATETIME

The following examples show literal DATETIME as an expression:

```
SELECT DATETIME (1997-12-6) YEAR TO DAY FROM customer

UPDATE cust_calls SET res_dtime = DATETIME (1998-07-07 10:40)
         YEAR TO MINUTE
   WHERE customer_num = 110
   AND call_dtime = DATETIME (1998-07-07 10:24) YEAR TO MINUTE

SELECT * FROM cust_calls
   WHERE call_dtime
   = DATETIME (1998-12-25 00:00:00) YEAR TO SECOND
```

For more information, see “Literal DATETIME” on page 4-132.

Literal INTERVAL

The following examples show literal INTERVAL as an expression:

```
INSERT INTO manufact VALUES ('CAT', 'Catwalk Sports',
   INTERVAL (16) DAY TO DAY)

SELECT lead_time + INTERVAL (5) DAY TO DAY FROM manufact
```

The second statement in the preceding example adds five days to each value of **lead_time** selected from the **manufact** table.

For more information, see “Literal INTERVAL” on page 4-135.

UNITS Operator

The UNITS operator specifies an INTERVAL value whose precision includes only one time unit. You can use UNITS in arithmetic expressions that increase or decrease one of the time units in an INTERVAL or DATETIME value.

If the *n* operand is not an integer, it is rounded down to the nearest whole number when the database server evaluates the expression.

In the following example, the first SELECT statement uses the UNITS operator to select all the manufacturer lead times, increased by five days. The second SELECT statement finds all the calls that were placed more than 30 days ago.

If the expression in the WHERE clause returns a value greater than 99 (maximum number of days), the query fails. The last statement increases the lead time for the ANZA manufacturer by two days:

```
SELECT lead_time + 5 UNITS DAY FROM manufact

SELECT * FROM cust_calls WHERE (TODAY - call_dtime) > 30 UNITS DAY

UPDATE manufact SET lead_time = 2 UNITS DAY + lead_time
   WHERE manu_code = 'ANZ'
```

NEXTVAL and CURRVAL Operators (IDS)

You can access the value of a sequence using the **NEXTVAL** or **CURRVAL** operators in SQL statements. You must qualify **NEXTVAL** or **CURRVAL** with the name (or synonym) of a sequence that resides on the same database in the format *sequence***.NEXTVAL** or *sequence***.CURRVAL**. An expression can also qualify *sequence* by the *owner* name, as in **zelaine.myseq.CURRVAL**. You can specify the SQL identifier of *sequence* or a valid synonym, if one exists.

In an ANSI-compliant database, you must qualify the name of the *sequence* with the name of its owner (*owner.sequence*) if you are not the owner.

To use **NEXTVAL** or **CURRVAL** with a sequence, you must have the Select privilege on the sequence or have the DBA privilege on the database. For information about sequence-level privileges, see the GRANT statement.

Using NEXTVAL: To access a sequence for the first time, you must refer to *sequence.***NEXTVAL** before you can refer to *sequence.***CURRVAL**. The first reference to **NEXTVAL** returns the initial value of the sequence. Each subsequent reference to **NEXTVAL** increments the value of the sequence by the defined *step* and returns a new incremented value of the sequence.

You can increment a given sequence only once within a single SQL statement. Even if you specify *sequence***.NEXTVAL** more than once within a single statement, the sequence is incremented only once, so that every occurrence of *sequence***.NEXTVAL** in the same SQL statement returns the same value.

Except for the case of multiple occurrences within the same statement, every *sequence***.NEXTVAL** expression increments the *sequence*, regardless of whether you subsequently commit or roll back the current transaction.

If you specify *sequence***.NEXTVAL** in a transaction that is ultimately rolled back, some sequence numbers might be skipped.

Using CURRVAL: Any reference to **CURRVAL** returns the current value of the specified sequence, which is the value that your last reference to **NEXTVAL** returned. After you generate a new value with **NEXTVAL**, you can continue to access that value using **CURRVAL**, regardless of whether another user increments the sequence.

If both *sequence***.CURRVAL** and *sequence***.NEXTVAL** occur in an SQL statement, the sequence is incremented only once. In this case, each *sequence***.CURRVAL** and *sequence***.NEXTVAL** expression returns the same value, regardless of the order of *sequence***.CURRVAL** and *sequence***.NEXTVAL** within the statement.

Concurrent Access to a Sequence: A sequence always generates unique values within a database without perceptible waiting or locking, even when multiple users refer to the same sequence concurrently. When multiple users use **NEXTVAL** to increment the sequence, each user generates a unique value that other users cannot see.

When multiple users concurrently increment the same sequence, gaps occur between the values that each user sees. For example, one user might generate a series of values, such as `1`, `4`, `6`, and `8`, from a sequence, while another user concurrently generates the values `2`, `3`, `5`, and `7` from the same sequence object.

Restrictions: **NEXTVAL** and **CURRVAL** are valid only in SQL statements, not directly in SPL statements. (But SQL statements that use **NEXTVAL** and **CURRVAL** can be used in SPL routines.) The following restrictions apply to these operators in SQL statements:

- You must have Select privilege on the *sequence*.
- In a CREATE TABLE or ALTER TABLE statement, you cannot specify **NEXTVAL** or **CURRVAL** in the following contexts:
  - In the Default clause
  - In the definition of a check constraint.
- In a SELECT statement, you cannot specify **NEXTVAL** or **CURRVAL** in the following contexts:
  - In the projection list when the DISTINCT keyword is used
  - In the WHERE, GROUP BY, or ORDER BY clauses
  - In a subquery
  - When the UNION operator combines SELECT statements.
- You also cannot specify **NEXTVAL** or CURRVAL in these contexts:
  - In fragmentation expressions
  - In reference to a remote sequence object in another database.

Examples: In the following examples, it is assumed that no other user is concurrently accessing the sequence and that the user executes the statements consecutively.

These examples are based on the following sequence object and table:

```
CREATE SEQUENCE seq_2
   INCREMENT BY 1 START WITH 1
   MAXVALUE 30 MINVALUE 0
   NOCYCLE CACHE 10 ORDER;

CREATE TABLE tab1 (col1 int, col2 int);
INSERT INTO tab1 VALUES (0, 0);
```

You can use **NEXTVAL** (or **CURRVAL**) in the Values clause of an INSERT statement, as the following example shows:

```
INSERT INTO tab1 (col1, col2)
   VALUES (seq_2.NEXTVAL, seq_2.NEXTVAL)
```

In the previous example, the database server inserts an incremented value (or the first value of the sequence, which is 1) into the **col1** and **col2** columns of the table.

You can use **NEXTVAL** (or **CURRVAL**) in the SET clause of the UPDATE statement, as the following example shows:

```
UPDATE tab1
   SET col2 = seq_2.NEXTVAL
   WHERE col1 = 1;
```

In the previous example, the incremented value of the **seq_2** sequence, which is 2, replaces the value in **col2** where **col1** is equal to 1.

The following example shows how you can use **NEXTVAL** and **CURRVAL** in the Projection clause of the SELECT statement:

```
SELECT seq_2.CURRVAL, seq_2.NEXTVAL FROM tab1;
```

In the previous example, the database server returns two rows of incremented values, 3 and 4, from both the **CURRVAL** and **NEXTVAL** expressions. For the first row of **tab1**, the database server returns the incremented value 3 for **CURRVAL** and **NEXTVAL**; for the second row of **tab1**, it returns the incremented value 4.

For more examples on how to use **NEXTVAL** and **CURRVAL**, see the *IBM Informix Guide to SQL: Tutorial*.

Literal Row (IDS)

The syntax for a literal representation of the value of a named or unnamed ROW data type is described in the section "Literal Row" on page 4-139. The following examples show literal rows as expressions:

```
INSERT INTO employee VALUES
   (ROW('103 Baker St', 'San Francisco',
      'CA', 94500))

UPDATE rectangles
   SET rect = ROW(8, 3, 7, 20)
   WHERE area = 140

EXEC SQL update table(:a_row)
   set x=0, y=0, length=10, width=20;

SELECT row_col FROM tab_b
   WHERE ROW(17, 'abc') IN (row_col)
```

For the syntax of expressions that evaluate to field values of a ROW data type, see "ROW Constructors" on page 4-64.

Literal Collection (IDS)

Dynamic Server supports expressions that are literal representations of the values of built-in or user-defined collection data types. The following examples show literal collections as expressions:

```
INSERT INTO tab_a (set_col) VALUES ("SET{6, 9, 3, 12, 4}")

INSERT INTO TABLE(a_set) VALUES (9765)

UPDATE table1 SET set_col = "LIST{3}"

SELECT set_col FROM table1
   WHERE SET{17} IN (set_col)
```

For more information, see "Literal Collection" on page 4-129. For the syntax of element values, see "Collection Constructors" on page 4-65.

Constructor Expressions (IDS)

A *constructor* is a function that the database server uses to create an instance of a specific data type. The database server supports ROW constructors and collection constructors.

Constructor Expressions:

```
               ┌─,──────────────────────┐
               │                  (1)   │
├───ROW──(─────▼─┤ Expression ├─────────┴──)──────────────────────────────────────────┤
    │                                 (2)     │
    └─┤ Collection Constructors ├─────────────┘
```

Notes:

1 See page 4-34

2 See page 4-65

ROW Constructors

You use ROW constructors to generate values for ROW-type columns. Suppose you create the following named ROW type and a table that contains the named ROW type **row_t** and an unnamed ROW type:

```
CREATE ROW TYPE row_t ( x INT, y INT);
CREATE TABLE new_tab
(
col1 row_t,
col2 ROW( a CHAR(2), b INT)
)
```

When you define a column as a named ROW type or unnamed ROW type, you must use a ROW constructor to generate values for the ROW-type column. To create a value for either a named ROW type or unnamed ROW type, you must complete the following steps:

- Begin the expression with the ROW keyword.
- Specify a value for each field of the ROW type.
- Enclose the comma-separated list of field values within parentheses.

The format of the value for each field must be compatible with the data type of the ROW field to which it is assigned.

You can use any kind of expression as a value with a ROW constructor, including literals, functions, and variables. The following examples show the use of different types of expressions with ROW constructors to specify values:

```
ROW(5, 6.77, 'HMO')

ROW(col1.lname, 45000)

ROW('john davis', TODAY)

ROW(USER, SITENAME)
```

The following statement uses literal numbers and quoted strings with ROW constructors to insert values into **col1** and **col2** of the **new_tab** table:

```
INSERT INTO new_tab
VALUES
(
ROW(32, 65)::row_t,
ROW('CA', 34)
)
```

When you use a ROW constructor to generate values for a named ROW type, you must explicitly cast the ROW value to the appropriate named ROW type. The cast is necessary to generate a value of the named ROW type. To cast the ROW value as a named ROW type, you can use the cast operator (**::**) or the CAST AS keywords, as the following examples show:

```
ROW(4,5)::row_t
CAST (ROW(3,4) AS row_t)
```

You can use a ROW constructor to generate ROW type values in INSERT, UPDATE, and SELECT statements. In the next example, the WHERE clause of a SELECT statement specifies a ROW type value that is cast as type **person_t**:

```
SELECT * FROM person_tab
   WHERE col1 = ROW('charlie','hunter')::person_t
```

For more information on using ROW constructors in INSERT and UPDATE statements, see the INSERT and UPDATE statements in this manual. For information on named ROW types, see the CREATE ROW TYPE statement. For information on unnamed ROW types, see the discussion of the ROW data type in the *IBM Informix Guide to SQL: Reference*. For task-oriented information on named ROW types and unnamed ROW types, see the *IBM Informix Database Design and Implementation Guide*.

Collection Constructors

Use a collection constructor to specify values for a collection column.

Collection Constructors:

```
├──┬─SET──────┬──{──┬───────────────────────┬──}──────────────────────────┤
   ├─MULTISET─┤     │  ┌─,───────────────┐  │
   └─LIST─────┘     │  ▼           (1)   │  │
                    └──┤ Expression ├────┴──┘
```

Notes:

1 See page 4-34

You can use collection constructors in the WHERE clause of the SELECT statement and the VALUES clause of the INSERT statement. You can also pass collection constructors to UDRs.

This table differentiates the types of collections that you can construct.

Keyword	Description
SET	Indicates a collection of elements with the following qualities: • The collection must contain unique values. • Elements have no specific order associated with them.
MULTISET	Indicates a collection of elements with the following qualities: • The collection can contain duplicate values. • Elements have no specific order associated with them.
LIST	Indicates a collection of elements with the following qualities: • The collection can contain duplicate values. • Elements have ordered positions.

The element type of the collection can be any built-in or extended data type. You can use any kind of expression with a collection constructor, including literals, functions, and variables.

When you use a collection constructor with a list of expressions, the database server evaluates each expression to its equivalent literal form and uses the literal values to construct the collection.

You specify an empty collection with a set of empty braces ({ }).

Elements of a collection cannot be NULL. If a collection element evaluates to a NULL value, the database server returns an error.

The element type of each expression must all be exactly the same data type. To accomplish this, cast the entire collection constructor expression to a collection type, or cast individual element expressions to the same type. If the database server cannot determine that the collection type and the element types are homogeneous, then the collection constructor returns an error. In the case of host variables, this determination is made at bind time when the client declares the element type of the host variable.

An exception to this restriction can occur when some elements of a collection are VARCHAR data types but others are longer than 255 bytes. Here the collection constructor can assign a CHAR(*n*) type to all elements, for *n* the length in bytes of the longest element. (But see "Collection Data Types" on page 4-30 for an example based on this exception, where the user avoids fixed-length CHAR elements by an explicit cast to the LVARCHAR data type.)

Examples of Collection Constructors: The following example shows that you can construct a collection with various expressions, if the resulting values are of the same data type:

```
CREATE FUNCTION f (a int) RETURNS int;
   RETURN a+1;
END FUNCTION;
CREATE TABLE tab1 (x SET(INT NOT NULL));
INSERT INTO tab1 VALUES
(
SET{10,
   1+2+3,
   f(10)-f(2),
   SQRT(100) +POW(2,3),
   (SELECT tabid FROM systables WHERE tabname = 'sysusers'),
   'T'::BOOLEAN::INT}
)
SELECT * FROM tab1 WHERE
x=SET{10,
   1+2+3,
   f(10)-f(2),
   SQRT(100) +POW(2,3),
   (SELECT tabid FROM systables WHERE tabname = 'sysusers'),
   'T'::BOOLEAN::INT}
}
```

This assumes that a cast from BOOLEAN to INT exists. (For a more restrictive syntax to specify collection values , see "Literal Collection" on page 4-129.)

NULL Keyword

The NULL keyword is valid in most contexts where you can specify a value. What it specifies, however, is the absence of any value (or an unknown or missing value).

NULL Keyword:

```
├──NULL──────────────────────────────────────────────────────────────┤
```

Within SQL, the keyword NULL is the only syntactic mechanism for accessing a NULL value. NULL is not equivalent to zero, nor to any specific value. In ascending ORDER BY operations, NULL values precede any non-NULL value; in descending sorts, NULL values follow any non-NULL value. In GROUP BY operations, all NULL values are grouped together. (Such groups may in fact be logically heterogeneous, if they include missing or unknown values.)

The keyword NULL is a global symbol in the syntactic context of expressions, meaning that its scope of reference is global.

Every data type, whether built-in or user-defined, can represent a NULL value. IBM Informix Dynamic Server supports cast expressions in the projection list. This means that users can write expressions of the form NULL**::***datatype*, in which *datatype* is any data type known to the database server.

IBM Informix Dynamic Server prohibits the redefinition of NULL, because allowing such definition would restrict the global scope of the NULL keyword. For this reason, any mechanism that restricts the global scope or redefines the scope of the keyword NULL will syntactically disable any cast expression involving a NULL value. You must ensure that the occurrence of the keyword NULL receives its global scope in all expression contexts.

For example, consider the following SQL code:

```
CREATE TABLE newtable
(
null int
);

SELECT null, null::int FROM newtable;
```

The CREATE TABLE statement is valid, because the column identifiers have a scope of reference that is restricted to the table definition; they can be accessed only within the scope of a table.

The SELECT statement in the example, however, poses some syntactic ambiguities. Does the identifier **null** appearing in the projection list refer to the global keyword NULL, or does it refer to the column identifier **null** that was declared in the CREATE TABLE statement?

- If the identifier **null** is interpreted as the column name, the global scope of cast expressions with the NULL keyword will be restricted.
- If the identifier **null** is interpreted as the NULL keyword, the SELECT statement must generate a syntactic error for the first occurrence of **null** because the NULL keyword can appear only as a cast expression in the projection list.

A SELECT statement of the following form is valid because the NULL column of **newtable** is qualified with the table name:

```
SELECT newtable.null, null::int FROM newtable;
```

More involved syntactic ambiguities arise in the context of an SPL routine that has a variable named **null**. An example follows:

```
CREATE FUNCTION nulltest() RETURNING INT;
DEFINE a INT;
DEFINE null INT;
DEFINE b INT;
LET a = 5;
LET null = 7;
LET b = null;
```

```
RETURN b;
END FUNCTION;

EXECUTE FUNCTION nulltest();
```

When the preceding function executes in DB-Access, in the expressions of the LET statement, the identifier **null** is treated as the keyword NULL. The function returns a NULL value instead of 7.

Using **null** as a variable of an SPL routine would restrict the use of a NULL value in the body of the SPL routine. Therefore, the preceding SPL code is not valid, and causes IBM Informix Dynamic Server to return the following error:

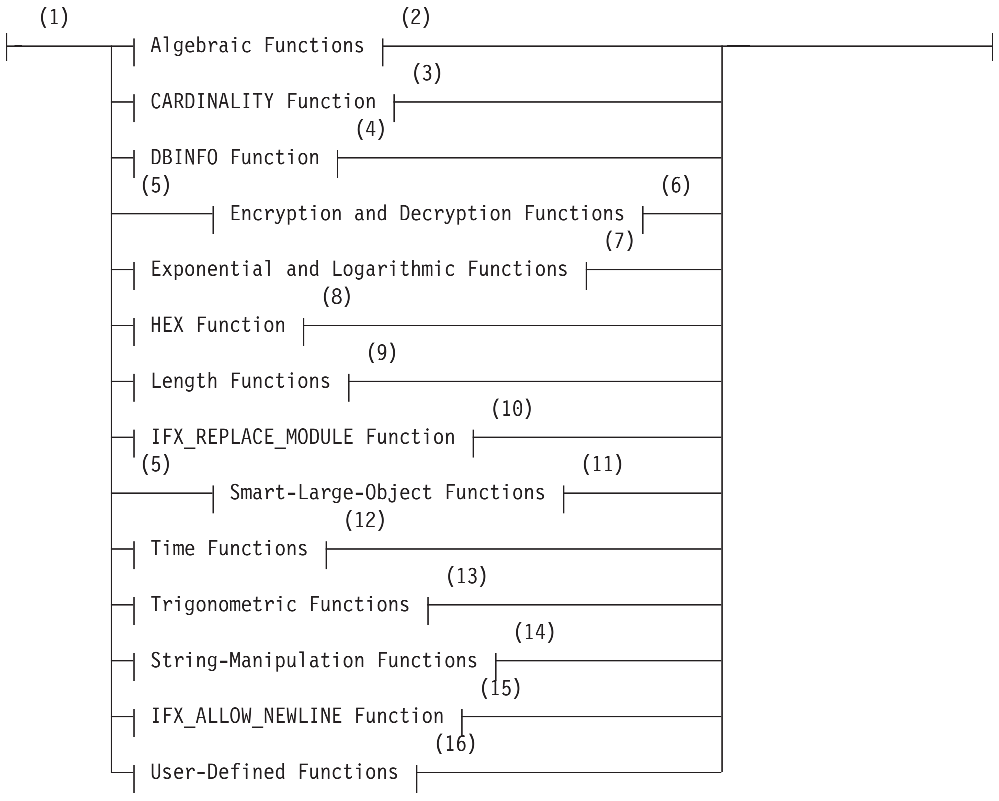
```
-947   Declaration of an SPL variable named 'null' conflicts
with SQL NULL value.
```

In ESQL/C, you should use an indicator variable if there is the possibility that a SELECT statement will return a NULL value.

Function Expressions

A function expression can return one or more values from built-in SQL functions or from user-defined functions, as the following diagram shows.

Function Expressions:


(1)
Algebraic Functions (2)
CARDINALITY Function (3)
DBINFO Function (4)
(5) Encryption and Decryption Functions (6)
Exponential and Logarithmic Functions (7)
HEX Function (8)
Length Functions (9)
IFX_REPLACE_MODULE Function (10)
(5) Smart-Large-Object Functions (11)
Time Functions (12)
Trigonometric Functions (13)
String-Manipulation Functions (14)
IFX_ALLOW_NEWLINE Function (15)
User-Defined Functions (16)

Notes:

1 Informix extension

2 See page 4-53

3 See page 4-63

4 See page 4-68

5 Dynamic Server only

6 See page 4-79

7 See page 4-87

8 See page 4-116

9 See page 4-89

10 See page 4-90

11 See page 4-91

12 See page 4-96

13 See page 4-100

14 See page 4-102

15 See page 4-111

16 See page 4-111

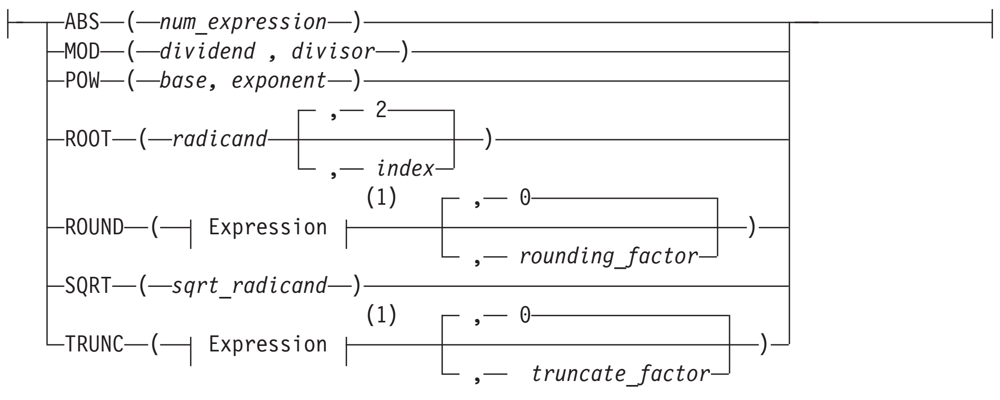
The following examples show function expressions:

```
EXTEND (call_dtime, YEAR TO SECOND)
MDY (12, 7, 1900 + cur_yr)
DATE (365/2)
LENGTH ('abc') + LENGTH (pvar)
HEX (customer_num)
HEX (LENGTH(123))
TAN (radians)
ABS (-32)
EXP (3)
MOD (10,3)
```

Algebraic Functions

Algebraic functions take one or more arguments of numeric data types.

Algebraic Functions:


ABS (num_expression)
MOD (dividend , divisor)
POW (base, exponent)
ROOT (radicand , 2 , index)
ROUND (Expression (1) , 0 , rounding_factor)
SQRT (sqrt_radicand)
TRUNC (Expression (1) , 0 , truncate_factor)

Notes:

1 See page 4-34

Element	Description	Restrictions	Syntax
base	Value to be raised to the power specified in *exponent*	Must return a real number	Expression, p. 4-34
dividend	Value to be divided by *divisor*	Must return a real number	Expression, p. 4-34
divisor	Value by which to divide *dividend*	Cannot return zero	Expression, p. 4-34
exponent	Power to which to raise *base*	Must return a real number	Expression, p. 4-34
index	Root to extract. The default is 2.	Must return a real number	Expression, p. 4-34
num_expression	Number with an absolute value	Must return a real number	Expression, p. 4-34
radicand	Value whose root is to be returned	Must return a real number	Expression, p. 4-34
rounding_factor	Position to left (-) or right (+) of decimal point to which argument is rounded. Default scale is zero.	Integer in range +32 to -32; see "ROUND Function" on page 4-71.	Literal Number, p. 4-137
sqrt_radicand	Number with real square roots	Must be a positive real number	Expression, p. 4-34
truncate_factor	Position to left (-) or right (+) of decimal point to which argument is truncated. Default scale is zero.	Integer in range +32 to -32; see "TRUNC Function" on page 4-71.	Literal Number, p. 4-137

ABS Function: The **ABS** function returns the absolute value of a numeric expression, returning the same data type as its single argument. The following example shows all orders of more than $20 paid in cash (+) or store credit (-). The stores_demo database does not contain any negative balances, but you might have negative balances in your application.

```
SELECT order_num, customer_num, ship_charge
  FROM orders WHERE ABS(ship_charge) > 20
```

MOD Function: The **MOD** function returns the remainder from integer division of two real number operands, after the integer part of the first argument (the *dividend*) is divided by the integer part of the second argument (the *divisor*) as an INT data type (or INT8 for remainders outside the range of INT). The quotient and any fractional part of the remainder are discarded. The *divisor* cannot be 0. Thus, `MOD (x,y)` returns `y (modulo x)`. Make sure that any variable that receives the result is of a data type that can store the returned value.

This example tests to see if the current date is within a 30-day billing cycle:

```
SELECT MOD(TODAY - MDY(1,1,YEAR(TODAY)),30) FROM orders
```

POW Function: The **POW** function raises the *base* to the *exponent.* This function requires two numeric arguments. The returned data type is FLOAT. The following example returns data for circles whose areas are less than 1,000 square units:

```
SELECT * FROM circles WHERE (3.1416 * POW(radius,2)) < 1000
```

To use *e*, the base of natural logarithms, see "EXP Function" on page 4-87.

ROOT Function: The **ROOT** function returns the root value of a numeric expression. This function requires at least one numeric argument (the *radicand* argument) and allows no more than two (the *radicand* and *index* arguments). If only the *radicand* argument is supplied, the value `2` is used as a default value for the *index* argument. The value `0` cannot be used as the value of *index.* The value that the **ROOT** function returns is a FLOAT data type.

The first SELECT statement in the following example takes the square root of the expression. The second takes the cube root of the expression.

```
SELECT ROOT(9) FROM angles         -- square root of 9
SELECT ROOT(64,3) FROM angles      -- cube root of 64
```

The **SQRT** function is equivalent to ROOT(x).

ROUND Function: The **ROUND** function returns the rounded value of an expression. The expression must be numeric or must be converted to numeric. If you omit the *rounding factor* specification, the value is rounded to a scale of zero, or to the units place. The range of 32 (+ and -) refers to the precision of the returned value, relative to the first argument.

Positive-digit values indicate rounding to the right of the decimal point; negative-digit values indicate rounding to the left of the decimal point, as Figure 4-1 shows.

Expression:

ROUND (24,536.8746, -2) = 24,500.00

ROUND (24,536.8746, 0) = 24,537.00

ROUND (24,536.8746, 2) = 24,536.87

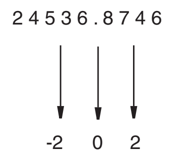


Figure 4-1. ROUND Function

The following example shows how you can use the **ROUND** function with a column expression in a SELECT statement. This statement displays the order number and rounded total price (to zero places) of items whose rounded total price (to zero places) is equal to 124.00.

```
SELECT order_num , ROUND(total_price) FROM items
   WHERE ROUND(total_price) = 124.00
```

If you use a MONEY data type as the argument for the **ROUND** function and you round to zero places, the value displays with .00. The SELECT statement in the following example rounds an INTEGER value and a MONEY value. It displays 125 and a rounded price in the form `xxx.00` for each row in **items**.

```
SELECT ROUND(125.46), ROUND(total_price) FROM items
```

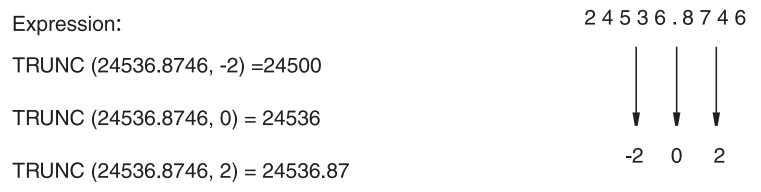
SQRT Function: The **SQRT** function returns the square root of a numeric expression. The next example returns the square root of 9 for each row of the angles table:

```
SELECT SQRT(9) FROM angles
```

TRUNC Function: The **TRUNC** function returns the truncated value of a numeric expression.

The expression must be numeric or a form that can be converted to a numeric expression. If you omit the *truncate factor* specification, the argument is truncated to a scale of zero, or to the unit place. The range of 32 (+ and -) refers to the precision of the returned value, relative to the first argument.

Positive digit values indicate truncating to the right of the decimal point; negative digit values indicate truncating to the left, as Figure 4-2 shows.


Expression:

TRUNC (24536.8746, -2) =24500

TRUNC (24536.8746, 0) = 24536

TRUNC (24536.8746, 2) = 24536.87

Figure 4-2. TRUNC Function

If a MONEY data type is the argument for the **TRUNC** function that specifies zero places, the fractional places are removed. For example, the following SELECT statement truncates a MONEY value and an INTEGER value. It displays 125 and a truncated price in integer format for each row in **items**.

```
SELECT TRUNC(125.46), TRUNC(total_price) FROM items
```

CARDINALITY Function (IDS)

The **CARDINALITY** function returns the number of elements in a collection column (SET, MULTISET, LIST).

CARDINALITY Function:

```
├──CARDINALITY──(──┬─collection_col─┬──)──────────────────────────────────────┤
                   └─collection_var─┘
```

Element	Description	Restrictions	Syntax
collection_col	An existing collection column	Must be declared as a collection data type	Identifier, p. 5-22
collection_var	Host or program collection variable	Must be declared as a collection data type	Language specific

Suppose that the **set_col** SET column contains the following value:

```
{3, 7, 9, 16, 0}
```

The following SELECT statement returns 5 as the number of elements in the **set_col** column:

```
SELECT CARDINALITY(set_col)
   FROM table1
```

If the collection contains duplicate elements, **CARDINALITY** counts each individual element.

DBINFO Function

The following diagram shows the syntax of the **DBINFO** function.

DBINFO Function:

```
├──DBINFO──────────────────────────────────────────────────────────────────►
```

```
►─(──┬─'dbspace' ─,──┬─tblspace_num─┬────────────────────────────────┬─)──────────┤
     │               └─expression───┘                                │
     ├─┬─'sqlca.sqlerrd1' ─┬─────────────────────────────────────────┤
     │ └─'sqlca.sqlerrd2' ─┘                                         │
     │ (1)                                                           │
     └──────────┬─'sessionid' ─────────────────────────────────────┤
                ├─'dbhostname' ────────────────────────────────────┤
                ├─┬─'version' ─,─'specifier' ─┬────────────────────┤
                │ └─'serial8' ────────────────┘                    │
                │ (2)                                              │
                └─────────┬─'coserverid' ──────────────────────────┤
                          ├─'coserverid' ─,─table.column─,─'currentrow' ─┤
                          └─'dbspace' ─,─table.column─,─'currentrow' ────┘
```

Notes:

1 Informix extension

2 Extended Parallel Server only

Element	Description	Restrictions	Syntax
column	Name of a column in the *table*	Must exist in *table*	Database Object Name, p. 5-17
expression	Expression that evaluates to *tblspace_num*	Can contain column names, SPL variables, host variables, or subqueries, but must return a numeric value	Expression, p. 4-34
specifier	Literal value that specifies which part of version string to return	For valid *specifier* values, see	Expression, p. 4-34
table	Table for which to display the dbspace name or coserver ID corresponding to each row	Must match the name of a table in the FROM clause of the query	Database- Object Name, p. 5-17
tblspace_ num	Tblspace number (partition number) of a table	Must exist in the **partnum** column of the **systables** table for the database	Literal Number, p. 4-137

DBINFO Options: The **DBINFO** function is actually a set of functions that return different types of information about the database. To invoke each function, specify a particular option after the **DBINFO** keyword. You can use any **DBINFO** option anywhere within SQL statements and within UDRs.

The following table shows the different types of database information that you can retrieve with the **DBINFO** options. The **Option** column shows the name of each **DBINFO** option. The **Effect** column shows the type of database information that the option retrieves.

The **Page** column shows the page where you can find more information about a given option.

Option	Effect	Page
’dbspace’ *tblspace_num*	Returns the name of a dbspace corresponding to a tblspace number	4-74
’sqlca.sqlerrd1’	Returns the last serial value inserted in a table	4-74
’sqlca.sqlerrd2’	Returns the number of rows processed by selects, inserts, deletes, updates, EXECUTE PROCEDURE statements, and EXECUTE FUNCTION statements	4-75
’sessionid’	Returns the session ID of the current session	4-75
’dbhostname’	Returns the hostname of the database server to which a client application is connected	4-76
’version’	Returns the exact version of the database server to which a client application is connected	4-76
’serial8’	Returns last SERIAL8 value inserted in a table	4-77
’coserverid’ (XPS)	Returns the coserver ID of the coserver to which the user who entered the query is connected	4-78
’coserverid’ *table.column* ’currentrow’ (XPS)	Returns the coserver ID of the coserver where each row of a specified table is located	4-78
’dbspace’ *table.column* ’currentrow’ (XPS)	Returns the name of the dbspace where each row of a specified table is located	4-79

Using the ’dbspace’ Option Followed by a Tblspace Number: The **’dbspace’** option returns a character string that contains the name of the dbspace that corresponds to a tblspace number. You must supply an additional parameter, either *tblspace_num* or an expression that evaluates to *tblspace_num*. The following example uses the **’dbspace’** option. First, it queries the systables system catalog table to determine the *tblspace_num* for the table customer, then it executes the function to determine the dbspace name.

```
SELECT tabname, partnum FROM systables
   where tabname = 'customer'
```

If the statement returns a partition number of 1048892, you insert that value into the second argument to find which dbspace contains the **customer** table, as the following example shows:

```
SELECT DBINFO ('dbspace', 1048892) FROM systables
   where tabname = 'customer'
```

If the table for which you want to know the dbspace name is fragmented, you must query the **sysfragments** system catalog table to find out the tblspace number of each table fragment. Then you must supply each tblspace number in a separate **DBINFO** query to find out all the dbspaces across which a table is fragmented.

Using the ’sqlca.sqlerrd1’ Option: The **’sqlca.sqlerrd1’** option returns a single integer that provides the last serial value that is inserted into a table. To ensure valid results, use this option immediately following a singleton INSERT statement that inserts a single row with a serial value into a table.

Tip: To obtain the value of the last SERIAL8 value that is inserted into a table, use the **’serial8’** option of **DBINFO**. For more information, see “Using the ’serial8’ Option” on page 4-77.

The following example uses the **’sqlca.sqlerrd1’** option:

```
EXEC SQL create table fst_tab (ordernum serial, partnum int);
EXEC SQL create table sec_tab (ordernum serial);
EXEC SQL insert into fst_tab VALUES (0,1);
EXEC SQL insert into fst_tab VALUES (0,4);
EXEC SQL insert into fst_tab VALUES (0,6);
EXEC SQL insert into sec_tab values (dbinfo('sqlca.sqlerrd1'));
```

This example inserts a row that contains a primary-key serial value into the **fst_tab** table, and then uses the **DBINFO** function to insert the same serial value into the **sec_tab** table. The value that the **DBINFO** function returns is the serial value of the last row that is inserted into **fst_tab**.

Using the 'sqlca.sqlerrd2' Option: The **'sqlca.sqlerrd2'** option returns a single integer that provides the number of rows that SELECT, INSERT, DELETE, UPDATE, EXECUTE PROCEDURE, and EXECUTE FUNCTION statements processed. To ensure valid results, use this option after SELECT, EXECUTE PROCEDURE, and EXECUTE FUNCTION statements have completed executing. In addition, to ensure valid results when you use this option within cursors, make sure that all rows are fetched before the cursors are closed.

The following example shows an SPL routine that uses the **'sqlca.sqlerrd2'** option to determine the number of rows that are deleted from a table:

```
CREATE FUNCTION del_rows (pnumb int)
RETURNING int;

DEFINE nrows int;

DELETE FROM fst_tab WHERE part_number = pnumb;
LET nrows = DBINFO('sqlca.sqlerrd2');
RETURN nrows;

END FUNCTION
```

Using the 'sessionid' Option: The **'sessionid'** option of the **DBINFO** function returns the session ID of your current session. When a client application makes a connection to the database server, the database server starts a session with the client and assigns a session ID for the client. The session ID serves as a unique identifier for a given connection between a client and a database server.

The database server stores the value of the session ID in a data structure in shared memory that is called the *session control block*. The session control block for a given session also includes the user ID, the process ID of the client, the name of the host computer, and a variety of status flags.

When you specify the **'sessionid'** option, the database server retrieves the session ID of your current session from the session control block and returns this value to you as an integer. Some of the System-Monitoring Interface (SMI) tables in the **sysmaster** database include a column for session IDs, so you can use the session ID that the **DBINFO** function obtained to extract information about your own session from these SMI tables. For further information on the session control block, see the *IBM Informix Administrator's Guide*. For further information on the **sysmaster** database and the SMI tables, see the *IBM Informix Administrator's Reference*.

In the following example, the user specifies the **DBINFO** function in a SELECT statement to obtain the value of the current session ID. The user poses this query against the **systables** system catalog table and uses a WHERE clause to limit the query result to a single row.

```
SELECT DBINFO('sessionid') AS my_sessionid
   FROM systables
   WHERE tabname = 'systables'
```

In the preceding example, the SELECT statement queries against the **systables** system catalog table. You can, however, obtain the session ID of the current session by querying against any system catalog table or user table in the database. For example, you can enter the following query to obtain the session ID of your current session:

```
SELECT DBINFO('sessionid') AS user_sessionid
   FROM customer
   WHERE customer_num = 101
```

You can use the **DBINFO ′sessionid′** option not only in SQL statements but also in SPL routines. The following example shows an SPL function that returns the value of the current session ID to the calling program or routine:

```
CREATE FUNCTION get_sess()
   RETURNING INT;
   RETURN DBINFO('sessionid');
END FUNCTION;
```

Using the ‘dbhostname’ Option: You can use the **′dbhostname′** option to retrieve the hostname of the database server to which a database client is connected. This option retrieves the physical computer name of the computer on which the database server is running.

In the following example, the user enters the **′dbhostname′** option of **DBINFO** in a SELECT statement to retrieve the hostname of the database server to which DB–Access is connected:

```
SELECT DBINFO('dbhostname')
   FROM systables
   WHERE tabid = 1
```

The following table shows the result of this query.

(constant)
rd_lab1

Using the ‘version’ Option: You can use the **′version′** option of the **DBINFO** function to retrieve the exact version number of the database server against which the client application is running. This option retrieves the exact version string from the message log. The value of the full version string is the same as that displayed by the **-V** option of the **oninit** utility.

Use the *specifier* parameter of the **′version′** option to specify which part of the version string you want to retrieve. The following table lists the values that you can enter in the *specifier* parameter, shows which part of the version string is returned for each *specifier* value, and gives an example of what is returned by each value of *specifier*.

Each example returns part of the complete version string Dynamic Server `Version 10.00.UC1`.

Specifier Parameter	Part of Version String Returned		Example of Return Value
'server-type'	Type of database server		`Dynamic Server`
'major'	Major version number of the current database server version		10
'minor'	Minor version number of the current database server version		0
'os'	Operating-system identifier within the version string:		`U`
	`T =`	Windows	
	`U =`	UNIX 32-bit running on a 32-bit operating system	
	`H =`	UNIX 32-bit running on a 64-bit operating system	
	`F =`	UNIX 64-bit running on a 64-bit operating system	
'level'	Interim release level of the current database server version		`C1`
'full'	Complete version string as it would be returned by **oninit -V**		`Dynamic Server, Version 10.00.UC1`

Important: Not all UNIX environments fit the word-length descriptions of operating- system (os) codes in the preceding table. For example, some `U` versions can run on 64-bit operating systems. Similarly, some `F` versions can run on operating systems with 32-bit kernels that support 64-bit applications.

The following example shows how to use the **'version'** option of **DBINFO** in a SELECT statement to retrieve the major version number of the database server that the DB–Access client is connected to:

```
SELECT DBINFO('version', 'major')
   FROM systables
   WHERE tabid = 1
```

The following table shows the result of this query.

(constant)
7

Using the 'serial8' Option: The **'serial8'** option returns a single integer that provides the last SERIAL8 value that is inserted into a table. To ensure valid results, use this option immediately following an INSERT statement that inserts a SERIAL8 value.

Tip: To obtain the value of the last SERIAL value that is inserted into a table, use the **'sqlca.sqlerrd1'** option of **DBINFO( )**. For more information, see "Using the 'sqlca.sqlerrd1' Option" on page 4-74.

The following example uses the **'serial8'** option:

```
EXEC SQL create table fst_tab
   (ordernum serial8, partnum int);
EXEC SQL create table sec_tab (ordernum serial8);
EXEC SQL insert into fst_tab VALUES (0,1);
EXEC SQL insert into fst_tab VALUES (0,4);
EXEC SQL insert into fst_tab VALUES (0,6);

EXEC SQL insert into sec_tab
   select dbinfo('serial8')
   from fst_tab where partnum = 6;
```

This example inserts a row that contains a primary-key SERIAL8 value into the **fst_tab** table and then uses the **DBINFO** function to insert the same SERIAL8 value into the **sec_tab** table. The value that the **DBINFO** function returns is the SERIAL8 value of the last row that is inserted into **fst_tab**. The subquery in the last line contains a WHERE clause so that a single value is returned.

Using the ’coserverid’ Option with No Other Arguments (XPS): The **’coserverid’** option with no other arguments returns a single integer that corresponds to the coserver ID of the coserver to which the user who entered the query is connected.

Suppose that you use the following statement to create the **mytab** table:

```
CREATE TABLE mytab (mycol INT)
   FRAGMENT BY EXPRESSION
      mycol < 5 in rootdbs.1
      mycol > 5 in rootdbs.2
```

Further, suppose that the dbspace named **rootdbs.1** resides on coserver 1, and the dbspace named **rootdbs.2** resides on coserver 2. Also suppose that you use the following statements to insert rows into the **mytab** table:

```
INSERT INTO mytab VALUES ('1');
INSERT INTO mytab VALUES ('6');
```

Finally, suppose that you are logged on to coserver 1 when you make the following query, which displays the values of all columns in the row where the value of the **mycol** column is 1. This query also displays the coserver ID of the coserver to which you are logged on when you enter the query:

```
SELECT *, DBINFO ('coserverid') AS cid
   FROM mytab
   WHERE mycol = 1
```

The following table shows the result of this query.

mycol	cid
1	1

Using the ’coserverid’ Option Followed by Table and Column Names (XPS): Use the **’coserverid’** option followed by the table name and column name and the **’currentrow’** string to find out the coserver ID where each row in a specified table is located. This option is especially useful when you fragment a table across multiple coservers.

In the following example, the user asks to see all columns and rows of the **mytab** table as well as the coserver ID of the coserver where each row resides. For a description of the **mytab** table, see “Using the ’coserverid’ Option with No Other Arguments (XPS)” on page 4-78:

```
SELECT *, DBINFO ('coserverid', mytab.mycol, 'currentrow')
   AS dbsp
   FROM mytab
```

The following table shows the result of this query.

mycol	**cid**
1	1
6	2

The column that you specify in the **DBINFO** function can be any column in the specified table.

Using the ’dbspace’ Option Followed by Table and Column Names (XPS): Use the **’dbspace ’** option followed by the table name and column name and the **’currentrow’** string to find out the name of the dbspace where each row in a specified table is located. This option is especially useful when you fragment a table across multiple dbspaces.

In the following example, the user asks to see all columns and rows of the **mytab** table as well as the name of the dbspace where each row resides. For a description of the **mytab** table, see “Using the ’coserverid’ Option with No Other Arguments (XPS)” on page 4-78.

```
SELECT *, DBINFO ('dbspace', mytab.mycol, 'currentrow')
   AS dbsp
   FROM mytab
```

The following table shows the result of this query.

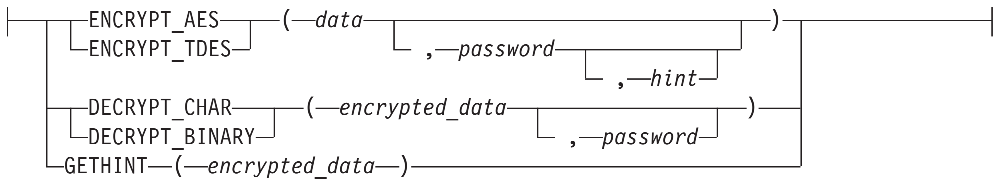
mycol	**cid**
1	rootdbs.1
6	rootdbs.2

The column arguments to **DBINFO** can be any columns in the specified table.

Encryption and Decryption Functions

Dynamic Server supports built-in encryption and decryption functions. The encryption functions **ENCRYPT_AES** and **ENCRYPT_TDES** each returns an *encrypted_data* value that encrypts the *data* argument. Conversely, decryption functions **DECRYPT_CHAR** and **DECRYPT_BINARY** return a plain-text *data* value from the *encrypted_data* argument. Use this syntax to call these functions:

Encryption and Decryption Functions:



Element	Description	Restrictions	Syntax
data	A plain text character string, variable, or large object of type BLOB or CLOB to be encrypted	Must be a character or BLOB data type	Expression, p. 4-34
encrypted _data	A character string or variable containing output from **ENCRYPT_AES** or from **ENCRYPT_TDES**	Decryption requires the encryption password	Expression, p. 4-34
hint	A character string that you define here. Default is the value from the WITH HINT clause of the SET ENCRYPTION statement that defined password.	No more than 32 bytes	Quoted string, p. 4-142
password	A character string that the encryption function defines. Default is the session password value defined by the SET ENCRYPTION statement	At least 6 bytes, but no more than 128 bytes	Quoted string, p. 4-142

You can invoke these encryption and decryption functions from within DML statements or with the EXECUTE FUNCTION statement.

For distributed operations over a network, all participating database servers must support these (or equivalent) functions. If the network is not secure, the DBSA must enable the *encryption communication support module* (ENCCSM) to provide data encryption between the database server and client systems, in order to avoid transmitting passwords as plain text.

Encryption or decryption calls slow the performance of the SQL statement within which these functions are invoked, but have no effect on other statements.

Column Level and Cell Level Encryption: The encryption and decryption functions can support two ways of using data encryption features, namely *column level* and *cell level* encryption.

- Column level encryption means that all values in a given column are encrypted with the same password (which can be a word or phrase), the same cipher, and the same cipher mode.

  Users of this form of encryption should consider not using the *hint* feature of these functions, but instead store a mnemonic hint for remembering the password in some other location. Otherwise, the same *hint* will occupy disk space in every row that contains an encrypted value.
- Cell level encryption means that within a column of encrypted data many different passwords (or different ciphers or cipher modes) are used.

  This use of encryption is also called *row-column level* or *set-column level* encryption. Compared to column-level encryption, this makes the task of data management more complex, because if different passwords are required for decrypting different rows of the same table, it is not possible to write a single SELECT statement to fetch all the decrypted data. In some situations, however, individual users may need this technique to protect personal data.

To protect data security and confidentiality, the database server does not store information in the system catalog to indicate whether any table (or any column or row) includes encrypted data. Similarly, the logical logs of Dynamic Server do not record SET ENCRYPTION statements, nor calls to encryption or decryption functions. (The Trusted Facility feature for secure auditing, however, can use the 'STEP' audit-event mnemonic to record execution of the SET ENCRYPTION statement, and can use the 'CRPT' audit-event mnemonic to record successful or unsuccessful calls to **DECRYPT_CHAR** or **DECRYPT_BINARY**.)

The Password and Hint Specifications: The SET ENCRYPTION statement or an encryption function can define a password and hint for the current session. The *password* must be specified as a character expression that returns at least 6 bytes, but no more than 128. The optional *hint* is specified as a character expression that returns no more than 32 bytes.

The purpose of the *hint* is to help users to remember the *password*. When you call **ENCRYPT_AES** or **ENCRYPT_TDES** with a *hint* argument, it is encrypted and embedded in the *encrypted_data*, from which **GETHINT** can retrieve it. But if you define *hint* as NULL, or omit *hint* when SET ENCRYPTION specified no default *hint* for the *session password*, no *hint* is embedded in the *encrypted_data*.

The *password* used for encryption and decryption is either the *password* argument to the function, or if you omit this argument, it is the *session password* specified in the last SET ENCRYPTION statement executed before you invoke the function.

The **DECRYPT_CHAR**, **DECRYPT_BINARY**, or **GETHINT** function call fails with an error if the *encrypted_data* argument is not in an encrypted format, or if the *password* argument to a decryption function is omitted when no *session password* value was set by SET ENCRYPTION. An error also results if the *password* used for decryption is not the same *password* used for encryption.

Encryption key management, which is critical to the secure operation of the database, is delegated entirely to the application. This implementation means that the *password* itself is not stored in the database. Without help from the user through the application, the database server cannot decrypt the encrypted data.

If you invoke any of these functions from a UDR, you might prefer to set a *session password* in the SET ENCRYPTION statement. Otherwise, *password* will be visible to users who can view the **sysprocbody.data** column in the system catalog.

Data Types, Encoding, and Size of Encrypted Values: The *data* and corresponding *encrypted_data* values can be of any character type (CHAR, LVARCHAR, NCHAR, NVARCHAR, or VARCHAR), or a smart large object of type BLOB or CLOB. Corresponding *data* and *encrypted_data* values that the encryption functions return have the same character, BLOB, or CLOB type. (Use CLOB in place of TEXT, which these functions do not support.)

Except for original *data* of BLOB or CLOB data types, the *encrypted_data* value is encoded in BASE64 format. An encrypted value requires more space than the corresponding plain text, because the database must also store the information (except for the encryption key) that is needed for decryption. If a *hint* is used, it adds to the length of *encrypted_data*.

The BASE64 encoding scheme stores 6 bits of input data as 8 bits of output. To encode N bytes of data, BASE64 requires at least ((4N+3/3) bytes of storage, where (/) represents integer division. Padding and headers can increase BASE64 storage requirements above this ((4N+3)/3) ratio. "Example of Column Level Encryption" on page 4-82 lists formulae to estimate the size of data values encrypted in BASE64 format. It typically requires changes to the schema of an existing table that will store BASE64 format encrypted data, especially if a hint will also be stored.

The following table shows how the data type of the input string corresponds to the data type of the value that **ENCRYPT_AES** or **ENCRYPT_TDES** returns:

Table 4-1. Data Types for ENCRYPT_AES and ENCRYPT_TDES Functions

Plain Text Data Type	Encrypted Data Type	Decryption Function
CHAR	CHAR	**DECRYPT_CHAR**
NCHAR	NCHAR	**DECRYPT_CHAR**
VARCHAR	VARCHAR or CHAR	**DECRYPT_CHAR**
NVARCHAR	NVARCHAR or NCHAR	**DECRYPT_CHAR**
LVARCHAR	LVARCHAR	**DECRYPT_CHAR**
BLOB	BLOB	**DECRYPT_BINARY**
CLOB	BLOB	**DECRYPT_CHAR**

Columns of type VARCHAR and NVARCHAR store no more than 255 bytes. If the *data* string is too long for these data types to store both the encrypted data and encryption overhead, then the value returned by the encryption function is automatically changed from VARCHAR or NVARCHAR into a fixed CHAR or NCHAR value, with no trailing blanks in the encoded encrypted value.

Encrypted values of type BLOB or CLOB are not in BASE64 encoding format, and their size increase after encryption is independent of the original data size. For BLOB or CLOB values, the encrypted size (in bytes) has the following formula, where N is the original size of the plain text, and H is the size of the unencrypted hint string, if encryption is performed by **ENCRYPT_TDES**:

```
N + H + 24 bytes.
```

For BLOB or CLOB values that **ENCRYPT_AES** encrypts, the overhead is larger:

```
N + H + 32 bytes.
```

Example of Column Level Encryption: The following example illustrates how to use the built-in encryption and decryption functions of Dynamic Server to create and use a table that stores encrypted credit card numbers in a column that has a character data type.

For purposes of this example, assume that the plain text of the values to be encrypted consists of strings of 16 digits. Because encryption functions support character data types, these values will be stored in a CHAR column, rather than in an INT or INT8 column.

Calculating storage requirements for encrypted data:

The **LENGTH** function provides a convenient way to calculate the storage requirements of encrypted data directly:

```
EXECUTE FUNCTION LENGTH(ENCRYPT_TDES("1234567890123456", "simple password"))
```

This returns 55.

```
EXECUTE FUNCTION LENGTH(ENCRYPT_TDES("1234567890123456", "simple password",
"12345678901234567890123456789012"))
```

This returns 107.

```
EXECUTE FUNCTION LENGTH(ENCRYPT_AES("1234567890123456", "simple password"))
```

This returns 67.

```
EXECUTE FUNCTION LENGTH(ENCRYPT_AES("1234567890123456", "simple password",
"12345678901234567890123456789012"))
```

This returns 119.

The required storage size for encrypted data is sensitive to three factors:

- N, the number of bytes in the plain text
- whether or not a hint is provided
- which encryption function you use (**ENCRYPT_TDES**or **ENCRYPT_TDES**)

The following formulae describe the four possible cases, and are not simplified:

- Encryption by **ENCRYPT_TDES( )** with no hint:
  ```
  Encrypted size = (4 x ((8 x((N + 8)/8) + 10)/3) + 11)
  ```
- Encryption by **ENCRYPT_AES( )** with no hint:
  ```
  Encrypted size = (4 x ((16 x((N + 16)/16) + 10)/3) + 11)
  ```
- Encryption by **ENCRYPT_TDES( )** with a hint:
  ```
  Encrypted size = (4 x ((8 x((N + 8)/8) + 50)/3) + 11)
  ```
- Encryption by **ENCRYPT_AES( )** with no hint:
  ```
  Encrypted size = (4 x ((16 x((N + 16)/16) + 50)/3) + 11)
  ```

The integer divsion (/) returns an integer quotient and discards any remainder.

Based on these formulae, the following table shows the encrypted size (in bytes) for selected ranges of values of N:

N	ENCRYPT_TDES No Hint	ENCRYPT_AES No Hint	ENCRYPT_TDES With Hint	ENCRYPT_AES With Hint
1 to 7	35	43	87	99
8 to 15	43	43	99	99
16 to 23	55	67	107	119
24 to 31	67	67	119	119
32 to 39	75	87	131	139
40 to 47	87	87	139	139
100	163	171	215	227
200	299	299	355	355
500	695	707	747	759

If the column size is smaller than the data size returned by encryption functions, the encrypted value is truncated when it is inserted. In this case, it will not be possible to decrypt the data, because the header will indicate that the length should be longer than the data value that the column contains.

These formulae and the values returned by the **LENGTH** function, however, indicate that the table schema in the next example can store the encrypted form of 16-digit credit card numbers (with a hint).

Implementing column-level encryption:

The following steps create a table from which a user who knows the password can retrieve rows that include one column of encrypted data.

1. Create a database table containing at least one column of type BLOB, CLOB, or a character data type of sufficient length to store the encrypted values. For example, the following statement creates a table called **customer** in which the column **creditcard** can store encrypted credit card numbers:

```
CREATE TABLE customer (id CHAR(20), creditcard CHAR(107));
```

2. Specify a password (and optional hint) and insert encrypted data:

```
SET ENCRYPTION PASSWORD 'credit card number is encrypted'
   WITH HINT 'Why is this difficult to read?';
INSERT INTO customer VALUES ('Alice',
   encrypt_tdes('1234567890123456'));
INSERT INTO customer VALUES ('Bob',
   encrypt_tdes('2345678901234567'));
```

3. Query the encrypted data, using a decryption function:

```
SELECT id, DECRYPT_CHAR(creditcard,
   'credit card number is encrypted') FROM customer;
```

The following query call a decryption function in the WHERE clause, using the *session password* default, rather than an explicit *password* argument:

```
SELECT id FROM customer
   WHERE DECRYPT_CHAR(creditcard) = '2345678901234567'
```

Column level encryption offers the coding convenience of passing the implicit *session password* for all rows with encrypted columns, and in multiple encryption and decryption function calls in the same SQL statement. Confidentiality of the data, however, requires users who know the password on encrypted columns to avoid compromising its secrecy. Triggers and UDRs, for example, should always use the *session password*, rather than explicit *password* arguments if they invoke the encryption or decryption functions.

The DBSA can manage highly confidential data with column level encryption. Dynamic Server does not, however, prevent users with sufficient privileges from entering data encrypted by some other password into a table whose other rows use the designated column level encryption password.

DECRYPT_CHAR Function

The **DECRYPT_CHAR** function accepts as its first argument an *encrypted_data* character string that can have any character type (CHAR, LVARCHAR, NCHAR, NVARCHAR, or VARCHAR). You must specify a *password* as its second argument, unless the SET ENCRYPTION statement has specified for this session the same *session password* by which the first argument was encrypted.

The **DECRYPT_CHAR** function also accepts as its first argument an *encrypted_data* large object of type BLOB or CLOB. You must specify a password as its second argument, unless the SET ENCRYPTION statement has specified as the default for this session the same *password* by which the first argument was encrypted. If the call to **DECRYPT_CHAR** is successful, it returns a CLOB large object that contains the plain text version of the *encrypted_data* argument.

If the call to **DECRYPT_CHAR** with an encrypted string argument is successful, it returns a character string that contains the plain text version of the *encrypted_data* argument. The following example returns a character string containing a decrypted value from the **ssid** column of the **engineers** table for the row whose **empno** value is 287:

```
SELECT DECRYPT_CHAR (ssid) FROM engineers WHERE empno = 287
```

If the first argument to **DECRYPT_CHAR** is not an encrypted value, or if the second argument (or the default *password* specified by SET ENCRYPTION) is not the *password* that was used when the first argument was encrypted, Dynamic Server issues an error, and the call to **DECRYPT_CHAR** fails. (See the description of the “GETHINT Function” on page 4-87 for one possible action to take when you cannot remember the *password* that was used for encryption.)

Do not use **DECRYPT_CHAR** (or any other decryption function) to create a functional index on an encrypted column. This would store the decrypted values as plain text data in the database, defeating the purpose of encryption.

For additional information about using data encryption in column values of Dynamic Server databases, see "Encryption and Decryption Functions" on page 4-79, and "SET ENCRYPTION PASSWORD" on page 2-560.

DECRYPT_BINARY Function

The **DECRYPT_BINARY** function accepts as its first argument an *encrypted_data* large object of type BLOB or CLOB. You must specify a *password* as its second argument, unless the SET ENCRYPTION statement has specified as the default for this session the same *password* by which the first argument was encrypted.

If the call to **DECRYPT_BINARY** is successful, it returns a BLOB or CLOB large object that contains the plain text version of the *encrypted_data* argument.

If the first argument to **DECRYPT_BINARY** is an encrypted value of a character data type, Dynamic Server invokes the **DECRYPT_CHAR** function and attempts to decrypt the specified value.

If the first argument to **DECRYPT_BINARY** is not an encrypted value, or if the second argument (or the default *password* specified by SET ENCRYPTION) is not the *password* that was used when the first argument was encrypted, Dynamic Server issues an error, and the call to **DECRYPT_BINARY** fails. (See the description of the "GETHINT Function" on page 4-87 for one possible action to take when you cannot remember the *password* that was used for encryption.)

Do not use **DECRYPT_BINARY** (or any other decryption function) to create a functional index on an encrypted column. This would store the decrypted values as plain text data in the database, defeating the purpose of encryption.

For additional information about using data encryption in column values of Dynamic Server databases, see "Encryption and Decryption Functions" on page 4-79, and "SET ENCRYPTION PASSWORD" on page 2-560.

ENCRYPT_AES Function

The **ENCRYPT_AES** function returns an encrypted value that it derives by applying the AES (Advanced Encryption Standard) algorithm to its first argument, which must be an unencrypted character expression or a smart large object (that is, a BLOB or CLOB data type). A character argument can have a length of up to 32640 bytes if an explicit or default *hint* is used, or 32672 bytes if no hint (or a NULL hint) is specified. Theoretical size limits on BLOB or CLOB arguments are many orders of magnitude larger, but practical limits might be imposed by your hardware, or by time required for encryption and decryption.

You must specify a *password* as its second argument, unless a SET ENCRYPTION statement has specified a *session password*, which the database server uses by default if you omit the second argument. If a *session password* has been set, any *password* that you specify overrides the *session password* for the returned value of this function call. The explicit or default *password* will also be required for any subsequent decryption of the returned encrypted value. A valid *password* must have at least 6 bytes but no more than 128.

You can optionally specify a *hint* as the third argument. If the SET ENCRYPTION statement specified a default *hint* for this session, and you specify no hint, that default *hint* is stored in an encrypted form within the returned value. Any *hint* that you specify overrides the default *hint*. A valid *hint* can be no longer than 32 bytes. You can use consecutive quotation marks (″) to specify a NULL *hint*. If you specify an explicit *hint*, you must also specify an explicit *password*.

The purpose of the *hint* is to help users to remember the *password*. For example, if the *password* is ″**buggy**,″ you might define the hint as ″**whip**.″ Neither string is restricted to a single word, but the size of the *hint* contributes to the size of the returned value. If you subsequently cannot remember the *hint*, use the returned value from **ENCRYPT_AES** as the argument to **GETHINT** to retrieve the *hint*.

The following example calls **ENCRYPT_AES** from the VALUES clause of an INSERT statement that stores in **tab1** a plain-text string and an *encrypted_data* value that **ENCRYPT_AES** returns from its 12-byte first argument. Here SET ENCRYPTION defines a *session password* and *hint* that are used as default second and third arguments to the **ENCRYPT_AES** function:

```
EXEC SQL SET ENCRYPTION PASSWORD 'CHARYBDIS' WITH HINT 'messina'
EXEC SQL INSERT INTO tab1 VALUES ('abcd', ENCRYPT_AES("111-222-3333"));
```

The call to **ENCRYPT_AES** fails with an error if the *password* argument is omitted when no *session password* has been set, or if the length of an explicit *password* argument is shorter than 6 bytes or longer than 128 bytes.

In some contexts, an error is issued if the encrypted returned value is too large to be stored by the data type that receives it.

For additional information about using data encryption in column values of Dynamic Server databases, see “Encryption and Decryption Functions” on page 4-79, and “SET ENCRYPTION PASSWORD” on page 2-560.

ENCRYPT_TDES Function

The **ENCRYPT_TDES** function returns a value that is the result of encrypting a character expression, or a BLOB or CLOB value, by applying the TDES (Triple Data Encryption Standard, which is sometimes also called DES3) algorithm to its first argument. This algorithm is slower than the DES algorithm that is used by the **ENCRYPT_AES** function, but is considered somewhat more secure. The disk space required as encryption overhead resembles that of **ENCRYPT_AES**, but is somewhat smaller because of the smaller block size of ENCRYPT_TDES. (See ″Calculating storage requirements for encrypted data″ on page 4-82 for a discussion of how to estimate the size of encrypted character strings.)

Those differences in performance, tamper-resistance, and in the returned *encrypted_data* size that the previous paragraph lists are the practical differences between the **ENCRYPT_TDES** and **ENCRYPT_AES** functions, which otherwise follow the same rules, defaults, and restrictions that appear in the description of **ENCRYPT_AES** on the previous page in regard to the following features:

- The required first argument (the plain text *data* value to be encrypted)
- The explicit or default second argument (the *password* string that must also be an argument to **DECRYPT_CHAR** or **DECRYPT_BINARY** to decrypt the returned *encrypted_data* value). This must be specified unless a default *session password* has been set by the SET ENCRYPTION statement
- The optional third argument (the *hint* value) that might assist users who forget the *password*. If you subsequently cannot remember an explicit or default *hint* that was defined for *password*, you can use the returned value from **ENCRYPT_TDES** as the argument to **GETHINT** to retrieve the *hint*.

The following example calls **ENCRYPT_TDES** from the SET clause of an UPDATE statement. Here the *session password* is 'PERSEPHONE' and the *hint* string is "pomegranate", with column **colU** of table **tabU** the *data* argument. Because the WHERE clause condition of "1=1" is true for all rows of **tabU**, the effect of this statement is to replace every plain text **colU** value with encrypted strings returned by the algorithm that **ENCRYPT_TDES** implements:

```
EXEC SQL SET ENCRYPTION PASSWORD 'PERSEPHONE' WITH HINT 'pomegranate'
EXEC SQL UPDATE tabU SET colU = ENCRYPT_TDES (colU) WHERE 1=1;
```

This example assumes that the character data type of **colU** is of sufficient size to store the new encrypted values without truncation. (A more cautious example might execute an appropriate ALTER TABLE statement before the UPDATE.)

For additional information about using data encryption in column values of Dynamic Server databases, see "Encryption and Decryption Functions" on page 4-79, and "SET ENCRYPTION PASSWORD" on page 2-560.

GETHINT Function

The **GETHINT** function returns a character string that a previously executed SET ENCRYPTION PASSWORD statement defined for the *password* that was used when *encrypted_data* was encrypted by the **ENCRYPT_AES** function or by the **ENCRYPT_TDES** function. This *hint* string typically provides information that helps the user to specify the *password* needed to return the plain text version of *encrypted_data* with the **DECRYPT_CHAR** or **DECRYPT_BINARY** decryption function. The *hint* string, however, should not be the same as the *password*. In the following example, a query returns the *hint* string into a host variable called **myhint**:

```
EXEC SQL SELECT GETHINT(creditcard) INTO :myhint
   FROM customer WHERE id = :myid;
```

An error is returned, rather than a *hint* string, if the *encrypted_data* argument to the **GETHINT** function is not an encrypted string or an encrypted large object.

For additional information about using data encryption in column values of Dynamic Server databases, see "Encryption and Decryption Functions" on page 4-79, and "SET ENCRYPTION PASSWORD" on page 2-560.

Exponential and Logarithmic Functions

Exponential and logarithmic functions take at least one argument and return a FLOAT data type.

Exponential and Logarithmic Functions:

```
|--+-EXP--(--float_expression--)---+-------------------------------------|
   +-LOGN--(--float_expression--)--+
   '-LOG10--(--float_expression--)-'
```

Element	Description	Restrictions	Syntax
float_expression	An argument to the **EXP**, **LOGN**, or **LOG10** functions. For the meaning of *float_expression* in these functions, see the individual heading for each function on the pages that follow.	The domain is the set of real numbers, and the range is the set of positive real numbers	Expression, p. 4-34

EXP Function: The **EXP** function returns the exponent of a numeric expression. The following example returns the exponent of 3 for each row of the **angles** table:

```
SELECT EXP(3) FROM angles
```

For this function, the base is always *e*, the base of natural logarithms, as the following example shows:

```
e=exp(1)=2.718281828459
```

When you want to use the base of natural logarithms as the base value, use the **EXP** function. If you want to specify a particular value to raise to a specific power, see the "POW Function" on page 4-70.

LOG10 Function: The **LOG10** function returns the log of a value to base 10. The following example returns the log base 10 of distance for each row of the **travel** table:

```
SELECT LOG10(distance) + 1 digits FROM travel
```

LOG10 Function: The **LOG10** function returns the log of a value to base 10. The following example returns the log base 10 of distance for each row of the **travel** table:

```
SELECT LOG10(distance) + 1 digits FROM travel
```

LOGN Function: The **LOGN** function returns the natural logarithm of a numeric argument. This value is the inverse of the exponential value. The following query returns the natural log of **population** for each row of the **history** table:

```
SELECT LOGN(population) FROM history WHERE country='US'
   ORDER BY date
```

HEX Function

The **HEX** function returns the hexadecimal encoding of an integer expression.

HEX Function:

```
├──HEX──(──int_expression──)──────────────────────────────────────────┤
```

Element	Description	Restrictions	Syntax
int_expression	Expression for which you want the hexadecimal equivalent	Must be a literal integer or some other expression that returns an integer	Expression, p. 4-34

The next example displays the data type and column length of the columns of the **orders** table in hexadecimal format. For MONEY and DECIMAL columns, you can then determine the precision and scale from the lowest and next-to-the-lowest bytes. For VARCHAR and NVARCHAR columns, you can determine the minimum space and maximum space from the lowest and next-to-the-lowest bytes. For more information about encoded information, see the *IBM Informix Guide to SQL: Reference*.

```
SELECT colname, coltype, HEX(collength)
   FROM syscolumns C, systables T
   WHERE C.tabid = T.tabid AND T.tabname = 'orders'
```

The following example lists the names of all the tables in the current database and their corresponding tblspace number in hexadecimal format.

```
SELECT tabname, HEX(partnum) FROM systables
```

The two most significant bytes in the hexadecimal number constitute the dbspace number. They identify the table in **oncheck** output (in Dynamic Server) and in **onutil check** output (in Extended Parallel Server).

The **HEX** function can operate on an expression, as the next example shows:

```
SELECT HEX(order_num + 1) FROM orders
```

Length Functions

Use length functions to determine the length of a column, string, or variable.

Length Functions:

```
   (1)                                                   (2)
├────────────┬─LENGTH─────────────┬─(─┬─┤ Quoted String ├────────────┬─)──────────┤
             ├─┬─CHAR_LENGTH──────┤   │ (3)    (4)                   │
             │ └─CHARACTER_LENGTH─┤   ├────────────────variable_name─┤
             └─OCTET_LENGTH───────┘   └─┬────────┬─column────────────┘
                                        └─table.─┘
```

Notes:

1 Informix extension

2 See page 4-142

3 ESQL/C

4 Stored Procedure Language

Element	Description	Restrictions	Syntax
column	Name of a column in *table*	Must have a character data type	Identifier, p. 5-22
table	Name of the table in which the specified column occurs	Must exist	Database Object Name, p. 5-17
variable	Host variable or SPL variable that contains a character string	Must have a character data type	See language-specific rules for names.

Each of these functions has a distinct purpose:

- **LENGTH**
- **OCTET_LENGTH**
- **CHAR_LENGTH** (also known as **CHARACTER_LENGTH**)

The LENGTH Function: The **LENGTH** function returns the number of bytes in a character column, not including any trailing blank spaces. For BYTE or TEXT columns, **LENGTH** returns the full number of bytes, including any trailing blank spaces.

In ESQL/C, **LENGTH** can also return the length of a character variable.

The next example illustrates the use of the **LENGTH** function:

```
SELECT customer_num, LENGTH(fname) + LENGTH(lname),
   LENGTH('How many bytes is this?')
   FROM customer WHERE LENGTH(company) > 10
```

See also the discussion of **LENGTH** in the *IBM Informix GLS User's Guide*.

The OCTET_LENGTH Function: **OCTET_LENGTH** returns the number of bytes in a character column, including any trailing spaces. See also the *IBM Informix GLS User's Guide*.

The CHAR_LENGTH Function: The **CHAR_LENGTH** function (also called **CHARACTER_LENGTH**) returns the number of logical characters (which can be distinct from the number of bytes in some East Asian locales) in a character column value. For a discussion of this function, see the *IBM Informix GLS User's Guide*.

IFX_REPLACE_MODULE Function (IDS, C)

The **IFX_REPLACE_MODULE** function replaces a loaded shared-object file with a new version that has a different name or location. If the IFX_EXTEND_ROLE configuration parameter is set to ON, authorization to use this function is available only to the Database Server Administrator (DBSA), and to users whom the DBSA has granted the EXTEND role.

IFX_REPLACE_MODULE Function:

```
├──IFX_REPLACE_MODULE──(──old_module──,──new_module──,──"C"──)──────────────────┤
```

Element	Description	Restrictions	Syntax
new_module	Full pathname of the new shared-object file to replace the shared-object file that *old_module* specifies	The shared-object file must exist with the specified pathname, which can be no more than 255 bytes long	Quoted String, p. 4-142
old_module	Full pathname of the shared-object file to replace with the shared-object file that *new_module* specifies	The shared-object file must exist with the specified pathname, which can be no more than 255 bytes long	Quoted String, p. 4-142

The **IFX_REPLACE_MODULE** function returns an integer value to indicate the status of the shared-object-file replacement, as follows:

- Zero (0) to indicate success
- A negative integer to indicate an error

Important: Do not use the **IFX_REPLACE_MODULE** function to reload a module of the same name. If the full names of the old and new modules that you send to **ifx_replace_module( )** are the same, then unpredictable results can occur.

After **IFX_REPLACE_MODULE** completes execution, the database server ages out the *old_module* shared-object file; that is, all statements subsequent to the **IFX_REPLACE_MODULE** function will use UDRs in the *new_module* shared-object file, and the old module will be unloaded when any statements that were using it are complete. Thus, for a brief time, both the *old_module* and the *new_module* shared-object files could be resident in memory. If this aging out behavior is undesirable, use the **IFX_UNLOAD_MODULE** procedure to unload the shared-object file completely.

On UNIX, for example, suppose you want to replace the **circle.so** shared library, which contains UDRs written in the C language. If the old version of this library resides in the **/usr/apps/opaque_types** directory and the new version in the **/usr/apps/shared_libs** directory, then the following EXECUTE FUNCTION statement executes the **IFX_REPLACE_MODULE** function:

```
EXECUTE FUNCTION ifx_replace_module(
   "/usr/apps/opaque_types/circle.so",
   "/usr/apps/shared_libs/circle.so", "C")
```

On Windows, for another example, suppose you want to replace the **circle.dll** dynamic link library, which contains C UDRs. If the old version of this library resides in the C:**\usr\apps\opaque_types** directory and the new version in the C:**\usr\apps\DLLs** directory, then the following EXECUTE FUNCTION statement executes the **IFX_REPLACE_MODULE** function:

```
EXECUTE FUNCTION ifx_replace_module(
   "C:\usr\apps\opaque_types\circle.dll",
   "C:\usr\apps\DLLs\circle.dll", "C")
```

To execute the **IFX_REPLACE_MODULE** function in an IBM Informix ESQL/C application, you must associate the function with a cursor.

For more information on how to use **IFX_REPLACE_MODULE** to replace a shared-object file, see the chapter on how to design a UDR in *IBM Informix User-Defined Routines and Data Types Developer's Guide*. For information on how to use the **IFX_UNLOAD_MODULE** procedure, see the section "IFX_UNLOAD_MODULE Procedure (IDS, C)" on page 2-337.

Smart-Large-Object Functions (IDS)

The smart-large-object functions support BLOB and CLOB data types:

Smart-Large-Object Functions:

```
├──┬─┬─FILETOBLOB─┬──(─pathname─,─file_destination─┬─────────────────────┬─)─┬──────────────────┤
   │ └─FILETOCLOB─┘                                └─,─table─,─column─┘   │
   ├─LOTOFILE─(──┬─BLOB_column─┬──,─pathname─,─file_destination─)─────────┤
   │             └─CLOB_column─┘                                          │
   └─LOCOPY─(──┬─BLOB_column─┬──┬─────────────────────┬─)─────────────────┘
               └─CLOB_column─┘  └─,─table─,─column─┘
```

Element	Description	Restrictions	Syntax
BLOB_*column*, CLOB_*column*	A column of type BLOB; a column of type CLOB	In *table*.*column*, the *column* must have BLOB or CLOB data type	Identifier, p. 5-22
column	Column within *table* for the copy of the BLOB or CLOB value	Must have CLOB or BLOB as its data type	Quoted String, p. 4-142
file_destination	Name of the system on which to put or get the smart large object	The only valid values are the strings server or client	Quoted String, p. 4-142
pathname	Directory path and filename to locate the smart large object	Must exist on *file_destination* system. See also "Pathnames with Commas" on page 4-93.	Quoted String, p. 4-142
table	Name or synonym of a table that contains *column* whose storage characteristics are used for the copy of BLOB or CLOB value	Must exist in the database and must contain a CLOB or BLOB column	Quoted String, p. 4-142

FILETOBLOB and FILETOCLOB Functions: The **FILETOBLOB** function creates a BLOB value for data that is stored in a specified operating-system file. Similarly, the **FILETOCLOB** function creates a CLOB value for data that is stored in an operating-system file.

These functions determine the operating-system file to use from the following parameters:
- The *pathname* parameter identifies the directory path and name of the source file.
- The *file destination* parameter identifies the computer, client or server, on which this file resides:
  - Set *file destination* to `client` to identify the client computer as the location of the source file. The *pathname* can be either a full pathname or relative to the current directory.
  - Set *file destination* to `server` to identify the server computer as the location of the source file. The *pathname* must be a full pathname.

The *table* and *column* parameters are optional:
- If you omit *table* and *column*, the **FILETOBLOB** function creates a BLOB value with the system-specified storage defaults, and the **FILETOCLOB** function creates a CLOB value with the system-specified storage defaults.

  These functions obtain the system-specific storage characteristics from either the ONCONFIG file or the sbspace. For more information on system-specified storage defaults, see the *IBM Informix Administrator's Guide*.
- If you specify *table* and *column*, the **FILETOBLOB** and **FILETOCLOB** functions use the storage characteristics from the specified column for the BLOB or CLOB value that they create.

The **FILETOBLOB** function returns a handle value (a pointer) to the new BLOB value. Similarly, **FILETOCLOB** returns a handle value to the new CLOB value. Neither function actually copies the smart-large-object value into a database column. You must assign the BLOB or CLOB value to the appropriate column.

The **FILETOCLOB** function performs any code-set conversion that might be required when it copies the file from the client or server computer to the database.

The following INSERT statement uses the **FILETOCLOB** function to create a CLOB value from the value in the **smith.rsm** file:

```
INSERT INTO candidate (cand_num, cand_lname, resume)
   VALUES (2, 'Smith', FILETOCLOB('smith.rsm', 'client'))
```

In the preceding example, the **FILETOCLOB** function reads the **smith.rsm** file in the current directory on the client computer and returns a handle value to a CLOB value that contains the data in this file. Because the **FILETOCLOB** function does not specify a table and column name, this new CLOB value has the system-specified storage characteristics. The INSERT statement then assigns this CLOB value to the **resume** column in the **candidate** table.

The following INSERT statement uses the **FILETOBLOB** function to create a BLOB value in a remote table, **election2006**, from the value in the **photos.xxx** file on the local database server:

```
INSERT INTO rdb@rserv:election2006 (cand_pic)
   VALUES (FILETOBLOB('C:\tmp\photos.xxx', 'server',
      'candidate', 'cand_photo'))
```

In the preceding example, the **FILETOBLOB** function reads the **photos.xxx** file in the specified directory on the local database server and returns a handle value to a BLOB value that contains the data in this file. The INSERT statement then assigns this BLOB value to the **cand_pic** column in the remote **election2006** table. This new BLOB value has the storage characteristics of the **cand_photo** column in the **candidate** table on the local database server.

In the following example, the new BLOB value has the storage characteristics of the **cand_pix** column in the **election96** table on a remote database server:

```
INSERT INTO rdb@rserv:election2006 (cand_pic)
   VALUES (FILETOBLOB('C:\tmp\photos.xxx', 'server',
      'rdb2@rserv2:election96', 'cand_pix'))
```

When you qualify the **FILETOBLOB** or **FILETOCLOB** function with the name of a remote database and a remote database server, the *pathname* and the *file destination* become relative to the remote database server.

When you specify `server` as the file destination, as the following example shows, the **FILETOBLOB** function looks for the source file (in this case, **photos.xxx**) on the remote database server:

```
INSERT INTO rdb@rserv:election (cand_pic)
   VALUES (rdb@rserv:FILETOBLOB('C:\tmp\photos.xxx', 'server'))
```

When you specify `client` as the file destination, however, as in the following example, the **FILETOBLOB** function looks for the source file (in this case, **photos.xxx**) on the local client computer:

```
INSERT INTO rdb@rserv:election (cand_pic)
   VALUES (rdb@rserv:FILETOBLOB('photos.xxx', 'client'))
```

Pathnames with Commas: If a comma (**,**) symbol is within the *pathname* of the function, the database server expects the pathname to have the following format:

"*offset*, *length*, *pathname*"

For pathnames that contain a comma, you must also specify an offset and length, as in the following example:

```
FILETOBLOB("0,-1,/tmp/blob,x","server")
```

The first term in the quoted *pathname* string is an *offset* of `0`, which instructs the database server to begin reading at the start of the file.

The second term is a *length* of `-1`, which instructs the database server to continue reading until the end of the entire file.

The third term is the */tmp/blob,x pathname*, specifying which file to read. (Notice the comma symbol that precedes the *x*.)

Because the *pathname* includes a comma, the comma-separated *offset* and *length* specifications are necessary in this example to avoid an error when **FILETOBLOB** is called. You do not need to specify *offset* and *length* for pathnames that include no comma, but including 0,-1, as the initial characters of the pathname string avoids this error for any valid pathname.

LOTOFILE Function: The **LOTOFILE** function copies a smart large object to an operating-system file. The first parameter specifies the BLOB or CLOB column to copy. The function determines what file to create from the following parameters:

- The *pathname* identifies the directory path and the source file name.
- The *file destination* identifies the computer, client or server, on which this file resides:

– Set *file destination* to `client` to identify the client computer as the location of the source file. The *pathname* can be either a full pathname or a path relative to the current directory.
– Set *file destination* to `server` to identify the server computer as the location of the source file. The full pathname is required.

By default, the **LOTOFILE** function generates a filename of the form:

```
file.hex_id
```

In this format, *file* is the filename you specify in *pathname* and *hex_id* is the unique hexadecimal smart-large-object identifier. The maximum number of digits for a smart-large-object identifier is 17; however most smart large objects would have an identifier with significantly fewer digits.

For example, suppose that you specify a UNIX *pathname* value as follows:

```
'/tmp/resume'
```

If the CLOB column has the identifier **203b2**, then **LOTOFILE** creates the file:

```
/tmp/resume.203b2
```

For another example, suppose that you specify a Windows *pathname* value as follows:

```
'C:\tmp\resume'
```

If the CLOB column has an identifier of **203b2**, the **LOTOFILE** function would create the file:

```
C:\tmp\resume.203b2
```

To change the default filename, you can specify the following wildcards in the filename of the *pathname*:

- One or more contiguous question mark (?) characters in the filename can generate a unique filename.

  The **LOTOFILE** function replaces each question mark with a hexadecimal digit from the identifier of the BLOB or CLOB column.

  For example, suppose that you specify a UNIX *pathname* value as follows:

  ```
  '/tmp/resume??.txt'
  ```

  The **LOTOFILE** function puts 2 digits of the hexadecimal identifier into the name. If the CLOB column has an identifier of **203b2**, the **LOTOFILE** function would create the file:

  ```
  /tmp/resume20.txt
  ```

  If you specify more than 17 question marks, **LOTOFILE** ignores them.
- An exclamation (!) point at the end of the filename indicates that the filename does not need to be unique.

  For example, suppose that you specify a Windows pathname value as follows:

  ```
  'C:\tmp\resume.txt!'
  ```

  The **LOTOFILE** function does not use the smart-large-object identifier in the filename, so it generates the following file:

  ```
  C:\tmp\resume.txt
  ```

If the filename you specify already exists, **LOTOFILE** returns an error.

The **LOTOFILE** function performs any code-set conversion that might be required when it copies a CLOB value from the database to a file on the client or server computer.

When you qualify **LOTOFILE** with the name of a remote database and a remote database server, the BLOB or CLOB column, the *pathname*, and the *file destination* become relative to the remote database server.

When you specify `server` as the file destination, as in the next example, the **LOTOFILE** function copies the smart large object from the remote database server to a source file in the specified directory on the remote database server:

```
rdb@rserv:LOTOFILE(blob_col, 'C:\tmp\photo.gif!', 'server')
```

If you specify `client` as the file destination, as in the following example, the **LOTOFILE** function copies the smart large object from the remote database server to a source file in the specified directory on the local client computer:

```
rdb@rserv:LOTOFILE(clob_col, 'C:\tmp\essay.txt!', 'client')
```

LOCOPY Function: The **LOCOPY** function creates a copy of a smart large object. The first parameter specifies the BLOB or CLOB column to copy. The *table* and *column* parameters are optional.

- If you omit *table* and *column*, the **LOCOPY** function creates a smart large object with system-specified storage defaults and copies the data in the BLOB or CLOB column into it.

  The **LOCOPY** function obtains the system-specific storage defaults from either the ONCONFIG file or the sbspace. For more information on system-specified storage defaults, see the *IBM Informix Administrator's Guide*.
- When you specify *table* and *column*, the **LOCOPY** function uses the storage characteristics from the specified *column* for the BLOB or CLOB value that it creates.

The **LOCOPY** function returns a handle value (a pointer) to the new BLOB or CLOB value. This function does *not* actually store the new smart-large-object value into a column in the database. You must assign the BLOB or CLOB value to the appropriate column.

The following ESQL/C code fragment copies the CLOB value in the **resume** column of the **candidate** table to the **resume** column of the **interview** table:

```
/* Insert a new row in the interviews table and get the
 * resulting SERIAL value (from sqlca.sqlerrd[1])
 */
EXEC SQL insert into interviews (intrv_num, intrv_time)
   values (0, '09:30');
intrv_num = sqlca.sqlerrd[1];

/* Update this interviews row with the candidate number
 * and resume from the candidate table. Use LOCOPY to
 * create a copy of the CLOB value in the resume column
 * of the candidate table.
 */
EXEC SQL update interviews
   SET (cand_num, resume) =
      (SELECT cand_num,
         LOCOPY(resume, 'candidate', 'resume')
      FROM candidate
      WHERE cand_lname = 'Haven')
   WHERE intrv_num = :intrv_num;
```

In the preceding example, the **LOCOPY** function returns a handle value for the copy of the CLOB **resume** column in the **candidate** table. Because the **LOCOPY** function specifies a table and column name, this new CLOB value has the storage characteristics of this **resume** column. If you omit the table (**candidate**) and column (**resume**) names, the **LOCOPY** function uses the system-defined storage defaults for the new CLOB value. The UPDATE statement then assigns this new CLOB value to the **resume** column in the **interviews** table.

In the following example, the **LOCOPY** function executes on the local database server and returns a handle value on the local server for the copy of the BLOB **cand_pic** column in the remote **election2006** table. The INSERT statement then assigns this new BLOB value to the **cand_photo** column in the local **candidate** table.

```
INSERT INTO candidate (cand_photo)
   SELECT LOCOPY(cand_pic) FROM rdb@rserv:election2006;
```

When the **LOCOPY** function executes on the same database server as the original BLOB or CLOB column in a distributed query, it produces two copies of the BLOB or CLOB value, one on the remote database server and the other on the local database server, as the following two examples show.

In the first example, the **LOCOPY** function executes on the remote database server and returns a handle value on the remote server for the copy of the BLOB **cand_pic** column in the remote **election2006** table. The INSERT statement then assigns this new BLOB value to the **cand_photo** column in the local **candidate** table:

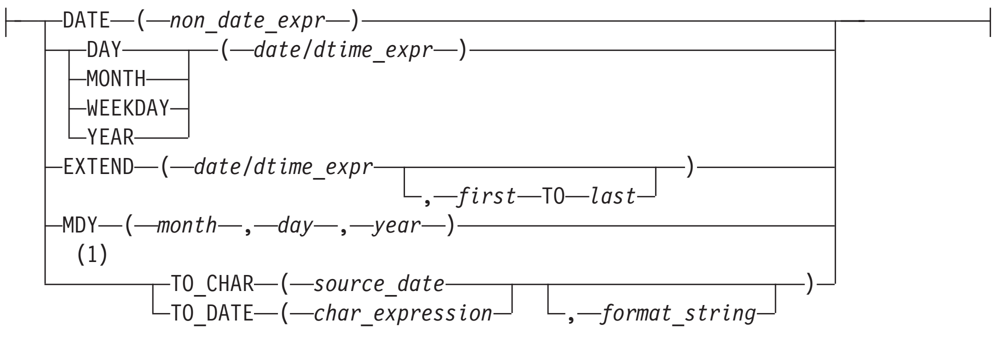
```
INSERT INTO candidate (cand_photo)
   SELECT rdb@rserv:LOCOPY(cand_pic)
      FROM rdb@rserv:election2006
```

In the second example, the **LOCOPY** function executes on the local database server and returns a handle value on the local server for the copy of the BLOB **cand_photo** column in the local **candidate** table. The INSERT statement then assigns this new BLOB value to the **cand_pic** column in the remote **election2006** table:

```
INSERT INTO rdb@rserv:election2006 (cand_pic)
   SELECT LOCOPY(cand_photo) FROM candidate
```

Time Functions

Time Functions:



Notes:

1 Dynamic Server only

Element	Description	Restrictions	Syntax
char _expression	Expression to be converted to a DATE or DATETIME value	Must be a literal, host variable, expression, or column of a character type	Expression, p. 4-34
date/dtime _expr	Expression that returns a DATE or DATETIME value	Must return a DATE or DATETIME value	Expression, p. 4-34
day	Expression that returns the number of a day of the month	Must return integer > 0 but not greater than number of days in specified month	Expression, p. 4-34
first	Largest time unit in the result. If you omit *first* and *last*, the default *first* is YEAR.	Must be a DATETIME qualifier that specifies a time unit no smaller than *last*	DATETIME Qualifier, p. 4-32
format_string	String that contains a format mask for the DATE or DATETIME value	Must be a character data type and contain a valid date format. Can be a column, host variable, expression, or constant	Quoted String, p. 4-142
last	Smallest time unit in the result	Must be a DATETIME qualifier that specifies a time unit no smaller than *first*	DATETIME Qualifier, p. 4-32
month	Expression that represents the number of the month	Must evaluate to an integer in the range from 1 to 12, inclusive	Expression, p. 4-34
non _date_expr	Expression that represents a value to be converted to a DATE data type	Typically an expression that returns a CHAR, DATETIME, or INTEGER value that can be converted to a DATE data type	Expression, p. 4-34
source_date	Date to be converted to a character string	Type DATETIME or DATE. Can be host variable, expression, column, or constant.	Expression, p. 4-34
year	Expression that represents the year	Must evaluate to a 4-digit integer. You cannot use a 2-digit abbreviation.	Expression, p. 4-34

DATE Function: The **DATE** function converts a non-DATE expression to a DATE value. The argument can be any expression that can be converted to a DATE value, usually a CHAR, DATETIME, or INTEGER value. The following WHERE clause specifies a CHAR value for the non-DATE expression:

```
WHERE order_date < DATE('12/31/04')
```

When the **DATE** function interprets a CHAR non-DATE expression, it expects this expression to conform to any DATE format that the **DBDATE** environment specifies. For example, suppose **DBDATE** is set to `Y2MD/` when you execute the following query:

```
SELECT DISTINCT DATE('02/01/1998') FROM ship_info
```

This SELECT statement generates an error because the **DATE** function cannot convert this non-DATE expression. The **DATE** function interprets the first part of the date string (`02`) as the year and the second part (`01`) as the month.

For the third part (`1998`), the **DATE** function encounters four digits when it expects a two-digit day (valid day values must be between `01` and `31`). It therefore cannot convert the value. For the SELECT statement to execute successfully with the `Y2MD/` value for **DBDATE**, the non-DATE expression would need to be '98/02/01'. For information on the format of **DBDATE**, see the *IBM Informix Guide to SQL: Reference*.

When you specify a positive INTEGER value for the non-DATE expression, the **DATE** function interprets this as the number of days after December 31, 1899.

If the integer value is negative, the **DATE** function interprets the value as the number of days before December 31, 1899. The following WHERE clause specifies an INTEGER value for the non-DATE expression:

```
WHERE order_date  <  DATE(365)
```

The database server searches for rows with an **order_date** value less than December 31, 1900 (which is 12/31/1899 plus 365 days).

DAY Function: The **DAY** function returns an integer that represents the day of the month. The following example uses the **DAY** function with the **CURRENT** function to compare column values to the current day of the month:

```
WHERE DAY(order_date) > DAY(CURRENT)
```

MONTH Function: The **MONTH** function returns an integer corresponding to the month portion of its type DATE or DATETIME argument. The following example returns a number from 1 through 12 to indicate the month when the order was placed:

```
SELECT order_num, MONTH(order_date) FROM orders
```

WEEKDAY Function: The **WEEKDAY** function returns an integer that represents the day of the week; zero (0) represents Sunday, one (1) represents Monday, and so on. The following example lists all the orders that were paid on the same day of the week, which is the current day:

```
SELECT * FROM orders
   WHERE WEEKDAY(paid_date) = WEEKDAY(CURRENT)
```

YEAR Function: The **YEAR** function returns a four-digit integer that represents the year.

The following example lists orders in which the **ship_date** is earlier than the beginning of the current year:

```
SELECT order_num, customer_num FROM orders
   WHERE year(ship_date) < YEAR(TODAY)
```

Similarly, because a DATE value is a simple calendar date, you cannot add or subtract a DATE value with an INTERVAL value whose *last* qualifier is smaller than DAY. In this case, convert the DATE value to a DATETIME value.

EXTEND Function: The **EXTEND** function adjusts the precision of a DATETIME or DATE value. The expression cannot be a quoted string representation of a DATE value.

If you do not specify *first* and *last* qualifiers, the default qualifiers are YEAR TO FRACTION(3).

If the expression contains fields that are not specified by the qualifiers, the unwanted fields are discarded.

If the *first* qualifier specifies a larger (that is, more significant) field than what exists in the expression, the new fields are filled in with values returned by the **CURRENT** function. If the *last* qualifier specifies a smaller field (that is, less significant) than what exists in the expression, the new fields are filled in with constant values. A missing MONTH or DAY field is filled in with `1`, and the missing HOUR to FRACTION fields are filled in with `0`.

In the following example, the first EXTEND call evaluates to the **call_dtime** column value of YEAR TO SECOND. The second statement expands a literal DATETIME so that an interval can be subtracted from it. You must use the **EXTEND** function with a DATETIME value if you want to add it to or subtract it from an INTERVAL value that does not have all the same qualifiers. The third example updates only a portion of the datetime value, the hour position. The **EXTEND** function yields just the *hh:mm* part of the datetime. Subtracting 11:00 from the hours and minutes of the datetime yields an INTERVAL value of the difference, plus or minus, and subtracting that from the original value forces the value to 11:00.

```
EXTEND (call_dtime, YEAR TO SECOND)

EXTEND (DATETIME (1989-8-1) YEAR TO DAY, YEAR TO MINUTE)
   - INTERVAL (720) MINUTE (3) TO MINUTE

UPDATE cust_calls SET call_dtime = call_dtime -
(EXTEND(call_dtime, HOUR TO MINUTE) - DATETIME (11:00)
HOUR TO MINUTE) WHERE customer_num = 106
```

MDY Function: The **MDY** function returns a type DATE value with three expressions that evaluate to integers that represent the month, day, and year. The first expression must evaluate to an integer that represents the number of the month (1 to 12).

The second expression must evaluate to an integer that represents the number of the day of the month (1 to 28, 29, 30, or 31, as appropriate for the month).

The third expression must evaluate to a four-digit integer that represents the year. You cannot use a two-digit abbreviation for the third expression. The following example sets the **paid_date** associated with the order number 8052 equal to the first day of the present month:

```
UPDATE orders SET paid_date = MDY(MONTH(TODAY), 1, YEAR(TODAY))
   WHERE po_num = '8052'
```

TO_CHAR Function (IDS): The **TO_CHAR** function converts a DATE or DATETIME value to a character string. The character string contains the date that was specified in the *source_date* parameter and represents this date in the format that was specified in the *format_string* parameter.

Any argument to this function must be of a built-in data type.

If the value of the *source_date* parameter is NULL, the function returns a NULL value.

If you omit the *format_string* parameter, the **TO_CHAR** function uses the default date format to format the character string. The default date format is specified by environment variables such as **GL_DATETIME** and **GL_DATE**.

The *format_string* parameter does not have to imply the same qualifiers as the *source_date* parameter. When the implied formatting mask qualifier in *format_string* is different from the qualifier in *source_date*, the **TO_CHAR** function extends the DATETIME value as if it had called the **EXTEND** function.

In the following example, the user wants to convert the **begin_date** column of the **tab1** table to a character string. The **begin_date** column is defined as a DATETIME YEAR TO SECOND data type. The user uses a SELECT statement with the **TO_CHAR** function to perform this conversion:

```
SELECT TO_CHAR(begin_date, '%A %B %d, %Y %R') FROM tab1
```

The symbols in the *format_string* parameter in this example have the following meanings. For a complete list of format symbols and their meanings, see the **GL_DATE** and **GL_DATETIME** environment variables in the *IBM Informix GLS User's Guide*.

Symbol	Meaning
%A	Full weekday name as defined in the locale
%B	Full month name as defined in the locale
%d	Day of the month as a decimal number
%Y	Year as a 4-digit decimal number
%R	Time in 24-hour notation

The result of applying the specified *format_string* to the **begin_date** column is as follows:

```
Wednesday July 23, 1997 18:45
```

TO_DATE Function (IDS): The **TO_DATE** function converts a character string to a DATETIME value. The function evaluates the *char_expression* parameter as a date according to the date format you specify in the *format_string* parameter and returns the equivalent date. If *char_expression* is NULL, then a NULL value is returned.

Any argument to the **TO_DATE** function must be of a built-in data type.

If you omit the *format_string* parameter, the **TO_DATE** function applies the default DATETIME format to the DATETIME value. The default DATETIME format is specified by the **GL_DATETIME** environment variable.

In the following example, the user wants to convert a character string to a DATETIME value in order to update the **begin_date** column of the **tab1** table with the converted value. The **begin_date** column is defined as a DATETIME YEAR TO SECOND data type. The user uses an UPDATE statement that contains a **TO_DATE** function to accomplish this result:

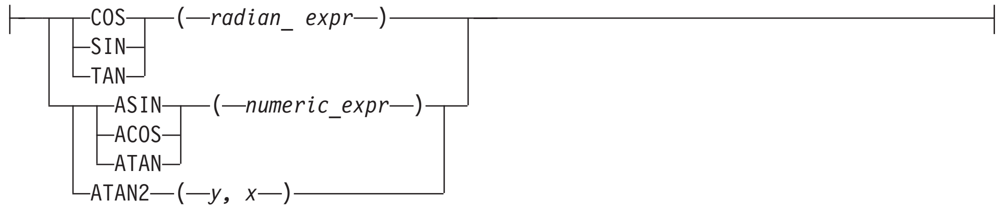
```
UPDATE tab1
   SET begin_date = TO_DATE('Wednesday July 23, 1997 18:45',
   '%A %B %d, %Y %R');
```

The *format_string* parameter in this example tells the **TO_DATE** function how to format the converted character string in the **begin_date** column. For a table that shows the meaning of each format symbol in this format string, see “TO_CHAR Function (IDS)” on page 4-99.

Trigonometric Functions

The built-in trigonometric functions have the following syntax.

Trigonometric Functions:



Element	Description	Restrictions	Syntax
numeric_expr	Expression that serves as an argument to the ASIN, ACOS, or ATAN functions	Must return a value between -1 and 1, inclusive	Expression, p. 4-34
radian_expr	Expression that represents the number of radians	Must return a numeric value	Expression, p. 4-34
x	Expression that represents the x coordinate of the rectangular coordinate pair (*x*, *y*)	Must return a numeric value	Expression, p. 4-34
y	Expression that represents the y coordinate of the rectangular coordinate pair (*x*, *y*)	Must return a numeric value	Expression, p. 4-34

Formulas for Radian Expressions: The **COS**, **SIN**, and **TAN** functions take the number of radians (*radian_expr*) as an argument. If you are using degrees and want to convert degrees to radians, use the following formula:

```
# degrees * p/180= # radians
```

To convert radians to degrees, use the following formula:

```
# radians * 180/p = # degrees
```

COS Function: The **COS** function returns the cosine of a radian expression. The following example returns the cosine of the values of the degrees column in the **anglestbl** table. The expression passed to the **COS** function in this example converts degrees to radians.

```
SELECT COS(degrees*180/3.1416) FROM anglestbl
```

SIN Function: The **SIN** function returns the sine of a radian expression. This example returns the sine of the values in the **radians** column of the **anglestbl** table:

```
SELECT SIN(radians) FROM anglestbl
```

TAN Function: The **TAN** function returns the tangent of a radian expression. This example returns the tangent of the values in the **radians** column of the **anglestbl** table:

```
SELECT TAN(radians) FROM anglestbl
```

ACOS Function: The **ACOS** function returns the arc cosine of a numeric expression. The following example returns the arc cosine of the value (-0.73) in radians:

```
SELECT ACOS(-0.73) FROM anglestbl
```

ASIN Function: The **ASIN** function returns the arc sine of a numeric expression. The following example returns the arc sine of the value (-0.73) in radians:

```
SELECT ASIN(-0.73) FROM anglestbl
```

ATAN Function: The **ATAN** function returns the arc tangent of a numeric expression. The following example returns the arc tangent of the value (-0.73) in radians:

```
SELECT ATAN(-0.73) FROM anglestbl
```

ATAN2 Function: The **ATAN2** function computes the angular component of the polar coordinates (*r*, q) associated with (*x*, *y*). The following example compares *angles* to q for the rectangular coordinates (4, 5):

```
WHERE angles > ATAN2(4,5)     --determines q for (4,5) and
                                --compares to angles
```

You can determine the length of the radial coordinate *r* using the expression that the following example shows:

```
SQRT(POW(x,2) + POW(y,2))     --determines r for (x,y)
```

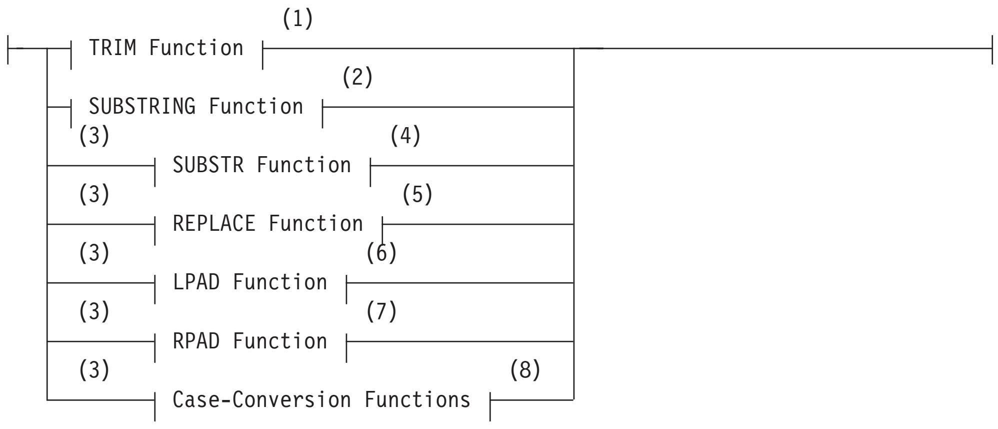
You can determine the length of the radial coordinate *r* for the rectangular coordinates (4,5) using the expression that the following example shows:

```
SQRT(POW(4,2) + POW(5,2))     --determines r for (4,5)
```

String-Manipulation Functions

String-manipulation functions perform various operations on strings of characters. The syntax for string-manipulation functions is as follows.

String-Manipulation Functions:



Notes:

1 See page 4-102

2 See page 4-104

3 Informix extension

4 See page 4-105

5 See page 4-107

6 See page 4-107

7 See page 4-108

8 See page 4-109

TRIM Function: The **TRIM** function removes leading or trailing pad characters from a string.

TRIM Function:

```
├──TRIM──(─┬──────────────────────────────────────────┬─source_expression)──┤
           │  ┌─BOTH─────┐                           │
           └──┼─TRAILING─┼──┬─────────────────┬─FROM─┘
              └─LEADING──┘  └─trim_expression─┘
```

Element	Description	Restrictions	Syntax
trim _expression	Expression that evaluates to a single character or NULL. Default is a blank space (= ASCII 32)	Must be a character expression	Quoted String, p. 4-142
source _expression	Character expression, including a character column name, or a call to another TRIM function	Cannot be LVARCHAR nor a host variable	Quoted String, p. 4-142

The **TRIM** function returns a VARCHAR value identical to its character string argument, except that any leading or trailing whitespace characters, if specified, are deleted. If no trim qualifier (LEADING, TRAILING, or BOTH) is specified, BOTH is the default. If no *trim_expression* is used, a single blank space is assumed. If either the *trim_expression* or the *source_expression* evaluates to null, the result of the **TRIM** function is NULL. The maximum length of the returned string must be 255 bytes or fewer, because the VARCHAR data type supports no more than 255 bytes.

The following example shows some generic uses for the **TRIM** function:

```
SELECT TRIM (c1) FROM tab;
SELECT TRIM (TRAILING '#' FROM c1) FROM tab;
SELECT TRIM (LEADING FROM c1) FROM tab;
UPDATE c1='xyz' FROM tab WHERE LENGTH(TRIM(c1))=5;
SELECT c1, TRIM(LEADING '#' FROM TRIM(TRAILING '%' FROM
   '###abc%%%')) FROM tab;
```

When you use the DESCRIBE statement with a SELECT statement that uses the **TRIM** function in the projection list, the described character type of the trimmed column depends on the database server that you are using and on the data type of the *source_expression*. For further information on the GLS aspects of the **TRIM** function in ESQL/C, see the *IBM Informix GLS User's Guide*.

Fixed Character Columns: The **TRIM** function can be specified on fixed-length character columns. If the length of the string is not completely filled, the unused characters are padded with blank space. Figure 4-3 shows this concept for the column entry '##A2T##', where the column is defined as CHAR(10).

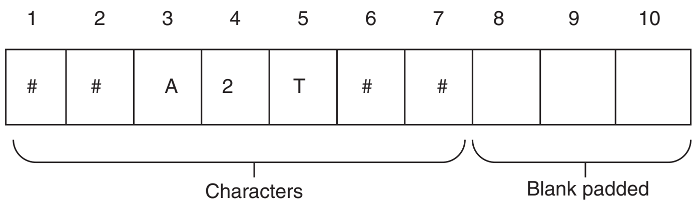


Figure 4-3. Column Entry in a Fixed-Length Character Column

If you want to trim the sharp sign (#) *trim_expression* from the column, you need to consider the blank padded spaces as well as the actual characters.

For example, if you specify the trim specification BOTH, the result from the trim operation is A2T##, because the **TRIM** function does not match the blank padded space that follows the string. In this case, the only sharp signs (#) trimmed are those that precede the other characters. The SELECT statement is shown, followed by Figure 4-4, which presents the result.

```
SELECT TRIM(LEADING '#' FROM col1) FROM taba;
```

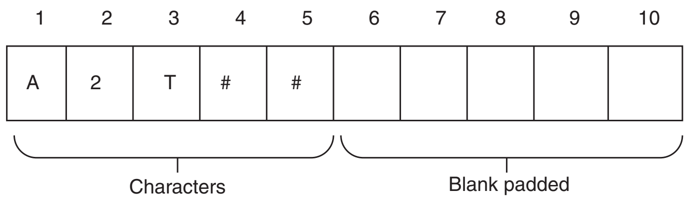


Figure 4-4. Result of TRIM Operation

This SELECT statement removes all occurrences of the sharp (#) sign:

```
SELECT TRIM(BOTH '#' FROM TRIM(TRAILING ' ' FROM col1)) FROM taba;
```

SUBSTRING Function: The **SUBSTRING** function returns a subset of a character string.

SUBSTRING Function:

```
├──SUBSTRING──(──source_string──FROM──start_position──┬──────────────┬──)──────────┤
                                                       └─FOR──length──┘
```

Element	Description	Restrictions	Syntax
length	Number of characters to return from *source_string*	Must be an expression, constant, column, or host variable that returns an integer	Literal Number, p. 4-137
source_string	String argument to the **SUBSTRING** function	Must be an expression, constant, column, or host variable whose value can be converted to a character data type	Expression, p. 4-34
start_position	Position in *source_string* of first returned character	Must be an expression, constant, column, or host variable that returns an integer	Literal Number, p. 4-137

Any argument to the **SUBSTRING** function must be of a built-in data type.

The subset begins at the column position that *start_position* specifies. The following table shows how the database server determines the starting position of the returned subset based on the input value of the *start_position.*

Value of Start_Position	How the Database Server Determines the Starting Position of the Return Subset
Positive	Counts forward from the first character in *source_string* For example, if *start_position* = 1, the first character in the *source_string* is the first character in the returned subset.
Zero (0)	Counts from one position before (that is, to the left of) the first character in *source_string* For example, if *start_position* = 0 and *length* = 1, the database server returns NULL, whereas if *length* = 2, the database server returns the first character in *source_string*.
Negative	Counts backward from one position after (that is, to the right of) the last character in *source_string* For example, if *start_position* = -1, the starting position of the returned subset is the last character in *source_string.*

In locales for languages with a right-to-left writing direction, such as Arabic, Farsi, or Hebrew, *right* should replace *left* in the preceding table.

The size of the subset is specified by *length*. The *length* parameter refers to the number of logical characters, rather than to the number of bytes. If you omit the *length* parameter, or if you specify a *length* that is greater than the number of characters from *start_position* to the end of *source_string*, the **SUBSTRING** function returns the entire portion of *source_ string* that begins at *start_position.* The following example specifies that the subset of the source string that begins in column position 3 and is two characters long should be returned:

```
SELECT SUBSTRING('ABCDEFG' FROM 3 FOR 2) FROM mytable
```

The following table shows the output of this SELECT statement.

(constant)
CD

In the following example, the user specifies a negative *start_position* for the return subset:

```
SELECT SUBSTRING('ABCDEFG' FROM -3 FOR 7)
   FROM mytable
```

The database server starts at the -3 position (four positions before the first character) and counts forward for 7 characters. The following table shows the output of this SELECT statement.

(constant)
ABC

SUBSTR Function: The **SUBSTR** function has the same purpose as the **SUBSTRING** function (to return a subset of a source string), but it uses different syntax.

SUBSTR Function:

```
├──SUBSTR──(──source_string──,──start_position──┬─────────────┬──)────────────┤
                                                 └─,──length──┘
```

Element	Description	Restrictions	Syntax
length	Number of characters to be returned from source_string	Must be an expression, literal, column, or host variable that returns an integer	Expression, p. 4-34
source_string	String that serves as input to the **SUBSTR** function	Must be an expression, literal, column, or host variable of a data type that can be converted to a character data type	Expression, p. 4-34
start_position	Column position in *source_string* where the **SUBSTR** function starts to return characters	Must be an integer expression, literal, column, or host variable. Can have a plus sign (+), a minus sign (-), or no sign.	Literal Number, p. 4-137

Any argument to the **SUBSTR** function must be of a built-in data type.

The **SUBSTR** function returns a subset of *source_string*. The subset begins at the column position that *start_position* specifies. The following table shows how the database server determines the starting position of the returned subset based on the input value of the *start_position.*

Value of Start_Position	How the Database Server Determines the Starting Position of the Returned Subset
Positive	Counts forward from the first character in *source_string*
Zero (`0`)	Counts forward from the first character in *source_string* (that is, treats a *start_position* of 0 as equivalent to 1)
Negative	Counts backward from an origin that immediately follows the last character in *source_string* A value of -1 returns the last character in *source_string*.

The *length* parameter specifies the number of logical characters (not the number of bytes) in the subset. If you omit the *length* parameter, the **SUBSTR** function returns the entire portion of *source_string* that begins at *start_position.*

If you specify a negative *start_position* whose absolute value is greater than the number of characters in *source_string*, or if *length* is greater than the number of characters from *start_position* to the end of *source_string*, **SUBSTR** returns NULL. (In this case, the behavior of **SUBSTR** is different from that of the **SUBSTRING** function, which returns all the characters from *start_position* to the last character of *source_string*, rather than returning NULL.)

The next example specifies that the string of characters to be returned begins at a starting position 3 characters before the end of a 7-character *source_string*. This implies that the starting position is the fifth character of *source_string*. Because the user does not specify a value for *length*, the database server returns a string that includes all characters from character-position 5 to the end of *source_string*.

```
SELECT SUBSTR('ABCDEFG', -3)
   FROM mytable
```

The following table shows the output of this SELECT statement.

(constant)
EFG

REPLACE Function: The **REPLACE** function replaces specified characters within a source string with different characters.

REPLACE Function:

```
├──REPLACE──(──source_string──,──old_string──┬─────────────────┬──)──────────────────┤
                                             └─,──new_string───┘
```

Element	Description	Restrictions	Syntax
new_string	Character or characters that replace *old_string* in the return string	Must be an expression, constant, column, or host variable of a data type that can be converted to a character data type	Expression, p. 4-34
old_string	Character or characters in *source_string* that are to be replaced by *new_string*	Must be an expression, constant, column, or host variable of a data type that can be converted to a character data type	Expression, p. 4-34
source_string	String of characters argument to the **REPLACE** function	Must be an expression, constant, column, or host variable of a data type that can be converted to a character data type	Expression, p. 4-34

Any argument to the **REPLACE** function must be of a built-in data type.

The **REPLACE** function returns a copy of *source_string* in which every occurrence of *old_string* is replaced by *new_string*. If you omit the *new_string* option, every occurrence of *old_string* is omitted from the return string.

In the following example, the user replaces every occurrence of `xz` in the source string with `t`:

```
SELECT REPLACE('Mighxzy xzime', 'xz', 't')
   FROM mytable
```

The following table shows the output of this SELECT statement.

(constant)
`Mighty time`

LPAD Function: The **LPAD** function returns a copy of *source_string* that is left-padded to the total number of characters specified by *length*.

LPAD Function:

```
├──LPAD──(──source_string──,──length──┬──────────────────┬──)──────────────────────┤
                                      └─,──pad_string────┘
```

Element	Description	Restrictions	Syntax
length	Integer value that specifies total number of characters in the returned string	Must be an expression, constant, column, or host variable of a data type that can be converted to a character data type	Literal Number, p. 4-137
pad_string	String that specifies the pad character or characters	Must be an expression, constant, column, or host variable of a data type that can be converted to a character data type	Expression, p. 4-34
source_string	String that serves as input to the LPAD function	Must be an expression, constant, column, or host variable of a data type that can be converted to a character data type	Expression, p. 4-34

Any argument to the **LPAD** function must be of a built-in data type.

The *pad_string* parameter specifies the character or characters to be used for padding the source string. The sequence of pad characters occurs as many times as necessary to make the return string the length specified by *length*.

The series of pad characters in *pad_string* is truncated if it is too long to fit into *length*. If you specify no *pad_string*, the default value is a single blank.

In the following example, the user specifies that the source string is to be left-padded to a total length of 16 characters. The user also specifies that the pad characters are a series consisting of a hyphen and an underscore (-_).

```
SELECT LPAD('Here we are', 16, '-_') FROM mytable
```

The following table shows the output of this SELECT statement.

(constant)
`-_-_-Here we are`

RPAD Function: The **RPAD** function returns a copy of *source_string* that is right-padded to the total number of characters that *length* specifies.

RPAD Function:

```
|--RPAD--(--source_string--,--length--+----------------+--)--------------|
                                      '-,--pad_string--'
```

Element	Description	Restrictions	Syntax
length	The number of characters in the returned string	Must be an expression, constant, column, or host variable that returns an integer	Literal Number, p. 4-137
pad_string	String that specifies the pad character or characters	Must be an expression, column, constant, or host variable of a data type that can be converted to a character data type	Expression, p. 4-34
source_string	String that serves as input to the RPAD function	Same as for *pad_stringe*	Expression, p. 4-34

Any argument to the **RPAD** function must be of a built-in data type.

The *pad_string* parameter specifies the pad character or characters to be used to pad the source string.

The series of pad characters occurs as many times as necessary to make the return string reach the length that *length* specifies. The series of pad characters in *pad_string* is truncated if it is too long to fit into *length*. If you omit the *pad_string* parameter, the default value is a single blank space.

In the following example, the user specifies that the source string is to be right-padded to a total length of 18 characters. The user also specifies that the pad characters to be used are a sequence consisting of a question mark and an exclamation point (?!)

```
SELECT RPAD('Where are you', 18, '?!')
   FROM mytable
```

The following table shows the output of this SELECT statement.

(constant)
`Where are you?!?!?`

Case-Conversion Functions

The case-conversion functions perform lettercase conversion on alphabetic characters. In the default locale, only the ASCII characters `A - Z` and `a - z` can be modified by these functions, which enable you to perform case-insensitive searches in your queries and to specify the format of the output.

The case-conversion functions are **UPPER**, **LOWER**, and **INITCAP**. The following diagram shows the syntax of these case-conversion functions.

Case-Conversion Functions:

```
├──┬─UPPER───┬──(──expression──)──────────────────────────────┤
   ├─LOWER───┤
   └─INITCAP─┘
```

Element	Description	Restrictions	Syntax
expression	Expression returning a character string	Must be a character type. If a host variable, its length must be long enough to store the converted string.	Expression, p. 4-34

The *expression* must return a character data type. When the column is described, the data type returned by the database server is that of *expression*. For example, if the input type is CHAR, the output type is also CHAR.

Argument to these functions must be of the built-in data types.

In all locales, the byte length returned from the description of a column with a case-conversion function is the input byte length of the source string. If you use a case-conversion function with a multibyte *expression* argument, the conversion might increase or decrease the length of the string. If the byte length of the result string exceeds the byte length *expression*, the database server truncates the result string to fit into the byte length of *expression*.

Only characters designated as ALPHA class in the locale file are converted, and this occurs only if the locale recognizes the construct of lettercase.

If *expression* is NULL, the result of a case-conversion function is also NULL.

The database server treats a case-conversion function as an SPL routine in the following instances:

- If it has no argument
- If it has one argument, and that argument is a named argument
- If it has more than one argument
- If it appears in a projection list with a host variable as an argument

If none of the conditions in the preceding list are met, the database server treats a case-conversion function as a system function.

The following example uses all the case-conversion functions in the same query to specify multiple output formats for the same value:

```
Input value:

SAN Jose

Query:

SELECT City, LOWER(City), LOWER("City"),
   UPPER (City), INITCAP(City)
      FROM Weather;

Query output:

SAN Jose   san jose   city   SAN JOSE   San Jose
```

UPPER Function: The **UPPER** function accepts an *expression* argument and returns a character string in which every lowercase alphabetical character in the *expression* is replaced by a corresponding uppercase alphabetic character.

The following example uses the **UPPER** function to perform a case-insensitive search on the **lname** column for all employees with the last name of **Curran**:

```
SELECT title, INITCAP(fname), INITCAP(lname) FROM employees
   WHERE UPPER (lname) = "CURRAN"
```

Because the **INITCAP** function is specified in the projection list, the database server returns the results in a mixed-case format. For example, the output of one matching row might read: `accountant James Curran`.

LOWER Function: The **LOWER** function accepts an *expression* argument and returns a character string in which every uppercase alphabetic character in the *expression* is replaced by a corresponding lowercase alphabetic character.

The following example shows how to use the **LOWER** function to perform a case-insensitive search on the **City** column. This statement directs the database server to replace all instances (that is, any variation) of the words `san jose`, with the mixed-case format, `San Jose`.

```
UPDATE Weather SET City = "San Jose"
WHERE LOWER (City) = "san jose";
```

INITCAP Function: The **INITCAP** function returns a copy of the *expression* in which every word in the *expression* begins with an uppercase letter. With this function, a *word* begins after any character other than a letter. Thus, in addition to a blank space, symbols such as commas, periods, colons, and so on, introduce a new word.

For an example of the **INITCAP** function, see "UPPER Function" on page 4-110.

IFX_ALLOW_NEWLINE Function

The **IFX_ALLOW_NEWLINE** function sets a newline mode that allows newline characters in quoted strings or disallows newline characters in quoted strings within the current session.

IFX_ALLOW_NEWLINE Function:

```
├──IFX_ALLOW_NEWLINE──(──┬─' t '─┬──)──────────────────────────────────┤
                         └─' f '─┘
```

If you enter `'t'` as the argument of this function, you enable newline characters in quoted strings in the session. If you enter `'f'` as the argument, you disallow newline characters in quoted strings in the session.

You can set the newline mode for all sessions by setting the ALLOW_NEWLINE parameter in the **ONCONFIG** file to a value of `0` (newline characters not allowed) or to a value of `1` (newline characters allowed). If you do not set this configuration parameter, the default value is `0`. Each time you start a session, the new session inherits the newline mode set in the **ONCONFIG** file. To change the newline mode for the session, execute the **IFX_ALLOW_NEWLINE** function. Once you have set the newline mode for a session, the mode remains in effect until the end of the session or until you execute the **IFX_ALLOW_NEWLINE** function again within the session.

In the following example, assume that you did not specify any value for the ALLOW_NEWLINE parameter in the **ONCONFIG** file, so, by default, newline characters are not allowed in quoted strings in any session. After you start a new session, you can enable newline characters in quoted strings in that session by executing the **IFX_ALLOW_NEWLINE** function:

```
EXECUTE PROCEDURE IFX_ALLOW_NEWLINE('t')
```

In ESQL/C, the newline mode that is set by the ALLOW_NEWLINE parameter in the **ONCONFIG** file or by the execution of the **IFX_ALLOW_NEWLINE** function in a session applies only to quoted-string literals in SQL statements. The newline mode does not apply to quoted strings contained in host variables in SQL statements. Host variables can contain newline characters within string data regardless of the newline mode currently in effect.

For example, you can use a host variable to insert data that contains newline characters into a column even if the ALLOW_NEWLINE parameter in the **ONCONFIG** file is set to 0.

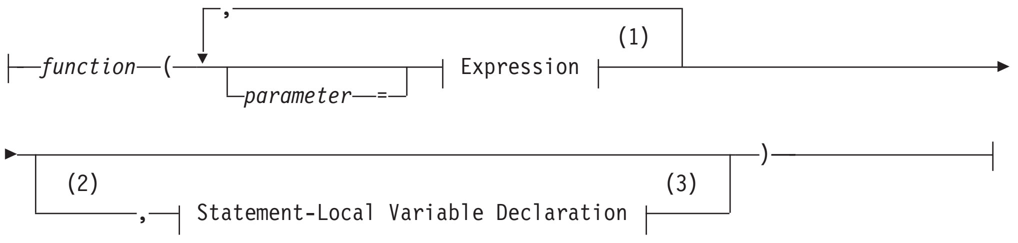
For further information on how the **IFX_ALLOW_NEWLINE** function affects quoted strings, see "Quoted String" on page 4-142. For further information on the ALLOW_NEWLINE parameter in the **ONCONFIG** file, see the *IBM Informix Administrator's Reference*.

User-Defined Functions

A user-defined function is a function that you write in SPL or in a language external to the database, such as C or Java.

User-Defined Functions:

Expression



Notes:

1 See page “Expression” on page 4-34

2 Dynamic Server only

3 See page “Statement-Local Variable Declaration (IDS)” on page 4-113

Element	Description	Restrictions	Syntax
function	Name of the function	Function must exist	Database Object Name, p. 5-17
parameter	Name of an argument that was declared in a CREATE FUNCTION statement	If you use the *parameter* = option for any argument in the called function, you must use it for all arguments	Identifier, p. 5-22

You can call user-defined functions within SQL statements. Unlike built-in functions, user-defined functions can only be used by the creator of the function, the DBA, and the users who have been granted the Execute privilege on the function. For more information, see “GRANT” on page 2-371.

The following examples show some user-defined function expressions. The first example omits the *parameter* option when it lists the function argument:

```
read_address('Miller')
```

This second example uses the *parameter* option to specify the argument value:

```
read_address(lastname = 'Miller')
```

When you use the *parameter* option, the *parameter* name must match the name of the corresponding parameter in the function registration. For example, the preceding example assumes that the **read_address( )** function had been registered as follows:

```
CREATE FUNCTION read_address(lastname CHAR(20))
   RETURNING address_t ...  ;
```

In Dynamic Server, a *statement-local variable* (SLV) enables you to transmit a value from a user-defined function call to another part of the SQL statement.

To use an SLV with a call to a user-defined function:

1. Write one or more OUT parameters (and for UDRs written in Java language, INOUT parameters) for the user-defined function.

   For information on how to write a UDR with OUT or INOUT parameters, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.
2. When you register the user-defined function, specify the OUT keyword before each OUT parameter, and the INOUT keyword before each INOUT parameter.

For more information, see "Specifying INOUT Parameters for a User-Defined Routine (IDS)" on page 5-64, and "Specifying OUT Parameters for User-Defined Routines" on page 5-63.

3. Declare the SLV in a function expression that calls the user-defined function with each OUT and INOUT parameter.

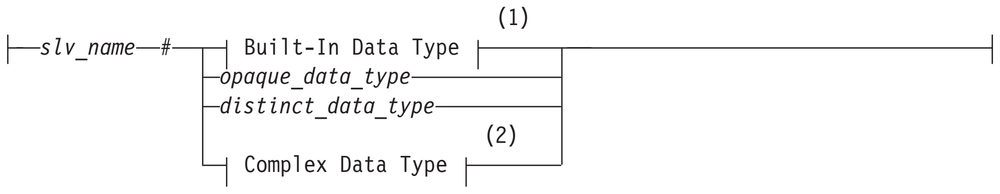
   The call to the user-defined function must be made within a WHERE clause. For information about the syntax to declare the SLV, see "Statement-Local Variable Declaration (IDS)" on page 4-113.

4. Use the SLV that the user-defined function has initialized within the SQL statement.

   Once the call to the user-defined function has initialized the SLV, you can use this value in other parts of the SQL statement. For information about the use of an SLV within an SQL statement, see "Statement-Local Variable Expressions (IDS)" on page 4-114.

Statement-Local Variable Declaration (IDS): The Statement-Local Variable Declaration declares a statement-local variable (SLV) in a call to a user-defined function that defines one or more OUT or INOUT parameters.

Statement-Local Variable Declaration:



Notes:

1 See page 4-18

2 See page 4-28

Element	Description	Restrictions	Syntax
distinct_data_type	Name of a distinct data type	The distinct data type must already exist in the database	Identifier, p. 5-22
opaque_data_type	Name of an opaque data type	The opaque data type must already exist in the database	Identifier, p. 5-22
slv_name	Name of a statement local variable you are defining	The *slv_name* is valid only for the life of the statement, and must be unique within the statement	Identifier, p. 5-22

You declare an SLV in a user-defined function call so that a user-defined function can assign the value of its OUT or INOUT parameter to the SLV. The UDF *must* be invoked in the WHERE clause of the SQL statement. For example, if you register a function with the following CREATE FUNCTION statement, you can use its **y** parameter as an SLV in a WHERE clause:

```
CREATE FUNCTION find_location(a FLOAT, b FLOAT, OUT y INTEGER)
RETURNING VARCHAR(20)
EXTERNAL NAME "/usr/lib/local/find.so"
LANGUAGE C
```

In this example, **find_location( )** accepts two FLOAT values that represent a latitude and a longitude and return the name of the nearest city with an extra value of type INTEGER that represents the population rank of the city.

You can now call **find_location( )** in a WHERE clause:

```
SELECT zip_code_t FROM address
   WHERE address.city = find_location(32.1, 35.7, rank # INT)
   AND rank < 101;
```

The function expression passes two FLOAT values to **find_location( )** and declares an SLV named **rank** of type INT. In this case, **find_location( )** will return the name of the city nearest latitude 32.1 and longitude 35.7 (which might be a heavily populated area) whose population rank is between 1 and 100. The statement then returns the zip code that corresponds to that city.

The WHERE clause of the SQL statement *must* produce an SLV that is used within other parts of the statement. The following SELECT statement is *invalid* because the projection list of the Projection clause produces the SLV:

```
-- invalid SELECT statement
SELECT title, contains(body, 'dog and cat', rank # INT), rank
   FROM documents
```

The data type you use when you declare the SLV in a statement must be the same as the data type of the corresponding OUT or INOUT parameter in the CREATE FUNCTION statement. If you use different but compatible data types, such as INTEGER and FLOAT, the database server automatically performs the cast between the data types.

SLVs share the name space with UDR variables and the column names of the table involved in the SQL statement. Therefore, the database uses the following precedence to resolve ambiguous situations:

- UDR variables
- Column names
- SLVs

Once the user-defined function assigns its OUT parameter to the SLV, you can use this SLV value in other parts of the SQL statement. For more information, see "Statement-Local Variable Expressions (IDS)" on page 4-114.

Statement-Local Variable Expressions (IDS)

The Statement-Local Variable Expression specifies a statement-local variable (SLV) that you can use elsewhere in the same SQL statement.

Statement-Local Variable Expressions:

```
├──SLV_variable──────────────────────────────────────────────────────┤
```

Element	Description	Restrictions	Syntax
SLV_variable	Statement-local variable (SLV) assigned in a call to a user-defined function in the same SQL statement	The *SLV_variable* exists only for the life of the statement. Its name must be unique within the statement	Identifier, p. 5-22

You define an SLV in the call to a user-defined function in the WHERE clause of the SQL statement. This user-defined function must be defined with one or more OUT or INOUT parameters. The call to the user-defined function assigns the value of the OUT or INOUT parameters to the SLVs. For more information, see "Statement-Local Variable Declaration (IDS)" on page 4-113.

Once the user-defined function assigns its OUT or INOUT parameters to the SLVs, you can use these values in other parts of the SQL statement, subject to the following scope-of-reference rules:

- The SLV is *read-only* throughout the query (or subquery) in which it is defined.
- The scope of an SLV extends from the query in which the SLV is defined down into all nested subqueries.

  In other words, if a query contains a subquery, an SLV that is visible in the query is also visible to all subqueries of that query.
- In nested queries, the scope of an SLV does not extend upwards.

  In other words, if a query contains a subquery and the SLV is defined in the subquery, it is not visible to the parent query.
- In queries that involve UNION, the SLV is only visible in the query in which it is defined.

  The SLV is not visible to all other queries involved in the UNION.
- For INSERT, DELETE, and UPDATE statements, an SLV is not visible outside the SELECT portion of the statement.

  Within this SELECT portion, all the above scoping rules apply.

Important: A statement-local variable is in scope only for the duration of a single SQL statement.

The following SELECT statement calls the **find_location( )** function in a WHERE clause and defines the **rank** SLV. Here **find_location( )** accepts two values that represent a latitude and a longitude and return the name of the nearest city with an extra value of type INTEGER that represents the population rank of the city.

```
SELECT zip_code_t FROM address
   WHERE address.city = find_location(32.1, 35.7, rank # INT)
   AND rank < 101;
```

When execution of the **find_location()** function completes successfully, the function has initialized the **rank** SLV. The SELECT then uses this **rank** value in a second WHERE clause condition. In this example, the Statement-Local Variable Expression is the variable **rank** in the second WHERE clause condition:

```
rank < 101
```

The number of OUT and INOUT parameters and SLVs that a UDF can have is not restricted. (Releases of Dynamic Server earlier than Version 9.4 restricted user-defined functions to a single OUT parameter and no INOUT parameters, thereby restricting the number of SLVs to no more than one.)

If the user-defined function that initializes the SLVs is *not* executed in an iteration of the statement, the SLVs each have a value of NULL. Values of SLVs do not persist across iterations of the statement. At the start of each iteration, the database server sets the SLV values to NULL.

The following partial statement calls two user-defined functions with OUT parameters, whose values are referenced with the SLV names **out1** and **out2**:

```
SELECT...
   WHERE func_2(x, out1 # INTEGER) < 100
   AND (out1 = 12 OR out1 = 13)
   AND func_3(a, out2 # FLOAT) = "SAN FRANCISCO"
   AND out2 = 3.1416;
```

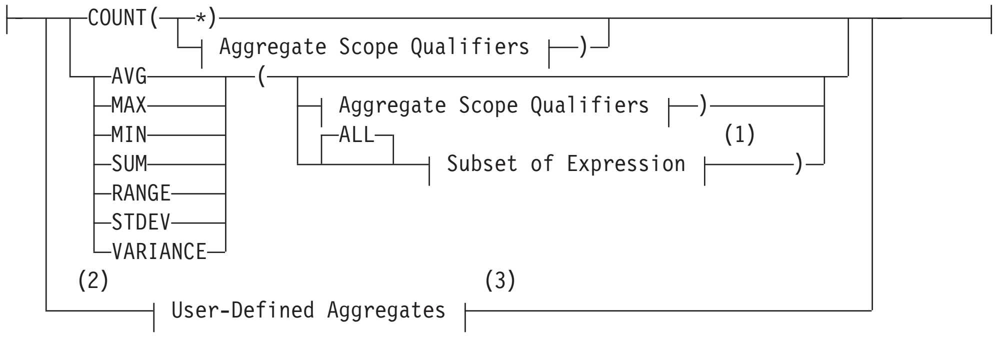
If a function assigns one or more OUT or INOUT parameter values from another database of the local database server to SLVs, the values must be of built-in data types, or DISTINCT data types whose base types are built-in data types (and that you explicitly cast to built-in data types), or must be UDTs that you explicitly cast to built-in data types. All the UDTs, DISTINCT types, and casts must be defined in all of the participating databases.

For more information on how to write a user-defined function with OUT or INOUT parameters, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

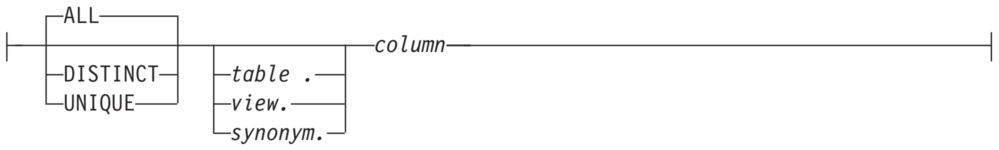
Aggregate Expressions

An aggregate expression uses an aggregate function to summarize selected database data. The built-in aggregate functions have the following syntax.

Aggregate Expressions:



Aggregate Scope Qualifiers:



Notes:

1 See page "Subset of Expressions Valid in an Aggregate Expression" on page 4-118

2 Dynamic Server only

3 See page "User-Defined Aggregates" on page 4-117

Element	Description	Restrictions	Syntax
column	Column to which aggregate function is applied	See headings for individual keywords on pages that follow	Identifier, p. 5-22
synonym, table, view	Synonym, table, or view that contains *column*	*Synonym* and the *table* or *view* to which it points must exist	Database Object Name, p. 5-17

You cannot use an aggregate expression in a condition that is part of a WHERE clause unless you use the aggregate expression within a subquery. You cannot apply an aggregate function to a BYTE or TEXT column. For other general restrictions, see "Subset of Expressions Valid in an Aggregate Expression" on page 4-118.

An aggregate function returns one value for a set of queried rows. The following examples show aggregate functions in SELECT statements:

```
SELECT SUM(total_price) FROM items WHERE order_num = 1013

SELECT COUNT(*) FROM orders WHERE order_num = 1001

SELECT MAX(LENGTH(fname) + LENGTH(lname)) FROM customer
```

If you use an aggregate function and one or more columns in the projection list of the Projection clause, you must put all the column names that are not used as part of an aggregate or time expression in the GROUP BY clause.

Types of Aggregate Expressions

SQL statements can include *built-in* aggregates and *user-defined* aggregates. The built-in aggregates include all the aggregates shown in the syntax diagram in "Aggregate Expressions" on page 4-116 except for the "User-Defined Aggregates" category. User-defined aggregates are any new aggregates that the user creates with the CREATE AGGREGATE statement.

Built-in Aggregates: Built-in aggregates are aggregate functions that are defined by the database server, such as AVG, SUM, and COUNT. These aggregates work only with built-in data types, such as INTEGER and FLOAT. You can extend these built-in aggregates to work with extended data types. To extend built-in aggregates, you must create UDRs that overload several binary operators.

After you overload the binary operators for a built-in aggregate, you can use that aggregate with an extended data type in an SQL statement. For example, if you have overloaded the **plus** operator for the SUM aggregate to work with a specified row type and assigned this row type to the **complex** column of the **complex_tab** table, you can apply the SUM aggregate to the **complex** column:

```
SELECT SUM(complex) FROM complex_tab
```

For more information on how to extend built-in aggregates, see *IBM Informix User-Defined Routines and Data Types Developer's Guide*. For information on how to invoke built-in aggregates, see the descriptions of individual built-in aggregates in the following pages.

User-Defined Aggregates: A user-defined aggregate is an aggregate that you define to perform an aggregate computation that the database server does not provide. For example, you can create a user-defined aggregate named SUMSQ that returns the sum of the squared values of a specified column. User-defined aggregates can work with built-in data types or extended data types or both, depending on how you define the support functions for the user-defined aggregate.

To create a user-defined aggregate, use the CREATE AGGREGATE statement. In this statement you name the new aggregate and specify the support functions for the aggregate. Once you create the new aggregate and its support functions, you can use the aggregate in SQL statements. For example, if you created the SUMSQ aggregate and specified that it works with the FLOAT data type, you can apply the SUMSQ aggregate to a FLOAT column named **digits** in the **test** table:

```
SELECT SUMSQ(digits) FROM test
```

For more information on how to create user-defined aggregates, see "CREATE AGGREGATE" on page 2-84 and the discussion of user-defined aggregates in *IBM Informix User-Defined Routines and Data Types Developer's Guide*. For information on how to invoke user-defined aggregates, see "User-Defined Aggregates (IDS)" on page 4-125.

Subset of Expressions Valid in an Aggregate Expression

As indicated in the diagrams for "Aggregate Expressions" on page 4-116 and "User-Defined Aggregates (IDS)" on page 4-125, not all expressions are available when you use an aggregate expression. The argument of an aggregate function, for example, cannot itself contain an aggregate function. You cannot use aggregate functions in the following contexts:

- In a WHERE clause, unless it is contained in a subquery, or unless the aggregate is on a correlated column from a parent query and the WHERE clause is in a subquery within a HAVING clause
- As an argument to an aggregate function

  The following nested aggregate expression is invalid:

  ```
  MAX (AVG (order_num))
  ```
- On a BYTE or TEXT column

You cannot use a column that is a collection data type as an argument to the following aggregate functions:

- **AVG**
- **SUM**
- **MIN**
- **MAX**

Expression or *column* arguments to built-in aggregates (except for **COUNT**, **MAX**, **MIN**, and **RANGE**) must return numeric or INTERVAL data types, but **RANGE** also accepts DATE and DATETIME arguments.

For **SUM** and **AVG**, you cannot use the difference between two DATE values directly as the argument to an aggregate, but you can use DATE differences as operands within arithmetic expression arguments. For example:

```
SELECT . . .  AVG(ship_date - order_date)
```

returns error -1201, but the following equivalent expression is valid:

```
SELECT . . .  AVG((ship_date - order_date)*1)
```

Including or Excluding Duplicates in the Row Set

The DISTINCT keyword restricts the argument to unique values from the specified column. The UNIQUE and DISTINCT keywords are synonyms.

The ALL keyword specifies that all values selected from the column or expression, including any duplicate values, are used in the calculation.

AVG Function

The **AVG** function returns the average of all values in the specified column or expression. You can apply the **AVG** function only to number columns. If you use the DISTINCT keyword, the average (meaning the *mean*) is calculated from only the distinct values in the specified column or expression. The query in the following example finds the average price of a helmet:

```
SELECT AVG(unit_price) FROM stock WHERE stock_num = 110
```

NULLs are ignored unless every value in the column is NULL. If every column value is NULL, the **AVG** function returns a NULL for that column.

Overview of COUNT Functions

The **COUNT** function is actually a set of functions that enable you to count column values in different ways, according to arguments after the COUNT keyword. Each form of the **COUNT** function is explained in the following subsections. For a comparison of the different forms of the **COUNT** function, see "Comparison of the Different COUNT Functions" on page 4-120.

COUNT(*) Function

The **COUNT (*)** function returns the number of rows that satisfy the WHERE clause of a SELECT statement. The following example finds how many rows in the **stock** table have the value HRO in the **manu_code** column:

```
SELECT COUNT(*) FROM stock WHERE manu_code = 'HRO'
```

The following example queries one of the System Management Interface (SMI) tables to find the number of extents in the **customer** table:

```
SELECT COUNT(*) FROM sysextents WHERE dbs_name = 'stores' AND tabname = customer"
```

You can use **COUNT(*)** as the Projection clause in queries of this general format to obtain information from the SMI tables. For information about **sysextents** and other SMI tables, see the *IBM Informix Administrator's Reference* chapter that describes the **sysmaster** database.

If the SELECT statement does not have a WHERE clause, the **COUNT (*)** function returns the total number of rows in the table. The following example finds how many rows are in the **stock** table:

```
SELECT COUNT(*) FROM stock
```

If the SELECT statement contains a GROUP BY clause, the **COUNT (*)** function reflects the number of values in each group. The following example is grouped by the first name; the rows are selected if the database server finds more than one occurrence of the same name:

```
SELECT fname, COUNT(*) FROM customer GROUP BY fname
   HAVING COUNT(*) > 1
```

If the value of one or more rows is NULL, the **COUNT (*)** function includes the NULL columns in the count unless the WHERE clause explicitly omits them.

COUNT DISTINCT and COUNT UNIQUE Functions

The **COUNT DISTINCT** function returns the number of unique values in the column or expression, as the following example shows. If the **COUNT DISTINCT** function encounters NULL values, it ignores them:

```
SELECT COUNT (DISTINCT item_num) FROM items
```

NULLs are ignored unless every value in the specified column is NULL. If every column value is NULL, the **COUNT DISTINCT** function returns zero (0).

The UNIQUE keyword has the same meaning as the DISTINCT keyword in **COUNT** functions. The UNIQUE keyword instructs the database server to return the number of unique non-NULL values in the column or expression. The following example calls the **COUNT UNIQUE** function, but it is equivalent to the preceding example that calls the **COUNT DISTINCT** function:

```
SELECT COUNT (UNIQUE item_num) FROM items
```

COUNT column Function

The **COUNT** *column* function returns the total number of non-NULL values in the column or expression, as the following example shows:

```
SELECT COUNT (item_num) FROM items
```

The ALL keyword can precede the specified column name for clarity, but the query result is the same whether you include the ALL keyword or omit it.

The following example shows how to include the ALL keyword in the **COUNT** *column* function:

```
SELECT COUNT (ALL item_num) FROM items
```

Comparison of the Different COUNT Functions

You can use the different forms of the **COUNT** function to retrieve different types of information about a table. The following table summarizes the meaning of each form of the **COUNT** function.

COUNT Function	Description
COUNT (*)	Returns the number of rows that satisfy the query If you do not specify a WHERE clause, this function returns the total number of rows in the table.
COUNT (DISTINCT) or COUNT (UNIQUE)	Returns the number of unique non-NULL values in the specified column
COUNT (*column*) or COUNT (ALL *column*)	Returns the total number of non-NULL values in the specified column

Some examples can help to show the differences among the different forms of the **COUNT** function. Most of the following examples query against the **ship_instruct** column of the **orders** table in the demonstration database. For information on the structure of the **orders** table and the data in the **ship_instruct** column, see the description of the demonstration database in the *IBM Informix Guide to SQL: Reference*.

Examples of the COUNT(*) Function: In the following example, the user wants to know the total number of rows in the **orders** table. So the user calls the **COUNT(*)** function in a SELECT statement without a WHERE clause:

```
SELECT COUNT(*) AS total_rows FROM orders
```

The following table shows the result of this query.

total_rows
23

In the following example, the user wants to know how many rows in the **orders** table have a NULL value in the **ship_instruct** column. The user calls the **COUNT(*)** function in a SELECT statement with a WHERE clause, and specifies the IS NULL condition in the WHERE clause:

```
SELECT COUNT (*) AS no_ship_instruct FROM orders
   WHERE ship_instruct IS NULL
```

The following table shows the result of this query.

no_ship_instruct
2

In the following example, the user wants to know how many rows in the **orders** table have the value `express` in the **ship_instruct** column. So the user calls the **COUNT(*)** function in the projection list and specifies the equals (=) relational operator in the WHERE clause.

```
SELECT COUNT (*) AS ship_express FROM ORDERS
   WHERE ship_instruct = 'express'
```

The following table shows the result of this query.

ship_express
6

Examples of the COUNT DISTINCT Function: In the next example, the user wants to know how many unique non-NULL values are in the **ship_instruct** column of the **orders** table. The user calls the **COUNT DISTINCT** function in the projection list of the SELECT statement:

```
SELECT COUNT(DISTINCT ship_instruct) AS unique_notnulls
   FROM orders
```

The following table shows the result of this query.

unique_notnulls
16

Examples of the COUNT column Function: In the following example the user wants to know how many non-NULL values are in the **ship_instruct** column of the **orders** table. The user invokes the **COUNT(***column***)** function in the Projection list of the SELECT statement:

```
SELECT COUNT(ship_instruct) AS total_notnullsFROM orders;
```

The following table shows the result of this query.

total_notnulls
21

A similar query for non-NULL values in the **ship_instruct** column can include the ALL keyword in the parentheses that follow the COUNT keyword:

```
SELECT COUNT(ALL ship_instruct) AS all_notnulls FROM orders
```

The following table shows that the query result is the same whether you include or omit the ALL keyword (because ALL is the default).

all_notnulls
21

MAX Function

The **MAX** function returns the largest value in the specified column or expression. Using the DISTINCT keyword does not change the results. The query in the following example finds the most expensive item that is in stock but has not been ordered:

```
SELECT MAX(unit_price) FROM stock
   WHERE NOT EXISTS (SELECT * FROM items
      WHERE stock.stock_num = items.stock_num AND
      stock.manu_code = items.manu_code)
```

NULLs are ignored unless every value in the column is NULL. If every column value is NULL, the **MAX** function returns a NULL for that column.

MIN Function

The **MIN** function returns the lowest value in the column or expression. Using the DISTINCT keyword does not change the results. The following example finds the least expensive item in the **stock** table:

```
SELECT MIN(unit_price) FROM stock
```

NULL values are ignored unless every value in the column is NULL. If every column value is NULL, the **MIN** function returns a NULL for that column.

SUM Function

The **SUM** function returns the sum of all the values in the specified column or expression, as the following example shows. If you use the DISTINCT keyword, the sum is for only distinct values in the column or expression:

```
SELECT SUM(total_price) FROM items WHERE order_num = 1013
```

NULL values are ignored unless every value in the column is NULL. If every column value is NULL, the **SUM** function returns a NULL for that column. You cannot use the **SUM** function with a non-numeric column.

RANGE Function

The **RANGE** function computes the range of returned values. It calculates the difference between the maximum and the minimum values, as follows:

```
range(expr) = max(expr) - min(expr)
```

You can apply the **RANGE** function only to numeric columns. The following query finds the range of ages for a population:

```
SELECT RANGE(age) FROM u_pop
```

As with other aggregates, the **RANGE** function applies to the rows of a group when the query includes a GROUP BY clause, as the next example shows:

```
SELECT RANGE(age) FROM u_pop GROUP BY birth
```

Because DATE values are stored internally as integers, you can use the **RANGE** function on DATE columns. With a DATE column, the return value is the number of days between the earliest and latest dates in the column.

NULL values are ignored unless every value in the column is NULL. If every column value is NULL, the **RANGE** function returns a NULL for that column.

Important: All computations for the **RANGE** function are performed in 32-digit precision, which should be sufficient for many sets of input data. The computation, however, loses precision or returns incorrect results when all of the input data values have 16 or more digits of precision.

STDEV Function

The **STDEV** function computes the standard deviation of a data set, which is the square root of the **VARIANCE** function. You can apply the **STDEV** function only to numeric columns. The next query finds the standard deviation:

```
SELECT STDEV(age) FROM u_pop WHERE u_pop.age > 0
```

As with the other aggregates, the **STDEV** function applies to the rows of a group when the query includes a GROUP BY clause, as this example shows:

```
SELECT STDEV(age) FROM u_pop GROUP BY birth WHERE STDEV(age) > 0
```

NULL values are ignored unless every value in the specified column is NULL. If every column value is NULL, **STDEV** returns a NULL for that column.

Important: All computations for the **STDEV** function are performed in 32-digit precision, which should be sufficient for many sets of input data. The computation, however, loses precision or returns incorrect results when all of the input data values have 16 or more digits of precision.

You cannot use this function on columns of type DATE.

Within a SELECT Statement with GROUP BY clause, **STDEV** returns a zero variance for a count of 1. You can omit this special case through appropriate query construction (for example, "`HAVING COUNT(*) > 1`"). Otherwise, a data set that has only a few cases might block the rest of the query result.

VARIANCE Function

The **VARIANCE** function returns an estimate of the population variance, as the standard deviation squared. **VARIANCE** calculates the following value:

$(SUM(X_i^2) - (SUM(X_i)^2)/N)/(N - 1)$

In this formula, X_i is each value in the column and N is the total number of non-NULL values in the column (unless all values are NULL, in which case the variance is logically undefined, and the **VARIANCE** function returns NULL).

You can apply the **VARIANCE** function only to numeric columns.

The following query estimates the variance of **age** values for a population:

```
SELECT VARIANCE(age) FROM u_pop WHERE u_pop.age > 0
```

As with the other aggregates, the **VARIANCE** function applies to the rows of a group when the query includes a GROUP BY clause, as in this example:

```
SELECT VARIANCE(age) FROM u_pop GROUP BY birth
   WHERE VARIANCE(age) > 0
```

As previously noted, **VARIANCE** ignores NULL values unless every qualified row is NULL for a specified column. If every value is NULL, then **VARIANCE** returns a NULL result for that column. (This typically indicates missing data, and is not necessarily a good estimate of underlying population variance.)

If *N*, the total number of qualified non-NULL column values, equals one, then the **VARIANCE** function returns zero (another implausible estimate of the true population variance). To omit this special case, you can modify the query. For example, you might include a `HAVING COUNT(*) > 1` clause.

Important: All calculations for the **VARIANCE** function are performed in 32-digit precision, which should be sufficient for many sets of input data. The computation, however, loses precision or returns incorrect results when all of the input data values have 16 or more digits of precision.

Although DATE values are stored internally as an integer, you cannot use the **VARIANCE** function on columns of data type DATE.

Error Checking in ESQL/C

Aggregate functions always return one row. If no rows are selected, the function returns a NULL. You can use the **COUNT (*)** function to determine whether any rows were selected, and you can use an indicator variable to determine whether any selected rows were empty. Fetching a row with a cursor that is associated with an aggregate function always returns one row; hence, `100` for end of data is never returned into the **sqlcode** variable for a first fetch attempt.

You can also use the GET DIAGNOSTICS statement for error checking.

Summary of Aggregate Function Behavior

An example can help to summarize the behavior of the aggregate functions. Assume that the **testtable** table has a single INTEGER column that is named **num**. The contents of this table are as follows.

num
2
2
2
3
3
4
(NULL)

You can use aggregate functions to obtain information about the **num** column and the **testtable** table. The following query uses the **AVG** function to obtain the average of all the non-NULL values in the **num** column:

```
SELECT AVG(num) AS average_number FROM testtable
```

The following table shows the result of this query.

average_number
2.66666666666667

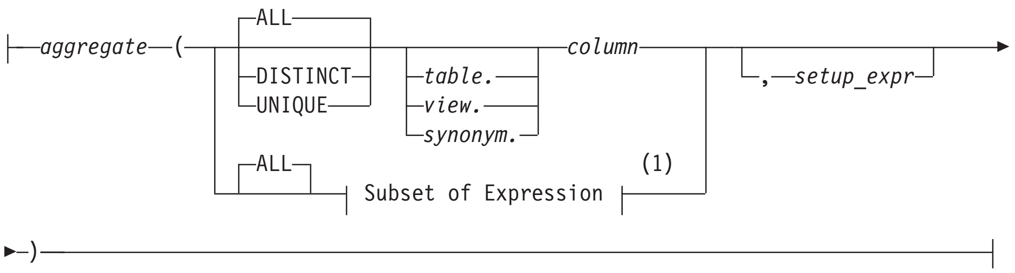
You can use the other aggregate functions in SELECT statements that are similar to the preceding example. If you enter a series of SELECT statements that have different aggregate functions in the projection list and do not include a WHERE clause, you receive the results that the following table shows.

Function	Results	Function	Results
COUNT (*)	7	MAX	4
COUNT (DISTINCT)	3	MAX(DISTINCT)	4
COUNT (ALL *num*)	6	MIN	2
COUNT (*num*)	6	MIN(DISTINCT)	2
AVG	2.66666666666667	RANGE	2
AVG (DISTINCT)	3.00000000000000	SUM	16
STDEV	0.74535599249993	SUM(DISTINCT)	9
VARIANCE	0.55555555555556		

User-Defined Aggregates (IDS)

You can create your own aggregate expressions with the CREATE AGGREGATE statement and then invoke these aggregates wherever you can invoke the built-in aggregates. The following diagram shows the syntax for invoking a user-defined aggregate.

User-Defined Aggregates:



Notes:

1 See page 4-118

Element	Description	Restrictions	Syntax
aggregate	Name of the user-defined aggregate to invoke	The *aggregate* and the support functions defined for *aggregate* must exist	Identifier, p. 5-22
column	Name of a column within *table*	Must exist and have a numeric data type	Quoted String, p. 4-142
setup_expr	Set-up expression that customizes *aggregate* for a specific invocation	Cannot be a lone host variable. Any columns referenced in *setup_expr* must be in the GROUP BY clause of the query	Expression, p. 4-34
synonym, table, view	Synonym, table, or view in which *column* occurs	The *synonym* and the table or view to which it points must exist	Database Object Name, p. 5-17

Use the DISTINCT or UNIQUE keywords to specify that the user-defined aggregate is to be applied only to unique values in the named column or expression. Use the ALL keyword to specify that the aggregate is to be applied to all values in the named column or expression.

If you omit the DISTINCT, UNIQUE, and ALL keywords, ALL is the default. For further information on the DISTINCT, UNIQUE, and ALL keywords, see "Including or Excluding Duplicates in the Row Set" on page 4-118.

When you specify a setup expression, this value is passed to the **INIT** support function that was defined for the user-defined aggregate in the CREATE AGGREGATE statement.

In the following example, you apply the user-defined aggregate named **my_avg** to all values of the **quantity** column in the **items** table:

```
SELECT my_avg(quantity) FROM items
```

In the following example, you apply the user-defined aggregate named **my_sum** to unique values of the **quantity** column in the **items** table. You also supply the value 5 as a setup expression. This value might specify that the initial value of the sum that **my_avg** will compute is 5.

```
SELECT my_sum(DISTINCT quantity, 5) FROM items
```

In the following example, you apply the user-defined aggregate named **my_max** to all values of the **quantity** column in the remote **items** table:

```
SELECT my_max(remote.quantity) FROM rdb@rserv:items remote
```

If the **my_max** aggregate is defined as EXECUTEANYWHERE, then the distributed query can be pushed to the remote database server, **rserv**, for execution. If the **my_max** aggregate is not defined as EXECUTEANYWHERE, then the distributed query scans the remote **items** table and computes the **my_max** aggregate on the local database server.

You cannot qualify a user-defined aggregate with the name of a remote database server, as the following example shows. In this case, the database server returns an error:

```
SELECT rdb@rserv:my_max(remote.quantity)
FROM rdb@rserv:items remote
```

For further information on user-defined aggregates, see "CREATE AGGREGATE" on page 2-84 and the discussion of user-defined aggregates in *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Related Information

For a discussion of expressions in the context of the SELECT statement, see the *IBM Informix Guide to SQL: Tutorial*.

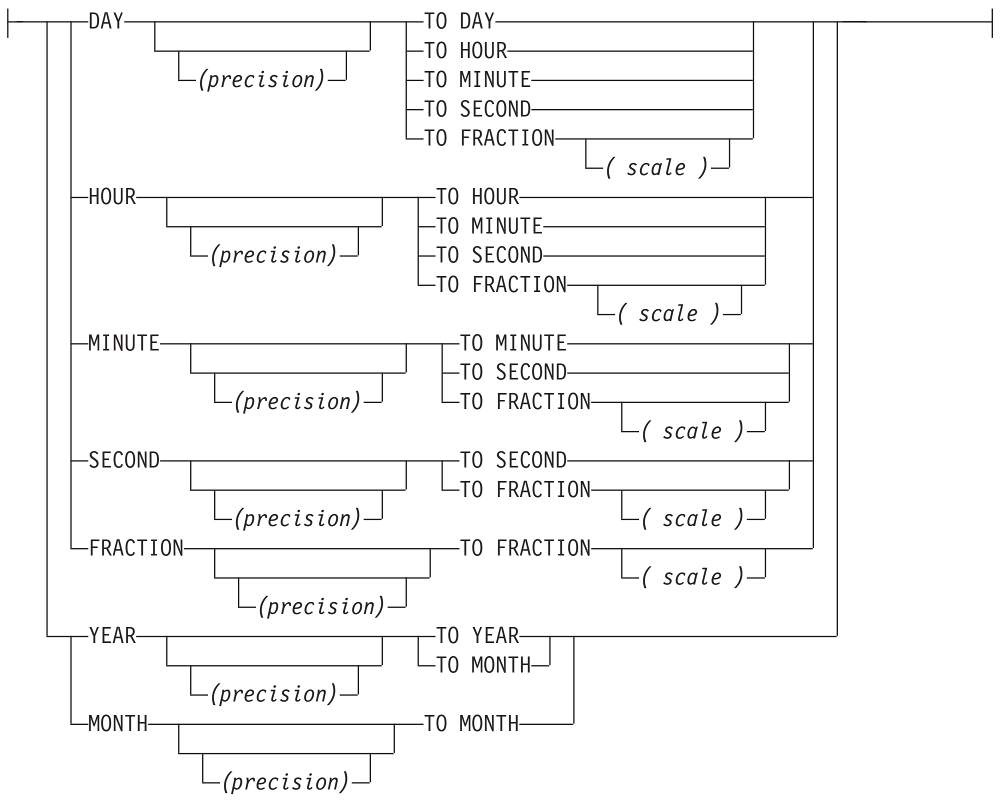
For discussions of column expressions, length functions, and the **TRIM** function, see the *IBM Informix GLS User's Guide*.

INTERVAL Field Qualifier

The INTERVAL field qualifier specifies the precision, in time units, for an INTERVAL value. Use the INTERVAL Field Qualifier segment whenever you see a reference to an INTERVAL field qualifier in a syntax diagram.

Syntax

INTERVAL Field Qualifier:



Element	Description	Restrictions	Syntax
scale	Integer number of digits in FRACTION field. Default is 3.	Must be in the range from 1 to 5	"Literal Number" on page 4-137
precision	Integer number of digits in the largest time unit that the INTERVAL includes. For YEAR, the default is 4. For all other time units, the default is 2.	Must be in the range from 1 to 9	"Literal Number" on page 4-137

Usage

This segment specifies the precision and scale of an INTERVAL data type.

A keyword specifying the *largest* time unit must be the first keyword, and a keyword specifying the *smallest* time unit must follow the TO keyword. These can be the same keyword. This segment resembles the syntax of a "DATETIME Field Qualifier" on page 4-32, but with these exceptions:

- If the largest time unit keyword is YEAR or MONTH, the smallest time unit keyword cannot specify a time unit smaller than MONTH.

- You can specify up to 9-digit precision after the first time unit, unless FRACTION is the first time unit (in which case the limit is 5 digits).

Because *year* and *month* are not fixed-length units of time, the database server treats INTERVAL data types that include the YEAR or MONTH keywords in their qualifiers as incompatible with INTERVAL data types whose qualifiers are time units smaller than MONTH. The database server supports no implicit casts between these two categories of INTERVAL data types.

The next two examples show YEAR TO MONTH qualifiers of INTERVAL data types. The first example can hold an interval of up to 999 years and 11 months, because it gives 3 as the precision of the YEAR field. The second example uses the default precision on the YEAR field, so it can hold an interval of up to 9,999 years and 11 months.

```
YEAR (3) TO MONTH

YEAR TO MONTH
```

When you want a value to specify only one kind of time unit, the first and last qualifiers are the same. For example, an interval of whole years is qualified as YEAR TO YEAR or YEAR (5) TO YEAR, for an interval of up to 99,999 years.

The following examples show several forms of INTERVAL field qualifiers:

```
YEAR(5) TO MONTH

DAY (5) TO FRACTION(2)

DAY TO DAY

FRACTION TO FRACTION (4)
```

Related Information

For information about how to specify INTERVAL field qualifiers and how to use INTERVAL data in arithmetic and relational operations, see the discussion of the INTERVAL data type in the *IBM Informix Guide to SQL: Reference*.

Literal Collection

Use the Literal Collection segment to specify values for a collection data type. For the syntax of expressions that return values of individual elements within a collection, see "Collection Constructors" on page 4-65.

Syntax

Literal Collection:

```
├──┬─"──┬─SET──────┬─{─┤ Literal Data ├─}."──┬──────────────────────────────────────────┤
   │    ├─MULTISET─┤                         │
   │    └─LIST─────┘                         │
   └─'──┬─SET──────┬─{─┤ Literal Data ├─}.'──┘
        ├─MULTISET─┤
        └─LIST─────┘
```

Literal Data:

```
   ┌─,──────────────────────────────────────────────────────────────────────────────┐
   ▼                          (1)                                                   │
├────┬─┤ Element Literal Value ├────────────────────────────────────────────────────┬─┴──────────┤
     │                           (2)                                           (2)  │
     └─┤ Nested Quotation Marks ├───────┤ Literal Collection ├──┤ Nested Quotation Marks ├──────┘
```

Notes:

1 See "Element Literal Value" on page 4-130

2 See "Nested Quotation Marks" on page 4-130

Usage

You can specify literal collection values for SET, MULTISET, or LIST data types.

To specify a single literal-collection value, specify the collection type and the literal values. The following SQL statement inserts four integer values into a column called **set_col** that was declared as `SET(INT NOT NULL)`:

```
INSERT INTO table1 (set_col) VALUES ('SET{6, 9, 9, 4}');
```

Specify an empty collection with an empty pair of braces ({ }) symbols. This example inserts an empty list into a column **list_col** that was declared as LIST(INT NOT NULL):

```
INSERT INTO table2 (list_col) VALUES ('LIST{}')
```

A pair of single (′) or double (″) quotes must delimit the collection. In databases where delimited identifiers are enabled, however, double quotes are not valid, except to delimit SQL identifiers.

If you are passing a literal collection as an argument to an SPL routine, make sure that there is a blank space between the parentheses that surround the arguments and the quotation marks that indicate the beginning and end of the literal collection.

If you specify a collection as a literal value in a row-string literal, you can omit the quotation marks around the collection itself. Only the outermost quotation marks that delimit the row-string literal are necessary. No quotation marks need surround the nested collection type. For an example, see "Literals for Nested Rows" on page 4-141.

Element Literal Value

The diagram for "Literal Collection" on page 4-129 refers to this section. Elements of a collection can be literal values for the following data types.

For a Collection of Type	Literal Value Syntax
BOOLEAN	`t` or `f`, representing TRUE or FALSE as a quoted string
CHAR, VARCHAR, NCHAR, NVARCHAR, CHARACTER VARYING, LVARCHAR, DATE	"Quoted String" on page 4-142
DATETIME	"Literal DATETIME" on page 4-132
DECIMAL, MONEY, FLOAT, INTEGER, INT8, SMALLFLOAT, SMALLINT	"Literal Number" on page 4-137
INTERVAL	"Literal INTERVAL" on page 4-135
Opaque data types	"Quoted String" on page 4-142. The string literal must be recognized by the input support function for the associated opaque type.
Row Type	"Literal Row" on page 4-139. When the collection element type is a named ROW type, you do not need to cast the inserted values to the named ROW type.

Important: You cannot specify the simple-large-object data types (BYTE and TEXT) as the element type for a collection.

Quoted strings must be specified with a different type of quotation mark than the quotation marks that encompass the collection, so that the database server can parse the quoted strings. Thus, if you use double (") quotation marks to specify the collection, use single (') quotation marks to specify individual, quoted-string elements. (In databases where delimited identifiers are enabled, however, double quotes are not valid, except to delimit SQL identifiers.)

Nested Quotation Marks

The diagram for "Literal Collection" on page 4-129 refers to this section.

A *nested collection* is a collection that is the element type for another collection.

Whenever you nest collection literals, use nested quotation marks. In these cases, you must follow the rule for nesting quotation marks. Otherwise, the database server cannot correctly parse the strings.

The general rule is that you must double the number of quotation marks for each new level of nesting. For example, if you use double (") quotation marks for the first level, you must use two double quotation marks for the second level, four double quotation marks for the third level, eight for the fourth level, sixteen for the fifth level, and so on.

Likewise, if you use single (') quotes for the first level, you must use two single quotation marks for the second level and four single quotation marks for the third level. There is no limit to the number of levels you can nest, as long as you follow this rule.

The following examples illustrate the case for two levels of nested collection literals, using double (″) quotation marks. Here table **tab5** is a single-column table whose only column, **set_col**, is a nested collection type.

The following statement creates the **tab5** table:

```
CREATE TABLE tab5 (set_col SET(SET(INT NOT NULL) NOT NULL));
```

The following statement inserts values into the table **tab5**:

```
INSERT INTO tab5 VALUES ( "SET{""SET{34, 56, 23, 33}""}" )
```

For each literal value, the opening quotation mark and the closing quotation mark must match. Thus, if you open a literal with two double quotes, you must close that literal with two double quotes (`""a literal value""`).

To specify nested quotation marks within an SQL statement in an ESQL/C program, use the C escape character for every double quote inside a single-quote string. Otherwise, the ESQL/C preprocessor cannot correctly interpret the literal collection value. For example, the preceding INSERT statement on the **tab5** table would appear in an ESQL/C program as follows:

```
EXEC SQL insert into tab5
   values ('set{\"set{34, 56, 23, 33}\"}');
```

For more information, see the chapter on complex data types in the *IBM Informix ESQL/C Programmer's Manual*.

If the collection is a nested collection, you must include the collection-constructor syntax for each level of collection type. Suppose you define the following column:

```
nest_col SET(MULTISET (INT NOT NULL) NOT NULL)
```

The following statement inserts three elements into the **nest_col** column:

```
INSERT INTO tabx (nest_col)
   VALUES ("SET{'MULTISET{1, 2, 3}'}")
```

Related Information

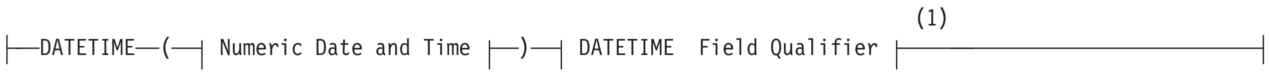
To learn how to use quotation marks in INSERT statements, see “Nested Quotation Marks” on page 4-130.

Literal DATETIME

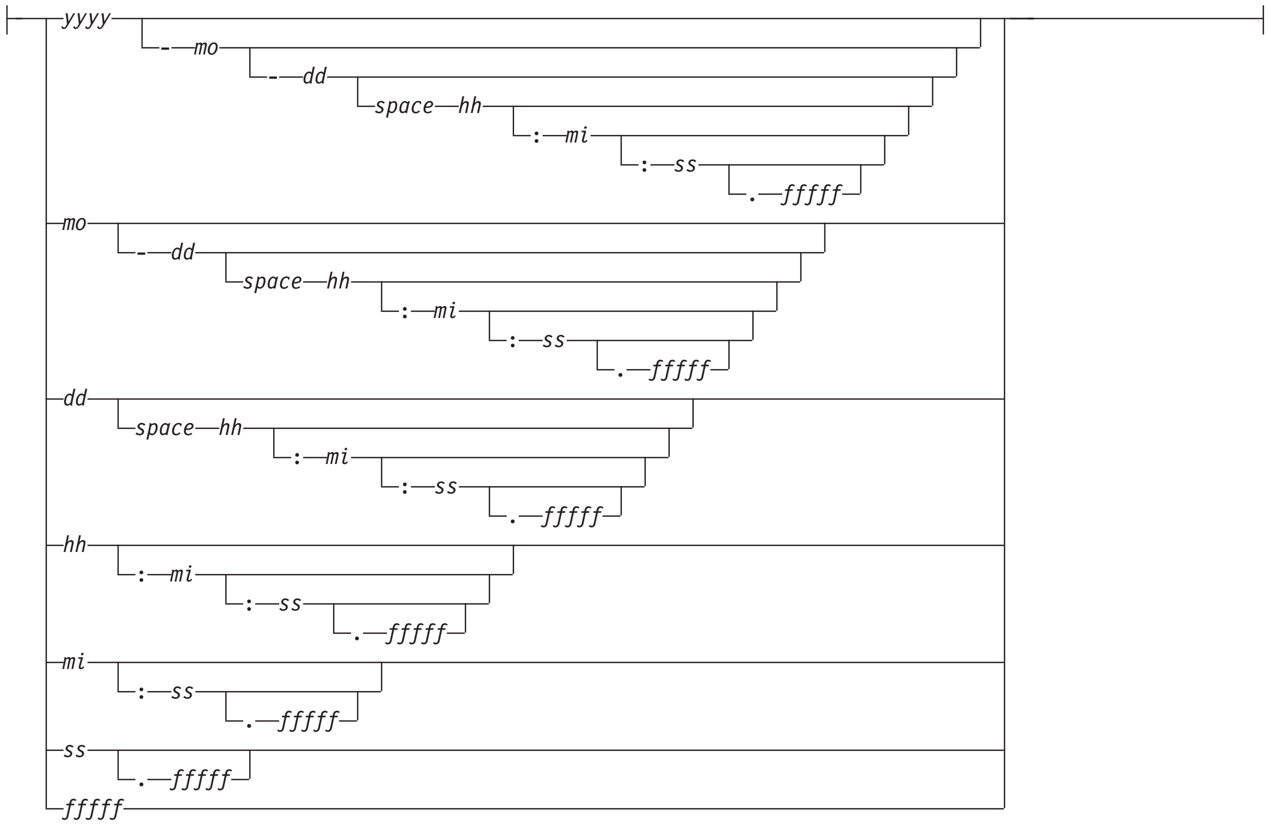
The Literal DATETIME segment specifies a DATETIME value. Use this segment when you see a reference to a literal DATETIME in a syntax diagram.

Syntax

Literal DATETIME:



Numeric Date and Time:



Notes:

1 See “DATETIME Field Qualifier” on page 4-32

Element	Description	Restrictions	Syntax
dd	Day of month, expressed in digits	1 ≤ *dd* ≤ 28, 29, 30, or 31	"Literal Number" on page 4-137
fffff	Fraction of a second, in digits	0 ≤ *fffff* ≤ 9999	"Literal Number" on page 4-137
hh	Hour of day, expressed in digits	0 ≤ *hh* ≤ 23	"Literal Number" on page 4-137
mi	Minute of hour, expressed in digits	0 ≤ *mi* ≤ 59	"Literal Number" on page 4-137
mo	Month of year, expressed in digits	1 ≤ *mo* ≤ 11	"Literal Number" on page 4-137
space	Blank space (ASCII 32)	Exactly 1 blank character	Literal blank space
ss	Second of minute, in digits	0 ≤ *ss* ≤ 59	"Literal Number" on page 4-137
yyyy	Year, expressed in digits	You can specify up to 4 digits	"Literal Number" on page 4-137

Usage

You must specify both a numeric date and a DATETIME field qualifier for this date in the Literal DATETIME segment. The DATETIME field qualifier must correspond to the numeric date you specify. For example, if you specify a numeric date that includes a year as the largest unit and a minute as the smallest unit, you must also specify YEAR TO MINUTE as the DATETIME field qualifier.

If you specify two digits for the year, the database server uses the setting of the **DBCENTURY** environment variable to expand the abbreviated year value to four digits. If the **DBCENTURY** is not set, the first two digits of the current year are used to expand the abbreviated year value.

The following examples show literal DATETIME values:

```
DATETIME (97-3-6) YEAR TO DAY

DATETIME (09:55:30.825) HOUR TO FRACTION

DATETIME (97-5) YEAR TO MONTH
```

The following example shows a literal DATETIME value used with the EXTEND function:

```
EXTEND (DATETIME (1997-8-1) YEAR TO DAY, YEAR TO MINUTE)
   - INTERVAL (720) MINUTE (3) TO MINUTE
```

Casting Numeric Date and Time Strings to DATE Data Types

The database server provides a built-in cast to convert DATETIME values to DATE values, as in the following SPL program fragment:

```
DEFINE my_date DATE
DEFINE my_dt DATETIME YEAR TO SECOND
. . .
LET my_date = CURRENT
```

Here the DATETIME value that CURRENT returns is implicitly cast to DATE. You can also cast DATETIME to DATE explicitly:

```
LET my_date = CURRENT::DATE
```

Both of these LET statements assign the *year*, *month*, and *day* information from the DATETIME value to the local SPL variable **my_date** of type DATE.

Similarly, you can explicitly cast a string that has the format of the Numeric Date and Time segment, as defined in the Literal DATETIME syntax diagram, to a DATETIME data type, as in the following example:

```
LET my_dt = ('2005-02-22 05:58:44.000')::DATETIME
```

There is neither an implicit nor an explicit built-in cast, however, for directly converting a character string that has the Numeric Date and Time format to a DATE value. Both of the following statements, for example, fail with error -1218:

```
LET my_date = ('2005-02-22 05:58:44.000');
LET my_date = ('2005-02-22 05:58:44.000')::DATE;
```

To convert a character string that specifies a valid numeric date and time value to a DATE data type, you must first cast the string to DATETIME, and then cast the resulting DATETIME value to DATE, as in this example:

```
LET my_date = ('2005-02-22 05:58:44.000')::DATETIME::DATE;
```

A direct string-to-DATE cast can succeed only if the string specifies a valid DATE value.

Related Information

For discussions of the DATETIME data type and the **DBCENTURY** environment variable, see the *IBM Informix Guide to SQL: Reference*.

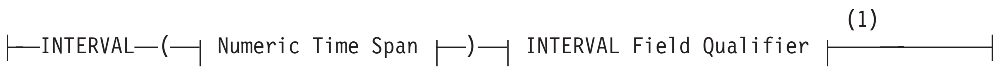
For a discussion of how to use the **GL_DATETIME** environment variable to customize the display format of DATETIME values in non-default locales, see the *IBM Informix GLS User's Guide*.

Literal INTERVAL

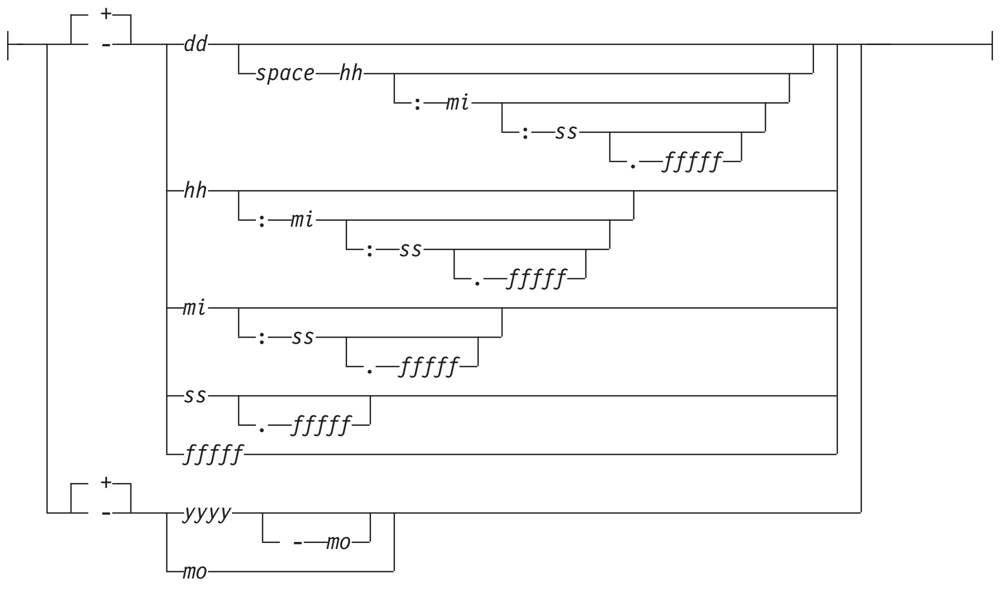
The Literal INTERVAL segment specifies a literal INTERVAL value. Use this whenever you see a reference to a literal INTERVAL in a syntax diagram.

Syntax

Literal INTERVAL:



Numeric Time Span:



Notes:

1 See "INTERVAL Field Qualifier" on page 4-127

Element	Description	Restrictions	Syntax
dd	Number of days	-10**10 < *dd* < 10**10	"Literal Number" on page 4-137
fffff	Fractions of a second	0 ≤ *fffff* ≤ 9999	"Literal Number" on page 4-137
hh	Number of hours	If not first, 0 ≤ *hh* ≤ 23	"Literal Number" on page 4-137
mi	Number of minutes	If not first, 0 ≤ *mi* ≤ 59	"Literal Number" on page 4-137
mo	Number of months	If not first, 0 ≤ *mo* ≤ 11	"Literal Number" on page 4-137
space	Blank space (ASCII 32)	Exactly 1 blank character is required	Literal blank space
ss	Number of seconds	If not first, 0 ≤ *ss* ≤ 59	"Literal Number" on page 4-137
yyyy	Number of years	-10**10 < *yyyy* < 10**10	"Literal Number" on page 4-137

Usage

Unlike DATETIME literals, INTERVAL literals can include the unary plus (**+**) or unary minus (**-**) sign. If you specify no sign, the default is plus.

The precision of the first time unit can be specified by the INTERVAL qualifier. Except for FRACTION, which can have no more than 5 digits of precision, the first time unit can have up to 9 digits of precision, if you specified a nondefault precision in the declaration of the INTERVAL column or variable.

The following examples show literal INTERVAL values:

```
INTERVAL (3-6) YEAR TO MONTH
INTERVAL (09:55:30.825) HOUR TO FRACTION
INTERVAL (40 5) DAY TO HOUR
INTERVAL (299995.2567) SECOND(6) TO FRACTION(4)
```

Only the last of these examples has nondefault precision. For the syntax of declaring the precision of INTERVAL data types and the default values for each time unit, refer to “INTERVAL Field Qualifier” on page 4-127.

Related Information

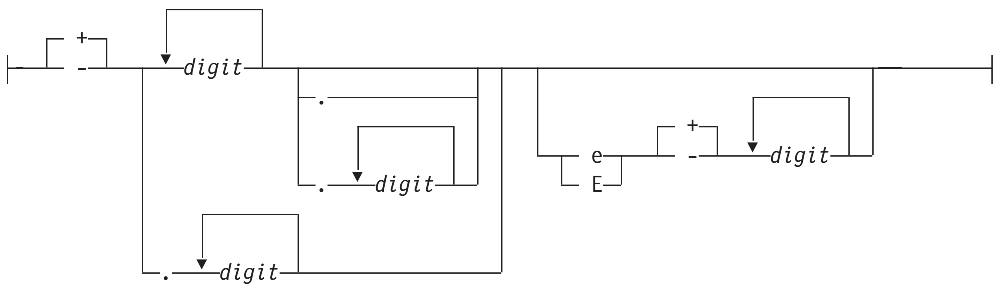
For information on how to use INTERVAL data in arithmetic and relational operations, see the discussion of the INTERVAL data type in the *IBM Informix Guide to SQL: Reference*.

Literal Number

A *literal number* is the base-10 representation of a real number as an integer, as a fixed-point decimal number, or in exponential notation. Use the Literal Number segment whenever you see a reference to a literal number in a syntax diagram.

Syntax

Literal Number:



Element	Description	Restrictions	Syntax
digit	Integer in range 0 through 9	Must be an ASCII digit	Literal entered from the keyboard.

Usage

You cannot include comma (**,**) or blank (ASCII 32) character. The unary plus (**+**) or minus (**-**) sign can precede a literal number, mantissa, or exponent.

You cannot include non-ASCII digits in literal numbers, such as the Hindi numbers that some nondefault locales support.

Integer Literals

In many contexts, a literal number is restricted to an integer literal. An integer has no fractional part and cannot include a decimal point. Built-in data types of SQL that can be exactly represented as literal integers include INT8, INT, SMALLINT, SERIAL, SERIAL8, and DECIMAL(*p*, 0).

If you use the representation of a number in a base other than 10 (such as a binary, octal, or hexadecimal) in any context where a literal integer is valid, the database server will attempt to interpret the value as a base-10 literal integer. For most data values, the result will be incorrect.

The following examples show some valid literal integers:

```
10             -27             +25567
```

Thousands separators (such as comma symbols) are not valid in literal integers, nor in any other literal number.

Fixed-Point Decimal Literals

Fixed-point decimal literals can exactly represent DECIMAL(*p,s*) and MONEY values. These can include a decimal point:

```
-123.456        00123456        +123456.0
```

The digits to the right of the decimal point in these examples are the fractional portions of the numbers.

Floating-Point Decimal Literals

Floating-point literals can exactly represent FLOAT, SMALLFLOAT, and DECIMAL(*p*) values, using a decimal point or exponential notation, or both. They can approximately represent real numbers in exponential notation. The next examples show floating point numbers:

```
-123.45E6      1.23456E2      123456.0E-3
```

The `E` in the previous examples is the symbol for exponential notation. The digit that follows `E` is the value of the exponent. For example, the number 3E5 (or 3E+5) means 3 multiplied by 10 to the fifth power, and the number 3E-5 means 3 multiplied by the reciprocal of 10 to the fifth power.

Literal Numbers and the MONEY Data Type

When you use a literal number as a MONEY value, do not include a currency symbol or include commas. The **DBMONEY** environment variable or the locale file can format how MONEY values are displayed in output.

Related Information

For discussions of numeric data types, such as DECIMAL, FLOAT, INTEGER, and MONEY, see the *IBM Informix Guide to SQL: Reference*.

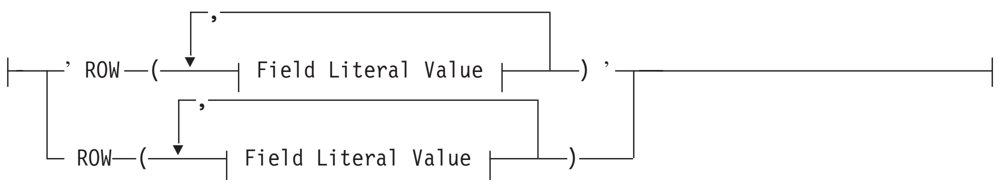
Literal Row

The Literal Row segment specifies the syntax for literal values of named and unnamed ROW data types.

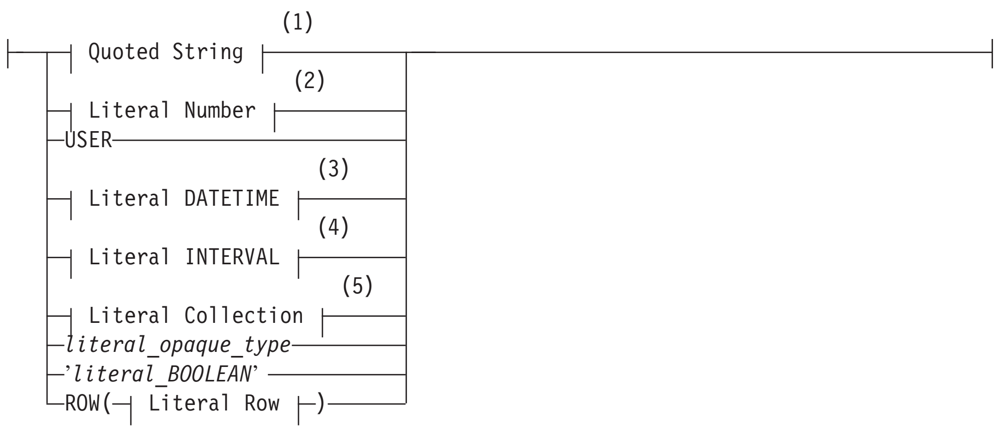
Only Dynamic Server supports this syntax. For expressions that evaluate to field values within a ROW data type, see "ROW Constructors" on page 4-64.

Syntax

Literal Row:



Field Literal Value:



Notes:

1 See "Quoted String" on page 4-142

2 See "Literal Number" on page 4-137

3 See "Literal DATETIME" on page 4-132

4 See "Literal INTERVAL" on page 4-135

5 See "Literal Collection" on page 4-129

Element	Description	Restrictions	Syntax
literal_opaque_type	Literal representation for an opaque data type	Must be a literal that is recognized by the input support function for the associated opaque data type	Defined by the developer of the opaque data type
literal_BOOLEAN	Literal representation of a BOOLEAN value	Must be either `'t'` (= TRUE) or `'f'` (= FALSE) specified as a quoted string	"Quoted String" on page 4-142

Usage

You can specify literal values for named ROW and unnamed ROW data types. A ROW constructor introduces a literal ROW value, which can optionally be enclosed between quotation marks.

The format of the value for each field of the ROW type must be compatible with the data type of the corresponding field.

Important: You cannot specify simple-large-object data types (BYTE or TEXT) as the field type for a row.

Fields of a row can be literal values for the data types in the following table.

For a Field of Type	Literal Value Syntax
BOOLEAN	`t` or `f`, representing TRUE or FALSE
CHAR, VARCHAR, LVARCHAR, NCHAR, NVARCHAR, CHARACTER VARYING, DATE	"Quoted String" on page 4-142
DATETIME	"Literal DATETIME" on page 4-132
DECIMAL, MONEY, FLOAT, INTEGER, INT8, SMALLFLOAT, SMALLINT	"Literal Number" on page 4-137
INTERVAL	"Literal INTERVAL" on page 4-135
Opaque data types	"Quoted String" on page 4-142 The string must be a literal that is recognized by the input support function for the associated opaque type.
Collection type (SET, MULTISET, LIST)	"Literal Collection" on page 4-129 For information on literal collection values as variable or column values, see "Nested Quotation Marks" on page 4-130. For information on literal collection values for a ROW type, see "Literals for Nested Rows" on page 4-141.
Another ROW type (named or unnamed)	For information on ROW type values, see "Literals for Nested Rows" on page 4-141.

Literals of an Unnamed Row Type

To specify a literal value for an unnamed ROW type, introduce the literal row with the ROW constructor; you must enclose the values between parentheses. For example, suppose that you define the **rectangles** table as follows:

```
CREATE TABLE rectangles
(
   area FLOAT,
   rect ROW(x INTEGER, y INTEGER, length FLOAT, width FLOAT),
)
```

The following INSERT statement inserts values into the **rect** column of the **rectangles** table:

```
INSERT INTO rectangles (rect)
   VALUES ("ROW(7, 3, 6.0, 2.0)")
```

Literals of a Named Row Type

To specify a literal value for a named ROW type, introduce the literal row with the ROW type constructor and enclose the literal values for each field in parentheses. In addition, you can cast the row literal to the appropriate named ROW type to ensure that the row value is generated as a named ROW type. The following statements create the named ROW type **address_t** and the **employee** table:

```
CREATE ROW TYPE address_t
(
street CHAR(20),
city CHAR(15),
state CHAR(2),
zipcode CHAR(9)
);

CREATE TABLE employee
(
   name CHAR(30),
   address address_t
);
```

The following INSERT statement inserts values into the **address** column of the **employee** table:

```
INSERT INTO employee (address)
VALUES (
"ROW('103 Baker St', 'Tracy','CA', 94060)"::address_t)
```

Literals for Nested Rows

If the literal value is for a nested row, specify the ROW type constructor for each row level. If you include quotation marks as delimiters, they should enclose the outermost row. For example, suppose that you create the **emp_tab** table:

```
CREATE TABLE emp_tab
(
   emp_name CHAR(10),
   emp_info ROW( stats ROW(x INT, y INT, z FLOAT))
);
```

The following INSERT statement adds a row to the **emp_tab** table:

```
INSERT INTO emp_tab VALUES ('joe boyd', "ROW(ROW(8,1,12.0))" );
```

Similarly, if the row-string literal contains a nested collection, only the outermost literal row can be enclosed between quotation marks. Do not put quotation marks around an inner, nested collection type.

Related Information

Related statements: CREATE ROW TYPE, INSERT, UPDATE, and SELECT

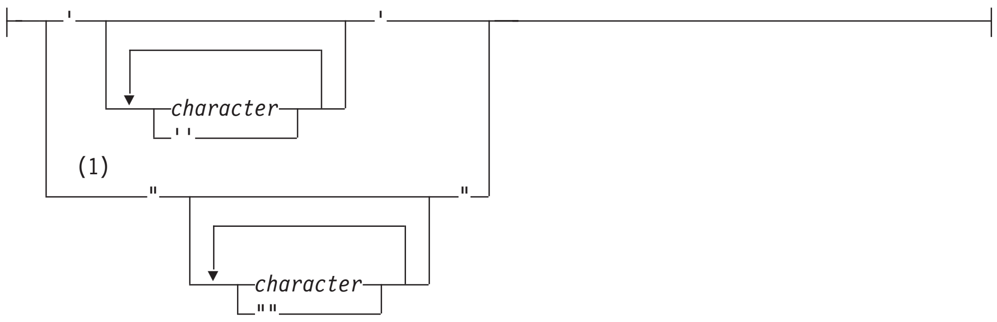
For information on ROW constructors, see the Expression segment. See also the Collection Literal segment.

Quoted String

A quoted string is a string literal between quotation marks. Use this segment whenever you see a reference to a quoted string in a syntax diagram.

Syntax

Quoted String:



Notes:

1 Informix extension

Element	Description	Restrictions	Syntax
character	Code set element within quoted string	Cannot enclose between double quotes if the **DELIMIDENT** environment variable is set	Literal value from the keyboard

Usage

Use quoted strings to specify string literals in data-manipulation statements and other SQL statements. For example, you can use a quoted string in an INSERT statement to insert a value into a column of a character data type.

Restrictions on Specifying Characters in Quoted Strings

You must observe the following restrictions on *character* in quoted strings:

- If you are using the ASCII code set, you can specify any printable ASCII character, including a single quote or double quote. For restrictions that apply to using quotes in quoted strings, see “Using Quotes in Strings” on page 4-144.
- In some locales, you can specify non-ASCII characters, including multibyte characters, that the locale supports. See the discussion of quoted strings in the *IBM Informix GLS User's Guide*.
- If you enable newline characters for quoted strings, you can embed newline characters in quoted strings. For further information, see “Newline Characters in Quoted Strings” on page 4-143.
- You can enter DATETIME and INTERVAL data values as quoted strings. For the restrictions that apply to entering DATETIME and INTERVAL data in quoted-string format, see “DATETIME and INTERVAL Values as Strings” on page 4-144.
- Quoted strings that are used with the LIKE or MATCHES keyword in a search condition can include wildcard characters that have a special meaning in the search condition. For further information, see “LIKE and MATCHES in a Condition” on page 4-145.

- When you insert a value that is a quoted string, you must observe a number of restrictions. For further information, see “Inserting Values as Quoted Strings” on page 4-145.

The DELIMIDENT Environment Variable

If the **DELIMIDENT** environment variable is set on the database server, you cannot use double quotes (″) to delimit literal strings. If **DELIMIDENT** is set, the database server interprets strings enclosed in double quotes as SQL identifiers, not as literal strings. If **DELIMIDENT** is not set, a string between double quotes is interpreted as a literal string, not an identifier. For further information, see “Using Quotes in Strings” on page 4-144, and the description of **DELIMIDENT** in *IBM Informix Guide to SQL: Reference*.

DELIMIDENT is also supported on client systems, where it can be set to `y`, to `n`, or to no setting.

- `y` specifies that client applications must use single quote (′) symbols to delimit literal strings, and must use double quote (″) symbols only around delimited SQL identifiers. Delimited identifiers can support a larger character set than is valid for undelimited identifiers. Letters within delimited strings or delimited identifiers are case-sensitive.
- `n` specifies that client applications can use double quote (″) or single quote (′) symbols to delimit character strings, but not to delimit SQL identifiers. If the database server encounters a string delimited by double or single quote symbols in a context where an SQL identifier is required, it issues an error. An owner name, however, that qualifies an SQL identifier can be delimited by single quote (′) symbols. You must use a pair of the same quote symbols to delimit a character string.
- Specifying **DELIMIDENT** with no value on the client system requires client applications to use the **DELIMIDENT** setting that is the default for their application programming interface (API).

Client APIs of Dynamic Server use the following default **DELIMIDENT**settings:

- For OLE DB and .NET, the default **DELIMIDENT** setting is `y`
- For ESQL/C, JDBC, and ODBC, the default **DELIMIDENT** setting is `n`
- APIs that have ESQL/C as an underlying layer, such as Informix 4GL, the DataBlade API (LIBDMI), and the C++ API, behave as ESQL/C, and use ′n′ as the default if no value for **DELIMIDENT** is specified on the client system.

Even if **DELIMIDENT** is set, you can use single quote (′) symbols to delimit *authorization identifiers* as the owner name component of a database object name, as in the following example:

```
RENAME COLUMN 'Owner'.table2.collum3 TO column3
```

The general rule, however, is that when **DELIMIDENT** is set, the SQL parser interprets strings delimited by single quotes as string literals, and interprets character strings delimited by double quotes (″) as SQL identifiers.

Newline Characters in Quoted Strings

By default, the string constant must be written on a single line. That is, you cannot use embedded newline characters in a quoted string. You can, however, override this default behavior in one of two ways:

- To enable newline characters in quoted strings in all sessions, set the ALLOW_NEWLINE parameter to 1 in the **ONCONFIG** file.

- To enable newline characters in quoted strings for the current session, execute the built-in function **IFX_ALLOW_NEWLINE**.

This enables newline characters in quoted strings for the current session:

```
EXECUTE PROCEDURE IFX_ALLOW_NEWLINE('T')
```

If newline characters in quoted strings are not enabled for a session, the following statement is invalid and returns an error:

```
SELECT 'The quick brown fox
   jumped over the old gray fence'
   FROM customer
   WHERE customer_num = 101
```

If you enable newline characters in quoted strings for the session, however, the statement in the preceding example is valid and executes successfully.

For more information on the **IFX_ALLOW_NEWLINE** function, see "IFX_ALLOW_NEWLINE Function" on page 4-111. For more information on the ALLOW_NEWLINE parameter in the **ONCONFIG** file, see your *IBM Informix Administrator's Reference*.

Using Quotes in Strings

The single quote (′) has no special significance in string literals delimited by double quotes. Conversely, double quote (″) has no special significance in strings delimited by single quotes. For example, these strings are valid:

```
"Nancy's puppy jumped the fence"
'Billy told his kitten, "No!" '
```

A string delimited by double quotes can include a double quote character by preceding it with another double quote, as the following string shows:

```
"Enter ""y"" to select this row"
```

When the **DELIMIDENT** environment variable is set, double quotes can only delimit SQL identifiers, not strings. For more information on delimited identifiers, see "Delimited Identifiers" on page 5-23.

DATETIME and INTERVAL Values as Strings

You can enter DATETIME and INTERVAL data in the literal forms described in the "Literal DATETIME" on page 4-132 and "Literal INTERVAL" on page 4-135, or you can enter them as quoted strings.

Valid literals that are entered as character strings are converted automatically into DATETIME or INTERVAL values.

These statements enter INTERVAL and DATETIME values as quoted strings:

```
INSERT INTO cust_calls(call_dtime) VALUES ('1997-5-4 10:12:11')
INSERT INTO manufact(lead_time) VALUES ('14')
```

The format of the value in the quoted string must exactly match the format specified by the INTERVAL or DATETIME qualifiers of the column. For the first INSERT in the preceding example, the **call_dtime** column must be defined with the qualifiers YEAR TO SECOND for the INSERT statement to be valid.

LIKE and MATCHES in a Condition

Quoted strings with the LIKE or MATCHES keyword in a condition can include wildcard characters. For a complete description of how to use wildcard characters, see "Condition" on page 4-5.

Inserting Values as Quoted Strings

In the default locale, if you are inserting a value that is a quoted string, you must adhere to the following restrictions:

- Enclose CHAR, VARCHAR, NCHAR, NVARCHAR, DATE, DATETIME, INTERVAL, and (for Dynamic Server) LVARCHAR values in quotation marks.
- Specify DATE values in the *mm/dd/yyyy* format (or in the format that the **DBDATE** or **GL_DATE** environment variable specifies, if set).
- In Extended Parallel Server, you cannot insert strings longer than 256 bytes.
- In Dynamic Server, you cannot insert strings longer than 32 kilobytes.
- Numbers with decimal values must include a decimal separator. Comma (,) is not valid as a decimal separator in the default locale.
- MONEY values cannot include a dollar sign ($) or commas.
- You can enter NULL in a column only if it accepts null values.

Related Information

For a discussion of the **DELIMIDENT** environment variable, see the *IBM Informix Guide to SQL: Reference*.

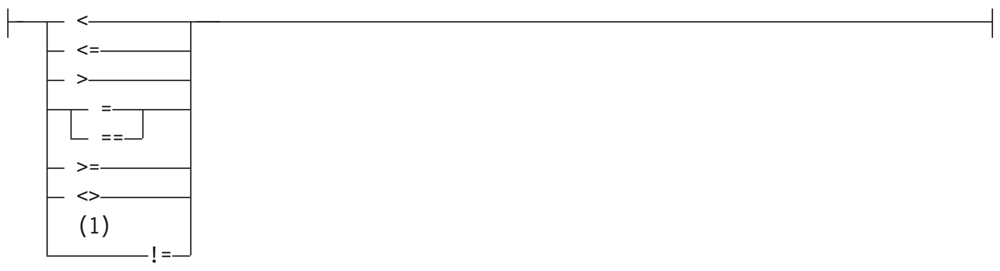
For a discussion of the GLS aspects of quoted strings, see the *IBM Informix GLS User's Guide*.

Relational Operator

A relational operator compares two expressions quantitatively. Use the Relational Operator segment whenever you see a reference to a relational operator in a syntax diagram.

Syntax

Relational Operator:



Notes:

1 Informix extension

Usage

The relational operators of SQL have the following meanings.

Relational Operator	Meaning
<	Less than
<=	Less than or equal to
>	Greater than
= *or* ==	Equal to
>=	Greater than or equal to
<> *or* !=	Not equal to

Usage

For number expressions, *greater than* means to the right on the real line.

For DATE and DATETIME expressions, *greater than* means later in time.

For INTERVAL expressions, *greater than* means a longer span of time.

For CHAR, VARCHAR, and LVARCHAR expressions, *greater than* means *after* in code-set order. (For NCHAR and NVARCHAR expressions, *greater than* means *after* in the localized collation order, if one exists; otherwise, it means in code-set order.)

Locale-based collation order, if defined for the locale, is used for NCHAR and NVARCHAR expressions. So for NCHAR and NVARCHAR expressions, *greater than* means *after* in the locale-based collation order. For more information on locale-based collation order and the NCHAR and NVARCHAR data types, see the *IBM Informix GLS User's Guide*.

Using Operator Functions in Place of Relational Operators

Each relational operator is bound to a particular operator function, as the table shows. The operator function accepts two values and returns a boolean value of true, false, or unknown.

Relational Operator	Associated Operator Function
<	**lessthan( )**
<=	**lessthanorequal( )**
>	**greaterthan( )**
>=	**greaterthanorequal( )**
= *or* ==	**equal( )**
<> *or* !=	**notequal( )**

Connecting two expressions with a relational operator is equivalent to invoking the operator function on the expressions. For example, the next two statements both select orders with a shipping charge of $18.00 or more.

The >= operator in the first statement implicitly invokes the **greaterthanorequal( )** operator function:

```
SELECT order_num FROM orders
   WHERE ship_charge >= 18.00;

SELECT order_num FROM orders
   WHERE greaterthanorequal(ship_charge, 18.00);
```

The database server provides the operator functions associated with the relational operators for all built-in data types. When you develop a user-defined data type, you must define the operator functions for that type for users to be able to use the relational operator on the type.

If you define **less_than( )**, **greater_than( )**, and the other operator functions for a user-defined type, then you should also define **compare( )**. Similarly, if you define **compare( )**, then you should also define **less_than( )**, **greater_than( )**, and the other operator functions. All of these functions must be defined in a consistent manner, to avoid the possibility of incorrect query results when UDT values are compared in the WHERE clause of a SELECT.

Collating Order for U.S. English Data

If you are using the default locale (U.S. English), the database server uses the code-set order of the default code set when it compares the character expressions that precede and follow the relational operator.

On UNIX, the default code set is the ISO8859-1 code set, which consists of the following sets of characters:

- The ASCII characters have code points in the range of 0 to 127.

  This range contains control characters, punctuation symbols, English-language characters, and numerals.
- The 8-bit characters have code points in the range 128 to 255.

  This range includes many non-English-language characters (such as é, â, ö, and ñ) and symbols (such as £, ©, and ¿).

In Windows, the default code set is Microsoft 1252. This code set includes both the ASCII code set and a set of 8-bit characters.

This table lists the ASCII code set. The **Num** columns show ASCII code point numbers, and the **Char** columns display corresponding ASCII characters. In the default locale, ASCII characters are sorted according to their code-set order. Thus, lowercase letters follow uppercase letters, and both follow digits. In this table, ASCII 32 is the blank character, and the caret symbol (^) stands for the `CTRL` key. For example, ^X means `CONTROL-X`.

Num	Char	Num	Char	Num	Char	Num	Char	Num	Char	Num	Char	Num	Char
0	^@	20	^T	40	(	60	<	80	P	100	d	120	x
1	^A	21	^U	41	)	61	=	81	Q	101	e	121	y
2	^B	22	^V	42	*	62	>	82	R	102	f	122	z
3	^C	23	^W	43	+	63	?	83	S	103	g	123	{
4	^D	24	^X	44	,	64	@	84	T	104	h	124	|
5	^E	25	^Y	45	-	65	A	85	U	105	i	125	}
6	^F	26	^Z	46	.	66	B	86	V	106	j	126	~
7	^G	27	esc	47	/	67	C	87	W	107	k	127	del
8	^H	28	^\	48	0	68	D	88	X	108	l		
9	^I	29	^]	49	1	69	E	89	Y	109	m		
10	^J	30	^^	50	2	70	F	90	Z	110	n		
11	^K	31	^_	51	3	71	G	91	[	111	o		
12	^L	32		52	4	72	H	92	\	112	p		
13	^M	33	!	53	5	73	I	93	]	113	q		
14	^N	34	″	54	6	74	J	94	^	114	r		
15	^O	35	#	55	7	75	K	95	_	115	s		
16	^P	36	$	56	8	76	L	96	`	116	t		
17	^Q	37	%	57	9	77	M	97	a	117	u		
18	^R	38	&	58	:	78	N	98	b	118	v		
19	^S	39	′	59	;	79	O	99	c	119	w		

Support for ASCII Characters in Nondefault Code Sets (GLS)

Most code sets for nondefault locales (called *nondefault code sets*) support the ASCII characters. In a nondefault locale, the database server uses ASCII code-set order for ASCII data in CHAR and VARCHAR expressions, if the code set supports these ASCII characters. If the current collation (as specified by **DB_LOCALE** or by SET COLLATION) supports a localized collating order, however, that localized order is used when the database server sorts NCHAR or NVARCHAR values.

Literal Numbers as Operands

You might obtain unexpected results if a literal number that you specify as an operand is not in a format that can exactly represent the data type of another value with which it is compared by a relational operator. Because of rounding errors, for example, a relational operator like `=` or the **equals( )** operator function generally cannot return `TRUE` if one operand returns a FLOAT value and the other an INTEGER. For information about which of the built-in data types store values that can be exactly represented as literal numbers, see the section "Literal Number" on page 4-137.

Related Information

For a discussion of relational operators in the SELECT statement, see the *IBM Informix Guide to SQL: Tutorial*.

For a discussion of the GLS aspects of relational operators, see the *IBM Informix GLS User's Guide*.

Chapter 5. Other Syntax Segments

In This Chapter

Syntax segments are language elements, such as database object names or optimizer directives, that appear as a subdiagram reference in the syntax diagrams of some SQL or SPL statements. Most segments that can occur in only one statement are described in Chapter 2 or Chapter 3 within the description of the statement. For the sake of clarity, ease of use, and comprehensive treatment, however, most segments that can occur in various SQL or SPL statements, and that are not data types nor expressions, are discussed separately here.

The previous chapter described the syntax segments that specify data types and expressions. This chapter describes additional syntax segments that are neither data types, expressions, nor complete SQL statements or SPL statements. These segments are referenced in various syntax diagrams that appear in Chapter 2 and in other chapters of this manual.

Arguments

Use the Argument segment to pass a specific value as input to a routine. Use this segment wherever you see a reference to an *argument* in a syntax diagram.

Syntax

Argument:

```
                                               (1)
├──┬───────────────┬──┬─┤ Subset of Expression ├─┬──────────────────────┤
   └─parameter──=──┘  ├─NULL─────────────────────┤
                      └─(──singleton_select──)───┘
```

Notes:

1 See “Subset of Expressions Valid as an Argument” on page 5-3

Element	Description	Restrictions	Syntax
parameter	A parameter whose value you specify	Must match a name that CREATE FUNCTION or CREATE PROCEDURE statement declared	“Identifier” on page 5-22
singleton _select	Embedded query that returns a single value	Must return exactly one value of a data type and length compatible with *parameter*	“SELECT” on page 2-479

Usage

The CREATE PROCEDURE or CREATE FUNCTION statement can define a parameter list for a UDR. If the parameter list is not empty, you must enter arguments when you invoke the UDR. An *argument* is a specific value whose data type is compatible with that of the corresponding UDR parameter.

When you execute a UDR, you can enter arguments in either of two ways:

- With a parameter name (in the form *parameter name = expression)*, even if the arguments are not in the same order as the parameters
- By position, with no *parameter* name, where each *expression* is in the same order as the parameter to which the argument corresponds. (This is sometimes called *ordinal* format.)

You cannot mix these two ways of specifying arguments within a single invocation of a routine. If you specify a *parameter* name for one argument, for example, you must use parameter names for all the arguments.

In the following example, both statements are valid for a user-defined procedure that expects three character arguments, **t**, **d**, and **n**:

```
EXECUTE PROCEDURE add_col (t ='customer', d ='integer',
   n ='newint');

EXECUTE PROCEDURE add_col ('customer','newint','integer') ;
```

Comparing Arguments to the Parameter List

When you create or register a UDR with CREATE PROCEDURE or CREATE FUNCTION, you declare a *parameter list* with the names and data types of the parameters that the UDR expects. (Parameter names are optional for external routines written in the C or Java languages.) See “Routine Parameter List” on page 5-61 for details of declaring parameters.

User-defined routines can be *overloaded*, if different routines have the same identifier, but have different numbers of declared parameters. For more information about overloading, see "Routine Overloading and Naming UDRs with a Routine Signature (IDS)" on page 5-19.

If you attempt to execute a UDR with more arguments than the UDR expects, you receive an error.

If you invoke a UDR with fewer arguments than the UDR expects, the omitted arguments are said to be *missing*. The database server initializes missing arguments to their corresponding default values. This initialization occurs before the first executable statement in the body of the UDR.

If missing arguments have no default values, Dynamic Server issues an error. Extended Parallel Server can invoke a routine with missing arguments that have no default values, but the routine might fail if a missing argument causes another error (for example, an undefined value for a variable).

Named parameters cannot be used to invoke UDRs that overload data types in their routine signatures. Named parameters are valid in resolving non-unique routine names only if the signatures have different numbers of parameters:

```
func( x::integer, y );    -- VALID if only these 2 routines
func( x::integer, y, z ); -- have the same 'func' identifier

func( x::integer, y );    -- NOT VALID if both routines have
func( x::float, y ;       -- same identifier and 2 parameters
```

For both ordinal and named parameters, the routine with the fewest parameters is executed if two or more UDR signatures have multiple numbers of defaults:

```
func( x, y default 1 )
func( x, y default 1, z default 2 )
```

If two registered UDRs that are both called **func** have the signatures shown above, then the statement `EXECUTE func(100)` invokes **func(100,1)**.

You cannot supply a subset of default values using named parameters unless they are in the positional order of the routine signature. That is, you cannot skip a few arguments and rely on the database server to supply their default values.

For example, given the signature:

```
func( x, y default 1, z default 2 )
```

you can execute:

```
func( x=1, y=3 )
```

but you cannot execute:

```
func( x=1, z=3 )
```

Subset of Expressions Valid as an Argument

The diagram for "Arguments" on page 5-2 refers to this section.

You can use any expression as an argument, except an aggregate function. If you use a subquery or function call as an argument, the subquery or function must return a single value of the appropriate data type and size. For the syntax and usage of SQL expressions, see "Expression" on page 4-34.

Arguments to UDRs in Remote Databases

Only non-opaque built-in data types are valid for arguments in calls to UDRs in databases of other database servers.

For calls to UDRs in other databases of the same Dynamic Server instance, the arguments can be built-in data types (including the BLOB, BOOLEAN, CLOB, and LVARCHAR built-in opaque types), or UDTs that you explicitly cast to built-in types. You can also use DISTINCT types whose base types are built-in types, and that you explicitly cast to built-in types. All the UDTs, DISTINCT data types, casts, and cast functions must be registered in all of the participating databases.

Related Information

Related Statements: ALTER FUNCTION, ALTER PROCEDURE, ALTER ROUTINE, CALL, CREATE FUNCTION, CREATE FUNCTION FROM, CREATE PROCEDURE FROM, “EXECUTE FUNCTION” on page 2-329, EXECUTE PROCEDURE.

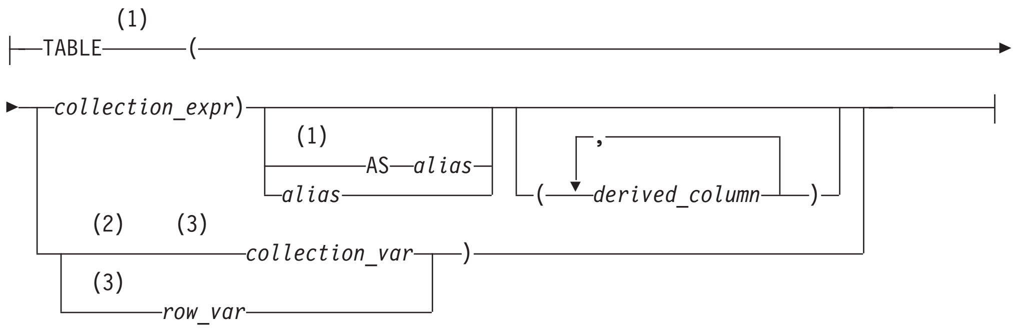
Related Segments: “Routine Parameter List” on page 5-61

Collection-Derived Table

A *collection-derived table* is a virtual table in which the values in the rows of the table are equivalent to elements of a collection. Use this segment where you see a reference to Collection-Derived Table in a syntax diagram. Only Dynamic Server supports this syntax, which is an extension to the ANSI/ISO standard for SQL.

Syntax

Collection-Derived Table:



Notes:

1 Informix extension

2 Stored Procedure Language

3 ESQL/C

Element	Description	Restrictions	Syntax
alias	Temporary name for a collection-derived table whose scope is a SELECT statement. The default is implementation dependent.	If potentially ambiguous, you must precede *alias* with the AS keyword. See "The AS Keyword" on page 2-494.	"Identifier" on page 5-22
collection_expr	Any expression that evaluates to the elements of a single collection	See "Restrictions with the Collection-Expression Format" on page 5-6.	"Expression" on page 4-34
collection_var, row_var	Name of a typed or untyped collection variable, or an ESQL/C **row** variable that holds the collection-derived table	Must have been declared in an ESQL/C program or (for *collection_var*) in an SPL routine	See the *IBM Informix ESQL/C Programmer's Manual* or "DEFINE" on page 3-7.
derived _column	Temporary name for a derived column in a table	If the underlying collection is not of a ROW data type, you can specify only one derived-column name	"Identifier" on page 5-22

Usage

A collection-derived table can appear where a *table* name is valid in the UPDATE statement, in the FROM clause of the SELECT or DELETE statement, or in the INTO clause of an INSERT statement.

Use the collection-derived-table segment to accomplish these tasks:

- Access the elements of a collection as you would the rows of a table.

- Specify a collection variable to access, instead of a table name.
- Specify an ESQL/C **row** variable to access, instead of a table name.

The TABLE keyword converts a collection into a virtual table. You can use the collection expression format to query a collection column, or you can use the **collection** variable or **row** variable format to manipulate the data in a collection column.

Accessing a Collection Through a Virtual Table

When you use the collection expression format of the collection-derived table segment to access the elements of a collection, you can select elements of the collection directly through a virtual table. You can use this format in the FROM clause of a SELECT statement. The FROM clause can be in either a query or a subquery.

With this format you can use joins, aggregates, the WHERE clause, expressions, the ORDER BY clause, and other operations that are not available when you use the collection-variable format. This format reduces the need for multiple cursors and temporary tables.

Examples of possible collection expressions include column references, scalar subquery, dotted expression, functions, operators (through overloading), collection subqueries, literal collections, collection constructors, cast functions, and so on.

3 The following example uses a SELECT statement in the FROM clause whose result
3 set defines a virtual table consisting of the fifty-first through seventieth qualifying
3 rows, ordered by the **employee_id** column value.

```
3  SELECT * FROM TABLE(MULTISET(SELECT SKIP 50 FIRST 20 * FROM employees
3     ORDER BY employee_id)) vt(x,y), tab2 WHERE tab2.id = vt.x;
```

3 The following example uses a join query to create a virtual table of no more than
3 twenty rows (beginning with the 41st row), ordered by value in the **salary** column
3 of the collection-derived table:

```
3              SELECT emp_id, emp_name, emp_salary
3              FROM  TABLE(MULTISET(SELECT SKIP 40 LIMIT 20 id, name, salary
3                                   FROM e1, e2
3                                   WHERE e1.id = e2.id ORDER BY salary ))
3                  AS etab(emp_id, emp_name, emp_salary);
```

3 Restrictions with the Collection-Expression Format

When you use the collection-expression format, certain restrictions apply:

- A collection-derived table is read-only.
  - It cannot be the target of INSERT, UPDATE, or DELETE statements.

    To perform insert, update, and delete operations, you must use the collection-variable format.
  - It cannot be the underlying table of an updatable cursor or view.
- If the collection is a LIST data type, the resulting collection-derived table does not preserve the order of the elements in the LIST.
- The underlying collection expression cannot evaluate to NULL.
- The collection expression cannot contain a reference to a collection on a remote database server.
- The collection expression cannot contain column references to tables that appear in the same FROM clause. That is, the collection-derived table must be independent of other tables in the FROM clause.

For example, the following statement returns an error because the collection-derived table, `TABLE (parents.children)`, refers to the table **parents**, which is also referenced in the FROM clause:

```
SELECT COUNT(*)
   FROM parents, TABLE(parents.children) c_table
   WHERE parents.id = 1001
```

To counter this restriction, you might write a query that contains a subquery in the Projection clause:

```
SELECT (SELECT COUNT(*)
      FROM TABLE(parents.children) c_table)
   FROM parents WHERE parents.id = 1001
```

Additional Restrictions That Apply to ESQL/C: In addition to the previously described restrictions, the following restrictions also apply when you use the collection-expression format with ESQL/C:

- You cannot specify an untyped COLLECTION as the host-variable data type.
- You cannot use the format `TABLE(?)`.

  The data type of the underlying collection variable must be determined statically. To counter this restriction, you can explicitly cast the variable to a typed collection data type (SET, MULTISET, or LIST) that the database server recognizes. For example,

  ```
  TABLE(CAST(? AS type))
  ```
- You cannot use the format `TABLE(:`*hostvar*`)`.

  To counter this restriction, you must explicitly cast the variable to a typed collection data type (SET, MULTISET, or LIST) that the database server recognizes. For example,

  ```
  TABLE(CAST(:hostvar AS type))
  ```

Row Type of the Resulting Collection-Derived Table

If you do not specify a derived-column name, the behavior of the database server depends on the data types of the elements in the underlying collection.

Although a collection-derived table appears to contain columns of individual data types, these columns are, in fact, the fields of a ROW data type. The data type of the ROW type as well as the column name depend on several factors.

If the data type of the elements of the underlying collection expression is *type*, the database server determines the ROW type of the collection-derived table by the following rules:

- If *type* is a ROW data type, and no derived-column list is specified, then the ROW type of the collection-derived table is *type*.
- If *type* is a ROW data type and a derived column list is specified, then the ROW type of the collection-derived table is an unnamed ROW type whose column data types are the same as those of *type* and whose column names are taken from the derived column list.
- If *type* is not a ROW data type, the ROW type of the collection-derived table is an unnamed ROW type that contains one column of *type* and whose name is specified in the derived column list. If no name is specified, the database server assigns an implementation-dependent name to the column.

The extended examples that the following table shows illustrate these rules. The table uses the following schema for its examples:

```
CREATE ROW TYPE person (name CHAR(255), id INT);
CREATE TABLE parents
   (
   name CHAR(255),
   id INT,
   children LIST (person NOT NULL)
   );
CREATE TABLE parents2
   (
   name CHAR(255),
   id INT,
   children_ids LIST (INT NOT NULL)
   );
```

ROW Type	Explicit Derived-Column List	Resulting ROW Type of the Collection-Derived Table	Code Example
Yes	No	*Type*	`SELECT (SELECT c_table.name     FROM TABLE(parents.children) c_table     WHERE c_table.id = 1002) FROM parents WHERE parents.id = 1001` In this example, the ROW type of **c_table** is **parents**.
Yes	Yes	Unnamed ROW type of which the column type is *Type* and the column name is the name in the derived-column list	`SELECT (SELECT c_table.c_name    FROM TABLE(parents.children)     c_table(c._name, c_id) WHERE c_table.c_id = 1002) FROM parents WHERE parents.id = 1001` In this example, the ROW type of **c_table** is ROW(**c_name** CHAR(255), **c_id** INT).
No	No	Unnamed ROW that contains one column of *Type* that is assigned an implementation-dependent name	In the following example, if you do not specify **c_id**, the database server assigns a name to the derived column. In this case, the ROW type of **c_table** is ROW(*server_defined_name* INT).
No	Yes	Unnamed ROW type that contains one column of *Type* whose name is in the derived-column list	`SELECT(SELECT c_table.c_id FROM TABLE(parents2.child_ids) c_table (c_id)    WHERE c_table.c_id = 1002) FROM parents WHERE parents.id = 1001` Here the ROW type of **c_table** is ROW(**c_id** INT).

The following program fragment creates a collection-derived table using an SPL function that returns a single value:

```
CREATE TABLE wanted(person_id int);
CREATE FUNCTION
    wanted_person_count (person_set SET(person NOT NULL))
RETURNS INT;
RETURN( SELECT COUNT (*)
    FROM TABLE (person_set) c_table, wanted
    WHERE c_tabel.id = wanted.person_id);
END FUNCTION;
```

The next program fragment shows the more general case of creating a collection-derived table using an SPL function that returns multiple values:

```
-- Table of categories and child categories,
-- allowing any number of levels of subcategories
CREATE TABLE CategoryChild (
         categoryId      INTEGER,
         childCategoryId SMALLINT
);

INSERT INTO CategoryChild VALUES (1, 2);
INSERT INTO CategoryChild VALUES (1, 3);
INSERT INTO CategoryChild VALUES (1, 4);
INSERT INTO CategoryChild VALUES (2, 5);
INSERT INTO CategoryChild VALUES (2, 6);
INSERT INTO CategoryChild VALUES (5, 7);
INSERT INTO CategoryChild VALUES (7, 8);
INSERT INTO CategoryChild VALUES (7, 9);
INSERT INTO CategoryChild VALUES (4, 10);

-- "R" == ROW type
CREATE ROW TYPE categoryLevelR (
         categoryId      INTEGER,
         level   SMALLINT );

-- DROP FUNCTION categoryDescendants (
--               INTEGER, SMALLINT );
CREATE FUNCTION categoryDescendants (
         pCategoryId INTEGER,
         pLevel      SMALLINT DEFAULT 0 )
RETURNS MULTISET (categoryLevelR NOT NULL)

-- "p" == Prefix for Parameter names
-- "l" == Prefix for Local variable names
DEFINE lCategoryId LIKE CategoryChild.categoryId;
DEFINE lRetSet MULTISET (categoryLevelR NOT NULL);
DEFINE lCatRow categoryLevelR;

-- TRACE ON;
-- Must initialize collection before inserting rows
LET lRetSet = 'MULTISET{}' :: MULTISET (categoryLevelR NOT NULL);
FOREACH
SELECT childCategoryId INTO lCategoryId
   FROM CategoryChild WHERE categoryId = pCategoryId;
INSERT INTO TABLE (lRetSet)
   VALUES (ROW (lCategoryId, pLevel+1)::categoryLevelR);

-- INSERT INTO TABLE (lRetSet);
-- EXECUTE FUNCTION categoryDescendantsR ( lCategoryId,
-- pLevel+1 );
-- Need to iterate over results and insert into SET.
-- See the SQL Tutorial, pg. 10-52:
-- "Tip: You can only insert one value at a time
-- into a simple collection."
   FOREACH
   EXECUTE FUNCTION categoryDescendantsR ( lCategoryId, pLevel+1 )
     INTO lCatRow;
       INSERT INTO TABLE (lRetSet)
           VALUES (lCatRow);
   END FOREACH;
END FOREACH;

RETURN lRetSet;
END FUNCTION
;
-- "R" == recursive
-- DROP FUNCTION categoryDescendantsR (INTEGER, SMALLINT);
CREATE FUNCTION categoryDescendantsR (
         pCategoryId INTEGER,
         pLevel      SMALLINT DEFAULT 0
)
RETURNS categoryLevelR;
DEFINE lCategoryId      LIKE CategoryChild.categoryId;
DEFINE lCatRow          categoryLevelR;
```

```
FOREACH
   SELECT  childCategoryId
   INTO    lCategoryId
   FROM    CategoryChild
   WHERE   categoryId = pCategoryId
   RETURN ROW (lCategoryId, pLevel+1)::categoryLevelR WITH RESUME;

   FOREACH
   EXECUTE FUNCTION categoryDescendantsR ( lCategoryId, pLevel+1 )
      INTO    lCatRow
      RETURN  lCatRow WITH RESUME;
   END FOREACH;
END FOREACH;
END FUNCTION;

-- Test the functions:
SELECT lev, col
FROM    TABLE ((
         categoryDescendants (1, 0)
         )) AS CD (col, lev);
```

Accessing a Collection Through a Collection Variable

When you use the collection-variable format of the collection-derived table segment, you use a host or program variable to access and manipulate the elements of a collection. This format allows you to modify the contents of a variable as you would a table in the database, and then update the actual table with the contents of the **collection** variable.

You can use the collection-variable format (the TABLE keyword preceding a **collection** variable) in place of the name of a table, synonym, or view in the following SQL statements (or in the FOREACH statement of SPL):

- The FROM clause of the SELECT statement to access an element of the **collection** variable
- The INTO clause of the INSERT statement to add a new element to the **collection** variable
- The DELETE statement to remove an element from the **collection** variable
- The UPDATE statement to modify an existing element in the **collection** variable
- The DECLARE statement to declare a select or insert cursor to access multiple elements of an ESQL/C **collection** host variable
- The FETCH statement to retrieve a single element from a **collection** host variable that is associated with a select cursor
- The PUT statement to retrieve a single element from a **collection** host variable that is associated with an insert cursor
- The FOREACH statement to declare a cursor to access multiple elements of an SPL collection variable and to retrieve a single element from this **collection** variable

Using a Collection Variable to Manipulate Collection Elements

When you use data manipulation statements (SELECT, INSERT, UPDATE, or DELETE) of Dynamic Server in conjunction with a **collection** variable, you can modify one or more elements in a collection.

To modify elements in a collection:

1. Create a **collection** variable in your SPL routine or ESQL/C program.

   For information on how to declare a **collection** variable in ESQL/C, see the *IBM Informix ESQL/C Programmer's Manual*. For information on how to define a **COLLECTION** variable in SPL, see "DEFINE" on page 3-7.

2. In ESQL/C, allocate memory for the collection; see "ALLOCATE COLLECTION" on page 2-4.
3. Optionally, use a SELECT statement to select a COLLECTION column into the **collection** variable.

   If the variable is an untyped COLLECTION variable, you must perform a SELECT from the COLLECTION column before you use the variable in the collection-derived table segment. The SELECT statement allows the database server to obtain the collection data type.
4. Use the appropriate data manipulation statement with the collection-derived table segment to add, delete, or update elements in the collection variable.

   To insert more than one element or to update or delete a *specific* element of a collection, you must use a cursor for the collection variable.
   - For more information on how to use an update cursor with ESQL/C, see "DECLARE" on page 2-260.
   - For more information on how to use an update cursor with SPL, see "FOREACH" on page 3-20.
5. After the collection variable contains the correct elements, use an INSERT or UPDATE statement on the table or view that holds the actual collection column to save the changes that the collection variable holds.
   - With UPDATE, specify the collection variable in the SET clause.
   - With INSERT, specify the collection variable in the VALUES clause.

The collection variable stores the elements of the collection. It has no intrinsic connection, however, with a database column. Once the collection variable contains the correct elements, you must then save the variable into the actual collection column of the table with either an INSERT or an UPDATE statement.

Example of Deleting from a Collection in ESQL/C: Suppose that the **set_col** column of a row in the **table1** table is defined as a SET and for one row contains the values {1,8,4,5,2}. The following ESQL/C code fragment uses an update cursor and a DELETE statement with a WHERE CURRENT OF clause to delete the element whose value is 4:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection set(smallint not null) a_set;
   int an_int;
EXEC SQL END DECLARE SECTION;
...
EXEC SQL allocate collection :a_set;
EXEC SQL select set_col into :a_set from table1 where int_col = 6;
EXEC SQL declare set_curs cursor for
   select * from table(:a_set) for update;

EXEC SQL open set_curs;
while (i<coll_size)
{
   EXEC SQL fetch set_curs into :an_int;
   if (an_int = 4)
   {
      EXEC SQL delete from table(:a_set) where current of set_curs;
      break;
   }
   i++;
}
```

```
EXEC SQL update table1 set set_col = :a_set
   where int_col = 6;
EXEC SQL deallocate collection :a_set;
EXEC SQL close set_curs;
EXEC SQL free set_curs;
```

After the DELETE statement executes, this collection variable contains the elements {1,8,5,2}. The UPDATE statement at the end of this code fragment saves the modified collection into the **set_col** column. Without this UPDATE statement, element 4 of the collection column is not deleted.

Example of Deleting from a Collection: Suppose that the **set_col** column of a row in the **table1** table is defined as a SET and one row contains the values {1,8,4,5,2}. The following SPL code fragment uses a FOREACH loop and a DELETE statement with a WHERE CURRENT OF clause to delete the element whose value is 4:

```
CREATE_PROCEDURE test6()

   DEFINE a SMALLINT;
   DEFINE b SET(SMALLINT NOT NULL);
   SELECT set_col INTO b FROM table1
      WHERE id = 6;
      -- Select the set in one row from the table
      -- into a collection variable
   FOREACH cursor1 FOR
      SELECT * INTO a FROM TABLE(b);
         -- Select each element one at a time from
         -- the collection derived table b into a
      IF a = 4 THEN
         DELETE FROM TABLE(b)
            WHERE CURRENT OF cursor1;
            -- Delete the element if it has the value 4
         EXIT FOREACH;
      END IF;
   END FOREACH;

   UPDATE table1 SET set_col = b
      WHERE id = 6;
      -- Update the base table with the new collection

END PROCEDURE;
```

This SPL routine declares two SET variables, **a** and **b**, each to hold a set of SMALLINT values. The first SELECT statement copies a SET column from one row of **table1** into variable **b**. The routine then declares a cursor called **cursor1** that copies one element at a time from **b** into SET variable **a**. When the cursor is positioned on the element whose value is 4, the DELETE statement removes that element from SET variable **b**. Finally, the UPDATE statement replaces the row of **table1** with the new collection that is stored in variable **b**.

For information on how to use collection variables in an SPL routine, see the *IBM Informix Guide to SQL: Tutorial*.

Example of Updating a Collection: Suppose that the **set_col** column of a table called **table1** is defined as a SET and that it contains the values {1,8,4,5,2}. The following ESQL/C program changes the element whose value is 4 to a value of 10:

```
main
{
   EXEC SQL BEGIN DECLARE SECTION;
      int a;
      collection b;
   EXEC SQL END DECLARE SECTION;

   EXEC SQL allocate collection :b;
   EXEC SQL select set_col into :b from table1
      where int_col = 6;

   EXEC SQL declare set_curs cursor for
      select * from table(:b) for update;
   EXEC SQL open set_curs;
   while (SQLCODE != SQLNOTFOUND)
   {
      EXEC SQL fetch set_curs into :a;
      if (a = 4)
      {
         EXEC SQL update table(:b)(x)
            set x = 10 where current of set_curs;
         break;
      }
   }
   EXEC SQL update table1 set set_col = :b
      where int_col = 6;
   EXEC SQL deallocate collection :b;
   EXEC SQL close set_curs;
   EXEC SQL free set_curs;
}
```

After you execute this ESQL/C program, the **set_col** column in **table1** contains the values {1,8,10,5,2}.

This ESQL/C program defines two **collection** variables, **a** and **b**, and selects a SET from **table1** into **b**. The WHERE clause ensures that only one row is returned. Then the program defines a collection cursor, which selects elements one at a time from **b** into **a**. When the program locates the element with the value 4, the first UPDATE statement changes that element value to 10 and exits the loop.

In the first UPDATE statement, **x** is a derived-column name used to update the current element in the collection-derived table. The second UPDATE statement updates the base table **table1** with the new collection.

For information on how to use **collection** host variables in an ESQL/C program, see the discussion of complex data types in the *IBM Informix ESQL/C Programmer's Manual*.

Example of Inserting a Value into a Multiset Collection: Suppose the ESQL/C host variable **a_multiset** has the following declaration:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection multiset(integer not null) a_multiset;
EXEC SQL END DECLARE SECTION;
```

The following INSERT statement adds a new MULTISET element of 142,323 to **a_multiset**:

```
EXEC SQL allocate collection :a_multiset;
EXEC SQL select multiset_col into :a_multiset from table1
   where id = 107;
EXEC SQL insert into table(:a_multiset) values (142323);
EXEC SQL update table1 set multiset_col = :a_multiset
   where id = 107;

EXEC SQL deallocate collection :a_multiset;
```

When you insert elements into a **client-collection** variable, you cannot specify a SELECT statement or an EXECUTE FUNCTION statement in the VALUES clause of the INSERT. When you insert elements into a **server-collection** variable, however, the SELECT and EXECUTE FUNCTION statements are valid in the VALUES clause. For more information on **client-** and **server-collection** variables, see the *IBM Informix ESQL/C Programmer's Manual*.

Accessing a Nested Collection

If the element of the collection is itself a complex type (**collection** or **row** type), the collection is a *nested collection*. For example, suppose the ESQL/C **collection** variable, **a_set**, is a nested collection that is defined as follows:

```
EXEC SQL BEGIN DECLARE SECTION;
   client collection set(list(integer not null)) a_set;
   client collection list(integer not null) a_list;
   int an_int;
EXEC SQL END DECLARE SECTION;
```

To access the elements (or fields) of a nested collection, use a **collection** or **row** variable that matches the element type (**a_list** and **an_int** in the preceding code fragment) and a select cursor.

Accessing a Row Variable

The TABLE keyword can make an ESQL/C **row** variable a collection-derived table. That is, a row appears as a table in an SQL statement. For a **row** variable, think of the collection-derived table as a table of one row, with each field of the **row** type being a column of the row. Use the TABLE keyword in place of the name of a table, synonym, or view in these SQL statements:

- The FROM clause of the SELECT statement to access a field of the **row** variable
- The UPDATE statement to modify an existing field in the **row** variable

The DELETE and INSERT statements do not support a **row** variable in the collection-derived-table segment.

For example, suppose an ESQL/C host variable **a_row** has the following declaration:

```
EXEC SQL BEGIN DECLARE SECTION;
   row(x int, y int, length float, width float) a_row;
EXEC SQL END DECLARE SECTION;
```

The following ESQL/C code fragment adds the fields in the **a_row** variable to the **row_col** column of the **tab_row** table:

```
EXEC SQL update table(:a_row)
   set x=0, y=0, length=10, width=20;
EXEC SQL update rectangles set rect = :a_row;
```

Related Information

DECLARE, DELETE, DESCRIBE, FETCH, INSERT, PUT, SELECT, UPDATE, DEFINE, and FOREACH.

For information on how to use COLLECTION variables in an SPL routine, see the *IBM Informix Guide to SQL: Tutorial*.

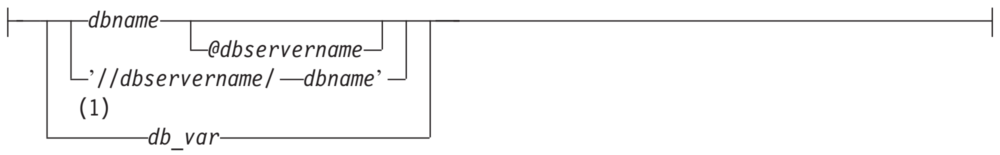
For information on how to use **collection** or **row** variables in an ESQL/C program, see the chapter on complex data types in the *IBM Informix ESQL/C Programmer's Manual*.

Database Name

Use the Database Name segment to specify the name of a database. Use this segment when you see a reference to a database name in a syntax diagram.

Syntax

Database Name:



Notes:

1 ESQL/C only

Element	Description	Restrictions	Syntax
dbname	Database name (with no pathname nor database server name)	Must be unique among the names of databases of the database server	"Identifier" on page 5-22
dbservername	Database server on which the database *dbname* resides	Must exist. No blank space can separate @ from *dbservername*.	"Identifier" on page 5-22
db_var	Host variable whose value specifies a database environment	Variable must be a fixed-length character data type	Language specific

Usage

Database names are not case sensitive. You cannot use delimited identifiers for a database name.

The identifiers *dbname* and *dbservername* can each have a maximum of 128 bytes.

3 If the name of a database server is a delimited identifier or if it includes uppercase
3 letters, that database server cannot participate in cross-server distributed DML
3 operations. To avoid this restriction, use only undelimited names that include no
3 uppercase letters when you declare the name or the alias of a database server.

In a nondefault locale, *dbname* can include alphabetic characters from the code set of the locale. In a locale that supports a multibyte code set, keep in mind that the maximum length of the database name refers to the number of bytes, not the number of characters. For more information on the GLS aspects of naming databases, see the *IBM Informix GLS User's Guide*.

Examples

You can choose a database on another database server as your current database by specifying a database server name. The database server that *dbservername* specifies must match the name of a database server that is listed in your **sqlhosts** information.

Using the @ Symbol

The @ symbol is a literal character. If you specify a database server name, blank spaces are not valid between the @ symbol and the database server name. Either put a blank space between *dbname* and the @ symbol, or omit the blank space.

The following examples show valid database specifications, qualified by the database server name:

```
empinfo@personnel
empinfo @personnel
```

In these examples, **empinfo** is the name of the database and **personnel** is the name of the database server.

Using a Path-Type Naming Notation

If you specify a pathname, do not put blank spaces between the quotes, slashes, and names. The following example specifies a valid UNIX pathname:

```
'//personnel/empinfo'
```

Here **empinfo** is the *dbname* and **personnel** is the name of the database server.

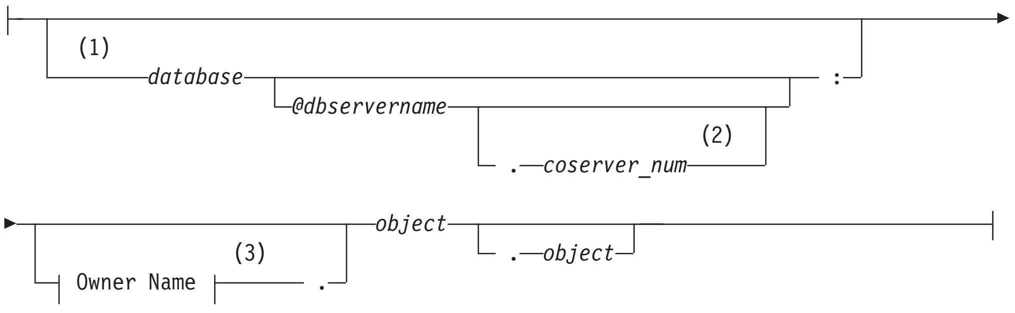
Using a Host Variable

You can use a host variable within an ESQL/C application to store a value that represents a database environment.

Database Object Name

Use the Database Object Name segment to specify the name of a database object, such as a column, table, view, or user-defined routine. Use this segment whenever you see a reference to a database object name.

Syntax



Notes:

1 Informix extension

2 Extended Parallel Server only

3 See "Owner Name" on page 5-43

Element	Description	Restrictions	Syntax
coserver_num	Coserver where *object* resides	Must exist.	"Literal Number" on page 4-137
database	Database where *object* resides	Must exist.	"Database Name" on page 5-15
dbservername	Database server of *database*	Must exist. No blankspace after `@`.	"Identifier" on page 5-22
object	Name of a database object	See "Usage" on page 5-17.	"Identifier" on page 5-22

Usage

A database object name can include qualifiers and separator symbols to specify a database, a server, a coserver (for XPS only), an owner, and (for some objects) another object of which the current database object is a component. For example, this expression specifies the **unit-price** column of the **stock** table, owned by user **informix**, in the **stores_demo** database of a database server called **butler**:

```
stores_demo@butler:informix.stock.unit_price
```

If you are creating or renaming a database object, the new name that you declare must be unique among objects of the same type in the database. Thus, the name of a new view must be unique among the names and synonyms of tables, views, and sequence objects that already exist in the same database. (But a view can have the same name as a view in a different database of the same server, or the same name as a trigger, for example, because these are different types of objects.)

In an ANSI-compliant database, the *ownername.object* combination must be unique in the database for the type of object. A database object specification must include the owner name for a database object that you do not own. For example, if you specify a table that you do not own, you must also specify the owner of the table. The owner of all the system catalog tables is **informix**.

In Dynamic Server, the uniqueness requirement does not apply to the name of a user defined routine (UDR). For more information, see "Routine Overloading and Naming UDRs with a Routine Signature (IDS)" on page 5-19.

Characters from the code set of your database locale are valid in database object names. For more information, see *IBM Informix GLS User's Guide*.

Specifying a Database Object in an External Database

You can specify a database object in either an external database on the local database server or in an external database on a remote database server.

Specifying a Database Object in a Cross-Database Query: To specify an object in another database of the local database server, you must qualify the identifier of the object with the name of the database (and of the owner, if the external database is ANSI compliant), as in this example:

```
corp_db:hrdirector.executives
```

In this example, the name of the external database is **corp_db**. The name of the owner of the table is **hrdirector**. The name of the table is **executives**. Here the colon (**:**) separator is required after the *database* qualifier.

In Dynamic Server, queries and other data manipulation language (DML) operations on other databases of the local database server can access the built-in opaque data types BOOLEAN, BLOB, CLOB, and LVARCHAR. DML operations can also access user-defined data types (UDTs) that can be cast to built-in types, as well as DISTINCT types that are based on built-in types, if each DISTINCT types and UDT is explicitly cast to a built-in type, and if all the DISTINCT types, UDTs, and casts are defined in all of the participating databases. The same data-type restrictions also apply to the arguments and to the returned values of a user-defined routine (UDR) that accesses other databases of the local Dynamic Server instance, if the UDR is defined in all of the participating databases.

Specifying a Database Object in a Cross-Server Query: To specify an object in a database of a remote database server, you must use a *fully-qualified identifier* that specifies the database, database server, and owner (if the external database is ANSI compliant) in addition to the database object name. For example, **hr_db@remoteoffice:hrmanager.employees** is a fully-qualified table name.

Here the database is **hr_db**, the database server is **remoteoffice**, the table owner is **hrmanager**, and the table name is **employees**. The at (**@**) separator, with no blank spaces, is required between the *database* and *database server* qualifiers. Cross-server queries can only access columns of built-in data types that are not opaque data types. (You cannot access UDTs, nor opaque, complex, or other extended data types in cross-server operations.)

In Dynamic Server, if a UDR exists on a remote database server, you must specify a fully-qualified identifier for the UDR. Like cross-server DML operations, a remote UDR is limited to built-in non-opaque data types for its arguments, parameters, and returned values.

You can refer to a remote database object in the following statements only. For information on the support in these statements across databases of the local server, or across database servers, refer to the *IBM Informix Guide to SQL: Tutorial*.

CREATE DATABASE	EXECUTE FUNCTION	LOCK TABLE
CREATE SYNONYM	EXECUTE PROCEDURE	SELECT
CREATE VIEW	INFO	UNLOAD
DATABASE	INSERT	UNLOCK TABLE
DELETE	LOAD	UPDATE

3 If the name of a database server is a delimited identifier or if it includes uppercase
3 letters, that database server cannot participate in distributed DML operations. To
3 avoid this restriction, use only undelimited names that include no uppercase letters
3 when you declare the name or the alias of a database server.

Routine Overloading and Naming UDRs with a Routine Signature (IDS)

Because of routine overloading, the name of a user-defined routine does not need to be unique to the database. You can define more than one UDR with the same name, provided that the *routine signature* for each UDR is different.

UDRs are uniquely identified by their signatures. The signature of a UDR includes the following items of information:

- The type of routine (function or procedure)
- The identifier of the routine
- The cardinality, data type, and order of the parameters
- In an ANSI-compliant database, the owner name

For any given UDR, at least one item in the routine signature must be unique among all the UDRs registered in the database.

Specifying an Existing UDR: To reference an existing UDR by a name that does not uniquely identify the UDR, you must also specify the parameter data types after the UDR name, in the same order that they were declared when the UDR was created. Dynamic Server then uses routine resolution rules to identify the instance of the UDR to alter, drop, or execute. As an alternative, you can specify its *specific name*, if one was declared when the UDR was created. Specific names are described in the section "Specific Name" on page 5-68. For more details of routine resolution, see "Comparing Arguments to the Parameter List" on page 5-2, and *IBM Informix User-Defined Routines and Data Types Developer's Guide*.

Owners of Objects Created by UDRs

When a DDL statement within an owner-privileged UDR creates a new database object, the owner of the routine (rather than the user who executes it, if that user is not the owner of the routine) becomes the owner of the new database object. For a DBA-privileged UDR, however, the user who executes the routine (and who must hold DBA privilege) becomes the owner of any objects that the UDR creates.

External Routine Reference

Use an External Routine Reference when you write an external routine. Only Dynamic Server supports this syntax segment.

Syntax

External Routine Reference:

```
                                                   (1)
├──EXTERNAL NAME──┤ Shared-Object Filename ├──────LANGUAGE──┬─C────┬──────────────►
                                                            └─JAVA─┘

►──┬─────────────────────────────────────┬──┬──────────────────────────────┬──────┤
   │                  ┌─INFORMIX─┐        │  │ (2)    (3)    ┌─VARIANT─────┐ │
   └─PARAMETER STYLE──┴──────────┘        ┘  └───────────────┴─NOT VARIANT─┴─┘
```

Notes:

1 See "Shared-Object Filename" on page 5-65

2 C

3 Java

Usage

If the IFX_EXTEND_ROLE configuration parameter is set to ON, authorization to use this segment is available only to the Database Server Administrator (DBSA), and to users whom the DBSA has granted the EXTEND role. By default, the DBSA is user **informix**.

This segment specifies the following information about an external routine:

- Pathname to the executable object code, stored in a shared-object file

  For C routines, this file is either a DLL or a shared library, depending on your operating system.

  For Java routines, this file is a jar file. Before you can create a UDR written in the Java language, you must assign a jar identifier to the external jar file with the **sqlj.install_jar** procedure. For more information, see "sqlj.install_jar" on page 2-339.
- The name of the programming language in which the UDR is written
- The parameter style of the UDR

  By default, the parameter style is INFORMIX. (This implies that if you specify OUT or INOUT parameters, the OUT or INOUT values are passed by reference.)
- The VARIANT or NOT VARIANT option, if you specify one. (This option is not available for SPL routines.)

VARIANT or NOT VARIANT Option

A function is *variant* if it can return different results when it is invoked with the same arguments or if it modifies the state of a database or of a variable. For example, a function that returns the current date or time is a variant function.

By default, user-defined functions are variant. If you specify NOT VARIANT when you create or modify a function, it cannot contain any SQL statements.

If the function is nonvariant, the database server might cache the return variant functions. For more information on functional indexes, see “CREATE INDEX” on page 2-116.

To register a nonvariant function, add the NOT VARIANT option in this clause or in the Routine Modifier clause that is discussed in “Routine Modifier” on page 5-54. If you specify the modifier in both contexts, however, you must use the same modifier (either VARIANT or NOT VARIANT) in both clauses.

Example of a C User-Defined Function

The next example registers an external function named **equal( )** that takes two **point** data type values as arguments. In this example, **point** is an opaque data type that specifies the **x** and **y** coordinates of a two-dimensional point.

```
CREATE FUNCTION equal( a point, b point ) RETURNING BOOLEAN;
   EXTERNAL NAME "/usr/lib/point/lib/libbtype1.so(point1_equal)"
   LANGUAGE C
END FUNCTION;
```

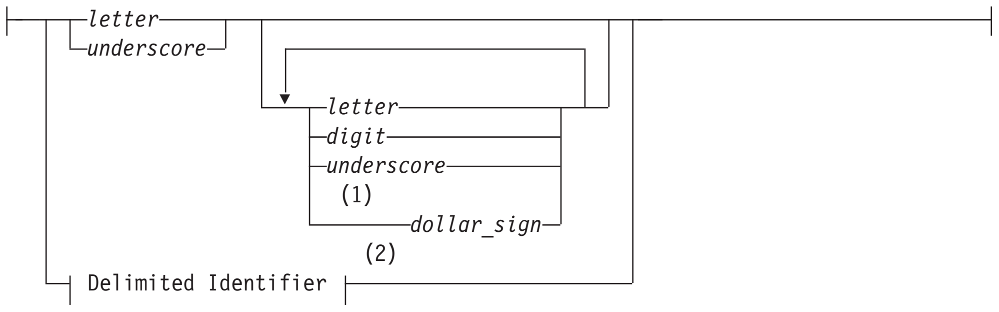
The function returns a single value of type BOOLEAN. The external name specifies the path to the C shared-object file where the object code of the function is stored. The external name indicates that the library contains another function, **point1_equal( )**, which is invoked while **equal( )** executes.

Identifier

An *identifier* specifies the unqualified name of a database object, such as an access method, aggregate, alias, blobspace, cast, column, constraint, correlation, data type, index, operator class, optimizer directive, partition, procedure, table, trigger, sequence, synonym, or view. Use the Identifier segment whenever you see a reference to an identifier in a syntax diagram.

Syntax

Identifier:



Notes:

1 Dynamic Server only

2 See "Delimited Identifiers" on page 5-23

Element	Description	Restrictions	Syntax
digit	Integer in range 0 to 9	Cannot be the first character	"Literal Number" on page 4-137
dollar_sign	Dollar ($) symbol	Cannot be the first character	Literal symbol entered from the keyboard.
letter	Upper- or lowercase letter of the alphabet	In the default locale, must be an ASCII character in the range A to Z or a to z	Literal symbol entered from the keyboard.
underscore	Underscore (_) character	Cannot substitute a space, hyphen, or other non-alphanumeric character	Literal symbol entered from the keyboard.

Usage

This is a logical subset of "Database Object Name" on page 5-17, a segment that can specify the *owner*, *database*, and *database server* of external objects.

To include other non-alphanumeric symbols, such as a blank space (ASCII 32), in an identifier, you must use a delimited identifier. It is recommended that you do not use the dollar sign ($) in identifiers, because this symbol is a special character whose inclusion in an identifier might cause conflicts with other syntax elements. For more information, see "Delimited Identifiers" on page 5-23.

An identifier must have a length of at least 1 byte, but no more than 128 bytes. For example, **employee_information** is valid as a table name. If you are using a multibyte code set, keep in mind that the maximum length of an identifier refers to the number of bytes, not to the number of logical characters.

For letter characters in nondefault locales, see "Support for Non-ASCII Characters in Identifiers" on page 5-23. For further information on the GLS aspects of identifiers, see Chapter 3 of the *IBM Informix GLS User's Guide*.

When you use ESQL/C with Dynamic Server, the database server checks the internal version number of the client application and the setting of the **IFX_LONGID** environment variable to determine whether a client application supports long identifiers (up to 128 bytes in length). For more information, see the *IBM Informix Guide to SQL: Reference*.

Use of Uppercase Characters

You can specify the name of a database object with uppercase characters, but the database server shifts these to lowercase characters unless the **DELIMIDENT** environment variable is set and the identifier of the database object is enclosed between double (") quotes. In this case, the database server treats the name of the database object as a delimited identifier and preserves the uppercase characters in the name, as described in "Delimited Identifiers" on page 5-23.

3 If the name of a database server includes uppercase letters, that database server
3 cannot participate in distributed DML operations. To avoid this restriction, use
3 only undelimited names that include no uppercase letters when you declare the
3 name or the alias of a database server.

Use of Keywords as Identifiers

Although you can use almost any word as an identifier, syntactic ambiguities can result from using keywords as identifiers in SQL statements. The statement might fail or might not produce the expected results. For a discussion of the syntactic ambiguities that can result from using keywords as identifiers and an explanation of workarounds for these problems, see "Potential Ambiguities and Syntax Errors" on page 5-25.

Delimited identifiers provide the easiest and safest way to use a keyword as an identifier without syntactic ambiguities. No workarounds are necessary for a keyword as a delimited identifier. For the syntax and usage of delimited identifiers, see "Delimited Identifiers" on page 5-23. Delimited identifiers require, however, that your code always use single (') quotes, rather than double (") quotes, to delimit character-string literals.

For the keywords of the implementation of SQL in Dynamic Server, see Appendix A, "Reserved Words for IBM Informix Dynamic Server," on page A-1.

The keywords of SQL in Extended Parallel Server are listed in Appendix B, "Reserved Words for IBM Informix Extended Parallel Server," on page B-1.

Tip: If an error message seems unrelated to the statement that caused the error, check to see if the statement uses a keyword as an undelimited identifier.

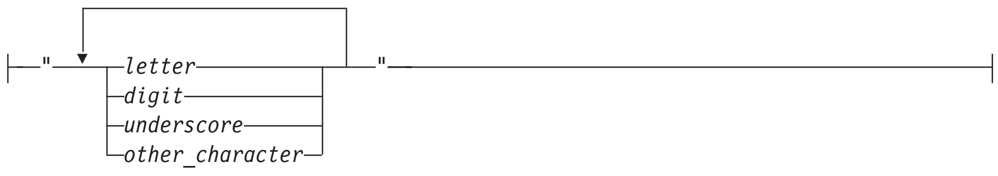
Support for Non-ASCII Characters in Identifiers

In a nondefault locale, you can use any alphabetic character that your locale recognizes as a *letter* in an SQL identifier. This feature enables you to use non-ASCII characters in the names of some database objects. For objects that support non-ASCII characters, see the *IBM Informix GLS User's Guide*.

Delimited Identifiers

By default, the character set of a valid SQL identifier is restricted to letters, digits, underscore, and dollar-sign symbols. If you set the **DELIMIDENT** environment variable, however, SQL identifiers can also include additional characters from the code set implied by the setting of the **DB_LOCALE** environment variable.

Delimited Identifier:



Element	Description	Restrictions	Syntax
digit	Integer in the range 0 to 9	Cannot be the first character	"Literal Number" on page 4-137
letter	Letter that forms part of the delimited identifier	Letters in delimited identifiers are case-sensitive	Literal value entered from the keyboard.
other _character	Nonalphanumeric character, such as #, $, or blank space	Must be an element in the code set of the database locale	Literal value entered from the keyboard.
underscore	Underscore (_) symbol in the delimited identifier	Cannot include more than 128	Literal value entered from the keyboard.

If the database supports delimited identifiers, double quotes (″) must enclose every SQL identifier in your code, and single (′) quotes, rather than double (″) quotes, must delimit all character-string literals.

Delimited identifiers enable you to declare names that are otherwise identical to SQL keywords, such as TABLE, WHERE, DECLARE, and so on. The only type of object for which you cannot specify a delimited identifier is a database name.

Letters in delimited identifiers are case sensitive. If you are using the default locale, *letter* must be an upper- or lowercase character in the range a to z or A to Z (in the ASCII code set). If you are using a nondefault locale, *letter* must be an alphabetic character that the locale supports. For more information, see "Support for Non-ASCII Characters in Delimited Identifiers (GLS)" on page 5-24.

Delimited identifiers are compliant with the ANSI/ISO standard for SQL.

When you create a database object, avoid including leading blank spaces or other whitespace characters between the first delimiting quotation mark and the first nonblank character of the delimited identifier. (Otherwise, you might not be able to reference the object in some contexts.)

3 If the name of a database server is a delimited identifier or if it includes uppercase
3 letters, that database server cannot participate in distributed DML operations. To
3 avoid this restriction, use only undelimited names that include no uppercase letters
3 when you declare the name or the alias of a database server.

Support for Nonalphanumeric Characters: You can use delimited identifiers to specify nonalphanumeric characters in the names of database objects. You cannot use delimited identifiers, however, to specify nonalphanumeric characters in the names of storage objects such as dbspaces, partitions, and blobspaces.

Support for Non-ASCII Characters in Delimited Identifiers (GLS): When you are using a nondefault locale whose code set supports non-ASCII characters, you can specify non-ASCII characters in most delimited identifiers. The rule is that if you can specify non-ASCII characters in the undelimited form of the identifier, you can also specify non-ASCII characters in the delimited form of the same identifier. For a list of identifiers that support non-ASCII characters and for information on non-ASCII characters in delimited identifiers, see the *IBM Informix GLS User's Guide*.

Effect of DELIMIDENT Environment Variable: To use delimited identifiers, you must set the **DELIMIDENT** environment variable. While **DELIMIDENT**is set , strings enclosed in double quotes (″) are treated as identifiers of database objects, and strings enclosed in single quotes (′) are treated as literal strings. If the **DELIMIDENT** environment variable is not set, however, strings enclosed in double quotes are also treated as literal strings.

If **DELIMIDENT** is set, the SELECT statement in the following example must be in single quotes in order to be treated as a quoted string:

```
PREPARE ... FROM 'SELECT * FROM customer';
```

If a delimited identifier is used in the SELECT statement that defines a view, then the **DELIMIDENT** environment variable must be set in order for the view to be accessed, even if the view name itself contains no special characters.

Examples of Delimited Identifiers: The next example shows how to create a table with a case-sensitive name:

```
CREATE TABLE "Proper_Ranger" (...);
```

The following example creates a table whose name includes a whitespace character. If the table name were not enclosed by double (″) quotes, and if **DELIMIDENT** were not set, you could not use a blank space in the identifier.

```
CREATE TABLE "My Customers" (...);
```

The next example creates a table that has a keyword as the table name:

```
CREATE TABLE "TABLE" (...);
```

The following example (for Dynamic Server) shows how to delete all the rows from a table that is named FROM when you omit the keyword FROM in the DELETE statement:

```
DELETE "FROM";
```

Using Double Quotes Within a Delimited Identifier: To include a double quote (″) in a delimited identifier, you must precede the double quote (″) with another double quote (″), as this example shows:

```
CREATE TABLE "My""Good""Data" (...);
```

Potential Ambiguities and Syntax Errors

IBM does not recommend using any keyword of SQL as an identifier, because to do so tends to make your code more difficult to read and to maintain. If you ignore this potential problem for human readers, however, you can use almost any keyword as an SQL identifier, but various syntactic ambiguities can occur. An ambiguous statement might not produce the desired results. The following sections identify some potential ambiguities and workarounds.

Using the Names of Built-In Functions as Column Names

The following two examples show a workaround for using a built-in function as a column name in a SELECT statement. This workaround applies to the aggregate functions (AVG, COUNT, MAX, MIN, SUM) as well as the function expressions (algebraic, exponential and logarithmic, time, hex, length, dbinfo, trigonometric, and trim functions).

Using **avg** as a column name causes the next example to fail because the database server interprets **avg** as an aggregate function rather than as a column name:

```
SELECT avg FROM mytab; -- fails
```

If the **DELIMIDENT** environment variable is set, you could use **avg** as a column name as the following example shows:

```
SELECT "avg" from mytab -- successful
```

The workaround in the following example removes ambiguity by including a table name with the column name:

```
SELECT mytab.avg FROM mytab;
```

If you use the keyword TODAY, CURRENT, or USER as a column name, ambiguity can occur, as the following example shows:

```
CREATE TABLE mytab (user char(10),
   CURRENT DATETIME HOUR TO SECOND,TODAY DATE);

INSERT INTO mytab VALUES('josh','11:30:30','1/22/1998');

SELECT user,current,today FROM mytab;
```

The database server interprets **user**, **current**, and **today** in the SELECT statement as the built-in functions USER, CURRENT, and TODAY. Thus, instead of returning `josh, 11:30:30,1/22/1998`, the SELECT statement returns the current user name, the current time, and the current date.

If you want to select the actual columns of the table, you must write the SELECT statement in one of the following ways:

```
SELECT mytab.user,  mytab.current,  mytab.today FROM mytab;

EXEC SQL select * from mytab;
```

Using Keywords as Column Names

Specific workarounds exist for using a keyword as a column name in a SELECT statement or other SQL statement. In some cases, more than one suitable workaround might be available.

Using ALL, DISTINCT, or UNIQUE as a Column Name

If you want to use the ALL, DISTINCT, or UNIQUE keywords as column names in a SELECT statement, you can take advantage of a workaround.

First, consider what happens when you try to use one of these keywords without a workaround. In the following example, using **all** as a column name causes the SELECT statement to fail because the database server interprets **all** as a keyword rather than as a column name:

```
SELECT all FROM mytab -- fails;
```

You must use a workaround to make this SELECT statement execute successfully. If the **DELIMIDENT** environment variable is set, you can use **all** as a column name by enclosing **all** in double quotes. In the following example, the SELECT statement executes successfully because the database server interprets **all** as a column name:

```
SELECT "all" from mytab; -- successful
```

The workaround in the following example uses the keyword ALL with the column name **all**:

```
SELECT ALL all FROM mytab;
```

The examples that follow show workarounds for using the keywords UNIQUE or DISTINCT as a column name in a CREATE TABLE statement.

The next example fails to declare a column named **unique** because the database server interprets **unique** as a keyword rather than as a column name:

```
CREATE TABLE mytab (unique INTEGER); -- fails
```

The following workaround uses two SQL statements. The first statement creates the column **mycol**; the second statement renames the column **mycol** to **unique**:

```
CREATE TABLE mytab (mycol INTEGER);

RENAME COLUMN mytab.mycol TO unique;
```

The workaround in the following example also uses two SQL statements. The first statement creates the column **mycol**; the second alters the table, adds the column **unique**, and drops the column **mycol**:

```
CREATE TABLE mytab (mycol INTEGER);

ALTER TABLE mytab
   ADD (unique INTEGER),
   DROP (mycol);
```

Using INTERVAL or DATETIME as a Column Name

The examples in this section show workarounds for using the keyword INTERVAL (or DATETIME) as a column name in a SELECT statement.

Using **interval** as a column name causes the following example to fail because the database server interprets **interval** as a keyword and expects it to be followed by an INTERVAL qualifier:

```
SELECT interval FROM mytab; -- fails
```

If the **DELIMIDENT** environment variable is set, you could use **interval** as a column name, as the following example shows:

```
SELECT "interval" from mytab; -- successful
```

The workaround in the following example removes ambiguity by specifying a table name with the column name:

```
SELECT mytab.interval FROM mytab;
```

The workaround in the following example includes an owner name with the table name:

```
SELECT josh.mytab.interval FROM josh.mytab;
```

Using rowid as a Column Name (IDS)

Every nonfragmented table has a virtual column named **rowid**. To avoid ambiguity, you cannot use **rowid** as a column name. Performing the following actions causes an error:

- Creating a table or view with a column named **rowid**
- Altering a table by adding a column named **rowid**

- Renaming a column to **rowid**

You can, however, use the term **rowid** as a table name.

```
CREATE TABLE rowid (column INTEGER, date DATE, char CHAR(20));
```

Important: It is recommended that you use primary keys as an access method, rather than exploiting the **rowid** column.

Examples

Examples in this section show workarounds that involve owner naming when the keyword STATISTICS or OUTER is a table name. (This workaround also applies to STATISTICS or OUTER as a view name or synonym.)

Using **statistics** as a table name causes the following example to fail because the database server interprets it as part of the UPDATE STATISTICS syntax rather than as a table name in an UPDATE statement:

```
UPDATE statistics SET mycol = 10;
```

The workaround in the following example specifies an owner name with the table name, to avoid ambiguity:

```
UPDATE josh.statistics SET mycol = 10;
```

Using **outer** as a table name causes the following example to fail because the database server interprets **outer** as a keyword for performing an outer join:

```
SELECT mycol FROM outer; -- fails
```

The following successful example uses owner naming to avoid ambiguity:

```
SELECT mycol FROM josh.outer;
```

Workarounds that Use the Keyword AS

In some cases, although a statement is not ambiguous and the syntax is correct, the database server returns a syntax error. The preceding pages show existing syntactic workarounds for several situations. You can use the AS keyword to provide a workaround for the exceptions.

You can use the AS keyword in front of column labels or table aliases.

The following example uses the AS keyword with a column label:

```
SELECT column_name AS display_label FROM table_name;
```

The following example uses the AS keyword with a table alias:

```
SELECT select_list FROM table_name AS table_alias;
```

Using AS with Column Labels

The examples in this section show workarounds that use the AS keyword with a column label. The first two examples show how you can use the keyword UNITS (or YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, or FRACTION) as a column label.

Using **units** as a column label causes the next example to fail because the database server interprets it as part of an INTERVAL expression in which the **mycol** column is the operand of the UNITS operator:

```
SELECT mycol units FROM mytab;
```

The workaround in the following example includes the AS keyword:

```
SELECT mycol AS units FROM mytab;
```

The following examples uses the AS or FROM keyword as a column label.

Using **as** as a column label causes the following example to fail because the database server interprets **as** as identifying **from** as a column label and thus finds no required FROM clause:

```
SELECT mycol as from mytab; -- fails
```

The following successful example repeats the AS keyword:

```
SELECT mycol AS as from mytab;
```

Using **from** as a column label causes the following example to fail because the database server expects a table name to follow the first **from**:

```
SELECT mycol from FROM mytab; -- fails
```

This example uses the AS keyword to identify the first **from** as a column label:

```
SELECT mycol AS from FROM mytab;
```

Using AS with Table Aliases

Examples in this section show workarounds that use the AS keyword with a table alias. The first pair shows how to use the ORDER, FOR, GROUP, HAVING, INTO, UNION, WITH, CREATE, GRANT, or WHERE keyword as a table alias.

Using **order** as a table alias causes the following example to fail because the database server interprets **order** as part of an ORDER BY clause:

```
SELECT * FROM mytab order -- fails
```

The workaround in the following example uses the keyword AS to identify **order** as a table alias:

```
SELECT * FROM mytab AS order;
```

The next two examples show how to use the keyword WITH as a table alias.

Using **with** as a table alias causes the next example to fail because the database server interprets **with** as part of the WITH CHECK OPTION syntax:

```
EXEC SQL select * from mytab with; -- fails
```

The workaround in the following example uses the keyword AS to identify **with** as a table alias:

```
EXEC SQL select * from mytab as with; -- succeeds
```

The next two examples use the keyword CREATE as a table alias. Using **create** as a table alias causes the next example to fail because the database server interprets the keyword as part of the syntax to create a new database object, such as a table, synonym, or view:

```
EXEC SQL select * from mytab create; -- fails
EXEC SQL select * from mytab as create; -- succeeds
```

The workaround uses the keyword AS to identify **create** as a table alias.
(Using grant as an alias would similarly fail, but is valid after the AS keyword.)

Fetching Cursors that have Keywords as Names

In a few situations, no workaround exists for the syntactic ambiguity that occurs when a keyword is used as an identifier in an SQL program.

In the following example, the FETCH statement specifies a cursor named **next**. The FETCH statement generates a syntax error because the preprocessor interprets **next** as a keyword, signifying the next row in the active set and expects a cursor name to follow **next**. This occurs whenever the keyword NEXT, PREVIOUS, PRIOR, FIRST, LAST, CURRENT, RELATIVE, or ABSOLUTE is used as a cursor name:

```
/* This code fragment fails */
EXEC SQL declare next cursor for
    select customer_num, lname from customer;
EXEC SQL open next;
EXEC SQL fetch next into :cnum, :lname;
```

Fetching Cursors that have Keywords as Names

If you use any of the following keywords as identifiers for variables in a user-defined routine (UDR), you can create ambiguous syntax:

CURRENT	INTERVAL	OUT
DATETIME	NULL	PROCEDURE
GLOBAL	OFF	SELECT

Using CURRENT, DATETIME, INTERVAL, and NULL in INSERT

A UDR cannot insert a variable that was declared using the CURRENT, DATETIME, INTERVAL, or NULL keywords as the name. For example, if you declare a variable called **null**, when you try to insert the value **null** into a column, you receive a syntax error, as the following example shows:

```
CREATE PROCEDURE problem()
. . .
DEFINE null INT;
LET null = 3;
INSERT INTO tab VALUES (null); -- error, inserts NULL, not 3
```

Using NULL and SELECT in a Condition

If you declare a variable with the name **null** or **select**, including it in a condition that uses the IN keyword is ambiguous. The following example shows three conditions that cause problems: in an IF statement, in a WHERE clause of a SELECT statement, and in a WHILE condition:

```
CREATE PROCEDURE problem()
. . .
DEFINE x,y,select, null, INT;
DEFINE pfname CHAR[15];
LET x = 3; LET select = 300;
LET null = 1;
IF x IN (select, 10, 12) THEN LET y = 1; -- problem if

IF x IN (1, 2, 4) THEN
SELECT customer_num, fname INTO y, pfname FROM customer
   WHERE customer IN (select , 301 , 302, 303); -- problem in

WHILE x IN (null, 2)     -- problem while
. . .
END WHILE;
```

You can use the variable **select** in an IN list if you ensure it is not the first element in the list. The workaround in the following example corrects the IF statement that the preceding example shows:

```
IF x IN (10, select, 12) THEN LET y = 1; -- problem if
```

No workaround exists to using **null** as a variable name and attempting to use that variable in an IN condition.

Using ON, OFF, or PROCEDURE with TRACE

If you define an SPL variable called **on**, **off**, or **procedure**, and you attempt to use it in a TRACE statement, the value of the variable is not traced. Instead, the TRACE ON, TRACE OFF, or TRACE PROCEDURE statements execute. You can trace the value of the variable by making the variable into a more complex expression.

The following example shows the ambiguous syntax and the workaround:

```
DEFINE on, off, procedure INT;

TRACE on;                    --ambiguous
TRACE 0+ on;  --ok
TRACE off;                   --ambiguous
TRACE ''||off;--ok

TRACE procedure;  --ambiguous
TRACE 0+procedure;--ok
```

Using GLOBAL as the Name of a Variable

If you attempt to define a variable with the name **global**, the define operation fails. The syntax that the following example shows conflicts with the syntax for defining global variables:

```
DEFINE global INT; -- fails;
```

If the **DELIMIDENT** environment variable is set, you could use **global** as a variable name, as the following example shows:

```
DEFINE "global" INT; -- successful
```

Important: Although workarounds that the preceding sections show can avoid compilation or runtime syntax conflicts from keywords used as identifiers, keep in mind that such identifiers tend to make code more difficult to understand and to maintain.

Using EXECUTE, SELECT, or WITH as Cursor Names

Do not use an EXECUTE, SELECT, or WITH keyword as the name of a cursor. If you try to use one of these keywords as the name of a cursor in a FOREACH statement, the cursor name is interpreted as a keyword in the FOREACH statement. No workaround exists.

The following example does not work:

```
DEFINE execute INT;
FOREACH execute FOR SELECT col1 -- error, looks like
                                -- FOREACH EXECUTE PROCEDURE
    INTO var1 FROM tab1;
```

SELECT Statements in WHILE and FOR Statements

If you use a SELECT statement in a WHILE or FOR loop, and if you need to enclose it in parentheses, enclose the entire SELECT statement in a BEGIN...END statement block. The SELECT statement in the first WHILE statement in the following example is interpreted as a call to the procedure **var1**; the second WHILE statement is interpreted correctly:

```
DEFINE var1, var2 INT;
WHILE var2 = var1
   SELECT col1 INTO var3 FROM TAB -- error, interpreted as call var1()
   UNION
   SELECT co2 FROM tab2;
END WHILE;

WHILE var2 = var1
   BEGIN
      SELECT col1 INTO var3 FROM TAB -- ok syntax
      UNION
      SELECT co2 FROM tab2;
   END
END WHILE;
```

SET Keyword in the ON EXCEPTION Statement

If you use a statement that begins with the keyword SET in ON EXCEPTION, you must enclose it in a BEGIN ... END statement block. The following list shows some of the SQL statements that begin with the keyword SET:

SET ALL_MUTABLES	SET INDEXES
SET AUTOFREE	SET ISOLATION
SET CONNECTION	SET LOCK MODE
SET CONSTRAINTS	SET LOG
SET DATASKIP	SET OPTIMIZATION
SET DEBUG FILE	SET PDQPRIORITY
SET Default Table Space	SET PLOAD FILE
SET Default Table Type	SET ROLE
SET DEFERRED_PREPARE	SET SCHEDULE LEVEL
SET DESCRIPTOR	SET SESSION AUTHORIZATION
SET ENCRYPTION	SET STATEMENT CACHE
SEY ENVIRONMENT	SET TABLE
SET EXPLAIN	SET TRANSACTION
SET INDEX	SET TRIGGER

The following examples show the incorrect and correct use of a SET LOCK MODE statement inside an ON EXCEPTION statement.

The following ON EXCEPTION statement returns an error because the SET LOCK MODE statement is not enclosed in a BEGIN ... END statement block:

```
ON EXCEPTION IN (-107)
   SET LOCK MODE TO WAIT; -- error, value expected, not 'lock'
END EXCEPTION;
```

The following ON EXCEPTION statement executes successfully because the SET LOCK MODE statement is enclosed in a BEGIN ... END statement block:

```
ON EXCEPTION IN (-107)
   BEGIN
   SET LOCK MODE TO WAIT; -- ok
   END
END EXCEPTION;
```

Related Information

For a discussion of owner naming, see your *IBM Informix Performance Guide*.

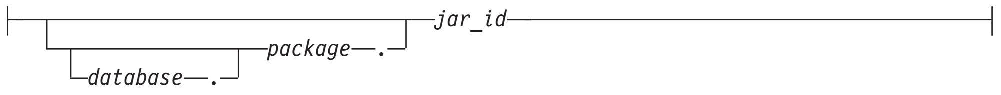
For a discussion of identifiers that support non-ASCII characters and a discussion of non-ASCII characters in delimited identifiers, see the *IBM Informix GLS User's Guide*.

Jar Name

Use the Jar Name segment to specify the name of a jar ID. Use this segment whenever you see a reference to Jar Name in a syntax diagram. Only Dynamic Server supports this syntax segment.

Syntax

Jar Name:



Element	Description	Restrictions	Syntax
database	Database in which to install or access *jar_id*. Default is the current database.	Fully qualified *database*.*package*.*jar_id* identifier must not exceed 255 bytes	"Database Name" on page 5-15
jar_id	The **.jar** file that contains the Java class to be accessed	File must exist in *database*.*package*	"Identifier" on page 5-22
package	Name of the package	Package must exist in *database*	"Identifier" on page 5-22

If a jar name is specified as a character string argument to the **sqlj.install_jar**, **sqlj.replace_jar**, or **sqlj.remove_jar** procedures, then any identifiers in the jar name that are delimited identifiers will include the surrounding double quote characters.

Before you can access a *jar_id* in any way (including its use in a CREATE FUNCTION or CREATE PROCEDURE statement), it must be defined in the current database with the **install_jar( )** procedure. For more information, see "EXECUTE PROCEDURE" on page 2-336.

Related Information

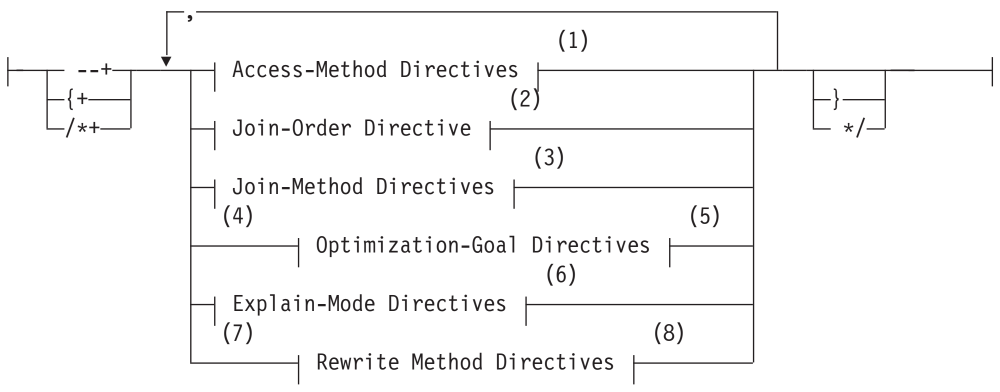
For information on how to update the three-part names of JAR files after you rename the database, see the *J/Foundation Developer's Guide*.

Optimizer Directives

The Optimizer Directives segment specifies keywords that you can use to partially or fully specify the query plan of the optimizer. Use this segment whenever you see a reference to Optimizer Directives in a syntax diagram.

Syntax

Optimizer Directives:



,
--+
{+
/*+
Access-Method Directives (1)
Join-Order Directive (2)
Join-Method Directives (3)
(4) Optimization-Goal Directives (5)
Explain-Mode Directives (6)
(7) Rewrite Method Directives (8)
}
*/

Notes:

1 See "Access-Method Directives" on page 5-35

2 See "Join-Order Directive" on page 5-37

3 See "Join-Method Directives" on page 5-38

4 Dynamic Server only

5 See "Optimization-Goal Directives (IDS)" on page 5-40

6 See "Explain-Mode Directives" on page 5-40

7 Extended Parallel Server only

8 See "Rewrite Method Directive (XPS)" on page 5-42

Usage

Optimizer directives are valid in any query of a DELETE, SELECT, or UPDATE statement. Use one or more directives to partially or fully specify the query plan of the optimizer. The scope of the directive is the current query only.

Directives are enabled by default. To obtain information about how specified directives are processed, view the output of the SET EXPLAIN statement. To disable directives, set the **IFX_DIRECTIVES** environment variable to `0` or `OFF`, or set the DIRECTIVES parameter in the ONCONFIG file to `0`.

Optimizer Directives as Comments

Optimizer directives require the SQL or C comment indicators as delimiters.

- If `{+` are the opening delimiters, you must use `}` as the closing delimiter.
- If `/*` are the opening delimiters, you must use `*/` as the closing delimiters.
- If `--+` are the opening delimiters, then no closing delimiter is needed.

An optimizer directive or a list of optimizer directives immediately follows the DELETE, SELECT, or UPDATE keyword in the form of a comment. After the comment symbol, the first character in an optimizer directive is always a plus (+) sign. No blank space or other whitespace character is allowed between the comment indicator and the plus sign.

You can use any of the following comment indicators:

- A double hyphen (--) delimiter

  The double hyphen needs no closing symbol because it specifies only the remainder of the current line as comment. When you use this style, include the optimizer directive on only the current line.
- Braces ({ }) delimiters

  The comment extends from the left brace ({) until the next right (}) brace; this can be in the same line or in some subsequent line.
- C-language style slash and asterisk (`/*  */`) delimiters

  The comment extends from the initial slash-asterisk (`/*`) pair until the next asterisk-slash (`*/`) characters in the same line or in some subsequent line.

  In ESQL/C, the -**keep** command option to the **esql** compiler must be specified when you use C-style comments.

For additional information, see "How to Enter SQL Comments" on page 1-3.

If you specify multiple directives in the same query, you must separate them with a blank space, a comma, or by any character that you choose. It is recommended that you separate successive directives with a comma.

If the query declares an alias for a table, use the alias (rather than the actual table name) in the optimizer directive specification. Because system-generated index names begin with a blank character, use quotation marks to delimit such names.

Syntax errors in an optimizer directive do not cause a valid query to fail. You can use the SET EXPLAIN statement to obtain information related to such errors.

Restrictions on Optimizer Directives

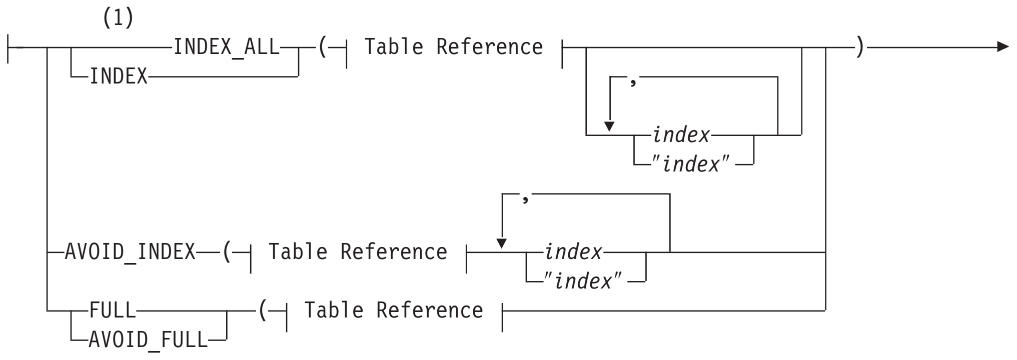
You can specify optimizer directives for any query in a DELETE, SELECT, or UPDATE statement, unless it includes any of the following syntax elements:

- A query that accesses a table outside the current database
- In ESQL/C, a statement with the WHERE CURRENT OF *cursor* clause

Access-Method Directives

Use the access-method directive to specify the manner in which the optimizer should search the tables.

Access-Method Directives:



```
►─┬──────────┬──────────────────────────────────────────────────────┤
  └─comments─┘
```

Table Reference:

```
├──┬─alias───┬──────────────────────────────────────────────────────┤
   ├─synonym─┤
   └─table───┘
```

Notes:

1 Extended Parallel Server only

Element	Description	Restrictions	Syntax
alias	Temporary alternative table name declared in the FROM clause	If an *alias* is declared, it must be used in the optimizer directive	"Identifier" on page 5-22
comments	Text that documents the optimizer directive	Must be outside the parenthesis but inside the comment symbols	Character string
index	Index for which to specify a query plan directive	Must exist. With AVOID _INDEX, at least one *index* is required	"Database Object Name" on page 5-17
synonym, table	Synonym or table in a query for which to specify a directive	Synonym and the table to which it points must exist	"Database Object Name" on page 5-17

Use commas or blank spaces to separate elements within the parentheses.

The following table describes each of the access-method directives and indicates how it affects the query plan of the optimize.

Keywords	Effect	Optimizer Action
AVOID_FULL	No full-table scan on the listed table	The optimizer considers the various indexes it can scan. If no index exists, the optimizer performs a full-table scan.
AVOID_INDEX	Does not use any of the indexes listed	The optimizer considers the remaining indexes and a full- table scan. If all indexes for a table are specified, optimizer uses a full-table scan to access the table.
FULL	Performs a full-table scan	Even if an index exists on a column, the optimizer uses a full-table scan to access the table.
INDEX	Uses the index specified to access the table	If more than one index is specified, the optimizer chooses the index that yields the least cost. If no indexes are specified, then all the available indexes are considered.
INDEX_ALL	Access the table using all listed indexes (Multi-index scan)	If more than one index is specified, all are used. If only one is specified, optimizer follows an INDEX SKIP SCAN using that index. If no index is specified, then all available indexes are considered.

Both the AVOID_FULL and INDEX keywords specify that the optimizer should avoid a full scan of a table. It is recommended, however, that you use the AVOID_FULL keyword to specify the intent to avoid a full scan on the table. In addition to specifying that the optimizer not use a full-table scan, the negative directive allows the optimizer to use indexes that are created after the access-method directive is specified.

In general, you can specify only one access-method directive per table. You can, however, specify both AVOID_FULL and AVOID_INDEX for the same table. When you specify both of these access-method directives, the optimizer avoids performing a full scan of the table and it avoids using the specified index or indexes.

This combination of negative directives allows the optimizer to use indexes that are created after the access-method directives are specified.

Suppose that you have a table named **emp** that contains the following indexes: **loc_no**, **dept_no**, and **job_no**. When you perform a SELECT that uses the table in the FROM clause, you might direct the optimizer to access the table in one of the following ways:

- Example using a positive directive:
  ```
  SELECT {+INDEX(emp dept_no)}
  ```
  In this example the access-method directive forces the optimizer to scan the index on the **dept_no** column.
- Example using a negative directive:
  ```
  SELECT {+AVOID_INDEX(emp loc_no, job_no), AVOID_FULL(emp)}
  ```
  This example includes multiple access-method directives. These access-method directives also force the optimizer to scan the index on the **dept_no** column. If a new index, **emp_no** is created for table **emp**, however, the optimizer can consider it.

Join-Order Directive

Use the ORDERED join-order directive to force the optimizer to join tables or views in the order in which they appear in the FROM clause of the query.

Join-Order Directive:

```
├──ORDERED──┬──────────┬──────────────────────────────────────────────┤
            └─comments─┘
```

Element	Description	Restrictions	Syntax
comments	Text to document the directive	Must appear between comment symbols	Character string

For example, the following query forces the database server to join the **dept** and **job** tables and then join the result with the **emp** table:

```
SELECT --+ ORDERED
   name, title, salary, dname
FROM dept, job, emp WHERE title = 'clerk' AND loc = 'Palo Alto'
   AND emp.dno = dept.dno
   AND emp.job= job.job;
```

Because no predicates occur between the **dept** table and the **job** table, this query forces the database server to construct a Cartesian product.

When your query involves a view, the placement of the ORDERED join-order directive determines whether you are specifying a partial- or total-join order.

- Specifying partial-join order when you create a view

  If you use the ORDERED directive when you create a view, the base tables are joined contiguously in the order of the view definition.

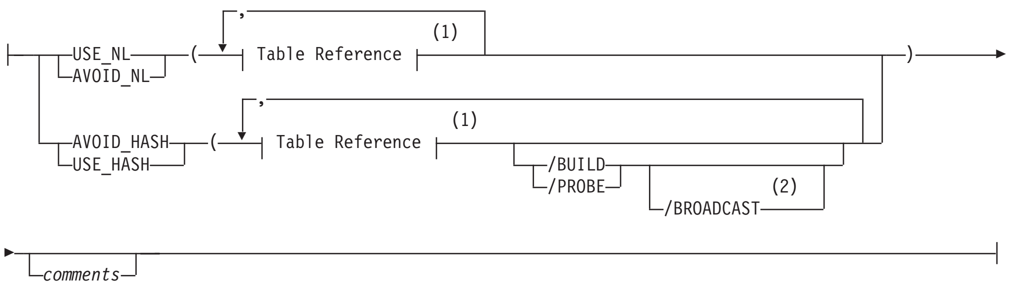
  For all subsequent queries on the view, the database server joins the base tables contiguously in the order specified in the view definition. When used in a view, the ORDERED directive does not affect the join order of other tables named in the FROM clause in a query.
- Specifying total-join order when you query a view

  When you specify the ORDERED join-order directive in a query that uses a view, all tables are joined in the order specified, even those tables that form views. If a view is included in the query, the base tables are joined contiguously in the order of the view definition. For examples of ORDERED with views, refer to your *IBM Informix Performance Guide*.

Join-Method Directives

Use join-method directives to influence how tables are joined in a query.

Join-Method Directives:



Notes:

1 See "Access-Method Directives" on page 5-35

2 Extended Parallel Server only

Element	Description	Restrictions	Syntax
comments	Text to documents the directive	Must appear between comment symbols	Character string

This diagram is simplified: /BROADCAST is not valid with AVOID_HASH.

Use commas or blank spaces to separate the elements within the parentheses.

The following table describes each of the join-method directives.

Keyword	Effect
USE_NL	Uses the specified tables as the inner table in a nested-loop join If *n* tables are specified in the FROM clause, then at most *n-1* tables can be specified in the USE_NL join-method directive.
USE_HASH	Uses a hash join to access the specified table

	You can also choose whether the table will be used to create the hash table or to probe the hash table.
AVOID_NL	Does not use the specified table as inner table in a nested loop join A table listed with this directive can still participate in a nested loop join as the outer table.
AVOID_HASH	Does not access the specified table using a hash join You can optionally use a hash join, but impose restrictions on the role of the table within the hash join.

A join-method directive takes precedence over the join method forced by the OPTCOMPIND configuration parameter.

When you specify the USE_HASH or AVOID_HASH directives (to use or avoid a hash join, respectively), you can also specify the role of each table:

- /BUILD

  With the USE_HASH directive, this keyword indicates that the specified table be used to construct a hash table. With the AVOID_HASH directive, this keyword indicates that the specified table *not* be used to construct a hash table.
- /PROBE

  With the USE_HASH directive, this keyword indicates that the specified table be used to probe the hash table. With the AVOID_HASH directive, this keyword indicates that the specified table *not* be used to probe the hash table. You can specify multiple probe tables as long as there is at least one table for which you do not specify PROBE.
- /BROADCAST

  Only Extended Parallel Server supports the BROADCAST directive, which can improve performance when small base tables or derived tables with few records (< 100K in data size) are involved in a join. In such cases, all the records of the small tables are sent to each instance of a given join operation. The BROADCAST directive must also include either /BUILD or /PROBE, but it is not valid with AVOID_HASH. If the /BUILD option is included, the USE_HASH table is broadcast. If the /PROBE option is included, the join in which the USE_HASH table participates is broadcast.

For the optimizer to find an efficient join query plan, you must at least run UPDATE STATISTICS LOW for every table that is involved in the join, so as to provide appropriate cost estimates. Otherwise, the optimizer might choose to broadcast the entire table to all instances, even if the table is large.

If neither the /BUILD nor the /PROBE keyword is specified, the optimizer uses cost estimates to determine the role of the table.

In this example, the USE_HASH directive forces the optimizer to construct a hash table on the **dept** table and consider only the hash table to join **dept** with the other tables. Because no other directives are specified, the optimizer can choose the least expensive join methods for the other joins in the query.

```
SELECT /*+ USE_HASH (dept /BUILD)
   The optimizer must use dept to construct a hash table */
   name, title, salary, dname
   FROM emp, dept, job WHERE loc = 'Phoenix'
      AND emp.dno = dept.dno  AND emp.job = job.job;
```

Optimization-Goal Directives (IDS)

Use optimization-goal directives to specify the measure that is used to determine the performance of a query result.

Optimization-Goal Directives:

```
├──┬─ALL_ROWS───┬──┬──────────┬──────────────────────────────────────────┤
   └─FIRST_ROWS─┘  └─comments─┘
```

Element	Description	Restrictions	Syntax
comments	Text documenting the directive	Must appear between comment symbols	Character string

The two optimization-goal directives are:

- FIRST_ROWS

  This tells the optimizer to choose a plan that optimizes the process of finding only the first screenful of rows that satisfies the query. Use this option to decrease initial response time for queries that use an interactive mode or that require the return of only a few rows.

- ALL_ROWS

  This directive tells the optimizer to choose a plan that optimizes the process of finding all rows that satisfy the query.

  This form of optimization is the default.

An optimization-goal directive takes precedence over the **OPT_GOAL** environment variable setting and over the OPT_GOAL configuration parameter.

For information about how to set the optimization goal for an entire session, see the SET OPTIMIZATION statement.

You cannot use an optimization-goal directive in the following contexts:

- In a view definition
- In a subquery

The following query returns the names of the employees who earned the top fifty bonuses. The optimization-goal directive directs the optimizer to return the first screenful of rows as fast as possible.

```
SELECT {+FIRST_ROWS
   Return the first screenful of rows as fast as possible}
```

Explain-Mode Directives

Use the explain-mode directives to test and debug query plans and to print information about the query plan to the **sqexplain.out** file.

Explain-Mode Directives:

```
├──EXPLAIN──┬──────────────────────────┬──┬──────────────┬─────────────────────┤
            └──┬───┬──AVOID_EXECUTE──┘  └──comments──┘
               └─,─┘
```

Element	Description	Restrictions	Syntax
comments	Text documenting the directive	Must appear between comment symbols	Character string

The following table lists the effect of each explain-mode directive.

Keyword	**Effect**
EXPLAIN	Turns SET EXPLAIN ON for the specified query
AVOID_EXECUTE	Prevents the data manipulation statement from executing; instead, the query plan is printed to the **sqexplain.out** file

The EXPLAIN directive is primarily useful for testing and debugging query plans. It is redundant when SET EXPLAIN ON is already in effect. It is not valid in a view definition or in a subquery.

The next query executes and prints the query plan to the **sqexplain.out** file:

```
SELECT {+EXPLAIN}
   c.customer_num, c.lname, o.order_date
   FROM customer c, orders o WHERE c.customer_num = o.customer_num;
```

The AVOID_EXECUTE directive prevents execution of a query on either the local or remote site, if a remote table is part of the query. This directive does not prevent nonvariant functions in a query from being evaluated.

The next query does returns no data, but writes its query plan to file **sqexplain.out**:

```
SELECT {+EXPLAIN, AVOID_EXECUTE}   c.customer_num, c.lname, o.order_date
FROM customer c, orders o WHERE c.customer_num = o.customer_num;
```

You must use both the EXPLAIN and AVOID_EXECUTE directives to see the query plan of the optimizer (in the **sqexplain.out** file) without executing the query. The comma (,) separating these two directives is optional.

If you omit the EXPLAIN directive when you specify the AVOID_EXECUTE directive, no error is issued, but no query plan is written to the **sqexplain.out** file and no DML statement is executed.

You cannot use the explain-mode directives in the following contexts:
- In a view definition
- In a trigger
- In a subquery

They are valid, however, in a SELECT statement within an INSERT statement.

Rewrite Method Directive (XPS)

By default, the database server attempts to unnest correlated subqueries. You can use the NESTED rewrite directive in the outermost query to prevent the query plan from being rewritten with unnested subqueries.

Rewrite Method Directive:

```
├──NESTED──┬──────────┬────────────────────────────────────────────┤
           └─comments─┘
```

Element	Description	Restrictions	Syntax
comments	Text documenting the directive	Must appear between comment symbols	Character string

Related Information

For information about the **sqexplain.out** file, see SET EXPLAIN.

For information about how to create optimizer directives that the database server stores in the **sysdirectives** system catalog table for use with subsequent queries, see SAVE EXTERNAL DIRECTIVES.

For information about how to set optimization settings for an entire session, see the description of SET OPTIMIZATION.

For a discussion about optimizer directives and performance, see your *IBM Informix Performance Guide*.

For descriptions of the **IFX_DIRECTIVES** and **IFX_EXTDIRECTIVES** environment variables, see the *IBM Informix Guide to SQL: Reference*.

For information on the DIRECTIVES parameter in the **onconfig** file, see your *IBM Informix Administrator's Reference*.

Owner Name

The owner name specifies the owner of a database object. Use this segment whenever you see a reference to Owner Name in a syntax diagram. A synonym for owner name is *authorization identifier*.

Syntax

Owner Name:

```
├──┬─ owner──┬──────────────────────────────────────────────────────────┤
   ├─'owner'─┤
   └─"owner"─┘
```

Element	Description	Restrictions	Syntax
owner	User name of the owner of an object in a database	Maximum length is 32 bytes	Must conform to the rules of your operating system.

Usage

In an ANSI-compliant database, you must specify the *owner* of any database object that you do not own. The ANSI term for *owner name* is *schema name.*

In databases that are not ANSI-compliant, the *owner* name is optional. You do not need to specify *owner* when you create database objects or use data access statements. If you do not specify *owner* when you create a database object, the database server assigns your login name as the owner of the object, in most cases. For exceptions to this rule, see "Ownership of Created Database Objects" on page 2-112 in CREATE FUNCTION and "Ownership of Created Database Objects" on page 2-150 in CREATE PROCEDURE. When a DDL statement in an owner-privileged UDR creates a new database object, the owner of the routine (rather than the user who executes it, if that user is not the owner of the routine) becomes the owner of the new database object.

If you specify *owner* in data-access statements, the database server checks it for correctness. Without quotation marks, *owner* is case insensitive. The following four queries all can access data from the table **kaths.tab1**:

```
SELECT * FROM tab1;
SELECT * FROM kaths.tab1;
SELECT * FROM KATHS.tab1;
SELECT * FROM Kaths.tab1;
```

Using Quotation Marks

Within quotation marks, *owner* is case sensitive. Quotation marks instruct the database server to read or store the name exactly as typed when you create or access a database object. For example, suppose that you have a table whose owner is `Sam`. You can use either one of the following two statements to access data in the table:

```
SELECT * FROM table1;
SELECT * FROM 'Sam'.table1;
```

The first query succeeds because the owner name is not required. The second query succeeds because the specified owner name matches the owner name as it is stored in the database.

Accessing Information from the System Catalog Tables

If you use the owner name as one of the selection criteria to access database object information from one of the system catalog tables, the owner name is case sensitive. You enclose *owner* in quotation marks, and you must type the owner name exactly as it is stored in the system catalog table. Of the following two examples, only the second successfully accesses information on the table **Kaths.table1**.

```
SELECT * FROM systables WHERE tabname = 'tab1' AND owner = 'kaths';
SELECT * FROM systables WHERE tabname = 'tab1' AND owner = 'Kaths';
```

User **informix** is the owner of the system catalog tables.

Tip: The USER keyword returns the login name exactly as it is stored on the system. If the owner name is stored differently from the login name (for example, a mixed-case owner name and an all lowercase login name), the `owner = USER` syntax fails.

ANSI-Compliant Database Restrictions and Case Sensitivity

The following table describes how the database server reads and stores *owner* when you create, rename, or access a database object.

Owner Name Specification	What the ANSI-Compliant Database Server Does
Omitted	Reads or stores *owner* exactly as the login name is stored in the system, but returns an error if the user is not the *owner*.
Specified without quotation marks	Reads or stores *owner* in uppercase letters
Enclosed between quotation marks	Reads or stores *owner* exactly as entered. See also “Using Quotation Marks” on page 5-43 and “Accessing Information from the System Catalog Tables” on page 5-44.

If you specify the owner name when you create or rename a database object in an ANSI-compliant database, you must include the owner name in data access statements. You must include the owner name when you access a database object that you do not own.

Because the database server automatically shifts *owner* to uppercase letters if not between quotation marks, case-sensitive errors can cause queries to fail. For example, if you are user **nancy** and you use the following statement, the resulting view has the name **nancy.njcust**:

```
CREATE VIEW 'nancy'.njcust AS
   SELECT fname, lname FROM customer WHERE state = 'NJ';
```

The following SELECT statement fails because it tries to match the name **NANCY.njcust** to the actual owner and table name of **nancy.njcust**:

```
SELECT * FROM nancy.njcust;
```

In a Dynamic Server distributed query, if the owner name is not between quotation marks, the remote database follows the lettercase convention of the local database. If the local database is ANSI-compliant, then the remote database processes the owner name in *uppercase*. If the local database is not ANSI- compliant, then the remote database processes the owner name in *lowercase*.

Tip: When you use the owner name as one of the selection criteria in a query (for example, `WHERE owner = 'kaths'`), make sure that the quoted string matches the owner name exactly as it is stored in the database. If the database server cannot find the database object or database, you might need to modify the query so that the quoted string uses uppercase letters (for example, `WHERE owner = 'KATHS'`).

Because owner name is an authorization identifier, rather than an SQL identifier, you can enclose *owner* between single-quotation marks (′) in SQL statements of a database where the **DELIMIDENT** environment variable specifies support for delimited identifiers, thereby requiring double-quotes (″) around SQL identifiers.

Setting ANSIOWNER for an ANSI-Compliant Database

The default behavior of an ANSI-compliant database is to replace any lowercase letters with uppercase letters in any *owner* specification that is not enclosed in quotation marks. You can prevent this by setting the **ANSIOWNER** environment variable to 1 before the database server is initialized. This preserves whatever lettercase you use when you specify the *owner* string without quotation marks.

Default Owner Names

If you create a database object without explicitly specifying an owner name in a database that is not ANSI-compliant, your authorization identifier (as the default owner of the object) is stored in the system catalog of the database as if you had specified your authorization identifier within quotes (that is, preserving the lettercase).

If you create a database object without explicitly specifying an owner name in a database that is ANSI-compliant, your authorization identifier (as the default owner of the object) is stored in the system catalog of the database in uppercase characters, unless the **ANSIOWNER** environment variable was set to 1 before the database server was initialized. If **ANSIOWNER** was set to 1, however, the database stores the default owner of the object as your authorization identifier, with its lettercase preserved.

Purpose Options

The CREATE ACCESS_METHOD, CREATE XADATASOURCE TYPE, and ALTER ACCESS_METHOD statements of Dynamic Server can specify purpose options with the following syntax.

Syntax

Purpose Options:

```
├──┬─task── =──external_routine─────┬──────────────────────────────────────────┤
   ├─value── =──┬─string_value──┬───┤
   │            └─numeric_value─┘   │
   └─flag───────────────────────────┘
```

Element	Description	Restrictions	Syntax
external _routine	User-defined function that performs a *task*	Must be registered in the database	"Database Object Name" on page 5-17
flag	Keyword indicating which feature a flag enables	The interface specifies flag names	*Flag* Purpose Category in the table in "Purpose Functions, Methods, Flags, and Values" on page 5-47.
numeric _value	A value of a real number	Must be within the range of a numeric data type	"Literal Number" on page 4-137
string _value	A value that is expressed as one or more characters	Characters must be from the code set of the database	"Quoted String" on page 4-142.
task	Keyword that identifies a purpose function	Keywords to which you can assign a function (whose name cannot match the keyword)	*Task* Purpose Category in the table in "Purpose Functions, Methods, Flags, and Values" on page 5-47.
value	Keyword that identifies configuration information	Predefined configuration keywords to which you can assign values	*Value* Purpose Category in the table in "Purpose Functions, Methods, Flags, and Values" on page 5-47.

Usage

Dynamic Server supports purpose options in two contexts:

3 • Defining or modifying primary and secondary access methods for local or
3 remote tables, views, and indexes

3 • Defining access methods for XA-compliant external data sources.

3 #### Purpose Options for Access Methods

A registered access method is a set of attributes, including a name and options called *purpose options* that you can use to accomplish the following tasks:

- Specify which functions perform data access and manipulation tasks, such as opening, reading, and closing a data source.
- Set configuration options, such as a storage-space type.
- Set flags, such as enabling rowid interpretation.

You specify purpose options when you create an access method with the CREATE ACCESS_METHOD statement. To change the purpose options of an access method, use the ALTER ACCESS_METHOD statement.

Each *task*, *value*, or *flag* keyword corresponds to a column name in the **sysams** system catalog table. The keywords let you set the following attributes:

- Purpose function

  A *purpose-function attribute* maps the name of a user-defined function or method to a *task* keyword, such as **am_create**, **am_beginscan**, or **am_getnext**. For a complete list of these keywords, see the "Task" category in the table in "Purpose Functions, Methods, Flags, and Values."
  The *external_routine* specifies the corresponding function (C) that you supply for the access method. Example setting:

  ```
  am_create = FS_create
  ```
- Purpose flag

  A *purpose flag* indicates whether an access method supports a given SQL statement or keyword. Example setting:

  ```
  am_rowids
  ```
- Purpose value

  These string, character, or numeric values provide configuration information that a flag cannot supply. Example setting:

  ```
  am_sptype = 'X'
  ```

To enable a user-defined function or method as a purpose function, you must first register the C function or Java method that performs the appropriate tasks, using the CREATE FUNCTION statement, and then set the purpose keyword equal to the registered function or method name. This creates a new access method. An example on page "Example" on page 2-9 adds a purpose method to an existing access method.

To enable a purpose flag, specify the name without a corresponding value.

To clear a purpose-option setting in the **sysams** table, use the DROP clause of the ALTER ACCESS_METHOD statement.

Purpose Functions, Methods, Flags, and Values

The following table describes the possible settings for the **sysams** columns that contain purpose functions or methods, flags, and values. The entries appear in the same order as the corresponding **sysams** columns.

Keyword	Explanation	Category	Default
am_sptype	A character that specifies from what type of storage space a primary or secondary-access method can access data. The **am_sptype** character can have any of the following settings: • ′X′ indicates the method accesses only extspaces. • ′S ′ indicates the method accesses only sbspaces. • ′A′ indicates the method can access extspaces and sbspaces. Valid only for a new access method. You cannot change or add an **am_sptype** value with ALTER ACCESS_METHOD. Do not set **am_sptype** to ′D′ or attempt to store a virtual table in a dbspace.	Value	Virtual-Table Interface (C): ′A′
am_defopclass	The default operator class for a secondary-access method. The access method must exist before you can define its operator class, so you set this value in the ALTER ACCESS_METHOD statement.	Value	None

Purpose Options

Keyword	Explanation	Category	Default
am_keyscan	A flag that, if set, indicates that **am_getnext** returns rows of index keys for a secondary-access method. If a query selects only the columns in the index key, the database server uses the row of index keys that the secondary-access method puts in shared memory, without reading the table.	Flag	Not set
am_unique	A flag to set if a secondary-access method checks for unique keys	Flag	Not set
am_cluster	A flag that you set if a primary- or secondary-access method supports clustering of tables	Flag	Not set
am_rowids	A flag that you set if a primary-access method can retrieve a row from a specified address	Flag	Not set
am_readwrite	A flag to set if a primary-access method supports data changes. The default setting, not set, indicates that the virtual data is read-only. For the C Virtual-Table Interface, set this flag if your application will write data, to avoid the following problems: • An INSERT, DELETE, UPDATE, or ALTER FRAGMENT statement causes an SQL error. • Function **am_insert**, **am_delete**, or **am_update** is not executed.	Flag	Not set
am_parallel	A flag that the database server sets to indicate which purpose functions or methods can execute in parallel in a primary or secondary-access method. If set, the hexadecimal **am_parallel** bitmap contains one or more of the following bit settings: • The 1 bit is set for parallelizable scan. • The 2 bit is set for parallelizable delete. • The 4 bit is set for parallelizable update. • The 8 bit is set for parallelizable insert. Insertions, deletions, and updates are not supported in the Java Virtual-Table Interface.	Flag	Not set
am_costfactor	A value by which the database server multiplies the cost that the am_scancost purpose function or method returns for a primary or secondary-access method. An **am_costfactor** value from 0.1 to 0.9 reduces the cost to a fraction of the value that **am_scancost** calculates. An **am_costfactor** value of 1.1 or greater increases the **am_scancost** value.	Value	1.0
am_create	A keyword that you associate with a user-defined function or method (UDR) name that creates a virtual table or virtual index	Task	None
am_drop	A keyword that you associate with the name of a UDR that drops a virtual table or virtual index	Task	None
am_open	A keyword that you associate with the name of a UDR that makes a fragment, extspace, or sbspace available	Task	None
am_close	A keyword that you associate with the name of a UDR that reverses the initialization that **am_open** performs	Task	None
am_insert	A keyword that you associate with the name of a UDR that inserts a row or an index entry	Task	None
am_delete	A keyword that you associate with the name of a UDR that deletes a row or an index entry	Task	None
am_update	A keyword that you associate with the name of a UDR that changes the values in a row or key	Task	None
am_stats	A keyword that you associate with the name of a UDR that builds statistics based on the distribution of values in storage spaces	Task	None

Keyword	Explanation	Category	Default
am_scancost	A keyword that you associate with the name of a UDR that calculates the cost of qualifying and retrieving data	Task	None
am_check	A keyword that you associate with the name of a UDR that tests the physical structure of a table or performs an integrity check on an index	Task	None
am_beginscan	A keyword that you associate with the name of a UDR that sets up a scan	Task	None
am_endscan	A keyword that you associate with the name of a UDR that reverses the setup that **am_beginscan** initializes	Task	None
am_rescan	A keyword that you associate with the name of a UDR that scans for the next item from a previous scan to complete a join or subquery	Task	None
am_getnext	A keyword that you associate with the name of the required UDR that scans for the next item that satisfies a query	Task	None
am_getbyid	A keyword that you associate with the name of a UDR that fetches data from a specific physical address; **am_getbyid** is available only for primary-access methods	Task	None
am_truncate	A keyword that you associate with the name of a UDR that deletes all rows of a virtual table (primary-access method) or that deletes all corresponding keys in a virtual index (secondary-access method)	Task	None

The following rules apply to the purpose-option specifications in the CREATE ACCESS_METHOD and ALTER ACCESS_METHOD statements:

- To specify multiple purpose options in one statement, separate them with commas.
- The CREATE ACCESS_METHOD statement must specify a user-defined function or method name that corresponds to the **am_getnext** keyword.

  The ALTER ACCESS_METHOD statement cannot drop the function or method name that corresponds to **am_getnext** but can modify it.
- The ALTER ACCESS_METHOD statement cannot add, drop, or modify the **am_sptype** value.
- You can specify the **am_defopclass** value only with the ALTER ACCESS_METHOD statement.

  You must first register a secondary-access method with the CREATE ACCESS_METHOD statement before you can assign a default operator class.

3 Purpose Options for XA Data Source Types

3 The CREATE XADATASOURCE TYPE statement specifies purpose functions that
3 provide access to data from external data sources that comply with the X/Open
3 XA standards. These functions also enable external data to be processed in
3 accordance with the transactional semantics of Dynamic Server. Only databases
3 that use transaction logging, such as ANSI-compliant databases and Dynamic
3 Server databases that support explicit transactions, can support transaction
3 coordination.

3 The following statement creates a new XA data source type called **MQSeries**,
3 owned by user **informix**.

```
3 CREATE XADATASOURCE TYPE 'informix'.MQSeries(
3                            xa_flags    = 1,
3                            xa_version  = 0,
3                            xa_open     = informix.mqseries_open,
3                            xa_close    = informix.mqseries_close,
3                                  xa_start    = informix.mqseries_start,
3                                  xa_end      = informix.mqseries_end,
3                                  xa_rollback = informix.mqseries_rollback,
3                                  xa_prepare  = informix.mqseries_prepare,
3                                  xa_commit   = informix.mqseries_commit,
3                                  xa_recover  = informix.mqseries_recover,
3                                  xa_forget   = informix.mqseries_forget,
3                                 xa_complete = informix.mqseries_complete);
```

3 These values represents the fields in the XA Switch Structure, as listed in the file
3 **$INFORMIXDIR/incl/public/xa.h**. The order of specifications in this example
3 follows the order of column names in the **sysxasourcetypes** system catalog table,
3 but they can be listed in any order, provided that no item is repeated. The **xa_flags**
3 and **xa_version** values must be numbers; the rest must be names of UDRs that the
3 Transaction Manager can invoke. These UDRs must already exist in the database
3 before you can issue a CREATE XADATASOURCE TYPE statement that references
3 them among its purpose option specifications.

3 The DROP FUNCTION or DROP ROUTINE statement cannot drop a UDR that is
3 listed among the purpose options of a CREATE XADATASOURCE TYPE statement
3 until all of the XA datasource types that were defined using the UDR are dropped.

3 For information about how to use the UDRs in the previous example to coordinate
3 transactions with external XA data sources, see the *IBM Informix DataBlade API*
3 *Programmer's Guide*.

3 For information about the MQDataBlade module, see the *IBM Informix Built-In*
3 *DataBlade Modules User's Guide*.

Related Information

3 Related statements: ALTER ACCESS_METHOD, CREATE ACCESS_METHOD,
3 CREATE OPCLASS, and CREATE XADATASOURCE TYPE

For the following topics, see the *IBM Informix Virtual-Table Interface Programmer's Guide* (for C):

- Managing storage spaces, executing in parallel, and calculating statement costs
- Registering the access method and purpose functions
- Purpose-function reference

For the following topics, see the *IBM Informix Virtual-Index Interface Programmer's Guide* (for C):

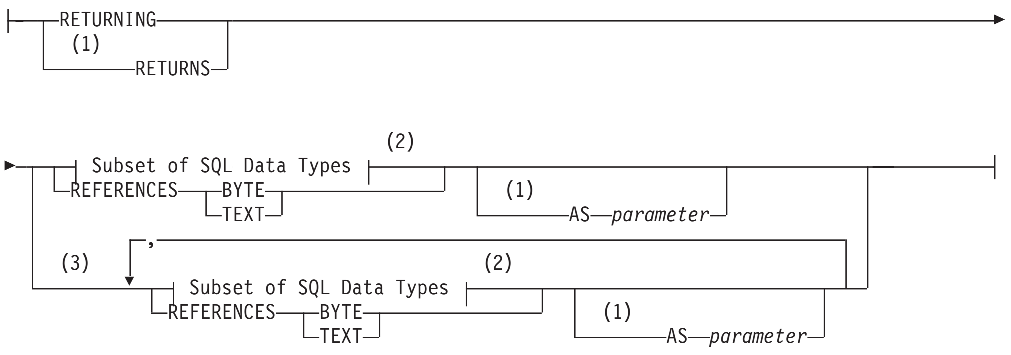
- Managing storage spaces, executing in parallel, calculating statement costs, bypassing table scans, and enforcing unique-index constraints
- Registering the access method and purpose functions
- Purpose-function reference

Return Clause

The Return clause specifies the data type of a value or values that a user-defined function returns. You can use this segment in UDR definitions.

Syntax

Return Clause:



Notes:

1 Dynamic Server only

2 See "Subset of SQL Data Types" on page 5-62

3 Stored Procedure Language only

Element	Description	Restrictions	Syntax
parameter	Name that you declare here for a returned parameter of the UDR	Must be unique among returned *parameters* of UDRs. If any returned value of the UDR has a name, then all must have names.	"Identifier" on page 5-22

Usage

In Dynamic Server, for backward compatibility, you can create SPL functions with the CREATE PROCEDURE statement. (That is, you can include a Return clause in CREATE PROCEDURE statements.) Use CREATE FUNCTION, however, to create new SPL routines that return one or more values.

After the Return clause has indicated what data types are to be returned, you can use the RETURN statement of SPL at any point in the statement block to return SPL variables that correspond to the values in the Return clause.

Limits on Returned Values

An SPL function can specify more than one data type in the Return clause.

An external function (a function written in the C or the Java language) can specify only one data type in the Return clause, but an external function can return more than one row of data if it is an iterator function. For more information, see "ITERATOR" on page 5-57.

Subset of SQL Data Types

Not all data types are valid in the Return clause. For more information, see the table that follows. See also "Data Type" on page 4-18.

A user-defined function of Extended Parallel Server can return values of any built-in data type *except* SERIAL, SERIAL8, TEXT, or BYTE.

In Dynamic Server, a UDF can return values of any built-in data type *except* the complex, serial, and large object types that are not blank in the following table.

Data Type	C	Java	SPL
BLOB	X		X
BYTE	X	X	X
COLLECTION		X	
CLOB	X		X
LIST		X	
MULTISET		X	
ROW		X	X
SET		X	X
SERIAL	X	X	X
SERIAL8	X	X	X
TEXT	X	X	X

In Dynamic Server, if you use a complex data type in the Return clause, the calling user-defined routine must define variables of the appropriate complex types to hold the values that the C or SPL user-defined function returns.

User-defined functions can return a value of opaque or distinct data types that are defined in the database.

The default precision of a DECIMAL that an SPL function returns is 16 digits. For a function to return a DECIMAL with a different number of significant digits, you must specify the returned precision explicitly in the Return clause.

Returning a Value from Another Database (IDS)

UDRs can return only built-in non-opaque types from tables in databases of other database servers. UDRs cannot return the BOOLEAN, BLOB, CLOB, and LVARCHAR built-in opaque data types in cross-server operations.

If an SPL function uses the Return clause to return values from another database of the local database server, the values can built-in types, including built-in opaque types. Also valid are DISTINCT types whose base types are built-in types, and user-defined types, if you explicitly cast the DISTINCT types and UDTs to built-in data types. All of the DISTINCT types, the UDTs, and the casts must be defined in all of the participating databases.

The same data-type restrictions apply to a value that an external function returns from another database.

Using the REFERENCES Clause to Point to a Simple Large Object

A user-defined function cannot return a BYTE or TEXT value (collectively called *simple large objects*) directly. A user-defined function can, however, use the REFERENCES keyword to return a descriptor that contains a pointer to a BYTE or TEXT object. The following example shows how to select a TEXT column within an SPL routine and then return the value:

```
CREATE FUNCTION sel_text()
   RETURNING REFERENCES text;
   DEFINE blob_var REFERENCES text;
   SELECT blob_col INTO blob_var
      FROM blob_table WHERE key_col = 10;
   RETURN blob_var;
END FUNCTION;
```

In Extended Parallel Server, to emulate this example, you can use the CREATE PROCEDURE statement instead of the CREATE FUNCTION statement.

Named Return Parameters (IDS)

You can declare names for the returned parameters of an SPL routine, or a name for the single value that an external function can return.

If an SPL routine returns more than one value, you must either declare names for all of the returned parameters, or else none of them can have names. The names must be unique. Here is an example of named parameters:

```
CREATE PROCEDURE p (inval INT DEFAULT 0)
RETURNING INT AS serial_num,
   CHAR(10) AS name,
   INT AS points;
RETURN (inval + 1002), "Newton", 100;
END PROCEDURE;
```

Executing this UDR would return:

```
serial_num    name      points
1002          Newton    100
```

There is no relationship between the names of returned parameters and the names of any variables in the body of the routine. For example, you can define a function to return an INTEGER as **xval**, but in the body of the same function, a variable declared as **xval** could be of the data type INTERVAL YEAR TO MONTH.

Cursor and Noncursor Functions

A *cursor* function can fetch returned values one by one by iterating the generated result set of returned values. Such a function is an *implicitly iterated function*.

A function that returns only one set of values (such as one or more columns from a single row of a table) is a *noncursor* function.

The Return clause is valid in a cursor function or in a noncursor function. In the following example, the Return clause can return zero (0) or one value in a noncursor function. In a cursor function, however, it returns more than one row from a table, and each returned row contains zero or one value:

```
RETURNING INT;
```

In the following example, the Return clause can return zero (0) or two values if it occurs in a noncursor function. In a cursor function, however, it returns more than one row from a table, and each returned row contains zero or two values:

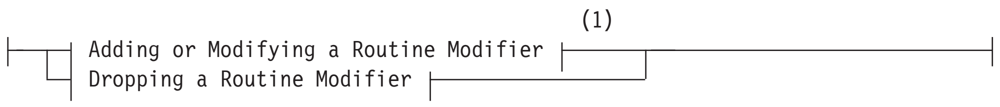
```
RETURNING INT, INT;
```

In both of the preceding examples, the receiving function or program must be written appropriately to accept the information that the function returns.

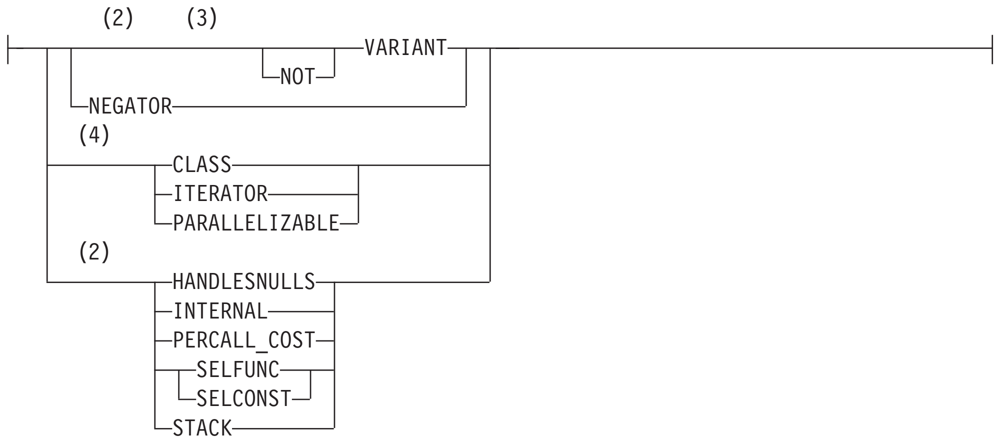
Routine Modifier

A routine modifier specifies characteristics of how a user-defined routine (UDR) behaves. Only Dynamic Server supports routine modifiers.

Syntax


(1)
Adding or Modifying a Routine Modifier
Dropping a Routine Modifier

Dropping a Routine Modifier:



Notes:

1 See "Adding or Modifying a Routine Modifier" on page 5-55

2 C only

3 SPL only

4 External routines only

Element	Description	Restrictions	Syntax
parameter	Name that you declare here for a returned parameter of the UDR	Must be unique among returned *parameters* of UDRs. If any returned value of the UDR has a name, then all must have names.	"Identifier" on page 5-22

Usage

If you drop an existing modifier in an ALTER FUNCTION, ALTER PROCEDURE, or ALTER ROUTINE statement, the database server sets the value of the modifier to the default value, if a default exists.

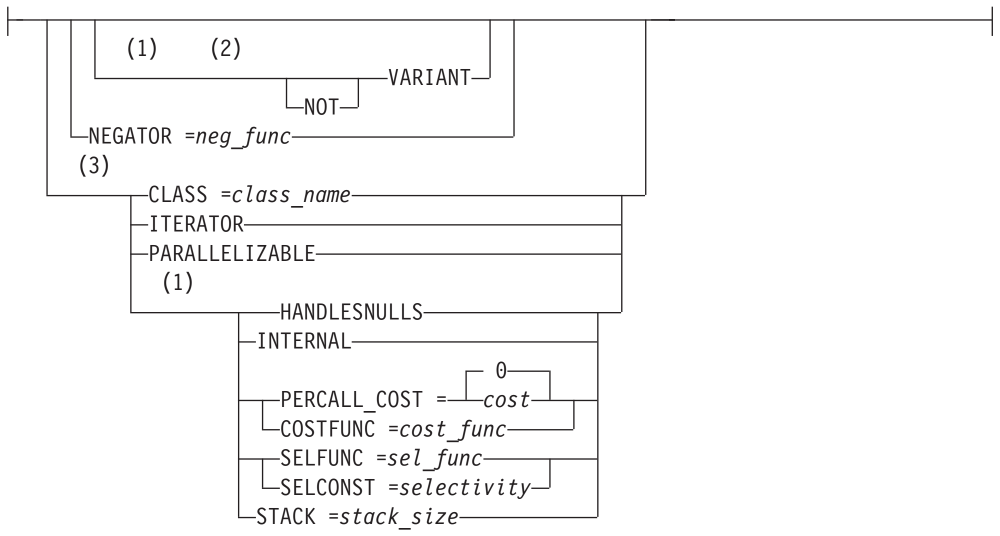
Some modifiers are available only with user-defined functions. For information on whether a specific routine modifier applies only to user-defined functions (that is, if it does not apply to user-defined procedures), see the description of the modifier in the sections that follow. In these sections, as elsewhere in this manual, *external* refers to UDRs written in the C or Java languages. Features valid for only one language are so designated in the previous diagrams.

Except for VARIANT and NOT VARIANT modifiers, none of the options in this segment are valid for SPL routines.

Adding or Modifying a Routine Modifier

Use this segment in the ALTER FUNCTION, ALTER PROCEDURE, or ALTER ROUTINE statement to add or modify values for routine modifiers of a UDR.

Adding or Modifying a Routine Modifier:



Notes:

1 C language

2 Stored Procedure Language

3 External routines only

Element	Description	Restrictions	Syntax
class_name	Virtual processor (VP) class in which to run the external routine	Any C UDR must run in the CPU VP or in a user-defined VP class	"Quoted String" on page 4-142.
cost	CPU use cost for each invocation of a C language UDR. Default is 0.	Integer; 1 ≤ *cost* ≤ 2^{31}-1 (highest cost).	"Literal Number" on page 4-137
cost_func	Name of a companion user-defined cost function to invoke	Must have same owner as the UDR. Execute privilege needed to invoke	"Identifier" on page 5-22
neg_func	Negator function that can be invoked instead of the UDR	Must have same owner as the UDR. Execute privilege needed to invoke	"Identifier" on page 5-22
sel_func	Name of a companion user-defined selectivity function to invoke	Must have same owner as the UDR. Execute privilege needed to invoke	"Identifier" on page 5-22
selectivity	CPU use cost for each invocation of a C language UDR. Default is 0.	See "Concept of Selectivity" on page 5-59.	"Literal Number" on page 4-137
stack_size	Size (in bytes) of stack of the thread that executes the C-language UDR	Must be a positive integer	"Literal Number" on page 4-137

You can add these modifiers in any order. If you list the same modifier more than once, the last setting overrides any previous values.

Modifier Descriptions

The following sections describe the modifiers that you can use to help the database server optimally execute a UDR.

CLASS

Use the CLASS modifier to specify the name of a virtual-processor (VP) class in which to run an external routine. A user-defined VP class must be defined before the UDR can be invoked.

You can execute C UDRs in the following types of VP classes:

- The CPU virtual-processor class (CPU VP)
- A user-defined virtual-processor class.

If you omit the CLASS modifier to specify a VP class for a UDR written in C, the UDR runs in the CPU VP. User-defined VP classes protect the database server from ill-behaved C UDRs. An ill-behaved C UDR has at least one of the following characteristics:

- It runs in the CPU VP for a long time without yielding.
- It is not thread safe.
- It calls an unsafe operating-system routine.

A well-behaved C UDR has none of these characteristics. Execute only well-behaved C UDRs in the CPU VP.

Warning: Execution of an ill-behaved C UDR in the CPU VP can cause serious interference with the operation of the database server, and the UDR might not produce correct results. For a discussion of ill-behaved UDRs, see the *IBM Informix DataBlade API Programmer's Guide*.

By default, a UDR written in Java runs in a Java virtual processor class (JVP). Therefore, the CLASS modifier is optional for a UDR written in Java. However, use the CLASS modifier when you register a UDR written in Java to improve readability of your SQL statements.

COSTFUNC

Use the COSTFUNC modifier to specify the cost of a C UDR. The *cost* of the UDR is an estimate of the time required to execute it.

Occasionally, the cost of a UDR depends on its inputs. In that case, you can use a user-defined function to calculate a cost that depends on input values.

To execute *cost_func*, you must have Execute privilege on it and on the UDR.

HANDLESNULLS

Use the HANDLESNULLS modifier to specify that a C UDR can handle NULL values that are passed to it as arguments. If you do not specify HANDLESNULLS for a C language UDR, and if you pass to it an argument that has a NULL value, the UDR does not execute and returns a NULL value.

By default, a C language UDR does *not* handle NULL values.

The HANDLESNULLS modifier is not available for SPL routines because SPL routines handle NULL values by default.

INTERNAL

Use the INTERNAL modifier with an external routine to specify that an SQL or SPL statement cannot call the external routine. An external routine that is specified as INTERNAL is not considered during routine resolution. Use the INTERNAL modifier for external routines that define access methods, language managers, and so on.

By default, an external routine is *not* internal; that is, an SQL or SPL statement can call the routine.

ITERATOR

Use the ITERATOR modifier with external functions to specify that the function is an *iterator function*. An iterator function is a function that returns a single element per function call to return a set of data; that is, it is called with an initial call and zero or more subsequent calls until the set is complete.

By default, an external C or Java language function is *not* an iterator function.

An SPL iterator function requires the RETURN WITH RESUME statement, rather than the ITERATOR modifier.

In ESQL/C, an iterator function requires a cursor. The cursor allows the client application to retrieve the values one at a time with the FETCH statement.

For more information on how to write iterator functions, see *IBM Informix User-Defined Routines and Data Types Developer's Guide* and the *IBM Informix DataBlade API Programmer's Guide*.

For information about using an iterator function with a virtual table interface in the FROM clause of a query, see "Iterator Functions (IDS)" on page 2-499.

NEGATOR

Use the NEGATOR modifier with UDRs that return Boolean values.

The NEGATOR modifier names a companion user-defined function, called a *negator function*, to the current function. A negator function takes the same arguments as its companion function, in the same order, but returns the Boolean complement.

That is, if a function returns `TRUE` for a given set of arguments, its negator function returns `FALSE` when passed the same arguments, in the same order. For example, the following functions are negator functions:

```
equal(a,b)
notequal(a,b)
```

Both functions take the same arguments, in the same order, but return complementary Boolean values. When it is more efficient to do so, the optimizer can use the negator function instead of the function you specify.

To invoke a user-defined function that has a negator function, you must have the Execute privilege on both functions. In addition, the function must have the same owner as its negator function.

PARALLELIZABLE

Use the PARALLELIZABLE modifier to indicate that an external routine can be executed in parallel in the context of a parallelizable data query (PDQ).

By default, an external routine is non-parallelizable; that is, it executes in sequence.

If your UDR has a complex or smart large object data type as either a parameter or a returned value, you cannot use the PARALLELIZABLE modifier.

If you specify the PARALLELIZABLE modifier for an external routine that cannot be parallelizable, the database server returns a runtime error.

A C language UDR that calls only PDQ thread-safe DataBlade API functions is parallelizable. These categories of DataBlade API functions are PDQ thread safe:

- Data handling

  An exception in this category is that collection manipulation functions (**mi_collection_***) are not PDQ thread safe.
- Session, thread, and transaction management
- Function execution
- Memory management
- Exception handling
- Callbacks
- Miscellaneous

For details of the DataBlade API functions that are included in each category, see the *IBM Informix DataBlade API Function Reference*.

If your C language UDR calls a function that is not included in one of these categories, it is not PDQ thread safe and is therefore not parallelizable.

To parallelize Java language UDR calls, the database server must have multiple instances of JVPs. UDRs written in the Java language and that open a JDBC connection are not parallelizable.

PERCALL_COST (C)

Use the PERCALL_COST modifier to specify the approximate CPU usage cost that a C language UDR incurs each time it executes. The optimizer uses the cost you specify to determine the order in which to evaluate SQL predicates in the UDR for best performance. For example, the following query has two predicates joined by a logical AND:

```
SELECT * FROM tab1 WHERE func1() = 10 AND func2() = 'abc';
```

In this example, if one predicate returns `FALSE`, the optimizer need not evaluate the other predicate.

The optimizer uses the specified cost to order the predicates so that the least expensive predicate is evaluated first. The CPU usage cost must be an integer between 1 and 2^{31}-1, with 1 the lowest cost and 2^{31}-1 the most expensive.

To calculate an approximate cost per call, add the following two figures:

- The number of lines of code executed each time the C UDR is called
- The number of predicates that require an I/O access

The default cost per execution is `0`. When you drop the PERCALL_COST modifier, the cost per execution returns to `0`.

SELCONST (C)

Use the SELCONST modifier to specify the selectivity of a C UDR. The *selectivity* of the UDR is an estimate of the fraction of the rows that the query will select.

The value of selectivity constant, **selconst**, is a floating-point number between 0 and 1 that represents the fraction of the rows for which you expect the UDR to return TRUE.

SELFUNC (C)

Use the SELFUNC modifier with a C UDR to name a companion user-defined function, called a *selectivity function*, to the current UDR. The selectivity function provides selectivity information about the current UDR to the optimizer.

The *selectivity* of a UDR is an estimate of the fraction of the rows that the query will select. That is, it is an estimate of the number of times the UDR will execute.

To execute *sel_func*, you must have Execute privilege on it and on the UDR.

Concept of Selectivity: *Selectivity* refers to the number of rows that would qualify for a query that does a search based on an equality predicate. The fewer the number of rows that qualify, the more selective the query.

For example, the following query has a search condition based on the **customer_num** column in the **customer** table:

```
SELECT * FROM customer WHERE customer_num = 102;
```

Because each row in the table has a different customer number, this query is highly selective. In contrast, the following query is not selective:

```
SELECT * FROM customer WHERE state = 'CA';
```

Because most of the rows in the **customer** table are for customers in California, more than half of the rows in the table would be returned.

Restrictions on the SELFUNC Modifier: The selectivity function that you specify must satisfy the following criteria:

- It must take the same number of arguments as the current C UDR.
- The data type of each argument must be SELFUNC_ARG.
- It must return a value of type FLOAT between `0` and `1`, which represents the percentage of selectivity of the function. (`1` is highly selective; `0` is not at all selective.)
- It can be written in any language that the database server supports.

A user who invokes the C UDR must have the Execute privilege both on that UDR and on the selectivity function that the SELFUNC modifier specifies.

Both the C UDR and the selectivity function must have the same owner.

For information on how to use the **mi_funcarg*** functions to extract information about the arguments of a selectivity function, see the *IBM Informix DataBlade API Programmer's Guide*.

STACK (C)

Use the STACK modifier with a C UDR to override the default stack size that the STACKSIZE configuration parameter specifies.

The STACK modifier specifies the size (in bytes) of the thread stack, which a user thread that executes the UDR uses to hold information such as routine arguments and returned values from functions.

A UDR needs to have enough stack space for all its local variables. For a particular UDR, you might need to specify a stack size larger than the default size to prevent stack overflow.

When a UDR that includes the STACK modifier executes, the database server allocates a thread-stack size of the specified number of bytes. Once the UDR completes execution, subsequent UDRs execute in threads with a stack size that the STACKSIZE configuration parameter specifies (unless any of these subsequent UDRs have also specified the STACK modifier).

For more information about the thread stack, see your *IBM Informix Administrator's Guide* and the *IBM Informix DataBlade API Function Reference*.

VARIANT and NOT VARIANT

Use the VARIANT and NOT VARIANT modifiers with C user-defined functions and SPL functions. A function is *variant* if it returns different results when it is invoked with the same arguments or if it modifies a database or variable state. For example, a function that returns the current date or time is a variant function.

By default, user-defined functions are variant. If you specify NOT VARIANT when you create or modify a user-defined function, the function cannot contain any SQL statements.

If the user-defined function is nonvariant, the database server might cache the returned values of expensive functions. You can create functional indexes only on nonvariant functions. For more information on functional indexes, see “CREATE INDEX” on page 2-116.

In ESQL/C, you can specify VARIANT or NOT VARIANT in this clause or in the EXTERNAL Routine Reference. For more information, see “External Routine Reference” on page 5-20. If you specify the modifier in both places, however, you must use the same modifier in both clauses.

Related Information

For more information on user-defined routines, see *IBM Informix User-Defined Routines and Data Types Developer's Guide* and the *IBM Informix DataBlade API Programmer's Guide*.

For more information about how these modifiers can affect performance, see your *IBM Informix Performance Guide*.

Routine Parameter List

Use the appropriate part of the Routine Parameter List segment whenever you see a reference to a Routine Parameter List in a syntax diagram.

Syntax

Routine Parameter List:

```
      ┌─,────────────────────────────┐
      ▼                              │
├─────┬─────────────┬─┤ Parameter ├──┴──────────────────────────────┤
      ├─OUT─────────┤
      │        (1)  │
      └─INOUT───────┘
```

Parameter:

```
                                                     (3)
├──┬─parameter─┬──┬─┬─┤ Subset of SQL Data Type ├─────┬──┬──────────────────┬─┬──┤
   │  (2)      │  │ └─LIKE──table──.──column──────────┘  └─DEFAULT──value───┘ │
   └───────────┘  └─REFERENCES───┬─BYTE─┬───┬──────────────┬─────────────────┘
                                 └─TEXT─┘   └─DEFAULT NULL─┘
```

Notes:

1 Dynamic Server only

2 External routines only

3 See "Subset of SQL Data Types" on page 5-62

Element	Description	Restrictions	Syntax
column	Name of a column whose data type is declared for *parameter*	Must exist in the specified table	"Database Object Name" on page 5-17
parameter	Name of a parameter of the UDR	Name is required for SPL routines	"Identifier" on page 5-22
table	Table that contains *column*	The table must exist in the database	"Identifier" on page 5-22
value	Default used if UDR is called with no value for *parameter*	Must be a literal, of the same data type as *parameter*. For opaque types, an input function must be defined	"Literal Number" on page 4-137

Usage

A *parameter* is a formal argument in the declaration of a UDR. (When you subsequently invoke a UDR that has parameters, you must substitute an actual argument for the parameter, unless the parameter has a default value.)

The name of the parameter is optional for external routines of Dynamic Server.

When you create a UDR, you declare a *name* and *data type* for each parameter. You can specify the data type directly, or use the LIKE or REFERENCES clause to specify the data type. You can optionally specify a default value.

You can define any number of SPL routine parameters, but the total length of all parameters passed to an SPL routine must be less than 64 kilobytes.

No more than nine arguments to a UDR written in the Java language can be DECIMAL data types of SQL that the UDR declares as BigDecimal data types of the Java language.

Any C language UDR that returns an opaque data type must specify **opaque_type** in the `var binary` declaration of the C host variable.

Subset of SQL Data Types

Serial and large-object data types are not valid as parameters. A UDR can declare a parameter of any other data type defined in the database, including any built-in data types except SERIAL, SERIAL8, TEXT, BYTE, CLOB, or BLOB.

On Dynamic Server, a parameter can also be a complex data type or a UDT, but complex data types are not valid for parameters of external UDRs written in the Java language.

Using the LIKE Clause

Use the LIKE clause to specify that the data type of a parameter is the same as a column defined in the database. If the ALTER TABLE statement changes the data type of the column, the data type of the parameter also changes.

In Dynamic Server, if you use the LIKE clause to declare any parameter, you cannot overload the UDR. For example, suppose you create the following user-defined procedure:

```
CREATE PROCEDURE cost (a LIKE tableX.colY, b INT)
. . .
END PROCEDURE;
```

You cannot create another procedure named **cost( )** in the same Dynamic Server database with two arguments. You can, however, create a procedure named **cost( )** with a number of arguments other than two. (Another way to circumvent this restriction on the LIKE clause is through user-defined data types.)

Using the REFERENCES Clause

Use the REFERENCES clause to specify that a parameter contains BYTE or TEXT data. The REFERENCES keyword allows you to use a pointer to a BYTE or TEXT object as a parameter. If you use the DEFAULT NULL option in the REFERENCES clause, and you call the UDR without a parameter, a NULL value is used as the default value.

Using the DEFAULT Clause

Use the DEFAULT keyword followed by an expression to specify a default value for a parameter. If you provide a default value for a parameter, and the UDR is called with fewer arguments than were defined for that UDR, the default value is used. If you do not provide a default value for a parameter, and the UDR is called with fewer arguments than were defined for that UDR, the calling application receives an error.

The following example shows a CREATE FUNCTION statement that specifies a default value for a parameter. This function finds the square of the *i* parameter. If the function is called without specifying the argument for the *i* parameter, the database server uses the default value `0` for the *i* parameter.

```
CREATE FUNCTION square_w_default
   (i INT DEFAULT 0) {Specifies default value of i}
RETURNING INT; {Specifies return of INT value}
   DEFINE j INT; {Defines routine variable j}
   LET j = i * i; {Finds square of i and assigns it to j}
   RETURN j; {Returns value of j to calling module}
END FUNCTION;
```

In Extended Parallel Server, to re-create this example, use the CREATE PROCEDURE statement instead of the CREATE FUNCTION statement.

Extended Parallel Server supports no more than a single OUT parameter. If one is specified, it must be the last item in the parameter list.

Warning: When you specify a date value as the default value for a parameter, make sure to specify 4 digits instead of 2 digits for the year. When you specify a 2-digit year, the **DBCENTURY** environment variable setting can affect how the database server interprets the date value, so the UDR might not use the default value that you intended. For more information, see the *IBM Informix Guide to SQL: Reference*.

Specifying OUT Parameters for User-Defined Routines

When you register a user-defined routine of Dynamic Server, you can use the OUT keyword to specify that any parameter in the list is an OUT parameter. Each OUT parameter corresponds to a value the routine returns indirectly, through a pointer. The value that the routine returns through the pointer is an extra value, in addition to any values that it returns explicitly.

After you have registered a user-defined function that has one or more OUT parameters, you can use the function with a statement-local variable (SLV) in an SQL statement. (For information about statement-local variables, see “Statement-Local Variable Expressions (IDS)” on page 4-114.)

If you specify any OUT parameters, and you use Informix-style parameters, the arguments are passed to the OUT parameters by reference. The OUT parameters are not significant in determining the routine signature.

For example, the following declaration of a C user-defined function allows you to return an extra value through the **y** parameter:

```
int my_func( int x, int *y );
```

Register the C function with a CREATE FUNCTION statement similar to this:

```
CREATE FUNCTION my_func( x INT, OUT y INT )
   RETURNING INT
   EXTERNAL NAME "/usr/lib/local_site.so"
   LANGUAGE C
END FUNCTION;
```

In the next example, this Java method returns an extra value by passing an array:

```
public static String allVarchar(String arg1, String[] arg2)
throws SQLException
{
arg2[0] = arg1;
return arg1;
}
```

To register this as a UDF, use a statement similar to the following example:

```
CREATE FUNCTION all_varchar(VARCHAR(10), OUT VARCHAR(7))
   RETURNING VARCHAR(7)
   WITH (class = "jvp")
EXTERNAL NAME 'informix.testclasses.jlm.Param.allVarchar(java.lang.String,
java.lang.String[ ])'
LANGUAGE JAVA;
```

Specifying INOUT Parameters for a User-Defined Routine (IDS)

UDRs of Dynamic Server that are written in the SPL, C, or Java languages can also support INOUT parameters. When the UDR is invoked, a value for each INOUT parameter is passed by reference as an argument to the UDR. When the UDR completes execution, it can return a modified value for the INOUT parameter to the calling context. The INOUT parameter can be of any data type that Dynamic Server supports, including user-defined and complex data types.

In the following example, the CREATE PROCEDURE statement registers a C routine that has a single INOUT parameter:

```
CREATE PROCEDURE CALC ( INOUT param1 float )
   EXTERNAL NAME "$INFORMIXDIR/etc/myudr.so(calc)"
       LANGUAGE C;
```

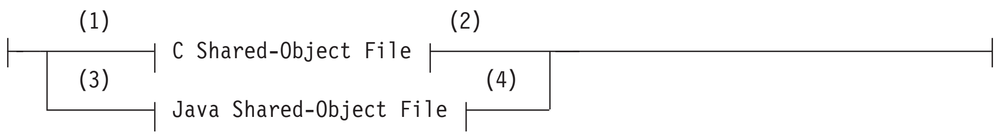
You can assign INOUT parameters to statement-local variables (SLVs), which the section "Statement-Local Variable Expressions (IDS)" on page 4-114 describes.

Shared-Object Filename

Use a shared-object filename to specify a pathname to an executable object file when you register or alter an external routine. Only Dynamic Server supports this syntax segment.

Syntax

Shared-Object File:



Notes:

1 C only

2 See “C Shared-Object File”

3 Java only

4 See “Java Shared-Object File” on page 5-66

Usage

If the IFX_EXTEND_ROLE configuration parameter is set to 1 or to ON, only users to whom the DBSA has granted the built-in EXTEND role are authorized to use this segment.

The Database Server Administrator should include in the DB_LIBRARY_PATH configuration parameter settings every file system where the security policy authorizes DataBlade modules and UDRs to reside. Unless DB_LIBRARY_PATH is absent or has no setting, the database server cannot access a file that this segment specifies unless its pathname begins with a string that exactly matches one of the values of DB_LIBRARY_PATH.

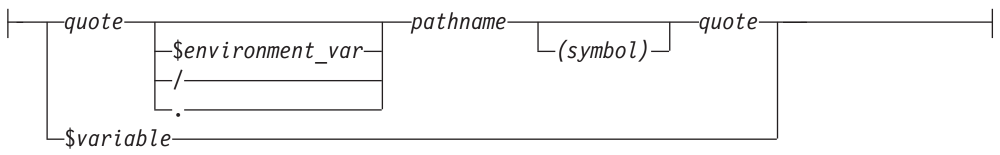
For example, if "**$INFORMIXDIR/extend**" is one of the DB_LIBRARY_PATH values on a Linux system, then shared-object files can have pathnames within the **$INFORMIXDIR/extend** file system or its subdirectories. (This is also the file system where built-in DataBlade modules reside, and the default location where the DataBlade Developer's Kit creates user-defined DataBlade modules.)

The syntax by which you specify a shared-object filename depends on whether the external routine is written in the C language or in the Java language. Sections that follow describe each of these external languages.

C Shared-Object File

To specify the location of a C shared-object file, specify the path to the dynamically loaded executable file within a quoted pathname or as a variable.

C Shared-Object File:



Element	Description	Restrictions	Syntax
environment_var	Platform-independent indicator	Must begin with a dollar sign ($)	"Identifier" on page 5-22
pathname	Pathname to the file	See notes that follow this table	"Identifier" on page 5-22
quote	Either single (′) or double (″) quotation mark symbol	Opening and closing quotation mark symbols must match	Literal symbol (either ′ or ″)
symbol	Entry point to the file	Must be enclosed in parentheses	"Identifier" on page 5-22
variable	Platform-independent indicator	Must begin with a dollar sign ($)	"Identifier" on page 5-22

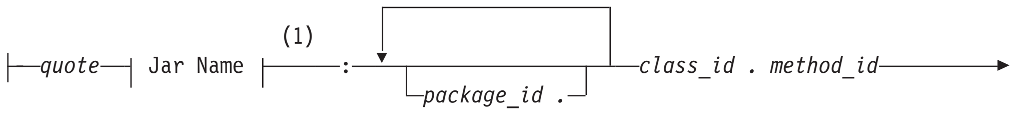
The following rules affect *pathname* and filename specifications in C:

- A filename (with no *pathname*) can specify an internal function.
- You can omit the period (.) symbol if *pathname* is relative to the current directory when the CREATE or ALTER statement is run.
- On UNIX, an absolute pathname must begin with a slash (/) symbol, and each directory name must end with a slash (/) symbol.
- On Windows, an absolute pathname must begin with a backslash (\ ) symbol, and each directory name must end with a backslash (\ ) symbol.
- The filename at the end of *pathname* must have the **.so** file extension and must refer to an executable file in a shared object library.
- Use a *symbol* only if the entry point to the dynamically loadable executable object file has a different name from the UDR that you are registering with CREATE FUNCTION or CREATE PROCEDURE.
- If you specify a *variable*, it must contain the full pathname to the executable file.
- You can include whitespace characters, such as blank spaces or tab characters, within a quoted pathname.

Java Shared-Object File

To specify the name of a Java shared-object file, specify the name of the static Java method to which the UDR corresponds and the location of the Java binary that defines the method.

Java Shared-Object File:



```
►──┬──────────────────────────────────────────────────┬──quote──────────────┤
   │      ┌─,──────────────┐                           │
   │      ▼                │                           │
   └─(────┬────────────────┴─)──RETURNS──java_type─────┘
          └─java_type──┘
```

Notes:

1 See "Jar Name" on page 5-33

Element	Description	Restrictions	Syntax
class_id	Java class whose method implements the UDR	Class must exist in the **.jar** file that Jar Name identifies	Must conform to rules for Java identifiers
java_type	Java data type for a parameter in the Java-method signature	Must be defined in a JDBC class or by an SQL-to-Java mapping	Must conform to rules for Java identifiers
method_id	Name of the Java method that implements the UDR	Must exist in the Java class that *java_class_name* specifies	Must conform to rules for Java identifiers
package_id	Name of package that contains the Java class	Must exist	Must conform to rules for Java identifiers
quote	Single (′) or double (″) quotation mark delimiters	Opening and closing quotation marks must match	Literal symbol (′ or ″) entered at the keyboard

Before you can create a UDR written in the Java language, you must assign a jar identifier to the external jar file with the **sqlj.install_jar** procedure. (For more information, see "sqlj.install_jar" on page 2-339.) You can include the Java signature of the method that implements the UDR in the shared-object filename.

- If you do *not* specify the Java signature, the routine manager determines the *implicit* Java signature from the SQL signature in the CREATE FUNCTION or CREATE PROCEDURE statement.

  It maps SQL data types to the corresponding Java data types with the JDBC and SQL-to-Java mappings. For information on mapping user-defined data types to Java data types, see "sqlj.setUDTextName" on page 2-342.
- If you do specify the Java signature, the routine manager uses this *explicit* Java signature as the name of the Java method to use.

For example, if the Java method **explosiveReaction( )** implements the Java UDR **sql_explosive_reaction( )** as discussed in "sqlj.install_jar" on page 2-339, its shared-object filename could be:

```
course_jar:Chemistry.explosiveReaction
```

The preceding shared-object filename provides an implicit Java signature. The following shared-object filename is the equivalent with an explicit Java signature:

```
course_jar:Chemistry.explosiveReaction(int)
```

Related Information

See the "External Routine Reference" on page 5-20 segment for the context in which a shared-object filename appears within EXTERNAL NAME clause of the ALTER FUNCTION, ALTER PROCEDURE, ALTER ROUTINE, CREATE FUNCTION, and CREATE PROCEDURE statements. For further information on the DB_LIBRARY_PATH parameter in the **ONCONFIG** file, see the *IBM Informix Administrator's Reference*.

Specific Name

Use a specific name to declare an identifier for a UDR that is unique in the database or name space. Use the Specific Name segment whenever you see a reference to a specific name in a syntax diagram. Only Dynamic Server supports specific names.

Syntax

Specific Name:

```
├──┬─────────────┬──specific_id──────────────────────────────────────┤
   └─owner──.────┘
```

Element	Description	Restrictions	Syntax
owner	Owner of the UDR	No more than 32 bytes. Must be same as *owner* of function or procedure name of this UDR. See also "Restrictions on the Owner Name" on page 5-68.	"Owner Name" on page 5-43
specific_id	Unique name of the UDR	Must be no more than 128 bytes long. See also "Restrictions on the Specific Name" on page 5-68.	"Identifier" on page 5-22

Usage

A *specific name* is a unique identifier that the CREATE PROCEDURE or CREATE FUNCTION statement declares as an alternative name for a UDR.

Because you can overload routines, a database can have more than one UDR with the same name and different parameter lists. You can assign a UDR a specific name that uniquely identifies the specific UDR.

If you declare a specific name when you create the UDR, you can later use that name when you alter, drop, grant, or revoke privileges, or update statistics on that UDR. Otherwise, you need to include the parameter data types with the UDR name, if the name alone does not uniquely identify the UDR.

Restrictions on the Owner Name

When you declare a specific name, the *owner* must be the same *authorization identifier* that qualifies the function name or procedure name of the UDR that you create. That is, whether or not you specify the owner name to qualify either the UDR name or the specific name or both, the names of the *owner* must match.

When you specify no owner name in the DDL statement that creates a UDR, Dynamic Server uses the login name of the user who creates the UDR. Therefore, if you specify the owner name in one location and not the other, the owner name that you specify must match your user ID.

Restrictions on the Specific Name

In a database that is not ANSI-compliant, *specific_id* must be unique among routine names within the database. Two UDRs cannot have the same *specific_id*, even if they have different owners.

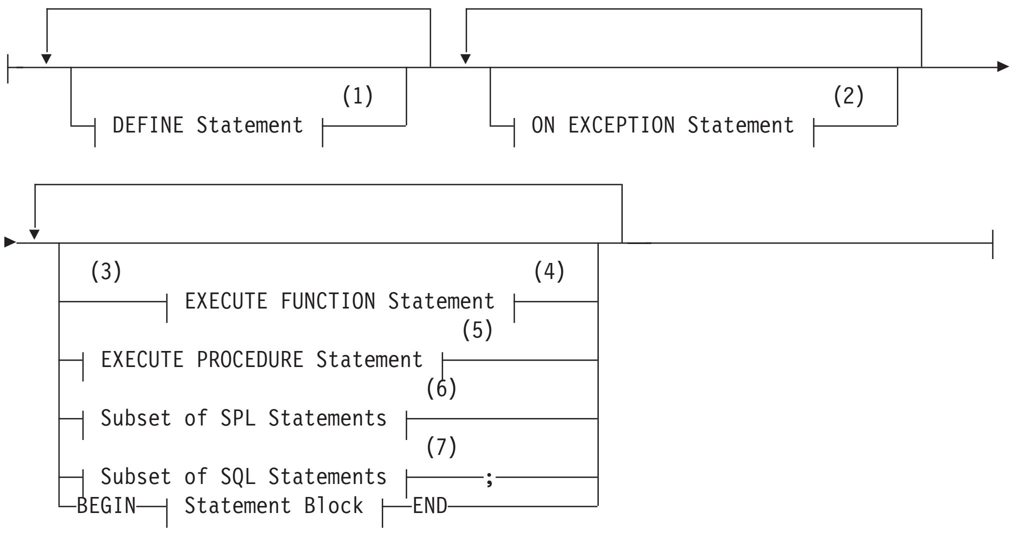
In an ANSI-compliant database, the combination *owner.specific_id* must be unique. That is, the specific name must be unique among UDRs that have the same owner.

Statement Block

Use a statement block to specify SPL and SQL operations to take place when an SPL statement that includes this segment is executed.

Syntax

Statement Block:



DEFINE Statement (1)
ON EXCEPTION Statement (2)
(3) EXECUTE FUNCTION Statement (4)
EXECUTE PROCEDURE Statement (5)
Subset of SPL Statements (6)
Subset of SQL Statements (7) ;
BEGIN Statement Block END

Notes:

1 See "DEFINE" on page 3-7

2 See "ON EXCEPTION" on page 3-31

3 Dynamic Server only

4 See "EXECUTE FUNCTION" on page 2-329

5 See "EXECUTE PROCEDURE" on page 2-336

6 See "Subset of SPL Statements Valid in the Statement Block"

7 See "Subset of SQL Data Types" on page 5-62

Usage

SPL and SQL statements can appear in a *statement block*, a set of zero or more statements that can define the scope of a variable or of the ON EXCEPTION statement of SPL. If the statement block is empty, no operation takes place when control of execution within the SPL routine passes to the empty SPL statement block.

Subset of SPL Statements Valid in the Statement Block

The diagram for the "Statement Block" on page 5-69 refers to this section. You can use any of the following SPL statements in the statement block:

CALL	FOR	LET	SYSTEM
CONTINUE	FOREACH	RAISE EXCEPTION	TRACE
EXIT	IF	RETURN	WHILE

SQL Statements Not Valid in an SPL Statement Block

The diagram for the "Statement Block" on page 5-69 refers to this section. The following SQL statements are *not* valid in an SPL statement block:

ALLOCATE COLLECTION
ALLOCATE DESCRIPTOR
ALLOCATE ROW
CLOSE
CLOSE DATABASE
CONNECT
CREATE DATABASE
CREATE FUNCTION
CREATE FUNCTION FROM
CREATE PROCEDURE
CREATE PROCEDURE FROM
CREATE ROUTINE FROM
DATABASE
DEALLOCATE COLLECTION
DEALLOCATE DESCRIPTOR
DEALLOCATE ROW
DECLARE
DESCRIBE
DISCONNECT
DROP DATABASE
EXECUTE
EXECUTE IMMEDIATE
FETCH
FLUSH
FREE
GET DESCRIPTOR
INFO
LOAD
OPEN
OUTPUT
PREPARE
PUT
RENAME DATABASE
SET CONNECTION
SET DESCRIPTOR
UNLOAD
UPDATE STATISTICS
WHENEVER

For example, you cannot close the current database or select a new database within an SPL routine. Likewise you cannot drop the current SPL routine within the same routine. You can, however, drop another SPL routine.

You can use a SELECT statement in only two cases:

- You can use the INTO TEMP clause to put the results of the SELECT statement into a temporary table.
- You can use the SELECT ... INTO form of the SELECT statement to put the resulting values into SPL variables.

If an SPL routine is later to be called as part of a data-manipulation language (DML) statement, additional restrictions exist. For more information, see "Restrictions on SPL Routines in Data-Manipulation Statements" on page 5-71.

Nested Statement Blocks

You can use the BEGIN and END keywords to delimit a statement block that is nested within another statement block.

Scope of Reference of SPL Variables and Exception Handlers: The BEGIN-END keywords can limit the scope of SPL variables and exception handlers. Declarations of variables and definitions of exception handlers inside a BEGIN-END statement block are local to that statement block and are not visible from outside the statement block. The following code uses a BEGIN-END statement block to delimit the scope of reference of variables:

```
CREATE DATABASE demo;
CREATE TABLE tracker (
   who_submitted CHAR(80), -- Show what code was running.
   value INT,              -- Show value of the variable.
   sequential_order SERIAL -- Show order of statement execution.
    );
CREATE PROCEDURE demo_local_var()
DEFINE var1, var2 INT;
   LET var1 = 1;
   LET var2 = 2;
   INSERT INTO tracker (who_submitted, value)
    VALUES ('var1 param before sub-block', var1);
BEGIN
   DEFINE var1 INT;   -- same name as global parameter.
   LET var1 = var2;
   INSERT INTO tracker (who_submitted, value)
   VALUES ('var1 var defined inside the "IF/BEGIN".', var1);
END
INSERT INTO tracker (who_submitted, value)
   VALUES ('var1 param after sub-block (unchanged!)', var1);
END PROCEDURE;
EXECUTE PROCEDURE demo_local_var();
SELECT sequential_order, who_submitted, value FROM tracker
 ORDER BY sequential_order;
```

This example declares three variables, two of which are named **var1**. (Name conflicts are created here to illustrate which variables are visible. Using the same name for different variables is generally not recommended, because conflicting names of variables can make your code more difficult to read and to maintain.)

Because of the statement block, only one **var1** variable is in scope at a time.

The **var1** variable that is declared inside the statement block is the only **var1** variable that can be referenced from within the statement block.

The **var1** variable that is declared outside the statement block is not visible within the statement block. Because it is out of scope, it is unaffected by the change in value to the **var1** variable that takes place inside the statement block. After all the statements run, the outer **var1** still has a value of 1.

The **var2** variable is visible within the statement block because it was not superseded by a name conflict with a block-specific variable.

Restrictions on SPL Routines in Data-Manipulation Statements

If you call the SPL routine in a SQL statement that is not a data-manipulation language (DML) statement (namely EXECUTE FUNCTION or EXECUTE PROCEDURE), the SPL routine can execute any statement that is not listed in the section “SQL Statements Not Valid in an SPL Statement Block” on page 5-70.

In Dynamic Server, if you call the SPL routine as part of a DML statement (namely, an INSERT, UPDATE, DELETE, or SELECT statement), then the routine cannot execute any SQL statement in the following list:

ALTER ACCESS_METHOD	CREATE AGGREGATE
ALTER FRAGMENT	CREATE DISTINCT TYPE
ALTER INDEX	CREATE OPAQUE TYPE
ALTER OPTICAL CLUSTER	CREATE OPCLASS
ALTER SEQUENCE	CREATE ROLE
ALTER TABLE	CREATE ROW TYPE
BEGIN WORK	CREATE SEQUENCE
COMMIT WORK	CREATE TRIGGER
CREATE ACCESS_METHOD	DELETE

DROP ACCESS_METHOD	DROP TRIGGER
DROP AGGREGATE	DROP TYPE
DROP INDEX	DROP VIEW
DROP OPCLASS	INSERT
DROP OPTICAL CLUSTER	RENAME COLUMN
DROP ROLE	RENAME DATABASE
DROP ROW TYPE	RENAME SEQUENCE
DROP SEQUENCE	RENAME TABLE
DROP SYNONYM	ROLLBACK WORK
DROP TABLE	SET CONSTRAINTS
	TRUNCATE
	UPDATE

In Extended Parallel Server, if you call the SPL routine as part of a DML statement (namely, an INSERT, UPDATE, DELETE, MERGE, or SELECT statement), then the routine can execute *only* the following statements of SQL:

SELECT	SET EXPLAIN
SET PLOAD FILE	SET OPTIMIZATION
SET DEBUG FILE TO	

For both Dynamic Server and Extended Parallel Server, these restrictions do not apply to an SPL routine that is invoked by a trigger, because in this case the SPL routine is not called by the DML statement, and therefore can include any SQL statement, such as UPDATE, INSERT and DELETE, that is not listed among the "SQL Statements Not Valid in an SPL Statement Block" on page 5-70.

Transactions in SPL Routines

In a database that is not ANSI-compliant, you can use the BEGIN WORK and COMMIT WORK statements in an SPL statement block to start a transaction, to finish a transaction, or start and finish a transaction in the same SPL routine. If you start a transaction in a routine that is executed remotely, you must finish the transaction before the routine exits.

As previously noted, however, the ROLLBACK WORK statement is not valid in an SPL statement block.

Support for Roles and User Identity

You can use roles with SPL routines. You can execute role-related statements (CREATE ROLE, DROP ROLE, GRANT ROLE, REVOKE ROLE, and SET ROLE) and SET SESSION AUTHORIZATION statements within an SPL routine. You can also grant privileges or grant other roles to roles with the GRANT or (for Dynamic Server only) GRANT FRAGMENT statement within an SPL routine, or use REVOKE to cancel the privileges (or roles) of roles. Privileges that a user has acquired by enabling a role or by a SET SESSION AUTHORIZATION statement are not automatically relinquished after an SPL routine completes execution.

For further information about roles, see the CREATE ROLE, DROP ROLE, GRANT, REVOKE, and SET ROLE statements in Chapter 2.

Appendix A. Reserved Words for IBM Informix Dynamic Server

The ISO standard SQL language has many keywords. Some are designated as *reserved words* and others as *non-reserved words.* In ISO SQL, reserved words cannot be used as identifiers for database objects (like tables, columns, and so forth). To use such a name in a valid SQL statement requires a delimited identifier ("Delimited Identifiers" on page 5-23) that you enclose between double (" ") quotation marks.

In contrast, the dialect of SQL that IBM Informix database servers implement has very few *reserved words* in the sense of a character string that obeys the rules for identifiers ("Identifier" on page 5-22) but always produces a compilation error or runtime error when used as an identifier. Your application might encounter restricted functionality, however, or unexpected results, if you define an SPL routine that has the same name as a built-in SQL function, expression, or operator.

This appendix lists the keywords in the IBM Informix implementation of SQL for Dynamic Server. Do not declare any of these keywords as SQL identifiers. If you do, errors or syntactic ambiguities can occur if the identifier appears in a context where the keyword is valid. In addition, your code will be more difficult to read and to maintain. Do not use keywords of C or C++ (nor of any other programming language that you will be using in an embedded mode) in your database structures.

If you receive an error message that seems unrelated to the SQL statement that caused the error, you might wish to review this appendix to see if a keyword has been used as an identifier.

To avoid using a keyword as an identifier, you can qualify the identifier with an owner name or modify the identifier. For example, rather than name a database object **CURRENT**, you might name it **o_current** or **juanita.current**. For a discussion of potential problems in using keywords as identifiers, and of additional workarounds for specific keywords, see "Use of Keywords as Identifiers" on page 5-23. See also *IBM Informix Guide to SQL: Tutorial* for more information about using keywords as identifiers in SQL applications.

A

ABSOLUTE
ACCESS
ACCESS_METHOD
ACTIVE
ADD
AFTER
AGGREGATE
ALIGNMENT
ALL
ALL_ROWS
ALLOCATE
ALTER
AND
ANSI
ANY
APPEND
AS
ASC
AT
ATTACH
AUDIT
AUTHORIZATION
AUTO
AUTOFREE
AVG
AVOID_EXECUTE
AVOID_SUBQF

B

BEFORE	BOOLEAN	BY
BEGIN	BOTH	BYTE
BETWEEN	BUFFERED	
BINARY	BUILTIN	

C

CACHE	CLOSE	CONST
CALL	CLUSTER	CONSTRAINT
CANNOTHASH	CLUSTERSIZE	CONSTRAINTS
CARDINALITY	COARSE	CONSTRUCTOR
CASCADE	COBOL	CONTINUE
CASE	CODESET	COPY
CAST	COLLATION	COSTFUNC
CHAR	COLLECTION	COUNT
CHAR_LENGTH	COLUMN	CRCOLS
CHARACTER	COMMIT	CREATE
CHARACTER_LENGTH	COMMITTED	CROSS
CHECK	COMMUTATOR	CURRENT
CLASS	CONCURRENT	CURRENT_ROLE
CLIENT	CONNECT	CURSOR
	CONNECTION	CYCLE

D

DATABASE	DECLARE	DIAGNOSTICS
DATAFILES	DECODE	DIRECTIVES
DATASKIP	DEFAULT	DIRTY
DATE	DEFAULT_ROLE	DISABLED
DATETIME	DEFERRED	DISCONNECT
DAY	DEFERRED_PREPARE	DISTINCT
DBA	DEFINE	DISTRIBUTEBINARY
DBDATE	DELAY	DISTRIBUTESREFERENCES
DBPASSWORD	DELETE	DISTRIBUTIONS
DBSERVERNAME	DELIMITER	DOCUMENT
DEALLOCATE	DELUXE	DOMAIN
DEBUG	DEREF	DONOTDISTRIBUTE
DEC	DESC	DORMANT
DEC_T	DESCRIBE	DOUBLE
DECIMAL	DESCRIPTOR	DROP
	DETACH	DTIME_T

E

EACH	ERROR	EXIT
ELIF	ESCAPE	EXPLAIN
ELSE	EXCEPTION	EXPLICIT
ENABLED	EXCLUSIVE	EXPRESS
ENCRYPTION	EXEC	EXPRESSION
END	EXECUTE	EXTEND
ENUM	EXECUTEANYWHERE	EXTENT
ENVIRONMENT	EXISTS	EXTERNAL

F

FALSE	FIXCHAR	FORTRAN
FAR	FIXED	FOUND
FETCH	FLOAT	FRACTION
FILE	FLUSH	FRAGMENT
FILLFACTOR	FOR	FREE
FILTERING	FOREACH	FROM
FIRST	FOREIGN	FULL
FIRST_ROWS	FORMAT	FUNCTION

G

GENERAL	GLOBAL	GRANT
GET	GO	GROUP
GK	GOTO	

H

HANDLESNULLS	HIGH	HOUR
HASH	HINT	HYBRID
HAVING	HOLD	

I

IF	INDICATOR	INTEGER
IFX_INT8_T	INFORMIX	INTERNAL
IFX_LO_CREATE_SPEC_T	INIT	INTERNALLENGTH
IFX_LO_STAT_T	INITCAP	INTERVAL
IMMEDIATE	INLINE	INTO
IMPLICIT	INNER	INTRVL_T
IN	INOUT	IS
INACTIVE	INSERT	ISCANONICAL
INCREMENT	INSTEAD	ISOLATION
INDEX	INT	ITEM
INDEXES	INT8	ITERATOR
	INTEG	

J - K

JOIN	KEEP	KEY

3

L

LABELEQ	LEADING	LOCAL
LABELGE	LEFT	LOCATOR
LABELGLB	LET	LOCK
LABELGT	LEVEL	LOCKS
LABELLE	LIKE	LOG
LABELLT	LIMIT	LONG
LABELLUB	LIST	LOW
LABELTOSTRING	LISTING	LOWER
LANGUAGE	LOAD	LVARCHAR
LAST	LOC_T	

M

MATCHES	MEDIUM	MODERATE
MAX	MEMORY_RESIDENT	MODIFY
MAXERRORS	MIDDLE	MODULE
MAXLEN	MIN	MONEY
MAXVALUE	MINUTE	MONTH
MDY	MINVALUE	MOUNTING
MEDIAN	MODE	MULTISET

N

NAME	NOCYCLE	NORMAL
NCHAR	NOMAXVALUE	NOT
NEGATOR	NOMIGRATE	NOTEMPLATEARG
NEW	NOMINVALUE	NULL
NEXT	NON_RESIDENT	NUMERIC
NO	NONE	NVARCHAR
NOCACHE	NOORDER	NVL

O

OCTET_LENGTH	OPAQUE	OPTION
OF	OPCLASS	OR
OFF	OPEN	ORDER
OLD	OPERATIONAL	OUT
ON	OPTCOMPIND	OUTER
ONLINE	OPTICAL	OUTPUT
ONLY	OPTIMIZATION	

P

PAGE	PDQPRIORITY	PRIMARY
PARALLELIZABLE	PERCALL_COST	PRIOR
PARAMETER	PLI	PRIVATE
PARTITION	PLOAD	PRIVILEGES
PASCAL	PRECISION	PROCEDURE
PASSEDBYVALUE	PREPARE	PUBLIC
PASSWORD	PREVIOUS	PUT

R

RAISE
RANGE
RAW
READ
REAL
RECORDEND
REF
REFERENCES
REFERENCING
REGISTER
REJECTFILE
RELATIVE
RELEASE
REMAINDER
RENAME
REOPTIMIZATION
REPEATABLE
REPLICATION
RESERVE
RESOLUTION
RESOURCE
RESTART
RESTRICT
RESUME
RETAIN
RETURN
RETURNING
RETURNS
REUSE
REVOKE
RIGHT
ROBIN
ROLE
ROLLBACK
ROLLFORWARD
ROUND
ROUTINE
ROW
ROWID
ROWIDS
ROWS

3 S

SAMEAS
SAMPLES
SAVE
SCHEDULE
SCHEMA
SCRATCH
SCROLL
SECOND
SECONDARY
SECTION
SELCONST
SELECT
SELFUNC
SEQUENCE
SERIAL
SERIAL8
SERIALIZABLE
SERVERUUID
SESSION
SET
SHARE
SHORT
SIGNED
SITENAME
SIZE
SKALL
SKINHIBIT
SKIP
SKSHOW
SMALLFLOAT
SMALLINT
SOME
SPECIFIC
SQL
SQLCODE
SQLCONTEXT
SQLERROR
SQLSTATE
SQLWARNING
STABILITY
STACK
STANDARD
START
STATIC
STATISTICS
STDEV
STEP
STOP
STORAGE
STRATEGIES
STRING
STRINGTOLABEL
STRUCT
STYLE
SUBSTR
SUBSTRING
SUM
SUPPORT
SYNC
SYNONYM
SYSTEM

T

TABLE
TEMP
TEMPLATE
TEST
TEXT
THEN
TIME
TIMEOUT
TO
TODAY
TRACE
TRAILING
TRANSACTION
TRIGGER
TRIGGERS
TRIM
TRUE
TRUNCATE
TYPE
TYPEDEF
TYPEID
TYPENAME
TYPEOF

U

UNCOMMITTED	UNKNOWN	UPPER
UNDER	UNLOAD	USAGE
UNION	UNLOCK	USE_SUBQF
UNIQUE	UNSIGNED	USER
UNITS	UPDATE	USING

V

VALUE	VARIABLE	VIEW
VALUES	VARIANCE	VIOLATIONS
VAR	VARIANT	VOID
VARCHAR	VARYING	VOLATILE

W - Z

WAIT	WHILE	XADATASOURCE
WARNING	WITH	XID
WHEN	WITHOUT	XLOAD
WHENEVER	WORK	XUNLOAD
WHERE	WRITE	YEAR

Appendix B. Reserved Words for IBM Informix Extended Parallel Server

The ISO standard SQL language has many keywords. Some are designated as *reserved words* and others as *non-reserved words.* In ISO SQL, reserved words cannot be used as identifiers for database objects (like tables, columns, and so forth). To use such a name in a valid SQL statement requires a delimited identifier ("Delimited Identifiers" on page 5-23) that you enclose between double (" ") quotation marks.

By contrast, the dialect of SQL that IBM Informix database servers implement has very few *reserved words* in the sense of a character string that obeys the rules for identifiers ("Identifier" on page 5-22) but always produces a compilation error or runtime error when used as an identifier. Your application might encounter restricted functionality, however, or unexpected results, if you define an SPL routine that has the same name as a built-in SQL function, expression, or operator.

This appendix lists the keywords in the IBM Informix implementation of SQL for Extended Parallel Server. Do not declare any of these keywords as SQL identifiers. If you do, errors or syntactic ambiguities can occur if the identifier appears in a context where the keyword is valid. In addition, your code will be more difficult to read and to maintain. Do not use keywords of C or C++ (nor of any other programming language that you will be using in an embedded mode) in your database structures.

If you receive an error message that seems unrelated to the SQL statement that caused the error, you might wish to review this appendix to see if a keyword has been used as an identifier.

To avoid using a keyword as an identifier, you can qualify the identifier with an owner name or modify the identifier. For example, rather than name a database object **CURRENT**, you might name it **o_current** or **'juanita'.current**. For a discussion of potential problems in using keywords as identifiers, and of additional workarounds for specific keywords, see "Use of Keywords as Identifiers" on page 5-23. See also *IBM Informix Guide to SQL: Tutorial* for more information about using keywords as identifiers in SQL applications.

A

ADD
AFTER
ALL
ALL_MUTABLES
ALTER
AND
ANSI
ANY
APPEND
AS
ASC
AT
ATTACH
AUDIT
AUTHORIZATION
AVG

B

BEFORE	BINARY	BOUND_IMPL_PDQ
BEGIN	BITMAP	BUFFERED
BETWEEN	BOTH	BY
		BYTE

C

CACHE	CLOSE	CONNECT
CALL	CLUSTER	CONSTRAINT
CASCADE	CLUSTERSIZE	CONSTRAINTS
CASE	COARSE	CONTINUE
CHAR	COBOL	COPY
CHAR_LENGTH	CODESET	COUNT
CHARACTER	COLUMN	CREATE
CHARACTER_LENGTH	COMMIT	CURRENT
CHECK	COMMITTED	CURRENT_ROLE
CLIENT_TZ	COMPUTE_QUOTA	CURSOR

D

DATABASE	DEC	DELUXE
DATAFILES	DECIMAL	DESC
DATASKIP	DECLARE	DETACH
DATE	DECODE	DIRTY
DATETIME	DEFAULT	DISCONNECT
DAY	DEFAULT_ROLE	DISTINCT
DBA	DEFERRED	DISTRIBUTIONS
DBDATE	DEFINE	DOCUMENT
DBSERVERNAME	DELETE	DOUBLE
DEBUG	DELIMITER	DROP

E

EACH	EXCEPTION	EXPLAIN
ELIF	EXCLUSIVE	EXPRESS
ELSE	EXEC	EXPRESSION
END	EXECUTE	EXTEND
ENVIRONMENT	EXISTS	EXTENT
ERROR	EXIT	EXTERNAL
ESCAPE		

F

FETCH	FLOAT	FORTRAN
FILE	FOR	FOUND
FILLFACTOR	FOREACH	FRACTION
FILTERING	FOREIGN	FRAGMENT
FIRST	FORMAT	FROM
		FUNCTION

G

GK	GO	GRANT
GLOBAL	GOTO	GROUP

H

HASH	HIGH	HOUR
HAVING	HOLD	HYBRID

I

IF	INDICATOR	INT8
IMMEDIATE	INIT	INTEGER
IMMUTABLE	INITCAP	INTERVAL
IMPLICIT_PDQ	INNER	INTO
IN	INSERT	IS
INDEX	INT	ISOLATION

J-K

JOIN	KEY

L

LABELEQ	LEADING	LOCAL
LABELGE	LEFT	LOCK
LABELGT	LET	LOCKS
LABELLE	LEVEL	LOG
LABELLT	LIKE	LOW
LANGUAGE	LISTING	LOWER
	LOAD	

M

MATCHES	MERGE	MODULE
MAX	MIDDLE	MONEY
MAXERRORS	MIN	MONTH
MAXSCAN	MINUTE	MOUNTING
MEDIUM	MODE	MOVE
MEMORY_RESIDENT	MODIFY	MUTABLE

N

NCHAR	NON_RESIDENT	NULL
NEW	NONE	NUMERIC
NEXT	NORMAL	NVARCHAR
NO	NOT	NVL

O

OCTET_LENGTH	ONLY	OPTION
OF	OPEN	OR
OFF	OPERATIONAL	ORDER
OLD	OPTICAL	OUTER
ON	OPTIMIZATION	

P

PAGE	PLOAD	PRIVATE
PASCAL	PRECISION	PRIVILEGES
PDQPRIORITY	PREPARE	PROCEDURE
PLI	PRIMARY	PUBLIC

R

RAISE	REMAINDER	RETURNS
RANGE	RENAME	REVOKE
RAW	REPEATABLE	RIDLIST
READ	RESERVE	ROBIN
REAL	RESOLUTION	ROLLBACK
RECORDEND	RESOURCE	ROLLFORWARD
RECOVER	RESTRICT	ROLE
REFERENCES	RESUME	ROUND
REFERENCING	RETAIN	ROW
REJECTFILE	RETURN	ROWS
RELEASE	RETURNING	

S

SAMEAS	SHARE	STANDARD
SAMPLES	SITENAME	START
SCHEDULE	SIZE	STATIC
SCHEMA	SKALL	STATISTICS
SCRATCH	SKINHIBIT	STDEV
SCROLL	SKSHOW	STEP
SECOND	SMALLFLOAT	STOP
SECTION	SMALLINT	SUBSTR
SELECT	SOME	SUBSTRING
SERIAL	SQL	SUM
SERIAL8	SQLCODE	SYNC
SERIALIZABLE	SQLERROR	SYNONYM
SET	SQLSTATE	SYSTEM
	SQLWARNING	

T

TABLE	TIMEOUT	TRANSACTION
TEMP	TMPSPACE_LIMIT	TRIGGER
TEMP_TABLE_EXT_SIZE	TO	TRIM
TEMP_TABLE_NEXT_SIZE	TODAY	TRUNC
TEXT	TRACE	TRUNCATE
THEN	TRAILING	TYPE

U

UNCOMMITTED	UNITS	UPDATE
UNION	UNLOAD	UPPER
UNIQUE	UNLOCK	USER
		USING

V

VALUES	VARIANT	VIEW
VARCHAR	VARYING	VIOLATIONS
VARIANCE		

W

WAIT	WHENEVER	WITH
WARNING	WHERE	WORK
WHEN	WHILE	WRITE

X-Z

XLOAD	XUNLOAD	YEAR

Appendix C. Accessibility

The syntax diagrams in the HTML version of this manual are available in dotted decimal syntax format, which is an accessible format that is available only if you are using a screen reader.

Dotted Decimal Syntax Diagrams

In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), the elements can appear on the same line, because they can be considered as a single compound syntax element.

Each line starts with a dotted decimal number; for example, `3` or `3.1` or `3.1.1`. To hear these numbers correctly, make sure that your screen reader is set to read punctuation. All syntax elements that have the same dotted decimal number (for example, all syntax elements that have the number `3.1`) are mutually exclusive alternatives. If you hear the lines `3.1 USERID` and `3.1 SYSTEMID`, your syntax can include either `USERID` or `SYSTEMID`, but not both.

The dotted decimal numbering level denotes the level of nesting. For example, if a syntax element with dotted decimal number `3` is followed by a series of syntax elements with dotted decimal number `3.1`, all the syntax elements numbered `3.1` are subordinate to the syntax element numbered `3`.

Certain words and symbols are used next to the dotted decimal numbers to add information about the syntax elements. Occasionally, these words and symbols might occur at the beginning of the element itself. For ease of identification, if the word or symbol is a part of the syntax element, the word or symbol is preceded by the backslash (\) character. The `*` symbol can be used next to a dotted decimal number to indicate that the syntax element repeats. For example, syntax element `*FILE` with dotted decimal number 3 is read as `3 \* FILE`. Format `3* FILE` indicates that syntax element `FILE` repeats. Format `3* \* FILE` indicates that syntax element `* FILE` repeats.

Characters such as commas, which are used to separate a string of syntax elements, are shown in the syntax just before the items they separate. These characters can appear on the same line as each item, or on a separate line with the same dotted decimal number as the relevant items. The line can also show another symbol that provides information about the syntax elements. For example, the lines `5.1*`, `5.1 LASTRUN`, and `5.1 DELETE` mean that if you use more than one of the `LASTRUN` and `DELETE` syntax elements, the elements must be separated by a comma. If no separator is given, assume that you use a blank to separate each syntax element.

If a syntax element is preceded by the `%` symbol, this identifies a reference that is defined elsewhere. The string following the `%` symbol is the name of a syntax fragment rather than a literal. For example, the line `2.1 %OP1` means that you should refer to a separate syntax fragment `OP1`.

The following words and symbols are used next to the dotted decimal numbers:

? Specifies an optional syntax element. A dotted decimal number followed by the ? symbol indicates that all the syntax elements with a corresponding dotted decimal number, and any subordinate syntax elements, are optional. If there is only one syntax element with a dotted decimal number, the ? symbol is displayed on the same line as the syntax element (for example, 5? NOTIFY). If there is more than one syntax element with a dotted decimal number, the ? symbol is displayed on a line by itself, followed by the syntax elements that are optional. For example, if you hear the lines 5 ?, 5 NOTIFY, and 5 UPDATE, you know that syntax elements NOTIFY and UPDATE are optional; that is, you can choose one or none of them. The ? symbol is equivalent to a bypass line in a railroad diagram.

! Specifies a default syntax element. A dotted decimal number followed by the ! symbol and a syntax element indicates that the syntax element is the default option for all syntax elements that share the same dotted decimal number. Only one of the syntax elements that share the same dotted decimal number can specify a ! symbol. For example, if you hear the lines 2? FILE, 2.1! (KEEP), and 2.1 (DELETE), you know that (KEEP) is the default option for the FILE keyword. In this example, if you include the FILE keyword but do not specify an option, default option KEEP is applied. A default option also applies to the next higher dotted decimal number. In this example, if the FILE keyword is omitted, default FILE(KEEP) is used. However, if you hear the lines 2? FILE, 2.1, 2.1.1! (KEEP), and 2.1.1 (DELETE), the default option KEEP only applies to the next higher dotted decimal number, 2.1 (which does not have an associated keyword), and does not apply to 2? FILE. Nothing is used if the keyword FILE is omitted.

***** Specifies a syntax element that can be repeated zero or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line 5.1* data-area, you know that you can include more than one data area or you can include none. If you hear the lines 3*, 3 HOST, and 3 STATE, you know that you can include HOST, STATE, both together, or nothing.

Notes:

1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.
2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you could write HOST STATE, but you could not write HOST HOST.
3. The * symbol is equivalent to a loop-back line in a railroad syntax diagram.

+ Specifies a syntax element that must be included one or more times. A dotted decimal number followed by the + symbol indicates that this syntax element must be included one or more times. For example, if you hear the line 6.1+ data-area, you must include at least one data area. If you hear the lines 2+, 2 HOST, and 2 STATE, you know that you must include HOST, STATE, or both. As for the * symbol, you can only repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the * symbol, is equivalent to a loop-back line in a railroad syntax diagram.

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Printed in USA

G251-2284-02

Spine information:

IBM Informix **Version 10.0/8.5** **IBM Informix Guide to SQL: Syntax**