ACTIAN™

SQL Engine Reference

Zen v15

Activate Your Data™

Contents

About This Document

This documentation covers the scope and functionality of the Zen query language.

Who Should Read This Manual

This manual provides information for creating and running SQL scripts in a Zen database.

Actian Corporation would appreciate your comments and suggestions about this manual. As a user of our documentation, you are in a unique position to provide ideas that can have a direct impact on future releases of this and other documentation. If you have comments or suggestions for the product documentation, post your request at the Community Forum on the Zen website.

Note: Unless otherwise noted, all references in this book to the Zen product refer to the current version.

For More Information

For complete information on the ODBC specification, see the Microsoft ODBC documentation.

SQL Overview

The following topics present an overview of SQL and provide details on Zen support for SQL.

- Working with SQL in Zen
- Zen Metadata
- Relational Engine Limits

You can also go to SQL Syntax Reference to look up specific SQL grammar supported by Zen.

Working with SQL in Zen

Structured Query Language (SQL) uses Englishlike statements to perform database operations. Both the American National Standards Institute (ANSI) and IBM have defined SQL standards. The IBM standard is Systems Application Architecture (SAA). Zen implements most features of both ANSI SQL and IBM SAA SQL and provides extensions that neither standard specifies. The following table lists the SQL statements that you can create in Zen and the tasks you can accomplish using each type of statement.

SQL Statement Type	Tasks
Data Definition	Create, modify, and delete tables. Create and delete views. Create and delete indexes. Create and delete stored SQL procedures. Create and delete triggers. Create and delete user-defined functions.
Data Manipulation	Retrieve, insert, update, and delete data in tables. Define transactions. Define and delete views. Execute stored SQL procedures. Execute triggers.
Data Control	Enable and disable security for a dictionary. Create and delete users. Add and drop users from groups. Change user passwords. Grant and revoke table access rights.

The rest of this topic gives general information about each type of SQL statement. For detailed information about each statement, see SQL Syntax Reference.

- Data Definition Statements
- Data Manipulation Statements
- Data Control Statements

Note: Most SQL editors do not use statement delimiters to execute multiple statements, but SQL Editor in ZenCC requires them. To execute the examples here in other environments, you may need to remove the pound sign or semicolon separators.

Data Definition Statements

Data definition statements let you specify the characteristics of your database. When you execute data definition statements, Zen stores the description of your database in a data dictionary. You must define your database in the dictionary before you can store or retrieve information.

Zen allows you to construct data definition statements to do the following:

- Create, modify, and delete tables.
- Create and delete views.
- Create and delete indexes.
- Create and delete triggers.
- Create and delete stored procedures.
- Create and delete user-defined functions.

The following topics briefly describe the SQL statements associated with each of these tasks. For general information about defining the characteristics of your database, see *Zen Programmer's Guide*.

Creating, Modifying, and Deleting Tables

You can create, modify, and delete tables from a database using the following SQL statements.

CREATE TABLE	Defines a table and optionally creates the corresponding data file.
ALTER TABLE	Changes a table definition. With an ALTER TABLE statement, you can perform such actions as add a column to the table definition, remove a column from the table definition, change column data type or length (or other characteristics), add or remove a primary key or a foreign key, and associate the table definition with an different data file.
DROP TABLE	Deletes a table from the data dictionary and optionally deletes the associated data file.

Creating and Deleting Views

You can create and delete views from a database using the following SQL statements.

CREATE VIEW	Defines a new view.
DROP VIEW	Deletes a view.

Creating and Deleting Indexes

You can create and delete indexes from a database using the following SQL statements.

CREATE INDEX	Defines a new index (a named index) for an existing table.
DROP INDEX	Deletes a named index.

Creating and Deleting Triggers

You can create and delete triggers from a database using the following SQL statements.

CREATE TRIGGER	Defines a trigger for an existing table.
DROP TRIGGER	Deletes a trigger.

Zen provides additional SQL control statements, which you can only use in the body of a trigger. You can use the following statements in triggers.

BEFORE	Defines the trigger execution before the INSERT, UPDATE, or DELETE operation.
AFTER	Defines the trigger execution after the INSERT, UPDATE, or DELETE operation.

Creating and Deleting Stored Procedures

A stored procedure consists of statements you can precompile and save in the dictionary. To create and delete stored procedures, use the following SQL statements.

CREATE PROCEDURE	Stores a new procedure in the data dictionary.
DROP PROCEDURE	Deletes a stored procedure from the data dictionary.

Zen provides additional SQL control statements, which you can only use in the body of a stored procedure. You can use the following statements in stored procedures.

IF...THEN...ELSE	Provides conditional execution based on the truth value of a condition.
LEAVE	Continues execution by leaving a block or loop statement.
LOOP	Repeats the execution of a block of statements.
WHILE	Repeats the execution of a block of statements while a specified condition is true.

Creating and Deleting User-Defined Functions (UDF)

In addition to the built-in functions, Zen allows you to create your own user-defined functions (UDFs) and use them in SQL queries.

A user-defined function is a database object that encapsulates one or more SQL statements that can be reused. A user-defined function takes zero or more input arguments and evaluates a scalar return value.

User-defined functions are defined within the context of a database. Successful execution of a CREATE FUNCTION statement stores the UDF definition in the database where it was executed. The UDF can then be modified, invoked, or deleted.

A UDF can use one or more SQL statements to output a scalar value of the data type in the RETURNS clause of its CREATE FUNCTION statement. For a list of supported data types, see Supported Scalar Input Parameters and Returned Data Types.

To create and delete user-defined functions, use the SQL statements listed in the following table.

CREATE FUNCTION	Creates a scalar user-defined function in the database.
DROP FUNCTION	Deletes a scalar user-defined function from the database.

Data Manipulation Statements

Data manipulation statements let you access and modify the contents of your database. Zen allows you to construct data manipulation statements to do the following:

- Retrieve data from tables.
- Modify data in tables.
- Define transactions.
- Create and delete views.
- Execute stored procedures.
- Execute triggers.

The following sections briefly describe the SQL statements associated with each of these tasks.

Retrieving Data

All statements you use to retrieve information from a database are based on SELECT.

SELECT	Retrieves data from one or more tables in the database.

When you create a SELECT statement, you can use various clauses to specify different options in retrieving data. The following table lists the types of clauses used in a SELECT statement.

FROM	Specifies the tables or views from which to retrieve data.
WHERE	Defines search criteria that qualify the data a SELECT statement retrieves.
GROUP BY	Combines sets of rows according to the criteria you specify and allows you to determine aggregate values for one or more columns in a group.
HAVING	Allows you to limit a view by specifying criteria that the aggregate values of a group must meet.
ORDER BY	Determines the order in which Zen returns selected rows.

In addition, you can use the UNION keyword to obtain a single result table from multiple SELECT queries.

Modifying Data

The following table gives statements to add, change, or delete data from tables and views.

INSERT	Adds rows to one or more tables or a view.
UPDATE	Changes data in a table or a view.
DELETE	Deletes rows from a table or a view.

When you create a DELETE or UPDATE statement, you can use a WHERE clause to define search criteria that restrict the data upon which the statement acts.

Creating and Deleting Views

You can create and delete views using the following SQL statements.

CREATE VIEW	Defines a database view and stores the definition in the dictionary.
DROP VIEW	Deletes a view from the data dictionary.

Executing Stored Procedures

A stored procedure consists of statements that you can precompile and save in the dictionary. To execute stored procedures, use the following SQL statements.

CALL or EXEC[UTE]	Recalls a previously compiled procedure and executes it.

Executing System Stored Procedures

A system stored procedure helps you accomplish those administrative and informative tasks that are not covered by the Data Definition Language. The system stored procedures have a **psp_** prefix. To execute system stored procedures, use the following SQL statements.

CALL or EXEC[UTE]	Recalls a system stored procedure and executes it.

For more details, see System Stored Procedures.

Executing Triggers

A trigger consists of statements you can precompile and save in the dictionary. Triggers are executed automatically by the engine when the specified conditions occur.

Data Control Statements

Data control statements let you define security for your database. When you create a dictionary, no security is defined for it until you explicitly enable security for that dictionary. Zen allows you to construct data control statements to do the following:

- Enable and disable security.
- Create and delete users and groups.
- Add and drop users from groups and change user passwords.
- Grant and revoke rights.

Note: If you have a Btrieve owner name set on a file that is a table in a secure database, the Master user of the database must include the owner name in any GRANT statement to give permissions on the table to any user, including the Master user.

The following sections briefly describe the SQL statements associated with each of these tasks.

Enabling and Disabling Security

You can enable or disable security for a database by issuing the following statement.

SET SECURITY	Enables or disables security for the database and sets the Master password.

Creating and Deleting Users and Groups

You can create or delete users and user groups for the database using the following SQL statements.

ALTER USER	Rename a user or change a password.
CREATE USER	Creates a new user with or without a password or membership in a group.
DROP USER	Delete a user.
ALTER GROUP	Adds users to a group. Drops users from a group.
CREATE GROUP	Creates a new group of users.

DROP GROUP	Deletes a group of users.
GRANT LOGIN TO	Creates users and passwords, or adds users to groups.
REVOKE LOGIN FROM	Removes a user from the dictionary.

Granting and Revoking Rights

You can assign or remove rights from users or groups by issuing the following statements.

GRANT (access rights)	Grants a specific type of rights to a user or a group. The rights you can grant with a GRANT (access rights) statement are All, Insert, Delete, Alter, Select, Update, and References.
GRANT CREATETAB TO	Grants the right to create tables to a user or a group.
REVOKE (access rights)	Revokes access rights from a user or a group.
REVOKE CREATETAB FROM	Revokes the right to create tables from a user or a group.

Zen Metadata

The Zen relational interface supports two versions of metadata, referred to as version 1 or V1 and version 2 or V2.

Metadata version is a property of the database that you specify when you create a database. V1 metadata is the default. When you create a database, you must specify V2 metadata if you want that version.

Metadata version applies to all data dictionary files (DDFs) within that database. A single database cannot use some DDFs with V1 metadata and others with V2 metadata. DDFs from the two versions cannot interact.

The database engine can, however, concurrently access multiple databases and each database can use either V1 metadata or V2 metadata.

All databases created with Zen versions before PSQL v10 use V1 metadata. A database created in PSQL v10 or later may use either metadata version depending on the setting at the time of database creation.

Comparison of Metadata Versions

Version 2 metadata allows for many identifier names to be up to 128 bytes long. See Relational Engine Limits for additional information. In addition, V2 metadata allows for permissions on views and stored procedures. See Permissions on Views and Stored Procedures.

DDF names for V2 metadata differ from those for V1. V2 DDFs contain additional fields and changes to V1 fields. See System Tables.

Relational Engine Limits

The following table shows the limits or conditions that apply to features of the Relational Engine. A Zen database may contain four billion objects in any valid combination. The objects are persisted in the data dictionary files.

See also Naming Conventions in *Zen Programmer's Guide*.

Zen Feature	**Limit or Condition**	**Metadata**	
		V1	**V2**
Arguments in a parameter list for a stored procedure	300	**X**	**X**
CHAR column size	8,000 bytes[1]	**X**	**X**
Character string literal	See String Values.	**X**	**X**
Columns in a table	1,536	**X**	**X**
Columns allowed in a trigger or stored procedure	300	**X**	**X**
Column name[2]	20 bytes	**X**	
	128 bytes		**X**
Column size	2 GB	**X**	**X**
Correlation name	Limited by memory	**X**	**X**
Cursor name	18 bytes	**X**	**X**
Database name[2]	20 bytes	**X**	**X**
Database sessions	Limited by memory	**X**	**X**

Zen Feature	Limit or Condition	Metadata	
		V1	V2
Data file path name	64 bytes (the maximum length of the data file path name is a combination of Xf$Loc path and the data file path)	X	
	250 bytes (the maximum length of the data file path name is a combination of Xf$Loc path and the data file path)		X
Function (user-defined) name[2]	30 bytes	X	
	128 bytes		X
Group name[2]	30 bytes	X	
	128 bytes		X
Index name[2]	20 bytes	X	
	128 bytes		X
Key name[2]	20 bytes	X	
	128 bytes		X
Label name	limited by memory	X	X
NCHAR column size	4,000 UCS-2 units (8,000 bytes[1])	X	X
NVARCHAR column size	4,000 UCS-2 units (8,000 bytes[1])	X	X
Number of ANDed and ORed predicates	3000	X	X
Number of database objects	65,536	X	
	4 billion		X
Parameter name	126 bytes	X	X
Password[2]	8 bytes	X	
	128 bytes		X
Procedure name[2]	30 bytes	X	
	128 bytes		X
Referential integrity (RI) constraint name	20 bytes	X	
	128 bytes		X

Zen Feature	Limit or Condition	Metadata	
		V1	V2
Representation of single quote	Two consecutive single quotes ('')	X	X
Result name	Limited by memory	X	X
Savepoint name	Limited by memory	X	X
SELECT list columns in a query	1,600	X	X
Size of a single term (quoted literal string) in a SQL statement	14,997, excluding null terminator and quotations (15,000 total)	X	X
SQL statement length	512 KB	X	X
SQL statements per session	Limited by memory	X	X
Stored procedure size	64 KB	X	X
Table name[2]	20 bytes	X	
	128 bytes		X
Table rows	13.0 file format: 9,223,372,036,854,775,807 (~9.2 quintillion) Older file formats: 2,147,483,647 (~2.1 billion)	X	X
Joined tables per query	Limited by memory	X	X
Trigger name[2]	20 bytes	X	
	128 bytes		X
User name[2]	30 bytes	X	
	128 bytes		X
VARCHAR column size	8,000 bytes[1]	X	X
Variable name	Limited by memory	X	X
View name[2]	20 bytes	X	
	128 bytes		X

[1]The maximum size of a CHAR, NCHAR, VARCHAR or NVARCHAR column that may be fully indexed is 255 bytes.

[2]See also Identifier Restrictions in *Advanced Operations Guide*.

Fully Qualified Object Names

A fully qualified object name uses dot notation to combine database and object names. For example, if the database mydbase has a view myview, then its fully qualified object name is mydbase.myview.

Fully qualified object names must be unique within a database. For example, if database mydbase has table acctpay and user-defined function acctpay, then Zen cannot resolve the name mydbase.acctpay.

Delimited Identifiers in SQL Statements

Table, column, and index names must be delimited if they contain spaces or nonstandard characters or if the identifier is a keyword. The delimiter character is the double quotation mark.

Examples

```
SELECT "last-name" FROM "non-standard-tbl"
```

The hyphen is a nonstandard character.

```
SELECT "password" FROM my_pword_tbl
```

"Password" is a keyword in the SET PASSWORD statement.

SQL Syntax Reference

This section covers SQL syntax supported by Zen.

The following topics cover the SQL grammar supported by Zen:

- Literal Values
- SQL Grammar in Zen
- Grammar Element Definitions
- Global Variables
- Other Characteristics

Literal Values

Zen supports the standard literal formats. This topic provides some of the most common examples.

- String Values
- Number Values
- Date Values
- Time Values
- Time Stamp Values

String Values

String constants may be expressed in SQL statements by surrounding the given string of characters with single quotes. If the string itself contains a single-quote or apostrophe, the character must be preceded by another single-quote.

String literals have type VARCHAR. Characters are encoded using the database code page. If the literal is preceded by the letter N, the literal has type NVARCHAR and characters are encoded using UCS-2. A literal embedded in a SQL query string may go through additional encoding conversions in the SQL access methods before final conversion in the SQL engine. In particular, if the SQL text is converted to an encoding that does not support all Unicode characters, characters in the SQL text may be lost before the engine converts the string literal to NVARCHAR.

Examples

In the first example, the apostrophe or single quotation mark contained within the string must be escaped by another single quotation mark.

```
SELECT * FROM t1 WHERE c1 = 'Roberta''s Restaurant'
SELECT STREET FROM address WHERE city LIKE 'san%'
```

Number Values

Date Values

Date constants may be expressed in SQL statements as a character string or embedded in a vendor string. The first case is treated as data type CHAR and the vendor string representation is treated as a value of type DATE. This distinction becomes important when conversions are attempted.

Zen partially supports extended SQL grammar as outlined in this function.

Zen supports the date literal format 'YYYY-MM-DD'.

Dates may be in the range of year 0 to 9999.

Examples

The next two statements return all the classes whose start date is after 1995-06-05.

```
SELECT * FROM Class WHERE Start_Date > '1995-06-05'
SELECT * FROM Class WHERE Start_Date > {d '1995-06-05'}
```

Time Values

Zen supports the time literal format 'HH:MM:SS'.

Time constants may be expressed in SQL statements as a character string or embedded in a vendor string. Character string representation is treated as a string of type CHAR and the vendor string representation as a value of type TIME.

Zen partially supports extended SQL grammar as outlined in this function.

Examples

The following two statements retrieve records from the Class table where the class start time is 14:00:00:

```
SELECT * FROM Class WHERE Start_time = '14:00:00'
SELECT * FROM Class WHERE Start_time = {t '14:00:00'}
```

Time Stamp Values

Time stamp constants may be expressed in SQL statements as a character string or embedded in a vendor string. Zen treats the character string representation as a string of type CHAR and the vendor string representation as a value of type SQL_TIMESTAMP.

Zen supports the time stamp literal format 'YYYY-MM-DD HH:MM:SS.MMM'

Examples

The next two statements retrieve records from the Billing table where the start day and time for the log is 1996-03-28 at 17:40:49.

```
SELECT * FROM Billing WHERE log = '1996-03-28 17:40:49'
SELECT * FROM Billing WHERE log = {ts '1996-03-28 17:40:49'}
```

SQL Grammar in Zen

The following topics cover the SQL grammar supported by Zen. Statements and keywords are listed in alphabetical order.

Note: You can use the SQL Editor in with Zen Control Center to test most of the SQL examples. Exceptions are noted in the discussion of the grammar elements. For more information, see SQL Editor in *Zen User's Guide*.

Note: Most popular SQL editors do not use statement delimiters to execute multiple statements. However, SQL Editor in ZenCC requires them. If you wish to execute the examples in other environments, you may need to remove the pound sign or semicolon separators.

ADD

Remarks

Use the ADD clause within the ALTER TABLE statement to specify one or more column definitions, column constraints, or table constraints to be added.

See Also

ALTER TABLE

FOREIGN KEY

PRIMARY KEY

ALL

Remarks

When you specify the ALL keyword before a subquery, Zen performs the subquery and uses the result to evaluate the condition in the outer query. If all the rows returned by the subquery meet the outer query condition for a particular row, then Zen includes that row in the final result table generated by the statement.

Generally, you can use the EXISTS or NOT EXISTS keyword instead of ALL.

Examples

The following SELECT statement compares the ID column from the Person table to the ID columns in the result table of the subquery:

```
SELECT p.ID, p.Last_Name
FROM Person p
WHERE p.ID <> ALL
(SELECT f.ID FROM Faculty f WHERE f.Dept_Name = 'Chemistry')
```

If the ID value from Person does not equal any of the ID values in the subquery result table, Zen includes the row from Person in the final result table of the statement.

See Also

SELECT (with INTO)

SELECT

UNION

ALTER (rename)

The ALTER (rename) statement allows you to change the name of indexes, user-defined functions, stored procedures, tables, triggers, or views.

Syntax

```
ALTER object-type RENAME qualified-object-name TO new-object-name

object-type ::= INDEX

    | FUNCTION

    | PROCEDURE

    | TABLE

    | TRIGGER

    | VIEW

qualified-object-name ::= database-name.table-name.object-name

    | database-name.object-name

    | table-name.object-name

    | object-name

database-name, table-name, object-name, new-object-name ::= user-defined name
```

Remarks

You cannot rename the following objects if they were created with Zen versions before PSQL v9:

- Stored procedures
- Triggers
- Views

In these earlier releases, the system table index on the name of these objects was created as not modifiable. The indexes for these objects became modifiable in PSQL v9.

You can use *database-name* to qualify any *object-type*. However, if it is used to qualify an INDEX or TRIGGER object, you must also include *table-name*. You can use *table-name* to qualify only the objects INDEX and TRIGGER.

The ALTER statement can rename an object in a database. You must use *database-name* to qualify *object-type* if the object resides in a database to which your session is **not** currently connected. The renamed object occurs in the same database as *database-name*.

If you omit *database-name* as a qualifier, the database to which your session is currently connected is used to identify and rename the objects.

Note that *new-object-name* never uses a database name as a qualifier. The context of the new name always matches the context of the original name.

Note: The database engine does **not** check dependencies for renamed objects. Be sure that all objects with a dependency on the previous name are revised as needed. For example, if a trigger refers to a table named t1 and you rename table t1 to t5, the trigger now contains invalid SQL that will fail.

You can also use the psp_rename system stored procedure to rename objects.

Examples

The following statement alters the name of index suplid to vendor_id in the database to which your session is currently connected. The index applies to table region5.

```
ALTER INDEX RENAME region5.suplid TO vendor_id
```

The following statement alters the name of the user-defined function calbrned to caloriesburned in database foodforlife.

```
ALTER FUNCTION RENAME foodforlife.calbrned TO caloriesburned
```

The following statement alters the name of stored procedure checkstatus to isEligible in database international.

```
ALTER PROCEDURE RENAME international.checkstatus TO isEligible
```

The following statement alters the name of table payouts to accts_payable in the database to which your session is currently connected.

```
ALTER TABLE RENAME payouts TO accts_payable
```

The following statement alters the name of trigger testtrig3 to new_customer in table domestic and database electronics.

```
ALTER TRIGGER RENAME electronics.domestic.testtrig3 TO new_customer
```

The following statement alters the name of view suplrcds to vendor_codes in the database to which your session is currently connected.

```
ALTER VIEW RENAME suplrcds TO vendor_codes
```

See Also

CREATE FUNCTION

CREATE PROCEDURE

CREATE TABLE

CREATE TRIGGER

CREATE VIEW

psp_rename

ALTER GROUP

The ALTER GROUP statement adds or removes a user account from a group.

Syntax

```
ALTER GROUP group-name

    <ADD USER user-name [ , user-name ]...

    | DROP USER user-name [ , user-name ]...>
```

Remarks

Only the Master user can execute this statement.

This statement must be used with one of the two available keywords.

A user account cannot be added to a group if the group is not already created in the database. To create users and add them to groups simultaneously, see GRANT.

Dropping a user account from a group does not remove the group from the database.

User accounts cannot belong to multiple groups simultaneously. A user account cannot be added to a group if it is currently a member of another group. Such a user account must first be dropped from its current group and then added to another group.

A user name must be enclosed in double quotes if it contains spaces or other nonalphanumeric characters.

For further general information about users and groups, see Master User and Users and Groups in *Advanced Operations Guide*, and Assigning Permissions Tasks in *Zen User's Guide*.

Examples

The following examples show how to add a user account to a group:

```
ALTER GROUP developers ADD USER pgranger
```

The existing user account *pgranger* is added to the existing group *developers*.

============

```
ALTER GROUP developers ADD USER "polly granger"
```

The user account *polly granger* (containing nonalphanumeric characters) is added to the group *developers*.

============

```
ALTER GROUP developers ADD USER "polly granger", bflat
```

The user accounts *polly granger* (containing nonalphanumeric characters) and *bflat* are added to the group *developers*.

============

The following examples show how to drop a user account from a group.

```
ALTER GROUP developers DROP USER pgranger
```

The user account *pgranger* is removed from the group *developers*.

============

```
ALTER GROUP developers DROP USER "polly granger"
```

The user account *polly granger* (with a name containing nonalphanumeric characters) is removed from the group *developers*.

============

```
ALTER GROUP developers DROP USER "polly granger", bflat
```

The user accounts *polly granger* (containing nonalphanumeric characters) and *bflat* are removed from the group *developers*.

See Also

ALTER USER

CREATE GROUP

CREATE USER

DROP GROUP

GRANT

REVOKE

SET SECURITY

ALTER TABLE

The ALTER TABLE statement modifies a table definition. Note that using ALTER TABLE to modify a column does not add to its existing definition, but rather replaces that definition with a new one.

Syntax

```
ALTER TABLE table-name [ IN DICTIONARY ]
    [ USING 'path_name'] [ WITH REPLACE ] alter-options
```

```
table-name ::= user-defined name
```

```
option ::= DCOMPRESS | PCOMPRESS | PAGESIZE = size | LINKDUP = number | SYSDATA_KEY_2
```

```
path_name ::= a simple file name or relative path and file name
```

```
alter-options ::= alter-option-list1 | alter-option-list2
```

```
alter-option-list1 ::= alter-option |(alter-option [, alter-option ]...)
```

```
alter-option ::= ADD [ COLUMN ] column-definition
    | ADD table-constraint-definition
    | ALTER [ COLUMN ] column-definition
    | DROP [ COLUMN ] column-name
    | DROP CONSTRAINT constraint-name
    | DROP PRIMARY KEY
    | MODIFY [ COLUMN ] column-definition
```

```
alter-option-list2 ::= PSQL_MOVE [ COLUMN ] column-name TO [ [ PSQL_PHYSICAL ] PSQL_POSITION ] new-
column-position | RENAME COLUMN column-name TO new-column-name
```

```
column-definition ::= column-name data-type [ DEFAULT default-value-expression ] [ column-constraint
[ column-constraint ]... [CASE (string) | COLLATE collation-name ]
```

```
column-name ::= user-defined name
```

```
new-column-position ::= new ordinal position (a positive integer value). The value must be greater
than zero and less than or equal to the total number of columns in the table.
```

```
new-column-name ::= user-defined name
```

```
data-type ::= data-type-name [ (precision [ , scale ] ) ]
```

```
precision ::= integer
scale ::= integer
```

```
default-value-expression ::= default-value-expression + default-value-expression
    | default-value-expression - default-value-expression
    | default-value-expression * default-value-expression
    | default-value-expression / default-value-expression
    | default-value-expression & default-value-expression
    | default-value-expression | default-value-expression
    | default-value-expression ^ default-value-expression
    | ( default-value-expression )
    | -default-value-expression
    | +default-value-expression
    | ~default-value-expression
    | ?
    | literal
    | scalar-function
    | { fn scalar-function }
    | USER
    | NULL
```

```
default-literal ::= 'string' | N'string'
    | number
    | { d 'date-literal' }
    | { t 'time-literal' }
    | { ts 'timestamp-literal' }
```

```
default-scalar-function ::= USER()
    | NULL()
    | NOW()
    | CURDATE()
    | CURTIME()
    | CURRENT_DATE()
    | CURRENT_TIME()
    | CURRENT_TIMESTAMP()
    | CONVERT()
```

```
column-constraint ::= [ CONSTRAINT constraint-name ] col-constraint
```

```
constraint-name ::= user-defined-name
```

```
col-constraint ::= NOT NULL
    | NOT MODIFIABLE
    | UNIQUE
    | PRIMARY KEY
    | REFERENCES table-name [ ( column-name ) ] [ referential-actions ]
```

```
referential-actions ::= referential-update-action [ referential-delete-action ]
    | referential-delete-action [ referential-update-action ]
```

```
referential-update-action ::= ON UPDATE RESTRICT
```

```
referential-delete-action ::= ON DELETE CASCADE
    | ON DELETE RESTRICT
```

```
collation-name ::= 'string'
```

```
table-constraint-definition ::= [ CONSTRAINT constraint-name ] table-constraint
```

```
table-constraint ::= UNIQUE (column-name [ , column-name ]... )
    | PRIMARY KEY ( column-name [ , column-name ]... )
    | FOREIGN KEY ( column-name [ , column-name ] )
    REFERENCES table-name
    [ ( column-name [ , column-name ]... ) ]
    [ referential-actions ]
```

Remarks

See CREATE TABLE for information pertaining to primary and foreign keys and referential integrity.

Conversions between CHAR, VARCHAR, or LONGVARCHAR and NCHAR, NVARCHAR, or NLONGVARCHAR assume that CHAR values are encoded using the database code page. A column of type LONGVARCHAR cannot be altered to type NLONGVARCHAR nor NLONGVARCHAR to LONGVARCHAR.

ALTER TABLE requires an exclusive lock on a table. If the same table is being held open with another statement, ALTER TABLE fails and returns status code 88. Ensure that you execute all data definition statements before executing data manipulation statements. For an example showing this, see PSQL_MOVE.

An ALTER TABLE statement with the SYSDATA_KEY_2 keyword automatically changes the file to version 13.0 if it is not already in that format. It then adds system data v2, which enables the sys$create and sys$update virtual columns for use in queries. For more information, see Accessing System Data v2.

Use of IN DICTIONARY with the SYSDATA_KEY_2 keyword causes the ALTER TABLE statement to ignore SYSDATA_KEY_2, and the sys$create and sys$update virtual columns are not available for the table.

IN DICTIONARY

The purpose of using this keyword is to notify the database engine that you wish to make modifications to the DDFs, while leaving the underlying physical data unchanged. IN DICTIONARY is a powerful feature for advanced users. It should only be used by system administrators, and only when absolutely necessary. Normally, Zen keeps DDFs and data files totally synchronized, but this feature allows users the flexibility to force table dictionary definitions to match an existing data file. This can be useful when you want to create a definition in the dictionary to match an existing data file, or when you want to use a USING clause to change the data file path name for a table.

You cannot use IN DICTIONARY on a bound database.

IN DICTIONARY is allowed on CREATE and DROP TABLE, in addition to ALTER TABLE. IN DICTIONARY affects dictionary entries only, no matter what CREATE/ALTER options are specified. Since Zen allows multiple options (any combination of ADD, DROP, ADD CONSTRAINT, and so on), IN DICTIONARY is honored under all circumstances to guarantee only the DDFs are affected by the schema changes.

The error "Table not found" results if you query a detached table or a table that does not exist. If you determine that a table exists but you receive the "Table not found" error, the error resulted because the data file could not be opened. This indicates a detached table. (Tables that exist in the DDFs only (the data file does not exist) are called detached entries. These tables are inaccessible via queries or other operations that attempt to open the physical underlying file.)

You can verify whether a table really exists by using the catalog functions (see System Catalog Functions) or by directly querying the Xf$Name column of X$File:

```
SELECT * FROM X$File WHERE Xf$Name = 'table_name'
```

The SELECT statement returns the Xf$Loc value, which is the name of the physical file for the table. Combine the name with a data path defined for the database to get the complete path to the file.

It is possible for a detached table to cause confusion, so the IN DICTIONARY feature must be used with extreme care. It is crucial that it should be used to force table definitions to match physical files, not to detach them. Consider the following examples, assuming that the file test123.btr does not exist. (USING is explained below, in the next subtopic.)

```
CREATE TABLE t1 USING 't1.btr' (c1 INT)
ALTER TABLE t1 IN DICTIONARY USING 'test123.btr'
```

Or, combining both statements:

```
CREATE TABLE t1 IN DICTIONARY USING 'test123.btr' (c1 INT)
```

If you then attempt to SELECT from t1, you receive an error that the table was not found. Confusion can arise, because you just created the table – how can it not be found? Likewise, if you attempt to DROP the table without specifying IN DICTIONARY, you receive the same error. These errors are generated because there is no data file associated with the table.

Whenever you create a relational index definition for an existing Btrieve data file (for example, by issuing an ALTER TABLE statement to add a column definition of type IDENTITY), Zen automatically checks the Btrieve indexes defined on the file to determine whether an existing Btrieve index offers the set of parameters requested by the relational index definition. If an existing Btrieve index matches the new definition being created, then an association is created between the relational index definition and the existing Btrieve index. If there is no match, then Zen creates a new index definition and, if IN DICTIONARY is not specified, a new index in the data file.

USING

The USING keyword allows you to associate a CREATE TABLE or ALTER TABLE action with a particular data file.

Because Zen requires a named database to connect, the path name provided must always be a simple file name or relative path and file name. Paths are always relative to the first data path specified for the named database to which you are connected.

The path and file name passed are partially validated when the statement is prepared.

The following rules must be followed when specifying the path name:

- The text must be enclosed in single quotation marks, as shown in the grammar definition.

- Text must be 1 to 64 characters in length for V1 metadata and 1 to 250 characters for V2 metadata, and is stored in Xf$Loc in X$File. The entry is stored exactly as typed (trailing spaces are truncated and ignored).
- The path must be a simple, relative path. Paths that reference a server or volume are not allowed.
- Relative paths are allowed to contain a period ('.' - current directory), double period ('..' - parent directory), slash '\', or any combination of the three. The path must contain a file name representing the SQL table name (`path_name` cannot end in a slash '\' or a directory name). When you create a file with CREATE or ALTER TABLE, all file names, including those specified with relative paths, are relative to the first Data Path as defined in the Named Database configuration. (If you use IN DICTIONARY, the file name does not have to relative to the first data location.)
- Root-based relative paths are allowed. For example, assuming that the first data path is D:\mydata\demodata, Zen interprets the path name in the following statement as D:\temp\test123.btr.

  CREATE TABLE t1 USING '\temp\test123.btr' (c1 int)
- Slash ('\') characters in relative paths may be specified either Linux style ('/') or in the customary backslash notation ('\'), depending on your preference. You may use a mixture of the two types, if desired. This is a convenience feature since you may know the directory structure scheme, but not necessarily know (or care) what type of server you are connected to. The path is stored in X$File exactly as typed. Zen engine converts the slash characters to the appropriate platform type when utilizing the path to open the file. Also, since data files share binary compatibility between all supported platforms, this means that as long as the directory structure is the same between platforms (and path-based file names are specified as relative paths), the database files and DDFs can be moved from one platform to another with no modifications. This makes for a much simpler cross-platform deployment with a standardized database schema.
- If specifying a relative path, the directory structure in the USING clause must first exist. Zen does not create directories to satisfy the path specified in the USING clause.

Include a USING clause to specify the physical location and name of an existing data file to associate with an existing table. A USING clause also allows you to create a new data file at a particular location using an existing dictionary definition. (The string supplied in the USING clause is stored in the Xf$Loc column of the dictionary file X$File.) The original data file must be available when you create the new file since some of the file information must be obtained from the original.

In the Demodata sample database, the Person table is associated with the file PERSON.MKD. If you create a new file named PERSON2.MKD, the statement in the following example changes the dictionary definition of the Person table so that the table is associated with the new file.

```
ALTER TABLE Person IN DICTIONARY USING 'person2.mkd'
```

You must use either a simple file name or a relative path in the USING clause. If you specify a relative path, Zen interprets it relative to the first data file path associated with the database name.

The USING clause can be specified in addition to any other standard ALTER TABLE option. This means columns can be manipulated in the same statement that specifies the USING path.

If you specify a data file name that differs from the data file name currently used to store the table data and you do not specify IN DICTIONARY, Zen creates the new file and copies all of the data from the existing file into the new file. For example, suppose person.mkd is the current data file that holds the data for table Person. You then alter table Person using data file person2.mkd, as shown in the statement above. The contents of person.mkd are copied into person2.mkd. Person2.mkd then becomes the data file associated with table Person and database operations affect person2.mkd. Person.mkd is not deleted, but it is not associated with the database any more.

The reason for copying the data is because Zen allows all other ALTER TABLE options at the same time as USING. The new data file created needs to be fully populated with data from the existing table. The file structure is not simply copied, but instead the entire contents are moved over, similar to a Btrieve BUTIL -CREATE and BUTIL -COPY. This can be helpful for rebuilding a SQL table, or compressing a file that once contained a large number of records but now contains only a few.

Note: ALTER TABLE USING copies the contents of the existing data file into the newly specified data file, leaving the old data file intact but unlinked.

WITH REPLACE

Whenever WITH REPLACE is specified with USING, Zen automatically overwrites any existing file name with the specified file name. The file is always overwritten as long as the operating system allows it.

WITH REPLACE affects only the data file and not the DDFs.

The following rules apply when using WITH REPLACE:

- WITH REPLACE can only be used with USING.
- When used with IN DICTIONARY, WITH REPLACE is ignored because IN DICTIONARY specifies that only the DDFs are affected.

Note: No data is lost or discarded if WITH REPLACE is used with ALTER TABLE. The newly created data file, even if overwriting an existing file, still contains all data from the previous file. You cannot lose data by issuing an ALTER TABLE command.

Include WITH REPLACE in a USING clause to instruct Zen to replace an existing file (the file must reside at the location you specified in the USING clause). If you include WITH REPLACE, Zen creates a new file and copies all the data from the existing file into it. If you do not include WITH REPLACE and a file exists at the specified location, Zen returns a status code and does not create the new file. The status code is error -4940.

MODIFY COLUMN and ALTER COLUMN

The ability to modify the nullability or data type of a column is subject to the following restrictions:

- The target column cannot have a PRIMARY/FOREIGN KEY constraint defined on it.
- If converting the old type to the new type causes an overflow (arithmetic or size), the ALTER TABLE operation is aborted.
- If a nullable column contains NULL values, the column cannot be changed to a nonnullable column.

If you must change the data type of a primary or foreign key column, you can do so by dropping the constraint, changing the data type of the column, and adding back the constraint. Keep in mind that you must ensure that all associated key columns remain synchronized. For example, if you have a primary key in table T1 that is referenced by foreign keys in tables T2 and T3, you must first drop the foreign keys. Then you can drop the primary key. Then you need to change all three columns to the same data type. Finally, you must add back the primary key and then the foreign keys.

The ANSI standard includes the ALTER keyword. Zen also supports use of the keyword MODIFY in the ALTER TABLE statement. The keyword COLUMN is optional. For example:

```
ALTER TABLE t1 MODIFY c1 INTEGER
ALTER TABLE t1 ALTER c1 INTEGER
ALTER TABLE t1 MODIFY COLUMN c1 INTEGER
ALTER TABLE t1 ALTER COLUMN c1 INTEGER
```

Zen allows altering a column to a smaller length if the actual data does not overflow the new, smaller length of the column. This behavior is similar to that of Microsoft SQL Server.

You can add, drop, or modify multiple columns on a single ALTER TABLE statement. Although it simplifies operations, this behavior is not considered ANSI-compliant. The following is a sample multicolumn ALTER statement.

```
ALTER TABLE t1 (ALTER c2 INT, ADD D1 CHAR(20), DROP C4, ALTER C5 LONGVARCHAR, ADD D2 LONGVARCHAR NOT
NULL)
```

You can convert legacy data types (Pervasive.SQL v7 or earlier) to data types natively supported by the current Zen release. If you wish to convert new data types backward to legacy data types, contact Zen Support.

To add a LONGVARCHAR/LONGVARBINARY column to a legacy table that contains a NOTE/LVAR column, the NOTE/LVAR column first has to be converted to a LONGVARCHAR or LONGVARBINARY column. After converting the NOTE/LVAR column to LONGVARCHAR/LONGVARBINARY, you can add more LONGVARCHAR/LONGVARBINARY columns to the table. Note that the legacy engine does not work with this new table because the legacy engine can work with only one variable length column per table.

PSQL_MOVE

The PSQL_MOVE syntax allows you to keep the columns of a table at desired ordinal positions. You may change the ordinal position of existing columns or for a new column after adding it. You can move a column logically and physically.

Type of Move	Result
Logical	Columns are rearranged when listed in a result set, but the physical order of the columns in the table does not change. For example, you can rearrange how the columns are listed in a result set with a query such as SELECT * FROM *table-name*. A logical move affects only queries that list the columns, such as SELECT * FROM from *table-name*.
Physical	A column is physically relocated from its current position to a new position in the file. A physical move affects the data file of the table. To move a column physically, you must specify the PSQL_PHYSICAL keyword. If the PSQL_PHYSICAL keyword is omitted, a logical move occurs by default. Note that only column offsets in the DDFs are changed if IN DICTIONARY is used in the ALTER TABLE statement. Columns in the data file are **not** physically moved because IN DICTIONARY overrides the MOVE . . . PSQL_PHYSICAL syntax for the data file.

Note: Once you move columns logically, that order becomes the default order for listing columns in result sets. For instance, if you move columns physically after moving them logically, the logical order is used for queries such as SELECT * FROM from *table-name*. Logical column changes are stored in X$Attrib.

The PSQL_MOVE keyword must specify a column location greater than zero but less than the total number of columns. For example, assume that table t1 has only two columns, col1 and col2. Both of the following statement return an error:

```
ALTER TABLE t1 PSQL_MOVE col1 to 0
ALTER TABLE t1 PSQL_MOVE col1 to 3
```

The first statement attempts to move the column to position zero. The second statements attempts to move the column to position three, which is a number greater than the total number of columns (two).

ALTER TABLE requires an exclusive lock on a table. If the same table is being help open by another statement, ALTER TABLE fails and returns status code 88. Ensure that you execute all data definition statements before executing data manipulation statements.

For example, the following stored procedure fails and returns status code 88 because the INSERT statement has table t1 open, which prevents the ALTER TABLE statement from obtaining an exclusive lock.

```
CREATE PROCEDURE proc1() AS
BEGIN
CREATE TABLE t1(c1 INT,c2 INT,c3 INT);
INSERT INTO t1 VALUES (123,345,678);
ALTER TABLE t1 PSQL_MOVE c3 to 1;
END;
```

A way to resolve this is to execute the statements pertaining first to the table creation and data insertion, then call the procedure:

```
CREATE TABLE t1(c1 INT,c2 INT,c3 INT);
INSERT INTO t1 VALUES (123,345,678);
CALL proc1;

CREATE PROCEDURE proc1() AS
BEGIN
ALTER TABLE t1 PSQL_MOVE c3 to 1;
END;
```

RENAME COLUMN

Rename column allows you to change the name of a column to a new name. You cannot rename a column to the name of an existing column in the same table.

Renaming a column can invalidate objects that reference the previous name. For example, a trigger might reference column c1 in table t1. Renaming c1 to c5 results in the trigger being unable to execute successfully.

You can also use the psp_rename system stored procedure to rename columns.

Note: The database engine does not check dependencies for renamed columns. If you rename a column, ensure that all objects with a dependency on the previous (changed from) name are revised appropriately.

ON DELETE CASCADE

See Delete Rule for CREATE TABLE.

Examples

This section provides a number of examples of ALTER TABLE.

The following statement adds the Emergency_Phone column to the Person table

```
ALTER TABLE person ADD Emergency_Phone NUMERIC(10,0)
```

The following statement adds two integer columns col1 and col2 to the Class table.

```
ALTER TABLE class(ADD col1 INT, ADD col2 INT)
```

============

To drop a column from a table definition, specify the name of the column in a DROP clause. The following statement drops the emergency phone column from the Person table.

```
ALTER TABLE person DROP Emergency_Phone
```

The following statement drops col1 and col2 from the Class table.

```
ALTER TABLE class(DROP col1, DROP col2)
```

The following statement drops the constraint c1 in the Faculty table.

```
ALTER TABLE Faculty(DROP CONSTRAINT c1)
```

============

This example adds an integer column col3 and drops column col2 to the Class table

```
ALTER TABLE class(ADD col3 INT, DROP col2 )
```

============

The following example creates a primary key named c1 on the ID field in the Faculty table. Note that you cannot create a primary key on a nullable column. Doing so returns an error.

```
ALTER TABLE Faculty(ADD CONSTRAINT c1 PRIMARY KEY(ID))
```

The following example creates a primary key using the default key name PK_ID on the Faculty table.

```
ALTER TABLE Faculty(ADD PRIMARY KEY(ID))
```

============

The following example adds the constraint UNIQUE to the columns col1 and col2. The combined value of col1 and col2 in any row is unique within the table. Neither column needs to be unique individually.

```
ALTER TABLE Class(ADD UNIQUE(col1,col2))
```

============

The following example drops the primary key in the Faculty table. Because a table can have only one primary key, you cannot add a primary key to a table that already has a primary key defined. To change the primary key of a table, delete the existing key then add the new primary key.

```
ALTER TABLE Faculty(ADD PRIMARY KEY)
```

Before you can drop a primary key from a parent table, you must drop any corresponding foreign keys from dependent tables.

============

The following example adds a new foreign key to the Class table. The Faculty_ID column is defined as a column that does not include NULL values. You cannot create a foreign key on a nullable column.

```
ALTER TABLE Class ADD CONSTRAINT Teacher FOREIGN KEY (Faculty_ID) REFERENCES Faculty (ID) ON DELETE
RESTRICT
```

In this example, the restrict rule for deletions prevents someone from removing a faculty member from the database without first either changing or deleting all of that member's classes. Also note that the column listed in the REFERENCES clause (ID) is optional. Columns listed in the REFERENCES clause can be included, if you choose, to improve clarity of the statement. The only columns that can be referenced in the REFERENCES clause are the primary keys of the referenced table.

The following statement shows how to drop the foreign key added in this example. Zen drops the foreign key from the dependent table and eliminates the referential constraints between the dependent table and the parent table.

```
ALTER TABLE Class DROP CONSTRAINT Teacher
```

============

The following example adds a foreign key to the Class table without using the CONSTRAINT clause. In this case, a foreign key constraint is generated internally to reference the primary key (ID) of Faculty. The column listed in the REFERENCES clause is optional. Columns listed in the REFERENCES clause can be included, if you choose, to improve clarity of the statement. The only column that can be used in the REFERENCES clause is the primary key of the referenced table.

```
ALTER TABLE Class ADD FOREIGN KEY (Faculty_ID) REFERENCES Faculty (ID) ON DELETE RESTRICT
```

This creates foreign key FK_Faculty_ID. To drop the foreign key, specify the CONSTRAINT keyword:

```
ALTER TABLE Class DROP CONSTRAINT FK_Faculty_ID
```

============

The following example shows adding and dropping of constraints and columns in a table. This statement drops column salary, adds a column col1 of type integer, and drops constraint c1 in the Faculty table.

```
ALTER TABLE Faculty(DROP salary, ADD col1 INT, DROP CONSTRAINT c1)
```

============

The following examples both illustrate altering the data type of multiple columns.

```
ALTER TABLE t1 (ALTER c2 INT, ADD D1 CHAR(20), DROP C4, ALTER C5 LONGVARCHAR, ADD D2 LONGVARCHAR NOT
NULL)
ALTER TABLE t2 (ALTER c1 CHAR(50), DROP CONSTRAINT MY_KEY, DROP PRIMARY KEY, ADD MYCOLUMN INT)
```

============

The following examples illustrate how the column default and alternate collating sequence can be set or dropped with the ALTER or MODIFY column options.

```
CREATE TABLE t1 (c1 INT DEFAULT 10, c2 CHAR(10))
ALTER TABLE t1 ALTER c1 INT DEFAULT 20
```

– resets column c1 default to 20

```
ALTER TABLE t1 ALTER c1 INT
```

– drops column c1 default

```
ALTER TABLE t1 ALTER c2 CHAR(10)
COLLATE 'file_path\upper.alt'
```

– sets alternate collating sequence on column c2

```
ALTER TABLE t1 ALTER c2 CHAR(10)
```

– drops alternate collating sequence on column c2

Upper.alt treats upper and lower case letters the same for sorting. For example, if a database has values abc, ABC, DEF, and Def, inserted in that ordered, the sorting with upper.alt returns as abc, ABC, DEF, and Def. (The values abc and ABC, and the values DEF and Def are considered duplicates and are returned in the order in which they were inserted.) Normal ASCII sorting sequences upper case letters before lower case, such that the sorting would return as ABC, DEF, Def, abc.

============

The following statement logically moves column Registrar_ID from its current position to the second position when the columns are listed in a results set.

```
ALTER TABLE Billing PSQL_MOVE Registrar_ID TO 2
```

The following statement moves columns Amount_Owed and Amount_Paid from their current positions to the second and third positions, respectively, when the columns are listed in a result set.

```
ALTER TABLE Billing ( PSQL_MOVE Amount_Owed TO 2, PSQL_MOVE Amount_Paid TO 3 )
```

============

The following statement physically moves column Registrar_ID from its current position to the second column in the data file. This causes the data file to be rebuilt to reflect the change.

```
ALTER TABLE Billing PSQL_MOVE Registrar_ID TO PSQL_PHYSICAL 2
```

The following statement physically moves columns Amount_Owed and Amount_Paid from their current positions to the second and third column positions, respectively, in the data file.

```
ALTER TABLE Billing ( PSQL_MOVE Amount_Owed TO PSQL_PHYSICAL 2, PSQL_MOVE Amount_Paid TO
PSQL_PHYSICAL 3 )
```

============

Assume that table t1 contains columns c1 and col2. The following statement renames column c1 to c2.

```
ALTER TABLE t1 RENAME COLUMN c1 TO c2
```

============

Assume that table t1 contains columns c1 and col2. The following statement returns an error (duplicate column name) because it attempts to rename a column (col2) to the name of an existing column (c1).

```
ALTER TABLE t1 (RENAME COLUMN c1 TO c2, RENAME COLUMN col2 TO c1)
```

Instead, you must issue two separate ALTER statements. The first renames c1 to c2. The second renames col2 to c1.

```
ALTER TABLE t1 (RENAME COLUMN c1 TO c2)
```

```
ALTER TABLE t1 (RENAME COLUMN col2 TO c1)
```

See Also

CREATE TABLE

DROP TABLE

CREATE INDEX

DEFAULT

SET DEFAULTCOLLATE

ALTER USER

The ALTER USER statement changes the name or password of a user account.

Syntax

```
ALTER USER user-name < RENAME TO new-user-name | WITH PASSWORD user-password >
```

Remarks

Only the Master user can rename a user. Other users can change their passwords with the WITH PASSWORD clause or by using SET PASSWORD. See SET PASSWORD.

Security must be turned on to perform this statement.

This statement must be used with either the RENAME TO option or the WITH PASSWORD keywords.

New-user-name must be unique in the database.

User-name and user-password must be enclosed in double quotes if they contain spaces or other nonalphanumeric characters. See Granting Privileges to Users and Groups for more information on created users.

Note: For information on password restrictions, see Identifier Restrictions, and the topic Database Security in *Advanced Operations Guide*. For further general information about users and groups, see Master User and Users and Groups in *Advanced Operations Guide* and Assigning Permissions Tasks in *Zen User's Guide*.

Examples

The following examples show how to rename a user account.

```
ALTER USER pgranger RENAME TO grangerp
```

The name of the account *pgranger* is changed to *pgranger*.

```
ALTER USER pgranger RENAME TO "polly granger"
```

The name of the account *pgranger* is changed to *polly granger* containing nonalphanumeric characters.

============

The following examples show how to change the password for a user account.

```
ALTER USER pgranger WITH PASSWORD Prvsve1
```

The password for user account *pgranger* is changed to *Prvsve1* (case-sensitive).

```
ALTER USER pgranger WITH PASSWORD "Nonalfa$"
```

The password for user account *pgranger* is changed to `Nonalfa$` (case-sensitive) containing nonalphanumeric characters.

See Also

ALTER (rename)

CREATE GROUP

CREATE USER

DROP USER

GRANT

SET PASSWORD

ANY

Remarks

The ANY keyword works similarly to the ALL keyword except that Zen includes the compared row in the result table if the condition is true for any row in the subquery result table.

Examples

The following statement compares the ID column from Person to the ID columns in the result table of the subquery. If the ID value from Person is equal to any of the ID values in the subquery result table, Zen includes the row from Person in the result table of the SELECT statement.

```
SELECT p.ID, p.Last_Name
FROM Person p
WHERE p.ID = ANY
(SELECT f.ID FROM Faculty f WHERE f.Dept_Name = 'Chemistry')
```

See Also

SELECT

AS

Remarks

Include an AS clause to assign a name to a select term or to a table name. You can use this name elsewhere in the statement to reference the select term. The name is often referred to as an alias.

When you use the AS clause on a nonaggregate column, you can reference the name in WHERE, ORDER BY, GROUP BY, and HAVING clauses. When you use the AS clause on an aggregate column, you can reference the name only in an ORDER BY clause.

The name you define must be unique in the SELECT list.

Column aliases are returned as column names. Computed columns, including group aggregates, with no column alias are assigned a system-generated name, such as EXPR-1, EXPR-2, and so on.

Examples

The AS clause in the following statement instructs Zen to assign the name Total to the select term SUM (Amount_Paid) and order the results by the total for each student:

```
SELECT Student_ID, SUM (Amount_Paid) AS Total
FROM Billing
GROUP BY Student_ID
ORDER BY Total
```

The keyword AS is optional when used for table aliases as in this next example. When you use the AS clause on a table name in a FROM clause, you can reference the name in a WHERE, ORDER BY, GROUP BY, and HAVING clause.

```
SELECT DISTINCT c.Name, p.First_Name, c.Faculty_Id
FROM Person AS p, class AS c
WHERE p.Id = c.Faculty_Id
ORDER BY c.Faculty_Id
```

You can rewrite this query without using the AS clause in the FROM clause as follows.

```
SELECT DISTINCT c.Name, p.First_Name, c.Faculty_Id
FROM Person p, class c
WHERE p.Id = c.Faculty_Id
ORDER BY c.Faculty_Id
```

Once you establish a table alias, do not intermix the table name and its alias in a WHERE clause. The following does not work:

```
SELECT DISTINCT c.Name, p.First_Name, c.Faculty_Id
FROM Person p, class c
WHERE Person.Id = c.Faculty_Id
ORDER BY c.Faculty_Id
```

See Also

SELECT

BEGIN [ATOMIC]

Remarks

The BEGIN and END keywords are used to define the body of a stored procedure, a user-defined function, or a trigger declaration. The keywords create a compound statement within that procedure, function, or trigger.

You can add the ATOMIC keyword to control transactional behavior of the block of statements as if they were a single transaction. ATOMIC specifies that all statements within the block must either succeed or be rolled back.

Example

In this example, a BEGIN and END block is set as ATOMIC. The records will be inserted only if both inserts execute without error. If either statement returns an error (status code 5 for the second insert in this case), then neither record is inserted.

```
CREATE PROCEDURE Add_Tuition();
BEGIN ATOMIC
INSERT INTO Tuition(ID, Degree, Residency, Cost_Per_Credit, Comments) VALUES (9, 'Test', 0, 100.0,
'Training');
INSERT INTO Tuition(ID, Degree, Residency, Cost_Per_Credit, Comments) VALUES (8, 'Test', 0, 100.0,
'Training');
END
```

See Also

END

CREATE PROCEDURE

CREATE TRIGGER

CALL

Remarks

Use the CALL statement to invoke a stored procedure. The stored procedure may be a user-defined one or a system stored procedure.

Examples

The following example calls a user-defined procedure without parameters:

```
CALL NoParms() or CALL NoParms
```

The following examples call a user-defined procedure with parameters:

```
CALL Parms(vParm1, vParm2)
CALL CheckMax(N.Class_ID)
```

============

The following statement lists the column information for all columns in the Dept table by calling a system stored procedure.

```
CALL psp_columns('Demodata','Dept')
```

See Also

CREATE PROCEDURE

CREATE TRIGGER

EXECUTE

System Stored Procedures

CASCADE

Remarks

If you specify CASCADE when creating a foreign key, Zen uses the DELETE CASCADE rule. When a user deletes a row in the parent table, Zen deletes the corresponding rows in the dependent table.

Use caution with delete cascade. Zen allows a circular delete cascade on a table that references itself. See examples in Delete Cascade in *Advanced Operations Guide*.

See Also

ALTER TABLE

CREATE TABLE

CASE (expression)

A CASE expression returns a value. CASE expression has two formats:

- Simple When/Then. This format compares a value expression to a set of value expressions to determine a result. The value expressions are evaluated in their order listed. If a value expression evaluates to TRUE, CASE returns the value expression for the THEN clause.
- Searched When/Then. This format evaluates a set of Boolean expressions to determine a result. The Boolean expressions are evaluated in their order listed. If a Boolean expression evaluates to TRUE, CASE returns the expression for the THEN clause.

Both formats support an optional ELSE argument. If no ELSE clause is used, then ELSE NULL is implied.

Syntax

Simple When/Then:

```
CASE case_value_expression

    WHEN when_expression THEN then_expression [...]

    [ ELSE else_expression ]

END
```

Searched When/Then:

```
CASE

    WHEN search_expression THEN then_expression [...]

    [ ELSE else_expression ]

END
```

Arguments

```
case_value_expression ::= the expression evaluated by the simple When/Then CASE format.

when_expression ::= The expression to which case_value_expression is compared. The data types of
case_value_expression and each when_expression must be the same or must be an implicit conversion.

then_expression ::= the expression returned when case_value_expression equals when_expression
evaluates to TRUE.

else_expression ::= the expression returned if no comparison operation evaluates to TRUE. If this
argument is omitted and no comparison operation evaluates to TRUE, CASE returns NULL.

search_expression ::= the Boolean expression evaluated by the searched CASE format. Search_expression
may be any valid Boolean expression.
```

Remarks

A CASE expression must be used within a SELECT statement. The SELECT statement may be within a stored procedure or within a view.

Examples

The following statement uses the simple When/Then format to report the prerequisites for the art courses listed in the Course table.

```
SELECT name 'Course ID', description 'Course Title',
CASE name
WHEN 'Art 101' THEN 'None'
WHEN 'Art 102' THEN 'Art 101 or instructor approval'
WHEN 'Art 203' THEN 'Art 102'
WHEN 'Art 204' THEN 'Art 203'
WHEN 'Art 305' THEN 'Art 101'
WHEN 'Art 406' THEN 'None'
WHEN 'Art 407' THEN 'Art 305'
END
AS 'Prerequisites' FROM Course WHERE Dept_Name = 'Art' ORDER BY name
```

The query returns the following:

Course ID	Course Title	Prerequisites
Art 101	Drawing I	None
Art 102	Drawing II	Art 101 or instructor approval
Art 203	Drawing III	Art 102
Art 204	Drawing IV	Art 203
Art 305	Sculpture	Art 101
Art 406	Modern Art	None
Art 407	Baroque Art	Art 305

============

The previous statement can be changed to include an ELSE clause:

```
SELECT name 'Course ID', description 'Course Title',
CASE name
WHEN 'Art 101' THEN 'None'
WHEN 'Art 102' THEN 'Art 101 or instructor approval'
WHEN 'Art 203' THEN 'Art 102'
WHEN 'Art 204' THEN 'Art 203'
WHEN 'Art 305' THEN 'Art 101'
ELSE 'Curriculum plan for Art History majors'
END
AS 'Prerequisites' FROM Course WHERE Dept_Name = 'Art' ORDER BY name
```

The query now returns the following:

Course ID	**Course Title**	**Prerequisites**
Art 101	Drawing I	None
Art 102	Drawing II	Art 101 or instructor approval
Art 203	Drawing III	Art 102
Art 204	Drawing IV	Art 203
Art 305	Sculpture	Art 101
Art 406	Modern Art	Curriculum plan for Art History majors
Art 407	Baroque Art	Curriculum plan for Art History majors

============

The following statement uses the searched When/Then format to report the funding program for which a person may be eligible.

```
SELECT last_name, first_name,
CASE
WHEN scholarship = 1 THEN 'Scholastic'
WHEN citizenship <> 'United States' THEN 'Foreign Study'
WHEN (date_of_birth >= '1960-01-01' AND date_of_birth <= '1970-01-01') THEN 'AJ-44 Funds'
ELSE 'NONE'
END
AS 'Funding Program' FROM Person ORDER BY last_name
```

Here is a partial listing of what the query returns:

Last_Name	First_Name	Funding Program
Abad	Alicia	NONE
Abaecherli	David	Foreign Study
Abebe	Marta	Foreign Study
Abel	James	AJ-44 Funds
Abgoon	Bahram	Foreign Study
Abken	Richard	NONE
Abu	Austin	Foreign Study
Abuali	Ibrahim	AJ-44 Funds
Acabbo	Joseph	NONE
Acar	Dennis	Foreign Study

============

The following example shows how a CASE expression may be used within a stored procedure.

```
CREATE PROCEDURE pcasetest() RETURNS (d1 CHAR(10), d2 CHAR(10));
BEGIN
SELECT c1, CASE WHEN c1 = 1 THEN c4
```

```
WHEN c1 = 2 THEN c5
ELSE
CASE WHEN c2 = 100.22 THEN c4
WHEN c2 = 101.22 THEN c5 END END
FROM tcasetest;
END

CALL pcasetest
```

============

The following example shows how a CASE expression may be used within a view.

```
CREATE VIEW vcasetest (vc1, vc2) AS
SELECT c1, CASE WHEN c1 = 1 THEN c4
WHEN c1 = 2 THEN c5
ELSE
CASE WHEN c2 = 100.22 THEN c4
WHEN c2 = 101.22 THEN c5 END END
FROM TCASEWHEN

SELECT * FROM vcasetest
```

See Also

COALESCE, SELECT

CASE (string)

Remarks

The CASE keyword causes Zen to ignore case when evaluating restriction clauses involving a string column. CASE can be specified as a column attribute in a CREATE TABLE or ALTER TABLE statement, or in an ORDER BY clause of a SELECT statement.

For example, suppose you have a column called Name that is defined with the CASE attribute. If you insert two rows with Name = 'Smith' and Name = 'SMITH', then a query with a restriction specifying Name = 'smith' correctly returns both rows.

Note: CASE (string) does **not** support multiple-byte character strings and NCHAR strings. The keyword assumes that the string data is single-byte ASCII. This means that the CASE attribute is not supported for NVARCHAR and NCHAR data type columns. The string functions do support multiple-byte character strings and NCHAR strings. See String Functions.

Examples

The following example shows how you add a column to the Student table with the CASE keyword.

```
ALTER TABLE Student ADD Name char(64) CASE
```

The following example shows how to use CASE in an ORDER BY clause of a SELECT statement.

```
SELECT Id, Last_Name+', '+First_Name AS Whole_Name, Phone FROM Person ORDER BY Whole_Name CASE
```

See Also

ALTER TABLE

CREATE TABLE

SELECT

CLOSE

Syntax

```
CLOSE cursor-name

cursor-name ::= user-defined-name
```

Remarks

The CLOSE statement closes an open SQL cursor.

The cursor that the cursor name specifies must be open.

This statement is allowed only inside of a stored procedure, user-defined functions, or a trigger. Cursors and variables are only allowed inside of stored procedures, user-defined functions, and triggers.

Examples

The following example closes the cursor BTUCursor.

```
CLOSE BTUCursor;
```

============

```
CREATE PROCEDURE MyProc(OUT :CourseName CHAR(7)) AS
BEGIN
DECLARE cursor1 CURSOR
FOR SELECT Degree, Residency, Cost_Per_Credit
FROM Tuition ORDER BY ID;
OPEN cursor1;
FETCH NEXT FROM cursor1 INTO :CourseName;
CLOSE cursor1;
END
```

See Also

OPEN

CREATE PROCEDURE

CREATE TRIGGER

COALESCE

The COALESCE scalar function takes two or more arguments and returns the first nonnull argument, starting from the left in the expression list.

Syntax

```
COALESCE ( expression, expression[,...])

expression ::= any valid expression
```

Returned Value Types

The COALESCE function returns the value of one of the expressions in the list. For a detailed list of returned data types, see COALESCE Supported Combination Types and Result Data Types.

Restrictions

The function takes a minimum of two arguments.

```
COALESCE(10, 20)
```

Invalid:

```
COALESCE()
```

Note: An invalid instance results in a parse-time error: "COALESCE must have at least 2 arguments."

The expression list must contain at least one nonnull argument.

```
COALESCE (NULL, NULL, 20)
```

Invalid:

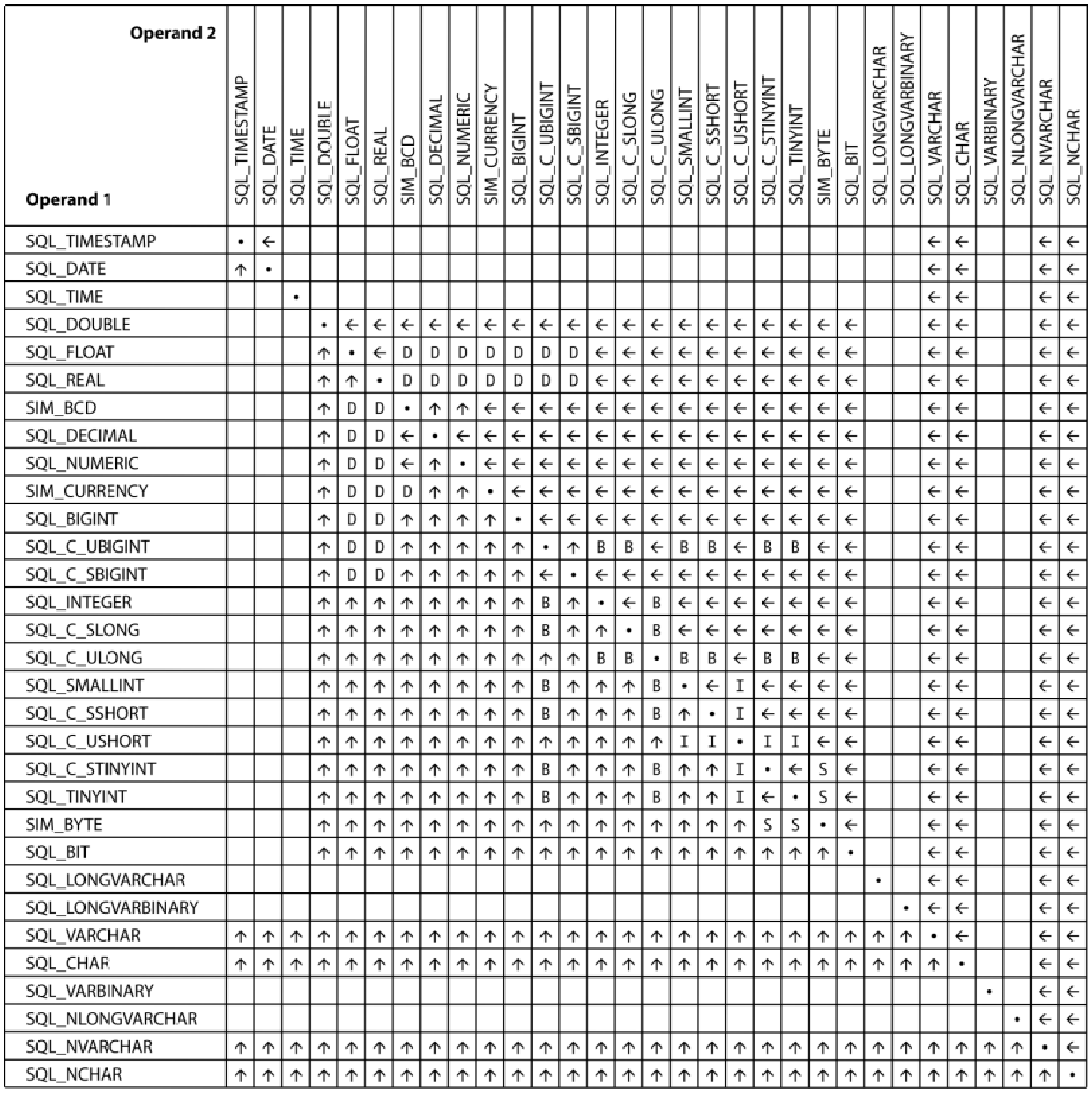
```
COALESCE (NULL, NULL, NULL)
```

Note: An invalid instance results in a parse-time error: "All arguments of COALESCE cannot be the NULL function."

The function does not support some data type combinations in the expression list. For example, COALESCE cannot have arguments that cannot be implicitly converted to each other, such as BINARY and VARCHAR.

COALESCE Supported Combination Types and Result Data Types

The following figure details the various supported combination types and also helps you identify the resultant data type for various combinations in a COALESCE function.



Operand 2 Operand 1	SQL_TIMESTAMP	SQL_DATE	SQL_TIME	SQL_DOUBLE	SQL_FLOAT	SQL_REAL	SIM_BCD	SQL_DECIMAL	SQL_NUMERIC	SIM_CURRENCY	SQL_BIGINT	SQL_C_UBIGINT	SQL_C_SBIGINT	SQL_INTEGER	SQL_C_SLONG	SQL_C_ULONG	SQL_SMALLINT	SQL_C_SSHORT	SQL_C_USHORT	SQL_C_STINYINT	SQL_TINYINT	SIM_BYTE	SQL_BIT	SQL_LONGVARCHAR	SQL_LONGVARBINARY	SQL_VARCHAR	SQL_CHAR	SQL_VARBINARY	SQL_NLONGVARCHAR	SQL_NVARCHAR	SQL_NCHAR
SQL_TIMESTAMP	•	←																								←	←			←	←
SQL_DATE	↑	•																								←	←			←	←
SQL_TIME			•																							←	←			←	←
SQL_DOUBLE				•	←	←	←	←	←	←	←	←	←	←	←	←	←	←	←	←	←	←	←			←	←			←	←
SQL_FLOAT				↑	•	←	D	D	D	D	D	D	D	←	←	←	←	←	←	←	←	←	←			←	←			←	←
SQL_REAL				↑	↑	•	D	D	D	D	D	D	D	←	←	←	←	←	←	←	←	←	←			←	←			←	←
SIM_BCD				↑	D	D	•	↑	↑	←	←	←	←	←	←	←	←	←	←	←	←	←	←			←	←			←	←
SQL_DECIMAL				↑	D	D	←	•	←	←	←	←	←	←	←	←	←	←	←	←	←	←	←			←	←			←	←
SQL_NUMERIC				↑	D	D	←	↑	•	←	←	←	←	←	←	←	←	←	←	←	←	←	←			←	←			←	←
SIM_CURRENCY				↑	D	D	D	↑	↑	•	←	←	←	←	←	←	←	←	←	←	←	←	←			←	←			←	←
SQL_BIGINT				↑	D	D	↑	↑	↑	↑	•	←	←	←	←	←	←	←	←	←	←	←	←			←	←			←	←
SQL_C_UBIGINT				↑	D	D	↑	↑	↑	↑	↑	•	↑	B	B	←	B	B	←	B	B	←	←			←	←			←	←
SQL_C_SBIGINT				↑	D	D	↑	↑	↑	↑	↑	←	•	←	←	←	←	←	←	←	←	←	←			←	←			←	←
SQL_INTEGER				↑	↑	↑	↑	↑	↑	↑	↑	B	↑	•	←	B	←	←	←	←	←	←	←			←	←			←	←
SQL_C_SLONG				↑	↑	↑	↑	↑	↑	↑	↑	B	↑	↑	•	B	←	←	←	←	←	←	←			←	←			←	←
SQL_C_ULONG				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	B	B	•	B	B	←	B	B	←	←			←	←			←	←
SQL_SMALLINT				↑	↑	↑	↑	↑	↑	↑	↑	B	↑	↑	↑	B	•	←	I	←	←	←	←			←	←			←	←
SQL_C_SSHORT				↑	↑	↑	↑	↑	↑	↑	↑	B	↑	↑	↑	B	↑	•	I	←	←	←	←			←	←			←	←
SQL_C_USHORT				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	I	I	•	I	I	←	←			←	←			←	←
SQL_C_STINYINT				↑	↑	↑	↑	↑	↑	↑	↑	B	↑	↑	↑	B	↑	↑	I	•	←	S	←			←	←			←	←
SQL_TINYINT				↑	↑	↑	↑	↑	↑	↑	↑	B	↑	↑	↑	B	↑	↑	I	←	•	S	←			←	←			←	←
SIM_BYTE				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	S	S	•	←			←	←			←	←
SQL_BIT				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	•			←	←			←	←
SQL_LONGVARCHAR																								•		←	←			←	←
SQL_LONGVARBINARY																									•	←	←			←	←
SQL_VARCHAR	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	•	←			←	←
SQL_CHAR	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	•			←	←
SQL_VARBINARY																												•		←	←
SQL_NLONGVARCHAR																													•	←	←
SQL_NVARCHAR	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	•	←
SQL_NCHAR	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	•

Chart Element	Description
↑	Types can be used directly in COALESCE function. The result type is that of operand 2.
←	Types can be used directly in COALESCE function. The result type is that of operand 1.

Chart Element	Description
blank cell	Types are not compatible. The operands cannot be used directly in COALESCE. An explicit CONVERT is required.
D	Result type is SQL_DOUBLE
B	Result type is SIM_BCD
I	Result type is SQL_INTEGER
S	Result type is SQL_SMALLINT

Using any of the unsupported type combinations (those left blank in the chart) in COALESCE function results in a parse-time error:

Error in row
Error in assignment
Expression evaluation error

Examples

In the following example, 10+2 is treated as a SMALLINT and ResultType (SMALLINT, SMALLINT) is SMALLINT. Hence, the result type is SMALLINT.

```
SELECT COALESCE(NULL,10 + 2,15,NULL)
```

The first parameter is NULL. The second expression evaluates to 12, which is not NULL and can be converted to result type SMALLINT. Therefore, the return value of this example is 12.

============

In the following example, ten is treated as a SMALLINT and ResultType (SMALLINT, VARCHAR) is SMALLINT. Hence, the result type is SMALLINT.

```
SELECT COALESCE(10, 'abc' + 'def')
```

The first parameter is 10, which can be converted to result type SMALLINT. Therefore, the return value of this example is 10.

COMMIT

The COMMIT statement signals the end of a logical transaction and converts temporary data into permanent data.

Syntax

```
COMMIT [ ]
```

Examples

The following example, within a stored procedure, begins a transaction which updates the Amount_Owed column in the Billing table. This work is committed. Another transaction updates the Amount_Paid column and sets it to zero. The final COMMIT WORK statement ends the second transaction.

```
START TRANSACTION;
UPDATE Billing B
SET Amount_Owed = Amount_Owed - Amount_Paid
WHERE Student_ID IN
(SELECT DISTINCT E.Student_ID
FROM Enrolls E, Billing B
WHERE E.Student_ID = B.Student_ID);
COMMIT WORK;
START TRANSACTION;
UPDATE Billing B
SET Amount_Paid = 0
WHERE Student_ID IN
(SELECT DISTINCT E.Student_ID
FROM Enrolls E, Billing B
WHERE E.Student_ID = B.Student_ID);
COMMIT WORK;
```

============

```
CREATE PROCEDURE UpdateBilling( ) AS
BEGIN
START TRANSACTION;
UPDATE Billing SET Amount_Owed = Amount_Owed + Amount_Owed;
UPDATE Billing set Amount_Owed = Amount_Owed + 100 WHERE Student_ID = 10;
COMMIT;
END;
```

See Also

CREATE PROCEDURE

ROLLBACK

START TRANSACTION

CREATE DATABASE

The CREATE DATABASE statement creates a new database. Any user logged in to a database can issue the statement. The user must also have permission from the operating system to create files in the specified location.

Syntax

```
CREATE DATABASE [ IF NOT EXISTS ] database-name DICTIONARY_PATH 'dict-path-name' [ DATA_PATH 'data-path-name' ] [ ; 'data-path-name' ]... ] [ NO_REFERENTIAL_INTEGRITY ] [ BOUND ] [ REUSE_DDF ] [ DBSEC_AUTHENTICATION ] [ DBSEC_AUTHORIZATION ] [ V1_METADATA | V2_METADATA ] [ ENCODING < 'codepage-name' | 'CPcodepage-number' | DEFAULT > ]

database-name ::= a user-defined name for the database

dict-path-name ::= a user-defined name for the location of the data dictionary files (DDFs)

data-path-name ::= a user-defined name for the location of the data files

codepage-name ::= the name of a valid code page

CPcodepage-number ::= a number of a valid code page preceded by "CP"
```

Remarks

If you are using ODBC, keep in mind that CREATE DATABASE creates only a database, not an associated data source name (DSN). You will need to create a DSN separately if you want one. See Setting Up ODBC Database Access in *Zen User's Guide*.

The CREATE DATABASE statement cannot be used to create the *first* database on a server. The reason is that a user must log on to a database before issuing the CREATE DATABASE statement. Therefore, at least one database must already exist.

The CREATE DATABASE statement cannot be used in a stored procedure or in a user-defined function.

Database Name and IF NOT EXISTS Clause

Database-name specifies a name for the new database. The database names must be unique within a server and conform to the rules for identifiers. See Identifier Restrictions in *Advanced Operations Guide*.

An error occurs if the database exists and you omit the IF NOT EXISTS clause (status code 2303). No error returns if you include the IF NOT EXISTS clause.

Dictionary Path

Dict-path-name specifies where the dictionary files (DDFs) reside on physical storage. The data files are also placed in this same location when you use the CREATE TABLE statement or create tables using Zen Control Center (ZenCC). See Dictionary Location in *Zen User's Guide*.

Data Path

Data-path-name specifies a possible location of the data files for the database (see note below). You can specify multiple path names by delimiting them with a semicolon.

Data-path-name can be any path that is valid from the database engine point of view, but not from the calling application perspective. The location specified must already exist. The CREATE DATABASE statement does not create directories.

Omit *data-path-name* if you want to use the same location for the data files as for the dictionary files. You may also specify the same location by passing an empty string for *data-path-name*. For example, specifying `DATA_PATH ''` indicates an empty string for the data path.

Note: If you create tables using the CREATE TABLE statement or with ZenCC, the **data files** are placed in the first *dict-path-name* specified. If no *dict-path-names* are specified, data files are created in the *dict-path-name* location.

Data-path-name is useful if you are creating tables through the Distributed Tuning Interface (DTI). The DTI function PvAddTable allows you to specify where you want the data files located. See PvAddTable() in *Distributed Tuning Interface Guide*.

Referential Integrity

By default, the database engine enforces referential integrity. If you specify the NO_REFERENTIAL_INTEGRITY clause, then any triggers and referential integrity defined in the database are not enforced.

See Setting Up Referential Integrity and Interactions Between Btrieve and Relational Constraints.

BOUND

If BOUND is specified, the DDFs are bound to the database. A bound database associates a database name with a single set of DDFs, which refer to only one set of data files. The DDFs are bound whether they already existed or are created through the execution of the CREATE DATABASE statement.

If DDFs are bound, you cannot use those DDFs for more than one database, nor can you refer to the data files by more than one set of DDFs.

If BOUND is not specified then the DDFs are not bound to a database.

See Bound Database versus Integrity Enforced in *Advanced Operations Guide*.

Dictionary Files

The REUSE_DDF keyword associates any existing DDFs with the database. The existing DDFs must in the *dict-path-name* location.

If REUSE_DDF is omitted, new DDFs are created *unless* DDFs already exists in the *dict-path-name* location. If DDFs exists in the *dict-path-name* location, they are associated with the database instead of new DDFs being created.

Security

The database engine supports three security models for the MicroKernel Engine:

- Classic. A user who successfully logs into the computer has access to the database contents at whatever level of file system rights the user has been assigned to the data file. File system rights are assigned through the operating system.
- Database. Database user accounts are unrelated to operating system user accounts. User access rights to the data are governed by user permissions set up in the database.
- Mixed. This policy has aspects of both of the other policies. Users log in using their operating system user names and passwords, but user access rights to the data are governed by user permissions set up in the database.

See Zen Security in *Advanced Operations Guide* for a complete discussion of security.

The DBSEC_AUTHENTICATION and DBSEC_AUTHORIZATION keywords set the security policy for the database:

Keyword Included or Omitted in Statement		**Security Model**		
DBSEC_AUTHENTICATION	**DBSEC_AUTHORIZATION**	**Classic**	**Database**	**Mixed**
omitted	omitted	**X**		
included	included		**X**	
omitted	included			**X**

Metadata Version

The Relational Engine supports two versions of metadata, referred to as version 1 (V1) and version 2 (V2). Metadata version applies to all data dictionary files (DDFs) within that database. V1 metadata is the default.

Among other features, V2 metadata allows for many identifier names to be up to 128 bytes long and for permissions on views and stored procedures. See Zen Metadata for a complete discussion.

You may include or omit the V1_METADATA keyword to specify V1 metadata. You must include the V2_METADATA keyword to specify V2 metadata.

Encoding

An encoding is a standard for representing character sets. Character data must be put in a standard format, that is, encoded, so that a computer can process it digitally. An encoding must be established between the Zen server engine and a Zen client application. A compatible encoding allows the server and client to interpret data correctly.

Encoding support is divided into database code page and client encoding. The two types of encoding are separate but interrelated. For more information, see Database Code Page and Client Encoding in *Advanced Operations Guide*.

Database code page and client encoding apply only to the Relational Engine. The MicroKernel Engine is not affected.

You specify a code page by using a name or by using the letters CP followed by a code page number. Both must be quoted with single quotation marks. For example, a valid name is UTF-8 and a valid number is CP1251.

Windows, Linux, and macOS operating systems have a default encoding referred to as the OS encoding. The default OS encoding differs among the operating systems. The keyword DEFAULT allows you to specify the OS encoding on the server.

If the ENCODING keyword is omitted, the database defaults to the server OS encoding.

An invalid code page number or name returns the error "Invalid code page."

Note that, for SQL statement that involve the use of more than one database, you need to ensure that the database code page is the same for all of the databases. Otherwise, string data can be returned incorrectly.

Note: The database engine does **not** validate the encoding of the data and metadata that an application inserts into a database. The engine assumes that all data was entered using the encoding of the server or the client, as explained in Database Code Page and Client Encoding in *Advanced Operations Guide*.

For SQL statements that involve the use of more than one database (such as a multidatabase join), ensure that the database code page is the same for all of the databases. Otherwise, string data can be returned incorrectly.

Valid Code Page Names and Numbers

You can view the list of supported code page names and numbers with ZenCC. Start ZenCC and access the New Database dialog (see To create a new database in *Zen User's Guide*). For the Database Code Page option, click **Change code page**. In the dialog that opens, click **Database code page** to see a list of available code pages.

On Linux and macOS, see the dbmaint utility man page to display a list of supported code page names and numbers. See the Examples topic for dbmaint in *Zen User's Guide*.

Examples

This section provides examples of CREATE DATABASE.

The following example creates a database named inventorydb and specifies its location for DDFs on drive D: in the folder mydbfiles\ddf_location. New DDFs are created because none exist in D:\mydbfiles\ddf_location. The data files are placed in the same location as the DDFs. The database uses V1 metadata.

```
CREATE DATABASE inventorydb DICTIONARY_PATH 'D:\mydbfiles\ddf_location'
```

============

The following example creates a database named HRUSBenefits if it does not already exist, and specifies its location for DDFs on drive C: in the folder HRDatabases\US. Possible locations for the data files include the C: drive in a directory called HRDatabases\US\DataFiles and the E: drive in a directory called Backups\HRUSData (see note under Data Path). Existing DDFs are used if they exist in the DICTIONARY_PATH. The database uses V1 metadata.

```
CREATE DATABASE IF NOT EXISTS HRUSBenefits DICTIONARY_PATH 'C:\HRDatabases\US' DATA_PATH
'C:\HRDatabases\US\DataFiles ; E:\Backups\HRUSData' REUSE_DDF
```

============

The following example creates a database named EastEurope, specifies its location for DDFs on drive C: in the folder Europe\DbaseFiles, creates new DDFs and binds them to the database, sets the security policy to mixed, and uses V2 metadata.

```
CREATE DATABASE EastEurope DICTIONARY_PATH 'C:\Europe\DbaseFiles' BOUND DBSEC_AUTHORIZATION
V2_METADATA
```

============

The following example creates a database named Region5Acct, specifies its location for DDFs on drive D: in the folder Canada\Region5\Accounting, and sets the database code page to the default code page used on the server.

```
CREATE DATABASE Region5Acct DICTIONARY_PATH 'D:\Canada\Region5\Accounting' ENCODING DEFAULT
```

============

The following example creates a database named Region2Inventory, specifies its location for DDFs on drive G: in the folder Japan\Region2, and sets the database code page to 932.

```
CREATE DATABASE Region2Inventory DICTIONARY_PATH 'G:\Japan\Region2' ENCODING 'CP932'
```

============

The following example creates a database named VendorCodes, specifies its location for DDFs on drive C: in the folder Capitol_Equipment\Milling, creates new DDFs and binds them to the database, sets the security policy to mixed, uses V2 metadata, and sets the database code page to 1252.

```
CREATE DATABASE VendorCodes DICTIONARY_PATH 'C:\Capitol_Equipment\Milling' BOUND DBSEC_AUTHORIZATION
V2_METADATA ENCODING 'CP1252'
```

See Also

DROP DATABASE

CREATE FUNCTION

The CREATE FUNCTION statement creates a scalar user-defined function (UDF) in the database. You can then invoke the user-defined function from a query.

Syntax

```
CREATE FUNCTION function-name ( [ [ IN ]

{ :parameter_name scalar_parameter_data_type [ DEFAULT value | = value ] } [...] ] )

RETURNS scalar_return_data_type

[AS]

BEGIN

    body_of_function

    RETURN scalar_expression

END;
```

```
function_name ::= name of the scalar UDF. UDF names must conform to the rules for identifiers and
must be unique within the database.

parameter_name ::= parameter in the scalar UDF. A maximum of 300 parameters are allowed. If no
default is specified, then a value must be supplied when the function is invoked.

scalar_parameter_data_type ::= data type for the specified parameter.

scalar_return_data_type ::= data type of the scalar return value of the UDF. Only scalar types are
supported.

value ::= default value to assign to parameter_name, using either the DEFAULT keyword or an equal
sign

body_of_function ::= statements that compose the scalar function.

scalar_expression ::= scalar return value of the UDF.
```

Remarks

Each UDF name (*database-name.function-name*) must be unique within a database. The UDF name cannot be the same as any of the following in the same database:

- Built-in function names
- Other UDF names
- Stored procedure names

Restrictions

You cannot use the CREATE DATABASE or the DROP DATABASE statement in a user-defined function. The table actions CREATE, ALTER, UPDATE, DELETE, and INSERT are not permitted within a user-defined function.

Only scalar input parameters are supported. No OUTPUT and INOUT parameters are allowed. By default, all parameters are input. You need not specify the IN keyword.

Limits

Observe the following limitations when you create user-defined functions.

Attribute	Limit
Number of parameters	300
Size of the UDF body	64 KB
Maximum length of UDF name	See Identifier Restrictions, in *Advanced Operations Guide*
Maximum length of UDF variable name	128 characters

Supported Scalar Input Parameters and Returned Data Types

Zen supports the data types shown in the following table for input scalar parameters and returned values. You can specify any data type except TEXT, NTEXT, IMAGE, or CURSOR.

AUTOTIMESTAMP	BIGDENTITY	BIGINT
BINARY	BIT	BLOB
CHAR	CHARACTER	CLOB
CURRENCY	DATE	DATETIME
DEC	DECIMAL	DOUBLE
FLOAT	IDENTITY	INT
INTEGER	LONG	LONGVARBINARY
LONGVARCHAR	NCHAR	NLONGVARCHAR
NUMERIC	NVARCHAR	REAL
SMALLIDENTITY	SMALLINT	TIME

TIMESTAMP	TIMESTAMP2	TINYINT
UBIGINT	UINT	UINTEGER
UNIQUEIDENTIFIER	USMALLINT	UTINYINT
VARBINARY	VARCHAR	

Examples

This topic provides a number of examples of CREATE FUNCTION.

The following example creates a function that calculates the area of a rectangular box whose details are stored in the **Box** table:

```
CREATE FUNCTION CalculateBoxArea(:boxName CHAR(20))

RETURNS REAL

AS

BEGIN

    DECLARE :len REAL;

    DECLARE :breadth REAL;

    SELECT len, breadth INTO :len, :breadth FROM box
    WHERE name = :boxName;

    RETURN(:len * :breadth);

END;
```

============

The following example creates a function that compares two integers and returns the smaller of the two:

```
CREATE FUNCTION GetSmallest(:A INTEGER, :B INTEGER)

RETURNS INTEGER

AS

BEGIN

    DECLARE :smallest INTEGER

    IF (:A < :B ) THEN

        SET :smallest = :A;

    ELSE

        SET :smallest = :B;

    END IF;
    RETURN :smallest;
END;
```

============

The following example creates a function that calculates simple interest using the formula SI = PTR/100, where P is the Principle, T is the period, and R is the rate of interest.

```
CREATE FUNCTION CalculateInterest(IN :principle FLOAT, IN :period REAL, IN :rate DOUBLE)
RETURNS DOUBLE
AS
BEGIN
    DECLARE :interest DOUBLE;
    SET :interest = ((:principle * :period * :rate) / 100);
    RETURN (:interest);
END;
```

Invoking a Scalar User-Defined Function

You can invoke a user-defined function wherever scalar expressions are supported by specifying the function name followed by a comma-separated list of arguments. The list of arguments is enclosed in parentheses.

A UDF can be invoked with or without a database qualifier prefix. When a database qualifier is not prefixed, the UDF is executed from the current database context. If a database qualifier is prefixed, the UDF is executed in the context of the specified database. In the examples below, some use a database qualifier prefix and some do not.

Limits

Parameter names cannot be specified in the arguments when invoking a function.

When you invoke a function, the argument values for all parameters must be in the same sequence in which they are defined in the CREATE FUNCTION statement.

Examples of User-Defined Functions

UDF in procedure

```
CREATE PROCEDURE procTestUdfInvoke() AS
BEGIN
```

```
    DECLARE :a INTEGER;

    SET :a = 99 + (222 + Demodata.GetSmallest(10, 9)) + 10;

    PRINT :a;

END;

CALL procTestUdfInvoke()
```

=============

The following example is similar to the previous one, except that the database qualifier is omitted.

```
CREATE PROCEDURE procTestUdfInvoke2() AS

BEGIN

    DECLARE :a INTEGER;

    SET :a = 99 + (222 + GetSmallest(10, 9)) +10;

    PRINT :a;

END;

CALL procTestUdfInvoke2
```

=============

UDF in SELECT list

```
SELECT GetSmallest(100,99)
```

=============

UDF in WHERE clause

```
SELECT name FROM class WHERE id <= GetSmallest(10,20)
```

=============

UDF within UDF

```
CREATE FUNCTION funcTestUdfInvoke() RETURNS INTEGER AS

BEGIN

    DECLARE :a INTEGER;

    SET :a = 99 + (222 - Demodata.GetSmallest(10, 9));

    RETURN :a;

END;
```

=============

UDF in INSERT statement

```
CREATE TABLE t1(col1 INTEGER, col2 INTEGER, col3 FLOAT)
INSERT INTO t1 VALUES (GetSmallest(10,20), 20 , 2.0)
INSERT INTO t1 (SELECT * FROM t1 WHERE col1 = getSmallest(10,20))
```

============

UDF in UPDATE statement

```
UPDATE t1 SET col2 = Demodata.GetSmallest(2,10) WHERE col1 = 2
```

```
UPDATE t1 SET col1 = 3 WHERE col2 = Demodata.GetSmallest(10, 5)
```

============

UDF in GROUP BY statement

```
SELECT col2 FROM t1 GROUP BY getSmallest(10,2), col2
```

============

UDF in ORDER BY statement

```
SELECT col2 FROM t1 ORDER BY Demodata.getSmallest(10,2), col2
```

============

Recursive UDF

```
CREATE FUNCTION factorial(IN :n INTEGER) RETURNS double AS BEGIN
    DECLARE :fact DOUBLE;
    IF (:n <= 0) THEN
        SET :fact = 1;
    ELSE
        SET :fact = (:n * Demodata.factorial(:n - 1));
    END IF;
    RETURN :fact;
END;
```

SELECT Demodata.factorial(20) can be used to get the factorial value of 20.

============

UDF with default value

```
CREATE FUNCTION testUdfDefault1(:z INTEGER DEFAULT 10) RETURNS INTEGER AS
BEGIN
    RETURN :z-1;
END;
```

SELECT Demodata.testUdfDefault1(). This function uses the default value specified (10) if a parameter is not provided.

```
CREATE FUNCTION testUdfDefault2(:a VARCHAR(20) = 'Accounting Report' ) RETURNS VARCHAR(20) as

BEGIN

   RETURN :a;

END;
```

SELECT Demodata.testUdfDefault2(). This function takes the default value specified (Accounting Report) if a parameter is not provided

=============

UDF with dynamic parameters

```
SELECT name FROM class WHERE id <= GetSmallest(?,?)
```

=============

UDF as an expression

```
SELECT 10 + Demodata.Getsmallest(10,20) + 15
```

=============

UDF used as parameters

```
SELECT demodata.calculateinterest (10+demodata.getsmallest(3000, 2000), demodata.factorial(2),
demodata.testUdfDefault(3))
```

See Also

DECLARE

DROP FUNCTION

CREATE GROUP

The CREATE GROUP statement creates one or more security groups.

Syntax

```
CREATE GROUP group-name [ , group-name ]...

group-name ::= user-defined-name
```

Remarks

Only the Master user can perform this statement.

Security must be turned on to perform this statement.

Examples

The following example creates a group named zengroup.

```
CREATE GROUP zengroup
```

The next example uses a list to create several groups at once.

```
CREATE GROUP zen_dev, zen_marketing
```

See Also

ALTER USER

CREATE USER

DROP GROUP

GRANT

SET SECURITY

REVOKE

CREATE INDEX

Use the CREATE INDEX statement to create a named index for a specified table.

Syntax

```
CREATE [ UNIQUE | PARTIAL ] [ NOT MODIFIABLE ] INDEX index-name [ USING index-number ][ IN DICTIONARY
] ON table-name [ index-definition ]

index-name ::= user-defined-name

index-number ::= user-defined-value (an integer between 0 and 118)

table-name ::= user-defined-name

index-definition ::= ( index-segment-definition [ , index-segment-definition ]... )

index-segment-definition ::= column-name [ ASC | DESC ]
```

Remarks

VARCHAR columns differ from CHAR columns in that either the length byte (Btrieve lstring) or a zero terminating byte (Btrieve zstring) are reserved, increasing the effective storage by 1 byte. In other words, if you create a column that is CHAR (100), it occupies 100 bytes in the records. A VARCHAR (100) occupies 101 bytes. NVARCHAR columns differ from NCHAR columns in that a zero terminating character is reserved, increasing the effective storage by 2 bytes. In other words, if you create a column that is NCHAR(50), it occupies 100 bytes in the records. A NVARCHAR(50) column occupies 102 bytes.

When Zen creates an index, its process varies depending on whether the statement includes IN DICTIONARY, USING, or both. The following table summarizes the results.

Operation	Process and Results	Additional Information
`CREATE INDEX`	When successful, an index is added to both the data file and X$Index. • If the data file has *no* defined indexes, the index created is index 0. • If the data file has *one or more* defined indexes, the index created is the smallest unused index number. In both cases, a new index with the same number is inserted into X$Index also.	See X$Index for V1 metadata or X$Index for V2 metadata.

Operation	Process and Results	Additional Information
`CREATE INDEX` `IN DICTIONARY`	When successful, an index is added to X$Index only. Nothing is inserted into the data file. The data file is examined to determine what index numbers are available. • If the data file has *no* defined indexes, the index inserted into X$Index is numbered 0. • If the data file has *one or more defined indexes*, the database engine checks to see if there is one that is not already defined in X$Index with column and index attributes that match the index to be added. If a match is found, this index number is used when the index is added to X$Index. If no match is found, the index number used is <*the largest data file index-number*> + 1. An index in X$Index without a matching key in the data file is referred to as a *phantom index* and is not used by the database engine.	See IN DICTIONARY
`CREATE INDEX USING` *`index-number`*	When successful, an index with the specified *index-number* is added to both the data file and X$Index. If the index-number is already in use in either the data file or X$Index, an error is returned.	See USING
`CREATE INDEX USING` *`index-number`* `IN DICTIONARY`	When successful, an index with the specified *index-number* is added to X$Index only. Nothing is inserted into the data file. If the specified *index-number* exists in the data file and not in X$Index, and the column and index attributes match the index to be added, the index with the specified *index-number* is added to X$Index. Otherwise, an error is returned.	See IN DICTIONARY

Index Segments

An index segment corresponds to a column specified in the index definition. A multiple segmented index is one that was created as a combination of multiple columns.

The total number of segments that you may use in all indexes defined on a given file depends on the file page size.

Page Size (bytes)	Maximum Key Segments by File Version			
	8.x and earlier	9.0	9.5	13.0
512	8	8	Rounded up[2]	Rounded up[2]
1,024	23	23	97	Rounded up[2]
1,536	24	24	Rounded up[2]	Rounded up[2]
2,048	54	54	97	Rounded up[2]
2,560	54	54	Rounded up[2]	Rounded up[2]
3,072	54	54	Rounded up[2]	Rounded up[2]
3,584	54	54	Rounded up[2]	Rounded up[2]
4,096	119	119	204[3]	183[3]
8,192	N/A[1]	119	420[3]	378[3]
16,384	N/A[1]	N/A[1]	420[3]	378[3]

[1]"N/A" stands for "not applicable"

[2]"Rounded up" means that the page size is rounded up to the next size supported by the file version. For example, 512 is rounded up to 1024, 2560 is rounded up to 4096, and so forth.

[3]While a 9.5 format or later file can have more than 119 segments, the number of indexes is limited to 119.

Note that nullable columns must also be considered. For example, a data file with 4096 byte page size is limited to 119 index segments per file. Because each indexed nullable column with true null support requires an index consisting of 2 segments, you cannot have more than 59 indexed nullable columns in a table (or indexed nullable true null fields in a Btrieve file). This limit is smaller for smaller page sizes.

Files support true nulls if they are created as file version of 7.x or higher and have TRUENULLCREATE set to on. Files created using an earlier file format, with Pervasive.SQL 7, or with TRUENULLCREATE set to off do not have true null support and do not have this limitation.

UNIQUE

A UNIQUE index key guarantees that the combination of the columns defined in the index for a particular row are unique in the file. It does not guarantee or require that each individual column be unique, in the case of a multisegmented index.

Note: All data types can be indexed *except* for the following:
BIT
BLOB
CLOB
LONGVARBINARY
LONGVARCHAR
NLONGVARCHAR

See also status code 6008: Too Many Segments in *Status Codes and Messages*.

PARTIAL

Use the PARTIAL keyword with a CREATE INDEX statement to create an index on a column, or group of columns, totalling more than 255 bytes.

Partial indexes are created using a prefix of a wide column, or by combining multiple small columns, so that searches using a prefix of the wide column will execute faster. Therefore, queries using WHERE clause restrictions, for example 'WHERE column_name LIKE 'prefix%' would execute faster using the partial index as opposed to not using any index.

If you include the PARTIAL keyword with a CREATE INDEX statement, and the index column(s) width and overhead do not equal or exceed 255 bytes, the PARTIAL keyword is ignored and a normal index is created instead.

Note: Width refers to the actual size of the column, and overhead refers to NULL indicators, string lengths, and the like.

Limitations of PARTIAL

The following limitations apply when using PARTIAL:

- Partial indexes may only be added to columns with the data type of CHAR or VARCHAR.
- Partial index columns should always be the last segment in the index definition, or should be the only segment in the index definition.

  When the partial index column is the only segment in the index, the column size can be up to 8,000 bytes, but the user-data index segment will be of size 255 bytes.

- Partial indexes are not used by the engine while executing queries with strict equality or collation operations, such as ORDER BY, GROUP BY or JOINs involving the partial column.
- Partial indexes are used only while matching WHERE clause restrictions of the following form:

```
WHERE col  =  'literal'
WHERE col  LIKE 'literal%'
WHERE col  =  ?
WHERE col  LIKE ?
```

  where the literal or actual parameter value can be of any length. It could be shorter or wider than the number of bytes indexed in the partial index column. Partial indexes won't be used if a LIKE clause is not of the form 'prefix%'.

If the WHERE clauses match the constraints listed previously, partial indexes will be used while creating the execution plan.

Note: If a partially indexed column length is altered using ALTER TABLE such that the new length fits in 255 bytes of the index or when the new length overshoots 255 bytes, it is the responsibility of the user to drop the index and recreate it according to his/her requirements.

Examples

This section provides a number of examples of CREATE PARTIAL INDEX.

The following example creates a table named Part_tbl with columns PartID, PartName, SerialNo and Description, using the specified data types and sizes.

```
CREATE TABLE part_tbl (partid INT, partname CHAR(50), serialno VARCHAR(200), description CHAR(300));
```

Next, the example creates a partial index named idx_01 using the Description column.

```
CREATE PARTIAL INDEX idx_01 on part_tbl (description);
```

Although the Description column used in the index is 300 bytes, using the PARTIAL keyword enables the index to only use the first 255 bytes (including overhead) as the prefix.

============

The following example creates a partial index named idx_02 for the same table in the previous example. Instead, this example uses the PartId, SerialNo, and Description columns collectively for the index.

```
CREATE PARTIAL INDEX idx_02 on part_tbl (partid, serialno, description);
```

The following table details the index columns so that you may understand how the wide column is allocated in the index.

Column Name	Data Type	Size	Overhead	Size in Index
PartID	Integer	4		4
SerialNo	Varchar	200	1	201
Description	Char	300		50
Total Index Size				255

NOT MODIFIABLE

This attribute prevents the index from being changed. Note that, for a multisegmented index, this attribute applies to **all** segments. Status code 10: The key field is not modifiable results if you attempt to edit any of the segments.

The following example creates a nonmodifiable segmented index in the Person table.

```
CREATE NOT MODIFIABLE INDEX X_Person on Person(ID, Last_Name)
```

USING

Use this keyword to control the index number when you create an index. Controlling the index number is important in cases where the data is being accessed through the Relational Engine as well as directly from the data files through the MicroKernel Engine.

When you create an index, the specified index number is inserted into both the data file and the X$Index.

If the index number you specify is already in use in either file, an error code is returned: status code 5: The record has a key field containing a duplicate key value for the X$Index and status code 6: The key number parameter is invalid for the data file.

```
CREATE INDEX "citizen-x" USING 3 On Person (citizenship)
```

IN DICTIONARY

This keyword notifies the database engine that you wish to make modifications to the DDFs while leaving the underlying physical data unchanged. This feature allows you to correct any table dictionary definitions that are not synchronized with their corresponding data files or to create a definition in the dictionary to match an existing data file. This is most often needed when data files are created and used by a Btrieve (transactional) application (which does not use DDFs), but ad-hoc queries or reports need to access the data using the Relational Engine.

Normally, the database engine keeps DDFs and data files perfectly synchronized. When you create an index without the IN DICTIONARY statement, the database engine assigns identical index numbers to the X$Index and the *data* file. IN DICTIONARY enables you to add an index to the X$Index only.

Caution! IN DICTIONARY is a powerful and advanced feature. It should only be used by system administrators or when absolutely necessary. Modifying a DDF without performing parallel modifications to the underlying data file can cause serious problems, such as incorrect results sets, performance problems, or unexpected results.

If you have created a *phantom* index, one that exists only in the DDF and not in the data file, and you attempt to drop the index without using IN DICTIONARY, you can encounter status code 6: The key number parameter is invalid. This error occurs because the database engine attempts to delete the index from the data file and cannot do so because no such index exists in the data file.

If you use both IN DICTIONARY and USING in the SQL statement when you create an index, a new index using the number specified by the USING keyword is inserted into the DFF *only* if the segment at the specified index number matches the SQL column. If the number specified by the USING keyword either does not match the SQL column or does not exist in the data file, the SQL engine returns an error message of "Btrieve key definition does not match the index definition." This ensures that no phantom indexes are created.

Note: You cannot use the keyword IN DICTIONARY on a bound database.

Examples

This section provides a number of examples of IN DICTIONARY

The following example creates a detached table, one with no associated data file, then adds and drops an index from the table definition. This index is a detached index because there is no underlying Btrieve index associated with it.

```
CREATE TABLE t1 IN DICTIONARY (c1 int, c2 int)
CREATE INDEX idx_1 IN DICTIONARY on t1(c1)
DROP INDEX t1.idx_1 IN DICTIONARY
```

============

The following example uses a table T1 that already exists. The data file has key1 defined and it is not currently in X$Index.

```
CREATE INDEX idx_1 USING 1 IN DICTIONARY on T1 (C2)
```

See Also

DROP INDEX

CREATE PROCEDURE

The CREATE PROCEDURE statement creates a new stored procedure. Stored procedures are SQL statements that are predefined and saved in the database dictionary.

Syntax

```
CREATE PROCEDURE procedure-name
( [ parameter [, parameter ]... ] )

    [ RETURNS ( result [ , result ]... ) ] see Remarks

    [ WITH DEFAULT HANDLER | WITH EXECUTE AS 'MASTER' | WITH DEFAULT HANDLER , EXECUTE AS 'MASTER' |
    WITH EXECUTE AS 'MASTER', DEFAULT HANDLER]

    as-or-semicolon

    proc-stmt

procedure-name ::= user-defined-name

parameter ::= parameter-type-name data-type [ DEFAULT proc-expr | = proc-expr ] | SQLSTATE

    parameter-type-name ::= parameter-name

    | parameter-type parameter-name

    | parameter-name parameter-type

parameter-type ::= IN | OUT | INOUT | IN_OUT

parameter-name ::= :user-defined-name

proc-expr ::= same as normal expression but does not allow IF expression or ODBC-style scalar
functions

result ::= user-defined-name data-type

as-or-semicolon ::= AS | ;

proc-stmt ::= [ label-name : ] BEGIN [ATOMIC] [ proc-stmt [ ; proc-stmt ]... ] END [ label-name ]

    | CALL procedure-name ( proc-expr [ , proc-expr ]... )

    | CLOSE cursor-name

    | DECLARE cursor-name CURSOR FOR select-statement [ FOR UPDATE | FOR READ ONLY ]

    | DECLARE variable-name data-type [ DEFAULT proc-expr | = proc-expr ]

    | DELETE WHERE CURRENT OF cursor-name
    | delete-statement

    | FETCH [ fetch-orientation [ FROM ] ]cursor-name [ INTO variable-name [ , variable-name ] ]

    | IF proc-search-condition THEN proc-stmt [ ; proc-stmt ]... [ ELSE proc-stmt [ ; proc-stmt ]...
    ] END IF

    | IF proc-search-condition proc-stmt [ ELSE proc-stmt ]

    | insert-statement

    | LEAVE label-name

    | [ label-name : ] LOOP proc-stmt [ ; proc-stmt ]... END LOOP [ label-name ]

    | OPEN cursor-name

    | PRINT proc-expr [ , 'string' ] -- applies only to Windows platforms

    | RETURN [ proc-expr ]

    | transaction-statement

    | select-statement-with-into

    | select-statement

    | SET variable-name = proc-expr

    | SIGNAL [ ABORT ] sqlstate-value

    | START TRANSACTION

    | update-statement

    | UPDATE SET column-name = proc-expr [ , column-name = proc-expr ]... WHERE CURRENT OF cursor-
    name

    | [ label-name : ] WHILE proc-search-condition DO [ proc-stmt [ ; proc-stmt ] ]... END WHILE [
    label-name ]

    | [ label-name : ] WHILE proc-search-condition proc-stmt

    | alter-table-statement

    | create-index-statement

    | create-table-statement

    | create-view-statement

    | drop-index-statement

    | drop-table-statement

    | drop-view-statement

    | grant-statement

    | revoke-statement

    | set-statement

transaction-statement ::= commit-statement

    | rollback-statement
    | release-statement

    commit-statement ::= see COMMIT

    rollback-statement ::= see ROLLBACK

    release-statement ::= see RELEASE SAVEPOINT

    create-table-statement ::= see CREATE TABLE

    alter-table-statement ::= see ALTER TABLE

    drop-table-statement ::= see DROP TABLE

    create-index-statement ::= see CREATE INDEX

    drop-index-statement ::= see DROP INDEX

    create-view-statement ::= see CREATE VIEW

    drop-view-statement ::= see DROP VIEW

    grant-statement ::= see GRANT

    revoke-statement ::= see REVOKE

    set-statement ::= see SET DECIMALSEPARATORCOMMA

label-name ::= user-defined-name

cursor-name ::= user-defined-name

variable-name ::= user-defined-name

proc-search-condition ::= same as search-condition but does not allow expressions that include
subqueries

fetch-orientation ::= NEXT

sqlstate-value ::= 'string'
```

Remarks

To execute stored procedures, use the CALL or EXECUTE statement.

Note that, in a procedure, the name of a variable and the name of a parameter must begin with a colon (:), both in the definition and use of the variable or parameter.

The RETURNS clause is *required* if the stored procedure returns a result set or a scalar value.

The RETURNS clause, when present, causes the procedure to continue execution when an error occurs. The default behavior (without this clause) is to abort the procedure with SQLSTATE set to the error state generated by the statement.

The use of a *StmtLabel* at the beginning (and optionally at the end) of an IF statement is an extension to ANSI SQL 3.

The PRINT statement applies only to Windows-based platforms. It is ignored on other operating system platforms.

In SQL Editor, the only way to test a stored procedure by using variable parameters is to call the stored procedure from another stored procedure. This technique is shown in the example for pdate (CREATE PROCEDURE pdate();).

You may use variables as SELECT items only within stored procedures. This technique is shown in the example for varsub1 (CREATE PROCEDURE varsub1();).

You cannot use the CREATE DATABASE or the DROP DATABASE statement in a stored procedure.

Trusted and Non-Trusted Stored Procedures

A trusted stored procedure includes the WITH EXECUTE AS 'MASTER clause. See Trusted and Non-Trusted Objects.

Memory Caching

By default, the database engine creates a memory cache in which to store multiple stored procedures for the duration of the SQL session. Once a stored procedure is executed, its compiled version is then retained in the memory cache. Typically, caching results in improved performance for each subsequent call to a cached procedure. The cache provides no performance improvement the *first* time that a stored procedure is executed since the procedure has not yet been loaded into memory.

Two SET statements apply to the memory cache:

- SET CACHED_PROCEDURES – specifies the number of procedures to cache. The default is 50.
- SET PROCEDURES_CACHE – specifies the amount of memory for the cache. The default is 5 MB.

Note that excessive memory swapping, or thrashing, could occur depending on the cache settings and the SQL being executed by your application. Thrashing can cause a decrease in performance.

Caching Exclusions

A stored procedure is **not** cached, regardless of the cache settings, for any of the following:

- If it references a local or a global temporary table. A local temporary table has a name that begins with the pound sign (#). A global temporary table has a name that begins with two pound signs (##). See CREATE (temporary) TABLE.
- If it contains any data definition language (DDL) statements. See Data Definition Statements.
- If it contains an EXEC[UTE] statement used to execute a character string, or an expression that returns a character string. For example: `EXEC ('SELECT Student_ID FROM ' + :myinputvar)`.

Data Type Restrictions

The following data types cannot be passed as parameters or declared as variables in a stored procedure or trigger:

BFLOAT4	BFLOAT8
MONEY	NUMERICSA
NUMERICSLB	NUMERICSLS
NUMERICSTB	NUMERICSTS

See Examples for how Zen data types that do not have a direct ODBC equivalent can be correctly mapped to be used by a procedure.

Limits

The following limitations must be observed when creating stored procedures.

Attribute	Limit
Number of columns allowed in a trigger or stored procedure	300
Number of arguments in a parameter list for a stored procedure	300
Size of a stored procedure	64 KB

Examples

The following example creates stored procedure Enrollstudent, which inserts a record into the Enrolls table, given the Student ID and the Class ID.

```
CREATE PROCEDURE Enrollstudent(IN :Stud_id INTEGER, IN :Class_Id INTEGER, IN :GPA REAL);
BEGIN
```

```
   INSERT INTO Enrolls VALUES(:Stud_id, :Class_id, :GPA);
END;
```

Use the following statement to call the stored procedure.

```
CALL Enrollstudent(1023456781, 146, 3.2)
```

Use the following statement to retrieve the newly inserted record.

```
SELECT * FROM Enrolls WHERE Student_id = 1023456781
```

The CALL and SELECT statements, respectively, call the procedure by passing arguments, then display the row that was added.

============

This example shows how to assign a default value to a parameter.

```
CREATE PROCEDURE ReportTitle1 (:rpttitle1 VARCHAR(20) = 'Finance Department') RETURNS (Title
VARCHAR(20));
BEGIN
 SELECT :rpttitle1;
END;
CALL ReportTitle1;
CREATE PROCEDURE ReportTitle2 (:rpttitle2 VARCHAR(20) DEFAULT 'Finance Department', :rptdate DATE
DEFAULT CURDATE()) RETURNS (Title VARCHAR(20), Date DATE);
BEGIN
  SELECT :rpttitle2, :rptdate;
END;
CALL ReportTitle2( , );
```

These procedures use the default value specified (Finance Department) if a parameter is not provided with the CALL. Note that any parameter can be omitted, but the placeholder must be provided.

============

The following procedure reads the Class table, using the classId parameter passed in by the caller and validates that the course enrollment is not already at its limit.

```
CREATE PROCEDURE Checkmax(in :classid integer);
BEGIN
   DECLARE :numenrolled integer;
   DECLARE :maxenrolled integer;
   SELECT COUNT(*) INTO :numenrolled FROM Enrolls WHERE class_ID = :classid;
```

```
    SELECT Max_size INTO :maxenrolled FROM Class WHERE id = :classid;

    IF (:numenrolled >= :maxenrolled) THEN

        PRINT 'Enrollment Failed. Number of students enrolled reached maximum allowed for this class'
        ;

    ELSE

        PRINT 'Enrollment Possible. Number of students enrolled has not reached maximum allowed for
        this class';

    END IF;

END;

CALL Checkmax(101)
```

Note that COUNT(expression) counts all nonnull values for an expression across a predicate. COUNT(*) counts all values, including null values.

===============

The following is an example of using the OUT parameter when creating stored procedures. Calling this procedure returns the number of students into the variable :outval that satisfies the WHERE clause.

```
CREATE PROCEDURE ProcOUT (out :outval INTEGER)

AS BEGIN

    SELECT COUNT(*) INTO :outval FROM Enrolls WHERE Class_Id = 101;

END;
```

===============

The following is an example of using the INOUT parameter when creating stored procedures. Calling this procedure requires an INPUT parameter :IOVAL and returns the value of the output in the variable :IOVAL. The procedure sets the value of this variable based on the input and the IF condition.

```
CREATE PROCEDURE ProcIODATE (INOUT :IOVAL DATE)

AS BEGIN

    IF :IOVAL = '1982-03-03' THEN

        SET :IOVAL ='1982-05-05';

    ELSE

        SET :IOVAL = '1982-03-03';

    END IF;

END;
```

You cannot call the above procedure using a literal value (as in `call prociodate('1982-03-03')`), because it requires an output parameter. You must first bind the parameter using ODBC calls, or you can test the procedure by creating another procedure to call it, as shown here:

```
CREATE PROCEDURE pdate();

BEGIN

    DECLARE :a DATE;

    CALL prociodate(:a);

    PRINT :a;

END

CALL pdate
```

============

The following example illustrates using the RETURNS clause in a procedure. This sample returns all of the data from the Class table where the Start Date is equal to the date passed in on the CALL statement.

```
CREATE PROCEDURE DateReturnProc(IN :PDATE DATE)
RETURNS(
DateProc_ID INTEGER,
DateProc_Name CHAR(7),
DateProc_Section CHAR(3),
DateProc_Max_Size USMALLINT,
DateProc_Start_Date DATE,
DateProc_Start_Time TIME,
DateProc_Finish_Time TIME,
DateProc_Building_Name CHAR(25),
DateProc_Room_Number UINTEGER,
DateProc_Faculty_ID UBIGINT
);
BEGIN

    SELECT ID, Name, Section, Max_Size, Start_Date, Start_Time, Finish_Time, Building_Name,
    Room_Number, Faculty_ID FROM Class WHERE Start_Date = :PDATE;

END;

CALL DateReturnProc('1995-06-05')
```

Note that the user-defined names in the RETURNS clause do not have to be named identically to the column names that appear in the selection list, as this example shows.

============

The following example shows the use of the WHERE CURRENT OF clause, which applies to positioned deletes.

```
CREATE PROCEDURE MyProc(IN :CourseName CHAR(7)) AS

BEGIN
```

```
    DECLARE c1 CURSOR FOR SELECT name FROM course WHERE name = :CourseName FOR UPDATE;

    OPEN c1;

    FETCH NEXT FROM c1 INTO :CourseName;

    DELETE WHERE CURRENT OF c1;

    CLOSE c1;

END;

CALL MyProc('HIS 305')
```

(Note that if you use a SELECT inside of a WHERE clause of a DELETE, it is a searched DELETE not a positioned DELETE.)

============

The following example shows the use of a variable (:i) as a SELECT item. The example assumes that table1 does not already exist. All records in the person table with an ID greater than 950000000 are selected, then inserted into col2 of table1. Col1 contains the value 0, 1, 2, 3, or 4 as defined by the WHILE loop.

```
CREATE TABLE table1 (col1 CHAR(10), col2 BIGINT);


CREATE PROCEDURE varsub1();

BEGIN

    DECLARE :i INT;

    SET :i = 0;

    WHILE :i < 5 DO

        INSERT INTO table1 (col1, col2) SELECT :i , A.ID FROM PERSON A WHERE A.ID > 950000000;

    SET :i = :i + 1;

    END WHILE;

END

CALL varsub1

SELECT * FROM table1

-- returns 110 rows
```

============

The following is an example of the use of ATOMIC, which groups a set of statements so that either all succeed or all fail. ATOMIC can be used only within the body of a stored procedure, user-defined function, or trigger.

The first procedure does not specify ATOMIC, while the second does.

```
CREATE TABLE t1 (c1 INTEGER)
CREATE UNIQUE INDEX t1i1 ON t1 (c1)
CREATE PROCEDURE p1();
BEGIN
    INSERT INTO t1 VALUES (1);
    INSERT INTO t1 VALUES (1);
END;
CREATE PROCEDURE p2();
BEGIN ATOMIC
    INSERT INTO t1 VALUES (2);
    INSERT INTO t1 VALUES (2);
END;
CALL p1()
CALL p2()
SELECT * FROM t1
```

Both procedures return an error because they attempt to insert duplicate values into a unique index.

The result is that t1 contains only one record because the first INSERT statement in procedure p1 succeeds even though the second fails. Likewise, the first INSERT statement in procedure p2 succeeds but the second fails. However, since ATOMIC is used in procedure p2, all of the execution in procedure p2 is rolled back when the error is encountered.

============

This example uses a stored procedure to create two tables and insert one row of default values into each. It then turns on security and grants privileges to user1.

```
CREATE PROCEDURE p1();
BEGIN
    CREATE TABLE t1 (c1 INT DEFAULT 10, c2 INT DEFAULT 100);
    CREATE TABLE t2 (c1 INT DEFAULT 1 , c2 INT DEFAULT 2);
    INSERT INTO t1 DEFAULT VALUES;
    INSERT INTO t2 DEFAULT VALUES;
    SET SECURITY = larry;
    GRANT LOGIN TO user1 u1pword;
    GRANT ALL ON * TO user1;
```

```
END;

CALL p1

SELECT * FROM t1

    -- returns 10, 100

SELECT * FROM t2

    -- returns 1, 2
```

Note: When you use the GRANT LOGIN statement in a stored procedure, you must separate the user name and password with a space character rather than a colon character. The colon character is reserved to identify local variables in a stored procedure.

============

This example uses a stored procedure to revoke privileges from user1, drop the two tables created in Example A, and turn off database security.

```
CREATE PROCEDURE p3();

BEGIN

    REVOKE ALL ON t1 FROM user1;

    REVOKE ALL ON t2 FROM user1;

    DROP TABLE t1;

    DROP TABLE t2;

    SET SECURITY = NULL;

END;

CALL p3

SELECT * FROM t1 -- returns an error, table not found

SELECT * FROM t2 -- returns an error, table not found
```

============

The following example shows how to loop through a cursor.

```
CREATE TABLE atable (c1 INT, c2 INT)

 INSERT INTO atable VALUES (1,1)

 INSERT INTO atable VALUES (1,2)

 INSERT INTO atable VALUES (2,2)

 INSERT INTO atable VALUES (2,3)

 INSERT INTO atable VALUES (3,3)

 INSERT INTO atable VALUES (3,4)
```

```

CREATE PROCEDURE pp();
BEGIN
    DECLARE :i INTEGER;
    DECLARE c1Bulk CURSOR FOR SELECT c1 FROM atable ORDER BY c1 FOR UPDATE;
    OPEN c1Bulk;
    BulkLinesLoop:
    LOOP
        FETCH NEXT FROM c1Bulk INTO :i;
        IF SQLSTATE = '02000' THEN
        LEAVE BulkLinesLoop;
        END IF;
        UPDATE SET c1 = 10 WHERE CURRENT OF c1Bulk;
    END LOOP;
    CLOSE c1Bulk;
END

CALL pp
    -- Succeeds
SELECT * FROM atable
    -- Returns 6 rows
```

============

This example creates a trusted stored procedure named InParam. User Master then grants User1 EXECUTE and ALTER permissions on InParam. This example assumes that table t99 exists and contains two columns of type INTEGER.

```
CREATE PROCEDURE InParam(IN :inparam1 INTEGER, IN :inparam2 INTEGER) WITH DEFAULT HANDLER, EXECUTE AS
'Master' AS
BEGIN
    INSERT INTO t99 VALUES(:inparam1 , :inparam2);
END;
GRANT ALL ON PROCEDURE InParam TO User1
```

Master and User1 can now call this procedure (for example, CALL InParam(2,4)).

=============

This example shows how Zen data types that do not have a direct ODBC equivalent can be correctly mapped to be used by a procedure. The data types NUMERICSA and NUMERICSTS are the ones without direct equivalents so they are mapped to NUMERIC instead.

```
CREATE TABLE test1 (id identity, amount1 numeric(5,2), amount2 numericsa(5,2), amount3
numericsts(5,2))


CREATE PROCEDURE ptest2 (IN :numval1 numeric(5,2), IN :numval2 numeric(5,2), IN :numval3
numeric(5,2))

AS

BEGIN

Insert into test1 values(0, :numval1, :numval2, :numval3);

END;


CALL ptest2(100.10, 200.20, 300.30)

SELECT * FROM test1
```

The procedure correctly formats all the amount values according to the Zen data types defined in the CREATE TABLE statement, despite the fact that they are all passed to the procedure as NUMERIC. See also Zen Supported Data Types for the mappings of data types.

Using Stored Procedures

As an example, CALL foo(a, b, c) executes the stored procedure foo with parameters a, b, and c. Any of the parameters may be a dynamic parameter ('?'), which is necessary for retrieving the values of output and inout parameters. For example: {CALL foo (?, ?, 'TX')}. The curly braces are optional in your source code.

This is how stored procedures work in the current version of Zen.

- Triggers (CREATE TRIGGER, DROP TRIGGER) are supported as a form of stored procedure. This support includes tracking dependencies that the trigger has on tables, and procedures, in the database. You cannot use CREATE PROCEDURE or CREATE TRIGGER in the body of a stored procedure or a trigger.
- CONTAINS, NOT CONTAINS, BEGINS WITH are not supported.
- LOOP: post conditional loops are not supported (REPEAT...UNTIL).
- ELSEIF: The conditional format uses IF ... THEN ... ELSE. There is no ELSEIF support.

General Stored Procedure Engine Limitations

You should be aware of the following limitations before using stored procedures.

- There is no qualifier support in CREATE PROCEDURE or CREATE TRIGGER.
- Maximum length of a stored procedure variable name is 128 characters.
- See Identifier Restrictions in *Advanced Operations Guide* for the maximum length of a stored procedure name.
- Only partial syntactical validation occurs at CREATE PROCEDURE or CREATE TRIGGER time. Column names are not validated until run time.
- There is currently no support for using subqueries everywhere expressions are used. For example an UPDATE statement with `set :arg = SELECT MIN(sal) FROM emp` is not supported. However, you could rewrite the subquery as `SELECT min(sal) INTO :arg FROM emp`.
- Only the default error handler is supported.

Limits to SQL Variables and Parameters

- Variable names must be preceded with a colon (:) or at sign (@). This allows the stored procedure parser to differentiate between variables and column names.
- Variable names are case insensitive.
- No session variables are supported. Variables are local to the procedure.

Limits to Cursors

- Positioned UPDATE does not accept a table name.
- Global cursors are not supported.

Limits when using Long Data

- When you pass long data as arguments to an embedded procedure, (that is, a procedure calling another procedure), the data is truncated to 65500 bytes.
- Long data arguments to and from procedures are limited to a total of 2 MB.

Internally long data may be copied between cursors with no limit on data length. If a long data column is fetched from one statement and inserted into another, no limit is imposed. If, however, more than one destination is required for a single long data variable, only the first destination table receives multiple calls to PutData. The remaining columns are truncated to the first 65500 bytes. This is a limitation of the ODBC GetData mechanism.

See Also

DROP PROCEDURE

SET CACHED_PROCEDURES

SET PROCEDURES_CACHE

Trusted and Non-Trusted Objects

CREATE TABLE

The CREATE TABLE statement creates a new table in a database.

CREATE TABLE contains functionality that goes beyond minimal or core SQL conformance. CREATE TABLE supports Referential Integrity features. Zen conforms closely to SQL 92 with the exception of *ColIDList* support.

You can also create temporary tables with the CREATE TABLE statement. See CREATE (temporary) TABLE.

Caution! In the same directory, no two files should share the same file name and differ only in their file name extension. For example, do not create a table (data file) Invoice.btr and another one Invoice.mkd in the same directory. This restriction applies because the database engine uses the file name for various areas of functionality while ignoring the file name extension. Since only the file name is used to differentiate files, files that differ only in their file name extension look identical to the database engine.

Syntax

```
CREATE TABLE table-name [ option ] [ IN DICTIONARY ]

[ USING 'path_name'] [ WITH REPLACE ]

( table-element [ , table-element ]... )


table-name ::= user-defined-name


option ::= DCOMPRESS | PCOMPRESS | PAGESIZE = size | LINKDUP = number | SYSDATA_KEY_2


number ::= user-defined value (sets the number of pointers to reserve for the addition of linked
duplicates index keys)


table-element ::= column-definition | table-constraint-definition


column-definition ::= column-name data-type [ DEFAULT default-value-expression ] [ column-constraint
[ column-constraint ]... [CASE (string) | COLLATE collation-name ]


column-name ::= user-defined-name

```

```
data-type ::= data-type-name [ (precision [ , scale ] ) ]

precision ::= integer

scale ::= integer

default-value-expression ::= default-value-expression + default-value-expression
        | default-value-expression - default-value-expression
        | default-value-expression * default-value-expression
        | default-value-expression / default-value-expression
        | default-value-expression & default-value-expression
        | default-value-expression | default-value-expression
        | default-value-expression ^ default-value-expression
        | ( default-value-expression )
        | -default-value-expression
        | +default-value-expression
        | ~default-value-expression
        | ?
        | literal
        | scalar-function
        | { fn scalar-function }
        | USER
        | NULL

literal ::= 'string' | N'string'
        | number
        | { d 'date-literal' }
        | { t 'time-literal' }
        | { ts 'timestamp-literal' }

scalar-function ::= see Scalar Functions

column-constraint ::= [ CONSTRAINT constraint-name ] col-constraint
```

```
constraint-name ::= user-defined-name

col-constraint ::= NOT NULL
    | NOT MODIFIABLE
    | UNIQUE
    | PRIMARY KEY
    | REFERENCES table-name [ ( column-name ) ] [ referential-actions ]

table-constraint-definition ::= [ CONSTRAINT constraint-name ] table-constraint

table-constraint ::=  UNIQUE ( column-name [ , column-name ]... )
    | PRIMARY KEY ( column-name [ , column-name ]... )
    | FOREIGN KEY ( column-name [ , column-name ] )
      REFERENCES table-name [ ( column-name [ , column-name ]... ) ] [ referential-actions ]

referential-actions ::= referential-update-action [ referential-delete-action ]
    | referential-delete-action [ referential-update-action ]

referential-update-action ::= ON UPDATE RESTRICT

referential-delete-action ::= ON DELETE CASCADE
    | ON DELETE RESTRICT

collation-name ::= 'string'
```

Remarks

The only indexes that can be created with the CREATE TABLE statement are IDENTITY, SMALLIDENTITY, or BIGIDENTITY, primary keys, and foreign keys. All other indexes must be created with the **CREATE INDEX** statement.

Foreign key constraint names must be unique in the dictionary. All other constraint names must be unique within the table in which they reside and must not have the same name as a column.

If the primary key name is omitted, the name of the first column in the key prefixed by "PK_" is used as the name of the constraint.

If a reference column is not listed, the reference becomes, by default, the primary key of the table referenced. If a primary key is unavailable, a "Key not found" error returns. You can avoid this situation by enumerating the target column.

If the foreign key name is omitted, the name of the first column in the key prefixed by "FK_" is used as the name of the constraint.

If the UNIQUE constraint is omitted, the name of the first column in the key prefixed by "UK_" is used as the name of the constraint.

If the NOT MODIFIABLE constraint is omitted, the name of the first column in the key prefixed by "NM_" is used as the name of the constraint. (If NOT MODIFIABLE is used, a not-unique, not-modifiable index is created on the column. The index is named NM_*column_name*.)

If the NOT NULL constraint is omitted, the name of the first column in the key prefixed by "NN_" is used as the name of the constraint.

A foreign key may reference the primary key of the same table (known as a self-referencing key).

If CREATE TABLE succeeds and a USING clause was not specified, the data file name for the created table is xxx.mkd, where xxx is the specified table name. If the physical file, xxx.mkd, already exists, a new file names xxxnnn.mkd is created, where nnn is a unique number. If the table already exists, it is not replaced, and error -1303, "Table already exists" is returned. You must drop the table before replacing it.

A CREATE TABLE statement with the SYSDATA_KEY_2 keyword automatically creates the file in the 13.0 file format. The new file uses system data v2, which enables the sys$create and sys$update virtual columns for use in queries. For more information, see Accessing System Data v2.

Use of IN DICTIONARY with the SYSDATA_KEY_2 keyword causes the CREATE TABLE statement to ignore SYSDATA_KEY_2, and the sys$create and sys$update virtual columns are not available for the new table.

Limitations on Record Size

The total size of the fixed-length portion of any data record may not exceed 65535 bytes. The fixed-length portion of any data record is made up of the following:

- all the columns that have a fixed sized (all columns except for LONGVARCHAR, LONGVARBINARY and NLONGVARCHAR)

- one byte for each column that allows null values
- 8 bytes for each variable-length column (column of type LONGVARCHAR, LONGVARBINARY or NLONGVARCHAR).

If you attempt to create a table that exceeds this limit, or if you attempt modifications that would cause a table to exceed the limit, Zen returns status code -3016, "The maximum fixed-length rowsize for the table has been exceeded."

To determine the size in bytes of the fixed-length portion of a record before you attempt to create a new table, you can use the following calculation:

(sum of the storage sizes in bytes for the fixed-length column) + (number of nullable columns) + (8 * number of variable-length columns) = record size in bytes

If you want to determine the size of the fixed-length portion of the record for an existing data file, you can use the BUTIL -STAT command to display a report that includes this information.

Example of Limitation on Record Size

Assume you have a table with the following columns defined:

Type	Number of Columns of This Type	Nullable?
VARCHAR(216)	1	Yes
VARCHAR(213)	5	All columns
CHAR(42)	1494	All columns

Each VARCHAR has two extra bytes reserved for it. One bite for the preceding NULL indicator and one trailing byte because VARCHAR is implemented as a ZSTRING. Each CHAR has a preceding byte reserved for the NULL indicator.

Therefore, the record size is 1 x 218 + 5 x 215 + 1494 x 43 = 65535 bytes

In this example, you could not add another column of any length without exceeding the fixed-length limit.

Delete Rule

You can include an ON DELETE clause with a foreign key constraint to define the delete rule Zen enforces for an attempt to delete the parent row to which a foreign key value refers. The delete rules you can choose are as follows:

- If you specify CASCADE, Zen uses the *delete cascade* rule. When a user deletes a row in the parent table, the database engine deletes the corresponding rows in the dependent table.
- If you specify RESTRICT, Zen enforces the *delete restrict* rule. A user cannot delete a row in the parent table if a foreign key value refers to it.

If you do not specify a delete rule, Zen applies the restrict rule by default.

Use caution with delete cascade. Zen allows a circular delete cascade on a table that references itself. See examples in Delete Cascade in *Advanced Operations Guide*.

Update Rule

Zen enforces the *update restrict* rule. This rule prevents the addition of a row containing a foreign key value if the parent table does not contain the corresponding primary key value. This rule is enforced whether or not you use the optional ON UPDATE clause, which allows you to specify the update rule explicitly.

IN DICTIONARY

See the discussion of IN DICTIONARY forALTER TABLE.

USING

The USING keyword allows you to associate a CREATE TABLE or ALTER TABLE action with a particular data file.

Because Zen requires a Named Database to connect, the *path_name* provided must always be a simple file name or relative path and file name. Paths are always relative to the first Data Path specified for the Named Database to which you are connected.

The path/file name passed is partially validated when the statement is prepared.

You must follow these rules when specifying the path name:

- The text must be enclosed in single quotes, as shown in the grammar definition.
- Text must not exceed the length limit for the version of metadata being used. The entry is stored in Xf$Loc in exactly as typed (trailing spaces are truncated and ignored). See Xf$Loc (for V1 metadata) and Xf$Loc (for V2 metadata).
- The path must be a simple relative path. Paths that reference a server or volume are not allowed.

- Relative paths are allowed to include a period for current directory, a double-period for parent directory, a slash, or any combination of the three. However, the path must contain a file name representing the SQL table name, meaning *path_name* cannot end in a slash or a directory name. All file names, including those specified with relative paths, are relative to the first Data Path as defined in the Named Database configuration.

The following features provide convenience and ease of use:

- Root-based relative paths are allowed. For example, assuming that the first data path is D:\mydata\demodata, Zen interprets the path name in the following statement as D:\temp\test123.btr.

  ```
  CREATE TABLE t1 USING '\temp\test123.btr' (c1 int)
  ```

- Slash characters in relative paths may be either Unix style (/) or Windows backslash (\). You may use a mixture of the two types, if desired. This is a convenience feature, since you may know the directory structure scheme but not necessarily know (or care) what type of server you are connected to. The path is stored in X$File exactly as typed. The Zen engine converts the slash characters to the appropriate platform type when utilizing the path to open the file. Also, since data files share binary compatibility between all supported platforms, this means that as long as the directory structure is the same between platforms (and path-based file names are specified as relative paths), then database files and DDFs can be moved from one platform to another without modification. This enables cross-platform deployment using a standardized database schema.
- When you specify a relative path, the directory structure in the USING clause does not need to already exist. When needed, Zen creates directories for the path in the USING clause.

Include a USING clause to specify the physical location of the data file associated with the table. This is necessary when you are creating a table definition for an existing data file, or when you want to specify explicitly the name or physical location of a new data file.

If you do not include a USING clause, Zen generates a unique file name from the table name with an .mkd extension and creates the file in the first directory specified in the data file path for the database.

If the USING clause points to an existing data file, Zen creates the table in the DDFs and returns SQL_SUCCESS_WITH_INFO. The informational message returned indicates that the dictionary entry now points to an existing data file. If you want CREATE TABLE to return only SQL_SUCCESS, specify IN DICTIONARY on the CREATE statement. If WITH REPLACE is specified (see below), then any existing data file with the same name is destroyed and overwritten with a newly created file.

???Per Chris' comments, need to re-visit SUCCESS_WITH_INFO.

Note: Zen returns a successful status code if you specify an existing data file.

Whenever you create a relational index definition for an existing data file (for example, CREATE TABLE USING with a column definition of type IDENTITY), Zen automatically checks the Btrieve indexes defined on the file to determine whether an existing Btrieve index offers the set of parameters in the relational index definition. If an existing Btrieve index matches the new definition, then an association is created between the relational index definition and the existing Btrieve index. If there is no match, then Zen creates a new index definition and, if IN DICTIONARY is not used, a new index in the file.

WITH REPLACE

Whenever WITH REPLACE is specified with the USING keyword, Zen automatically overwrites any existing file name with the specified file name. The file is always overwritten if the operating system allows it. WITH REPLACE affects only the data file. It does not affect the DDFs.

The following rules apply when using WITH REPLACE:

- WITH REPLACE can only be used with USING.
- When used with IN DICTIONARY, WITH REPLACE is ignored because IN DICTIONARY specifies that only the DDFs are affected.

If you include WITH REPLACE in your CREATE TABLE statement, Zen creates a new data file to replace the existing file (if the file exists at the location you specified in the USING clause). Zen discards any data stored in the original file with the same name. If you do not include WITH REPLACE and a file exists at the specified location, Zen returns a status code and does not create a new file. The table definition is added to the DDFs, however.

WITH REPLACE affects only the data file. It does not affect the table definition in the dictionary.

DCOMPRESS

The DCOMPRESS option specifies that the data file for a table use record compression to reduce the file size on disk. The following example creates a table with record compression and page size 1024 bytes:

```
CREATE TABLE t1 DCOMPRESS PAGESIZE=1024 (c1 INT DEFAULT 10, c2 CHAR(10) DEFAULT 'abc')
```

For details, see Record and Page Compression in *Advanced Operations Guide*.

PCOMPRESS

The PCOMPRESS option specifies that the data file for the specified table should use page compression. The following example creates a table with page compression and page size 1024 bytes:

```
CREATE TABLE t1 PCOMPRESS PAGESIZE=1024 (c1 INT DEFAULT 10, c2 CHAR(10) DEFAULT 'abc')
```

For details, see Record and Page Compression in *Advanced Operations Guide*.

PAGESIZE

The PAGESIZE option specifies that the data file for the specified table should use pages of *size* bytes. The value of *size* can be any of the following depending on file version:

- 512–4096 for file versions prior to 9.0 (a multiple of 512 bytes up to 4096)
- 512, 1024, 1536, 2048, 2560, 3072, 3584, 4096, or 8192 for file version 9.0
- 1024, 2048, 4096, 8192, or 16384 for file version 9.5
- 4096, 8192, or 16384 for file version 13.0

The following example creates a table with file compression and page size 8192 bytes, specifying creation of the particular data file identified by the relative path, `..\data1.mkd`:

```
CREATE TABLE t1 DCOMPRESS PAGESIZE=8192 USING '..\data1.mkd' (c1 INT DEFAULT 10, c2
CHAR(10) DEFAULT 'abc')
```

LINKDUP

Multiple records may carry the same duplicated value for index keys. The two methods to keep track of the records with duplicate key values are called linked duplicates (linkdup) and repeating duplicates. For a detailed discussion of linked duplicates and repeating duplicates, see Methods for Handling Duplicate Keys in *Advanced Operations Guide*.

If the LINKDUP keyword is **not** specified, a CREATE INDEX statement uses the repeating duplicates method.

Each linked duplicate index requires 8 extra bytes in the physical record. The LINKDUP keyword allows you to reserve these extra bytes for use in linked duplicated indexes that are subsequently created.

Thus, if the LINKDUP keyword **is** specified, the following applies:

- A CREATE INDEX statement uses the linked duplicates method up to the value specified for the number of pointers
- Once the value specified for the number of pointers is reached, a CREATE INDEX statement uses the repeating duplicates method
- If the value specified for the number of pointers has been reached and a linked-duplicate index is dropped, a CREATE INDEX statement uses the linked duplicates method for the next key
- A CREATE INDEX statement cannot create a repeating-duplicate key if pointers are still reserved for linked-duplicate keys.

Examples

The following examples demonstrate various uses of CREATE TABLE.

Syntax like the following creates a table named Billing with columns Student_ID, Transaction_Number, Log, Amount_Owed, Amount_Paid, Registrar_ID and Comments, using the specified data types.

```
CREATE TABLE Billing
(Student_ID UBIGINT,
Transaction_Number USMALLINT,
Log TIMESTAMP,
Amount_Owed DECIMAL(6,2),
Amount_Paid DECIMAL(6,2),
Registrar_ID DECIMAL(10,0),
Comments LONGVARCHAR)
```

============

This example creates a table named Faculty in the database with columns ID, Dept_Name, Designation, Salary, Building_Name, Room_Number, Rsch_Grant_Amount, and a primary key based on column ID.

```
CREATE TABLE Faculty
(ID UBIGINT,
Dept_Name CHAR(20) CASE,
Designation CHAR(10) CASE,
Salary CURRENCY,
Building_Name CHAR(25) CASE,
Room_Number UINTEGER,
Rsch_Grant_Amount DOUBLE,
PRIMARY KEY (ID))
```

The following example creates an index on the Name column and designates that index as not modifiable. Data in the Name column cannot be changed.

```
CREATE TABLE organizations
(Name LONGVARCHAR NOT MODIFIABLE,
Advisor CHAR(30),
Number_of_people INTEGER,
Date_started DATE,
Time_started TIME,
Date_modified TIMESTAMP,
Total_funds DOUBLE,
Budget DECIMAL(2,2),
Avg_funds REAL,
President VARCHAR(20) CASE,
Number_of_executives SMALLINT,
Number_of_meetings TINYINT,
Office UTINYINT,
Active BIT,)
```

============

In the next example, assume that you need a table called StudentAddress to contain student addresses. You need to alter the Student table *id* column to be a primary key and then create a StudentAddress table that references Student as the primary table. (The Student table is part of the Demodata sample database.) Four ways are shown to create the StudentAddress table.

First, make the *id* column of table Student a primary key.

```
ALTER TABLE Student ADD PRIMARY KEY (id)
```

This next statement creates a StudentAddress table to have a foreign key referencing the *id* column of table Student with the DELETE CASCADE rule. This means that whenever a row is deleted from the Student table (Student is the parent table in this case), all rows in the StudentAddress table with that same id are also deleted.

```
CREATE TABLE StudentAddress (id UBIGINT REFERENCES Student (id) ON DELETE CASCADE, addr CHAR(128))
```

This next statement creates a StudentAddress table to have a foreign key referencing the *id* column of table Student with the DELETE RESTRICT rule. This means that whenever a row is deleted from the Student table and there are rows in the StudentAddress table with that same id, an error occurs. You need to explicitly delete all the rows in StudentAddress with that *id* before the row in the Student table, the parent table, can be deleted.

```
CREATE TABLE StudentAddress (id UBIGINT REFERENCES Student (id) ON DELETE RESTRICT, addr CHAR(128))
```

This next statement creates a StudentAddress table to have a foreign key referencing the *id* column of table Student with the UPDATE RESTRICT rule. This means that an error occurs if a row is added to the StudentAddress table with an ID that does not occur in the Student table. In other words, you must have a parent row before you can have foreign keys refer to that row. This is the default behavior of Zen.

Moreover, Zen does not support any other UPDATE rules. Thus, whether this rule is stated explicitly makes no difference. Also, since a DELETE rule is not explicitly stated, DELETE RESTRICT is assumed.

```
CREATE TABLE StudentAddress (id UBIGINT REFERENCES Student (id) ON UPDATE RESTRICT, addr CHAR(128))
```

============

This example shows how to use an alternate collating sequence (ACS) when you create a table. The ACS file used is the sample one provided with Zen.

```
CREATE TABLE t5 (c1 CHAR(20) COLLATE 'file_path\upper.alt')
```

Upper.alt treats upper and lower case letters the same for sorting. For example, if a database has values `abc`, `ABC`, `DEF`, and `Def`, inserted in that order, then the sorting with upper.alt returns as `abc`, `ABC`, `DEF`, and `Def`.

The values `abc` and `ABC`, and the values `DEF` and `Def` are considered duplicates and are returned in the order in which they were inserted. Normal ASCII sorting sequences upper case letters before lower case, such that the sorting would return as `ABC`, `DEF`, `Def`, `abc`. Also, the statement SELECT c1 FROM t5 WHERE c1 = 'Abc' returns both `abc` and `ABC`.

============

The following example creates a table, t1, and reserves the number of pointers to use for linked duplicate keys to four. The CREATE INDEX statements create index keys for the table.

```
DROP table t1
```

```
CREATE table t1 LINKDUP=4 (c1 int, c2 int, c3 int)
```

```
CREATE INDEX link_1 on t1(c1,c2)
```

```
CREATE INDEX link_2 on t1(c1,c3)
```

```
CREATE UNIQUE INDEX link_3 on t1(c3)
```

```
CREATE INDEX link_4 on t1(c1)
```

```
CREATE INDEX link_5 on t1(c2)
CREATE INDEX link_6 on t1(c2,c3)
```

The results of the CREATE INDEX statements are the following:

- Linked duplicate keys: link_1, link_2, link_4, link_5
- Repeating duplicate keys: link_6 (because the number of pointers to use for linked duplicate keys reached the specified value, four)

```
DROP INDEX link_2
```

```
CREATE INDEX link_7 on t1(c3,c1)
```

These two statements result in the following:

- Linked duplicate keys: link_1, link_4, link_5, link_7 (because the DROP INDEX statement reduced the number of pointers to use for linked duplicate keys to three, which allowed link_7 to become the fourth linked duplicates index key)
- Repeating duplicate keys: link_6

============

The following statement creates a table and specifies that the columns should not allow NULL values (that is, null indicator bytes are not added).

```
CREATE TABLE NoNulls
(ID UBIGINT NOT NULL,
Name CHAR(20) NOT NULL CASE,
Amount DOUBLE NOT NULL)
```

============

If you need to create all columns as NOT NULL, you can first use the SET TRUENULLCREATE statement to disable the creation of true nulls, then create the table. This allows you to avoid specifying the NOT NULL attribute on each column. (See SET TRUENULLCREATE.) Note, however, that the resulting legacy table does not enforce a NOT NULL attribute on any columns. NULL is allowed even if NOT NULL is explicitly specified for the column. The following statements create the same table as in the previous example.

```
SET TRUENULLCREATE=OFF
CREATE TABLE NoNulls2
(ID BIGINT,
Name CHAR(20) CASE,
Amount DOUBLE)
SET TRUENULLCREATE=ON
```

============

CREATE TABLE supports the specification of a DEFAULT value for columns. This is used when rows are inserted without an explicitly specified value for that column. The next statement creates a table with defaults matching the column data types. Note that IDENTITY columns have an implied default of zero, which automatically generates the next highest value.

```
CREATE TABLE Defaults
(ID IDENTITY,
Name CHAR(20) DEFAULT 'none',
Amount DOUBLE DEFAULT 0.00,
EntryDay DATE DEFAULT CURDATE(),
EntryTime TIME DEFAULT CURTIME())
```

The next statements insert two rows using the defaults.

```
INSERT INTO Defaults (ID) VALUES (0)
INSERT INTO Defaults (ID, Name, Amount) VALUES (0, 'Joquin', '100')
```

A SELECT statement returns the results, containing default values.

```
SELECT * FROM Defaults

ID   Name        Amount     EntryDay    EntryTime
===  ========    ========   =========   ===========
  1  none             0.0    curdate     curtime
  2  Joquin         100.0    curdate     curtime
```

============

The following example assumes that you have a table Legacydata that contains columns with legacy data types in data file olddata.dat. New databases cannot create tables with the legacy data types. You could, however, create a DDF definition in a new database for Legacydata with the IN DICTIONARY clause.

```
CREATE TABLE "Legacydata" IN DICTIONARY USING 'olddata.dat' (
"col1" LSTRING(10) NOT NULL,
"col2" VARCHAR(9) NOT NULL,
"col3" LOGICAL NOT NULL,
"col4" LOGICAL2 NOT NULL,
"col5" NOTE(100) NOT NULL);
```

============

This example demonstrates the default creation of a Btrieve data file if a table is created without specifying either a USING clause or REPLACE. The default name of the file is the table name with the extension .mkd. If that file name already exists, a different name is generated using the table name followed by a number and then the .mkd extension.

To create the table xyz, which generates the data file xyz.mkd:

```
CREATE TABLE xyz (c1 int, c2 char(5))
```

Now, delete the table using IN DICTIONARY, so the data file is not deleted:

```
DROP TABLE xyz in dictionary
```

Finally, if you create table xyz again:

```
CREATE TABLE xyz (c1 int, c2 char(5))
```

It creates the table xyz and the data file xyz000.mkd.

See Also

ALTER TABLE

DROP TABLE

CREATE INDEX

DEFAULT

SET DEFAULTCOLLATE

CREATE (temporary) TABLE

You can also use the CREATE TABLE statement to create a temporary table. The CREATE TABLE syntax for temporary tables is more restrictive than for permanent tables. For this reason, and because of other characteristics, temporary tables are discussed separately. See Other Characteristics.

Syntax

```
CREATE TABLE <# | ##>table-name (table-element [ , table-element ]... )

table-name ::= user-defined-name

table-element ::= column-definition | table-constraint-definition

column-definition ::= column-name data-type [ DEFAULT default-value-expression ] [ column-constraint
[ column-constraint ]... [CASE (string) | COLLATE collation-name ]

column-name ::= user-defined-name

data-type ::= data-type-name [ (precision [ , scale ] ) ]

precision ::= integer

scale ::= integer

default-value-expression ::= default-value-expression + default-value-expression
        | default-value-expression - default-value-expression
        | default-value-expression * default-value-expression
        | default-value-expression / default-value-expression
        | default-value-expression & default-value-expression
        | default-value-expression | default-value-expression
        | default-value-expression ^ default-value-expression
        | ( default-value-expression )
        | -default-value-expression
        | +default-value-expression
        | ~default-value-expression
        | ?
        | literal
        | scalar-function
        | { fn scalar-function }
        | USER
        | NULL

literal ::= 'string' | N'string'
        | number
        | { d 'date-literal' }
        | { t 'time-literal' }
        | { ts 'timestamp-literal' }


column-constraint ::= [ CONSTRAINT constraint-name ] col-constraint

constraint-name ::= user-defined-name

col-constraint ::= NOT NULL
    | NOT MODIFIABLE
    | UNIQUE
    | PRIMARY KEY
    | REFERENCES table-name [ ( column-name ) ] [ referential-actions ]

table-constraint-definition ::= [ CONSTRAINT constraint-name ] table-constraint

table-constraint ::=  UNIQUE ( column-name [ , column-name ]... )
    | PRIMARY KEY ( column-name [ , column-name ]... )
    REFERENCES table-name [ ( column-name [ , column-name ]... ) ] [ referential-actions ]

referential-actions ::= referential-update-action [ referential-delete-action ]
```

```
    | referential-delete-action [ referential-update-action ]

referential-update-action ::= ON UPDATE RESTRICT

referential-delete-action ::= ON DELETE CASCADE
    | ON DELETE RESTRICT

collation-name ::= 'string'
```

Remarks

A temporary table is used for intermediate results or working storage. Unlike in permanent tables, data in a temporary table is destroyed at some point during the SQL session or at the end of the SQL session. The data is not saved in the database.

Temporary tables are useful to narrow down intermediate results by continuing to operate on intermediate tables. Complex data operations are often easier if split into a sequence of simpler steps, which each step operating on the table result of a previous step. A temporary table is a base table. That is, the data it contains is its own. Contrast this with a view, which is an indirect representation of data in other tables.

Zen supports two types of temporary tables:

- Local
- Global

Both types can be used within a stored procedure.

The following table summarizes characteristics of temporary tables contrasted with where the table is created or used. Characteristics can vary depending on whether the table is created or used within or outside of a stored procedure. Additional remarks are discussed as footnotes at the end of the table.

Except for permissible length of the temporary table name, the characteristics are the same for both V1 and V2 metadata.

Table Characteristic	Local Temporary Table		Global Temporary Table	
	Outside of SP[1]	Within SP	Outside of SP	Within SP
First character of table name must be # (see also Compatibility with Previous Releases below)	yes	yes	no	no
First character of table name must be ## (see also Compatibility with Previous Releases below)	no	no	yes	yes
Context of table same as database in which table is created	yes	yes	yes	yes
Two or more sessions can create table with same name[2]	yes	yes	no	no
For V1 metadata, see Identifier Restrictions in *Advanced Operations Guide* for the maximum length of a table name (the length **includes** #, ##, underscores, and ID).	yes[3]	yes[4]	yes[3]	yes[4]
For V2 metadata, see Identifier Restrictions in *Advanced Operations Guide* for the maximum length of a table name (the length **includes** #, ##, underscores, and ID).	yes[3]	yes[4]	yes[3]	yes[4]
Table in another database can be accessed by qualifying table name with other database name	no	no	yes	yes
SELECT, INSERT, UPDATE, and DELETE statements permitted on table	yes	yes	yes	yes
ALTER TABLE and DROP TABLE statements permitted on table	yes	yes	yes	yes
Can create view on table	no	no	no	no
Can create user-defined function on table	no	no	no	no
Can create trigger on table	no	no	no	no
Can grant or revoke permissions on table	no	no	no	no
FOREIGN KEY constraint allowed with CREATE TABLE statement[5]	no	no	no	no
SELECT INTO statement can populate table with data	yes	yes	yes	yes
SELECT INTO statement can create table[6]	yes	yes	yes	yes

Table Characteristic	Local Temporary Table		Global Temporary Table	
	Outside of SP[1]	Within SP	Outside of SP	Within SP
Table created in one SQL session can be accessed by other SQL sessions	no	no	yes	yes
Table created in procedure can be accessed outside of that procedure	N/A[9]	no	N/A[9]	yes
Table created in topmost procedure can be accessed by nested procedures	N/A[9]	no	N/A[9]	no
CREATE TABLE statement in a recursive stored procedure returns table name error on recursive call	N/A[9]	yes[7]	N/A[9]	yes[9]
Table dropped when explicitly dropped	yes	yes	yes	yes
Table dropped at end of session in which table created	yes	yes[8]	yes	yes
Table dropped at end of procedure in which table created	N/A[9]	yes	N/A[9]	no
Table dropped at end of transaction in another session	N/A[9]	N/A[9]	yes	yes

[1]SP stands for stored procedure

[2]The database engine automatically appends the name of the stored procedure and a session-specific ID to the user-defined name to ensure a unique table name. This functionality is transparent to the user.

[3]The total length of the table name includes # or ##, plus an underscore, plus a session ID. The session ID can be 8, 9, or 10 bytes depending on the operating system. See Identifier Restrictions in *Advanced Operations Guide*.

[4]The total length of the table name includes # or ##, plus an underscore, plus the name of the stored procedure, plus an underscore, plus a session ID. The session ID can be 8, 9, or 10 bytes depending on the operating system. See Identifier Restrictions in *Advanced Operations Guide*.

[5]Constraint returns a warning but table is created.

[6]A table can be created and populated with data with a single SELECT INTO statement.

[7]The table name already exists from the first execution of the stored procedure.

[8]If end of session occurs before the execution of the procedure ends.

[9]N/A means “not applicable.”

Compatibility with Previous Releases

Releases of Zen before PSQL v9 Service Pack 2 permitted the naming of permanent tables starting with # or ##. Permanent tables starting with # or ## cannot be used with PSQL v9 Service Pack 2 or later releases. Tables starting with # or ## are temporary tables and are created in the TEMPDB database.

A "table not found" error is returned if you attempt to access a permanent table starting with # or ## that was created with a version of Zen earlier than the version you are using.

See also Statement Separators in *Zen User's Guide*.

TEMPDB Database

The installation of Zen creates a system database named TEMPDB. TEMPDB holds all temporary tables. Never delete the TEMPDB database. If you remove it, you will be unable to create temporary tables.

TEMPDB is created in the install directory of the Zen product. See Where are the files installed? in *Getting Started with Zen*.

If you prefer, after installation, you may change the location of the dictionary files and data files for TEMPDB. See Database Properties in *Zen User's Guide*.

Caution! TEMPDB is a system database for exclusive use by the database engine. Do **not** use TEMPDB as a repository of your permanent tables, views, stored procedures, and so forth.

Table Names of Local Temporary Tables

The database engine automatically appends information to the names of local temporary tables to differentiate between temporary tables created across multiple sessions. The length of the appended information varies depending on the operating system.

The name of a local temporary table can be at least 10 bytes provided the number of stored procedures that *create* local temporary tables does not exceed 1296. The 10 bytes include the # character. The 1296 limit applies to stored procedures within the same session.

The maximum name length is 20 bytes, including the # character, the table name, and the appended information.

Transactions

A global temporary table can be explicitly dropped or is automatically dropped when the session in which the table was created ends. If a session other than the one that created the table uses the table in a transaction, the table is dropped when the transaction completes.

SELECT INTO

You can create a temporary table and populate it with data by using a single SELECT INTO statement. For example, SELECT * INTO #mytmptbl FROM Billing creates a local temporary table named #mytmptbl (provided #mytmptbl does not already exist). The temporary table contains the same data as the Billing table in the Demodata sample database.

If the SELECT INTO statement is executed a second time with the same temporary table name, an error returns because the temporary table already exists.

The SELECT INTO statement can create a temporary table from two or more tables. However, the column names must be unique in each of the tables from which the temporary table is created or an error returns.

The error can be avoided if you qualify the column names with the table names and provide an alias for each column. For example, suppose that table t1 and t2 both contain columns col1 and col2. The following statement returns an error: `SELECT t1.co1, t1.col2, t2.col1, t2.col2 INTO #mytmptbl FROM t1, t2`. Instead, use a statement such as this: `SELECT t1.co1 c1, t1.col2 c2, t2.col1 c3, t2.col2 c4 INTO #mytmptbl FROM t1, t2`.

Restrictions on SELECT INTO

- A local temporary table created within a stored procedure is inside the scope of the stored procedure. The local temporary table is destroyed after the stored procedure executes.
- The UNION and UNION ALL keywords are not permitted with a SELECT INTO statement.
- Only one temporary table can receive the results of the SELECT INTO statement. You cannot SELECT data into multiple temporary table with a single SELECT INTO statement.

Caching of Stored Procedures

Any stored procedure that references a local or a global temporary table is **not** cached, regardless of the cache settings. See SET CACHED_PROCEDURES and SET PROCEDURES_CACHE.

Examples of Temporary Tables

The following example creates a local temporary table named #b_temp and populates it with the data from the Billing table in the Demodata sample database.

```
SELECT * INTO "#b_temp" FROM Billing
```

============

The following example creates a global temporary table named ##tenurefac with columns ID, Dept_Name, Building_Name, Room_Number, and a primary key based on column ID.

```
CREATE TABLE ##tenurefac
(ID UBIGINT,
Dept_Name CHAR(20) CASE,
Building_Name CHAR(25) CASE,
Room_Number UINTEGER,
PRIMARY KEY (ID))
```

============

The following example alters temporary table ##tenurefac and adds the column Research_Grant_Amt.

```
ALTER TABLE ##tenurefac ADD Research_Grant_Amt DOUBLE
```

============

The following example drops temporary table ##tenurefac.

```
DROP TABLE ##tenurefac
```

============

The following example creates two temporary tables within a stored procedure, populates them with data, then assigns values to variables. The values are selected from the temporary tables.

Note: SELECT INTO is permitted within a stored procedure if used to assigned values to variables.

```
CREATE PROCEDURE "p11"()
AS BEGIN
    DECLARE :val1_int INTEGER;
    DECLARE :val2_char VARCHAR(20);
    CREATE TABLE #t11 (col1 INT, col2 VARCHAR(20));
    CREATE TABLE #t12 (col1 INT, col2 VARCHAR(20));
    INSERT INTO #t11 VALUES (1,'t1 col2 text');
    INSERT INTO #t12 VALUES (2,'t2 col2 text');
    SELECT col1 INTO :val1_int FROM #t11 WHERE col1 = 1;
    SELECT col2 INTO :val2_char FROM #t12 WHERE col1 = 2;
    PRINT :val1_int;
    PRINT :val2_char;
    COMMIT;
END;
CALL P11()
```

============

The following example creates global temporary table ##enroll_student_global_temp_tbl and then creates stored procedure Enrollstudent. When called, the procedure inserts a record into ##enroll_student_global_temp_tbl, given the Student ID, Class ID, and a grade point average (GPA). A SELECT selects all records in the temporary table and displays the result. The length of the name for the global temporary table is permissible only for V2 metadata.

```
CREATE TABLE ##enroll_student_global_temp_tbl (student_id INTEGER, class_id INTEGER, GPA REAL);
CREATE PROCEDURE Enrollstudent(in :Stud_id integer, in :Class_Id integer, IN :GPA REAL);
BEGIN
    INSERT INTO ##enroll_student_global_temp_tbl VALUES(:Stud_id, :Class_id, :GPA);
END;
CALL Enrollstudent(1023456781, 146, 3.2)
SELECT * FROM ##enroll_student_global_temp_tbl
```

============

The following example creates two temporary tables within a stored procedure, populates them with data, then assigns values to variables. The values are selected from the temporary tables.

```
CREATE PROCEDURE "p11"()
AS BEGIN
    DECLARE :val1_int INTEGER;
    DECLARE :val2_char VARCHAR(20);
    CREATE TABLE #t11 (col1 INT, col2 VARCHAR(20));
    CREATE TABLE #t12 (col1 INT, col2 VARCHAR(20));
    INSERT INTO #t11 VALUES (1,'t1 col2 text');
    INSERT INTO #t12 VALUES (2,'t2 col2 text');
    SELECT col1 INTO :val1_int FROM #t11 WHERE col1 = 1;
    SELECT col2 INTO :val2_char FROM #t12 WHERE col1 =  2;
    PRINT :val1_int;
    PRINT :val2_char;
    COMMIT;
END;
CALL P11()
```

See Also

ALTER TABLE

DROP TABLE

SELECT (with INTO)

CREATE TRIGGER

The CREATE TRIGGER statement creates a new trigger in a database. Triggers are a type of stored procedure that is automatically executed when table data is modified with an INSERT, UPDATE, or DELETE.

Unlike a regular stored procedure, a trigger cannot be executed directly, nor can it have parameters. Triggers do not return a result set, nor can they be defined on views.

Syntax

```
CREATE TRIGGER trigger-name before-or-after ins-upd-del ON table-name
    [ ORDER number ]
    [ REFERENCING referencing-alias ] FOR EACH ROW
    [ WHEN proc-search-condition ] proc-stmt

trigger-name ::= user-defined-name

before-or-after ::= BEFORE | AFTER

ins-upd-del ::= INSERT | UPDATE | DELETE

referencing-alias ::= OLD [ AS ] correlation-name [ NEW [ AS ] correlation-name ]
    | NEW [ AS ] correlation-name [ OLD [ AS ] correlation-name ]

correlation-name ::= user-defined-name
```

Remarks

Note: In a trigger, the name of a variable must begin with a colon (:).

OLD (OLD `correlation-name`) and NEW (NEW `correlation-name`) can be used inside triggers, not in a regular stored procedure.

In a DELETE or UPDATE trigger, the letters "OLD" or an OLD `correlation-name` must be prepended to a column name to reference a column in the row of data prior to the update or delete operation.

In an INSERT or UPDATE trigger, the letters "NEW" or a NEW `correlation-name` must be prepended to a column name to reference a column in the row about to be inserted or updated.

Trigger names must be unique in the dictionary.

Triggers are executed either before or after an UPDATE, INSERT, or DELETE statement is executed, depending on the type of trigger.

Note: CREATE TRIGGER statements are subject to the same length and other limitations as CREATE PROCEDURE. For more information, see Limits and Data Type Restrictions.

Examples

The following example creates a trigger that records any new values inserted into the Tuition table into TuitionIDTable.

```
CREATE TABLE Tuitionidtable (PRIMARY KEY(id), id UBIGINT);

CREATE TRIGGER InsTrig

BEFORE INSERT ON Tuition

REFERENCING NEW AS Indata

FOR EACH ROW

INSERT INTO Tuitionidtable VALUES(Indata.ID);
```

An INSERT on Tuition calls the trigger.

============

The following example shows how to keep two tables, A and B, synchronized with triggers. Both tables have the same structure.

```
CREATE TABLE A (col1 INTEGER, col2 CHAR(10));

CREATE TABLE B (col1 INTEGER, col2 CHAR(10));

CREATE TRIGGER MyInsert

AFTER INSERT ON A FOR EACH ROW

INSERT INTO B VALUES (NEW.col1, NEW.col2);

CREATE TRIGGER MyDelete

AFTER DELETE ON A FOR EACH ROW

DELETE FROM B WHERE B.col1 = OLD.col1 AND B.col2 = OLD.col2;

CREATE TRIGGER MyUpdate

AFTER UPDATE ON A FOR EACH ROW

UPDATE B SET col1 = NEW.col1, col2 = NEW.col2 WHERE B.col1 = OLD.col1 AND B.col2 = OLD.col2;
```

Note that OLD and NEW in the example keep the tables synchronized only if table A is altered with nonpositional SQL statements. If the SQLSetPOS API or a positioned update or delete is used, then the tables stay synchronized only if table A does not contain any duplicate records. A SQL statement cannot be constructed to alter one record but leave another duplicate record unaltered.

???see note on the Cursors section to discuss SQLSetPos. Need non-ODBC term from Cursors overview>

See Also

DROP TRIGGER

CREATE USER

The CREATE USER statement creates a new user account in a database.

This function can be used to create a user account in a database with a password, without a password, or as member of a group.

Syntax

```
CREATE USER user-name [ WITH PASSWORD user-password ][ IN GROUP referencing-alias ]
```

Remarks

Note: This statement creates a user with the same rights as those of a user created using the Zen Control Center (ZenCC). For example, the created user is not restricted by default from creating a database even if the user is not logged in as Master.

Only the Master user can execute this statement.

Security must be turned on to perform this statement.

User-name and *user-password* here only refer to Zen databases and are not related to user names and passwords set at the operating system level. Zen user names, groups, and passwords can also be configured through the Zen Control Center (ZenCC).

User name must be unique in the dictionary.

The user name and password must be enclosed in double quotes if they contain spaces or other nonalphanumeric characters.

If you create a user as the member of a group, you must set up the group before creating the user.

For further general information about users and groups, see Master User and Users and Groups in *Advanced Operations Guide*, and Assigning Permissions Tasks in *Zen User's Guide*.

Examples

The following examples show how to create a new user account without any login privileges and without a membership in any group.

```
CREATE USER pgranger
```

The new user name is *pgranger*. The user password is NULL and the user account is not a member of any group.

```
CREATE USER "polly granger"
```

The new user name is *polly granger* with nonalphanumeric characters. The user password is NULL and the user account is not a member of any group.

============

The following examples show how to create a new user account with login privileges that is not a member of any group.

```
CREATE USER pgranger WITH PASSWORD Prvsve1
```

The new user name is *pgranger*. The user password is *Prsve1* (case-sensitive).

```
CREATE USER pgranger WITH PASSWORD "Nonalfa$"
```

The new user name is *pgranger*. The user password is *Nonalfa$* (case-sensitive) with nonalphanumeric characters.

============

The following example shows how create a new user as a member of a group without login privileges.

```
CREATE USER pgranger IN GROUP developers
```

The new user name is *pgranger*. The new user account is a assigned to the group *developers*.

============

The following example shows how create a new user as a member of a group with login privileges.

```
CREATE USER pgranger WITH PASSWORD Prvsve1 IN GROUP developers
```

The new user name is *pgranger*. The new user account is assigned to the group *developers* and has the case-sensitive password *Prvsve1*. The order of this syntax (`CREATE USER..WITH PASSWORD...IN GROUP`) is absolutely necessary.

See Also

ALTER USER, DROP USER, GRANT

CREATE VIEW

The CREATE VIEW statement defines a stored view or virtual table.

Syntax

```
CREATE VIEW view-name [ ( column-name [ , column-name ]...) ]

[ WITH EXECUTE AS 'MASTER' ] AS query-specification

[ ORDER BY order-by-expression [ , order-by-expression ]... ]


view-name ::= user-defined-name


column-name ::= user-defined-name


order-by-expression ::= expression [ CASE (string) | COLLATE collation-name ] [ ASC | DESC ] (see
SELECT syntax)
```

Remarks

A view is a database object that stores a query and behaves like a table. Data returned by a view is stored in one or more tables, referenced by SELECT statements. Rows and columns in the view are refreshed each time it is referenced.

See Identifier Restrictions in *Advanced Operations Guide* for the maximum length of a view name. The maximum number of columns in a view is 256. View definitions have a 64 KB limit.

Zen supports grouped views, defined as views using any of the following in the SELECT statement:

- DISTINCT
- GROUP BY
- ORDER BY
- Scalar Functions
- Scalar Subqueries
- TOP or LIMIT
- UNION

Grouped views may be used in a subquery provided that the subquery is an expression. A subquery is **not** considered an expression if it is connected with the operators IN, EXISTS, ALL, or ANY.

View definitions cannot contain procedures.

ORDER BY

ORDER BY in a view works the same way as in a SELECT statement. Note especially the following:

- You may use aliases in an ORDER BY clause.
- You may use scalar subqueries in an ORDER BY clause.
- The use of TOP or LIMIT is recommended in views that use ORDER BY.
- If the engine uses a temporary table to return the ordered result of ORDER BY and the query uses a dynamic cursor, then the cursor is converted to static. For example, temporary tables are always required when ORDER BY is used on an unindexed column. Forward-only and static cursors are not affected.

Trusted and Non-Trusted Views

A trusted view includes WITH EXECUTE AS 'MASTER'. See Trusted and Non-Trusted Objects.

Examples of Trusted and Non-Trusted Views

The following statement creates a non-trusted view named vw_Person, which creates a phone list of all the people enrolled in a university. This view lists the last names, first names and telephone numbers with a heading for each column. The Person table is part of the Demodata sample database.

```
CREATE VIEW vw_Person (lastn,firstn,phone) AS SELECT Last_Name, First_Name,Phone FROM Person
```

In a subsequent query on the view, you may use the column headings in your SELECT statement:

```
SELECT lastn, firstn FROM vw_Person
```

The user executing the view must have SELECT permissions on the Person table.

============

The following example creates a similar view, but a trusted one.

```
CREATE VIEW vw_trusted_Person (lastn,firstn,phone) WITH EXECUTE AS 'MASTER' AS SELECT Last_Name,
First_Name,Phone FROM Person
```

Now assume that to user1 you grant SELECT permissions on vw_Person. User1 can use the column headings in a SELECT statement:

```
SELECT lastn, firstn FROM vw_trusted_Person
```

User1 is not required to have SELECT permissions on the Person table because the permissions were granted to the trusted view.

============

The following statement creates a view named vw_Person, which creates a phone list of all the people enrolled in a university. This view lists the last names, first names and telephone numbers with a heading for each column. The Person table is part of the Demodata sample database.

```
CREATE VIEW vw_Person (lastn, firstn, telphone) AS SELECT Last_Name, First_Name, Phone FROM Person
```

In a subsequent query on the view, you may use the column headings in your SELECT statement, as shown in the next example.

```
SELECT lastn, firstn FROM vw_Person
```

============

The example above can be changed to include an ORDER BY clause.

```
CREATE VIEW vw_Person_ordby (lastn, firstn, telphone) AS SELECT Last_Name, First_Name, Phone FROM
Person ORDER BY phone
```

The view returns the following (for brevity, not all records are shown).

```
Last_Name   First_Name       Phone

=========   ==========   ==========

Vqyles      Rex          2105551871

Qulizada    Ahmad        2105552233

Ragadio     Ernest       2105554654

Luckey      Anthony      2105557628
```

============

The following example creates a view that returns the grade point average (GPA) of students in descending order, and, for each GPA ordering, lists the students by last name descending.

```
CREATE VIEW vw_gpa AS SELECT Last_Name,Left(First_Name,1) AS First_Initial,Cumulative_GPA AS GPA FROM
Person LEFT OUTER JOIN Student ON Person.ID=Student.ID ORDER BY Cumulative_GPA DESC, Last_Name
```

The view returns the following (for brevity, not all records are shown).

```
Last_Name                  First_Initial        GPA

=========================   ===============   ======

Abuali                     I                  4.000
```

```
Adachi                      K                   4.000
Badia                       S                   4.000
Rowan                       A                   4.000
Ujazdowski                  T                   4.000
Wotanowski                  H                   4.000
Gnat                        M                   3.998
Titus                       A                   3.998
Mugaas                      M                   3.995
```

============

This example creates a view that returns the top 10 records from the Person table, ordered by ID.

```
CREATE VIEW vw_top10 AS SELECT TOP 10 * FROM person ORDER BY id;
```

The view returns the following (for brevity, not all columns are shown).

```
ID           First_Name    Last_Name
=========    ==========    ==========
100062607    Janis         Nipart
100285859    Lisa          Tumbleson
100371731    Robert        Mazza
100592056    Andrew        Sugar
100647633    Robert        Reagen
100822381    Roosevelt     Bora
101042707    Avram         Japadjief

10 rows were affected.
```

============

The following example creates a view to demonstrate that ORDER BY can be used with UNION.

```
CREATE VIEW vw_union_ordby_desc AS SELECT first_name FROM person UNION SELECT last_name FROM PERSON
ORDER BY first_name DESC
```

The view returns the following (for brevity, not all records are shown).

```
First_Name
===========
Zyrowski
Zynda
```

```
Zydanowicz
```

```
Yzaguirre
```

```
Yyounce
```

```
Xystros
```

```
Xyois
```

```
Xu
```

```
Wyont
```

```
Wynalda
```

```
Wykes
```

See Also

DROP VIEW

SELECT

SET ROWCOUNT

Trusted and Non-Trusted Objects

DECLARE

Remarks

Use the DECLARE statement to define a SQL variable.

This statement is allowed only inside of a stored procedure, a user-defined function, or a trigger.

The name of a variable must begin with a colon (:) or an at sign (@), both in the definition and use of the variable or parameter. A variable must be declared before it can be set to a value with SET.

Use a separate DECLARE statement for each variable (you cannot declare multiple variables with a single statement). Specify a value or values for data types that require a size, precision, or scale, such as CHAR, DECIMAL, NUMERIC, and VARCHAR.

Examples

The following examples show how to declare variables, including ones that require a value for size, precision, or scale.

```
DECLARE :SaleItem CHAR(15);
```

```
DECLARE :CruiseLine CHAR(25) DEFAULT 'Open Seas Tours'
```

```
DECLARE :UnitWeight DECIMAL(10,3);
```

```
DECLARE :Titration NUMERIC(12,3);
```

```
DECLARE :ReasonForReturn VARCHAR(200);
```

```
DECLARE :Counter INTEGER = 0;
```

```
DECLARE :CurrentCapacity INTEGER = 9;
```

```
DECLARE :Cust_ID UNIQUEIDENTIFIER = NEWID()
```

```
DECLARE :ISO_ID UNIQUEIDENTIFIER = '1129619D-772C-AAAB-B221-00FF00FF0099'
```

See Also

CREATE FUNCTION

CREATE PROCEDURE

CREATE TRIGGER

SET

DECLARE CURSOR

The DECLARE CURSOR statement defines a SQL cursor.

Syntax

```
DECLARE cursor-name CURSOR FOR select-statement [ FOR UPDATE | FOR READ ONLY ]


cursor-name ::= user-defined-name
```

Remarks

The DECLARE statement is only allowed inside of a stored procedure or a trigger, since cursors and variables are only allowed inside of stored procedures and triggers.

The default behavior for cursors is read-only. Therefore, you must use FOR UPDATE to explicitly designate an update (write or delete).

Examples

The following example creates a cursor that selects values from the Degree, Residency, and Cost_Per_Credit columns in the Tuition table and orders them by ID number.

```
DECLARE BTUCursor CURSOR
FOR SELECT Degree, Residency, Cost_Per_Credit
FROM Tuition
ORDER BY ID;
```

============

The following example uses FOR UPDATE to ensure a delete.

```
CREATE PROCEDURE MyProc(IN :CourseName CHAR(7)) AS
BEGIN
   DECLARE c1 CURSOR FOR SELECT name FROM course WHERE name = :CourseName FOR UPDATE;
   OPEN c1;
   FETCH NEXT FROM c1 INTO :CourseName;
   DELETE WHERE CURRENT OF c1;
   CLOSE c1;
END;
```

```
CALL MyProc('HIS 305')
```

=============

```
DECLARE cursor1 CURSOR

FOR SELECT Degree, Residency, Cost_Per_Credit

FROM Tuition ORDER BY ID

FOR UPDATE;
```

See Also

CREATE PROCEDURE, CREATE TRIGGER

DEFAULT

A table may have one or more columns that do not allow a null value. To avoid errors, it can be useful to define the default contents for those columns so that in new records they always have valid values. To do this, use the DEFAULT keyword in CREATE or ALTER column definitions to set the column value to be used with INSERT and UPDATE statements when one or both of the following apply:

- No explicit column value is provided.
- A column does not allow a binary zero and requires a valid value other than a null.

Once a default column value is defined, then when you insert or update a row, you can use the DEFAULT keyword to provide its value in a VALUES clause.

To summarize, the DEFAULT keyword can be used in the following instances:

- Column definition of CREATE TABLE
- Column definition of ALTER TABLE
- VALUES clause of INSERT
- VALUES clause of UPDATE

The default value is a literal or an expression. In a CREATE TABLE or ALTER TABLE statement it must:

- Match the data type of the column
- Conform to any other constraint imposed on the column, such as range or length

In INSERT and UPDATE statements, for columns with a DEFAULT expression defined, Zen evaluates the expression and writes the result while inserting or updating. Note that for INSERT, the columns in existing records are unchanged.

Syntax

See the syntax for the following statements for use of the DEFAULT keyword:

- ALTER TABLE
- CREATE TABLE
- CREATE FUNCTION
- CREATE PROCEDURE
- INSERT

- UPDATE

Remarks

You can specify a literal value or expression as DEFAULT for any column as explained in the following topics:

- Restrictions on Identity Data Types
- Scalar Functions and Simple Expressions as Default Column Values
- Using DEFAULT with ALTER TABLE

Restrictions on Identity Data Types

For an IDENTITY, SMALLIDENTITY, or BIGIDENTITY data type column in a CREATE TABLE or ALTER TABLE statement, you may set a default value of zero (DEFAULT 0 or DEFAULT `'0'`). No other default value is permissible for these data types.

Scalar Functions and Simple Expressions as Default Column Values

In addition to literals and NULL values, Zen also allows you to define DEFAULT values using scalar functions and simple expressions so long as they return a value with the same data type as the column. For example, USER() can be used for string columns CHAR and VARCHAR. The returned value is evaluated at the time of its use in new INSERT and UPDATE statements.

The following example shows the use of DEFAULT with a simple expression and a variety of scalar functions:

```
CREATE TABLE DEFAULTSAMPLE (
   a INT DEFAULT 100,
   b DOUBLE DEFAULT PI(),
   c DATETIME DEFAULT NOW(),
   d CHAR(20) DEFAULT USER(),
   e VARCHAR(10) DEFAULT UPPER(DAYNAME(CURDATE())),
   f VARCHAR(40) DEFAULT '{'+CONVERT(NEWID(),SQL_VARCHAR)+'}',
   g INTEGER DEFAULT DAYOFYEAR(NOW())
   );
INSERT INTO DEFAULTSAMPLE DEFAULT VALUES;
SELECT * FROM TX;
          a                          b                                c   d
```

```
===========   =======================   ==============================   ===================
        100         3.141592653589793          2021-11-12 17:25:59.288   Master

e           f                                                  g
=========   =======================================   ==========
FRIDAY      {EF66F711-36D2-40FA-B928-BAFCC486DA6B}           316
```

Using DEFAULT with ALTER TABLE

If you are using ALTER TABLE to modify a column definition in order to add a DEFAULT attribute, you need to include any attributes already defined on the column, since using ALTER TABLE to modify a column does not add to its existing definition, but instead replaces it. Also, as shown in the following example, altering a column to change its DEFAULT value has no effect on any existing value:

```
CREATE TABLE Tab10 (a INT, b CHAR(20) CASE); --column b is case-insensitive
ALTER TABLE Tab10 ALTER COLUMN b CHAR(20) DEFAULT 'xyz'; --column b has a default but is no longer
case-insensitive
INSERT INTO Tab10 DEFAULT VALUES;
SELECT * FROM Tab10;
          a   b
===========   ====================
     (Null)   xyz
1 row was affected.
SELECT * FROM Tab10 WHERE b = 'XYZ'; --case doesn't match so no row returned
          a   b
===========   ====================
0 rows were affected.
ALTER TABLE Tab10 ALTER COLUMN b CHAR(20) CASE DEFAULT 'xyz';  --column b is now case-insensitive
*and* has a default
SELECT * FROM Tab10 WHERE b = 'XYZ'; --case doesn't need to match
          a   b
===========   ====================
     (Null)   xyz
1 row was affected.
```

Examples

The following statement creates table Tab5. The default value of the col5 column is 200.

```
CREATE TABLE Tab5

(col5 INT DEFAULT 200)
```

============

This statement creates table Tab1 where column col1 is the DATE part of the result returned by NOW().

```
CREATE TABLE Tab1

(col1 DATE DEFAULT NOW())
```

============

This statement creates table Tab8 where column col8 is the time of the INSERT or UPDATE.

```
CREATE TABLE Tab8

(col8 TIMESTAMP DEFAULT CURRENT_TIMESTAMP())
```

============

The following statement creates table Tab6 where column col6 is the user name after an INSERT or UPDATE. DEFAULT USER is practical only with security enabled. Otherwise USER is always NULL. The keyword USER gives the same result as the USER() function.

```
CREATE TABLE Tab6

(col6 VARCHAR(20) DEFAULT USER)
```

============

The following statement shows an **invalid** example. It results in a parse-time error because TIME is not an allowed data type for a DATE column.

```
CREATE TABLE Tab

(col DATE DEFAULT CURTIME())
```

============

The following statement shows an **invalid** example. It results in a parse-time error because although '3.1' is convertible to a number, it is not a valid integer.

```
CREATE TABLE Tab

(col SMALLINT DEFAULT '3.1')
```

============

The following statement shows an **invalid** example. The CREATE TABLE statement succeeds, but the INSERT statement fails because -60000 is outside of the range supported by SMALLINT.

```
CREATE TABLE Tab
```

```
(col SMALLINT DEFAULT 3 * -20000)
```

```
INSERT INTO Tab values(DEFAULT)
```

============

The following statements show **valid** examples of setting a default value of zero for an IDENTITY and a SMALLIDENTITY data type.

```
CREATE TABLE t1 ( c1 IDENTITY DEFAULT '0' )
```

```
ALTER TABLE t1 ALTER c1 SMALLIDENTITY DEFAULT 0
```

============

The following statements show **invalid** examples of setting a default value for an IDENTITY and a SMALLIDENTITY data type.

```
CREATE TABLE t1 ( c1 IDENTITY DEFAULT 3 )
```

```
ALTER TABLE t1 ALTER c1 SMALLIDENTITY DEFAULT 1
```

See Also

ALTER TABLE

CREATE TABLE

CREATE FUNCTION

CREATE PROCEDURE

INSERT

UPDATE

DELETE (positioned)

Use the positioned DELETE statement to remove the current row of a view associated with a SQL cursor.

Syntax

```
DELETE WHERE CURRENT OF cursor-name

cursor-name ::= user-defined-name
```

Remarks

This statement is allowed in stored procedures, triggers, and at the session level.

Note: Even though positioned DELETE is allowed at the session level, the DECLARE CURSOR statement is not. The method to obtain the cursor name of the active result set depends on the Zen access method your application uses. See the Zen documentation for that access method.

Examples

The following sequence of statements provide the setting for the positioned DELETE statement. The required statements for the positioned DELETE statement are DECLARE CURSOR, OPEN CURSOR, and FETCH FROM *cursorname*.

The Modern European History class has been dropped from the schedule, so this example deletes the row for Modern European History (HIS 305) from the Course table in the sample database:

```
CREATE PROCEDURE DropClass();
DECLARE :CourseName CHAR(7);
DECLARE c1 CURSOR
FOR SELECT name FROM COURSE WHERE name = :CourseName;
BEGIN
    SET :CourseName = 'HIS 305';
    OPEN c1;
    FETCH NEXT FROM c1 INTO :CourseName;
    DELETE WHERE CURRENT OF c1;
END;
```

See Also

CREATE PROCEDURE

CREATE TRIGGER

DELETE

This statement deletes specified rows from a database table or view.

Syntax

```
DELETE [ FROM ] < table-name | view-name > [ alias-name ]
[ FROM table-reference [, table-reference ] ...
[ WHERE search-condition ]


table-name ::= user-defined-name


view-name ::= user-defined-name


alias-name ::= user-defined-name (Alias-name is not allowed if a second FROM clause is used. See
FROM Clause.)


table-reference ::= { OJ outer-join-definition }

    | [db-name.]table-name [ [ AS ] alias-name ]

    | [db-name.]view-name [ [ AS ] alias-name ]

    | join-definition

    | ( join-definition )

    | ( table-subquery )[ AS ] alias-name [ (column-name [ , column-name ]... ) ]


outer-join-definition ::= table-reference outer-join-type JOIN table-reference ON search-condition


outer-join-type ::= LEFT [ OUTER ] | RIGHT [ OUTER ] | FULL [ OUTER ]


search-condition ::= search-condition AND search-condition

    | search-condition OR search-condition

    | NOT search-condition

    | ( search-condition )

    | predicate


db-name ::= user-defined-name
```

```
view-name ::= user-defined-name

join-definition ::= table-reference [ join-type ] JOIN table-reference ON search-condition

    | table-reference CROSS JOIN table-reference

    | outer-join-definition

join-type ::= INNER | LEFT [ OUTER ] | RIGHT [ OUTER ] | FULL [ OUTER ]

table-subquery ::= query-specification [ [ UNION [ ALL ]
query-specification ]... ]
```

Remarks

DELETE statements, as with INSERT and UPDATE, behave in an atomic manner. That is, if a deletion of more than one row fails, then all deletions of previous rows by the same statement are rolled back.

FROM Clause

Some confusion may arise pertaining to the second optional FROM clause and references to the table whose rows are being deleted (referred to as the "delete table"). If the delete table occurs in the second FROM clause, then one of the occurrences is the same instance of the table whose rows are being deleted.

For example, in the statement `DELETE t1 FROM t1, t2 WHERE t1.c1 = t2.c1`, the t1 immediately after DELETE is the same instance of table t1 as the t1 after FROM. Therefore, the statement is identical to `DELETE t1 FROM t2 WHERE t1.c1 = t2.c1`.

If the delete table occurs in the second FROM clause multiple times, one occurrence must be identified as the same instance as the delete table. The second FROM clause reference that is identified as the same instance as the delete table is the one that does **not** have a specified alias.

Therefore, the statement `DELETE t1 FROM t1 a, t1 b WHERE a.c1 = b.c1` is invalid because both instances of t1 in the second FROM clause contain an alias. The following version is valid: `DELETE t1 FROM t1, t1 b WHERE t1.c1 = b.c1`.

The following conditions apply to the second FROM clause:

- If the DELETE statement contains an optional second FROM clause, the table reference prior to the FROM clause cannot have an alias specified. For example, `DELETE t1 a FROM t2 WHERE a.c1 = t2.c1` returns the following error:

```
SQL_ERROR (-1)
```

```
SQLSTATE of "37000"
```

```
"Table alias not allowed in UPDATE/DELETE statement with optional FROM."
```

  A valid version of the statement is `DELETE t1 FROM t2 WHERE t1.c1 = t2.c1` or `DELETE t1 FROM t1 a, t2 WHERE a.c1 = t2.c1`.

- If more than one reference to the delete table appears in the second FROM clause, then only one of the references can have a specified alias. For example, `DELETE t1 FROM t1 a, t1 b WHERE a.c1 = b.c1` returns the following error:

```
SQL_ERROR (-1)
```

```
SQLSTATE of "37000"
```

```
"The table t1 is ambiguous."
```

  In the erroneous statement, assume that you want table t1 with alias "a" to be the same instance of the delete table. A valid version of the statement is `DELETE t1 FROM t1, t1 b WHERE t1.c1 = b.c1`.

- The second FROM clause is supported in a DELETE statement only at the session level. The FROM clause is **not** supported if the DELETE statement occurs within a stored procedure.

Examples

The following statement deletes the row for first name Ellen from the person table in the sample database.

```
DELETE FROM person WHERE First_Name = 'Ellen'
```

The following statement deletes the row for Modern European History (HIS 305) from the course table in the sample database:

```
DELETE FROM Course WHERE Name = 'HIS 305'
```

DISTINCT

Include the DISTINCT keyword in your SELECT statement to remove duplicate values from the result. By using DISTINCT, you can retrieve all unique rows that match the selection.

The following rules apply:

- Zen supports DISTINCT in subqueries.
- DISTINCT is ignored if the selection list contains an aggregate. Aggregation already guarantees no duplicate result rows.

Examples

The following statements retrieve all courses taught by faculty ID 111191115. The second statement uses DISTINCT to eliminate rows with duplicate column values.

```
SELECT c.Name, c.Description
FROM Course c, class cl
WHERE c.name = cl.name AND cl.faculty_id = '111191115';

Name      Description
=======   ==================================================
CHE 203   Chemical Concepts and Properties I
CHE 203   Chemical Concepts and Properties I
CHE 205   Chemical Concepts and Properties II
CHE 205   Chemical Concepts and Properties II


SELECT DISTINCT c.Name, c.Description
FROM Course c, class cl
WHERE c.name = cl.name AND cl.faculty_id = '111191115';

Name      Description
=======   ==================================================
CHE 203   Chemical Concepts and Properties I
CHE 205   Chemical Concepts and Properties II
```

Note: The following use of DISTINCT is not allowed:

```
SELECT DISTINCT column1, DISTINCT column2
```

See Also

SELECT

For other uses of DISTINCT, see DISTINCT in Aggregate Functions.

DROP DATABASE

The DROP DATABASE statement deletes a database. Only the Master user can issue this statement.

Syntax

```
DROP DATABASE [ IF EXISTS ] database-name [ DELETE FILES ]

database-name ::= user-defined-name
```

Remarks

As Master user, you must be logged on to a database to issue the statement. The DROP DATABASE statement can be used to drop any database, including the one to which you are currently logged on, provided the security setting permits deletion. See Secured Databases below.

DROP DATABASE cannot be used to delete system databases such as defaultdb and tempdb. The statement can be used to delete the last remaining user-defined database if you choose, security permitting.

The DROP DATABASE statement cannot be used in a stored procedure or in a user-defined function.

The expression IF EXISTS causes the statement to return success instead of an error if a database does not exist. IF EXISTS does not suppress other errors.

Secured Databases

You cannot delete a database secured with the Database security model. You *can* delete a database secured with any of the following ways:

- Classic security
- Mixed security
- Relational security (Master password) in combination with Classic or Mixed security

For more information, see Zen Security in *Advanced Operations Guide*.

DELETE FILES

The DELETE FILES clause is for deleting data dictionary files (DDFs). Data files are not deleted.

If DELETE FILES is omitted, the DDFs remain on physical storage, but the database name is deleted from dbnames.cfg. Once the name is removed from dbnames.cfg, the database no longer exists to the database engine. Retaining the DDFs allows you to recreate the database should you so choose.

Note that the DDFs must not be in use to delete them. If you have Zen Control Center open, for example, a "file is locked" error returns if you use the DELETE FILES clause. While ZenCC is open, the DDFs are considered to be in use, which prevents their deletion.

Examples

The following example deletes a database named inventorydb from dbnames.cfg, but it retains the database DDFs (and data files) in physical storage.

```
DROP DATABASE inventorydb
```

============

The following example deletes a database named HRUSBenefits and its DDFs. Data files are retained for HRUSBenefits.

```
DROP DATABASE HRUSBenefits DELETE FILES
```

See Also

CREATE DATABASE

DROP FUNCTION

The DROP FUNCTION statement removes an existing user-defined function (UDF) from the database.

Note: An error message appears if you attempt to delete a UDF that does not exist.

Syntax

```
DROP FUNCTION [ IF EXISTS ] { function_name }


function_name ::= Name of the user-defined function to be removed.
```

Remarks

The expression IF EXISTS causes the statement to return success instead of an error if a function does not exist. IF EXISTS does not suppress other errors.

Examples

The following statement drops UDF fn_MyFunc from the database.

```
DROP FUNCTION fn_MyFunc
```

See Also

CREATE FUNCTION

DROP GROUP

This statement removes one or more groups in a secured database.

Syntax

```
DROP GROUP [ IF EXISTS ] group-name [ , group-name ]...
```

Remarks

Only the Master user can perform this statement. Separate multiple group names with a comma. A group must be empty to be dropped.

Security must be turned on to perform this statement.

The expression IF EXISTS causes the statement to return success instead of an error if a group does not exist. IF EXISTS does not suppress other errors.

Examples

The following example drops the group zengroup.

```
DROP GROUP zengroup
```

The following example uses a list to drop groups.

```
DROP GROUP zen_dev, zen_marketing
```

See Also

ALTER GROUP

CREATE GROUP

DROP INDEX

This statement drops a specific index from a designated table.

Syntax

```
DROP INDEX [ IF EXISTS ] [ table-name.]index-name [ IN DICTIONARY ]

table-name ::= user-defined-name

index-name ::= user-defined-name
```

Remarks

IN DICTIONARY is an advanced feature that should be used only by system administrators and when absolutely necessary. The IN DICTIONARY keyword allows you to drop an index from a DDF without removing the index from the underlying data file. Normally, Zen keeps DDFs and data files tightly synchronized, but this feature allows users the flexibility to force out-of-sync table dictionary definitions to match an existing data file. This can be useful when you want to create a new definition in the dictionary to match an existing data file.

Caution! Modifying a DDF without performing corresponding modifications to the underlying data file can cause serious problems.

The expression IF EXISTS causes the statement to return success instead of an error if an index does not exist. IF EXISTS does not suppress other errors.

For more information on this feature, see the discussion under IN DICTIONARY.

Partial Indexes

When dropping partial indexes, the PARTIAL modifier is not required.

Examples

The following statement drops the named index from the Faculty table.

```
DROP INDEX Faculty.Dept
```

=============

The following examples create a detached table, one with no associated data file, then add and drop an index from the table definition. The index is a detached index because there is no underlying Btrieve index associated with it.

```
CREATE TABLE t1 IN DICTIONARY (c1 int, c2 int)
```

```
CREATE INDEX idx_1 IN DICTIONARY on t1(c1)
```

```
DROP INDEX t1.idx_1 IN DICTIONARY
```

See Also

CREATE INDEX

DROP PROCEDURE

This statement removes one or more stored procedures from the current database.

Syntax

```
DROP PROCEDURE [ IF EXISTS ] procedure-name
```

Remarks

The expression IF EXISTS causes the statement to return success instead of an error if a procedure does not exist. IF EXISTS does not suppress other errors.

Examples

The following statement drops the stored procedure myproc from the dictionary:

```
DROP PROCEDURE myproc
```

See Also

CREATE PROCEDURE

DROP TABLE

This statement removes a table from a designated database.

Syntax

```
DROP TABLE [ IF EXISTS ] table-name [ IN DICTIONARY ]

table-name ::= user-defined-name for the table to be removed

IN DICTIONARY
```

See the discussion of IN DICTIONARY for ALTER TABLE.

Remarks

CASCADE and RESTRICT are not supported.

If any triggers depend on the table, the table is not dropped.

If a transaction is in progress and refers to the table, then an error is signaled and the table is not dropped.

The drop of table fails if other tables depend on the table to be dropped.

If a primary key exists, it is dropped. The user need not drop the primary key before dropping the table. If the primary key of the table is referenced by a constraint belonging to another table, then the table is not dropped and an error is signaled.

If the table has any foreign keys, then those foreign keys are dropped.

If the table has any other constraints (for example, NOT NULL, CHECK, UNIQUE, or NOT MODIFIABLE), then those constraints are dropped when the table is dropped.

The expression IF EXISTS causes the statement to return success instead of an error if a table does not exist. IF EXISTS does not suppress other errors.

Examples

The following statement drops the class table definition from the dictionary.

```
DROP TABLE Class
```

See Also

ALTER TABLE

CREATE TABLE

DROP TRIGGER

This statement removes a trigger from the current database.

Syntax

```
DROP TRIGGER [ IF EXISTS ] trigger-name
```

Remarks

The expression IF EXISTS causes the statement to return success instead of an error if a trigger does not exist. IF EXISTS does not suppress other errors.

Examples

The following example drops the trigger named InsTrig.

```
DROP TRIGGER InsTrig
```

See Also

CREATE TRIGGER

DROP USER

The DROP USER statement removes user accounts from a database.

Syntax

```
DROP USER [ IF EXISTS ] user-name [ , user-name ]...
```

Remarks

Only the Master user can execute this statement.

Security must be turned on to perform this statement.

Separate multiple user names with a comma.

If the user name contains spaces or other nonalphanumeric characters, it must be enclosed in double quotation marks.

Dropping a user account does not delete the tables, views, or other database objects created by the user.

The expression IF EXISTS causes the statement to return success instead of an error if a user does not exist. IF EXISTS does not suppress other errors.

For further general information about users and groups, see Master User and Users and Groups in *Advanced Operations Guide*, and Assigning Permissions Tasks in *Zen User's Guide*.

Examples

The following example removes the user account *pgranger*.

```
DROP USER pgranger
```

============

The following example removes multiple user accounts.

```
DROP USER pgranger, "lester pelling"
```

See Also

ALTER USER

CREATE USER

DROP VIEW

This statement removes a specified view from the database.

Syntax

```
DROP VIEW [ IF EXISTS ] view-name

view-name ::= user-defined name
```

Remarks

[**CASCADE** | **RESTRICT**] is not supported.

The expression IF EXISTS causes the statement to return success instead of an error if a view does not exist. IF EXISTS does not suppress other errors.

Examples

The following statement drops the vw_person view definition from the dictionary.

```
DROP VIEW vw_person
```

See Also

CREATE VIEW

END

Remarks

See the discussion for BEGIN [ATOMIC].

EXECUTE

The EXECUTE statement has two uses:

- To invoke a user-defined procedure or a system stored procedure. You may use EXECUTE in place of the CALL statement
- To execute a character string, or an expression that returns a character string, within a stored procedure.

Syntax

To invoke a stored procedure:

```
EXEC[UTE] stored-procedure [ ( [ procedure-parameter [ , procedure-parameter ]... ] ) ]

stored-procedure ::= the name of a stored procedure

procedure-parameter ::= the input parameters required by the stored procedure

```

Within a user-defined stored procedure:

```
EXEC[UTE] ( string [ + string ]... )

string ::= a string, string variable, or an expression that returns a character string
```

Remarks

The stored procedure syntax `EXEC[UTE] (string...)` does not support NCHAR values for literals and variables. Values used in constructing the string are converted to CHAR values before execution.

Examples

The following example executes a procedure without parameters:

```
EXEC NoParms() or CALL NoParms
```

The following examples execute a procedure with parameters:

```
EXEC Parms(vParm1, vParm2)
```

```
EXECUTE CheckMax(N.Class_ID)
```

============

The following procedure selects the student ID from the Billing table.

```
CREATE PROCEDURE tmpProc(IN :vTable CHAR(25)) RETURNS (sID INTEGER) AS
BEGIN
    EXEC ('SELECT Student_ID FROM ' + :vtable);
END;
EXECUTE tmpProc('Billing')
```

See Also

CALL

CREATE PROCEDURE

System Stored Procedures

EXISTS

The EXISTS keyword tests whether rows exist in the result of a subquery. True is returned if the subquery contains any rows.

Syntax

```
EXISTS ( subquery )
```

Remarks

For every row the outer query evaluates, Zen tests for the existence of a related row from the subquery. Zen includes in the statement's result table each row from the outer query that corresponds to a related row from the subquery.

You may use EXISTS for a subquery within a stored procedure. However, the subquery SELECT statement within the stored procedure may not contain a COMPUTE clause or the INTO keyword.

In most cases, a subquery with EXISTS can be rewritten to use IN. Zen can process the query more efficiently if the query uses IN.

Examples

The following statement returns a list containing only persons who have a 4.0 grade point average:

```
SELECT * FROM Person p WHERE EXISTS
(SELECT * FROM Enrolls e WHERE e.Student_ID = p.id
AND Grade = 4.0)
```

This statement can be rewritten to use IN:

```
SELECT * FROM Person p WHERE p.id IN
(SELECT e.Student_ID FROM Enrolls WHERE Grade = 4.0)
```

============

The following procedure selects the ID from the Person table using a value as an input parameter. The first EXEC of the procedure returns "Exists returned true." The second EXEC returns "Exists returned false."

```
CREATE PROCEDURE ex1(IN :vID INTEGER) RETURNS ( d1 VARCHAR(30) ) AS
BEGIN
    IF EXISTS (SELECT id FROM person WHERE id < :vID)
       THEN PRINT 'Exists returned true';
      ELSE PRINT 'Exists returned false';
    END IF;
END;
EXEC ex1(222222222);
EXEC ex1(1);
```

See Also

SELECT

FETCH

Syntax

```
FETCH [ [NEXT] FROM ] cursor-name INTO variable-name

cursor-name ::= user-defined-name
```

Remarks

A FETCH statement positions a SQL cursor on a specified row of a table and retrieves values from that row by placing them into the variables in a target list.

You may choose to omit the NEXT and FROM keywords while fetching data from any cursor.

Note: Zen supports only the forward-only cursor. So, you will not be able to control the flow of the cursor records even by omitting NEXT FROM.

Examples

The FETCH statement in this example retrieves values from cursor c1 into the CourseName variable. The Positioned UPDATE statement in this example updates the row for Modern European History (HIS 305) in the Course table in the Demodata sample database:

```
CREATE PROCEDURE UpdateClass();
BEGIN
    DECLARE :CourseName CHAR(7);
    DECLARE :OldName CHAR(7);
    DECLARE  c1 CURSOR FOR SELECT name FROM course WHERE name = :CourseName;
    OPEN c1;
    SET :CourseName = 'HIS 305';
    FETCH NEXT FROM c1 INTO :OldName;
    UPDATE SET name = 'HIS 306' WHERE CURRENT OF c1;
END;
```

============

```
CREATE PROCEDURE MyProc(OUT :CourseName CHAR(7)) AS
BEGIN
```

```
    DECLARE cursor1 CURSOR
    FOR SELECT Degree, Residency, Cost_Per_Credit FROM Tuition ORDER BY ID;
    OPEN cursor1;
    FETCH NEXT FROM cursor1 INTO :CourseName;
    CLOSE cursor1;
END
```

See Also

CREATE PROCEDURE

FOREIGN KEY

Remarks

Include the FOREIGN KEY keywords in the ADD clause to add a foreign key to a table definition.

Note: You must be logged in to the database using a database name before you can add a foreign key or conduct any other referential integrity (RI) operation. Also, when security is enabled, you must have the Reference right on the table to which the foreign key refers before you can add the key.

Include a FOREIGN KEY clause in your CREATE TABLE statement to define a foreign key on a dependent table. In addition to specifying a list of columns for the key, you can define a name for the key.

The columns in the foreign key column may be nullable. However, ensure that pseudo-null columns do not exist in an index that does not index pseudo-null values.

The foreign key name must be unique in the dictionary. If you omit the foreign key name, Zen uses the name of the first column in the key as the foreign key name. This can cause a duplicate foreign key name error if your dictionary already contains a foreign key with that name.

When you specify a foreign key, Zen creates an index on the columns that make up the key. This index has the same attributes as the index on the corresponding primary key except that it allows duplicate values. To assign other attributes to the index, create it explicitly using a CREATE INDEX statement. Then, define the foreign key with an ALTER TABLE statement. When you create the index, ensure that it does not allow null values and that its case and collating sequence attributes match those of the index on the corresponding primary key column.

The columns in a foreign key must be the same data types and lengths and in the same order as the referenced columns in the primary key. The only exception is that you can use an integer column in the foreign key to refer to an IDENTITY, SMALLIDENTITY, or BIGIDENTITY column in the primary key. In this case, the two columns must be the same length.

Zen checks for anomalies in the foreign keys before it creates the table. If it finds conditions that violate previously defined referential integrity (RI) constraints, it generates a status code and does not create the table.

Note: When you create a foreign key on a table that already contains data, Zen does not validate the data values already present in the foreign key columns and those in the primary key columns.

This constraint applies to an INSERT, UPDATE, or DELETE action made after the foreign key is created.

When you define a foreign key, you must include a REFERENCES clause indicating the name of the table that contains the corresponding primary key. The primary key in the parent table must already be defined. In addition, if security is enabled on the database, you must have the Reference right on the table that contains the primary key.

You cannot create a self-referencing foreign key with the CREATE TABLE statement. Use an ALTER TABLE statement to create a foreign key that references the primary key in the same table.

Also, you cannot create a primary key and a foreign key on the same set of columns in a single statement. Therefore, if the primary key of the table you are creating is also a foreign key on another table, you must use an ALTER TABLE statement to create the foreign key.

Examples

The following statement adds a new foreign key to the Class table. (The Faculty column is defined as an index that does not include null values.)

```
ALTER TABLE Class ADD CONSTRAINT Teacher FOREIGN KEY (Faculty_ID) REFERENCES Faculty ON DELETE
RESTRICT
```

In this example, the restrict rule for deletions prevents someone from removing a faculty member from the database without first either changing or deleting all of that faculty's classes.

See Also

ALTER TABLE

CREATE TABLE

GRANT

In a secured database, use the GRANT statement to manage access permissions for tables, views, and stored procedures. GRANT can give users rights to these permissions, can create new users, and can assign the users to existing user groups. If needed, use CREATE GROUP to create a new group before using GRANT.

The following topics cover use of GRANT statements:

- GRANT LOGIN TO
- Constraints on Permissions
- GRANT and Data Security

Syntax

```
GRANT CREATETAB | CREATEVIEW | CREATESP TO public-or-user-or-group-name [ , user-or-group-name ]...

GRANT LOGIN TO user_and_password [ , user_and_password ]... [ IN GROUP group-name ]

GRANT permission ON < * | [ TABLE ] table-name [ owner-name ] | VIEW view-name | PROCEDURE
stored_procedure-name >
TO user-or-group-name [ , user-or-group-name ]...

* ::= all of the objects (that is, all tables, views, and stored procedures)

permission ::=   ALL
    | ALTER
    | DELETE
    | INSERT [ ( table-column-name [ , table-column-name ]... ) ]
    | REFERENCES
    | SELECT [ ( table-column-name [ , table-column-name ]... ) ]
    | UPDATE [ ( table-column-name [ , table-column-name ]... ) ]
    | EXECUTE

table-name ::= user-defined table-name
```

```
owner-name ::= user-defined owner name

view-name ::= user-defined view-name

stored-procedure-name ::= user-defined stored_procedure-name

user_and_password ::= user-name [ : ] password

public-or-user-or-group-name ::= PUBLIC | user-or-group-name

user-or-group-name ::= user-name | group-name

user-name ::= user-defined user name

table-column-name ::= user-defined column name (tables only)
```

Remarks

CREATETAB, CREATESP, CREATEVIEW, and LOGIN TO keywords are extensions to the SQL grammar. You can use the GRANT statement to grant privileges for CREATE TABLE, CREATE VIEW, and CREATE PROCEDURE. The following table lists the syntax for a given action.

To GRANT Privileges for This Action	Use This Keyword with GRANT
CREATE TABLE	CREATETAB
CREATE VIEW	CREATEVIEW
CREATE PROCEDURE	CREATESP
LOGIN AS GROUP MEMBER	LOGIN TO

CREATETAB, CREATEVIEW, and CREATESP must be explicitly granted. These privileges are not included as part of a GRANT ALL statement.

GRANT LOGIN TO

GRANT LOGIN TO creates a user and allows that user to access the secured database. You must specify a user name and password to create a user. Optionally, you can use an existing group for the user, or use CREATE GROUP to create a new group, before using GRANT LOGIN TO.

Constraints on Permissions

The following constraints apply to permissions on objects:

- By Object Type
- ALL Keyword

By Object Type

The following table shows permissions applicable to object type.

Permission	Table[1]	View[1]	Stored Procedure
CREATETAB	X		
CREATEVIEW		X	
CREATESP			X
ALTER[2]	X	X	X
DELETE	X	X	
INSERT	X	X	
REFERENCES	X		
SELECT	X	X	
UPDATE	X	X	
EXECUTE[3]			X

[1] Columns can be specified only for tables. Permissions for a view can be granted only to the entire view, not to single columns.

[2] To drop a table, view, or stored procedure, a user must have ALTER permission on that object. Trusted views and stored procedures can be dropped only by the Master user.

[3] EXECUTE applies only to stored procedures. A stored procedure can be executed with either a CALL or an EXECUTE statement. The procedure can be trusted or non-trusted. See Trusted and Non-Trusted Objects.

ALL Keyword

The following table presents permissions granted by ALL with Object Type.

Permission Included by ALL	Table	View	Stored Procedure
ALTER[1]	X	X	X
DELETE	X	X	
INSERT	X	X	
REFERENCES	X		
SELECT	X	X	
UPDATE	X	X	
EXECUTE			X

[1]To drop a table, view, or stored procedure, a user must have ALTER permission on that object. Trusted views and stored procedures can be dropped only by the Master user.

For example, if you issue GRANT ALL ON * to User1, then User1 has all permissions listed in the table.

If you issue GRANT ALL ON VIEW myview1 TO User2, then User2 has ALTER, DELETE, INSERT, UPDATE, and SELECT permissions on myview1.

GRANT and Data Security

The following topics provide cover particular uses of GRANT to manage data security:

- Granting Privileges to Users and Groups
- Granting Access Using Owner Names

Granting Privileges to Users and Groups

Relational security is based on the existence of a default user named Master who has full access to the database when security is turned on. When you turn security on, you will be required to specify a password for the Master user.

Security must be turned on to perform this statement.

The Master user can create groups and other users using the GRANT LOGIN TO, CREATE USER, or CREATE GROUP commands and manage data access for these groups and users.

If you want to grant the same privileges to all users, you can grant them to the PUBLIC group. All users inherit the default privileges assigned to the PUBLIC group.

Note: If you wish to use groups, you must set up the groups before creating users.

User name and password must be enclosed in double quotes if they contain spaces or other nonalphanumeric characters.

For further general information about users and groups, see Master User and Users and Groups in *Advanced Operations Guide*, and Assigning Permissions Tasks in *Zen User's Guide*.

Granting Access Using Owner Names

An owner name is a string of bytes that unlocks access to a Btrieve file. Btrieve owner names have no connection with any operating system or database user name but rather serve as a file access password. For more information, see Owner Names.

If a Btrieve file that serves as a table in a secure SQL database has an owner name, the database Master user must provide that owner name in a GRANT statement to authorize access to the table, including for the Master user itself.

After the Master user has executed a GRANT statement for a user, that user can access the table, without having to give the owner name, simply by logging into the database. This authorization lasts for the duration of the current database connection. Also note that the SET OWNER statement allows you to specify one or more owner names for the connection session. See SET OWNER.

If a user tries to run SQL commands on a table that has an owner name, access is refused unless the Master user has granted rights to the table for that user by using the owner name in a GRANT statement.

If a table has an owner name with the read-only setting chosen, all users have SELECT rights on the table.

Permissions on Views and Stored Procedures

Views and stored procedures can be trusted or non-trusted, depending on how you want to handle the permissions for the objects referenced by the view or stored procedure.

Trusted and Non-Trusted Objects

Views and stored procedures reference objects, such as tables, other views or other stored procedures. Granting permissions on every referenced object could become highly time consuming depending on the number of objects and users. A simpler approach for many situations is the concept of a trusted view or stored procedure.

A *trusted* view or stored procedure is one that can be executed without having to explicitly set permissions for each referenced object. For example, if trusted view myview1 references tables t1 and t2, the Master user can grant permissions for myview1 without having to grant them for t1 and t2.

A *non-trusted* view or stored procedure is one that cannot be executed without having to explicitly set permissions for each referenced object.

The following table compares characteristics of trusted and non-trusted objects.

Object	Characteristic	Notes
Trusted view or **trusted** stored procedure	Requires V2 metadata	See Zen Metadata.
	Requires WITH EXECUTE AS 'MASTER' clause in CREATE statement	See CREATE VIEW and CREATE PROCEDURE.
	Only Master user can create the object	See Master User in *Advanced Operations Guide*.
	Only Master user can delete the object	See DROP VIEW and DROP PROCEDURE
	Master user must grant object permissions to other users	By default, only the Master user can access trusted views or stored procedures and must grant permissions to them.
	GRANT and REVOKE statements applicable to object	See also REVOKE.
	Object can exist in a secured or in an unsecured database	See Zen Security in *Advanced Operations Guide*.
	Changing a trusted object to a non-trusted one (or vice versa) requires deletion then recreation of object	The ALTER statement for a view or stored procedure cannot be used to add or remove the trusted characteristic of the object. If you need to change a trusted object to a non-trusted one, you must first delete the object then recreate it without the WITH EXECUTE AS 'MASTER' clause. Similarly, if you need to change a non-trusted object to a trusted one, you must first delete the object then recreate it with the WITH EXECUTE AS 'MASTER' clause.

Object	Characteristic	Notes
Non-trusted view or **non-trusted** stored procedures	Any user can create the object	User must be granted CREATEVIEW or CREATESP privilege. See Remarks.
	Any user can delete the object	User must be granted ALTER permission on the view or stored procedure. See GRANT.
	ALTER permission required to delete the object	ALTER permission is also required to delete a table. Note that, by default, only the Master user can delete trusted objects. Users (other than Master) who did not create the view or stored procedure must be granted ALTER permissions to delete the view or stored procedure.
	All users, by default, have all permissions for the object	For V2 metadata, if an unsecured database contains non-trusted objects, all permissions for the non-trusted objects are automatically granted to PUBLIC if security is enabled on the database.
	User executing the view or stored procedure needs permissions for the objects referenced by the view or stored procedure	The user must also have permissions on the top-most object. That is, on the view or stored procedure that references the other objects.
	GRANT and REVOKE statements applicable to object	See GRANT and REVOKE.
	Object can exist in a secured or in an unsecured database	See Zen Security in *Advanced Operations Guide*.
	Changing a trusted object to a non-trusted one (or vice versa) requires deletion then recreation of object	Same as above for trusted view or trusted stored procedure.

Examples

This section provides a number of examples of GRANT.

A GRANT ALL statement grants the INSERT, UPDATE, ALTER, SELECT, DELETE and REFERENCES privileges to the specified user or group. In addition, the user or group is granted the CREATE TABLE right for the dictionary. The following statement grants all of these permissions to user *dannyd* for table *Class*.

```
GRANT ALL ON Class TO dannyd
```

============

The following statement grants ALTER permission to user *debieq* for table *Class*.

```
GRANT ALTER ON Class TO debieq
```

============

The following statement gives INSERT permission to *keithv* and *miked* for table *Class*. The table has an owner name of *winsvr644AdminGrp*.

```
GRANT INSERT ON Class winsvr644AdminGrp TO keithv, miked
```

============

The following statement gives INSERT permission to *keithv* and *miked* for table *Class*.

```
GRANT INSERT ON Class TO keithv, miked
```

============

The following statement grants INSERT permission on two columns, First_name and Last_name, in the *Person* table to users *keithv* and *brendanb*

```
GRANT INSERT(First_name,last_name) ON Person to keithv,brendanb
```

============

The following statement grants CREATE TABLE rights to users aideenw and punitas

```
GRANT CREATETAB TO aideenw, punitas
```

============

The following GRANT LOGIN TO statement grants login rights to a user named *ravi* and specifies his password as *password*.

```
GRANT LOGIN TO ravi:password
```

Note: If the a user account that is granted login rights using the GRANT LOGIN TO statement does not currently exist, then it is created.

If GRANT LOGIN is used in a stored procedure, you must separate the user name and password with a space character and not with the colon character. The colon character is used to identify local variables in a stored procedure.

The user name and password here refer *only* to Zen databases and are not related to user names and passwords used for operating system or network authentication. Zen user names, groups, and passwords can also be set through Zen Control Center (ZenCC).

The following example grants login rights to users named dannyd and rgarcia and specifies their passwords as *password* and *1234567* respectively.

```
GRANT LOGIN TO dannyd:password,rgarcia:1234567
```

If there are spaces in a name you may use double quotes as in the following example. This statement grants login rights to user named Jerry Gentry and Punita and specifies their password as sun and moon respectively

```
GRANT LOGIN TO "Jerry Gentry":sun, Punita:moon
```

The following example grants the login rights to a user named Jerry Gentry with password 123456 and a user named rgarcia with password abcdef. It also adds them to the group zen_dev

```
GRANT LOGIN TO "Jerry Gentry":123456, rgarcia:abcdef IN GROUP zen_dev
```

============

The Master user has all rights on a table that does not have an owner name. To grant permissions on a table that has a Btrieve owner name, the Master user must supply the correct owner name in the GRANT statement.

The following example grants the SELECT right to the user Master on table t1 that has a Btrieve owner name of abcd.

```
GRANT SELECT ON t1 'abcd' TO Master
```

You can set an owner name on a table using Function Executor or the Maintenance utility under the Tools menu in ZenCC. For more information, see Owner Names in *Advanced Operations Guide*.

============

After the Master user performs the following set of SQL statements, the user jsmith has SELECT access to all tables in the current database. The user also has DELETE access to tab1 and UPDATE access to tab2.

```
GRANT DELETE ON tab1 TO jsmith
```

```
GRANT SELECT ON * TO jsmith
```

```
GRANT UPDATE ON tab2 TO jsmith
```

If the following statement is performed later by any user with CREATE TABLE privileges, the user jsmith will have SELECT access to the newly created table.

```
CREATE TABLE tab3 (col1 INT)
```

============

```
GRANT CREATETAB TO user1
```

============

```
GRANT CREATESP TO user1
```

============

The following example grants EXECUTE permissions on stored procedure cal_rtrn_rate to **all** users.

```
GRANT EXECUTE ON PROCEDURE cal_rtrn_rate TO PUBLIC
```

============

The following example shows how members of the group Accounting can update only the salary column in the employee table (employee is part of the Demodata sample database).

Assume that the following stored procedure exists:

```
CREATE PROCEDURE employee_proc_upd(in :EmpID integer, in :Salary money) WITH EXECUTE AS 'Master';
BEGIN
    UPDATE employee SET Salary = :Salary WHERE EmployeeID = :Empid;
END
GRANT EXECUTE ON PROCEDURE employee_proc_upd TO Accounting
```

Note that users belonging to group Accounting cannot update other columns in the Employee table because permissions were granted only for the stored procedure and the stored procedure updates only the salary column.

============

The following example assumes that you have enabled security on the Demodata sample database and added a user named USAcctsMgr. You now want to grant SELECT rights to the ID column in table Person to that user. Use the following statement.

```
GRANT SELECT ( ID ) ON Person TO 'USAcctsMgr'
```

See Also

CREATE GROUP	REVOKE
CREATE PROCEDURE	SET OWNER
CREATE VIEW	SET SECURITY
DROP GROUP	System Stored Procedures

GROUP BY

In addition to the GROUP BY syntax in a SELECT statement, Zen supports an extended GROUP BY syntax that can include vendor strings.

A GROUP BY query returns a result set which contains one row of the select list for every group encountered. (See SELECT for the syntax of a select list.)

The following example shows an extended GROUP BY that includes vendor strings in an escape sequence.

```
create table at1 (col1 integer, col2 char(10));
insert into at1 values (1, 'abc');
insert into at1 values (2, 'def');
insert into at1 values (3, 'aaa');

SELECT (--(*vendor(Microsoft), product(ODBC) fn left(at1.col2, 1) *)--) atv, count(*) Total FROM at1
GROUP BY atv
ORDER BY atv DESC

Returns:
atv           Total
======   ===========
d                  1
a                  2
```

See Also

SELECT

HAVING

Use a HAVING clause in conjunction with a GROUP BY keyword within SELECT statements to limit a view to groups whose aggregate values meet specific criteria.

The expressions in a HAVING clause may contain constants, set functions, or an exact replica of one of the expressions in the GROUP BY expression list.

The Zen database engine does not support the HAVING keyword without GROUP BY.

The HAVING keyword supports the use of aliases. The aliases must differ from any column names within the table.

Examples

The following example returns department names where the count of course names is greater than 5.

```
SELECT Dept_Name, COUNT(*) FROM Course GROUP BY Dept_Name HAVING COUNT(*) > 5
```

This same example could use aliases, in this case dn and ct, to produce the same result:

```
SELECT Dept_Name dn, COUNT(*) ct FROM Course GROUP BY dn HAVING ct > 5
```

Note that COUNT(expression) counts all nonnull values for an expression across a predicate. COUNT(*) counts all values, including NULL values.

============

The next example returns department name that matches Accounting and has a number of courses greater than 5.

```
SELECT Dept_Name, COUNT(*) FROM Course GROUP BY Dept_Name HAVING COUNT(*)  > 5 AND Dept_Name =
'Accounting'
```

See Also

SELECT

IF

Syntax

```
IF ( Boolean_condition )

    BEGIN

        Sql-statements

    END

ELSE

    BEGIN

        Sql-statements

    END
```

Remarks

IF statements provide conditional execution based on the value of a condition. The IF . . . THEN . . . ELSE . . . END IF construct controls flow based on which of two statement blocks will be executed. You may also use the IF . . . ELSE syntax.

You may use IF statements in the body of both stored procedures and triggers.

There is no limit to the number of nested IF statements allowed, although the query remains subject to the usual total length limitation and other applicable limitations.

Note: You cannot use a mixed syntax containing Zen and T.SQL. You may use either the IF...THEN...ELSE...END IF syntax or the IF…ELSE syntax. If you are using multiple statements with IF or ELSE conditions, you must use BEGIN and END to indicate the beginning and ending of the statement blocks.

Examples

The following example uses the IF statement to set the variable Negative to either 1 or 0, depending on whether the value of vInteger is positive or negative.

```
IF (:vInteger < 0) THEN

    SET :Negative = '1';

ELSE

    SET :Negative = '0';
```

```
END IF;
```

============

The following example uses the IF statement to test the loop for a defined condition (SQLSTATE = '02000'). If it meets this condition, then the WHILE loop is terminated.

```
FETCH_LOOP:
WHILE (:counter < :NumRooms) DO
    FETCH NEXT FROM cRooms INTO :CurrentCapacity;
    IF (SQLSTATE = '02000') THEN
        LEAVE FETCH_LOOP;
    END IF;
    SET :counter = :counter + 1;
    SET :TotalCapacity = :TotalCapacity +
    :CurrentCapacity;
END WHILE;
```

============

```
IF(:vInteger >50)
    BEGIN
        SET :vInteger = :vInteger + 1;
        INSERT INTO test VALUES('Test');
    END;
ELSE
SET :vInteger = :vInteger - 1;
```

See Also

CREATE PROCEDURE

CREATE TRIGGER

IN

Remarks

Use the IN operator to test whether the result of the outer query is included in the result of the subquery. The result table for the statement includes only rows the outer query returns that have a related row from the subquery.

Examples

The following example lists the names of all students who have taken Chemistry 408:

```
SELECT p.First_Name + '  ' +  p.Last_Name FROM Person p, Enrolls e WHERE (p.id = e.student_id) AND
(e.class_id IN
```

```
(SELECT c.ID FROM Class c WHERE c.Name = 'CHE 408'))
```

Zen first evaluates the subquery to retrieve the ID for Chemistry 408 from the Class table. It then performs the outer query, restricting the results to only those students who have an entry in the Enrolls table for that course.

Often, you can perform IN queries more efficiently using either the EXISTS keyword or a simple join condition with a restriction clause. Unless the purpose of the query is to determine the existence of a value in a subset of the database, it is more efficient to use the simple join condition because Zen optimizes joins more efficiently than it does subqueries.

See Also

SELECT

INSERT

This statement inserts column values into one table.

Syntax

```
INSERT INTO table-name

    [ ( column-name [ , column-name ]...) ] insert-values

    [ ON DUPLICATE KEY UPDATE column-name = < NULL | DEFAULT | expression | subquery-expression [ ,
    column-name = ... ] >

    [ [ UNION [ ALL ] query-specification ]...

    [ ORDER BY order-by-expression [ , order-by-expression ]... ]


table-name ::= user-defined name


column-name ::= user-defined name


insert-values ::= values-clause | query-specification


values-clause ::= VALUES ( expression [ , expression ]... ) | DEFAULT VALUES


expression ::= expression - expression | expression + expression

subquery-expression ::= ( query-specification ) [ ORDER BY order-by-expression
[ , order-by-expression ]... ] [ limit-clause ]


query-specification ::= ( query-specification )

    | SELECT [ ALL | DISTINCT ] [ top-clause ] select-list

      FROM table-reference [ , table-reference ]...

      [ WHERE search-condition ]

      [ GROUP BY expression [ , expression ]...

        [ HAVING search-condition ] ]


order-by-expression ::= expression [ CASE (string) | COLLATE collation-name ] [ ASC | DESC ]
```

Remarks

INSERT statements, as with DELETE and UPDATE, behave in an atomic manner. That is, if an insert of more than one row fails, then all insertions of previous rows by the same statement are rolled back.

INSERT ON DUPLICATE KEY UPDATE

Zen v13 R2 extends INSERT with INSERT ON DUPLICATE KEY UPDATE. This insert capability automatically compares unique keys for values to be inserted or updated with those in the target table. If either a duplicate primary or an index key is found, then for those rows the values are updated. If no duplicate primary or index key is found, then new rows are inserted. In popular jargon, this behavior is called an "upsert."

The INSERT can use either a values list or a SELECT query. As with all INSERT commands, the behavior is atomic.

For illustrations of this feature, see Examples for INSERT ON DUPLICATE KEY UPDATE.

Inserting Data Longer Than the Maximum Literal String

The maximum literal string supported by Zen is 15,000 bytes. You can handle data longer than this using direct SQL statements, breaking the insert into multiple calls. Start with a statement like this:

```
INSERT INTO table1 SET longfield = '15000 bytes of text' WHERE restriction
```

Then issue the following statement to add more data:

```
INSERT INTO table1 SET longfield = notefield + '15000 more bytes of text' WHERE restriction
```

Examples

- Examples for INSERT
- Examples for INSERT ON DUPLICATE KEY UPDATE
- Errors When Using DEFAULT

Examples for INSERT

This topic illustrates simple INSERT. For the use of duplicate unique keys to update instead of insert, see Examples for INSERT ON DUPLICATE KEY UPDATE.

The following statement uses expressions in the VALUES clause to add data to a table:

```
CREATE TABLE t1 (c1 INT, c2 CHAR(20))
INSERT INTO t1 VALUES ((78 + 12)/3, 'This is' + CHAR(32) + 'a string')
SELECT * FROM t1

c1         c2
---------- ----------------
30         This is a string
```

============

The following statement directly adds data to the Course table using three VALUES clauses:

```
INSERT INTO Course(Name, Description, Credit_Hours, Dept_Name)
VALUES ('CHE 308', 'Organic Chemistry II', 4, 'Chemistry')
INSERT INTO Course(Name, Description, Credit_Hours, Dept_Name)
VALUES ('ENG 409', 'Creative Writing II', 3, 'English')
INSERT INTO Course(Name, Description, Credit_Hours, Dept_Name)
VALUES ('MAT 307', 'Probability II', 4, 'Mathematics')
```

============

The following INSERT statement uses a SELECT clause to retrieve from the Student table the ID numbers of students who have taken classes.

The statement then inserts the ID numbers into the Billing table.

```
INSERT INTO Billing (Student_ID)
SELECT ID FROM Student WHERE Cumulative_Hours > 0
```

============

The following example illustrates the use of the CURTIME(), CURDATE() and NOW() variables to insert the current local time, date, and time stamp values inside an INSERT statement.

```
CREATE TABLE Timetbl (c1 TIME, c2 DATE, c3 TIMESTAMP)
INSERT INTO Timetbl(c1, c2, c3) VALUES(CURTIME(), CURDATE(), NOW())
```

============

The following example demonstrates basic usage of default values with INSERT and UPDATE statements.

```
CREATE TABLE t1 (c1 INT DEFAULT 10, c2 CHAR(10) DEFAULT 'abc')
INSERT INTO t1 DEFAULT VALUES
INSERT INTO t1 (c2) VALUES (DEFAULT)
INSERT INTO t1 VALUES (100, DEFAULT)
INSERT INTO t1 VALUES (DEFAULT, 'bcd')
INSERT INTO t1 VALUES (DEFAULT, DEFAULT)
SELECT * FROM t1

c1         c2
---------- ----------
10         abc
10         abc
100        abc
10         bcd
10         abc

UPDATE t1 SET c1 = DEFAULT WHERE c1 = 100
UPDATE t1 SET c2 = DEFAULT WHERE c2 = 'bcd'
UPDATE t1 SET c1 = DEFAULT, c2 = DEFAULT
SELECT * FROM t1

c1         c2
---------- ----------
10         abc
10         abc
10         abc
10         abc
10         abc
```

============

Based on the CREATE TABLE statement immediately above, the following two INSERT statements are equivalent.

```
INSERT INTO t1 (c1,c2) VALUES (20,DEFAULT)
INSERT INTO t1 (c1) VALUES (20)
```

============

The following SQL code shows the use of DEFAULT with multiple UPDATE values.

```
CREATE TABLE t2 (c1 INT DEFAULT 10,
c2 INT DEFAULT 20 NOT NULL,
c3 INT DEFAULT 100 NOT NULL)
INSERT INTO t2 VALUES (1, 1, 1)
INSERT INTO t2 VALUES (2, 2, 2)
SELECT * FROM t2

c1         c2         c3
---------- ---------- ----------
1          1          1
2          2          2

UPDATE t2 SET c1 = DEFAULT, c2 = DEFAULT, c3 = DEFAULT
WHERE c2 = 2
SELECT * FROM t2

c1         c2         c3
---------- ---------- ----------
1          1          1
10         20         100
```

Examples for INSERT ON DUPLICATE KEY UPDATE

This topic illustrates INSERT ON DUPLICATE KEY UPDATE. For simple INSERT, see Examples for INSERT.

For clarity, the query results in these examples show inserted values in black and updated values in red. Each example builds on the previous one, so you can execute them in series to see the behavior.

============

INSERT INTO with VALUES clause and without a column list. Unique index segment column values are available.

```
CREATE TABLE t1 (
  a INT NOT NULL DEFAULT 10,
  b INT,
  c INT NOT NULL,
  d INT DEFAULT 20,
  e INT NOT NULL DEFAULT 1,
  f INT NOT NULL DEFAULT 2,
  g INT,
  h INT,
  PRIMARY KEY(e, f) );
CREATE UNIQUE INDEX t1_ab ON t1 ( a, b, c, d );
INSERT INTO t1 VALUES ( 1, 2, 3, 4, 5, 6, 7, 8 )
ON DUPLICATE KEY UPDATE t1.a = 10, t1.b = 20, t1.c = 30, t1.d = 40;
SELECT * FROM t1;

       a          b          c          d          e          f          g          h
========   ========   ========   ========   ========   ========   ========   ========
       1          2          3          4          5          6          7          8
```

=============

INSERT INTO with VALUES clause and a complete column list. The row is updated.

```
INSERT INTO t1 ( a, b, c, d, e, f, g , h ) VALUES ( 1, 2, 3, 4, 5, 6, 7, 8 )
ON DUPLICATE KEY UPDATE t1.a = 10, t1.b = 20, t1.c = 30, t1.d = 40;
SELECT * FROM t1;

       a          b          c          d          e          f          g          h
========   ========   ========   ========   ========   ========   ========   ========
      10         20         30         40          5          6          7          8
```

=============

INSERT INTO with VALUES clause and a partial column list. A new row is inserted, and then the row is updated.

```
INSERT INTO t1 ( a, b, c, d  ) VALUES ( 1, 2, 3, 4 )
ON DUPLICATE KEY UPDATE t1.a = 11, t1.b = 12, t1.c = 13, t1.d = 14;
SELECT * FROM t1;

       a          b          c          d          e          f          g          h
========   ========   ========   ========   ========   ========   ========   ========
      10         20         30         40          5          6          7          8
       1          2          3          4          1          2     (Null)     (Null)

INSERT INTO t1 ( a, b, c  ) VALUES ( -1, -2, -3 )
ON DUPLICATE KEY UPDATE t1.a = 11, t1.b = 12, t1.c = 13, t1.d = 14;
SELECT * FROM t1;

       a          b          c          d          e          f          g          h
========   ========   ========   ========   ========   ========   ========   ========
      10         20         30         40          5          6          7          8
      11         12         13         14          1          2     (Null)     (Null)
```

============

INSERT INTO with VALUES clause and DEFAULT. A row is updated to return it to an earlier state, and then it is updated based on duplicate keys.

```
UPDATE t1 SET a = 1, b = 2, c = 3, d = 4, e = 11, f = 12 WHERE a = 11;
SELECT * FROM t1;

       a          b          c          d          e          f          g          h
========   ========   ========   ========   ========   ========   ========   ========
      10         20         30         40          5          6          7          8
       1          2          3          4         11         12     (Null)     (Null)

INSERT INTO t1 ( a, b, c, d, e, f ) VALUES ( 1, 2, 3, 4, DEFAULT, DEFAULT )
ON DUPLICATE KEY UPDATE g = VALUES ( a )  + VALUES ( b ) + VALUES ( c ), h = VALUES ( e )  + VALUES (
f );
SELECT * FROM t1;

       a          b          c          d          e          f          g          h
========   ========   ========   ========   ========   ========   ========   ========
      10         20         30         40          5          6          7          8
       1          2          3          4         11         12          6          3
```

=============

Subquery expression in UPDATE SET clause to update using values from the Person table in the Demodata sample database.

```
INSERT INTO t1 VALUES ( 1, 2, 3, 4, 5, 6, 7, 8 )

ON DUPLICATE KEY UPDATE t1.a = 10, t1.b = 20, t1.c = ( SELECT TOP 1 id FROM demodata.person ORDER BY
id ), t1.d = ( SELECT TOP 1 id FROM demodata.person ORDER BY id DESC, last_name );

SELECT * FROM t1;


       a          b          c          d          e          f          g          h

========   ========   ========   ========   ========   ========   ========   ========

      10         20  100062607  998332124          5          6          7          8

       1          2          3          4         11         12          6          3
```

Errors When Using DEFAULT

The following example shows possible error conditions because a column is defined as NOT NULL with no default value defined:

```
CREATE TABLE t1 (c1 INT DEFAULT 10, c2 INT NOT NULL, c3 INT DEFAULT 100 NOT NULL)

INSERT INTO t1 DEFAULT VALUES -- Error: No default value assigned for column <c2>.

INSERT INTO t1 VALUES (DEFAULT, DEFAULT, 10) -- Error: No default value assigned for column <c2>.

INSERT INTO t1 (c1,c2,c3) VALUES (1, DEFAULT, DEFAULT) -- Error: No default value assigned for column
<c2>.

INSERT INTO t1 (c1,c3) VALUES (1, 10) -- Error: Column <c2> not nullable.
```

=============

The following example shows what occurs when you use INSERT for IDENTITY columns and columns with default values.

```
CREATE TABLE t (id IDENTITY, c1 INTEGER DEFAULT 100)

INSERT INTO t (id) VALUES (0)

INSERT INTO t VALUES (0,1)

INSERT INTO t VALUES (10,10)

INSERT INTO t VALUES (0,2)

INSERT INTO t (c1) VALUES (3)

SELECT * FROM t
```

The SELECT shows the table contains the following rows:

```
1, 100
```

```
2, 1
```

```
10, 10
```

```
11, 2
```

```
12, 3
```

The first row illustrates that if zero is specified in the VALUES clause for an IDENTITY column, then the value inserted is 1 if the table is empty.

The first row also illustrates that if no value is specified in the VALUES clause for a column with a default value, then the specified default value is inserted.

The second row illustrates that if zero is specified in the VALUES clause for an IDENTITY column, then the value inserted is one greater than the largest value in the IDENTITY column.

The second row also illustrates that if a value is specified in the VALUES clause for a column with a default value, then the specified value overrides the default value.

The third row illustrates that if a value other than zero is specified in the VALUES clause for an IDENTITY column, then that value is inserted. If a row already exists that contains the specified value for the IDENTITY column, then the message "The record has a key field containing a duplicate value(Btrieve Error 5)" is returned and the INSERT fails.

The fourth rows shows again that if zero is specified in the VALUES clause for an IDENTITY column, then the value inserted is one greater than the largest value in the IDENTITY column. This is true even if gaps exist between the values (that is, the absence of one or more rows with IDENTITY column values less than the largest value).

The fifth row illustrates that if no value is specified in the VALUES clause for an IDENTITY column, then the value inserted is one greater than the largest value in the IDENTITY column.

See Also

CREATE TABLE

DEFAULT

SELECT

SET ANSI_PADDING

JOIN

You can specify a single table or view, multiple tables, or a single view and multiple tables. When you specify more than one table, the tables are said to be joined.

Syntax

```
join-definition ::= table-reference [ join-type ] JOIN table-reference ON search-condition

    | table-reference CROSS JOIN table-reference

    | outer-join-definition


join-type ::= INNER | LEFT [ OUTER ] | RIGHT [ OUTER ] | FULL [ OUTER ]


outer-join-definition ::= table-reference outer-join-type JOIN table-reference

ON search-condition


outer-join-type ::= LEFT [ OUTER ] | RIGHT [ OUTER ] | FULL [ OUTER ]
```

The following example illustrates a two-table outer join:

```
SELECT * FROM Person LEFT OUTER JOIN Faculty ON Person.ID = Faculty.ID
```

The following example shows an outer join embedded in a vendor string. The letters "OJ" can be either upper or lower case.

```
SELECT t1.deptno, ename FROM {OJ emp t2 LEFT OUTER JOIN dept t1 ON t2.deptno=t1.deptno}
```

Zen supports two-table outer joins as specified in the Microsoft ODBC documentation. In addition to simple two-table outer joins, Zen supports *n*-way nested outer joins.

The outer join may or may not be embedded in a vendor string. If a vendor string is used, Zen strips it off and parses the actual outer join text.

LEFT OUTER

Zen databases use the SQL92 (SQL2) model for LEFT OUTER JOIN. The syntax is a subset of the entire SQL92 syntax which includes cross joins, right outer joins, full outer joins, and inner joins. The TableRefList below occurs after the FROM keyword in a SELECT statement and before any subsequent WHERE, HAVING, and other clauses. Note the recursive nature of TableRef and LeftOuterJoin – a TableRef can be a left outer join that can include TableRefs which, in turn, can be left outer joins and so forth.

```
TableRefList :
    TableRef [, TableRefList]
    | TableRef
    | OuterJoinVendorString [, TableRefList]
    TableRef :
    TableName [CorrelationName]
    | LeftOuterJoin
    | ( LeftOuterJoin )
LeftOuterJoin :
TableRef LEFT OUTER JOIN TableRef ON SearchCond
```

The search condition (SearchCond) contains join conditions which in their usual form are *LT.ColumnName* = *RT.ColumnName*, where *LT* is left table, *RT* is right table, and *ColumnName* represents some column within a given domain. Each predicate in the search condition must contain some nonliteral expression.

The implementation of left outer join goes beyond the syntax in the Microsoft ODBC documentation.

Vendor Strings

The syntax in the previous section includes but goes beyond the ODBC syntax in the Microsoft ODBC documenation. Furthermore, the vendor string escape sequence at the beginning and end of the left outer join does not change the core syntax of the outer join.

Zen databases accept outer join syntax without the vendor strings. However, for applications that want to comply with ODBC across multiple databases, the vendor string construction should be used. Because ODBC vendor string outer joins do not support more than two tables, it may be necessary to use the syntax shown in the examples.

Examples

The following four tables are used in these examples.

Emp Table

FirstName	LastName	DeptID	EmpID
Franky	Avalon	D103	E1
Gordon	Lightfoot	D102	E2
Lawrence	Welk	D101	E3
Bruce	Cockburn	D102	E4

Dept Table

DeptID	LocID	Name
D101	L1	TV
D102	L2	Folk

Addr Table

EmpID	Street
E1	101 Mem Lane
E2	14 Young St.

Loc Table

LocID	Name
L1	PlanetX
L2	PlanetY

The following example shows a simple two-way Left Outer Join:

```
SELECT * FROM Emp LEFT OUTER JOIN Dept ON Emp.DeptID = Dept.DeptID
```

This two-way outer join produces the following result set:

Emp				Dept		
FirstName	LastName	DeptID	EmpID	DeptID	LocID	Name

Emp				**Dept**		
Franky	Avalon	D103	E1	NULL	NULL	NULL
Gordon	Lightfoot	D102	E2	D102	L2	Folk
Lawrence	Welk	D101	E3	D101	L1	TV
Bruce	Cockburn	D102	E4	D102	L2	Folk

Notice the NULL entry for Franky Avalon in the table. That is because no DeptID of D103 was found in the *Dept* table. In a standard (INNER) join, Franky Avalon would have been dropped from the result set altogether.

Algorithm

The Zen database engine uses the following algorithm for the previous example: Take the left table, traverse the right table, and for every case where the ON condition is TRUE for the current right table row, return a result set row composed of the appropriate right table row appended to the current left-table row.

If there is no right table row where the ON condition is TRUE, (it is FALSE for all right table rows given the current left table row), create a row instance of the right table with all column values NULL.

That result set, combined with the current left-table row for each row, is indexed in the returned result set. The algorithm is repeated for every left table row to build the complete result set. In the simple two-way left outer join shown previously, *Emp* is the left table and *Dept* is the right table.

Note: Although irrelevant to the algorithm, the appending of the left table to the right table assumes proper projection as specified in the select list of the query. This projection ranges from all columns (for example, SELECT * FROM . . .) to only one column in the result set (for example, SELECT FirstName FROM . . .).

============

With radiating left outer joins, all other tables are joined onto one central table. In the following example of a three-way radiating left outer join, *Emp* is the central table and all joins radiate from that table.

```
SELECT * FROM (Emp LEFT OUTER JOIN Dept ON Emp.DeptID = Dept.DeptID) LEFT OUTER JOIN Addr ON
Emp.EmpID = Addr.EmpID
```

Emp				**Dept**			**Addr**	
First Name	Last Name	Dept ID	Emp ID	Dept ID	Loc ID	Name	Emp ID	Street
Franky	Avalon	D103	E1	NULL	NULL	NULL	E1	101 Mem Lane
Gordon	Lightfoot	D102	E2	D102	L2	Folk	E2	14 Young St
Lawrence	Welk	D101	E3	D101	L1	TV	NULL	NULL
Bruce	Cockburn	D102	E4	D101	L1	TV	NULL	NULL

============

In a chaining left outer join, one table is joined to another, and that table, in turn, is joined to another. The following example illustrates a three-way chaining left outer join:

```
SELECT * FROM (Emp LEFT OUTER JOIN Dept ON Emp.DeptID = Dept.DeptID) LEFT OUTER JOIN Loc ON
Dept.LocID = Loc.LocID
```

Emp				**Dept**			**Loc**	
First Name	Last Name	Dept ID	Emp ID	Dept ID	Loc ID	Name	Loc ID	Name
Franky	Avalon	D103	E1	NULL	NULL	NULL	NULL	NULL
Gordon	Lightfoot	D102	E2	D102	L2	Folk	L2	PlanetY
Lawrence	Welk	D101	E3	D101	L1	TV	L1	PlanetX
Bruce	Cockburn	D102	E4	D101	L1	TV	L1	PlanetX

This join could also be expressed as:

```
SELECT * FROM Emp LEFT OUTER JOIN (Dept LEFT OUTER JOIN Loc ON Dept.LocID = Loc.LocID) ON Emp.DeptID
= Dept.DeptID
```

We recommend the first syntax because it lends itself to both the radiating and chaining joins. This second syntax cannot be used for radiating joins because nested left outer join ON conditions cannot reference columns in tables outside their nesting. In other words, in the following query, the reference to Emp.EmpID is illegal:

```
SELECT * FROM Emp LEFT OUTER JOIN (Dept LEFT OUTER JOIN Addr ON Emp.EmpID = Addr.EmpID) ON Emp.DeptID
= Dept.DeptID
```

============

The following example shows a three-way radiating left outer join, less optimized:

```
SELECT * FROM Emp E1 LEFT OUTER JOIN Dept ON E1.DeptID = Dept.DeptID, Emp E2 LEFT OUTER JOIN Addr ON
E2.EmpID = Addr.EmpID WHERE E1.EmpID = E2.EmpID
```

Emp				**Dept**			**Addr**	
First Name	Last Name	Dept ID	Emp ID	Dept ID	Loc ID	Name	Emp ID	Street
Franky	Avalon	D103	E1	NULL	NULL	NULL	E1	101 Mem Lane
Gordon	Lightfoot	D102	E2	D102	L2	Folk	E2	14 Young St
Lawrence	Welk	D101	E3	D101	L1	TV	NULL	NULL
Bruce	Cockburn	D102	E4	D101	L1	TV	NULL	NULL

This query returns the same results as shown in the Loc Table, assuming there are no NULL values for EmpID in Emp and EmpID is a unique valued column. This query, however, is not optimized as well as the one shown for the Loc Table and can be much slower.

See Also

SELECT

LAG

LAG is a set function that can be used only as a windowing function. LAG is used to retrieve values from previous rows in the current partition of the result set. It cannot be used as a GROUP BY aggregate.

Syntax

```
LAG ( expression[, lag-offset-expression[, lag-default-expression ] ] over-clause )
```

where:

- *expression* is a column or expression from a row in the result set.
- *lag-offset-expression* is an integer expression indicating the number of previous rows before the current row in the result set from which to draw values.
- *lag-default-expression* is the value to return if *lag-offset-expression* rows in the current partition have not yet accumulated in the result set.

Examples

To exercise the following LAG examples, first do these steps:

1. In ZenCC in Zen Explorer, right-click Databases and select **New > Database** to create a temporary database, in this case named SAMPLEDB.
2. Right-click SAMPLEDB and select **SQL Document**.
3. In SQL Editor, run the following **SQL script** to create a table in SAMPLEDB called checkout0:

```
create table checkout0 (StartTime TIMESTAMP, LaneNo INTEGER, Items INTEGER, Total MONEY(6,2),
Duration INTEGER);
```

```
insert into checkout0 values('2021-01-07 22:20:37.852', 1, 7, 18.72, 87);
```

```
insert into checkout0 values('2021-01-07 22:22:47.852', 1, 9, 23.45, 107);
```

```
insert into checkout0 values('2021-01-07 22:24:57.852', 1, 17, 68.22, 183);
```

```
insert into checkout0 values('2021-01-07 22:31:07.852', 1, 12, 48.17, 99);
```

```
insert into checkout0 values('2021-01-07 22:33:27.852', 1, 11, 37.77, 77);
```

```
insert into checkout0 values('2021-01-07 22:34:39.852', 1, 7, 23.32, 94);
```

```
insert into checkout0 values('2021-01-07 22:36:41.852', 1, 14, 56.61, 112);
```

```
insert into checkout0 values('2021-01-07 22:19:37.852', 2, 6, 16.72, 80);
insert into checkout0 values('2021-01-07 22:23:47.852', 2, 10, 25.45, 117);
```

```
insert into checkout0 values('2021-01-07 22:26:57.852', 2, 18, 72.22, 196);
```

```
insert into checkout0 values('2021-01-07 22:31:07.852', 2, 11, 58.17, 109);
```

```
insert into checkout0 values('2021-01-07 22:33:47.852', 2, 14, 47.77, 87);
```

```
insert into checkout0 values('2021-01-07 22:35:49.852', 2, 9, 27.32, 84);
```

```
insert into checkout0 values('2021-01-07 22:37:41.852', 2, 15, 46.16, 122 );
```

```
insert into checkout0 values('2021-01-07 22:20:07.852', 3, 8, 18.82, 64);
```

```
insert into checkout0 values('2021-01-07 22:24:17.852', 3, 8, 19.54, 74);
```

```
insert into checkout0 values('2021-01-07 22:27:37.852', 3, 16, 62.44, 131);
```

```
insert into checkout0 values('2021-01-07 22:31:37.852', 3, 13, 51.87, 119);
```

```
insert into checkout0 values('2021-01-07 22:34:17.852', 3, 12, 37.65, 89);
```

```
insert into checkout0 values('2021-01-07 22:36:19.852', 3, 11, 28.23, 86);
```

```
insert into checkout0 values('2021-01-07 22:38:11.852', 3, 18, 65.26, 128 );
```

4. You are now ready to run the following examples, which use data from a cashier checkout system.

   Note that as in all windowing functions, the default order for the result is <partition columns>, <order columns> as specified by the OVER clause. This order can be modified by using an outer ORDER BY.

The following query shows that each LaneNo has 7 rows, which can be numbered 1 to 7 using COUNT(*):

```
SELECT LaneNo, StartTime, RowNumInPart  FROM (select LaneNo, StartTime, COUNT(*) OVER (PARTITION BY
LaneNo ORDER BY StartTime) FROM checkout0) AS T(LaneNo, StartTime, RowNumInPart);
```

============

The following query shows how the LAG function can be used to retrieve the third row before the current row, as indicated by the RowNumInPart column. Note how 0 is returned until each partition has at least 3 rows:

```
SELECT LaneNo, StartTime, RowNumInPart, LAG(RowNumInPart, 3, 0) OVER (PARTITION BY LaneNo ORDER BY
StartTime) FROM (select LaneNo, StartTime, COUNT(*) OVER (PARTITION BY LaneNo ORDER BY StartTime)
FROM checkout0) AS T(LaneNo, StartTime, RowNumInPart);
```

============

The following query shows the time difference in seconds between each two consecutive rows in each partition, using the default LAG offset of 1 row:

```
SELECT LaneNo, StartTime, DATEDIFF (SECOND, LAG(StartTime) OVER (PARTITION BY LaneNo ORDER BY
StartTime), StartTime) AS Diff_in_secs FROM checkout0;
```

```
============
```

The following query shows how the number of items for each checkout in Lane 1 vary over time, compared to the previous checkout:

```
SELECT StartTime, LaneNo, Items, Items-LAG(Items) OVER (PARTITION BY LaneNo ORDER BY StartTime) AS
delta_items FROM checkout0 WHERE LaneNo = 1;
```

LEAVE

Remarks

A LEAVE statement continues execution by leaving a block or loop statement. You can use LEAVE statements in the body of a stored procedure or a trigger.

Examples

The following example increments the variable vInteger by 1 until it reaches a value of 11, when the loop is ended with a LEAVE statement.

```
TestLoop:

LOOP

    IF (:vInteger > 10) THEN

        LEAVE TestLoop;

    END IF;

    SET :vInteger = :vInteger + 1;

END LOOP;
```

See Also

IF

LOOP

LIKE and ILIKE

LIKE and ILIKE allow pattern matching within character-based column data. Their syntax is identical, but LIKE is case-sensitive, while ILIKE is case-insensitive.

Support for ILIKE was introduced in Zen v15 SP1. Under certain conditions it can provide better query performance than LIKE.

Syntax

```
WHERE expr [ NOT ] < LIKE | ILIKE > value
```

Remarks

The pattern value on the right side of a LIKE or ILIKE expression must be a simple string constant, the USER keyword, or (outside a stored procedure) a dynamic parameter supplied at run time, indicated by a question mark. Dynamic parameters are not supported within SQL Editor, but rather only in application code.

Use the percent sign wildcard in the pattern to match zero or more characters in the column values. Use the underscore wildcard to match a single character. Both wildcards can be used more than once in the pattern. To match either of these wildcard symbols as a literal character, use a backslash before the symbol. The following table provides more information on use of special characters.

Character	Purpose
Percent sign "%"	Wildcard: Matches zero or more characters.
Underscore "_"	Wildcard: Matches a single character.
Backslash "\"	An escape character to flag a following wildcard character as a literal character, in order to match the actual wildcard character itself. To match a backslash, enter two backslashes. For example, to match the "%" character in a column value, use "\%".
Two single quotation marks "''"	Two single quotation marks with no space between them must be used to match a single quotation mark in the result string. For example, if a row in the database contains the value "Jim's house," you can match this pattern by specifying `LIKE 'Jim''s house'` in the WHERE clause. A double-quotation mark in the pattern string is not a special character and can be used like any letter or digit.

Examples of LIKE

This section demonstrates use of LIKE. For comparison with ILIKE, see Examples of ILIKE.

This example matches all column values that are five characters long and have `abc` as the middle three characters:

```
SELECT Building_Name FROM Room WHERE Building_Name LIKE '_abc_'
```

============

This example matches all column values that contain a backslash:

```
SELECT Building_Name FROM Room where Building_Name LIKE '%\\%'
```

============

This example matches all column values *except* those that begin with a percent sign:

```
SELECT Building_Name FROM Room where Building_Name NOT LIKE '\%%'
```

============

This example matches all column values that contain one or more single-quotes:

```
SELECT Building_Name FROM Room where Building_Name LIKE '%''%'
```

============

This example matches all column values where the second character is a double-quote:

```
SELECT Building_Name FROM Room where Building_Name LIKE '_"%'
```

============

This example creates a stored procedure that returns any rows where the `Building_Name` column contains the characters stored in the input variable `:rname` and where the `Type` column contains the characters stored in the input variable `:rtype`.

```
CREATE PROCEDURE room_test(IN :rname CHAR(20), IN :rtype CHAR(20))
RETURNS(Building_Name CHAR(25), "Type" CHAR(20));
BEGIN
    DECLARE :like1 CHAR(25);
    DECLARE :like2 CHAR(25);
    SET :like1 = '%' + :rname + '%';
    SET :like2 = '%' + :rtype + '%';
    SELECT Building_Name, "Type" FROM Room WHERE Building_Name LIKE :like1 AND "Type" LIKE :like2;
END;
```

Note that the following statement, if placed in the stored procedure above, generates a syntax error because of the expression on the right side of the LIKE operator. The right side must be a simple constant.

The following syntax is incorrect and will fail:

```
SELECT Building_Name, "Type" from Room WHERE Building_Name LIKE '%' + :rname + '%';
```

Examples of ILIKE

The following two examples of LIKE and ILIKE return the same results from the Demodata sample database. The ILIKE statement does not need to use the UPPER string function.

```
SELECT First_Name, Last_Name, Email_Address from Person
WHERE UPPER(Email_Address) LIKE '%@BTU.EDU%';
```

```
SELECT First_Name, Last_Name, Email_Address from Person
WHERE Email_Address ILIKE '%@btu.edu%';
```

Note: ILIKE cannot use the index created on a case-sensitive column for optimization.

See Also

SELECT

LOOP

Remarks

A LOOP statement repeats the execution of a block of statements.

It is allowed only in stored procedures and triggers.

Zen does not support the postconditional loop REPEAT... UNTIL.

Examples

The following example increments the variable vInteger by 1 until it reaches a value of 11 and the loop ends.

```
TestLoop:
LOOP
    IF (:vInteger > 10) THEN
        LEAVE TestLoop;
    END IF;
    SET :vInteger = :vInteger + 1;
END LOOP;
```

See Also

CREATE PROCEDURE

CREATE TRIGGER

IF

NOT

Remarks

Using the NOT keyword with the EXISTS keyword allows you to test whether rows do not exist in the result of the subquery. For every row the outer query evaluates, Zen tests for the existence of a related row from the subquery. Zen excludes from the statement result table each row from the outer query that corresponds to a related row from the subquery.

By combining NOT with the IN operator, you can test whether the result of the outer query is not included in the result of the subquery. The result table includes only rows the outer query returns that do not have a related row from the subquery.

Examples

The following statement returns a list of students who are not enrolled in any classes:

```
SELECT * FROM Person p WHERE NOT EXISTS

(SELECT * FROM Student s WHERE s.id = p.id

AND Cumulative_Hours = 0)
```

This statement can be rewritten to use IN:

```
SELECT * FROM Person p WHERE p.id NOT IN

(SELECT s.id FROM Student s WHERE Cumulative_Hours = 0)
```

See Also

SELECT

EXISTS

IN

OPEN

Syntax

```
OPEN cursor-name

cursor-name ::= user-defined-name
```

Remarks

The OPEN statement opens a cursor. A cursor must be defined before it can be opened.

This statement is allowed only inside of a stored procedure or a trigger, since cursors and variables are only allowed inside of stored procedures and triggers.

Examples

The following example opens the declared cursor BTUCursor.

```
DECLARE BTUCursor CURSOR
FOR SELECT Degree, Residency, Cost_Per_Credit FROM Tuition ORDER BY ID;
OPEN BTUCursor;
```

============

```
CREATE PROCEDURE MyProc(IN :CourseName CHAR(7)) AS
BEGIN
    DECLARE cursor1 CURSOR
    FOR SELECT Degree, Residency, Cost_Per_Credit FROM Tuition  ORDER BY ID;
    (additional code would go here)
    OPEN cursor1;
    FETCH cursor1 INTO :CourseName;
    (additional code would go here)
    CLOSE cursor1;
    (additional code would go here)
END
```

See Also

CREATE PROCEDURE

CREATE TRIGGER

DECLARE CURSOR

PARTIAL

Remarks

To allow indexing on CHAR and VARCHAR columns wider than 255 bytes, include the PARTIAL keyword in the CREATE INDEX statement. If the columns that make up the partial index, including overhead, contain less than 255 bytes, PARTIAL is ignored.

Note: The DROP INDEX statement does not require PARTIAL to remove a partial index.

UNIQUE and PARTIAL are mutually exclusive and cannot be used in the same CREATE INDEX statement.

See Also

CREATE INDEX

DROP INDEX

UNIQUE

PRIMARY KEY

Remarks

Include PRIMARY KEY in the ADD clause to add a primary key to a table definition. The primary key is a unique index that does not include null values. When you specify a primary key, Zen creates a unique index with the specified attributes on the defined group of columns.

Because a table can have only one primary key, you cannot add a primary key to a table that already has a primary key defined. To change the primary key of a table, delete the existing key using a DROP clause in an ALTER TABLE statement and add the new primary key.

Note: You must be logged in to the database using a database name before you can add a primary key or conduct any other referential integrity (RI) operation.

Include PRIMARY KEY in the ADD clause with the ALTER TABLE statement to add a primary key to a table definition.

Before adding the primary key, you must ensure that the columns in the primary key column list are defined as NOT NULL. A primary key is a unique index and can be created only on not nullable columns.

If a unique index on not nullable columns already exists, the ADD PRIMARY KEY does not create another unique index. Instead, the existing unique index is promoted to a primary key. For example, the following statements would promote the named index T1_C1C2 to be a primary key.

```
CREATE TABLE t1 (c1 INT NOT NULL, c2 CHAR(10) NOT NULL)
```

```
CREATE UNIQUE INDEX t1_c1c2 ON t1(c1,c2)
```

```
ALTER TABLE t1 ADD PRIMARY KEY(c1, c2)
```

If such a primary key is dropped, the primary key would be switched to a unique index.

```
ALTER TABLE t1 DROP PRIMARY KEY
```

If no unique index on not nullable columns exists in the table, ADD PRIMARY KEY creates a unique index on not nullable columns. DROP PRIMARY KEY completely deletes the unique index.

Include a PRIMARY KEY clause with the CREATE TABLE statement to add a primary key to a table definition.

To define referential constraints on your database, you must include a PRIMARY KEY clause to specify the primary key on the parent table. The primary key can consist of one column or multiple columns but can only be defined on columns that are not null. The columns you specify must also appear in the column Definitions list of the CREATE TABLE statement.

When you specify a primary key, Zen creates an index with the specified attributes on the defined group of columns. If the columns are not specifically defined as NOT NULL in the CREATE TABLE statement, Zen forces the columns to be not nullable. Zen also creates a unique index on the columns.

For example, the following two statements yield the same results:

```
CREATE TABLE t1 (c1 INT, c2 CHAR(10), PRIMARY KEY(c1,c2))
```

```
CREATE TABLE t1 (c1 INT NOT NULL, c2 CHAR(10) NOT NULL, PRIMARY KEY(c1,c2))
```

Examples

The following statement defines a primary key on a table called Faculty.

```
ALTER TABLE Faculty ADD PRIMARY KEY (ID)
```

The ID column is defined as a unique index that does not include null values.

See Also

ALTER TABLE

CREATE TABLE

PRINT

Remarks

Use PRINT to print variable values or constants. The PRINT statement applies only to Windows-based platforms. It is ignored on other operating system platforms.

You can use PRINT only within stored procedures.

Examples

The following example prints the value of the variable :myvar.

```
PRINT( :myvar );
```

PRINT 'MYVAR = ' + :myvar;

============

The following example prints a text string followed by a numeric value. You must convert a number value to a text string to print the value.

```
PRINT 'Students enrolled in History 101: ' + convert(:int_val, SQL_CHAR);
```

============

Before the Windows Vista release, it was possible to use PRINT in a stored procedure to send output to a dialog box if Zen was running as a service using the local system account with the setting Allow service to interact with desktop. In Windows Vista and later releases, the operating system no longer allows this output. As shown in the following workaround, you can convert the value to a character string and return it in a SELECT statement.

```
DROP PROCEDURE varsub2;
CREATE PROCEDURE varsub2 ()
RETURNS (TestString CHAR(25));
DECLARE :vInteger INT;
DECLARE :tstring CHAR(25);
SET :vInteger = 0;
BEGIN
WHILE (:vInteger < 10) DO
SET :vInteger = :vInteger + 1;
END WHILE;
```

```
SET :tstring = 'The counter value is = ' + convert(:vInteger, SQL_CHAR);
SELECT :tstring;
END;
Call varsub2;
```

See Also

CREATE PROCEDURE

PUBLIC

Remarks

You can include the PUBLIC keyword in the FROM clause to revoke the Create Table right from all the users to whom the right was not explicitly assigned.

Include a FROM clause to specify the group or user from whom you are revoking rights. You can specify a single name or a list of names, or you can include the PUBLIC keyword to revoke access rights from all users whose rights are not explicitly assigned.

Examples

To assign access rights to all users in the dictionary, include the PUBLIC keyword to grant the rights to the PUBLIC group, as in the following example:

```
GRANT SELECT ON Course TO PUBLIC
```

This statement assigns the Select right on the Course table to all users defined in the dictionary. If you later revoke the Select right from the PUBLIC group, only users who are granted the Select right explicitly can access the table.

The following statement includes the PUBLIC keyword to grant the Create Table right to all the users defined in the dictionary:

```
GRANT CREATETAB TO PUBLIC
```

See Also

GRANT

REVOKE

RELEASE SAVEPOINT

Use the RELEASE SAVEPOINT statement to delete a savepoint.

Syntax

```
RELEASE SAVEPOINT savepoint-name

savepoint-name ::= user-defined-name
```

Remarks

RELEASE, ROLLBACK, and SAVEPOINT and are supported at the session level (outside of stored procedures) only if AUTOCOMMIT is off. Otherwise, RELEASE, ROLLBACK, and SAVEPOINT must be used within a stored procedure.

Any committed statements within a stored procedure are controlled by the outermost transaction of the calling SQL application.

Examples

The following example sets a SAVEPOINT then checks a condition to determine whether to ROLLBACK or to RELEASE the SAVEPOINT.

```
CREATE PROCEDURE Enroll_student( IN :student ubigint, IN :classnum INTEGER);
BEGIN
    DECLARE :CurrentEnrollment INTEGER;
    DECLARE :MaxEnrollment INTEGER;
    SAVEPOINT SP1;
    INSERT INTO Enrolls VALUES (:student,:classnum, 0.0);
    SELECT COUNT(*) INTO :CurrentEnrollment FROM Enrolls WHERE class_id = :classnum;
    SELECT Max_size INTO :MaxEnrollment FROM Class WHERE ID = :classnum;
    IF :CurrentEnrollment >= :MaxEnrollment THEN
        ROLLBACK TO SAVEPOINT SP1;
    ELSE
        RELEASE SAVEPOINT SP1;
    END IF;
```

```
END;
```

Note that COUNT(expression) counts all nonnull values for an expression across a predicate. COUNT(*) counts all values, including null values.

See Also

CREATE PROCEDURE

ROLLBACK

SAVEPOINT

RESTRICT

Remarks

If you specify RESTRICT, Zen enforces the DELETE RESTRICT rule. A user cannot delete a row in the parent table if a foreign key value refers to it.

If you do not specify a delete rule, Zen applies the RESTRICT rule by default.

See Also

ALTER TABLE

REVOKE

REVOKE deletes user IDs and removes privileges for specific users in a secured database. You can use the REVOKE statement to revoke CREATE TABLE, CREATE VIEW, and CREATE PROCEDURE privileges.

Syntax

```
REVOKE CREATETAB | CREATEVIEW | CREATESP FROM public-or-user-group-name [ , public-or-user-group-name
]...

REVOKE LOGIN FROM user-name [ , user-name ]...

REVOKE permission ON < * | [ TABLE ] table-name [ owner-name ]> | VIEW view-name | PROCEDURE
stored_procedure-name > FROM user-or-group-name [ , user-or-group-name ]...

* ::= all of the objects (that is, all tables, views and stored procedures)

permission ::=   ALL
    | SELECT [ ( column-name [ , column-name ]... ) ]
    | UPDATE [ ( column-name [ , column-name ]... ) ]
    | INSERT [ ( column-name [ , column-name ]... ) ]
    | DELETE
    | ALTER
    | REFERENCES
    | EXECUTE

table-name ::= user-defined table-name

view-name ::= user-defined view-name

stored-procedure-name ::= user-defined stored_procedure-name

public-or-user-group-name ::= PUBLIC | user-group-name
```

```
user-group-name ::= user-name | group-name

user-name ::= user-defined user-name

group-name ::= user-defined group-name
```

The following table shows the syntax for a given action.

To REVOKE Permissions For This Action	Use This Keyword with REVOKE
CREATE TABLE	CREATETAB
CREATE VIEW	CREATEVIEW
CREATE PROCEDURE	CREATESP

The following table shows which permissions are removed if you use the ALL keyword.

Permission Removed by ALL	Table	View	Stored Procedure
ALTER	X	X	X
DELETE	X	X	
INSERT	X	X	
REFERENCES	X		
SELECT	X	X	
UPDATE	X	X	
EXECUTE			X

Examples

The following statement revokes all of these permissions from dannyd for table Class.

```
REVOKE ALL ON Class FROM 'dannyd'
```

The following statement revokes all permissions from dannyd and rgarcia for table Class.

```
REVOKE ALL ON Class FROM dannyd, rgarcia
```

============

The following statement revokes DELETE permission from dannyd and rgarcia for table Class.

```
REVOKE DELETE ON Class FROM dannyd, rgarcia
```

============

The following example revokes INSERT rights from keithv and miked for table Class.

```
REVOKE INSERT ON Class FROM keithv, miked
```

The following example revokes INSERT rights from keithv and brendanb for table Person and columns First_name and Last_name.

```
REVOKE INSERT(First_name,Last_name) ON Person FROM keithv, brendanb
```

============

The following statement revokes ALTER rights from dannyd from table Class.

```
REVOKE ALTER ON Class FROM dannyd
```

============

The following example revokes SELECT rights from dannyd and rgarcia on table Class.

```
REVOKE SELECT ON Class FROM dannyd, rgarcia
```

The following statement revokes SELECT rights from dannyd and rgarcia in table Person for columns First_name and Last_name.

```
REVOKE SELECT(First_name, Last_name) ON Person FROM dannyd, rgarcia
```

============

The following example revokes UPDATE rights from dannyd and rgarcia for table Person.

```
REVOKE UPDATE ON Person ON dannyd, rgarcia
```

============

The following example revokes CREATE VIEW privilege from user1.

```
REVOKE CREATEVIEW FROM user1;
```

============

The following example revokes EXECUTE privilege for user1 for stored procedure MyProc1.

```
REVOKE EXECUTE ON PROCEDURE MyProc1 FROM user1;
```

============

The following example assumes that security was enabled on the Demodata sample database and a user named USAcctsMgr was granted SELECT rights to the ID column in table Person. You now want to revoke selection rights to that column for that user. Use the following statement.

```
REVOKE SELECT ( ID ) ON Person FROM 'USAcctsMgr'
```

See Also

GRANT

ROLLBACK

ROLLBACK returns the database to the state it was in before the current transaction began. This statement releases the locks acquired since the last SAVEPOINT or START TRANSACTION.

The ROLLBACK TO SAVEPOINT statement rolls back the transaction to the specified savepoint.

Syntax

```
ROLLBACK [ WORK ] [ TO SAVEPOINT savepoint-name ]

savepoint-name ::= user-defined-name
```

Remarks

ROLLBACK, SAVEPOINT, and RELEASE are supported at the session level (outside of stored procedures) only if AUTOCOMMIT is off. Otherwise, ROLLBACK, SAVEPOINT, and RELEASE must be used within a stored procedure.

Any committed statements within a stored procedure are controlled by the outermost transaction of the calling SQL application.

In the case of nested transactions, ROLLBACK rolls back to the nearest START TRANSACTION. For example, if transactions are nested five levels, then five ROLLBACK statements are needed to undo all of the transactions. A transaction is either committed or rolled back, but not both. That is, you cannot roll back a committed transaction.

Examples

The following statement undoes the changes made to the database since the beginning of a transaction.

```
ROLLBACK WORK;
```

The following statement undoes the changes made to the database since the last savepoint, named Svpt1.

```
ROLLBACK TO SAVEPOINT Svpt1;
```

See Also

COMMIT

RELEASE SAVEPOINT

SAVEPOINT

SAVEPOINT

SAVEPOINT defines a point in a transaction to which you can roll back.

Syntax

```
SAVEPOINT savepoint-name

savepoint-name ::= user-defined-name
```

Remarks

ROLLBACK, SAVEPOINT, and RELEASE are supported at the session level (outside of stored procedures) only if AUTOCOMMIT is off. Otherwise, ROLLBACK, SAVEPOINT, and RELEASE must be used within a stored procedure.

Any committed statements within a stored procedure are controlled by the outermost transaction of the calling SQL application.

A SAVEPOINT applies only to the procedure in which it is defined. That is, you cannot reference a SAVEPOINT defined in another procedure.

Examples

The following example sets a SAVEPOINT then checks a condition to determine whether to ROLLBACK or to RELEASE the SAVEPOINT.

```
CREATE PROCEDURE Enroll_student( IN :student ubigint, IN :classnum INTEGER);
BEGIN
    DECLARE :CurrentEnrollment INTEGER;
    DECLARE :MaxEnrollment INTEGER;
    SAVEPOINT SP1;
    INSERT INTO Enrolls VALUES (:student, :classnum, 0.0);
    SELECT COUNT(*) INTO :CurrentEnrollment FROM Enrolls WHERE class_id = :classnum;
    SELECT Max_size INTO :MaxEnrollment FROM Class WHERE ID = :classnum;
    IF :CurrentEnrollment >= :MaxEnrollment THEN
        ROLLBACK TO SAVEPOINT SP1;
    ELSE
```

```
        RELEASE SAVEPOINT SP1;
    END IF;
END;
```

Note that COUNT(expression) counts all nonnull values for an expression across a predicate. COUNT(*) counts all values, including null values.

See Also

COMMIT

CREATE PROCEDURE

RELEASE SAVEPOINT

ROLLBACK

SELECT

Retrieves specified information from a database. A SELECT statement creates a temporary view.

Syntax

```
query-specification [ [ UNION [ ALL ] query-specification ]...

[ ORDER BY order-by-expression [, order-by-expression ]... ] [ limit-clause ] [ FOR UPDATE ]


query-specification ::= ( query-specification )

    | SELECT [ ALL | DISTINCT ] [ top-clause ] select-list

      FROM table-reference [, table-reference ]...

      [ WHERE search-condition ]

      [ GROUP BY expression [, expression ]...

        [ HAVING search-condition ] ]


expression-or-subquery ::= expression | ( query-specification ) [ ORDER BY order-by-expression
[ , order-by-expression ]... ] [ limit-clause ]


subquery-expression ::= ( query-specification ) [ ORDER BY order-by-expression
[ , order-by-expression ]... ] [ limit-clause ]


order-by-expression ::= expression [ CASE (string) | COLLATE collation-name ] [ ASC | DESC ]


limit-clause ::= [ LIMIT [offset,] row_count | row_count OFFSET offset | ALL [OFFSET offset] ]


offset ::= number | ?

row_count ::= number | ?


top-clause ::= TOP or LIMIT number


select-list ::= * | select-item [, select-item ]...


select-item ::= expression [ [ AS ] alias-name ] | table-name.*
```

```
table-reference ::= { OJ outer-join-definition }

    | [db-name.]table-name [ [ AS ] alias-name ] [ WITH (table-hint ) ]

    | [db-name.]view-name [ [ AS ] alias-name ]

    | dbo.fsystem-catalog-function-name [ [ AS ] alias-name ]

    | join-definition

    | ( join-definition )

    | ( table-subquery )[ AS ] alias-name [ (column-name [, column-name ]... ) ]


outer-join-definition ::= table-reference outer-join-type JOIN table-reference

ON search-condition


outer-join-type ::= LEFT [ OUTER ] | RIGHT [ OUTER ] | FULL [ OUTER ]


table-hint ::= INDEX ( index-value [, index-value ]... )


index-value ::= 0 | index-name


index-name ::= user-defined-name


join-definition ::= table-reference [ join-type ] JOIN table-reference ON search-condition

    | table-reference CROSS JOIN table-reference

    | outer-join-definition


join-type ::= INNER | LEFT [ OUTER ] | RIGHT [ OUTER ] | FULL [ OUTER ]


table-subquery ::= query-specification [ [ UNION [ ALL ]
query-specification ]... ][ ORDER BY order-by-expression [, order-by-expression ]... ]


search-condition ::= search-condition AND search-condition

    | search-condition OR search-condition

    | NOT search-condition

    | ( search-condition )

    | predicate
```

```
predicate ::= expression [ NOT ] BETWEEN expression AND expression

    | expression-or-subquery comparison-operator expression-or-subquery

    | expression [ NOT ] IN ( query-specification )

    | expression [ NOT ] IN ( value [, value ]... )

    | expression [ NOT ] LIKE and ILIKE value

    | expression IS [ NOT ] NULL

    | expression comparison-operator ANY ( query-specification )

    | expression comparison-operator ALL ( query-specification )

    | [ NOT ] EXISTS ( query-specification )


comparison-operator ::= < | > | <= | >= | = | <> | !=


expression-or-subquery ::= expression | ( query-specification )


value ::= literal | USER | ?


expression ::= expression - expression

    | expression + expression

    | expression * expression

    | expression / expression

    | expression & expression

    | expression | expression

    | expression ^ expression

    | ( expression )

    | -expression

    | +expression

    | column-name

    | ?

    | literal

    | set-function

    | scalar-function

    | { fn scalar-function }

    | window-function
    | CASE case_value_expression WHEN when_expression THEN then_expression [...] [ ELSE
    else_expression ] END

    | COALESCE (expression, expression [ ,...] )

    | IF ( search-condition , expression , expression )

    | SQLSTATE

    |   subquery-expression

    | NULL

    | : user-defined-name

    | USER

    |   global-variable

    |   virtual-column


case_value_expression  when_expression, then_expression   else_expression ::= see CASE (expression)

subquery-expression ::= ( query-specification )


set-function ::= AVG ( [ DISTINCT | ALL ] expression )

    | COUNT ( < * | [ DISTINCT | ALL ] expression > )

    | COUNT_BIG ( < * | [ DISTINCT | ALL ] expression > )

    | LAG ( expression[, expression[, expression ] ] over-clause )

    | MAX ( [ DISTINCT | ALL ] expression )

    | MIN ( [ DISTINCT | ALL ] expression )

    | STDEV ( [ DISTINCT | ALL ] expression )

    | STDEVP ( [ DISTINCT | ALL ] expression )

    | SUM ( [ DISTINCT | ALL ] expression )

    | VAR ( [ DISTINCT | ALL ] expression )

    | VARP ( [ DISTINCT | ALL ] expression )


scalar-function ::= see Scalar Functions


global-variable ::= @:IDENTITY

    | @:ROWCOUNT

    | @@BIGIDENTITY

    | @@IDENTITY

    | @@ROWCOUNT
    | @@SPID
    | @@VERSION

virtual-column ::= SYS$CREATE
    | SYS$UPDATE

window-function ::= set-function over-clause

over-clause ::= OVER ( [ partition-by-clause ] order-by-in-over-clause [ row-clause ] )

partition-by-clause ::= PARTITION BY expression [, expression ] ...

order-by-in-over-clause ::= ORDER BY expression [ ASC | DESC ] [, expression [ ASC | DESC ]] ...

row-clause ::= ROWS window-frame-extent

window-frame-extent ::= { UNBOUNDED PRECEDING
    | unsigned-integer-literal PRECEDING
    | CURRENT ROW }
```

Note: Usage of ORDER BY in OVER clauses differs from ORDER BY elsewhere in Zen SQL. For details and related information applicable to the current release, see SQL Windowing Functions.

Remarks

These remarks cover the following topics related to use of SELECT:

- FOR UPDATE
- GROUP BY
- SQL Windowing Functions
- Dynamic Parameters
- Aliases
- SUM and DECIMAL Precision
- Subqueries
- Using Table Hints
- DISTINCT in Aggregate Functions
- TOP or LIMIT
- Table Hint Examples
- Accessing System Data v2

FOR UPDATE

SELECT FOR UPDATE locks the row or rows within the table that is selected by the query. The record locks are released when the next COMMIT or ROLLBACK statement is issued.

To avoid contention, SELECT FOR UPDATE locks the rows as they are retrieved.

SELECT FOR UPDATE takes precedence within a transactions if statement level SQL_ATTR_CONCURRENCY is set to SQL_CONCUR_LOCK. If SQL_ATTR_CONCURRENCY is set to SQL_CONCUR_READ_ONLY, the database engine does not return an error.

SELECT FOR UPDATE does not support a WAIT or NOWAIT keyword. SELECT FOR UPDATE returns status code 84: The record or page is locked if it cannot lock the rows within a brief period (20 retries).

???Need to re-visit return codes throughout chapter/book per Chris' comments.

Constraints

The SELECT FOR UPDATE statement has the following constraints:

- Is valid only within a transaction. The statement is ignored if used outside of a transaction.
- Is supported only for a single table. You cannot use SELECT FOR UPDATE with JOIN, nonsimple views, or the GROUP BY, DISTINCT, or UNION keywords.
- Is not supported within a CREATE VIEW statement.

GROUP BY

In addition to supporting a GROUP BY on a column list, Zen supports a GROUP BY on an expression list or on any expression in a GROUP BY expression list. See GROUP BY for more information on GROUP BY extensions. HAVING is not supported without GROUP BY.

Result sets and stored views generated by executing SELECT statements with any of the following characteristics are read-only (they cannot be updated). That is, using a positioned UPDATE or a positioned DELETE and a SQLSetPos call to add, alter or delete data is not allowed on the result set or stored view if:

???see note on the Cursors section to discuss SQLSetPos. Need non-ODBC term from Cursors overview>

- The selection list contains an aggregate:
  `SELECT SUM(c1) FROM t1`

- The selection list specifies DISTINCT:
  `SELECT DISTINCT c1 FROM t1`
- The view uses GROUP BY:
  `SELECT SUM(c1), c2 FROM t1 GROUP BY c2`
- The view is a join (references multiple tables):
  `SELECT * FROM t1, t2`
- The view uses the UNION operator and UNION ALL is not specified or all SELECT statements do not reference the same table:
  `SELECT c1 FROM t1 UNION SELECT c1 FROM t1`
  `SELECT c1 FROM t1 UNION ALL SELECT c1 FROM t2`

  Note that stored views do not allow the UNION operator.
- The view contains a subquery that references a table other than the table in the outer query:
  `SELECT c1 FROM t1 WHERE c1 IN (SELECT c1 FROM t2)`

SQL Windowing Functions

Zen provides a subset of ANSI standard SQL windowing usage. In the current release, this initial introduction has certain limitations and considerations.

Limitations

OVER clauses have the following limitations:

- All OVER clauses in a SELECT statement must match in their PARTITION BY, ORDER BY, and ROWS clauses. PARTITION BY expressions must be the same and in the same order, ORDER BY expressions must be the same and in the same order, and ROWS clauses must be identical. If any of these clauses is absent from an OVER clause, it must be absent from the others.
- An OVER clause must include an ORDER BY clause. A PARTITION BY clause is optional. If PARTITION BY is present, it must not use any of the same columns as the ORDER BY clause. If PARTITION BY is absent, the entire result set is treated as a single partition.
- In a PARTITION BY clause, the use of ROWS supports the following keywords:
  - UNBOUNDED
  - *n* PRECEDING
  - CURRENT ROW
- In a PARTITION BY clause, the use of ROWS does not support the following keywords:
  - BETWEEN

    - FOLLOWING
- The RANGE keyword is not supported.
- The DISTINCT keyword is not supported in set functions.
- In an OVER clause the ORDER BY clause does not support a COLLATE specification.
- Window functions can be used only with a forward-only cursor.

Considerations

Under the ANSI SQL standard, certain syntax combinations imply default RANGE semantics, which are not supported in the current Zen release. Accordingly, in the current Zen release, in cases where the default RANGE specification is RANGE UNBOUNDED PRECEDING, this default is implemented as ROWS UNBOUNDED PRECEDING.

In general, the difference between these two defaults affects a result set only if the combination of column values returned by the PARTITION BY and ORDER BY clauses is not unique for each row. Therefore, in the current Zen release, if the combination of those column values is not unique for each row, we recommend explicitly specifying ROWS UNBOUNDED PRECEDING, since that will return the expected result.

Dynamic Parameters

Dynamic parameters, represented by a question mark (?), are not supported as SELECT items. You may use dynamic parameters in any SELECT statement if the dynamic parameter is part of the predicate. For example, SELECT * FROM faculty WHERE id = ? is valid because the dynamic parameter is part of the predicate.

Note that you cannot use SQL Editor in Zen Control Center to execute a SQL statement with a dynamic parameter in the predicate.

You may use variables as SELECT items only within stored procedures. See CREATE PROCEDURE.

Aliases

Aliases may appear in a WHERE, HAVING, ORDER BY, or GROUP BY clause. Alias names must differ from any column names within the table. The following statement shows the use of aliases, a and b, in a WHERE clause and in a GROUP BY clause.

```
SELECT Student_ID a, Transaction_Number b, SUM (Amount_Owed) FROM Billing WHERE a < 120492810 GROUP
BY a, b UNION SELECT Student_ID a, Transaction_Number b, SUM (Amount_Paid) FROM Billing WHERE a >
888888888 GROUP BY a, b
```

SUM and DECIMAL Precision

When using the SUM aggregate function on a field that is of type DECIMAL, the following rules apply:

- The precision of the result is 74, while the scale is dependent on the column definition.
- The result may cause an overflow error if a number with precision greater than 74 is calculated (a very large number indeed). If an overflow occurs, no value is returned, and SQLSTATE is set to 22003, indicating a numeric value is out of range.

Subqueries

A subquery is a SELECT statement with one or more SELECT statements within it. A subquery produces values for further processing within the statement. The maximum number of nested subqueries allowed within the topmost SELECT statement is 16.

The following types of subqueries are supported:

- comparison
- quantified
- in
- exists
- correlated
- expression
- table

Correlated subquery predicates are not supported in a HAVING clause that references grouped columns.

Expression subqueries allow the subquery within the SELECT list. For example, SELECT (SELECT SUM(c1) FROM t1 WHERE t1.c2 = t1.(c2) FROM t2. Only one item is allowed in the subquery SELECT list. For example, the following statement returns an error because the subquery SELECT list contains more than one item: SELECT p.id, (SELECT SUM(b.amount_owed), SUM(b.amount_paid) FROM billing b) FROM person p.

A subquery as an expression may be correlated or noncorrelated. A correlated subquery references one or more columns in any of the tables in the topmost statement. A noncorrelated subquery references no columns in any of the tables in the topmost statement. The following example illustrates a correlated subquery in a WHERE clause:

```
SELECT * FROM student s WHERE s.Tuition_id IN
```

```
(SELECT t.ID FROM tuition t WHERE t.ID = s.Tuition_ID);
```

Note: Table subqueries support noncorrelated subqueries but not correlated subqueries.

A subquery connected with the operators IN, EXISTS, ALL, or ANY is **not** considered an expression.

Both correlated and noncorrelated subqueries can return only a single value. For this reason, both correlated and noncorrelated subqueries are also referred to as scalar subqueries.

Scalar subqueries may appear in the DISTINCT, GROUP BY, and ORDER BY clause.

You may use a subquery on the left-hand side of an expression:

`Expr-or-SubQuery` *`CompareOp`* *`Expr-or-SubQuery`*

where *`Expr`* is an expression, and *`CompareOp`* is one of:

< (less than)	> (greater than)	<= (less than or equal to)	>= (greater than or equal to)	= (equals)
<> (not equal)	!= (not equal)	LIKE	IN	NOT IN

The rest of this section covers the following topics:

- Subquery Optimization
- UNION in Subquery
- Table Subqueries

Subquery Optimization

Left-hand subquery behavior has been optimized for IN, NOT IN, and =ANY in cases where the subquery is not correlated and any join condition is an outer join. Other conditions may not be optimized. Here is an example of a query that meets these conditions:

```
SELECT count(*) FROM person WHERE id IN (SELECT faculty_id FROM class)
```

Performance improves if you use an index in the subquery because Zen optimizes a subquery based on the index. For example, the subquery in the following statement is optimized on student_id because it is an index in the Billing table:

```
SELECT (SELECT SUM(b.amount_owed) FROM billing b WHERE b.student_id = p.id) FROM person p
```

UNION in Subquery

Parentheses on different UNION groups within a subquery are not allowed. Parentheses are allowed within each SELECT statement.

For example, the parenthesis following IN and the last parenthesis are **not** allowed the following statement:

```
SELECT c1 FROM t5 WHERE c1 IN ( (SELECT c1 FROM t1 UNION SELECT c1 FROM t2) UNION ALL (SELECT c1 FROM
t3 UNION SELECT c1 from t4) )
```

Table Subqueries

Table subqueries can be used to combine multiple queries into one detailed query. A table subquery is a dynamic view, which is not persisted in the database. When the topmost SELECT query finishes, all resources associated with table subqueries are released.

Note: Only noncorrelated subqueries are allowed in table subqueries. Correlated subqueries are not allowed.

The following examples of pagination (1500 rows with 100 rows per page) show the use of table subqueries with the ORDER BY keyword:

The first 100 rows

```
SELECT * FROM ( SELECT TOP 100 * FROM ( SELECT TOP 100 * FROM person ORDER BY last_name asc ) AS foo
ORDER BY last_name desc ) AS bar ORDER BY last_name ASC
```

The second 100 rows

```
SELECT * FROM ( SELECT TOP 100 * FROM ( SELECT TOP 200 * FROM person ORDER BY last_name asc ) AS foo
ORDER BY last_name DESC ) AS bar ORDER BY last_name ASC
```

…

The fifteenth 100 rows

```
SELECT * FROM ( SELECT TOP 100 * FROM ( SELECT TOP 1500 * FROM person ORDER BY last_name ASC ) AS foo
ORDER BY last_name DESC ) AS bar ORDER BY last_name ASC
```

Using Table Hints

The table hint functionality allows you to specify which index, or indexes, to use for query optimization. A table hint overrides the default query optimizer used by the database engine.

If the table hint specifies INDEX(0), the engine performs a table scan of the associated table. (A table scan reads each row in the table rather than using an index to locate a specific data element.)

If the table hint specifies INDEX(*index-name*), the engine uses *index-name* to optimize the table based on restrictions of any JOIN conditions, or based on the use of DISTINCT, GROUP BY, or ORDER BY. If the table cannot be optimized on the specified index, the engine attempts to optimize the table based on any existing index.

If you specify multiple index names, the engine chooses the index that provides optimal performance or uses the multiple indexes for OR optimization. An example helps clarify this. Suppose that you have the following:

```
CREATE INDEX ndx1 on t1(c1)
```

```
CREATE INDEX ndx2 on t1(c2)
```

```
CREATE INDEX ndx3 on t1(c3)
```

```
SELECT * FROM t1 WITH (INDEX (ndx1, ndx2)) WHERE c1 = 1 AND c2 > 1 AND c3 = 1
```

The database engine uses ndx1 to optimize on c1 = 1 rather than using ndx2 for optimization. Ndx3 is not considered because the table hint does not include ndx3.

Now consider the following:

```
SELECT * FROM t1 WITH (INDEX (ndx1, ndx2)) WHERE (c1 = 1 OR c2 > 1) AND c3 = 1
```

The engine uses both ndx1 and ndx2 to optimize on (c1 = 1 OR c2 > 1).

The order in which the multiple index names appear in the table hint does not matter. The database engine chooses from the specified indexes the one(s) that provides for the best optimization.

Duplicate index names within the table hint are ignored.

For a joined view, specify the table hint after the appropriate table name, not at the end of the FROM clause. For example, the following statement is correct:

```
SELECT * FROM person WITH (INDEX(Names)), student WHERE student.id = person.id AND last_name LIKE
'S%'
```

Contrast this with the following statement, which is **incorrect**:

```
SELECT * FROM person, student WITH (INDEX(Names)) WHERE student.id = person.id AND last_name LIKE
'S%'
```

Note: The table hint functionality is intended for advanced users. Typically, table hints are not required because the database query optimizer usually picks the best optimization method.

Table Hint Restrictions

- The maximum number of index names that can be used in a table hint is limited only by the maximum length of a SQL statement (64 KB).

- The index name within a table hint must **not** be fully qualified with the table name.

Incorrect SQL:	SELECT * FROM t1 WITH (INDEX(t1.ndx1)) WHERE t1.c1 = 1
Returns:	SQL_ERROR
szSqlState:	37000
Message:	Syntax Error: SELECT * FROM t1 WITH (INDEX(t1.<< ??? >>ndx1)) WHERE t1.c1 = 1

- Table hints are ignored if they are used in a SELECT statement with a view.

Incorrect SQL:	SELECT * FROM myt1view WITH (INDEX(ndx1))
Returns:	SQL_SUCCESS_WITH_INFO
szSqlState:	01000
Message:	Index hints supplied with views will be ignored

- Zero is the only valid hint that is not an index name.

Incorrect SQL:	SELECT * FROM t1 WITH (INDEX(85))
Returns:	SQL_ERROR
szSqlState:	S1000
Message:	Invalid index hint

- The index name in a table hint must specify an existing index.

Incorrect SQL:	SELECT * FROM t1 WITH (INDEX(ndx4))
Returns:	SQL_ERROR
szSqlState:	S0012
Message:	Invalid index name; index not found

- A table hint cannot be specified on a subquery AS table.

Incorrect SQL:	SELECT * FROM (SELECT c1, c2 FROM t1 WHERE c1 = 1) AS a WITH (INDEX(ndx2)) WHERE a.c2 = 10

Returns:	SQL_ERROR
szSqlState:	37000
Message:	syntax Error: SELECT * FROM (SELECT c1, c2 FROM t1 WHERE c1 = 1) AS a WITH<< ??? >>(INDEX(ndx2)) WHERE a.c2 = 10

Accessing System Data v2

In data files using the 13.0 format, system data v2 enables Btrieve keys based on time stamps for record creation and record update. These create and update keys have the following properties:

- The creation key replaces the existing Btrieve system key 125 for use in transactional logging.
- The update key allows identifying of rows that have changed since a specific point in time, such as the creation time stamp in key 125. The update key is Btrieve system key 124.
- Both keys have a TIMESTAMP(7) format, YYYY-MM-DD HH:MM:SS.sssssss, with septasecond precision.
- In SQL queries, you can access the time stamps using the column names sys$create and sys$update. For a working example, see Queries with Sys$create and Sys$update.

Examples

This simple SELECT statement retrieves all the data from the Faculty table.

```
SELECT * FROM Faculty
```

This statement retrieves the data from the person and the faculty table where the id column in the person table is the same as the id column in the faculty table.

```
SELECT Person.id, Faculty.salary FROM Person, Faculty WHERE Person.id = Faculty.id
```

The rest of this section provides examples of variations on SELECT statements. Some of these headings are based on the variable given in the syntax definition for SELECT.

- FOR UPDATE
- Approximate Numeric Literal
- Between Predicate
- Correlation Name
- Exact Numeric Literal
- In Predicate
- Set Functions
- Date Literal
- Time Literal
- Time Stamp Literal
- String Literal
- Date Arithmetic
- IF
- Multidatabase Join
- Left Outer Join
- Right Outer Join
- Cartesian Join
- Queries with Sys$create and Sys$update

FOR UPDATE

The following example uses table t1 to demonstrate the use of FOR UPDATE. Assume that t1 is part of the Demodata sample database. The stored procedure creates a cursor for the SELECT FOR UPDATE statement. A loop fetches each record from t1 and, for those rows where c1=2, sets the value of c1 to four.

The procedure is called by passing the value 2 as the IN parameter.

The example assumes two users, A and B, logged in to Demodata. User A performs the following:

```
DROP TABLE t1

CREATE TABLE t1 (c1 INTEGER, c2 INTEGER)

INSERT INTO t1 VALUES (1,1)

INSERT INTO t1 VALUES (2,1)

INSERT INTO t1 VALUES (1,1)

INSERT INTO t1 VALUES (2,1)

CREATE PROCEDURE p1 (IN :a INTEGER)

AS

BEGIN

   DECLARE :b INTEGER;

   DECLARE :i INTEGER;

   DECLARE c1Bulk CURSOR FOR SELECT * FROM t1 WHERE c1 = :a FOR UPDATE;
```

```
    START TRANSACTION;
    OPEN c1Bulk;
    BulkLinesLoop:
    LOOP
        FETCH NEXT FROM c1Bulk INTO :i;
        IF SQLSTATE = '02000' THEN
        LEAVE BulkLinesLoop;
        END IF;
        UPDATE SET c1 = 4 WHERE CURRENT OF c1Bulk;
    END LOOP;
    CLOSE c1Bulk;
    SET :b = 0;
    WHILE (:b < 100000) DO
    BEGIN
        SET :b = :b + 1;
    END;
    END WHILE;
    COMMIT WORK;
    END;
CALL p1(2)
```

Notice that a WHILE loop delays the COMMIT of the transaction. During that delay, assume that User B attempts to update t1. Status code 84 is returned to User B because those rows are locked by the SELECT FOR UPDATE statement from User A.

============

The following example uses table t1 to demonstrate how SELECT FOR UPDATE locks records when the statement is used outside of a stored procedure. Assume that t1 is part of the Demodata sample database.

The example assumes that two users, A and B, are logged in to Demodata. User A performs the following:

```
DROP TABLE t1
CREATE TABLE t1 (c1 INTEGER, c2 INTEGER)
INSERT INTO t1 VALUES (1,1)
INSERT INTO t1 VALUES (2,1)
INSERT INTO t1 VALUES (1,1)
```

```
INSERT INTO t1 VALUES (2,1)
```

(turn off AUTOCOMMIT)

(execute and fetch): `"SELECT * FROM t1 WHERE c1 = 2 FOR UPDATE"`

The two records where c1 = 2 are locked until User A issues a COMMIT WORK or ROLLBACK WORK statement.

(User B attempts to update t1): `"UPDATE t1 SET c1=3 WHERE c1=2"` A status code 84 is returned to User B because those rows are locked by the SELECT FOR UPDATE statement from User A.

<??? determine SQL error code>

(Now assume that User A commits the transaction.) The two records where c1 = 2 are unlocked.

User B could now execute `"UPDATE t1 SET c1=3 WHERE c1=2"` and change the values for c1.

Approximate Numeric Literal

```
SELECT * FROM results WHERE quotient =-4.5E-2
```

```
INSERT INTO results (quotient) VALUES (+5E7)
```

Between Predicate

The syntax expression1 BETWEEN expression2 and expression3 returns TRUE if expression1 >= expression2 and expression1<= expression3. FALSE is returned if expression1 >= expression3, or is expression1 <= expression2.

Expression2 and expression3 may be dynamic parameters (for example, `SELECT * FROM emp WHERE emp_id BETWEEN ? AND ?`).

The next example retrieves the first names from the Person table whose ID falls between 10000 and 20000.

```
SELECT First_name FROM Person WHERE ID BETWEEN 10000 AND 20000
```

Correlation Name

Both table and column correlation names are supported.

The following example selects data from both the person table and the faculty table using the aliases T1 and T2 to differentiate between the two tables.

```
SELECT * FROM Person t1, Faculty t2 WHERE t1.id = t2.id
```

The correlation name for a table name can also be specified in using the FROM clause, as seen in the following example:

```
SELECT a.Name, b.Capacity FROM Class a, Room b
WHERE a.Room_Number = b.Number
```

Exact Numeric Literal

```
SELECT car_num, price FROM cars WHERE car_num =49042 AND price=49999.99
```

In Predicate

This selects the records from table Person table where the first names are Bill and Roosevelt.

```
SELECT * FROM Person WHERE First_name IN ('Roosevelt', 'Bill')
```

Set Functions

Zen supports the set functions AVG, COUNT, COUNT_BIG, LAG, MAX, MIN, STDEV, STDEVP, SUM, VAR, and VARP, which are illustrated in the following examples.

LAG is valid only as a windowing function. For details and examples, see the LAG keyword.

AVG, MAX, MIN, and SUM

The aggregate functions for AVG, MAX, MIN, and SUM operate as commonly expected. The following examples use these functions with the Salary field in the Faculty sample table.

```
SELECT AVG(Salary) FROM Faculty
SELECT MAX(Salary) FROM Faculty
SELECT MIN(Salary) FROM Faculty
SELECT SUM(Salary) FROM Faculty
```

Most often, these functions are used with GROUP BY to apply them to sets of rows with a common column, as shown in this example:

```
SELECT AVG(Salary) FROM Faculty GROUP BY Dept_Name
```

The following example retrieves student_id and sum of the amount_paid where it is greater than or equal to 100 from the billing table. It then groups the records by student_id.

```
SELECT Student_ID, SUM(Amount_Paid)
FROM Billing
GROUP BY Student_ID
HAVING SUM(Amount_Paid) >=100.00
```

If the expression is a positive integer literal, then that literal is interpreted as the number of the column in the result set and ordering is done on that column. No ordering is allowed on set functions or an expression that contains a set function.

COUNT and COUNT_BIG

COUNT(expression) and COUNT_BIG(expression) count all nonnull values for an expression across a predicate. COUNT(*) and COUNT_BIG(*) count all values, including NULL values. COUNT() returns an INTEGER data type with a maximum value of 2,147,483,647. COUNT_BIG() returns a BIGINT data type with a maximum value of 9,223,372,036,854,775,807.

The following example returns a count of chemistry majors who have a grade point average of 3.5 or greater (and the result does not equal null).

```
SELECT COUNT(*) FROM student WHERE (CUMULATIVE_GPA > 3.4 and MAJOR='Chemistry')
```

STDEV and STDEVP

The STDEV function returns the standard deviation of all values based on a sample of the data. The STDEVP function returns the standard deviation for the population for all values in the specified expression. Here are the equations for each function:

$$STDEV(x_n) = \sqrt{\frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)}} \qquad STDEVP(x_n) = \sqrt{\frac{n\Sigma x^2 - (\Sigma x)^2}{n^2}}$$

The following returns the standard deviation of the grade point average by major from the Student sample table.

```
SELECT STDEV(Cumulative_GPA), Major FROM Student GROUP BY Major
```

The following returns the standard deviation for the population of the grade point average by major from the Student sample table.

```
SELECT STDEVP(Cumulative_GPA), Major FROM Student GROUP BY Major
```

VAR and VARP

The VAR function returns the statistical variance for all values on a sample of the data. The VARP function returns the statistical variance for the population for all values in the specified expression. Here are the equations for each function:

$$VAR(x_n) = \frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)} \qquad VARP(x_n) = \frac{n\Sigma x^2 - (\Sigma x)^2}{n^2}$$

The following returns the statistical variance of the grade point average by major from the Student sample table.

```
SELECT VAR(Cumulative_GPA), Major FROM Student GROUP BY Major
```

The following returns the statistical variance for the population of the grade point average by major from the Student sample table.

```
SELECT VARP(Cumulative_GPA), Major FROM Student GROUP BY Major
```

Note that for STDEV, STDEVP, VAR, and VARP, the expression must be a numeric data type and an eight-byte DOUBLE is returned. A floating-point overflow error results if the difference between the minimum and maximum values of the expression is out of range. Expression cannot contain aggregate functions. There must be at least two rows with a value in the expression field or a result is not calculated and returns a NULL.

Date Literal

See Date Values.

Time Literal

See Time Values.

Time Stamp Literal

See Time Stamp Values.

String Literal

See String Values.

Date Arithmetic

See Date Arithmetic.

IF

The IF system scalar function provides conditional execution based on the truth value of a condition

This expression prints the column header as Prime1 and amount owed as 2000 where the value of the column amount_owed is 2000 or it prints a 0 if the value of the amount_owed column is not equal to 2000.

```
SELECT Student_ID, Amount_Owed,
IF (Amount_Owed = 2000, Amount_Owed, Convert(0, SQL_DECIMAL)) "Prime1"
FROM Billing
```

From table Class, the following example prints the value in the Section column if the section is equal to 001, else it prints "xxx" under column header Prime1.

Under column header Prime2, it prints the value in the Section column if the value of the section column is equal to 002, or else it prints "yyy."

```
SELECT ID, Name, Section,
IF (Section = '001', Section, 'xxx') "Prime1",
IF (Section = '002', Section, 'yyy') "Prime2"
FROM Class
```

You can combine header Prime1 and header Prime2 by using nested IF functions. Under column header Prime, the following query prints the value of the Section column if the value of the Section column is equal to 001 or 002. Otherwise, it print "xxx."

```
SELECT ID, Name, Section,
IF (Section = '001', Section, IF(Section = '002', Section, 'xxx')) Prime
FROM Class
```

Multidatabase Join

When needed, a database name may be prepended to an aliased table name in the FROM clause, to distinguish among tables from two or more different databases that are used in a join.

All of the specified databases must be serviced by the same database engine and have the same database code page settings. The databases do not need to reside on the same physical volume. The current database may be secure or unsecure, but all other databases in the join must be unsecure. With regard to Referential Integrity, all RI keys must exist within the same database. (See also Encoding.)

Literal database names are not permitted in the select-list or in the WHERE clause. If you wish to refer to specific columns in the select-list or in the WHERE clause, you must use an alias for each specified table. See examples.

Assume two separate databases, named accounting and customers, exist on the same server. You can join tables from the two databases using table aliases and SQL syntax similar to the following example:

```
SELECT ord.account, inf.account, ord.balance, inf.address
FROM accounting.orders ord, customers.info inf
WHERE ord.account = inf.account
```

============

In this example, the two separate databases are acctdb and loandb. The table aliases are a and b, respectively.

```
SELECT a.loan_number_a, b.account_no, a.current_bal, b.balance
```

```
FROM acctdb.ds500_acct_master b LEFT OUTER JOIN loandb.ml502_loan_master a ON (a.loan_number_a =
b.loan_number)
```

```
WHERE a.current_bal <> (b.balance * -1)
```

```
ORDER BY a.loan_number_a
```

Left Outer Join

The following example shows how to access the Person and Student tables from the Demodata database to obtain the Last Name, First Initial of the First Name and GPA of students. With the LEFT OUTER JOIN, all rows in the Person table are fetched (the table to the left of LEFT OUTER JOIN). Since not all people have GPAs, some of the columns have NULL values for the results. This is how outer join works, returning nonmatching rows from either table.

```
SELECT Last_Name,Left(First_Name,1) AS First_Initial,Cumulative_GPA AS GPA FROM "Person"
```

```
LEFT OUTER JOIN "Student" ON Person.ID=Student.ID
```

```
ORDER BY Cumulative_GPA DESC, Last_Name
```

Assume that you want to know everyone with perfectly rounded GPAs and have them all ordered by the length of their last name. Using the MOD statement and the LENGTH scalar function, you can achieve this by adding the following to the query:

```
WHERE MOD(Cumulative_GPA,1)=0 ORDER BY LENGTH(Last_Name)
```

Right Outer Join

The difference between LEFT and RIGHT OUTER JOIN is that all non matching rows show up for the table defined to the right of RIGHT OUTER JOIN. Change the query for LEFT OUTER JOIN to include a RIGHT OUTER JOIN instead. The difference is that the all nonmatching rows from the right table, in this case Student, show up even if no GPA is present. However, since all rows in the Student table have GPAs, all rows are fetched.

```
SELECT Last_Name,Left(First_Name,1) AS First_Initial,Cumulative_GPA AS GPA FROM "Person"
```

```
RIGHT OUTER JOIN "Student" ON Person.ID=Student.ID
```

```
ORDER BY Cumulative_GPA DESC, Last_Name
```

Cartesian Join

A Cartesian join is the matrix of all possible combinations of the rows from each of the tables. The number of rows in the Cartesian product equals the number of rows in the first table times the number of rows in the second table.

Assume you have the following tables in your database.

Addr Table

EmpID	Street
E1	101 Mem Lane
E2	14 Young St.

Loc Table

LocID	Name
L1	PlanetX
L2	PlanetY

The following performs a Cartesian JOIN on these tables:

```
SELECT * FROM Addr,Loc
```

This results in the following data set:

EmpID	Street	LocID	Name
E1	101 Mem Lane	L1	PlanetX
E1	101 Mem Lane	L2	PlanetY
E2	14 Young St	L1	PlanetX
E2	14 Young St	L2	PlanetY

Queries with Sys$create and Sys$update

The following example provides a simple instance of finding a record that has been updated since it was created.

```
create table sensorData SYSDATA_KEY_2 (location varchar(20), temp real);
```

```
insert into sensorData values('Machine1', 77.3);
insert into sensorData values('Machine2', 79.8);
insert into sensorData values('Machine3', 65.4);
insert into sensorData values('Machine4', 90.0);

select "sys$create", "sys$update", sensorData.* from sensorData;

--update a row:
update sensorData set temp = 90.1 where location = 'Machine1';

--find the row that has been updated:
select "sys$create", "sys$update", sensorData.* from sensorData where sys$update > sys$create;
```

DISTINCT in Aggregate Functions

DISTINCT is useful in aggregate functions. When used with SUM, AVG, and COUNT, it eliminates duplicate values before calculating the sum, average or count. With MIN, and MAX, however, it is allowed but does not change the result of the returned minimum or maximum.

For example, assume you want to know the salaries for different departments, including the minimum, maximum and salary, and you want to remove duplicate salaries. The following statement does this, excluding the computer science department:

```
SELECT dept_name, MIN(salary), MAX(salary), AVG(DISTINCT salary) FROM faculty WHERE
dept_name<>'computer science' GROUP BY dept_name
```

On the other hand, to include duplicate salaries, drop DISTINCT:

```
SELECT dept_name, MIN(salary), MAX(salary), AVG(salary) FROM faculty WHERE dept_name<>'computer
science' GROUP BY dept_name
```

For the use of DISTINCT in SELECT statements, see DISTINCT.

TOP or LIMIT

You can set the maximum number of rows returned by a SELECT statement by using the keywords TOP or LIMIT. The number must be a literal positive value. It is defined as a 32-bit unsigned integer. For example:

```
SELECT TOP 10 * FROM Person
```

returns the first 10 rows of the Person table in Demodata.

LIMIT is identical to TOP except that it provides the OFFSET keyword to enable you to "scroll" through the result set by choosing the first row in the returned records. For example, if the offset is 5, then the first row returned is row 6. LIMIT has two ways to specify the offset, both with and without the OFFSET keyword, as shown in the following examples, which return identical results:

```
SELECT * FROM Person LIMIT 10 OFFSET 5
```

```
SELECT * FROM Person LIMIT 5,10
```

Note that when you do not use the OFFSET keyword, you must put the offset value before the row count, separated by a comma.

You can use TOP or LIMIT with ORDER BY. If so, then the database engine generates a temporary table and populates it with the entire query result set if no index can be used for ORDER BY. The rows in the temporary table are arranged as specified by ORDER BY in the result set, but only the number of rows determined by TOP or LIMIT are returned by the query.

Views that use TOP or LIMIT may be joined with other tables or views.

The main difference between TOP or LIMIT and SET ROWCOUNT is that TOP or LIMIT affect only the current statement, while SET ROWCOUNT affects all subsequent statements issued during the current database session.

If SET ROWCOUNT and TOP or LIMIT are both used in a query, the query returns a number of rows equal to the lowest of the two values.

Either TOP or LIMIT is allowed within a single query or subquery, but not both.

Cursor Types and TOP or LIMIT

A SELECT query with a TOP or LIMIT clause that uses a dynamic cursor converts the cursor type to static. Forward-only and static cursors are not affected.

TOP or LIMIT Examples

The following examples use both TOP and LIMIT clauses, which are interchangeable as keywords and give the same results, although LIMIT offers more control of which rows are returned.

```
SELECT TOP 10 * FROM person; -- returns 10 rows
```

```
SELECT * FROM person LIMIT 10; -- returns 10 rows
```

```
SELECT * FROM person LIMIT 10 OFFSET 5; -- returns 10 rows starting with row 6
```

```
SELECT * FROM person LIMIT 5,10; -- returns 10 rows starting with row 6
```

```
SET ROWCOUNT = 5;
```

```
SELECT TOP 10 * FROM person; -- returns 5 rows

SELECT * FROM person LIMIT 10; -- returns 5 rows

SET ROWCOUNT = 12;

SELECT TOP 10 * FROM person ORDER BY id; -- returns the first 10 rows of the full list ordered by
column id

SELECT * FROM person LIMIT 20 ORDER BY id; -- returns the first 12 rows of the full list ordered by
column id
```

============

The following examples show a variety of behaviors when TOP or LIMIT is used in views, unions, or subqueries.

```
CREATE VIEW v1 (c1) AS SELECT TOP 10 id FROM person;

CREATE VIEW v2 (d1) AS SELECT TOP 5 c1 FROM v1;

SELECT * FROM v2 -- returns 5 rows

SELECT TOP 10 * FROM v2 -- returns 5 rows

SELECT TOP 2 * FROM v2 -- returns 2 rows

SELECT * FROM v2 LIMIT 10 -- returns 5 rows

SELECT * FROM v2 LIMIT 10 OFFSET 3 -- returns 2 rows starting with row 4

SELECT * FROM v2 LIMIT 3,10 -- returns 2 rows starting with row 4



SELECT TOP 10 id FROM person UNION SELECT TOP 13 faculty_id FROM class -- returns 17 rows

SELECT TOP 10 id FROM person UNION ALL SELECT TOP 13 faculty_id FROM class -- returns 23 rows

SELECT id FROM person WHERE id IN (SELECT TOP 10 faculty_id from class) -- returns 5 rows

SELECT id FROM person WHERE id >= any (SELECT TOP 10 faculty_id from class) -- returns 1040 rows
```

============

The following example returns last name and amount owed for students above a certain ID number.

```
SELECT p_last_name, b_owed FROM

    (SELECT TOP 10 id, last_name FROM person ORDER BY id DESC) p (p_id, p_last_name),

    (SELECT TOP 10 student_id, SUM (amount_owed) FROM billing GROUP BY student_id ORDER BY student_id
    DESC) b (b_id, b_owed)

WHERE p.p_id = b.b_id AND p.p_id > 714662900

ORDER BY p_last_name ASC
```

Table Hint Examples

This topic provides working examples for table hints. Use the SQL statements to create them in Zen.

```
DROP TABLE t1
```

```
CREATE TABLE t1 (c1 INTEGER, c2 INTEGER)
```

```
INSERT INTO t1 VALUES (1,10)
```

```
INSERT INTO t1 VALUES (1,10)
```

```
INSERT INTO t1 VALUES (2,20)
```

```
INSERT INTO t1 VALUES (2,20)
```

```
INSERT INTO t1 VALUES (3,30)
```

```
INSERT INTO t1 VALUES (3,30)
```

```
CREATE INDEX it1c1 ON t1 (c1)
```

```
CREATE INDEX it1c1c2 ON t1 (c1, c2)
```

```
CREATE INDEX it1c2 ON t1 (c2)
```

```
CREATE INDEX it1c2c1 ON t1 (c2, c1)
```

```
DROP TABLE t2
```

```
CREATE TABLE t2 (c1 INTEGER, c2 INTEGER)
```

```
INSERT INTO t2 VALUES (1,10)
```

```
INSERT INTO t2 VALUES (1,10)
```

```
INSERT INTO t2 VALUES (2,20)
```

```
INSERT INTO t2 VALUES (2,20)
```

```
INSERT INTO t2 VALUES (3,30)
```

```
INSERT INTO t2 VALUES (3,30)
```

Certain restrictions apply to the use of table hints. See Table Hint Restrictions for examples.

============

The following example optimizes on index it1c1c2.

```
SELECT * FROM t1 WITH (INDEX(it1c1c2)) WHERE c1 = 1
```

Contrast this with the following example, which optimizes on index it1c1 instead of on it1c2 because the restriction consists of only c1 = 1. If a query specifies an index that cannot be used to optimize the query, the hint is ignored.

```
SELECT * FROM t1 WITH (INDEX(it1c2)) WHERE c1 = 1
```

============

The following example performs a table scan of table t1.

```
SELECT * FROM t1 WITH (INDEX(0)) WHERE c1 = 1
```

============

The following example optimizes on indexes it1c1c2 and it1c2c1.

```
SELECT * FROM t1 WITH (INDEX(it1c1c2, it1c2c1)) WHERE c1 = 1 OR c2 = 10
```

============

The following example using a table hint in the creation of a view. When all records are selected from the view, the SELECT statement optimizes on index it1c1c2.

```
DROP VIEW v2
```

```
CREATE VIEW v2 as SELECT * FROM t1 WITH (INDEX(it1c1c2)) WHERE c1 = 1
```

```
SELECT * FROM v2
```

============

The following example uses a table hint in a subquery and optimizes on index it1c1c2.

```
SELECT * FROM (SELECT c1, c2 FROM t1 WITH (INDEX(it1c1c2)) WHERE c1 = 1) AS a WHERE a.c2 = 10
```

============

The following example uses a table hint in a subquery and an alias name "a." The alias name is required.

```
SELECT * FROM (SELECT Last_Name FROM Person AS P with (Index(Names)) ) a
```

============

The following example optimizes the query based on the c1 = 1 restriction and optimizes the GROUP BY clause based on index it1c1c2.

```
SELECT c1, c2, count(*) FROM t1 WHERE c1 = 1 GROUP BY c1, c2
```

============

The following example optimizes on index it1c1 and, unlike the previous example, optimizes only on the restriction and not on the GROUP BY clause.

```
SELECT c1, c2, count(*) FROM t1 WITH (INDEX(it1c1)) WHERE c1 = 1 GROUP BY c1, c2
```

Since the GROUP BY clause cannot be optimized using the specified index, it1c1, the database engine uses a temporary table to process the GROUP BY.

============

The following example uses a table hint in a JOIN clause and optimizes on index it1c1c2.

```
SELECT * FROM t2 INNER JOIN t1 WITH (INDEX(it1c1c2)) ON t1.c1 = t2.c1
```

Contrast this with the following statement, which does not use a table hint and optimizes on index it1c1.

```
SELECT * FROM t2 INNER JOIN t1 ON t1.c1 = t2.c1
```

============

The following example uses a table hint in a JOIN clause to perform a table scan of table t1.

```
SELECT * FROM t2 INNER JOIN t1 WITH (INDEX(0)) ON t1.c1 = t2.c1
```

Contrast this with the following example which also performs a table scan of table t1. However, because no JOIN clause is used, the statement uses a temporary table join.

```
SELECT * FROM t2, t1 WITH (INDEX(0)) WHERE t1.c1 = t2.c1
```

See Also

Global Variables

SELECT (with INTO)

The SELECT (with INTO) statement allows you to select column values from a specified table to insert into variables or to populate a table with data.

Syntax

```
SELECT [ ALL | DISTINCT ] [ top-clause ] select-list INTO variable | table-name | temp-table-name [ ,
variable ]...

 FROM table-reference [ , table-reference ]... [ WHERE search-condition ]

 [ GROUP BY expression [ , expression ]...[ HAVING search-condition ] ] [ UNION [ALL ] query-
specification ] [ ORDER BY order-by-expression [ , order-by-expression ]... ]


query-specification ::= ( query-specification )

    | SELECT [ ALL | DISTINCT ] [ top-clause ] select-list

       FROM table-reference [ , table-reference ]...

    [ WHERE search-condition ]

    [ GROUP BY expression [ , expression ]...

    [ HAVING search-condition ] ]


variable ::= user-defined-name


table-name ::= user-defined-name of a table


temp-table-name ::= user-defined-name of a temporary table
```

For the remaining syntax definitions, see SELECT.

Remarks

The variables must occur within a stored procedure, a trigger, or a user-defined function.

You can populate a table by using SELECT INTO only if the SELECT INTO statement occurs outside of a user-defined function or trigger. Populating or creating a table with SELECT INTO is not permitted within a user-defined function or trigger.

SELECT INTO is permitted within a stored procedure.

Only a single table can be created and populated with a SELECT INTO statement. A single SELECT INTO statement cannot create and populate multiple tables.

New tables created by SELECT INTO only maintain CASE and NOT NULL constraints from the source tables. Other constraints such as DEFAULT and COLLATE are not maintained. In addition, no indexes are created on the new table.

Examples

See the examples for CREATE (temporary) TABLE for how to use SELECT INTO to populate temporary tables.

The following example assigns into variables :x, :y the values of first_name and last_name in the Person table where first name is Bill.

```
SELECT first_name, last_name INTO :x, :y FROM person WHERE first_name = 'Bill'
```

See Also

CREATE FUNCTION

CREATE PROCEDURE

CREATE (temporary) TABLE

CREATE TABLE

SET

The SET statement assigns a value to a declared variable.

Syntax

```
SET variable-name = proc-expr
```

Remarks

You must declare variables before you can set them. SET is allowed only in stored procedures and triggers.

Examples

The following examples assigns a value of 10 to var1.

```
SET :var1 = 10;
```

See Also

CREATE PROCEDURE

DECLARE

SET ANSI_PADDING

The SET ANSI_PADDING statement allows the Relational Engine to handle CHAR data types padded with NULLs (binary zeros). CHAR is defined as a character data type of fixed length.

Zen supports two interfaces: transactional and relational. The MicroKernel Engine allows a CHAR to be padded with NULLs. The Relational Engine conforms to the ANSI standard for padding, which specifies that a CHAR be padded with spaces. For example, by default, a CHAR column created with a CREATE TABLE statement is always padded with spaces.

An application that uses *both* interfaces may need to process strings padded with NULLs.

Syntax

```
SET ANSI_PADDING=< ON | OFF >
```

Remarks

The default value is ON, meaning that strings padded with spaces are inserted into CHARs. Trailing spaces are considered as *insignificant* in logical expression comparisons. Trailing NULLs are considered as *significant* in comparisons.

If set to OFF, the statement means that strings padded with NULLs are inserted into CHARs. Both trailing NULLs and trailing spaces are considered as *insignificant* in logical expression comparisons.

On Windows, ANSI padding can be set to on or off for a DSN through a registry setting. See the Zen Knowledge Base on the Actian website and search for "ansipadding."

The following string functions support NULL padding:

CHAR_LENGTH	CONCAT	LCASE or LOWER
LEFT	LENGTH	LOCATE
LTRIM	POSITION	REPLACE
REPLICATE	RIGHT	RTRIM
STUFF	SUBSTRING	UCASE or UPPER

For information on how ANSI_PADDING affects each function, see its scalar function documentation.

Restrictions

The following restrictions apply to SET ANSI_PADDING:

- The statement applies only to the fixed length character data type CHAR, not to NCHAR, VARCHAR, NVARCHAR, LONGVARCHAR or NLONGVARCHAR.
- The statement applies to the session level.

Examples

The following example shows the results of string padding using the INSERT statement with SET ANSI_PADDING set to ON and to OFF.

```
DROP TABLE t1

CREATE TABLE t1 (c1 CHAR(4))

SET ANSI_PADDING = ON

INSERT INTO t1 VALUES ('a') -- string a = a\0x20\0x20\0x20

INSERT INTO t1 VALUES ('a' + CHAR(0) + CHAR(0) + CHAR(0)) -- string a = a\0x00\0x00\0x00

DROP TABLE t1

CREATE TABLE t1 (c1 CHAR(4))

SET ANSI_PADDING = OFF

INSERT INTO t1 VALUES ('a') -- string a = a\0x00\0x00\0x00

INSERT INTO t1 VALUES ('a' + CHAR(32) + CHAR(32) + CHAR(32)) -- string a = a\0x20\0x20\0x20
```

============

The following example shows the results of string padding using the UPDATE statement with SET ANSI_PADDING set to ON and to OFF.

```
DROP TABLE t1

CREATE TABLE t1 (c1 CHAR(4))

SET ANSI_PADDING = ON

UPDATE t1 SET c1 = 'a' -- all rows for c1 = a\0x20\0x20\0x20

UPDATE t1 SET c1 = 'a' + CHAR(0) + CHAR(0) + CHAR(0) -- all rows for c1 = a\0x00\0x00\0x00

DROP TABLE t1

CREATE TABLE t1 (c1 CHAR(4))

SET ANSI_PADDING = OFF

UPDATE t1 SET c1 = 'a' -- all rows for c1 = a\0x00\0x00\0x00

UPDATE t1 SET c1 = 'a' + CHAR(32) + CHAR(32) + CHAR(32) -- all rows for c1 = a\0x20\0x20\0x20
```

============

The following example shows how a character column, c1, can be cast to a BINARY data type so that you can display the contents of c1 in BINARY format. Assume that table t1 has the following six rows of data:

```
a\x00\x00\x00\x00
```

```
a\x00\x00\x00\x00
```

```
a\x00\x20\x00\x00
```

```
a\x00\x20\x00\x00
```

```
a\x20\x20\x20\x20
```

```
a\x20\x20\x20\x20
```

The following statement casts c1 as a BINARY data type:

```
SELECT CAST(c1 AS BINARY(4)) FROM t1
```

The SELECT statement returns the following:

```
0x61000000
```

```
0x61000000
```

```
0x61002000
```

```
0x61002000
```

```
0x61202020
```

```
0x61202020
```

See Also

INSERT

UPDATE

String Functions

Conversion Functions

SET CACHED_PROCEDURES

The SET CACHED_PROCEDURES statement specifies the number of stored procedures that the database engine caches in memory for a SQL session.

Syntax

```
SET CACHED_PROCEDURES = number
```

Remarks

The value of *number* can be any whole number in the range zero through approximately two billion. The database engine automatically defaults to 50. Each session can change its number of cached procedures by issuing the SET statement.

The companion statement to SET CACHED_PROCEDURES is SET PROCEDURES_CACHE.

- If you set both SET statements to zero, the database engine does **not** cache stored procedures. In addition, the engine removes any existing cache used for stored procedures. That is, the engine flushes from cache all stored procedures that *were* cached before you set both statements to zero.
- If you set only *one* of the statements to a value, either zero or a nonzero value, the other statement is implicitly set to zero. The statement implicitly set to zero is ignored. For example, if you are only interested in caching 70 procedures and are not concerned with the amount of memory, set CACHED_PROCEDURES to 70. The database engine implicitly sets PROCEDURES_CACHE to zero, which ignores the setting.

The following condition applies if you set CACHED_PROCEDURES to a nonzero value. The database engine removes the least-recently-used procedures from the cache if the execution of a procedure causes the number of cached procedures to exceed the CACHED_PROCEDURES value.

If a memory cache is used, it retains a compiled version of a stored procedure after the procedure executes. Typically, caching results in improved performance for each subsequent call to a cached procedure. Note that excessive memory swapping, or thrashing, could occur depending on the cache settings and the SQL being executed by your application. Thrashing can cause a decrease in performance.

Registry Setting

In addition to the SET statement, the number of cached procedures can be specified with a registry setting. The registry settings apply to all sessions and provides a convenient way to set an initial value. Each session can override the registry setting for that particular session by using the SET statement.

The registry setting applies to all server platforms where Zen Enterprise Server or Cloud Server is supported. You must manually modify the registry setting. On Windows, use the registry editor provided with the operating system. On Linux and macOS, you can use the psregedit utility.

If the registry setting is not specified, the database engine automatically defaults to 50.

To specify cached procedures registry setting on Windows

1. Locate the following key:

   HKEY_LOCAL_MACHINE\SOFTWARE\Actian\Zen\SQL Relational Engine

   Note that in most Windows operating systems, the key is under HKEY_LOCAL_MACHINE\SOFTWARE\Actian\Zen. However, its location below HKEY_LOCAL_MACHINE\SOFTWARE can vary depending on the operating system.
2. For this key, create a new string valued named **CachedProcedures**.
3. Set **CachedProcedures** to the desired number of procedures that you want to cache.

To set the cached procedures registry key in the Zen Registry on Linux and macOS

1. Locate the following key:

   PS_HKEY_CONFIG\SOFTWARE\Actian\Zen\SQL Relational Engine
2. For this key, create a new string valued named **CachedProcedures**.
3. Set **CachedProcedures** to the desired number of procedures that you want to cache.

Caching Exclusions

A stored procedure is **not** cached, regardless of the cache settings, for any of the following:

- The stored procedure references a local or a global temporary table. A local temporary table has a name that begins with the pound sign (#). A global temporary table has a name that begins with two pound signs (##). See CREATE (temporary) TABLE.
- The stored procedure contains any data definition language (DDL) statements. See Data Definition Statements.

- The stored procedure contains an EXEC[UTE] statement used to execute a character string, or an expression that returns a character string. For example: `EXEC ('SELECT Student_ID FROM ' + :myinputvar)`.

Examples

The following example sets a cache memory of 2 MB that stores up to 20 stored procedures.

```
SET CACHED_PROCEDURES = 20
```

```
SET PROCEDURES_CACHE = 2
```

============

The following example sets a cache memory of 1,000 MB that stores up to 500 stored procedures.

```
SET CACHED_PROCEDURES = 500
```

```
SET PROCEDURES_CACHE = 1000
```

============

The following example specifies that you do **not** want to cache stored procedures and that any existing procedures cache will be removed.

```
SET CACHED_PROCEDURES = 0
```

```
SET PROCEDURES_CACHE = 0
```

============

The following example specifies that you want to cache 120 stored procedures and ignore the amount of memory used for the cache.

```
SET CACHED_PROCEDURES = 120
```

(The database engine implicitly sets PROCEDURES_CACHE to zero.)

See Also

CREATE PROCEDURE

SET PROCEDURES_CACHE

SET DECIMALSEPARATORCOMMA

The Zen database engine by default displays decimal data using a period (.) as the separator between ones and tenths (for example, 100.95). The SET DECIMALSEPARATORCOMMA statement allows you to specify that results should be displayed using a comma to separate ones and tenths (for example, 100,95).

As with all SET statements, the effects of this statement apply to the remainder of the current database session, or until another SET DECIMALSEPARATORCOMMA statement is issued.

Syntax

```
SET DECIMALSEPARATORCOMMA=<ON|OFF>
```

Remarks

The default value is OFF, meaning that the period is used as the default decimal separator.

In locales where the comma is used as the decimal separator, decimal data can be entered using a comma or a period as the separator (literal values that use the comma as the separator must be enclosed in single quotes, for example: '123,43'). When the data is returned, however (as in the results of a SELECT statement), it is always displayed using a period unless SET DECIMALSEPARATORCOMMA=ON has been specified.

Likewise, if your database contains data that was entered using the period as the decimal separator, you can choose to specify the comma as the separator for output and display by using this statement.

This command affects output and display only. It has no effect on values being inserted, updated, or used in a comparison.

Examples

The following example shows how to insert period-delimited data and the effects of the SET DECIMALSEPARATORCOMMA statement on the SELECT results.

```
CREATE TABLE t1 (c1 real, c2 real)
```

```
INSERT INTO t1 VALUES (102.34, 95.234)
```

```
SELECT * FROM t1
```

Results:

```
c1      c2

------- -------

102.34  95.234


SET DECIMALSEPARATORCOMMA=ON

SELECT * FROM t1
```

Results:

```
c1      c2

------- -------

102,34  95,234
```

============

The following example shows how to insert comma-delimited data, and the effects of the SET DECIMALSEPARATORCOMMA statement on the SELECT results.

Note: The comma can only be used as the separator character if the client and/or server operating system locale settings are set to a locale that uses the comma as the separator. For example, if you have U.S. locale settings on both your client and server, you will receive an error if you attempt to run this example.

```
CREATE TABLE t1 (c1 real, c2 real)

INSERT INTO t1 VALUES ('102,34', '95,234')

SELECT * FROM t1
```

Results:

```
c1      c2

------- -------

102.34  95.234


SET DECIMALSEPARATORCOMMA=ON

SELECT * FROM t1
```

Results:

```
c1      c2

------- -------

102,34  95,234
```

See Also

Comma as Decimal Separator

SET DEFAULTCOLLATE

The SET DEFAULTCOLLATE statement specifies the collating sequence to use for all columns of data type CHAR, VARCHAR, LONGVARCHAR, NCHAR, NVARCHAR, or NLONGVARCHAR. The statement offers the following options:

- A null value to default to the numerical order of the current code page
- A path to a file containing alternate collating sequence (ACS) rules
- An International Sorting Rules (ISR) table name
- An International Components for Unicode (ICU) collation name

Syntax

```
SET DEFAULTCOLLATE = < NULL | 'sort-order' >


sort-order ::= path name to an ACS file or the name of an ISR table or a supported ICU collation name
```

Remarks

The SET DEFAULTCOLLATE statement offers the convenience of a global session setting. However, an individual column definition can use the COLLATE keyword to set its particular collating sequence. If so, then SET DEFAULTCOLLATE has no effect on that column.

The default setting for DEFAULTCOLLATE is null.

Using ACS Files

When you provide an ACS file for the *sort-order* parameter, the following statements apply:

- You must specify a path accessible to the database engine rather than to the calling application.
- The path must be enclosed in single quotation marks.
- The path must be at least 1 character but no more than 255 characters long.
- The path must already exist and must include the name of an ACS file. An ACS file is a 265-byte image of the format used by the MicroKernel Engine. By default, Zen installs the commonly used ACS file upper.alt in C:\ProgramData\Actian\Zen\samples. You can also use a custom file. For information on custom files, see User-Defined ACS in *Zen Programmer's Guide*.

- Relative paths are allowed and are relative to the DDF directory. Relative paths can contain a period (current directory), double period (parent directory), slash, or any combination of the three. Slash characters in relative paths may be either forward (/) or backslash (\). You may mix the types of slash characters in the same path.
- Universal naming convention (UNC) path names are permitted.

Using ISR Table Names

When you provide an ISR table name for the *sort-order* parameter, the following statements apply:

- Zen supports the table names listed in this documentation under International Sort Rules.
- The ISR table name is not the name of a file, but rather a string recognized by Zen as one of the ISRs that it supports.
- Zen supports selected Unicode collations based on International Components for Unicode (ICU). Simply use the ICU collation name in place of the ISR table name. The available collations are described under Collation Support Using an ICU Unicode Collation.

ACS, ISR, and ICU Examples

This ACS example sets a collating sequence using the upper.alt file supplied with Zen. The table t1 is created with three text columns and three columns not text. A SELECT statement executes against Zen system tables to return the ID, type, size, and attributes of the columns in t1. The result shows that the three text columns have an attribute of UPPER.

```
SET DEFAULTCOLLATE = 'C:\ProgramData\Actian\Zen\samples\upper.alt'

DROP TABLE t1

CREATE TABLE t1 (c1 INT, c2 CHAR(10), c3 BINARY(10), c4 VARCHAR(10), c5 LONGVARBINARY, c6
LONGVARCHAR)

SELECT * FROM x$attrib WHERE xa$id in (SELECT xe$id FROM x$field WHERE xe$file = (SELECT xf$id FROM
x$file WHERE xf$name = 't1'))



Xa$Id       Xa$Type      Xa$ASize      Xa$Attrs

=====    =======    ========    ========

  327    O              265     UPPER

  329    O              265     UPPER

  331    O              265     UPPER



3 rows were affected.
```

=============

The following ACS example continues with the use of table t1. An ALTER TABLE statement changes the text column c2 from a CHAR to an INTEGER. The result of the SELECT statement shows that now only two columns are affected by the default collating.

```
ALTER TABLE t1 ALTER c2 INT


SELECT * FROM x$attrib WHERE xa$id in (SELECT xe$id FROM x$field WHERE xe$file = (SELECT xf$id FROM
x$file WHERE xf$name = 't1'))


Xa$Id     Xa$Type     Xa$ASize     Xa$Attrs

=====    =======    ========    ========

  329    0               265     UPPER

  331    0               265     UPPER


2 rows were affected.
```

=============

The following ACS example uses an ALTER TABLE statement to change column c1 in table t1 from an INTEGER to a CHAR. The result of the SELECT statement shows that three columns are affected by the default collating.

```
ALTER TABLE t1 ALTER c1 CHAR(10)


SELECT * FROM x$attrib WHERE xa$id in (SELECT xe$id FROM x$field WHERE xe$file = (SELECT xf$id FROM
x$file WHERE xf$name = 't1'))


Xa$Id     Xa$Type     Xa$ASize     Xa$Attrs

=====    =======    ========    ========

  326    0               265     UPPER

  329    0               265     UPPER

  331    0               265     UPPER


3 rows were affected.
```

=============

The following ISR example creates a table with a VARCHAR column, assumes the default Windows encoding CP1252, and uses the ISR collation MSFT_ENUS01252_0.

```
CREATE TABLE isrtest (ord INT, value VARCHAR(19) COLLATE 'MSFT_ENUS01252_0' NOT NULL, PRIMARY
KEY(value));
```

The following ICU example creates a table with a VARCHAR column, assumes the default Linux encoding UTF-8, and uses the ICU collation u54-msft_enus_0.

```
CREATE TABLE isrtest (ord INT, value VARCHAR(19) COLLATE 'u54-msft_enus_0' NOT NULL, PRIMARY
KEY(value));
```

The following ICU example creates a table with an NVARCHAR column using the ICU collation u54-msft_enus_0.

```
CREATE TABLE isrtest (ord INT, value NVARCHAR(19) COLLATE 'u54-msft_enus_0' NOT NULL, PRIMARY
KEY(value));
```

See Also

ALTER TABLE

CREATE TABLE

Support for Collation and Sorting in *Advanced Operations Guide*

SET LEGACYTYPESALLOWED

The SET LEGACYTYPESALLOWED statement enables backward compatibility with data types no longer supported in the current release of Zen.

Syntax

```
SET LEGACYTYPESALLOWED = < ON | OFF >
```

Remarks

A SET LEGACYTYPESALLOWED statement is executed in a SQL session before CREATE TABLE or ALTER TABLE statements to enable their use of legacy data types supported in earlier releases of Zen.

The default value is OFF, meaning that these data types are not supported.

For more information, see Legacy Data Types.

Example

In this example, turning on LEGACYTYPESALLOWED before a CREATE TABLE statement enables the legacy data type to work, then is turned off again after the table is created:

```
SET LEGACYTYPESALLOWED=ON;
```

```
CREATE TABLE notes (c1 INTEGER, c2 NOTE(20));
```

```
SET LEGACYTYPESALLOWED=OFF;
```

Note: If you do not turn off the setting, like all SET commands, it ends with the SQL session.

SET OWNER

The SET OWNER statement lists owner names for files to be accessed by SQL commands in the current database session. For more information about this file-level security feature, see Owner Names.

Syntax

```
SET OWNER = [']ownername['] [,[']ownername[']] ...
```

Remarks

In SET OWNER statements, owner names that begin with a nonalphabetic character and ASCII owner names that contain spaces must be enclosed in single quotation marks. A long owner name in hexadecimal begins with 0x or 0X, so it always requires single quotation marks.

A SET OWNER statement can list all owner names needed for data files in a session. The Relational Engine caches the owner names to use as needed in requesting file access from the MicroKernel Engine.

A SET OWNER statement is effective only for the current connection session. If a user logs out after issuing SET OWNER, the command must be reissued the next time the user logs in.

Each SET OWNER statement resets the current owner name list for the session. You cannot add owner names to the list with more statements.

In a database with security turned off, the SET OWNER statement allows full access to any data file that has an owner name matching an owner name supplied in the statement.

In a database with security turned on, the SET OWNER statement has no effect for users other than the Master user. If the Master user has not granted itself rights, executing SET OWNER gives the Master user full access to any data file with one of the owner names provided. For other users, the Master user can authorize access in either of the following two ways:

- Execute SET OWNER with owner names, followed by GRANT with no owner name.
- Execute GRANT with an owner name.

These two options are illustrated in the following examples.

Examples

In this example, the owner name begins with a numeral, so it has single quotation marks.

```
SET OWNER = '1@lphaOm3gA'
```

============

This example provides a list of owner names used by files to be accessed in the current session.

```
SET OWNER = 'serverl7 region5', '0x7374726f6e672050617373776f7264212425fe'
```

Single quotation marks are used for the ASCII string because it includes a space and for the hexadecimal string because its prefix 0x starts with a numeral.

============

During a a database session, each SET OWNER statement overrides the previous one. In this example, after the second command runs, the first three owner names are no longer available to use for file access.

```
SET OWNER = judyann, krishna1, maxima
```

```
SET OWNER = d3ltagamm@, V3rs10nXIII, m@X1mumSp33d
```

============

This example demonstrates the use of SET OWNER by the Master user in a secure database where security has been turned on, but no permissions have been granted to users. The data file named inventory1 has the owner name `admin`.

To grant itself permissions, the Master user has two options. For the first, you can issue a SET OWNER followed by a GRANT without an owner name:

```
SET OWNER = admin
```

```
GRANT ALL ON inventory1 TO MASTER
```

For the second option, the Master user can omit the SET OWNER statement and issue a GRANT that includes the owner name:

```
GRANT ALL ON inventory1 admin TO MASTER
```

Both methods achieve the same result.

See Also

GRANT

REVOKE

SET PASSWORD

The SET PASSWORD statement provides the following functionality for a secured database:

- The Master user can change the password for the Master user or for another user.
- A normal user (non-Master user) can change his or her logon password to the database.

Syntax

```
SET PASSWORD [ FOR 'user-name'] = password

user-name ::= name of user logged on the database or authorized to log on the database

password ::= password string
```

Remarks

SET PASSWORD requires that the database have relational security enabled and may be issued at any time. In contrast, SET SECURITY is issued only when the Master user session is the only current database connection. See SET SECURITY.

SET PASSWORD may be issued by the Master user or by a normal, non-Master user. The Master user can change the password for any user authorized to log in to the database. Normal users can change only their own password. A password change takes effect the next time the user logs.

User Issuing SET PASSWORD statement	with FOR clause	without FOR clause
Master	Master can specify a user name of Master or of any user authorized to log on the database.[1] Password changed for user name.	Password changed for entire database (that is, changed for the Master user, which affects the entire database).
Normal	Normal user can specify a user name. The user must be logged in to the database. Password changed only for that user.	Password changed only for the user issuing the SET PASSWORD statement. The user must be logged on the database.

[1]*User-name* is a user who can log on to a Zen database. It can differ from operating system user names. For example, the user name Yogine can log on to the operating system. Security is enabled on database Demodata, where Yogine is added as user name DeptMgr, which is the user name to log on to Demodata.

Password Characteristics

- See Identifier Restrictions in *Advanced Operations Guide* for the maximum length of a password and the characters allowed.
- Passwords are case sensitive. If the password begins with a nonalphabetic character, the password must be enclosed in single quotes.
- The space character may be used in a password provided it is not the first character. If a password contains a space character, the password must be enclosed by single quotes. As a general rule, avoid using the space character in a password.
- "Password" is not a reserved word. It may be used as a name for a table or column. However, if used for a table or column name in a SQL statement, "password" must be enclosed by double quotation marks because it is a keyword.
- If you want to use the literal "null" as a password, you must enclose the word with single quotes ('null'). The quoted string prevents confusion with the statement SET SECURITY = NULL, which disables security on the database.

Examples

The following example shows the Master user enabling security on the database with the password `bluesky`. The Master user then grants login privilege to user `user45` with the password `tmppword` and grants that user SELECT permission to the table `person`. The Master user then changes the Master password to `reddawn`, which changes it for the entire database. Finally, it changes the user45 password to `newuser`.

```
SET SECURITY = bluesky
```

```
GRANT LOGIN TO user45:tmppword
```

```
GRANT SELECT ON person TO user45
```

```
SET PASSWORD = reddawn
```

```
SET PASSWORD FOR user45 = newuser
```

The following example assumes that user45 has logged on to the database with a password `newuser`. User45 changes its own password to `tomato`. User45 then selects all records in the table person.

```
SET PASSWORD FOR user45 = tomato
```

```
SELECT * FROM person
```

See Also

ALTER USER

CREATE USER

GRANT

SET SECURITY

SET PROCEDURES_CACHE

The SET PROCEDURES_CACHE statement specifies the amount of memory for a SQL session that the database engine reserves as a cache for stored procedures.

Syntax

```
SET PROCEDURES_CACHE = megabytes
```

Remarks

The value of *megabytes* can be any whole number in the range zero to approximately two billion. The database engine defaults to 5 MB. Each session can change its amount of cache memory by issuing this SET statement.

The companion statement to SET PROCEDURES_CACHE is SET CACHED_PROCEDURES.

- If you set both of these SET statements to zero, the database engine does **not** cache stored procedures. In addition, the engine removes any existing cache used for stored procedures. That is, the engine flushes from cache all stored procedures that were cached before you set both statements to zero.
- If you set only *one* of the statements to either a zero or a nonzero value, the other statement is implicitly set to zero. The statement implicitly set to zero is ignored. For example, if you are interested only in 30 MB as the amount of memory cached and are not concerned with the number of procedures cached, set PROCEDURES_CACHE to 30. The database engine implicitly sets CACHED_PROCEDURES to zero, which causes that setting to be ignored.

The following condition applies if you set PROCEDURES_CACHE to a nonzero value. The database engine removes the least recently used procedures from the cache if the execution of a procedure allocates memory that exceeds the PROCEDURES_CACHE value.

If a memory cache is used, it retains a compiled version of a stored procedure after the procedure executes. Typically, caching results in improved performance for subsequent calls to a cached procedure. Note that excessive memory swapping, or thrashing, can occur depending on the cache settings and the SQL statements executed by your application. Thrashing can lessen performance.

Registry Setting

In addition to the SET statement, the amount of memory reserved for the cache can be specified with a registry setting. The registry settings apply to all sessions and provides a convenient way to set an initial value. Each session can override the registry setting for that particular session by using the SET statement.

The registry setting applies to all server platforms where Zen Enterprise Server or Cloud Server is supported. You must manually modify the registry setting. On Windows, use the registry editor provided with the operating system. On Linux and macOS, you can use the psregedit utility.

If the registry setting is not specified, the database engine automatically defaults to 5 MB.

To specify the amount of cache memory in a registry setting on Windows

1. Locate the following key:

   HKEY_LOCAL_MACHINE\SOFTWARE\Actian\Zen\SQL Relational Engine

   Note that in most Windows operating systems, the key is under HKEY_LOCAL_MACHINE\SOFTWARE\Actian\Zen. However, its location below HKEY_LOCAL_MACHINE\SOFTWARE can vary depending on the operating system.

2. For this key, create a new string valued named **ProceduresCache**.
3. Set **ProceduresCache** to the desired amount of memory that you want to cache.

To set the amount of cache memory in the Zen Registry on Linux and macOS

1. Locate the following key:

   PS_HKEY_CONFIG\SOFTWARE\Actian\Zen\SQL Relational Engine

2. For this key, create a new string valued named **ProceduresCache**.
3. Set **ProceduresCache** to the desired amount of memory that you want to cache.

Caching Exclusions

A stored procedure is **not** cached, regardless of the cache setting(s), for any of the following:

- The stored procedure references a local or a global temporary table. A local temporary table has a name that begins with the pound sign (#). A global temporary table has a name that begins with two pound signs (##). See CREATE (temporary) TABLE.
- The stored procedure contains any data definition language (DDL) statements. See Data Definition Statements.
- The stored procedure contains an EXEC[UTE] statement used to execute a character string, or an expression that returns a character string. For example: `EXEC ('SELECT Student_ID FROM ' + :myinputvar)`.

Examples

The following example sets a cache memory of 2 MB that stores up to 20 stored procedures.

```
SET CACHED_PROCEDURES = 20
```

```
SET PROCEDURES_CACHE = 2
```

============

The following example sets a cache memory of 1,000 MB that stores up to 500 stored procedures.

```
SET CACHED_PROCEDURES = 500
```

```
SET PROCEDURES_CACHE = 1000
```

============

The following example specifies that you do **not** want to cache stored procedures and that any existing procedures cache will be removed.

```
SET CACHED_PROCEDURES = 0
```

```
SET PROCEDURES_CACHE = 0
```

============

The following example specifies that you want to set the amount of cache memory to 80 MB and ignore the number of procedures that may be cached.

```
SET PROCEDURES_CACHE = 80
```

(The database engine implicitly sets CACHED_PROCEDURES to zero.)

See Also

CREATE PROCEDURE

SET CACHED_PROCEDURES

SET ROWCOUNT

You may limit the number of rows returned by all subsequent SELECT statements within the current session by using the keyword SET ROWCOUNT.

The main difference between SET ROWCOUNT and TOP or LIMIT is that TOP affects only the current statement, while SET ROWCOUNT affects all statements issued during the current database session, until the next SET ROWCOUNT or until the session is terminated.

Syntax

```
SET ROWCOUNT = number
```

Remarks

If a SELECT statement subject to a SET ROWCOUNT condition contains an ORDER BY keyword and an index cannot be used to optimize on the ORDER BY clause, Zen generates a temporary table. The temporary table is populated with the entire query result set. The rows in the temporary table are ordered as specified by the ORDER BY value and return the ROWCOUNT *number* of rows in the ordered result set.

You may turn off the ROWCOUNT feature by setting ROWCOUNT to zero:

```
SET ROWCOUNT = 0
```

SET ROWCOUNT is ignored when dynamic cursors are used.

If both SET ROWCOUNT and TOP are applied to a given query, the number of rows returned is the lower of the two values.

Examples

Also see the examples for TOP or LIMIT.

```
SET ROWCOUNT = 10;
```

```
SELECT * FROM person;
```

```
    -- returns 10 rows
```

See Also

TOP or LIMIT

SET SECURITY

The SET SECURITY statement allows the Master user to enable or disable security for the database to which Master is logged on.

Syntax

```
SET SECURITY [USING authentication_type] = < 'password' | NULL >
```

Remarks

You must be logged on as Master to set security. You can then assign a password by using the SET SECURITY statement. No password is required for Master to log on to an unsecured database, but to set security for the database, that Master user must have a password assigned.

SET SECURITY can be issued only when the session for the Master user is the only current database connection. You can also set security from the Zen Control Center (ZenCC). See To turn on security using Zen Explorer in *Zen User's Guide*.

The authentication type string is either `local_db` or `domain`. If the USING clause is not included, the authentication type is set to `local_db`.

When the authentication type is domain, execution of SQL scripts related to users returns an error message that the statement is not supported under domain authentication. Examples of the unsupported statements include ALTER USER, CREATE USER, DROP USER, GRANT in relation to users, SET PASSWORD (for non-Master user), and REVOKE.

For password requirements, see Password Characteristics.

User Permissions

Permissions on objects such as tables, views, and stored procedures are retained in the system tables after SET SECURITY is set to NULL. Consider the following scenario:

- Security for database mydbase is enabled and user Master is logged in.
- Master creates users user1 and user2, and table t1 for database mydbase.
- Master grants User2 SELECT permission on t1.
- Security for mydbase is disabled.
- Table t1 is dropped.

Even though table t1 no longer exists, permissions for t1 are still retained in the system tables (the ID for t1 is still in X$Rights). Now consider the following:

- Security for database mydbase is enabled again.
- User1 logs in to the database.
- User1 creates a new table tbl1 for mydbase. It is possible for tbl1 to be assigned the same object ID that had been assigned to t1. In this particular scenario, the object IDs assigned to t1 and tbl1 are the same.
- The previous permissions for t1 are reinstated for tbl1. That is, user1 has SELECT permissions on tbl1 even though no permissions to the new table have been explicitly granted.

Note: If you want to delete permissions for an object, you must explicitly revoke them. This applies to tables, views, and stored procedures because permissions are associated with object IDs and the database reuses object IDs of deleted objects for new objects.

Examples

The following example enables security for the database and sets the Master password to "mypasswd".

```
SET SECURITY = 'mypasswd'
```

The following example enables domain authentication for the database and sets the Master password to 123456.

```
SET SECURITY USING domain = '123456'
```

============

The following example disables security.

```
SET SECURITY = NULL
```

See Also

ALTER USER

CREATE USER

GRANT

REVOKE

SET PASSWORD

SET TIME ZONE

The SET TIME ZONE keyword allows you to specify a current time offset from Coordinated Universal Time (UTC) for your locale, overriding the operating system time zone setting where the database engine is located.

Any SET TIME ZONE statement remains in effect until the end of the current database session, or until another SET TIME ZONE statement is executed.

Caution! You should always use the default behavior unless you have a specific need to override the time zone setting in your operating system. If you are using DataExchange replication or your application has dependencies on the sequential time order of records inserted, use of SET TIME ZONE to modify your time zone offset is not recommended.

Syntax

```
SET TIME ZONE < offset | LOCAL >


offset ::= <+|->hh:mm
```

Valid range of `hh` is 00–12.

Valid range of `mm` is 00–59.

Either a plus (+) or a minus (-) sign is required as part of the offset value.

Remarks

Default Behavior – SET TIME ZONE LOCAL is the default behavior, which is the same as not using the SET TIME ZONE command at all. Under the default behavior, the database engine establishes its time zone based on the operating system where it is running. For example, SELECT CURTIME() returns the current local time, while SELECT CURRENT_TIME() returns the current UTC time, both based on local system time and the time zone setting in the operating system.

The LOCAL keyword allows you to restore default behavior after specifying a offset value, without having to terminate and reopen the database session.

Under default behavior, literal time and date values, such as `1996-03-28` and `17:40:46`, are interpreted as current local time and date. In addition, during inserts, time stamp literal values are interpreted as current local time. Time stamp values are always adjusted and stored internally using UTC time, and converted to local time upon retrieval. For more information, see Time Stamp Values.

If no time zone is specified, or TIME ZONE LOCAL is specified...

CURDATE(), CURTIME(), NOW(), SYSDATETIME()	Return current local time and date based on system clock.
CURRENT_DATE(), CURRENT_TIME(), CURRENT_TIMESTAMP(), SYSUTCDATETIME()	Return current UTC time and date based on system clock and operating system locale setting.

Behavior When Offset is Specified – If a valid offset value is specified, then that value is used instead of the operating system time zone offset to generate values for CURDATE(), CURTIME(), NOW(), or SYSDATETIME(). For example, if a offset of -02:00 is specified, then the local time value of CURDATE() is calculated by adding -02:00 to the UTC time returned from the operating system.

Under this behavior, time and date literals are interpreted as local time, at their face values. Time stamp literals are interpreted as specifying a time such that if the offset value is subtracted from it, the result is UTC. Daylight savings is not a consideration, since the offset explicitly takes it into account. Time stamp values are always stored internally using UTC time.

If a valid offset value is specified...

CURDATE(), CURTIME(), NOW(), SYSDATETIME()	These functions return current local time and date values by adding *offset* to the current UTC time/ date values.
CURRENT_DATE(), CURRENT_TIME(), CURRENT_TIMESTAMP(), SYSUTCDATETIME()	These functions always return current UTC time and date based on system clock and operating system locale setting.

To convert a given local time value to UTC, you must subtract your time zone offset value from the local time value. In other words,

UTC time = local time – time zone offset

This table gives example conversions.

Local Time	Offset	UTC
10:10:15 Austin	US Central Standard Time -06:00	10:10:15-(-06:00)=16:10:15 UTC
16:10:15 London	Greenwich Mean Time +00:00	16:10:15-(+00:00)=16:10:15 UTC
22:10:15 Dhaka	+06:00	22:10:15-(+06:00)=16:10:15 UTC

A Note about Time Stamp Data Types

Because time stamp data is always stored as UTC, and literal time stamp values (including values stored on disk) are always converted to local time when retrieved, the behavior of NOW() and CURRENT_TIMESTAMP() values can be confusing. For example, consider the following table, assuming the database engine is located in Central Standard Time, U.S.

Statement	Value
SELECT NOW()	2001-10-01 12:05:00.123 displayed.
INSERT INTO t1 (c1) SELECT NOW()	2001-10-01 18:05:00.1234567 stored on disk.
SELECT * from t1	2001-10-01 12:05:00.123 displayed.
SELECT CURRENT_TIMESTAMP()	2001-10-01 18:05:00.123 displayed.
INSERT INTO t2 (c1) SELECT CURRENT_TIMESTAMP()	2001-10-01 18:05:00.1234567 stored on disk.
SELECT * from t2	2001-10-01 12:05:00.123 displayed.

It is important to note that the value displayed by a direct SELECT NOW() is not the same as the value stored on disk by the syntax INSERT SELECT NOW(). Likewise, note that the display value of SELECT CURRENT_TIMESTAMP() is not the same value that you will see if you INSERT the value of CURRENT_TIMESTAMP() then SELECT it, because the literal value stored in the data file is adjusted when it is retrieved.

Examples

In this example, no SET TIME ZONE statement has been issued yet, and the computer on which the database engine is running has its clock set to January 9, 2002, 16:35:03 CST (U.S.). Recall that CURRENT_TIMESTAMP() and the other CURRENT_ functions always return UTC time and/or date based on the system clock and locale settings of the computer where the database engine is running.

```
SELECT CURRENT_TIMESTAMP(), NOW(),
CURRENT_TIME(), CURTIME(),
CURRENT_DATE(), CURDATE()
```

Results:

```
2002-01-09 22:35:03.000 2002-01-09 16:35:03.000

22:35:03                16:35:03

01/09/2002              01/09/2002
```

Note that CST is 6 hours ahead of UTC.

```
SET TIME ZONE -10:00
```

Now the same SELECT statement above returns the following:

```
2002-01-09 22:35:03.000  2002-01-09 12:35:03.000

22:35:03                 12:35:03

2002-01-09               2002-01-09
```

Note that the value of NOW() changed after the SET TIME ZONE statement, but the value of CURRENT_TIMESTAMP() did not.

============

The following example demonstrates the difference between time stamp values that are stored as UTC values then converted to local values upon retrieval, and TIME or DATE values that are stored and retrieved at their face value. Assume that the system clock currently shows January 9, 2002, 16:35:03 CST (U.S.). Also assume that no SET TIME ZONE statement has been issued.

```
CREATE TABLE t1 (c1 TIMESTAMP, c2 TIMESTAMP, c3 TIME, c4 TIME, c5 DATE, c6 DATE)


INSERT INTO t1 SELECT CURRENT_TIMESTAMP(), NOW(), CURRENT_TIME(), CURTIME(), CURRENT_DATE(),
CURDATE()


SELECT * FROM t1
```

Results:

```
c1                       c2

-----------------------  -----------------------

2002-01-09 16:35:03.000  2002-01-09 16:35:03.000


c3       c4       c5         c6

-------- -------- ---------- ----------

22:35:03 16:35:03 01/09/2002 01/09/2002

```

Observe that NOW() and CURRENT_TIMESTAMP() have different values when displayed to the screen with SELECT NOW(), CURRENT_TIMESTAMP(), but once the literal values are saved to disk, UTC time is stored for both values. Upon retrieval, both values are converted to local time.

By setting the time zone offset to zero, we can view the actual data stored in the file, because it is adjusted by +00:00 upon retrieval:

```
SET TIME ZONE +00:00

SELECT * FROM t1
```

Results:

```
c1                      c2

----------------------- -----------------------

2002-01-09 22:35:03.000 2002-01-09 22:35:03.000



c3       c4       c5         c6

-------- -------- ---------- ----------

22:35:03 16:35:03 01/09/2002 01/09/2002
```

============

The following example demonstrates the expected behavior when the local date is different than the UTC date (for example, UTC is past midnight, but local time is not, or the reverse). Assume that the system clock currently shows January 9, 2002, 16:35:03 CST (U.S.).

```
SET TIME ZONE +10:00

SELECT CURRENT_TIMESTAMP(), NOW(),

CURRENT_TIME(), CURTIME(),

CURRENT_DATE(), CURDATE()
```

Results:

```
2002-01-09 22:35:03.000  2002-01-10 08:35:03.000

22:35:03                 08:35:03

01/09/2002               01/10/2002



INSERT INTO t1 SELECT CURRENT_TIMESTAMP(), NOW(), CURRENT_TIME(), CURTIME(), CURRENT_DATE(),
CURDATE()



SELECT * FROM t1

Results:

c1                           c2

-----------------------      -----------------------

2002-01-10 08:35:03.000      2002-01-10 08:35:03.000
```

```

c3       c4       c5         c6
-------- -------- ---------- ----------
22:59:55 08:59:55 01/09/2002 01/10/2002
```

As you can see, the UTC time and date returned by CURRENT_DATE() and CURRENT_TIME() are stored as literal values. Since they are not time stamp values, no adjustment is made to them when they are retrieved from the database.

See Also

TIMESTAMP data type

Time and Date Functions

SET TRUEBITCREATE

The SET TRUEBITCREATE statement allows you to specify whether the BIT data type can be indexed and can map to the LOGICAL transactional data type.

Syntax

```
SET TRUEBITCREATE = < ON | OFF >
```

Remarks

The default is on. This means that the BIT data type is 1 bit, cannot be indexed and is assigned a Zen type code of 16. When of type code 16, BIT has no equivalent transactional data type to which it maps.

For certain situations, such as compatibility with other DBMS applications, you may want to map BIT to the LOGICAL data type and be able to index the BIT data type. To do so, set TRUEBITCREATE to off. This maps BIT to LOGICAL, which is a 1-byte data type of type code 7.

The creation mode remains in effect until it is changed by issuing the statement again, or until the database connection is disconnected. Because this setting is maintained on a per-connection basis, separate database connections can maintain different creation modes, even within the same application. Every connection starts with the setting in default mode, where BITs are created with a Zen type code of 16.

This feature does not affect existing BITs, only ones created after the set statement is applied.

This setting can be toggled only in a SQL statement. It cannot be set in Zen Control Center. Note that Table Editor displays the relational data types for columns (so the type is displayed as "BIT"). If TRUEBITCREATE is turned off, then Table Editor allows you to index the BIT column.

Example

The following statement toggles the setting and specifies that new BITs should be created to allow indexing, map to the LOGICAL transactional data type, and have a type code of 7:

```
SET TRUEBITCREATE=OFF
```

SET TRUENULLCREATE

The SET TRUENULLCREATE statement turns on or off true nulls when you create new tables.

Syntax

```
SET TRUENULLCREATE = < ON | OFF >
```

Remarks

This setting first appeared in Pervasive.SQL 2000 (7.5). On is the default, causing tables to be created with a NULL indicator byte at the beginning of each empty field. If it is set to off by a SQL statement, tables are created from then on using the legacy NULL from Pervasive.SQL 7 and earlier releases. The legacy null behavior persists until the session is disconnected. In a new session, the setting is on again.

Since each connection has a TRUENULLCREATE setting, it can differ from others in an application.

Even though they are not true nulls, legacy nulls behave as nullable, and you can INSERT NULL into any column type. When you query the value, however, one of the following nonnull binary equivalents is returned:

- 0 for Binary types
- Empty string for STRING and BLOB types, including legacy types such as LVAR and LSTRING

Accordingly, you must use these equivalents in WHERE clauses to retrieve specific values.

The following table describes the interaction between default values and nullable columns.

Column Type	Default value used if no literal default value is defined for the column	Default value if literal value is defined
Nullable	NULL	As defined
Not NULL	Error – "No default value assigned for column"	As defined
Pre-v7.5 nullable	The legacy null for the column	As defined

If a statement attempts to insert an explicit NULL into a NOT NULL column that has a default value defined, the statement fails with an error. The default value is not used in place of the attempt.

For any column with a default value defined, that value may be invoked in an INSERT statement by omitting the column from the insert column list or using the keyword DEFAULT for the insert value.

If all columns in a table are either nullable or have default values defined, you can insert a record with all default values by using DEFAULT VALUES as the values clause. If any column is not nullable and no default is defined, or if you want to specify a column list, you cannot use this type of clause.

Using DEFAULT VALUES for BLOB, CLOB, or BINARY data types is not currently supported.

Examples

To toggle the setting and create new tables with legacy null support in the current session, use:

```
SET TRUENULLCREATE=OFF
```

To return the engine to the default and create tables with true null support in the current session, use:

```
SET TRUENULLCREATE=ON
```

SIGNAL

Remarks

The SIGNAL statement allows you to signal an exception condition or a completion condition other than successful completion.

Signalling a SQLSTATE value causes SQLSTATE to be set to a specific value. This value is then returned to the user, or made available to the calling procedure (through the SQLSTATE value). This value is available to the application calling the procedure.

You can also specify an error message with the SQLSTATE value.

Note: SIGNAL is available only inside a stored procedure or user-defined function.

Syntax

```
SIGNAL SQLSTATE_value [, error_message ]

SQLSTATE_value ::= user-defined value

error_message ::= user-defined message
```

Examples

The following example prints the initial SQLSTATE value 00000, then prints "SQLSTATE exception found" after the signal is raised. The final SQLSTATE value printed is W9001.

```
CREATE PROCEDURE GenerateSignal();
BEGIN
    SIGNAL 'W9001';
END;

CREATE PROCEDURE TestSignal() WITH DEFAULT HANDLER;
BEGIN
    PRINT SQLSTATE;
    CALL GenerateSignal();
    IF SQLSTATE <> '00000' THEN
```

```
        PRINT 'SQLSTATE exception found';
    END IF;
    PRINT SQLSTATE;
END;
```

=============

```
CREATE PROCEDURE GenerateSignalWithErrorMsg();
BEGIN
    SIGNAL 'W9001', 'Invalid Syntax';
END;
CALL GenerateSignalWithErrorMsg()
```

See Also

CREATE PROCEDURE

SQLSTATE

Remarks

The SQLSTATE value corresponds to a success, warning, or exception condition. The complete list of SQLSTATE values defined by ODBC can be found in the Microsoft ODBC documentation.

When a handler executes, the statements within it affect the SQLSTATE value in the same way as statements in the main body of the compound statement. However, a handler that is intended to take specific action for a specific condition can optionally leave that condition unaffected, by reassigning that condition at its conclusion. This does not cause the handler to be invoked again; that would cause a loop. Instead, Zen treats the exception condition as an unhandled exception condition, and execution stops.

See Also

CREATE PROCEDURE

SELECT

SIGNAL

START TRANSACTION

START TRANSACTION signals the start of a logical transaction and must always be paired with a COMMIT or a ROLLBACK.

Syntax

```
START TRANSACTION

Sql-statements

COMMIT | ROLLBACK [WORK]
```

Remarks

START TRANSACTION is supported only within stored procedures. You cannot use START TRANSACTION within SQL Editor. SQL Editor sets AUTOCOMMIT to on.

Examples

The following example, within a stored procedure, begins a transaction which updates the Amount_Owed column in the Billing table. This work is committed, while another transaction updates the Amount_Paid column and sets it to zero. The final COMMIT WORK statement ends the second transaction.

```
START TRANSACTION;

    UPDATE Billing B

    SET Amount_Owed = Amount_Owed - Amount_Paid

    WHERE Student_ID IN (SELECT DISTINCT E.Student_ID

    FROM Enrolls E, Billing B WHERE E.Student_ID = B.Student_ID);

    COMMIT WORK;

    START TRANSACTION;

        UPDATE Billing B

        SET Amount_Paid = 0

        WHERE Student_ID IN (SELECT DISTINCT E.Student_ID

        FROM Enrolls E, Billing B WHERE E.Student_ID = B.Student_ID);

COMMIT WORK;
```

See Also

COMMIT

CREATE PROCEDURE

ROLLBACK

UNION

Remarks

SELECT statements that use UNION or UNION ALL allow you to obtain a single result table from multiple SELECT queries. UNION queries are suitable for combining similar information contained in more than one data source.

UNION eliminates duplicate rows. UNION ALL preserves duplicate rows. Using the UNION ALL option is recommended unless you require duplicate rows to be removed.

With UNION, the Zen database engine orders the entire result set which, for large tables, can take several minutes. UNION ALL eliminates the need for the sort.

Zen databases do not support LONGVARBINARY columns in UNION statements. LONGVARCHAR and NLONGVARCHAR are limited to 65500 bytes in UNION statements. The operator UNION cannot be applied to any SQL statement that references one or more views.

The two query specifications involved in a union must be compatible. Each query must have the same number of columns and the columns must be of compatible data types.

You may use column names from the first SELECT list in the ORDER BY clause of the SELECT statement that follows the UNION keyword. Ordinal numbers are also allowed to indicate the desired columns. For example, the following statements are valid:

```
SELECT c1, c2, c3 FROM t1 UNION SELECT c4, c5, c6 FROM t2 ORDER BY t1.c1, t1.c2, t1.c3

SELECT c1, c2, c3 FROM t1 UNION SELECT c4, c5, c6 FROM t2 ORDER BY 1, 2, 3
```

You may also use aliases for the column names:

```
SELECT c1 x, c2 y, c3 z FROM t1 UNION SELECT c1, c2, c3 FROM t2 ORDER BY x, y, z

SELECT c1 x, c2 y, c3 z FROM t1 a UNION SELECT c1, c2, c3 FROM t1 b ORDER BY a.x, a.y, a.z
```

Aliases must differ from any table names and column names in the query.

Examples

The following example lists the ID numbers of each student whose last name begins with 'M' or who has a 4.0 grade point average. The result table does not include duplicate rows.

```
SELECT Person.ID FROM Person WHERE Last_name LIKE 'M%' UNION SELECT Student.ID FROM Student WHERE
Cumulative_GPA = 4.0
```

The next example lists the column id in the person table and the faculty table including duplicate rows.

```
SELECT person.id FROM person UNION ALL SELECT faculty.id from faculty
```

The next example lists the ID numbers of each student whose last name begins with 'M' or who has a 4.0 grade point average. The result table does not include duplicate rows and orders the result set by the first column

```
SELECT Person.ID FROM Person WHERE Last_name LIKE 'M%' UNION SELECT Student.ID FROM Student WHERE
Cumulative_GPA = 4.0 ORDER BY 1
```

It is common to use the NULL scalar function to allow a UNION select list to have a different number of entries than the parent select list. To do this, you must use the CONVERT function to force the NULL to the correct type.

```
CREATE TABLE t1 (c1 INTEGER, c2 INTEGER)
```

```
INSERT INTO t1 VALUES (1,1)
```

```
CREATE TABLE t2 (c1 INTEGER)
```

```
INSERT INTO t2 VALUES (2)
```

```
SELECT c1, c2 FROM t1
UNION SELECT c1, CONVERT(NULL(),sql_integer)FROM t2
```

See Also

SELECT

UNIQUE

Remarks

To specify that the index not allow duplicate values, include the UNIQUE keyword. If the column or columns that make up the index contains duplicate values when you execute the CREATE INDEX statement with the UNIQUE keyword, Zen returns status code 5 and does not create the index.

Note: You should not include the UNIQUE keyword in the list of index attributes following the column name you specify; the preferred syntax is CREATE UNIQUE INDEX.

See Also

ALTER TABLE

CREATE INDEX

CREATE TABLE

UPDATE

The UPDATE statement allows you to modify column values in a database.

Syntax

```
UPDATE < table-name | view-name > [ alias-name ]
    SET column-name = < NULL | DEFAULT | expression | subquery-expression > [ , column-name = ... ]
    [ FROM table-reference [, table-reference ] ...
    [ WHERE search-condition ]

table-name ::= user-defined-name

view-name ::= user-defined-name

alias-name ::= user-defined-name (Alias-name not allowed if FROM clause used. See FROM Clause.)

table-reference ::= { OJ outer-join-definition }
    | [db-name.]table-name [ [ AS ] alias-name ]
    | [db-name.]view-name [ [ AS ] alias-name ]
    | join-definition
    | ( join-definition )
    | ( table-subquery )[ AS ] alias-name [ (column-name [ , column-name ]... ) ]

outer-join-definition ::= table-reference outer-join-type JOIN table-reference ON search-condition

outer-join-type ::= LEFT [ OUTER ] | RIGHT [ OUTER ] | FULL [ OUTER ]

search-condition ::= search-condition AND search-condition
    | search-condition OR search-condition
    | NOT search-condition
    | ( search-condition )
    | predicate
```

```
db-name ::= user-defined-name

view-name ::= user-defined-name

join-definition ::= table-reference [ join-type ] JOIN table-reference ON search-condition
    | table-reference CROSS JOIN table-reference
    | outer-join-definition

join-type ::= INNER | LEFT [ OUTER ] | RIGHT [ OUTER ] | FULL [ OUTER ]

table-subquery ::= query-specification [ [ UNION [ ALL ]
query-specification ]... ]

subquery-expression ::= ( query-specification )
```

Remarks

UPDATE statements, as with DELETE and INSERT, behave in an atomic manner. That is, if an update of more than one row fails, then all updates of previous rows by the same statement are rolled back.

In the SET clause of an UPDATE statement, you may specify a subquery. This feature allows you to update information in a table based on data in another table or another part of the same table.

You may use the keyword DEFAULT to set the value to the default value defined for the given column. If no default value is defined, NULL is used if the column is nullable, and if not, an error is returned. For information about default values and true nulls and legacy nulls from older releases, see SET TRUENULLCREATE.

The UPDATE statement can update only a single table at a time. UPDATE can relate to other tables through a subquery in the SET clause. This can be a correlated subquery that depends in part on the contents of the table being updated, or it can be a noncorrelated subquery that depends only on another table.

For example, here is a correlated subquery:

```
UPDATE t1 SET t1.c2 = (SELECT t2.c2 FROM t2 WHERE t2.c1 = t1.c1)
```

Compared to a noncorrelated subquery:

```
UPDATE t1 SET t1.c2 = (SELECT SUM(t2.c2) FROM t2 WHERE t2.c1 = 10)
```

The same logic is used to process pure SELECT statements and subqueries, so the subquery can consist of any valid SELECT statement. Subqueries follow no special rules.

If SELECT within an UPDATE returns no rows, then the UPDATE inserts NULL. If the given columns are not nullable, then the UPDATE fails. If SELECT returns more than one row, then UPDATE fails.

An UPDATE statement does not allow the use of join tables in the statement. Instead, use a correlated subquery in the SET clause like the one shown in the example above.

For information about true nulls and legacy nulls, see SET TRUENULLCREATE.

Updating Data Longer Than the Maximum Literal String

The maximum literal string supported by Zen is 15,000 bytes. You can handle data longer than this using direct SQL statements, breaking the update into multiple calls. Start with a statement like this:

```
UPDATE table1 SET longfield = '15000 bytes of text' WHERE restriction
```

Then issue the following statement to add more data:

```
UPDATE table1 SET longfield = notefield + '15000 more bytes of text' WHERE restriction
```

FROM Clause

Some confusion may arise pertaining to the optional FROM clause and references to the table being updated (referred to as the "update table"). If the update table occurs in the FROM clause, then one of the occurrences is the same instance of the table being updated.

For example, in the statement `UPDATE t1 SET c1 = 1 FROM t1, t2 WHERE t1.c2 = t2.c2`, the t1 immediately after UPDATE is the same instance of table t1 as the t1 after FROM. Therefore, the statement is identical to `UPDATE t1 SET c1 = 1 FROM t2 WHERE t1.c2 = t2.c2`.

If the update table occurs in the FROM clause multiple times, one occurrence must be identified as the same instance as the update table. The FROM clause reference that is identified as the same instance as the update table is the one that does **not** have a specified alias.

Therefore, the statement `UPDATE t1 SET t1.c1 = 1 FROM t1 a, t1 b WHERE a.c2 = b.c2` is invalid because both instances of t1 in the FROM clause contain an alias. The following version is valid: `UPDATE t1 SET t1.c1 = 1 FROM t1, t1 b WHERE t1.c2 = b.c2`.

The following conditions apply to the FROM clause:

- If the UPDATE statement contains an optional FROM clause, the table reference prior to the FROM clause cannot have an alias specified. For example, `UPDATE t1 a SET a.c1 = 1 FROM t2 WHERE a.c2 = t2.c2` returns the following error:

```
SQL_ERROR (-1)
```

```
SQLSTATE of "37000"
```

```
"Table alias not allowed in UPDATE/DELETE statement with optional FROM."
```

  A valid version of the statement is `UPDATE t1 SET t1.c1 = 1 FROM t2 WHERE t1.c2 = t2.c2` or `UPDATE t1 SET t1.c1 = 1 FROM t1 a, t2 WHERE a.c2 = t2.c2`.

- If more than one reference to the update table appears in the FROM clause, then only one of the references can have a specified alias. For example, `UPDATE t1 SET t1.c1 = 1 FROM t1 a, t1 b WHERE a.c2 = b.c2` returns the following error:

```
SQL_ERROR (-1)
```

```
SQLSTATE of "37000" and
```

```
"The table t1 is ambiguous."
```

  In the erroneous statement, assume that you want table t1 with alias "a" to be the same instance of the update table. A valid version of the statement would then be `UPDATE t1 SET t1.c1 = 1 FROM t1, t1 b WHERE t1.c2 = b.c2`.

- The FROM clause is supported in an UPDATE statement only at the session level. The FROM clause is **not** supported if the UPDATE statement occurs within a stored procedure.

Examples

The following example updates the record in the faculty table and sets salary as 95000 for ID 103657107.

```
UPDATE Faculty SET salary = 95000.00 WHERE ID = 103657107
```

============

The following example shows how to use the DEFAULT keyword.

```
UPDATE t1 SET c2 = DEFAULT WHERE c2 = 'bcd'
```

```
UPDATE t1 SET c1 = DEFAULT, c2 = DEFAULT
```

============

The following example changes the credit hours for Economics 305 in the course table from 3 to 4.

```
UPDATE Course SET Credit_Hours = 4 WHERE Name = 'ECO 305'
```

============

The following example updates the address for a person in the Person table:

```
UPDATE Person p
SET p.Street = '123 Lamar',
p.zip = '78758',
p.phone = 5123334444
WHERE p.ID = 131542520
```

============

Subquery Example A

Two tables are created and rows are inserted. The first table, t5, is updated with a column value from the second table, t6, in each row where table t5 has the value 2 for column c1. Because there is more than one row in table t6 containing a value of 3 for column c2, the first UPDATE fails because more than one row is returned by the subquery. This result occurs even though the result value is the same in both cases. As shown in the second UPDATE, using the DISTINCT keyword in the subquery eliminates the duplicate results and allows the statement to succeed.

```
CREATE TABLE t5 (c1 INT, c2 INT)
CREATE TABLE t6 (c1 INT, c2 INT)
INSERT INTO t5(c1, c2) VALUES (1,3)
INSERT INTO t5(c1, c2) VALUES (2,4)
INSERT INTO t6(c1, c2) VALUES (2,3)
INSERT INTO t6(c1, c2) VALUES (1,2)
INSERT INTO t6(c1, c2) VALUES (3,3)
SELECT * FROM t5
```

Results:

```
c1         c2
---------- -----
1          3
2          4

UPDATE t5 SET t5.c1=(SELECT c2 FROM t6 WHERE c2=3) WHERE t5.c1=2 — Note that the query fails
UPDATE t5 SET t5.c1=(SELECT DISTINCT c2 FROM t6 WHERE c2=3) WHERE t5.c1=2 — Note that the query
succeeds
SELECT * FROM t5
```

Results:

```
c1         c2

---------- -----

1          3

3          4
```

============

Subquery Example B

Two tables are created and a variety of valid syntax examples are demonstrated. Note the cases where UPDATE fails because the subquery returns more than one row. Also note that UPDATE succeeds and NULL is inserted if the subquery returns no rows (where NULL values are allowed).

```
CREATE TABLE t1 (c1 INT, c2 INT)

CREATE TABLE t2 (c1 INT, c2 INT)

INSERT INTO t1 VALUES (1, 0)

INSERT INTO t1 VALUES (2, 0)

INSERT INTO t1 VALUES (3, 0)

INSERT INTO t2 VALUES (1, 100)

INSERT INTO t2 VALUES (2, 200)

UPDATE t1 SET t1.c2 = (SELECT SUM(t2.c2) FROM t2)

UPDATE t1 SET t1.c2 = 0

UPDATE t1 SET t1.c2 = (SELECT t2.c2 FROM t2 WHERE t2.c1 = t1.c1)

UPDATE t1 SET t1.c2 = @@IDENTITY

UPDATE t1 SET t1.c2 = @@ROWCOUNT

UPDATE t1 SET t1.c2 = (SELECT @@IDENTITY)

UPDATE t1 SET t1.c2 = (SELECT @@ROWCOUNT)

UPDATE t1 SET t1.c2 = (SELECT t2.c2 FROM t2) -- update fails

INSERT INTO t2 VALUES (1, 150)

INSERT INTO t2 VALUES (2, 250)

UPDATE t1 SET t1.c2 = (SELECT t2.c2 FROM t2 WHERE t2.c1 = t1.c1) -- update fails

UPDATE t1 SET t1.c2 = (SELECT t2.c2 FROM t2 WHERE t2.c1 = 5) – Note that the update succeeds, NULL is
inserted for all rows of t1.c2

UPDATE t1 SET t1.c2 = (SELECT SUM(t2.c2) FROM t2 WHERE t2.c1 = t1.c1)
```

=============

The following example creates table t1 and t2 and populates them with data. The UPDATE statement uses a FROM clause to specify another table from which to get the new value.

```
DROP table t1

CREATE table t1 (c1 integer, c2 integer)

INSERT INTO t1 VALUES (0, 10)

INSERT INTO t1 VALUES (0, 10)

INSERT INTO t1 VALUES (2, 20)

INSERT INTO t1 VALUES (2, 20)

DROP table t2

CREATE table t2 (c1 integer, c2 integer)

INSERT INTO t2 VALUES (2, 20)

INSERT INTO t2 VALUES (2, 20)

INSERT INTO t2 VALUES (3, 30)

INSERT INTO t2 VALUES (3, 30)

UPDATE t1 SET t1.c1 = t2.c1 FROM t2 WHERE t1.c2 = t2.c2

SELECT * FROM t1
```

See Also

ALTER TABLE

CREATE PROCEDURE

CREATE TRIGGER

DEFAULT

GRANT

INSERT

UPDATE (positioned)

The positioned UPDATE statement updates the current row of a rowset associated with a SQL cursor.

Syntax

```
UPDATE [ table-name ] SET column-name = proc-expr [ , column-name = proc-expr ]...
  WHERE CURRENT OF cursor-name

table-name ::= user-defined-name

cursor-name ::= user-defined-name
```

Remarks

This statement is allowed in stored procedures, triggers, and at the session level.

Note: Even though positioned UPDATE is allowed at the session level, the DECLARE CURSOR statement is not. The method to obtain the cursor name of the active result set depends on the Zen access method your application uses. See the Zen documentation for that access method.

The *table-name* may be specified in the positioned UPDATE statement only when used at the session level. *Table-name* cannot be specified with a stored procedure or trigger.

Examples

The following sequence of statements provide the setting for the positioned UPDATE statement. The required statements for a positioned UPDATE are DECLARE CURSOR, OPEN CURSOR, and FETCH FROM *cursorname*.

The positioned UPDATE statement in this example updates the name of the course HIS 305 to HIS 306.

```
CREATE PROCEDURE UpdateClass();
BEGIN
    DECLARE :CourseName CHAR(7);
    DECLARE :OldName CHAR(7);
    DECLARE c1 CURSOR FOR SELECT name FROM course WHERE name = :CourseName FOR UPDATE;

    SET :CourseName = 'HIS 305';

    OPEN c1;

    FETCH NEXT FROM c1 INTO :OldName;

    UPDATE SET name = 'HIS 306' WHERE CURRENT OF c1;

END;
```

See Also

CREATE PROCEDURE

CREATE TRIGGER

USER

Remarks

The USER keyword returns the current user name (such as Master) for each row returned by the SELECT restriction.

Example

The following examples return the user name from the course table.

```
SELECT USER FROM course
    -- returns 145 instances of Master (the table contains 145 rows)
SELECT DISTINCT USER FROM course
    -- returns 1 instance of Master
```

See Also

SELECT

SET SECURITY

WHILE

You can use a WHILE statement to control flow. It allows statements to be executed repeatedly as long as the WHILE condition is true. Optionally, you may use the WHILE statement with DO and END WHILE.

Note: You cannot use a mixed syntax for the WHILE statement. You may use either WHILE with DO and END WHILE, or only WHILE. If you are using compound statements with a WHILE condition, you must use BEGIN and END to indicate the beginning and ending of the statement blocks.

Syntax

```
[ label-name : ] WHILE proc-search-condition [ DO ] [ proc-stmt [; proc-stmt ] ]...
[ END WHILE ][ label-name ]
```

Remarks

A WHILE statement can have a beginning label, in which case it is called a labeled WHILE statement.

Examples

The following example increments the variable vInteger by 1 until it reaches a value of 10, when the loop ends.

```
WHILE (:vInteger < 10) DO
```

```
SET :vInteger = :vInteger + 1;
```

```
END WHILE
```

See Also

CREATE PROCEDURE

CREATE TRIGGER

Grammar Element Definitions

The following is an alphabetical list of element definitions used in the grammar syntax.

```
alter-options ::= alter-option-list1 | alter-option-list2
```

alter-option-list1 ::= *alter-option* |(*alter-option* [, *alter-option*]...)

alter-option ::= ADD [**COLUMN**] *column-definition*

| **ADD** *table-constraint-definition*

| **ALTER** [**COLUMN**] *column-definition*

| **DROP** [**COLUMN**] *column-name*

| **DROP CONSTRAINT** *constraint-name*

| **DROP PRIMARY KEY**

| **MODIFY** [**COLUMN**] *column-definition*

alter-option-list2 ::= **PSQL_MOVE** [**COLUMN**] *column-name* **TO** [[**PSQL_PHYSICAL**] **PSQL_POSITION**] *new-column-position* | **RENAME COLUMN** *column-name* **TO** *new-column-name*

as-or-semicolon ::= **AS** | **;**

before-or-after ::= **BEFORE** | **AFTER**

call-arguments ::= *positional-argument* [, *positional-argument*]...

col-constraint ::= **NOT NULL**

| **NOT MODIFIABLE**

| **UNIQUE**

| **PRIMARY KEY**

| **REFERENCES** *table-name* [(*column-name*)] [*referential-actions*]

collation-name ::= '*string*'

column-constraint ::= [**CONSTRAINT** *constraint-name*] *col-constraint*

column-definition ::= *column-name* data-type [**DEFAULT** *Expression*] [*column-constraint* [*column-constraint*]... [**CASE** | **COLLATE** *collation-name*]

column-name ::= *user-defined-name*

```
commit-statement ::= see COMMIT statement

comparison-operator ::= < | > | <= | >= | = | <> | !=

constraint-name ::= user-defined-name

correlation-name ::= user-defined-name

cursor-name ::= user-defined-name

data-type ::= data-type-name [ (precision [ , scale ] ) ]

data-type-name ::= see Zen Supported Data Types

db-name ::= user-defined-name

expression::= expression - expression
| expression + expression
| expression * expression
| expression / expression
| expression & expression
| expression | expression
| expression ^ expression
| ( expression )
| -expression
| +expression
| ~expression
| ?
| literal
| scalar-function
| { fn scalar-function }
| USER
```

```
literal ::= 'string' | N'string'
| number
| { d 'date-literal' }
| { t 'time-literal' }
| { ts 'timestamp-literal' }

scalar-function :: = See Scalar Functions

expression-or-subquery ::= expression | ( query-specification )

fetch-orientation ::= NEXT

group-name ::= user-defined-name

index-definition ::= ( index-segment-definition [ , index-segment-definition ]... )

index-name ::= user-defined-name

index-number ::= user-defined-value -- an integer between 0 and 118
index-segment-definition ::= column-name [ ASC | DESC ]

ins-upd-del ::= INSERT | UPDATE | DELETE

insert-values ::= values-clause
    |  query-specification

join-definition ::= table-reference [ INNER ] JOIN table-reference ON search-condition
    | table-reference CROSS JOIN table-reference
    | outer-join-definition

label-name ::= user-defined-name
```

```
literal ::= 'string' | N'string'
        | number
        | { d 'date-literal' }
        | { t 'time-literal' }
        | { ts 'timestamp-literal' }

order-by-expression ::= expression [ CASE | COLLATE collation-name ] [ ASC | DESC ]

outer-join-definition ::= table-reference outer-join-type JOIN table-reference ON search-condition

outer-join-type ::= LEFT [ OUTER ]| RIGHT [ OUTER ] | FULL [ OUTER ]

parameter ::= parameter-type-name data-type [ DEFAULT proc-expr | = proc-expr ]
    | SQLSTATE

parameter-type-name ::= parameter-name
    | parameter-type parameter-name
    | parameter-name parameter-type

parameter-type ::= IN | OUT | INOUT | IN_OUT

parameter-name ::= [ : ] user-defined-name

password ::= user-defined-name | 'string'

positional-argument ::= expression

precision ::= integer

predicate ::= expression [ NOT ] BETWEEN expression AND expression
    | expression comparison-operator expression-or-subquery
    | expression [ NOT ] IN ( query-specification )
    | expression [ NOT ] IN ( value [ , value ]... )

    | expression [ NOT ] LIKE value

    | expression IS [ NOT ] NULL

    | expression comparison-operator ANY ( query-specification )

    | expression comparison-operator ALL ( query-specification )

    | EXISTS ( query-specification )


proc-expr ::= same as normal expression but does not allow IF expression, or scalar functions


proc-search-condition ::= same as search-condition but does not allow expressions with subqueries


proc-stmt ::=  [ label-name : ] BEGIN [ ATOMIC ] [ proc-stmt [ ; proc-stmt ]... ] END [ label-name ]

    | CALL procedure-name ( proc-expr [ , proc-expr ]... )

    | CLOSE cursor-name

    | DECLARE cursor-name CURSOR FOR select-statement [ FOR UPDATE | FOR READ ONLY ]

    | DECLARE variable-name data-type [ DEFAULT proc-expr | = proc-expr ]

    | DELETE WHERE CURRENT OF cursor-name

    | delete-statement

    | FETCH [ fetch-orientation [ FROM ] ] cursor-name [ INTO variable-name [ , variable-name ] ]

    | IF proc-search-condition THEN proc-stmt [ ; proc-stmt ]... [ ELSE proc-stmt [ ; proc-stmt ]...
    ] END IF

    | IF proc-search-condition proc-stmt [ELSE proc-stmt]

    | insert-statement

    | LEAVE label-name

    | [ label-name : ] LOOP proc-stmt [ ; proc-stmt ]... END LOOP [ label-name ]

    | OPEN cursor-name

    | PRINT proc-expr [ , 'string' ]

    | RETURN [ proc-expr ]

    | transaction-statement

    | select-statement-with-into

    | select-statement

    | SET variable-name = proc-expr

    | SIGNAL [ ABORT ] sqlstate-value

    | START TRANSACTION [tran-name]
    | update-statement

    | UPDATE SET column-name = proc-expr [ , column-name = proc-expr ]... WHERE CURRENT OF cursor-
    name

    | [ label-name : ] WHILE proc-search-condition DO [ proc-stmt [ ; proc-stmt ] ]... END WHILE [
    label-name ]

    | [ label-name : ] WHILE proc-search-condition proc-stmt

    | alter-table-statement

    | create-index-statement

    | create-table-statement

    | create-view-statement

    | drop-index-statement

    | drop-table-statement

    | drop-view-statement

    | grant-statement

    | revoke-statement

    | set-statement


procedure-name ::= user-defined-name


public-or-user-group-name ::= PUBLIC | user-group-name


query-specification [ [ UNION [ ALL ] query-specification ]...

[ limit-clause ][ ORDER BY order-by-expression [ , order-by-expression ]... ] [ FOR UPDATE ]


query-specification ::= ( query-specification )

    | SELECT [ ALL | DISTINCT ] [ top-clause ] select-list

      FROM table-reference [ , table-reference ]...

      [ WHERE search-condition ]

      [ GROUP BY expression [ , expression ]...

        [ HAVING search-condition ] ]


referencing-alias ::= OLD [ AS ] correlation-name [ NEW [ AS ] correlation-name ]

    | NEW [ AS ] correlation-name [ OLD [ AS ] correlation-name ]
```

```
referential-actions ::= referential-update-action [ referential-delete-action ]
    | referential-delete-action [ referential-update-action ]

referential-update-action ::= ON UPDATE RESTRICT

referential-delete-action ::= ON DELETE CASCADE
    | ON DELETE RESTRICT

release-statement ::= see RELEASE statement

result ::= user-defined-name data-type

rollback-statement ::= see ROLLBACK WORK statement

savepoint-name ::= user-defined-name

scalar-function ::= see Scalar Function list

scale ::= integer

search-condition ::= search-condition AND search-condition
    | search-condition OR search-condition
    | NOT search-condition
    | ( search-condition )
    | predicate

select-item ::= expression [ [ AS ] alias-name ] | table-name.*

select-list ::= * | select-item [ , select-item ]...

set-function ::= AVG ( [ DISTINCT | ALL ] expression )
    | COUNT ( < * | [ DISTINCT | ALL ] expression > )
    | COUNT_BIG ( < * | [ DISTINCT | ALL ] expression > )
    | MAX ( [ DISTINCT | ALL ] expression )
    | MIN ( [ DISTINCT | ALL ] expression )
    | STDEV ( [ DISTINCT | ALL ] expression )
    | STDEVP ( [ DISTINCT | ALL ] expression )
    | SUM ( [ DISTINCT | ALL ] expression )
    | VAR ( [ DISTINCT | ALL ] expression )
    | VARP ( [ DISTINCT | ALL ] expression )

sqlstate-value ::= 'string'

table-constraint-definition ::= [ CONSTRAINT constraint-name ] table-constraint

table-constraint ::= UNIQUE (column-name [ , column-name ]... )
    | PRIMARY KEY ( column-name [ , column-name ]... )
    | FOREIGN KEY ( column-name [ , column-name ] )
    REFERENCES table-name
    [ ( column-name [ , column-name ]... ) ]
    [ referential-actions ]

table-element ::= column-definition
    | table-constraint-definition

table-expression ::=
    FROM table-reference [ , table-reference ]...
    [ WHERE search-condition ]
    [ GROUP BY expression [ , expression ]...
    [ HAVING search-condition ]

table-name ::= user-defined-name

table-permission ::= ALL
    | SELECT [ ( column-name [ , column-name ]... ) ]
    | UPDATE [ ( column-name [ , column-name ]... ) ]
    | INSERT [ ( column-name [ , column-name ]... ) ]
    | DELETE
    | ALTER
    | REFERENCES

table-reference ::= { OJ outer-join-definition }
    | [db-name.]table-name [ [ AS ] alias-name ]
    | join-definition
    | ( join-definition )

table-subquery ::= query-specification [ [ UNION [ ALL ]
query-specification ]...][ limit-clause ][ ORDER BY order-by-expression [ , order-by-expression ]...]

limit-clause ::= [ LIMIT [offset,] row_count | row_count OFFSET offset | ALL [OFFSET offset] ]

offset ::= number | ?
row_count ::= number | ?

transaction-statement ::= commit-statement
    | rollback-statement
    | release-statement

trigger-name ::= user-defined-name

user_and_password ::= user-name [ : ] password

user-group-name ::= user-name | group-name

user-name ::= user-defined-name

value ::= literal | USER | NULL | ?

value-list ::= ( value [ , value ]... )
```

```
values-clause ::= DEFAULT VALUES | VALUES ( expression [ , expression ]... )

variable-name ::= user-defined-name

view-name ::= user-defined-name
```

SQL Statement List

SqlStatementList is defined as:

```
SqlStatementList
statement ';' | SqlStatementList ';'
statement ::= statement-label ':' statement
| BEGIN ... END block
| CALL statement
| CLOSE CURSOR statement
| COMMIT statement
| DECLARE CURSOR statement
| DECLARE variable statement
| DELETE statement
| FETCH statement
| IF statement
| INSERT statement
| LEAVE statement
| LOOP statement
| OPEN statement
| PRINT statement
| RELEASE SAVEPOINT statement
| RETURN statement
| ROLLBACK statement
| SAVEPOINT statement
| SELECT statement
| SET statement
| SIGNAL statement
| START TRANSACTION statement
| UPDATE statement

| WHILE statement
```

Predicate

A predicate is defined as:

```
expression compare-operator expression

| expression [ NOT ] BETWEEN expression AND expression

| expression [ NOT ] LIKE string-literal

| expression IS [ NOT ] NULL

| NOT predicate

| predicate AND predicate

| predicate OR predicate

| '(' predicate ')'compare-operator ::= '=' | '>=' | '>' | '<=' | '<' | '<>' | '!='

| [ NOT ] IN value-list
```

Expression

An expression is defined as:

```
number

| string-literal

| column-name

| variable-name

| NULL

| CONVERT '(' expression ',' data-type ')'

| '-' expression

| expression '+' expression

| expression '-' expression

| expression '*' expression

| expression '/' expression

| expression '&' expression

| '~' expression

| expression '|' expression

| expression '^' expression
| function-name '(' [ expression-list ] ')'
| '(' expression')'
| '{' D string-literal '}'
| '{' T string-literal '}'
| '{' TS string-literal '}'
| @:IDENTITY
| @:ROWCOUNT
| @@BIGIDENTITY
| @@IDENTITY
| @@ROWCOUNT
| @@VERSION
```

An expression list is defined as:

```
expression-list ::= expression [ , expression ... ]
```

Global Variables

Zen supports the following global variables:

- @@IDENTITY and @@BIGIDENTITY
- @@ROWCOUNT
- @@SESSIONID
- @@SPID
- @@VERSION

Global variables are prefaced with two at signs, @@. All global variables are variables *per connection*. Each database connection has its own @@IDENTITY, @@BIGIDENTITY, @@ROWCOUNT, and @@SPID values. The value of @@VERSION is information about the version of the engine that executes the statement where it is used.

@@IDENTITY and @@BIGIDENTITY

Either of these variables returns its most recently inserted column value. The value is a signed integer value. The initial value is NULL.

The variable can refer to only a single column. If the target table includes more than one IDENTITY column, the value of this variable refers to the IDENTITY column serving as the table primary key. If no such column exists, then the value of this variable refers to the first IDENTITY column in the table.

If the most recent insert was to a table without an IDENTITY column, then the value of @@IDENTITY is set to NULL.

For BIGIDENTITY values, use @@BIGIDENTITY. For SMALLIDENTITY values, use @@IDENTITY.

Examples

```
SELECT @@IDENTITY
```

Returns NULL if no records have been inserted in the current connection, otherwise returns the IDENTITY column value of the most recently inserted row.

```
SELECT * FROM t1 WHERE @@IDENTITY = 12
```

Returns the most recently inserted row if it has an IDENTITY column value of 12. Otherwise, returns no rows.

```
INSERT INTO t1(c2) VALUES (@@IDENTITY)
```

Inserts the IDENTITY value of the last row inserted into column C2 of the new row.

```
UPDATE t1 SET t1.c1 = (SELECT @@IDENTITY) WHERE t1.c1 = @@IDENTITY + 10
```

Updates column C1 with the IDENTITY value of the last row inserted, if the value of C1 is 10 greater than the IDENTITY column value of the last row inserted.

```
UPDATE t1 SET t1.c1 = (SELECT NULL FROM t2 WHERE t2.c1 = @@IDENTITY)
```

Updates column C1 with the value NULL if the value of C1 equals the IDENTITY column value of the last row inserted.

The example below creates a stored procedure and calls it. The procedure sets variable V1 equal to the sum of the input value and the IDENTITY column value of the last row updated. The procedure then deletes rows from the table anywhere column C1 equals V1. The procedure then prints a message stating how many rows were deleted.

```
CREATE PROCEDURE TEST (IN :P1 INTEGER);
BEGIN
    DECLARE :V1 INTERGER;
    SET :V1 = :P1 + @@IDENTITY;
    DELETE FROM t1 WHERE t1.c1 = :V1;
    IF (@@ROWCOUNT = 0) THEN
        PRINT 'No row deleted';
    ELSE
        PRINT CONVERT(@@ROWCOUNT, SQL_CHAR) + ' rows deleted';
    END IF;
END;
CALL TEST (@@IDENTITY)
```

@@ROWCOUNT

This variable returns the number of rows that were affected by the most recent operation in the current connection. The value is an unsigned integer. The initial value is zero.

The @@ROWCOUNT variable is valid only when used after an INSERT, UPDATE, or DELETE statement.

Examples

```
SELECT @@ROWCOUNT
```

Returns zero if no records were affected by the previous operation in the current connection, otherwise returns the number of rows affected by the previous operation.

```
CREATE TABLE t1 (c1 INTEGER, c2 INTEGER)
INSERT INTO t1 (c1, c2) VALUES (100,200)
INSERT INTO t1(c1, c2) VALUES (300, @@ROWCOUNT)
SELECT @@ROWCOUNT
```

Results:

```
1 (in @@ROWCOUNT variable)
```

In line four, the @@ROWCOUNT variable has the value of 1 because the previous INSERT operation affected one row.

Also see the example for @@IDENTITY.

@@SESSIONID

This variable returns an eight-byte integer value that identifies the connection to a Zen server engine, reporting engine, or workgroup engine. The integer is a combination of a time value and an incremental counter. This variable can be used to identify uniquely each Zen connection.

@@SESSIONID requires a connection to the database engine to return a value. If the connection to the database engine is lost, the variable cannot return an identifier.

Example

```
SELECT @@SESSIONID
```

The example returns an integer identifier such as `26552653137523`.

@@SPID

This variable, the server process identifier, returns the identifier integer value of the system thread for the Zen connection.

If the connection to the database engine is lost, the SPID variable cannot return an identifier. Instead, the statement returns an error with a SqlState of 08S01.

Example

```
SELECT @@SPID
```

The example returns an integer identifier, such as `402`.

@@VERSION

SQL statements that use this variable return a value based on the Zen server engine, reporting engine, or workgroup engine to which the session is connected.

- For a Zen server, the value is the version of the local engine and the bitness, name, and version of the local operating system.
- For Zen Client Reporting Engine, it is the version of the local reporting engine and the bitness, name, and version of the local operating system.
- For Zen Client, it is the version of the engine on the remote Zen server to which the client is connected and the bitness, name, and version of the operating system where the server is running.
- For Zen Workgroup Engine, the value is the version of the local engine and the bitness, name, and version of the local operating system.

Example

```
SELECT @@version
```

The example returns text information resembling the following:

```
Actian Zen - 14.10.020.000 (x86_64) Server Engine - Copyright (C) Actian Corporation 2019 on (64-bit)
Windows NT 6.2 7d
```

Other Characteristics

This topic describes other characteristics of the SQL grammar. It is divided into the following sections:

- Temporary Files
- Working with NULL Values
- Working with Binary Data
- Creating Indexes
- Comma as Decimal Separator

Temporary Files

When Zen must generate a temporary table in order to process a given query, it creates the file in a location determined in one of the following ways:

- If you have manually added the string key value `PervasiveEngineOptions\TempFileDirectory` to ODBC.INI, Zen uses the path set for TempFileDirectory. The proper location for both 32- and 64-bit Zen installations on Windows is the registry location HKEY_LOCAL_MACHINE\SOFTWARE\ODBC\ODBC.INI. For Linux, macOS, and Raspbian, the ODBC.INI file is located in /usr/local/actianzen/etc.
- If you have set the temporary file directory property for a Zen engine using ZenCC or **bcfg**, Zen uses this location. For more information, see Temporary Files in *Advanced Operations Guide*.
- If you have not used either of the first two options listed here, then Zen checks for the file location using the following sequence on Window platforms:

  1. The path specified by the TMP environment variable
  2. The path specified by the TEMP environment variable
  3. The path specified by the USERPROFILE environment variable
  4. The Windows directory

  For example, if the TMP environment variable is not defined, Zen uses the path specified in the TEMP environment variable, and so on.

  On Linux and macOS distributions, Zen uses the current directory for the server process. No attempt is made to use TMP.

Zen deletes all temporary files used to process a query after the query is finished. If the query is a SELECT statement, then the temporary files exist as long as the result set is active, meaning until the result set is freed by the calling application.

When Are Temporary Files Created?

Zen uses three types of temporary files: in-memory, on-disk, and Btrieve (MicroKernel Engine).

In-Memory Temporary File

In-memory temporary files are used for the following circumstances:

- Forward-only cursor
- Number of bytes in the temporary file is less than 250,000.
- SELECT statements with ORDER BY, GROUP BY, or DISTINCT that do not use an index, that have no BLOB or CLOB in the ORDER BY, GROUP BY, or DISTINCT, and that have no BLOB or CLOB in selection list with UNION.

On-Disk Temporary File

On-disk temporary files are used for the following circumstances:

- Forward-only cursor
- Number of bytes in the temporary file is greater than 250,000.
- SELECT statements with ORDER BY, GROUP BY, or DISTINCT that do not use an index, that have no BLOB or CLOB in the ORDER BY, GROUP BY, or DISTINCT, and that have no BLOB or CLOB in selection list with UNION.

Btrieve Temporary File

Btrieve temporary files are used for the following circumstances:

- Forward-only cursor with BLOB or CLOB in ORDER BY, GROUP BY, or DISTINCT or with BLOB or CLOB in selection list with UNION
- Dynamic or static cursor with UNION queries or SELECT statements with ORDER BY, GROUP BY, or DISTINCT that do not use an index.

Zen does not create a Btrieve temporary file for each base table in a static cursor SELECT query. Instead, each base table is opened by using the MicroKernel to reserve pages in the file as a static representation of the file. Any change made through a static cursor cannot be seen by that cursor.

Working with NULL Values

Zen interprets a NULL as an unknown value. Thus, if you try to compare two NULL values, they will compare as not equal.

An expression that evaluates to `WHERE NULL=NULL` returns FALSE.

Working with Binary Data

Consider the following scenario: you insert the literal value '1' into a BINARY(4) column named c1, in table t1. Next, you enter the statement, SELECT * FROM t1 WHERE c1='1'.

The engine can retrieve data using the same binary format as was used to input the data. That is, the SELECT example above works properly and returns the value, 0x01000000, even though there is no literal match.

Note: The engine always adds a zero ('0') to the front of odd-digit binary values that are inserted. For example, if you insert the value '010', then the value '0x00100000' is stored in the data file.

Currently, Zen does not support suffix 0x to denote binary constants. Binary constants are a string of hexadecimal numbers enclosed by single quotation marks.

This behavior is the same as for Microsoft SQL Server.

Creating Indexes

The maximum column size for indexable VARCHAR columns is 254 bytes if the column does not allow Null values and 253 bytes if the column is nullable.

The maximum column size for CHAR columns is 255 bytes if the column does not allow Null values and 254 bytes if the column is nullable.

The maximum column size for indexable NVARCHAR columns is NVARCHAR(126). This limit applies to both nullable and not-null columns. The NVARCHAR size is specified in UCS-2 character units.

The maximum column size for NCHAR columns is NCHAR(127). This limit applies to both nullable and not-null columns. The NCHAR size is specified in UCS-2 character units.

The maximum Btrieve key size is 255. When a column is nullable and indexed a segmented key is created with 1 byte for the null indicator and a maximum 254 bytes from the column indexed. VARCHAR columns differ from CHAR columns in that either length byte (Btrieve lstring) or a zero terminating byte (Btrieve zstring) are reserved, increasing the effective storage by 1 byte.

NVARCHAR (Btrieve wzstring) columns differ from NCHAR columns in that a zero terminating character is reserved, increasing the effective storage by 2 bytes.

Comma as Decimal Separator

Many locales use a comma to separate whole numbers from fractional numbers within a floating point numeric field. For example, they would use 1,5 instead of 1.5 to represent the number one-and-one-half.

Zen supports both the period and the comma as decimal separators. Zen accepts input values using the period or the comma, based on the regional settings for the operating system. By default, the database engine displays values using the period.

Note: When the decimal separator is not a period, SQL statements must enclose numbers in quotes.

For output and display only, the session-level command SET DECIMALSEPARATORCOMMA can be used to specify output (for example, SELECT results) that uses the comma as the decimal separator. This command has no effect on data entry or storage.

Client-Server Considerations

Support for the comma as decimal separator is based on the locale setting in the operating system. Both the client operating system and the server operating system have a locale setting. The expected behavior varies according to both settings.

- If either the server or client locale setting uses the comma as decimal separator, then Zen accepts both period-separated values and quoted comma-separated values.
- If neither the server nor the client locale setting uses the comma decimal separator, then Zen does not accept comma-separated values.

Changing the Locale Setting

Decimal separator information can be retrieved or changed only for a machine running a Windows operating system. The decimal setting for Linux and macOS cannot be configured, and it is set to a period. If you have a Linux and macOS server engine and you want to use a comma as decimal separator, you must ensure that all your client computers are set to a locale that uses the decimal separator.

To change the regional settings on a Windows operating system, access the settings from the Control Panel. Stop and restart Zen services after your change to enable the database engine to use the setting.

Examples

Example A – Server locale uses a comma for decimal separator

Client locale uses a comma as decimal separator:

```
CREATE TABLE t1 (c1 DECIMAL(10,3), c2 DOUBLE)
```

```
INSERT INTO t1 VALUES (10.123, 1.232)
```

```
INSERT INTO t1 VALUES ('10,123', '1.232')
```

```
SELECT * FROM t1 WHERE c1 = 10.123
```

```
SELECT * FROM t1 FROM c1 = '10,123'
```

The above two SELECT statements, if executed from the client, return:

```
10.123, 1.232
```

```
10.123, 1.232
```

```
SET DECIMALSEPARATORCOMMA=ON
```

```
SELECT * FROM t1 FROM c1 = '10,123'
```

The above SELECT statement, if executed from the client after setting the decimal separator, returns:

```
10,123, 1,232
```

Client locale uses period as decimal separator, and these statements are issued from a new connection (meaning default behavior for SET DECIMALSEPARATORCOMMA):

```
CREATE TABLE t1 (c1 DECIMAL(10,3), c2 DOUBLE)
```

```
INSERT INTO t1 VALUES (10.123, 1.232)
```

```
INSERT INTO t1 VALUES ('10,123', '1.232')
```

```
SELECT * FROM t1 WHERE c1 = 10.123
```

```
SELECT * FROM t1 WHERE c1 = '10,123'
```

The above two SELECT statements, if executed from the client, return:

```
10.123, 1.232
```

```
10.123, 1.232
```

Example B – Server locale uses the period for decimal separator

Client locale uses comma as DECIMAL separator:

Same as client using comma in Example A.

Client locale uses period as DECIMAL separator:

```
CREATE TABLE t1 (c1 DECIMAL(10,3), c2 DOUBLE)
```

```
INSERT INTO t1 VALUES (10.123, 1.232)
```

```
INSERT INTO t1 VALUES ('10,123', '1,232') -- error in assignment
```

```
SELECT * FROM t1 WHERE c1 = 10.123
```

```
SELECT * FROM t1 WHERE c1 = '10,123' -- error in assignment
```

The first SELECT statement above, if executed from the client, returns:

```
10.123, 1.232
```

```
SET DECIMALSEPARATORCOMMA=ON
```

```
SELECT * FROM t1 FROM c1 = 10.123
```

The above SELECT statement, if executed after setting the decimal separator for display, returns:

```
10,123, 1,232
```

Scalar Functions

Scalar functions are covered in the following topics:

- Bitwise Operators
- Arithmetic Operators
- String Functions
- Numeric Functions
- Time and Date Functions
- System Functions
- Logical Functions
- Conversion Functions

Zen supports scalar functions that may be included in a SQL statement as a primary expression.

Bitwise Operators

Bitwise operators allow you to manipulate the bits of one or more operands. The following are the types of bitwise operators:

Operator	Meaning
&	bitwise AND
~	bitwise NOT
|	bitwise OR
^	bitwise exclusive OR

The storage length of the expression is a key factor to be considered while performing a bitwise operation. The following are the data types supported for bitwise operations:

BIT	TINYINT	SMALLINT
INTEGER	BIGINT	UTINYINT
USMALLINT	UINTEGER	UBIGINT

The following table gives the descriptions, syntax, values returned, and examples of bitwise operators. Each bitwise operator can take only numeric values as its operands.

Bitwise Operator	Description and Syntax	Values Returned	Example
AND	The bitwise AND operator performs a bitwise logical AND operation between two operands. AND compares two bits and assigns a value equal to 1 to the result only if the values of both the bits are equal to 1. Otherwise, the bit in the result is set to 0. *expression & expression* *Expression* is any valid expression containing the integer data type, which is transformed into a binary number for the bitwise operation.	In a bitwise AND operation involving operands of different integer data types, the argument of the smaller data type is converted to the larger data type or to the data type that is immediately larger than the larger of the two operands. If any of the operands involved in a bitwise AND operation is signed, then the resultant value is also signed.	The & operator can be used in conjunction with the IF function to find out whether a table is a system table or a user-defined table. `select Xf$Name, IF(Xf$Flags & 16 = 16, 'System table','User table') from X$File`
NOT	The bitwise NOT operator inverts the bit values of any variable and sets the corresponding bit in the result. *~ expression* *Expression* is any valid expression containing the integer data type, which is transformed into a binary number for the bitwise operation. The tilde (~) cannot be used as part of a user-defined name.	The bitwise NOT operator returns the reverse of its single operand of the integer data type. All ones are converted to zeros, and all zeros are converted to ones.	The following query performs the complement operation on a numeric literal: `SELECT ~12` The result is -13. The result is negative because the complement operator complements the sign bit also.

Bitwise Operator	**Description and Syntax**	**Values Returned**	**Example**

OR	The bitwise OR operator performs a bitwise logical OR operation between two operands. OR compares two bits and assigns a value equal to 1 to the result if the values of either or both the bits are equal to 1. If neither bit in the input expressions has a value of 1, the bit in the result is set to 0. The OR operator can take only numeric values as its operands.
	expression | *expression*
	Expression is any valid expression containing the integer data type, which is transformed into a binary number for the bitwise operation.
		In a bitwise OR operation involving operands of different integer data types, the argument of the smaller data type is converted to the larger data type or to the data type that is immediately larger than the larger of the two operands.
		If any of the operands involved in a bitwise OR operation is signed, then the resultant value will also be signed.
			The following could obtain a list of foreign key and primary constraints:
			`select B.Xf$Name "Table name", C.Xe$Name "Column name",`
			`IF (Xi$Flags & 8192 = 0, 'Primary key', 'Foreign key') "Key type" from X$Index A, X$File B, X$Field C`
			`where (A.Xi$Flags & (16384 \| 8192)) > 0 AND A.Xi$File = B.Xf$Id AND A.Xi$Field = C.Xe$Id`

OR (exclusive)	The bitwise exclusive OR operator performs a bitwise logical exclusive OR operation between two operands. Exclusive OR compares two bits and assigns a value equal to 0 to the result if the values of both the bits are either 0 or 1. Otherwise, this operator sets the corresponding result bit to 1. *expression* ^ *expression* *Expression* is any valid expression containing the integer data type, which is transformed into a binary number for the bitwise operation. The circumflex (^) cannot be used as part of a user-defined name.	In a bitwise exclusive OR operation involving operands of different integer data types, the argument of the smaller data type is converted to the larger data type or to the data type that is immediately larger than the larger of the two operands. If any of the operands involved in a bitwise exclusive OR operation is signed, then the resultant value is also signed.	The following SQL query performs the exclusive OR on two numeric literals: `SELECT 12 ^ 8` The result is 4.

Truth Table

The following is the truth table for bitwise operations.

A	B	A & B	A | B	A ^ B	~ A
0	0	0	0	0	1
0	1	0	1	1	1
1	0	0	1	1	0
1	1	1	1	0	0

Arithmetic Operators

Date Arithmetic

Zen supports adding or subtracting an integer from a date where the integer is the number of days to add or subtract, and the date is embedded in a vendor string. This is equivalent to executing a convert on the date.

Zen also supports subtracting one date from another to yield a number of days.

Example

```
SELECT * FROM person P, Class C WHERE p.Date_Of_Birth < ' 1973-09-05' AND c.Start_date >{d '1995-05-
08'} + 30
```

String Functions

String functions are used to process and manipulate columns that consist of text information, such as CHAR, NCHAR, VARCHAR, NVARCHAR, LONGVARCHAR, or NLONGVARCHAR data types.

The string functions support multiple-byte character strings. (Note, however, that **CASE (*string*)** does **not** support multiple-byte character strings. The **CASE (*string*)** keyword assumes that the string data is single-byte ASCII. See CASE (string).)

Arguments denoted as *string* can be the name of column, a string literal, or the result of another scalar function. The following table lists string functions in Zen.

Function	**Description**
ASCII (*string*)	Returns a numeric value for the left most character of *string*. The value is the position of the character in the database code page. See also UNICODE function.
BIT_LENGTH (*string*)	Returns the length in bits of *string*
CHAR (*code*)	Returns a single-character string where the *code* argument selects the character from the database code page. The argument must be an integer value. See also NCHAR function.
CHAR_LENGTH (*string*)	Returns the number of bytes in *string*. All padding is significant for CHAR and NCHAR *string*.
CHAR_LENGTH2 (*string*)	Returns the number of characters in *string*. All padding is significant for CHAR and NCHAR *string*. A value less than the size of the string may be returned if the data contains double-byte characters.
CHARACTER_LENGTH (*string*)	Same as CHAR_LENGTH.
CONCAT (*string1*, *string2*)	Returns a *string* that results from combining *string1* and *string2*.
ISNUMERIC(*string*)	Returns 1 (TRUE) if the string value can be evaluated as a numeric value. Otherwise returns 0 (FALSE).
LCASE or LOWER (*string*)	Converts all upper case characters in *string* to lower case.
LEFT (*string*, *count*)	Returns the left most *count* of characters in *string*. The value of *count* is an integer.
LENGTH (*string*)	Returns the number of characters in *string*. Trailing spaces are counted in a VARCHAR, NVARCHAR, LONGVARCHAR, or NLONGVARCHAR *string*. Trailing NULLs are counted in a CHAR, NCHAR, LONGVARCHAR, or NLONGVARCHAR *string*. The *string* termination character is not counted. When ANSI_PADDING = OFF, trailing NULLs are treated the same as trailing spaces and are not counted in the length of a CHAR column.

Function	Description
LOCATE (*string1*, *string2* [, *start*])	Returns the starting position of the first occurrence of *string1* within *string2*. The search within *string2* begins at the first character position unless you specify a starting position (*start*). The search begins at the starting position you specify. The first character position in *string2* is 1. The *string1* is not found, the function returns the value zero.
LTRIM (*string*)	Returns the characters of *string* with leading blanks removed. All padding is significant for CHAR and NCHAR *string*.
NCHAR (*code*)	Returns a single-character wide string where the *code* argument is a Unicode codepoint value. The argument must be an integer value. See also CHAR function.
OCTET_LENGTH (*string*)	Returns the length of *string* in octets (bytes). All padding is significant for CHAR and NCHAR *string*.
POSITION (*string1*, *string2*)	Returns the position of *string1* in *string2*. If *string1* does not exist in *string2*, a zero is returned.
REPLACE (*string1*, *string2*, *string3*)	Searches *string1* for occurrences of *string2* and replaces each with *string3*. Returns the result. If no occurrences are found, *string1* is returned.
REPLICATE (*string*, *count*)	Returns a character *string* composed of *string* repeated *count* times. The value of *count* is an integer.
REVERSE(*string)*	Returns a character *string* with the order of the characters reversed. Note that leading spaces in any string types are considered as significant, unlike trailing spaces which are not considered as significant. See Examples for an example.
RIGHT (*string*, *count*)	Returns the right most *count* of characters in *string*. The value of *count* is an integer.
RTRIM (*string*)	Returns the characters of *string* with trailing blanks removed. When ANSI_PADDING = OFF, trailing NULLs are treated the same as trailing spaces and are removed from a CHAR column value.
SOUNDEX (*string*)	Converts an alpha string to a four character code to find similar sounding words or names. Returns a four character (SOUNDEX) code to evaluate the similarity of two strings, usually a name. **Note:** Conforms to the current rule set for the official implementation of Soundex used by the United States Government.

Function	Description
SPACE (*count*)	Returns a character *string* consisting of *count* spaces.
STUFF (*string1*, *start*, *length*, *string2*)	Returns a character *string* where *length* characters in *string1* beginning at position *start* have been replaced by *string2*. The values of *start* and *length* are integers.
SUBSTRING (*string1*, *start*, *length*)	Returns a character *string* derived from *string1* beginning at the character position specified by *start* for *length* characters. The *start* value can be any number. The first position of *string1* is 1. A *start* value of 0 or a negative number is considered left of the first position. *Length* cannot be negative.
UCASE or UPPER (*string*)	Converts all lower case characters in *string* to upper case.
UNICODE (*string*)	Returns the Unicode codepoint value for the left most character of *string*. See also ASCII function.

Note: With the exception of CHAR_LENGTH, string functions operate only on strings of up to 65,500 bytes in length. CHAR_LENGTH operates on the full length of strings permitted by the data type in use.

Queries containing a WHERE clause with scalar functions RTRIM or LEFT can be optimized. For example, consider the following query:

```
SELECT * FROM T1, T2 WHERE T1.C1 = LEFT(T2.C1, 2)
```

In this case, both sides of the predicate are optimized if T1.C1 and T2.C2 are index columns. The *predicate* is the complete search condition following the WHERE keyword. Depending on the size of the tables involved in the join, the optimizer chooses the appropriate table to process first.

LTRIM and RIGHT cannot be optimized if they are contained in a complex expression on either side of the predicate.

Examples

The following example creates a new table with an integer and a character column. It inserts 4 rows with values for the character column only, then updates the integer column of those rows with the ASCII character code for each character.

```
CREATE TABLE numchars(num INTEGER,chr CHAR(1) CASE);
INSERT INTO numchars (chr) VALUES('a');
INSERT INTO numchars (chr) VALUES('b');
INSERT INTO numchars (chr) VALUES('A');
INSERT INTO numchars (chr) VALUES('B');
UPDATE numchars SET num=ASCII(chr);
SELECT * FROM numchars;
```

Results of SELECT:

```
num        chr
---------- ---
97         a
98         b
65         A
66         B

SELECT num FROM numchars WHERE num=ASCII('a')
```

Results of SELECT:

```
num
------
97
```

============

The following example concatenates the first and last names in the Person table and results in "RooseveltBora".

```
SELECT  CONCAT(First_name, Last_name) FROM Person WHERE First_name = 'Roosevelt'
```

============

The next example changes the case of the first name to lowercase and then to upper case, and results in "roosevelt", "ROOSEVELT".

```
SELECT LCASE(First_name),UCASE(First_name) FROM Person WHERE First_name = 'Roosevelt'
```

============

The following example results in first name trimmed to three characters beginning from left, the length as 9 and locate results 0. This query results in "Roo", 9, 0

```
SELECT  LEFT(First_name, 3),LENGTH(First_name), LOCATE(First_name, 'a') FROM Person WHERE First_name
= 'Roosevelt'
```

============

The following example illustrates use of LTRIM and RTRIM functions on strings, results in "Roosevelt", "Roosevelt", "elt".

```
SELECT LTRIM(First_name),RTRIM(First_name), RIGHT(First_name,3) FROM Person WHERE First_name =
'Roosevelt'
```

============

The following examples illustrate use of the SUBSTRING function.

This substring returns up to three characters starting with the second character in the specified column:

```
SELECT SUBSTRING(First_name,2, 3) FROM Person WHERE First_name = 'Roosevelt'
```

Results set:

```
'oos'
```

This substring returns an empty string because the starting position is beyond the end of the string:

```
SELECT substring('ABCDE',10,1);
```

The following substrings return values as specified:

`SELECT substring('ABCDE',0,2);` – Returns 'A'

`SELECT substring('ABCDE',-5,10);` – Returns 'ABCD'

`SELECT substring('ABCDE',-1,4);` – Returns 'AB'

============

The following example illustrates use of the SOUNDEX function on strings `Smith` and `Smythe`.

```
SELECT SOUNDEX ('Smith'), SOUNDEX ('Smythe')'
```

Results set:

```
S530
S530
```

============

The following example illustrates use of the SOUNDEX function on the Person table finding all last names that sound like "Kennedy".

```
SELECT Last_Name FROM Person WHERE SOUNDEX(last_name) = SOUNDEX ('Kennedy')
```

Results of SELECT:

```
Last_Name
---------
Kandy
Kenady
Kennedy
Kennedy
```

============

The following example illustrates use of the REVERSE function.

```
SELECT REVERSE(dept_name) from COURSE where dept_name = 'Music'
```

Results set:

```
               cisuM
               cisuM
               cisuM
               cisuM
               cisuM

5 rows were affected.
```

Because leading spaces are signficant, the following query returns zero rows:

```
SELECT * from COURSE WHERE REVERSE(dept_name) = 'cisuM'
```

This is because dept_name is defined as a CHAR field 20 characters wide. Either of the following query statements returns the expected results:

```
SELECT * from COURSE WHERE REVERSE(dept_name) = '               cisuM'

SELECT * from COURSE WHERE LTRIM(REVERSE(dept_name)) = 'cisuM'
```

Results set:

```
MUS 101   Hymnology      3   Music
MUS 102   Church         3   Music
MUS 203   Piano          3   Music
MUS 304   Music Theory   3   Music
MUS 405   Recital        3   Music

5 rows were affected.
```

Numeric Functions

Numeric functions are used to process and manipulate columns that consist of strictly numeric information, such as decimal and integer values. The following table lists numeric functions in Zen.

Function	Description
ABS (*numeric_exp*)	Returns the absolute (positive) value of *numeric_exp*.
ACOS (*float_exp*)	Returns the arc cosine of *float_exp* as an angle, expressed in radians.
ASIN (*float_exp*)	Returns the arc sine of *float_exp* as an angle, expressed in radians.
ATAN (*float_exp*)	Returns the arc tangent of *float_exp* as an angle, expressed in radians.
ATAN2 (*float_exp1*, *float_exp2*)	Returns the arc tangent of the x and y coordinates, specified by *float_exp1* and *float_exp2*, respectively, as an angle, expressed in radians.
CEILING (*numeric_exp*)	Returns the smallest integer greater than or equal to *numeric_exp*.

Function	Description
COS (*float_exp*)	Returns the cosine of *float_exp*, where *float_exp* is an angle expressed in radians.
COT (*float_exp*)	Returns the cotangent of *float_exp*, where *float_exp* is an angle expressed in radians.
DEGREES (*numeric_exp*)	Returns the number of degrees corresponding to *numeric_exp* radians.
EXP (*float_exp*)	Returns the exponential value of *float_exp*.
FLOOR (*numeric_exp*)	Returns the largest integer less than or equal to *numeric_exp*.
LOG (*float_exp*)	Returns the natural logarithm of *float_exp*.
LOG10 (*float_exp*)	Returns the base 10 logarithm of *float_exp*.
MOD (*integer_exp1*, *integer_exp2*)	Returns the remainder (modulus) of *integer_exp1* divided by *integer_exp2*.
PI()	Returns the constant value Pi as a floating point value.
POWER (*numeric_exp*, *integer_exp*)	Returns the value of *numeric_exp* to the power of *integer_exp*.
RADIANS (*numeric_exp*)	Returns the number of radians equivalent to *numeric_exp* degrees.
RAND (*integer_exp*)	Returns a random floating-point value using *integer_exp* as the optional seed value.
ROUND (*numeric_exp*, *integer_exp*)	Returns *numeric_exp* rounded to *integer_exp* places right of the decimal point. If *integer_exp* is negative, *numeric_exp* is rounded to |*integer_exp*| (absolute value of *integer_exp*) places to the left of the decimal point.
SIGN (*numeric_exp*)	Returns an indicator of the sign of *numeric_exp*. If *numeric_exp* is less than zero, -1 is returned. If *numeric_exp* equals zero, 0 is returned. If *numeric_exp* is greater than zero, 1 is returned.
SIN (*float_exp*)	Returns the sine of *float_exp*, where *float_exp* is an angle expressed in radians.
SQRT (*float_exp*)	Returns the square root of *float_exp*.
TAN (*float_exp*)	Returns the tangent of *float_exp*, where *float_exp* is an angle expressed in radians.

Function	Description
TRUNCATE (*numeric_exp*, *integer_exp*)	Returns *numeric_exp* truncated to *integer_exp* places right of the decimal point. If *integer_exp* is negative, *numeric_exp* is truncated to |*integer_exp*| (absolute value) places to the left of the decimal point.

Examples

The following example lists the modulus of the number and capacity columns in a table named Room.

```
SELECT  Number, Capacity, MOD(Number, Capacity)  FROM  Room WHERE Building_Name = 'Faske Building'
and Type = 'Classroom'
```

============

The following example selects all salaries from a table named Faculty that are evenly divisible by 100.

```
SELECT Salary FROM Faculty WHERE MOD(Salary, 100) = 0
```

Time and Date Functions

Time and date functions enable you to generate, process, and manipulate data with time and date data types. This topic covers the use of these functions.

You may use CURTIME(), CURDATE() and NOW() in INSERT statements to insert the current *local* date, time, and time stamp values. For example:

```
CREATE TABLE table1 (col1 DATE)
INSERT INTO table1 VALUES (CURDATE())
```

All time and date functions support a SELECT subquery in an INSERT statement, as shown here:

```
INSERT INTO t1 (c1, c2) SELECT CURRENT_DATE(), CURRENT_TIME()
```

Some functions, such as CURDATE(), CURTIME(), and NOW(), also support direct insert, as in:

```
INSERT INTO t1 (c1) VALUES (CURDATE())
```

For more examples, see Time and Date Function Examples.

The following table lists time and date functions in Zen.

Note: The date and time formats listed here may not match the ones used to display values the Text and Grid views in ZenCC. The displayed format is fixed by the application.

Function	**Description**
CURDATE()	Returns the current local date in the format 'yyyy-mm-dd'. Uses the local clock date by default. If SET TIME ZONE has been called, then the value of CURDATE() is determined by calculating UTC time and date from the system clock and operating system locale setting, then adding the offset value from SET TIME ZONE.
CURRENT_DATE()	Returns the current UTC date in the format 'dd/mm/yyyy'.
CURTIME()	Returns the current local time in the format 'hh:mm:ss'. Uses the local clock time by default. If SET TIME ZONE has been called, then the value of CURTIME() is determined by calculating UTC time and date from the system clock and operating system locale setting, then adding the offset value from SET TIME ZONE.
CURRENT_TIME()	Returns the current UTC time in the format 'hh:mm:ss'.
CURRENT_TIMESTAMP()	Returns the current UTC date and time in the format 'yyyy-mm-dd hh:mm:ss.mmm'.

Function	**Description**
DATEADD(*datepart*, *interval*, *date_exp*)	Returns a new DATETIME value by adding an interval to a date. For example, a *datepart* day, an *interval* of 11, and a *date_exp* of January 26, 2020 returns February 6, 2020. *Datepart* specifies the part of the date to which *interval* is added and must be one of the following values: • YEAR • QUARTER • MONTH • DAY • DAYOFYEAR • WEEK • HOUR • MINUTE • SECOND • MILLISECOND *Interval* specifies a positive or negative integer value used to increment *datepart*. If *interval* contains a fractional portion, the fraction part is ignored. *Date_exp* is an expression that returns a DATETIME value, a value that can be implicitly converted to a DATETIME value, or a character *string* in a DATE format. See DATETIME.

Function	Description
DATEDIFF(*datepart*, *start*, *end*)	Returns an integer for the difference between the two dates. The integer is the number of date and time boundaries crossed between the two dates. For example, table mytest has two columns,col1 and col2, both of which are DATETIME. The value in col1 is 2000-01-01 11:11:11.234 and the value in col2 is 2004-09-11 10:10:10.211. The following SELECT statement returns 56, because that is the difference in months between col1 and col2: `SELECT DATEDIFF(month, col1, col2) as Month_Difference FROM mytest` *Datepart* specifies the part of the date on which to calculate the difference and must be one of the following values: • YEAR • QUARTER • MONTH • DAY • DAYOFYEAR • WEEK • HOUR • MINUTE • SECOND • MILLISECOND *Start* specifies the beginning date for the difference calculation. *Start* is an expression that returns a DATETIME value or a Unicode character string in a DATE format. *End* specifies the ending date for the difference calculation. *End* is an expression that returns a DATETIME value or a Unicode character string in a DATE format. *Start* is subtracted from *end*. An error is returned if the return value is outside of the range for integer values. See Data Type Ranges.

Function	**Description**
DATEFLOOR(*timestamp_exp*, *interval_unit*)	Returns the time stamp determined by rounding *timestamp_exp* down to the nearest boundary of *interval_unit*. This rounding is done by setting all time stamp fields to the right of *interval_unit* to their minimum values. For example, if *interval_unit* is day, then year, month, and day are all retained from the *timestamp_exp* and hour, minute and second are set to zero. Valid values for *interval_unit* are: • YEAR • MONTH • DAY • HOUR • MINUTE • SECOND
DATEFROMPARTS(*year, month, day*)	Returns a date value for the specified year, month, and day. NULL is returned if any of the parameters are NULL.
DATENAME(*datepart*, *date_exp*)	Returns an English character string (a VARCHAR) that represents the *datepart* of *date_exp*. For example, a *datepart* month returns the name of the month such as January, February, and so forth. A *datepart* weekday returns the day of the week such as Monday, Tuesday, and so forth. *Datepart* specifies the part of the date to return and must be one of the following values: • YEAR • QUARTER • MONTH • DAY • DAYOFYEAR • WEEK • WEEKDAY • HOUR • MINUTE • SECOND • MILLISECOND *Date_exp* is an expression that returns a DATETIME value, a value that can be implicitly converted to a DATETIME value, or a character string in a DATE format. See DATETIME.

Function	Description
DATEPART(*datepart*, *date_exp*)	Returns an integer that represents the *datepart* of *date_exp*. For example, a *datepart* month returns an integer representing the month (January = 1, December = 12). A *datepart* weekday returns an integer representing the day of the week (Sunday = 1, Saturday = 7). *Datepart* is the part of the date to return and must be one of the following values: • YEAR • QUARTER • MONTH • DAY • DAYOFYEAR • WEEK • WEEKDAY • HOUR • MINUTE • SECOND • MILLISECOND • TZOFFSET The TZOFFSET value returns a time zone offset in number of minutes (signed). The DATEPART function with TZOFFSET works only with SYSDATETIMEOFFSET() and string literals containing a time zone offset. The time zone offset range is -14:00 through +14:00. See Time and Date Function Examples. *Date_exp* is an expression that returns a DATETIME value, a value that can be implicitly converted to a DATETIME value, or a character string in a DATE format. See DATETIME.
DAY(*date_exp*)	Returns the day of the month for the given *date_exp*. Identical to DATEPART(day, *date_exp*). See DATEPART(datepart, date_exp).
DAYNAME(*date_exp*)	Returns an English character string containing the name of the day (for example, Sunday through Saturday) for the day portion of *date_exp*. *Date_exp* can be a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.

Function	**Description**
DAYOFMONTH(*date_exp*)	Returns the day of the month in *date_exp* as an integer in the range of 1 to 31. *Date_exp* can be a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.
DAYOFYEAR(*date_exp*)	Returns the day of the year based on the year field in *date_exp* as an integer value in the range of 1-366.
DATETIMEFROMPARTS(*year, month, day, hour, minute, seconds, milliseconds*)	Returns a value constructed from the provided parameters. NULL is returned if any of the parameters are NULL.
DATETIMEOFFSETFROMPARTS(*year, month, day, hour, minute, seconds, fractions, hour_offset, minute_offset, scale*)	Returns a string value for a date and time using specified parameters. If any of the parameters except *scale* are NULL, then NULL is returned. If *scale* is NULL, then an error is returned. *Scale* specifies the precision of the fractions value and has a range from 0 to 7. *Fractions* depends on *scale* and has a range from 0 to 9999999. For example, if *scale* is 3, then each *fraction* represents a millisecond. The number of digits specified for *fractions* must be less or equal to the value for *scale*. The *hour_offset* specifies the hour portion of a time zone with a range from -14 to +14. The *minute_offset* specifies the minute portion of a time zone with a range from 0 to 59. *Hour_offset* and *minute_offset* must have the same sign unless *hour offset* is 0. The default string literal format for DATETIMEOFFSETFROMPARTS is YYYY-MM-DD hh:mm:ss[.nnnnnnn] [{+|-}hh:mm].

Function	Description
EVERYN(*interval_unit, timestamp_exp, rounding_unit, bucket_size*)	Returns the time stamp determined by rounding *timestamp_exp* down to the beginning of the most recent time bucket, assuming buckets of *bucket-size* * *interval_unit*, counting from the beginning of the most recent *rounding_unit*. For example, suppose you want to have ten groupings of data every minute. You would need 6-second buckets for this. EVERYN(SECOND, '2022-06-15 08:15:22.891', MINUTE, 6) rounds the given time stamp down to the beginning of the most recent 6-second bucket, counting from the beginning of the most recent MINUTE. The most recent minute is '2022-06-15 08:15:00.000', and the fourth 6-second bucket in this minute begins at '2022-06-15 08:15:18.000', so this is the value returned. The effect is that all time stamps within this bucket receive this same result from EVERYN. Valid values for both *interval_unit* and *rounding_unit*: • YEAR • MONTH • DAY • HOUR • MINUTE • SECOND **Note:** EVERYN gives useful results only if *rounding_unit* is a larger interval than *interval_unit*.
EXTRACT(*extract_field*, *extract_source*)	Returns the *extract_field* portion of the *extract_source*. The *extract_source* argument is a date, time, or interval expression. The following values are permitted for *extract_field* and are returned from the target expression: • YEAR • MONTH • DAY • HOUR • MINUTE • SECOND
HOUR(*time_exp*)	Returns the hour as an integer in the rage of 0 to 23. *Time_exp* can be a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.

Function	Description
MINUTE(*time_exp*)	Returns the minute as an integer in the range 0 to 59. *Time_exp* can be a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.
MONTH(*date_exp*)	Returns the month as an integer in the range of 1 to 12. *Date_exp* can be a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.
MONTHNAME(*date_exp*)	Returns an English character string containing the name of the month (for example, January through December) for the month portion of *date_exp*. *Date_exp* can be a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.
NOW()	Returns the current local date and time in the format 'yyyy-mm-dd hh:mm:ss.mmm'. Uses the local clock time by default. If SET TIME ZONE has been called, then the value of NOW() is determined by calculating UTC time and date from the system clock and operating system locale setting, then adding the offset value from SET TIME ZONE.
QUARTER(*date_exp*)	Returns the quarter in *date_exp* as an integer value in the range of 1- 4, where 1 represents January 1 through March 31. *Date_exp* can bebe a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.
SECOND(*time_exp*)	Returns the second as an integer in the range of 0 to 59. *Time_exp* can be a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.
SYSDATETIME()	Returns the current local date and time displayed in the format 'yyyy-mm-dd hh:mm:ss.nnnnnnnnn'. Uses the local clock time by default. Scale is septaseconds on Windows 10, nanoseconds on Linux, and microseconds on all other platforms. Trailing digits not returned are padded with zeros to 9 places. If SET TIME ZONE has been called, then the value of SYSDATETIME() is determined by calculating UTC time and date from the system clock and operating system locale setting, then adding the offset value from SET TIME ZONE.

Function	Description
SYSDATETIMEOFFSET()	Returns the current date and time along with the hour and minute offset between the current time zone and UTC of the computer on which the Zen database engine is running. Daylight saving time (DST) is accounted for. The default format returned is YYYY-MM-DD hh:mm:ss[.nnnnnnnnn] [<+ | ->hh:mm]. A plus sign indicates that the current time zone is ahead of the UTC. A minus sign indicates that the current time zone is behind the UTC.
SYSUTCDATETIME()	Returns the current local date and time displayed in the format 'yyyy-mm-dd hh:mm:ss.nnnnnnnnn'. Uses the local clock time by default. Scale is septaseconds on Windows 10, nanoseconds on Linux, and microseconds on all other platforms. Trailing digits not returned are padded with zeros to 9 places. If SET TIME ZONE has been called, then the value of SYSUTCDATETIME() is determined by calculating UTC time and date from the system clock and operating system locale setting.
TIMEFROMPARTS(*hour, minute, seconds, fractions, scale*)	Returns a time value constructed from the specified time parameters. If any of the parameters except *scale* are NULL, then NULL is returned. If *scale* is NULL, then an error is returned. *Scale* specifies the precision of the fractions value and has a range from 0 to 7. *Fractions* depends on *scale* and has a range from 0 to 9999999. For example, if *scale* is 3, then each *fraction* represents a millisecond. The number of digits specified for *fractions* must be less or equal to the value for *scale*. The default format for TIMEFROMPARTS is hh:mm:ss[.nnnnnnn].
TIMESTAMPADD(*interval*, *integer_exp*, *timestamp_exp*)	Returns the time stamp calculated by adding *integer_exp* intervals of type *interval* to *timestamp_exp*. The following values are allowed for *interval*: • SQL_TSI_YEAR • SQL_TSI_QUARTER • SQL_TSI_MONTH • SQL_TSI_WEEK • SQL_TSI_DAY • SQL_TSI_HOUR • SQL_TSI_MINUTE • SQL_TSI_SECOND

Function	Description
TIMESTAMPDIFF(*interval*, *timestamp_exp1*, *timestamp_exp2*)	Returns the integer number of intervals of type *interval* by which *timestamp_exp2* is greater than *timestamp_exp1*. The values allowed for *interval* are the same as for TIMESTAMPADD.
WEEK(*date_exp*)	Returns the week of the year based on the week field in *date_exp* as an integer in the range of 1 to 53. *Date_exp* can be a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.
WEEKDAY(*date_exp*)	Returns the day of the week for the given *date_exp*, where 1=Sunday and 7=Saturday. Identical to DATEPART(weekday, *date_exp*). See DATEPART(datepart, date_exp).
YEAR(*date_exp*)	Returns the year as an integer value. The range depends on the data source. *Date_exp* can be a DATE, SQL_TIMESTAMP literal, or a column containing DATE, DATETIME, or time stamp data.

Time and Date Function Examples

The following example illustrates the use of hour.

```
SELECT c.Name, c.Credit_Hours FROM Course c WHERE c.Name = ANY (SELECT cl.Name FROM Class cl WHERE
c.Name = cl.Name AND c.Credit_Hours >(HOUR (Finish_Time - Start_Time) + 1))
```

============

The following is an example of minute.

```
SELECT MINUTE(log) FROM billing
```

============

The following example illustrates the use of second.

```
SELECT SECOND(log) FROM billing;
SELECT log FROM billing WHERE SECOND(log) = 31
```

============

The following example illustrates the use of NOW().

```
SELECT NOW() - log FROM billing
```

============

The following is a more complex example that uses month, day, year, hour and minute.

```
SELECT Name, Section, MONTH(Start_Date), DAY(Start_Date), YEAR(Start_Date), HOUR(Start_Time),
MINUTE(Start_Time) FROM Class
```

============

The following example illustrates use of CURDATE().

```
SELECT ID, Name, Section FROM Class WHERE (Start_Date - CURDATE()) <= 2 AND (Start_Date - CURDATE())
>= 0
```

============

The next example gives the day of the month and day of the week of the start date of class from the class table.

```
SELECT DAYOFMONTH(Start_date), DAYOFWEEK(Start_date)  FROM Class;
```

```
SELECT * FROM person WHERE YEAR(Date_Of_Birth) < 1970
```

============

The following example illustrates use of DATEPART with the TZoffset parameter.

```
SELECT DATEPART(TZoffset, SYSDATETIMEOFFSET())
```

Assuming the statement returns -360, the current time zone is 360 minutes behind UTC.

Assume that SELECT SYSDATETIMEOFFSET() returns 2011-01-24 14:33:08.4650000 -06:00. Given this, the following query returns -360:

```
SELECT DATEPART(TZoffset, '2011-01-24 14:33:08.4650000 -06:00')
```

If the time zone portion is omitted from the string literal, 0 is returned:

```
SELECT DATEPART(TZoffset, '2011-01-24 14:33:08.4650000')
```

============

The following example uses DATEFROMPARTS to return a date from the provided values.

```
SELECT NOW(), DATEFROMPARTS(DATEPART(Year, NOW()), DATEPART(Month, NOW()), DATEPART(Day, NOW()))
```

Returns: `2013-05-09 14:33:34.835 PM     5/9/2013`

============

The following example uses TIMEFROMPARTS to return a time from the provided values.

```
SELECT NOW(), TIMEFROMPARTS(DATEPART(hour, NOW()), DATEPART(minute, NOW()), DATEPART(second, NOW()),
DATEPART(millisecond, NOW()), 3)
```

Returns: `2013-05-09 15:04:11.425 PM   15:04:11.425`

============

This example uses DATETIMEFROMPARTS to return a time stamp from the provided values.

```
SELECT DATETIMEFROMPARTS(1962, 08, 12, 17, 45, 0, 0)
```

Returns: `1962-08-12 17:45:00.000 PM`

============

The following example uses DATETIMEOFFSETFROMPARTS to return a string display for the time stamp plus a timezone specification.

```
SELECT DATETIMEOFFSETFROMPARTS (1962, 08, 12, 17, 45, 0, 0, 5, 0, 0) + ' GMT'
```

Returns: `1962-08-12 17:45:00 +05:00 GMT`

============

The following example uses EVERYN to group records in the Billing table into 6-second buckets based on the TIMESTAMP Log field.

```
SELECT COUNT(*) NumOfPayments, AVG(Amount_Paid) AveragePayment , EVERYN(SECOND,Log,MINUTE,6)
TimePeriodStart FROM Billing GROUP BY TimePeriodStart
```

============

This EVERYN example shows how to specify the rounding unit when the bucket size does not divide into it evenly. Suppose for example, every recorded value must be assigned to a 7-second bucket, but you do not want any bucket to cross an HOUR boundary. The following measurements show a series of value recorded around an HOUR boundary:

```
Time Stamp                EVERYN(SECOND, <time stamp>, HOUR, 7)
2022-06-15 08:59:50.891   2022-06-15 08:59:44.000
2022-06-15 08:59:57.891   2022-06-15 08:59:51.000
2022-06-15 08:59:59.891   2022-06-15 08:59:58.000
2022-06-15 09:00:02.891   2022-06-15 09:00:00.000
2022-06-15 09:00:05.891   2022-06-15 09:00:00.000
2022-06-15 09:00:08.891   2022-06-15 09:00:07.000
```

Note that the final interval of the HOUR, beginning at 2022-06-15 08:59:58.000, is only 2 seconds long because the next interval must start in the next HOUR, namely 2022-06-15 09:00:00.000.

Functionally, EVERYN allows you to parameterize an expression that otherwise would have to be constructed from several other functions and repeated values. For example, this expression using seven function calls:

```
DATEADD(SECOND,((FLOOR (DATEDIFF(SECOND, DATEFLOOR(ts_val, HOUR), ts_val)/ 8))* 8),
DATEFLOOR(ts_val, HOUR))
```

can be simplified by calling EVERYN:

```
EVERYN(SECOND, ts_val , HOUR, 8)
```

System Functions

System functions provide information at a system level.

Function	Description
DATABASE()	Returns the current database name.
NEWID()	Creates a unique value for data type uniqueidentifier
USER()	Returns the login name of the current user.

System Function Examples

The following examples show how to obtain the name of the current user and database:

```
SELECT USER();
SELECT DATABASE();
```

============

The following example creates a column of data type UNIQUEIDENTIFIER as the first column in new table table1. Setting a default value with the NEWID function provides a unique value for "col1" in each new row within the table.

```
CREATE TABLE table1 (col1 UNIQUEIDENTIFIER DEFAULT NEWID() NOT NULL, col2 INTEGER);
    INSERT INTO table1 (col2) VALUES (1);
    INSERT INTO table1 (col2) VALUES (2);
    INSERT INTO table1 (col2) VALUES (3);
```

Logical Functions

Logical functions are used to manipulate data based on certain conditions.

Function	Description
COALESCE (*expression1*, *expression2* [, ...])	Returns the first non-null argument, starting from the left in the expression list. See also COALESCE for additional details.
IF (*predicate*, *expression1*, *expression2*)	Returns *expression1* if predicate is true. Otherwise returns *expression2*.
NULL()	Sets a column as NULL values.

Function	Description
IFNULL (*exp*, *value*)	If *exp* is NULL, *value* is returned. If *exp* is not null, *exp* is returned. The possible data type or types of *value* must be compatible with the data type of *exp*.
ISNULL (*exp*, *value*)	Replaces NULL with the value specified for *value*. *Exp* is the expression to check for NULL. *Value* is the value returned if *exp* is NULL. *Exp* is returned if it is not NULL. The data type of *value* must be compatible with the data type of *exp*.
NULLIF (*exp1*, *exp2*)	NULLIF returns *exp1* if the two expressions are not equivalent. If the expressions are equivalent, NULLIF returns a NULL value.

Logical Function Examples

The COALESCE scalar function takes two or more arguments and returns the first non-null argument, starting from the left in the expression list.

```
select COALESCE(10, 'abc' + 'def')
```

Ten is treated as a SMALLINT and ResultType (SMALLINT, VARCHAR) is SMALLINT. Hence, the result type is SMALLINT.

The first parameter is 10, which can be converted to result type SMALLINT. Therefore, the return value of this example is 10.

============

The system scalar functions **IF** and **NULL** are SQL extensions.

IF allows you to enter different values depending on whether the condition is true or false. For example, if you want to display a column with logical values as "True" or "False" instead of a binary representation, you would use the following SQL statement:

```
SELECT IF(logicalcol=1, 'True', 'False')
```

============

The system scalar function NULL allows you to set a column as null values. The syntax is:

```
NULL()
```

For example, the following SQL statement inserts a row in the Room table with a NULL value for Capacity:

```
INSERT INTO Room VALUES ('Young Building', 222, NULL(), 'Lab')
```

=============

The following example demonstrates how ISNULL returns a value.

```
CREATE TABLE t8 (c1 INT, c2 CHAR(10));
INSERT INTO t8 VALUES (100, 'string1');
SELECT c1, c2, ISNULL(c1, 1000), ISNULL(C2, 'a string') from t8;
```

The SELECT returns `100` and `string1` because both c1 and c2 contain a value, not a NULL.

```
INSERT INTO t8 VALUES (NULL, NULL);
SELECT c1, c2, ISNULL(c1, 1000), ISNULL(C2, 'a string') from t8
```

The SELECT returns `1000` and `a string` because both c1 and c2 contain a NULL.

=============

The following statements demonstrate the IFNULL and NULLIF scalar functions. You use these functions when you want to do certain value substitution based on the presence or absence of NULLs and on equality.

```
CREATE TABLE Demo (col1 CHAR(3));
INSERT INTO Demo VALUES ('abc');
INSERT INTO Demo VALUES (NULL);
INSERT INTO Demo VALUES ('xyz');
```

Since the second row contains the NULL value, 'foo' is substituted in its place.

```
SELECT IFNULL(col1, 'foo') FROM Demo
```

This results in three rows fetched from one column:

```
"abc"
"foo"
"xyz"
3 rows fetched from 1 column.
```

The first row contains 'abc,' which matches the second argument of the following NULLIF call.

```
SELECT NULLIF(col1, 'abc') FROM Demo
```

A NULL is returned in its place:

```
<Null>
<Null>
"xyz"
3 rows fetched from 1 column.
```

Conversion Functions

Conversion functions convert an expression to a particular data type. The CONVERT function is best used when converting between a value and its text representation. The CAST function gives more control over the data type but less control over character formatting. Note that CONVERT supports only a subset of relational types.

CAST converts an expression to a Zen relational data type, provided that the expression can be converted. CAST can convert binary zeros in a string. For example, `CAST(c1 AS BINARY(10))`, where c1 is a character column that contains binary zeros (nulls).

If both input and output are character strings, output from CAST or CONVERT has the same collation as the input string.

Conversions between CHAR, VARCHAR, or LONGVARCHAR and NCHAR, NVARCHAR, or NLONGVARCHAR assume that CHAR values are encoded using the database code page.

TRY_CAST and TRY_CONVERT are identical to CAST and CONVERT except for handling of data values that cannot be converted. For CAST and CONVERT the entire query fails, but for TRY_CAST and TRY_CONVERT the columns in the query result that fail are filled with nulls. See Conversion Function Examples for the following list of conversion functions in Zen.

Function	Description	
CAST (*exp* AS *type*) TRY_CAST (*exp* AS *type*)	Converts *exp* to *type*, where *type* may be a data type listed under Zen Supported Data Types, which includes precision and scale parameters.	
CONVERT (*exp*, *type* [, *style*]) TRY_CONVERT (*exp*, *type* [, *style*])	Converts *exp* to the *type* indicated, using the following *type* arguments: SQL_BIGINT SQL_BINARY SQL_BIT SQL_CHAR SQL_DATE SQL_DECIMAL SQL_DOUBLE SQL_FLOAT SQL_GUID SQL_INTEGER SQL_LONGVARBINARY SQL_LONGVARCHAR SQL_NUMERIC SQL_REAL SQL_SMALLINT SQL_TIME SQL_TIMESTAMP SQL_TINYINT SQL_VARCHAR	SQL_WCHAR SQL_WLONGVARCHAR SQL_WVARCHAR The CONVERT arguments use SQL_ as a prefix for the data type. The Zen relational data types do not include the SQL_ prefix. Precision and scale take default values. The optional parameter *style* applies only to the DATETIME data type. Use of the parameter truncates the milliseconds portion of the DATETIME data type. A *style* value may be either 20 or 120. Both values specify the canonical format: yyyy-mm-dd hh:mm:ss. See Conversion Function Examples.

Conversion Function Examples

The following example casts a DATE to a CHAR.

```
CREATE TABLE u1(cdata DATE);
INSERT INTO u1 VALUES(curdate());
SELECT CAST(cdate as (CHAR20)) FROM u1;
```

If the current date were January 1, 2004, the SELECT returns 2004-01-01.

============

The following example converts, respectively, a UBIGINT to a CHAR, and string data to DATE, TIME, and TIMESTAMP.

```
SELECT  CONVERT(id , SQL_CHAR), CONVERT( '1995-06-05', SQL_DATE), CONVERT('10:10:10', SQL_TIME),
CONVERT('1990-10-10 10:10:10', SQL_TIMESTAMP) FROM  Faculty
```

============

The following example converts a string to DATE then adds 31 to DATE.

```
SELECT Name FROM Class WHERE Start_date > CONVERT ('1995-05-07', SQL_DATE) + 31
```

============

The following examples show how to cast and convert a UNIQUEIDENTIFIER data type.

```
CREATE TABLE table1(col1 CHAR(36), col2 UNIQUEIDENTIFIER DEFAULT NEWID());

INSERT INTO table1 (col1) VALUES ('1129619D-772C-AAAB-B221-00FF00FF0099');

SELECT CAST(col1 AS UNIQUEIDENTIFIER) FROM table1;

SELECT CAST(col2 AS LONGVARCHAR) FROM table1;

SELECT CONVERT(col2 , SQL_CHAR) FROM table1;

SELECT CONVERT('1129619D-772C-AAAB-B221-00FF00FF0099' , SQL_GUID) FROM table1;
```

============

The following examples show how to convert a DATETIME data type with and without the *style* parameter.

```
CREATE TABLE table2(col1 DATETIME);
INSERT INTO table2 (col1) VALUES ('2006-12-25 10:10:10.987');
SELECT CONVERT(col1 , SQL_CHAR, 20) FROM table2;
```

This returns `2006-12-25 10:10:10`.

```
SELECT CONVERT(col1 , SQL_CHAR, 120) FROM table2
```

This returns `2006-12-25 10:10:10`.

```
SELECT CONVERT(col1 , SQL_CHAR) FROM table2
```

This returns `2006-12-25 10:10:10.987`.

If you want to include the DATETIME milliseconds, omit the style parameter.

Note the following requirements when using the *style* parameter:

- The *type* parameter must be SQL_CHAR. Any other data type is ignored.
- The column data type of the expression must be DATETIME.
- The only permissible *style* values are 20 and 120. Any other value returns an error. The values 20 or 120 specify the canonical format: yyyy-mm-dd hh:mm:ss.

============

The following examples show the different results when using CAST and TRY_CAST. The same behavior occurs with CONVERT and TRY_CONVERT.

```
SELECT CAST ( '10' AS numeric(10,2)); – Success: returns 10.00
SELECT CAST( 'test' AS float ); – Error: returns Expression evaluation error.
SELECT TRY_CAST ( '10' AS numeric(10,2)); – Success: returns 10.00
SELECT TRY_CAST ( 'test' AS float );  – Success: returns NULL
```

System Stored Procedures

System stored procedures help you accomplish those administrative and informative tasks not covered by the Data Definition Language.

Zen System Stored Procedures

System stored procedures have a **psp_** prefix. The following table lists the system stored procedures currently supported in Zen.

psp_columns	psp_column_attributes	psp_column_rights
psp_fkeys	psp_groups	psp_help_sp
psp_help_trigger	psp_help_udf	psp_help_view
psp_indexes	psp_pkeys	psp_procedure_rights
psp_rename	psp_stored_procedures	psp_tables
psp_table_rights	psp_triggers	psp_udfs
psp_users	psp_view_rights	psp_views

Unless otherwise noted, examples for system stored procedures use the Demodata sample database or refer to Zen system tables.

If you execute a system stored procedure within a database to obtain information from a secured database, an error occurs. You cannot access information in a secured database from any other database.

Note: Do not create stored procedures with the psp_ prefix in their name. Any user-created stored procedure with the same name as a system stored procedure will fail to be executed.

psp_columns

Returns the list of columns and their corresponding information for a specified table, from the current database or the specified database.

Syntax

```
call psp_columns(['database_qualifier'],'table_name', ['column_name'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of database from which to obtain details
table_name	VARCHAR(255)	(no default value)	Name of table whose column information is required
column_name	VARCHAR(255)	All columns for the table	Column name of the table specified

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR (20)	Name of the database
TABLE_OWNER	VARCHAR (20)	Name of the table owner. Table owner is reserved for future use. It currently returns empty (NULL).
TABLE_NAME	VARCHAR(255)	Name of the table
COLUMN_NAME	VARCHAR(255)	Column name of the table
DATA_TYPE	SMALLINT	Data type code of the column. See Zen Supported Data Types.
TYPE_NAME	VARCHAR (32)	Name of the data type of the column corresponding to DATA_TYPE value
PRECISION	INTEGER	The precision of the column if the data type is Decimal, Numeric, and so forth. See Precision and Scale of Decimal Data Types.
LENGTH	INTEGER	The length of the column.
SCALE	SMALLINT	The scale of the column if the data type is Decimal, Numeric, and so forth.
RADIX	SMALLINT	Base for numeric data types
NULLABLE	SMALLINT	Specifies nullability: 1 - NULL allowed 0 - NULL not allowed
REMARKS	VARCHAR(255)	Remarks field

Example

```
create table tx (c_binary BINARY(10),
    c_char CHAR(10),
    c_tinyint TINYINT,
    c_smallint SMALLINT,
    c_int INT,
    c_bigint BIGINT,
    c_utinyint UTINYINT);
call psp_columns(, 'tx',);
```

Result Set

Table_ qualifier	Table_ owner	Table_ name	Column _name	Data_ type	Type_ name	P	L	S	R	N	R
'demodata'	Null	tx	C_binary	-2	Binary	10	10	Null	Null	1	Null
'demodata'	Null	tx	C_char	-1	Char	10	10	Null	Null	1	Null
'demodata'	Null	tx	C_tinyint	-6	Tinyint	Null	1	0	10	1	Null
.....											
Legend: **P** = Precision; **L** = Length; **S** = Scale; **R** = Radix; **N** = Nullable; **R** = Remarks											

============

Assume that you have a database named mydatabase that contains a table named tx.

```
call psp_columns('mydatabase', 'tx', )
```

Result Set

Table_ qualifier	Table_ owner	Table_ name	Column_ name	Data_ type	Type_ name	P	L	S	R	N	R
'wsrde'	Null	tx	C_binary	-2	Binary	10	10	Null	Null	1	Null
'wsrde'	Null	tx	C_char	-1	Char	10	10	Null	Null	1	Null
'wsrde'	Null	tx	C_tinyint	-6	Tinyint	Null	1	0	10	1	Null
.....											
Legend: **P** = Precision; **L** = Length; **S** = Scale; **R** = Radix; **N** = Nullable; **R** = Remarks											

============

```
call psp_columns('mydatabase', 'tx', 'c_binary')
```

Result Set

Table_ qualifier	Table_ owner	Table_ name	Column_ name	Data_ type	Type_ name	P	L	S	R	N	R
'wsrde'	Null	tx	C_binary	-2	Binary	10	10	Null	Null	1	Null
Legend: **P** = Precision; **L** = Length; **S** = Scale; **R** = Radix; **N** = Nullable; **R** = Remarks											

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
database_qualifier is an undefined database	Unable to open table: X$File
table_name is undefined in the database	No error is returned and no results are returned
table_name is null	Table name cannot be null
table_name is a blank string	Table name cannot be a blank string
column_name is a blank string	Column name cannot be a blank string
column_name is undefined in the table	No error is returned and no results are returned

psp_column_attributes

Returns the list of column attributes and the corresponding information from the current database or the specified database.

Syntax

```
call psp_column_attributes(['database_qualifier'], ['table_name'], ['column_name'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database you are logged in	Name of the database from which the details are to be obtained
table_name	VARCHAR(255)	All tables for the specified database	Name of the table whose column information is required
column_name	VARCHAR(255)	All columns for the specified table	Column name of the table specified

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR (20)	Name of the database
TABLE_OWNER	VARCHAR (20)	Name of the table owner
TABLE_NAME	VARCHAR(255)	Name of the table
COLUMN_NAME	VARCHAR(255)	Column name of the table
ATTRIB_TYPE	CHAR(10)	"Default" if a default value assigned to the column "Collate" if the column uses a collating sequence "L" if the column has a logical positioning Null or blank for all other types of attributes
ATTRIB_SIZE	USMALLINT	Size of the column attribute
ATTRIB_VALUE	LONGVARCHAR	Value of the column attribute

Examples

```
create table tx (c_binary binary (10) default 01,
    c_char char (11) default 'thisisatest',
    c_tinyint TINYINT,
    c_SMALLINT SMALLINT,
    c_int INT,
    c_bigint BIGINT,
    c_utinyint uTINYINT);
call psp_column_attributes(, , );
```

Result Set

Table_ qualifier	Table_ owner	Table_ name	Column_ name	Attrib_ Type	Attrib_ Size	Attrib_ Value
'demodata'	Null	tx	C_binary	Default	2	01
'demodata'	Null	tx	C_char	Default	11	'Thisisatest'

============

```
create table tlogicalmv (col1 integer, col2 char(20))
alter table tlogicalmv psql_move col1 to 2
call psp_column_attributes(, 'tlogicalmv' , )
```

Result Set

Table_ qualifier	Table_ owner	Table_ name	Column_ name	Attrib_ Type	Attrib_ Size	Attrib_ Value
'demodata'	Null	tlogicalmv	col2	L	1	1
'demodata'	Null	tlogicalmv	col1	L	1	2

============

```
call psp_column_attributes(, 'tx', 'c_binary')
```

Result Set

Table_ qualifier	Table_ owner	Table_ name	Column_ name	Attrib_ Type	Attrib_ Size	Attrib_ Value
'demodata'	Null	tx	C_binary	Default	2	01

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
database_qualifier is an undefined database	Unable to open table: X$File
table_name is undefined in the database	No error is returned and no results are returned
table_name is null	Table name cannot be null
table_name is a blank string	Table name cannot be a blank string
column_name is a blank string	Column name cannot be a blank string
column_name is undefined in the table	No error is returned and no results are returned

psp_column_rights

Returns the list of column rights and corresponding information for the specified table, from the current database or the specified database.

Note: This system stored procedure returns the list of column rights only if it has been explicitly specified using the GRANT syntax.

Syntax

```
call psp_column_rights(['database_qualifier'], 'table_name', ['column_name'], ['user_name'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
table_name	VARCHAR(255)	(no default value)	Name of the table for which rights have been specified
column_name	VARCHAR(255)	All columns of the specified table	Name of the column whose rights are to be obtained
user_name	VARCHAR(255)	Current user	Name of the user for whom the list of column rights need to be obtained. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR (20)	Name of the database
TABLE_OWNER	VARCHAR (20)	Name of the owner of the table
USER_NAME (GRANTEE)	VARCHAR(255)	Name of the user
TABLE_NAME	VARCHAR(255)	Name of the table
COLUMN_NAME	VARCHAR(255)	Name of the column for which the different rights have been granted

RIGHTS	VARCHAR(12)	One of the following values:
		SELECT
		UPDATE
		INSERT

Example

After granting the following permissions on table Dept in the Demodata database, retrieve the column permissions:

```
GRANT SELECT(Name, Building_Name) ON Dept TO John;
```

```
GRANT UPDATE(Name) ON Dept TO Mary;
```

```
GRANT INSERT(Building_Name) ON Dept TO John;
```

```
Call psp_column_rights(,'Dept', ,'%');
```

Result Set

Table_Qualifier	Table_owner	User_name	Table_name	Column_name	Rights
Demodata	Null	John	Dept	Name	SELECT
Demodata	Null	John	Dept	Building_name	SELECT
Demodata	Null	John	Dept	Building_name	INSERT
Demodata	Null	Mary	Dept	Name	UPDATE

Note: User Master has no explicit column rights defined, so psp_column_rights returns no results for that user.

Assume that user John is logged on to the database. The following statement prints column permissions on table Dept table for user John.

```
call psp_column_rights ('demodata', 'Dept', ,)
```

Result Set

Table_Qualifier	Table_owner	User_name	Table_name	Column_name	Rights
Demodata	Null	John	Dept	Building_name	INSERT
Demodata	Null	John	Dept	Building_name	SELECT
Demodata	Null	John	Dept	Name	SELECT

Note: If a user has been granted rights at the table level (for example, GRANT SELECT ON Dept TO Mary), a call to psp_column_rights returns no rights. The rights were granted to the table, not to specific columns.

The following statement prints column permissions on table Dept for column Name for the current user.

```
call psp_column_rights ('demodata', 'dept', 'name',)
```

Result Set

Table_Qualifier	Table_owner	User_name	Table_name	Column_name	Rights
Demodata	Null	John	Dept	Name	SELECT

The following statement prints column permissions on table Dept for user Mary:

```
call psp_column_rights('demodata', 'dept', , 'Mary')
```

Result Set

Table_Qualifier	Table_owner	User_name	Table_name	Column_name	Rights
Demodata	Null	Mary	Dept	Name	UPDATE

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
table_name is null	Table name cannot be null.
table_name is a blank string	Table name cannot be a blank string.
column_name is a blank string	Column name cannot be a blank string.
user_name is a blank string	User name cannot be a blank string.

psp_fkeys

Returns the foreign key information for the specified table in the current database.

Syntax

```
call psp_fkeys(['table_qualifier'], 'pkey_table_name', ['fkey_table_name'])
```

Arguments

Parameter	Type	Default Value	Description
table_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
pkey_table_name	VARCHAR(255)	(no default value)	Name of the table whose foreign key is associated with the primary key column
fkey_table_name	VARCHAR(255)	(no default value)	Name of the table whose foreign key information needs to be obtained

Returned Result Set

Column Name	Data Type	Description
PKTABLE_QUALIFIER	VARCHAR (20)	Database name of the primary key table
PKTABLE_OWNER	VARCHAR (20)	Name of the owner of the primary key table

Column Name	Data Type	Description
PKTABLE_NAME	VARCHAR(255)	Name of the primary key table
PKCOLUMN_NAME	VARCHAR(255)	Column name of the primary key column.
KEY_SEQ	USMALLINT	Key sequence. This column value corresponds to Xi$Part in X$Index. See X$Index.
FKTABLE_QUALIFIER	VARCHAR (20)	Database name of the foreign key table
FKTABLE_OWNER	VARCHAR (20)	Name of the owner of the foreign key table
FKTABLE_NAME	VARCHAR(255)	Name of the foreign key table
FKCOLUMN_NAME	VARCHAR(255)	Column name of the foreign key column.
UPDATE_RULE	Utinyint	Update Rule
DELETE_RULE	Utinyint	Delete Rule
PK_NAME	VARCHAR(255)	Name of the primary key
FK_NAME	VARCHAR(255)	Name of the foreign key

Example

```
CREATE TABLE Employee
(
Id INTEGER NOT NULL,
Name VARCHAR(50) NOT NULL,
SupId INTEGER NOT NULL
);

ALTER TABLE Employee
    ADD CONSTRAINT EmpPkey
    PRIMARY KEY(Id);

ALTER TABLE Employee
    ADD CONSTRAINT ForgnKey
    FOREIGN KEY(SupId) REFERENCES
    Employee(Id) ON DELETE CASCADE;
```

```
call psp_fkeys(,'Employee',);
```

Result Set

PkQ	PkO	PkT	PkCol	Seq	FkQ	FkO	FkT	FkCol	UR	DR	PK	FK
Demo data	Null	Em-ployee	Id	0	Demo data	Null	Em-ployee	Supid	1	2	EmpP key	Forgn Key

Legend: **PkQ** = Pkey_table_qualifier; **PkO** = Pkey_table_owner; **PkT** = Pktable_name; **PkCol** = Pk_column_name; **Seq** = Key_seq; **FkQ** = Fktable_qualifier; **FkO** = Fktable_owner; **FkT** = Fktable_name; **FkCol** = Fkcolumn_name; **UR** = Update_rule; **DR** = Delete_rule; **Pk** = Pk_name; **FK** = Fk_name

Error Conditions

Condition	Error Message
table_qualifier is a blank string	Table name cannot be a blank string.
pKey_table_name is a blank string	Primary key table name cannot be a blank string.
pKey_table_name is null	No argument or default value supplied. Argument: 2.
fKey_table_name is a blank string	Foreign key table name cannot be a blank string.

psp_groups

Returns the list of groups and the corresponding information from the current database or the specified database.

Syntax

```
call psp_groups(['database_qualifier'], ['group_name'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
group_name	VARCHAR(255)	(no default value)	Name of the group used to return group information. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
DATABASE_QUALIFIER	VARCHAR (20)	Name of the database
GROUP_ID	USMALLINT	Group Id
GROUP_NAME	VARCHAR (255)	Name of the group

Example

Assume that the Demodata sample database has two groups defined: DevGrp1 and DevGrp2.

```
call psp_groups(,)
```

Result Set

Database_qualifier	Group_Id	Group_Name
Demodata	1	PUBLIC
Demodata	2	DevGrp1
Demodata	3	DevGrp2

============

```
call psp_groups('Demodata', 'D%')
```

Result Set

Database_qualifier	Group_Id	Group_Name
Demodata	2	DevGrp1
Demodata	3	DevGrp2

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
group_name is a blank string	Group name cannot be a blank string.

psp_help_sp

Returns the definition text of a given stored procedure from the current database or the specified database.

Syntax

```
call psp_help_sp('[database_qualifier'], 'procedure_name')
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
procedure_name	CHAR(255)	(no default value)	Name of the procedure whose definition text is required. Pattern matching is not supported.

Returned Result Set

Column Name	Data Type	Description
DATABASE_QUALIFIER	VARCHAR (20)	Name of the database
SP_TEXT	LONGVARCHAR	Stored procedure definition text

Example

Assume that the Demodata sample database contains the following stored procedure saved as "Myproc."

```
Create procedure Myproc(:a integer, OUT :b integer) as
Begin
    Set :a = :a + 10;
    Set :b = :a;
End
```

The following statement prints the definition text for stored procedure "Myproc" in the current database.

```
call psp_help_sp(, 'Myproc')
```

Result Set

Database_Qualifier	SP_TEXT
Demodata	`Create procedure Myproc(:a integer, OUT :b integer) as`
	`Begin`
	`Set :a = :a + 10;`
	`Set :b = :a;`
	`End`

=============

Assume that a database named "wsrde" contains the following stored procedure saved as "Myproc1."

```
Create procedure Myproc1(:a integer)  returns (name char(20))

as

Begin

    Select name from employee where Id =:a;

End
```

The following statement prints the definition text for stored procedure "Myproc1" in database "wsrde."

```
call psp_help_sp('wsrde', 'Myproc1')
```

Result Set

Database_Qualifier	SP_TEXT
wsrde	`Create procedure Myproc1(:a integer) returns (name char(20))`
	`as`
	`Begin`
	`Select name from employee where Id =:a;`
	`End`

Error Conditions

Condition	Error Message
database_qualifier is a blank string or null	Please enter a valid database name. Database name cannot be a blank string
procedure_name is null	No argument or default value supplied.
procedure_name is a blank string	Procedure name cannot be a blank string.

psp_help_trigger

Returns the definition text of a trigger from the current database or the specified database.

Syntax

```
call psp_help_trigger (['database_qualifier'], 'trigger_name')
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
trigger_name	VARCHAR(255)	(no default value)	Name of the trigger whose definition text is to be returned. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
DATABASE_QUALIFIER	VARCHAR (20)	Name of the database
TRIGGER_TEXT	LONGVARCHAR	Trigger definition text.

Example

The following statement prints the definition of the 'MyInsert' trigger:

```
CREATE TABLE A
(
col1 INTEGER,
col2 CHAR(255)
);
CREATE TABLE B
(
col1 INTEGER,
col2 CHAR(255)
);
CREATE TRIGGER MyInsert
AFTER INSERT ON A
    FOR EACH ROW
    INSERT INTO B VALUES
    (NEW.col1, NEW.col2);
call psp_help_trigger(,'MyIns%');
```

Result Set

Database_Qualifier	TRIGGER_TEXT

Demodata	`CREATE TRIGGER MyInsert`
	`   AFTER INSERT ON A`
	`   FOR EACH ROW`
	`       INSERT INTO B VALUES`
	`       (NEW.col1, NEW.col2);`

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string
trigger_name is null	No argument or default value supplied.
trigger_name is a blank string	Trigger name cannot be a blank string.

psp_help_udf

Returns the text of a given user-defined function (UDF) from the current database or the specified database.

Syntax

```
call psp_help_udf (['database_qualifier'], 'udf_name')
```

Arguments

Parameter	Type	Default Value	Description
Database_qual	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
udf_name	VARCHAR(255)	(no default value)	Name of the user-defined function whose function text is required. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
DATABASE_QUALIFIER	VARCHAR (20)	Name of the database
UDF_TEXT	LONGVARCHAR	The text of the User Defined Function

Example

```
call psp_help_udf(, 'Myfunction')
```

Result Set

Database_Qualifier	UDF_TEXT
Demodata	`Create function Myfunction(:a integer) Returns integer` `as` `Begin` `Return :a * :a;` `End`

============

```
call psp_help_udf('mydbase', 'Get%')
```

Result Set

Database_Qualifier	UDF_TEXT

wsrde	`CREATE FUNCTION GetSmallest(:A integer, :B Integer)`
	`RETURNS Integer`
	`AS`
	`BEGIN`
	`   DECLARE :smallest INTEGER`
	`   IF (:A < :B ) THEN`
	`      SET :smallest = :A;`
	`   ELSE`
	`      SET :smallest = :B;`
	`   END IF;`
	`   RETURN :smallest;`
	`END`

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string
udf_name is null	No argument or default value supplied.
udf_name is a blank string	User-defined function name cannot be a blank string.

psp_help_view

Returns the definition text of a view, from the current database or the specified database.

Syntax

```
call psp_help_view(['database_qualifier'], 'view_name')
```

Arguments

Parameter	Type	Default Value	Description
Database_qual	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained

Parameter	Type	Default Value	Description
view_name	VARCHAR(255)	(no default value)	Name of the view whose definition text is required. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
DATABASE_QUALIFIER	VARCHAR (20)	Name of the database
VIEW_TEXT	LONGVARCHAR	View definition text.

Example

Assume that the following view exists for the Demodata sample database:

```
CREATE VIEW vw_Person (lastn,firstn,phone) AS
SELECT Last_Name, First_Name, Phone
FROM Person;
```

The following statement returns the definition text for view "vw_Person" in the Demodata database.

```
call psp_help_view(,'vw_Person')
```

or

```
call psp_help_view(,'vw_%')
```

Result Set

Database_Qualifier	VIEW_TEXT
Demodata	`SELECT "T1" ."Last_Name" ,"T1" ."First_Name" ,"T1" ."Phone" FROM "Person" "T1"`

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
view_name is null	No argument or default value supplied.

Condition	Error Message
view_name is a blank string	View name cannot be a blank string.

psp_indexes

Returns the list of indexes defined for the specified table. For each index, it also lists the index properties as persisted in the X$Index table.

Syntax

```
call psp_indexes(['table_qualifier'], ['table_name'])
```

Arguments

Parameter	Type	Default Value	Description
table_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
table_name	VARCHAR(255)	(no default value)	Name of the table for whose indexes are to be obtained. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR (20)	Name of the database
TABLE_OWNER	VARCHAR (20)	Name of the owner of the primary key table
TABLE_NAME	VARCHAR(255)	Name of the primary key table
INDEX_NAME	VARCHAR(255)	Name of the index
INDEX_TYPE	VARCHAR (20)	Type of the Index: primary, foreign, or normal
COLUMN_NAME	VARCHAR(255)	Name of the column on which index is defined
ORDINAL_POSITION	USMALLINT	Ordinal position of the index
DUPLICATES_ALLOWED	CHAR(3)	Yes, if it is a duplicate index No, if it is not a duplicate index

Column Name	Data Type	Description
UPDATABLE	CHAR(3)	Yes, if the index is updatable No, if the index is not updatable
CASE_SENSITIVE	CHAR(3)	Yes, if the index is case-sensitive No, if the index is not case-sensitive
ASC_DESC	CHAR(1)	D, Descending A, Ascending
NAMED_INDEX	CHAR(3)	Yes, if it is a named index No, if it is not a named index

Example

```
call psp_indexes(,)
```

Result Set

Qual	TO	TN	IN	IT	CN	Opos	Dup	Up	Case	A/D	NI
Demo data	Null	Billing	Student_ Trans	Normal Index	Student_ ID	0	No	Yes	No	A	Yes
Demo data	Null	Billing	Student_ Trans	Normal Index	Transaction_ Number	1	No	Yes	No	A	Yes
Demo data	Null	Billing	Student_ Trans	Normal Index	Log	2	No	Yes	No	A	Yes
…..											
Legend: **Qual** = Table_qualifier; **TO** = Table_owner; **TN** = Table_name; **IN** = Index_name; **IT** = Index_type; **CN** = Column_name; **Opos** = Ordinal_position; **Dup** = Duplicates_allowed; **UP** = Updatable; **Case** = Case_sensitive; **A/D** = Asc_desc; **NI** = Named_index											

============

```
call psp_indexes('demodata', 'Dep%')
```

Result Set

Qual	TO	TN	IN	IT	CN	Opos	Dup	Up	Case	A/D	NI
Demo data	Null	Dept	Building_ Room	Normal Index	Building _Name	0	Yes	Yes	Yes	A	Yes

Qual	TO	TN	IN	IT	CN	Opos	Dup	Up	Case	A/D	NI
Demo data	Null	Dept	Building_ Room	Normal Index	Room_ Number	1	Yes	Yes	No	A	Yes
Demo data	Null	Dept	Dept_Head	Normal Index	Head_ Of_Dept	0	No	Yes	No	A	Yes
Demo data	Null	Dept	Dept_Name	Normal Index	Name	0	No	Yes	Yes	A	Yes

Legend: **Qual** = Table_qualifier; **TO** = Table_owner; **TN** = Table_name; **IN** = Index_name; **IT** = Index_type; **CN** = Column_name; **Opos** = Ordinal_position; **Dup** = Duplicates_allowed; **UP** = Updatable; **Case** = Case_sensitive; **A/D** = Asc_desc; **NI** = Named_index

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
table_name is a blank string	View name cannot be a blank string.

psp_pkeys

Returns the primary key information for the specified table, from the current database or the database specified.

Syntax

```
call psp_pkeys(['pkey_table_qualifier']'table_name')
```

Arguments

Parameter	Type	Default Value	Description
pkey_table_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
table_name	VARCHAR(255)	(no default value)	Name of the table whose primary key information is requested. Pattern matching is supported

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR (20)	Name of the database
TABLE_OWNER	VARCHAR (20)	Name of the owner of the primary key table
TABLE_NAME	VARCHAR(255)	Name of the primary key table
COLUMN_NAME	VARCHAR(255)	Name of the primary key column
COLUMN_SEQ	USMALLINT	Sequence of the columns (a segmented index)
PK_NAME	VARCHAR(255)	Name of the primary key

Example

The following statement returns the information about the primary key defined on the 'pkeytest1' table:

```
CREATE TABLE pkeytest1
(
col1 int NOT NULL,
col2 int NOT NULL,
col3 VARCHAR(20) NOT NULL,
PRIMARY KEY(col1, col2),
UNIQUE(col3)
);

call psp_pkeys(,'pkeytest1');
```

Result Set

Table_ qualifier	Table_ owner	Table_ name	Column_ name	Column_ Seq	PK_ name
'demodata'	Null	Pkeytest1	Col1	0	PK_col1
'demodata'	Null	Pkeytest1	Col2	1	PK_col1

Error Conditions

Condition	Error Message
pkey_table_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
table_name is null	No argument or default value supplied.
table_name is a blank string	Table name cannot be a blank string.

psp_procedure_rights

Returns the list of procedure rights and corresponding information for the specified stored procedure, from the current database or the specified database. The stored procedure can be a trusted or a non-trusted one. See Trusted and Non-Trusted Objects.

Syntax

```
call psp_procedure_rights(['database_qualifier'], ['procedure_name'], ['user_name'])
```

Arguments

Parameter	Type	Default Value	Description
database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
procedure_name	VARCHAR(255)	(no default value)	Name of the procedure for which rights are specified. Pattern matching is supported.
user_name	VARCHAR(255)	Current user	Name of the user for whom the list of procedure rights needs to be obtained. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
PROCEDURE_QUALIFIER	VARCHAR (20)	Name of the database
PROCEDURE_OWNER	VARCHAR (20)	Name of the owner of the procedure
USER_NAME (GRANTEE)	VARCHAR(255)	Name of the user

Column Name	Data Type	Description
PROCEDURE_NAME	VARCHAR(255)	Name of the procedure
RIGHTS	VARCHAR(12)	One of the following values: ALTER EXECUTE Note that RIGHTS pertains only to procedures in a database that uses V2 metadata.

Example

Assume that the following permissions exist for the Demodata sample database:

```
GRANT EXECUTE ON PROCEDURE Dept1_Proc TO John;
```

```
GRANT ALTER ON PROCEDURE Dept1_Proc TO Mary;
```

```
GRANT ALTER ON PROCEDURE Dept1_Proc TO John;
```

```
GRANT EXECUTE ON PROCEDURE Proc2 TO Mary;
```

```
GRANT ALTER ON PROCEDURE Proc2 TO Mary;
```

```
GRANT ALTER ON PROCEDURE MyProc TO Mary;
```

The following statement prints the permissions on the "Dept1_Proc" stored procedure for user "John."

```
call psp_procedure_rights(,'Dept1_Proc', 'John');
```

Result Set

Procedure_Qualifier	Procedure_owner	User_name	Procedure_name	Rights
Demodata	Null	John	Dept1_Proc	ALTER
Demodata	Null	John	Dept1_Proc	EXECUTE

The following statement prints the permissions on the "Proc2" stored procedure for user "Mary."

```
call psp_procedure_rights('demodata', '%Pr%', 'M%')
```

Result Set

Procedure_Qualifier	Procedure_owner	User_name	Procedure_name	Rights
Demodata	Null	Mary	MyProc	ALTER
Demodata	Null	Mary	Proc2	ALTER
Demodata	Null	Mary	Proc2	EXECUTE

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
procedure_name is a blank string	Procedure name cannot be a blank string.
user_name is a blank string	User name cannot be a blank string.
psp_procedure_rights called for a database with V1 metadata	View and Stored Procedure permissions are not supported for metadata version 1.

psp_rename

Changes the name of a COLUMN, INDEX, FUNCTION, PROCEDURE, TABLE, TRIGGER or VIEW in the database to which your machine is currently connected.

Syntax

```
call psp_rename('object_name','new_name','object_type')
```

Arguments

Parameter	Type	Description
object_name	VARCHAR(776)	The current name of the column, index, user-defined function, stored procedure, table, trigger or view. Object_name must be specified in a particular format depending on the type of object: • Column: table_name.column_name. • Index: table_name.index_name. • Function: function_name • Procedure: procedure_name • Table: table_name • Trigger: table_name.trigger_name • View: view_name
new_name	VARCHAR(776)	A user-defined name for the object. The name must conform to the naming conventions for the type of object. See Naming Conventions in *Zen Programmer's Guide*.
object_type	VARCHAR(13)	The type of object being renamed. Object_type must be one of the following: COLUMN, INDEX, FUNCTION, PROCEDURE, TABLE, TRIGGER or VIEW.

Example

The following statement renames stored procedure "checkstatus" to "eligibility" in the current database.

```
call psp_rename('checkstatus', 'eligibility', 'PROCEDURE')
```

Error Conditions

All errors returned from psp_rename use status code -5099. See -5099: Error condition pertaining to a stored procedure in *Status Codes and Messages*.

psp_stored_procedures

Returns the list of stored procedures and their corresponding information from the current database or the specified database.

Syntax

```
call psp_stored_procedures(['database_qualifier'], ['procedure_name'], ['procedure_type'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
procedure_name	VARCHAR(255)	(no default value)	Name of the stored procedure whose information is required. Pattern matching is supported.
procedure_type	VARCHAR(5)	(no default value)	**'SP'** returns the stored procedures **'SSP'** returns the system stored procedures (this type is currently not supported)

Note: System stored procedures are defined in the internal PERVASIVESYSDB database, which does not display in Zen Control Center.

Returned Result Set

Column Name	Data Type	Description
PROCEDURE_QUALIFIER	VARCHAR (20)	Name of the database
PROCEDURE _OWNER	VARCHAR (20)	Name of the owner of the procedure
PROCEDURE _NAME	VARCHAR(255)	Name of the procedure
PROCEDURE_TYPE	VARCHAR(25)	Type of procedure. The types are STORED PROCEDURE or SYSTEM STORED PROCEDURE.
NUM_INPUT_PARAMS	INT	Returns null, because SQLPROCEDURES returns null when executed against Zen DSN
NUM_OUTPUT_PARAMS	INT	Returns null, because SQLPROCEDURES returns null when executed against Zen DSN
NUM_RESULT_SETS	INT	Returns null, since SQLPROCEDURES returns null when executed against Zen DSN
REMARKS	VARCHAR(255)	Remarks

Column Name	Data Type	Description
TRUSTEE	INTEGER	For V2 metadata, returns 0 for a trusted stored procedure and -1 for a nontrusted stored procedure. The TRUSTEE column is empty for V1 metadata.

Example

Assume that the current database mydbase contains two stored procedures: myproc1 and myproc2. The following statement lists the information about them.

```
Call psp_stored_procedures(, ,)
```

Result Set

Qualifier[1]	Owner[1]	Name[1]	Type[1]	Num_ input _params	Num_ output_ params	Num_ result_ sets	Remarks	Trustee
mydbase	Null	Myproc1	Stored Procedure	Null	Null	Null	Null	
mydbase	Null	Myproc2	Stored Procedure	Null	Null	Null	Null	

[1]The complete column name includes "procedure_" prepended to this name: Procedure_qualifier, procedure_owner, and so forth.

============

The following statement lists the information about the stored procedures in the PERVASIVESYSDB internal database.

```
call psp_stored_procedures('PERVASIVESYSDB', 'psp_u%', 'SP')
```

Result Set

Qualifier	Owner	Name	Type	Num_ input_ params	Num_ output_ params	Num_ result_ sets	Remarks	Trustee
pervasivesystdb	Null	psp_udfs	Stored Procedure	Null	Null	Null	Null	
pervasivesystdb	Null	psp_users	Stored Procedure	Null	Null	Null	Null	

Qualifier	Owner	Name	Type	Num_ input_ params	Num_ output_ params	Num_ result_ sets	Remarks	Trustee
Note: For qualifier, owner, name, and type, the complete column name includes "procedure_" prepended to this name: Procedure_qualifier, procedure_owner, and so forth.								

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string
table_name is a blank string	Table name cannot be a blank string.
procedure_type is a blank string	Procedure type cannot be a blank string.
procedure_type is a value other than SP, SSP, or null	Procedure type can be SP, SSP, or null.

psp_tables

Returns a list of tables along with their corresponding information, from the current database or the specified database.

Syntax

```
call psp_tables(['database_qualifier'], ['table_name'], ['table_type'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
table_name	VARCHAR(255)	(no default value)	Name of the table whose information needs to be obtained. Pattern matching is supported.

Parameter	Type	Default Value	Description
table_type	VARCHAR(20)	(no default value)	Must be one of the following: 'User table' returns only the user tables 'System table' returns all the system tables NULL returns all tables

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR (20)	Name of the database
TABLE_OWNER	VARCHAR (20)	Name of the table owner
TABLE_NAME	VARCHAR(255)	Name of the table
TABLE_TYPE	VARCHAR (15)	**System table -** if the table is a system table **User table -** if the table has been created by any user
REMARKS	VARCHAR(255)	Remarks
FILE_LOCATION	VARCHAR(255)	Location where the file is saved

Example

```
call psp_tables(,,)
```

Result Set

Table_ Qualifier	Table_ owner	Table_ name	Table_ Type	Remarks	File_ location
Demodata	Null	X$file	System table	Null	File.ddf
Demodata	Null	X$field	System table	Null	Field.ddf
Demodata	Null	X$Attrib	System table	Null	Attrib.ddf
Demodata	Null	Billing	User table	Null	Billing.mkd
…..					

=============

```
call psp_tables(, , 'user table')
```

Result Set

Table_ Qualifier	Table_ owner	Table_ name	Table_ Type	Remarks	File_ location
Demodata	Null	Class	User table	Null	class.mkd
Demodata	Null	Billing	User table	Null	Billing.mkd
.....					

=============

```
call psp_tables(, , 'system table')
```

Result Set

Table_ Qualifier	Table_ owner	Table_ name	Table_ Type	Remarks	File_ location
Demodata	Null	X$file	System table	Null	File.ddf
Demodata	Null	X$field	System table	Null	Field.ddf
Demodata	Null	X$Attrib	System table	Null	Attrib.ddf
.....					

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
table_name is a blank string	Table name cannot be a blank string.
table_type is a blank string	Table type cannot be a blank string.
table_type is something other than 'system table,' 'user table,' or null	Table type can be system table, user table or null.

psp_table_rights

Returns the list of table rights and corresponding information for the specified table, from the current database or the specified database.

Syntax

```
call psp_table_rights(['database_qualifier'], ['table_name'], ['user_name'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
table_name	VARCHAR(255)	All tables	Name of the table for which rights have are specified. Pattern matching is supported.
user_name	VARCHAR(255)	Current user	Name of the user for whom the list of table rights needs to be obtained. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR (20)	Name of the database
TABLE_OWNER	VARCHAR (20)	Name of the owner of the table
USER_NAME (GRANTEE)	VARCHAR(255)	Name of the user
TABLE_NAME	VARCHAR(255)	Name of the table

RIGHTS	VARCHAR(12)	One of the following values:
		SELECT
		ALTER
		DELETE
		INSERT
		REFERENCES
		SELECT
		UPDATE

Example

Assume that the following permissions exist for the Demodata sample database.

```
GRANT SELECT ON Dept TO John;
```

```
GRANT ALTER ON Dept TO John;
```

```
GRANT DELETE ON Dept TO John;
```

```
GRANT SELECT ON Class TO Mary;
```

```
GRANT ALTER ON Class TO Mary;
```

The following statement prints the table permissions on the "Dept" table for user "John" in the current database (Demodata).

```
call psp_table_rights(,'Dept', 'John');
```

Result Set

Table_Qualifier	Table_owner	User_name	Table_name	Rights
Demodata	Null	John	Dept	ALTER
Demodata	Null	John	Dept	DELETE
Demodata	Null	John	Dept	SELECT

============

Assume that user "Mary" is logged on the database. The following statement prints the table permissions on the "Class" table in the Demodata database for the current user (Mary).

```
call psp_table_rights('demodata', 'cl%', )
```

Result Set

Table_Qualifier	Table_owner	User_name	Table_name	Rights
Demodata	Null	Mary	Class	SELECT
Demodata	Null	Mary	Class	ALTER

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
table_name is a blank string	Table name cannot be a blank string.
user_name is a blank string	User name cannot be a blank string.

psp_triggers

Returns the list of triggers and their corresponding information from the current database or the specified database.

Syntax

```
call psp_triggers(['database_qualifier'], ['table_name'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
table_name	VARCHAR(255)	All tables	Name of the table for which the trigger is defined. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
TRIGGER_QUALIFIER	VARCHAR (20)	Name of the database
TRIGGER_OWNER	VARCHAR (20)	Name of the owner of the Trigger
TABLE_NAME	VARCHAR(255)	Name of the table for which the trigger is defined.
TRIGGER_NAME	VARCHAR(255)	Name of the trigger
ISUPDATE	UTINYINT	Is set if it is an update trigger
ISDELETE	UTINYINT	Is set if it is an delete trigger

Column Name	Data Type	Description
ISINSERT	UTINYINT	Is set if it an insert trigger
ISAFTER	UTINYINT	Is set if the trigger action time is "after"
ISBEFORE	UTINYINT	Is set if the trigger action time is "before"
REMARKS	VARCHAR(255)	Remarks

Example

Assume that the current database is mydbase. The following statement returns the list of triggers defined in the database:

```
CREATE TABLE A
(
   col1 INTEGER,
   col2 CHAR(255)
) ;

CREATE TABLE B
(
   col1 INTEGER,
   col2 CHAR(255)
) ;

CREATE TRIGGER Insert
AFTER INSERT ON A
   FOR EACH ROW
   INSERT INTO B VALUES
   (NEW.col1, NEW.col2);

call psp_triggers(,);
```

Result Set

Trigger_ qualifier	Trigger_ owner	Table_ name	Trigger_ name	isupdate	isdelete	isinsert	isafter	isbefore	Remarks
mydbase	Null	A	Insert	0	0	1	0	0	Null

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
table_name is a blank string	Table name cannot be a blank string.

psp_udfs

Returns the list of user-defined functions (UDF) and their corresponding information from the current database or the specified database.

Syntax

```
call psp_udfs(['database_qualifier'], ['udf_name'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
udf_name	VARCHAR(255)	All user-defined functions	Name of the udf whose details are needed. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
UDF_QUALIFIER	VARCHAR (20)	Name of the database
UDF_OWNER	VARCHAR (20)	Name of the owner of the UDF
UDF _NAME	VARCHAR(255)	Name of the UDF

Column Name	Data Type	Description
UDF_TYPE	VARCHAR(25)	Type of UDF (always set to 1) Special UDF types are not currently supported.
NUM_INPUT_PARAMS	INT	Returns null, because SQLPROCEDURES returns null when executed against Zen DSN.
NUM_OUTPUT_PARAMS	INT	Returns 1, because UDFs return only scalar values
NUM_RESULT_SETS	INT	Returns 0, because UDFs do not return resultsets
REMARKS	VARCHAR(255)	Remarks

Example

Assume that the current database mydbase has two user-defined functions: calcinterest and factorial.

```
call psp_udfs(, )
```

Result Set

UDF_ qualifier	UDF_ owner	UDF_ name	Udf_ type	Num_ input_ params	Num_ output_ params	Num_ result_ sets	Remarks
mydbase	Null	CalcInterest	1	Null	1	0	Null
mydbase	Null	Factorial	1	Null	1	0	Null

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
udf_name is a blank string	User-defined function name cannot be a blank string.

psp_users

Returns the list of users and the corresponding information from the current database or the specified database.

Syntax

```
call psp_users(['database_qualifier'], ['group_name'], ['user_name'])
```

Arguments

Parameter	Type	Default Value	Description
database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
group_name	VARCHAR(255)	All groups (if group_name is null)	Name of the group used to return the user information. Pattern matching is supported. If group name is specified (i.e. if it is not NULL), only users belonging to the same group will be returned.
user_name	VARCHAR(255)	All users (if user_name is null)	Name of the user. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
DATABASE_QUALIFIER	VARCHAR(20)	Name of the database
GROUP_ID	USMALLINT	Group ID of the group to which user belongs
GROUP_NAME	VARCHAR(255)	Name of the group to which user belongs
USER_ID	USMALLINT	ID of the user
USER_NAME	VARCHAR(255)	Name of the user

Example

Assume that current database mydbase has users John, Mary, and Michael, and groups DevGrp and DevGrp1.

```
call psp_users(, ,  )
```

Result Set

Database_qualifier	Group_Id	Group_Name	User_Id	User_Name
Demodata	1	DevGrp	3	John
Demodata	2	DevGrp1	1	Mary
Demodata	1	DevGrp	4	Michael

============

```
call psp_users(, 'Devgrp', )
```

Result Set

Database_qualifier	Group_Id	Group_Name	User_Id	User_Name
Demodata	1	DevGrp	3	John
Demodata	2	DevGrp	4	Michael

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string.
user_name is null	User name cannot be a null.
group_name is a blank string	Group name cannot be a blank string.

psp_view_rights

Returns the list of list of view rights and corresponding information for the specified view, from the current database or the specified database. The view can be a trusted or a non-trusted one. See Trusted and Non-Trusted Objects.

Psp_view_rights applies only to a database using V2 metadata.

Syntax

```
call psp_view_rights(['database_qualifier'], ['view_name'], ['user_name'])
```

Arguments

Parameter	Type	Default Value	Description
database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
view_name	VARCHAR(255)	All views (if view_name is null)	Name of the view for which rights are specified. Pattern matching is supported.
user_name	VARCHAR(255)	Current user (if user_name is null)	Name of the user for whom the list of view rights needs to be obtained. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
VIEW_QUALIFIER	VARCHAR (20)	Name of the database
VIEW_OWNER	VARCHAR (20)	Name of the owner of the view
USER_NAME (GRANTEE)	VARCHAR(255)	Name of the user
VIEW_NAME	VARCHAR(255)	Name of the view

RIGHTS	VARCHAR(12)	One of the following values:
		ALTER
		DELETE
		INSERT
		SELECT
		UPDATE

Example

Assume that the following permissions exist for the Demodata sample database:

```
GRANT SELECT ON VIEW vw_Dept TO John;
```

```
GRANT ALTER ON VIEW vw_Dept TO John;
```

```
GRANT DELETE ON VIEW vw_Dept TO John;
```

```
GRANT SELECT ON VIEW vw_Class TO Mary;
```

```
GRANT ALTER ON VIEW vw_Class TO Mary;
```

```
GRANT SELECT ON VIEW vw_Class TO Prakesh;
```

The following statement prints the view permissions on the "vw_Dept" view for user "John."

```
call psp_view_rights(,'vw_Dept', 'John');
```

Result Set

View_Qualifier	View_owner	User_name	View_name	Rights
Demodata	Null	John	vw_Dept	ALTER
Demodata	Null	John	vw_Dept	DELETE
Demodata	Null	John	vw_Dept	SELECT

============

Assume that user "Mary" is logged on the database. The following statement prints the view permissions on all views in the sample database Demodata for the current user (Mary).

```
call psp_view_rights('demodata', , )
```

Result Set

View_Qualifier	View_owner	User_name	View_name	Rights
Demodata	Null	Mary	vw_Class	ALTER
Demodata	Null	Mary	vw_Class	SELECT

============

The following statement prints the view permissions on the "vw_Class" view for user "Mary."

```
call psp_view_rights('demodata', 'vw_C%', 'Mary')
```

Result Set

View_Qualifier	View_owner	User_name	View_name	Rights
Demodata	Null	Mary	vw_Class	ALTER
Demodata	Null	Mary	vw_Class	SELECT

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string
view_name is a blank string	View name cannot be a blank string.
user_name is a blank string	User name cannot be a blank string.
psp_procedure_rights called for a database with V1 metadata	View and stored procedure permissions are not supported for V1 metadata.

psp_views

Returns the list of views along with their corresponding information, from the current database or from the database specified.

Syntax

```
call psp_views(['database_qualifier'], ['view_name'])
```

Arguments

Parameter	Type	Default Value	Description
Database_qualifier	VARCHAR(20)	Current database	Name of the database from which the details are to be obtained
view_name	VARCHAR(255)	(no default value)	Name of the view whose information is required. Pattern matching is supported.

Returned Result Set

Column Name	Data Type	Description
VIEW_QUALIFIER	VARCHAR (20)	Name of the database
VIEW_OWNER	VARCHAR (20)	Name of the owner of the view
VIEW_NAME	VARCHAR(255)	Name of the view
REMARKS	VARCHAR(255)	Remarks

Column Name	Data Type	Description
TRUSTEE	INTEGER	For V2 metadata, returns 0 for a trusted view and -1 for a non-trusted view. The TRUSTEE column is empty for V1 metadata.

Example

Assume that the following view exists for a V2 metadata database named Demodata2.

```
CREATE VIEW vw_Person (lastn,firstn,phone) WITH EXECUTE AS 'Master' AS
```

```
SELECT Last_Name, First_Name,Phone FROM Person;
```

The following statement prints the list of views in the current database, which is Demodata2.

```
call psp_views(, ,);
```

Result Set

View_Qualifier	View_Owner	View_Name	Remarks	Trustee
Demodata	Null	Vw_Person	Null	0

============

The following statement prints the view information for the "vw_Person" view in the Demodata database.

```
call psp_views('demodata', 'vw_P%')
```

Result Set

View_Qualifier	View_Owner	View_Name	Remarks	Trustee
Demodata	Null	Vw_Person	Null	

Error Conditions

Condition	Error Message
database_qualifier is a blank string	Please enter a valid database name. Database name cannot be a blank string
view_name is a blank string	Table name cannot be a blank string.

Performance Reference

The Zen database engine uses a number of optimizations. The following topics discuss how to take advantage of these in SQL statements. This technical material is meant for expert SQL users. For definitions of the terms used, see Terminology.

Restriction Analysis

This topic explains one method that the database engine uses to analyze and optimize on a Restriction. For definitions of the technical terms used, see Terminology.

Modified CNF Conversion

During SQL statement execution, the database engine attempts to convert the restriction into Modified Conjunctive Normal Form (Modified CNF). Conversion to modified CNF is a method for placing Boolean expressions in a uniform structure to facilitate restriction analysis for possible query processing optimizations. If the restriction can be converted to modified CNF, the database engine can methodically and thoroughly analyze the query for possible optimizations that make efficient use of available Indexes. If the database engine is unable to convert the restriction to modified CNF, it still analyzes the restriction for possible optimizations. In this case, however, the database engine is often unable to make use of the available indexes as effectively as it would for restrictions that either are already in modified CNF or can be converted internally to modified CNF.

Restrictions that Cannot be Converted

The database engine is unable to convert some restrictions into modified CNF depending on the contents of the restriction. A restriction is not converted to modified CNF if any of the following conditions is true:

- The restriction contains a subquery.
- The restriction contains a NOT operator.
- The restriction contains a dynamic parameter (a dynamic parameter is a question mark ("?") in the SQL statement, which will be prompted for when the statement is executed).

Conditions Under Which Conversion is Avoided

There are some cases in which the database engine may be capable of converting a restriction into modified CNF but will not do so. The database engine chooses not to convert a restriction to modified CNF in cases where it has determined that the restriction is more likely to benefit from optimizations that can be applied to its original form than from optimizations that could be applied after modified CNF conversion.

A restriction is not converted to modified CNF if either of the following conditions is true:

- The restriction is in Disjunctive Normal Form (DNF) and all Predicates involve only the equal (=), LIKE or IN comparison operators.

  For example, the database engine does not convert the following restriction to modified CNF:

```
(c1 = 1 AND c2 = 1) OR (c1 = 1 AND c2 = 2) OR (c1 = 2)
```

- The restriction meets all of the following conditions:
  - It contains an expression in Disjunctive Normal Form (DNF) that is AND connected to the rest of the restriction.
  - The specified DNF expression contains only Predicates that involve the equal (=), LIKE or IN comparison operator.
  - The predicates in identical positions in each Conjunct in the DNF expression reference the same column.

  For example, a Restriction that contains the following Expression will not be converted to modified CNF:

```
(c1 = 1 AND c2 = 1) OR (c1 = 1 AND c2 = 2)
```

Restriction Optimization

This section provides a detailed description of the primary techniques employed by the database engine to make use of expressions in a restriction for optimization purposes. The types of optimizations performed by the database engine are described below in order from the simplest to the most complex.

A clear understanding of optimization techniques used by the database engine may aid you in structuring queries to achieve optimal performance from the database engine. In addition, by understanding how the database engine uses indexes to optimize queries, you can determine how to construct indexes that provide the best performance for a given set of typical uses.

For the sake of simplicity, the descriptions below initially address expressions that reference columns from only a single table. Optimizations making use of join conditions, in which predicates compare columns from two different tables, are described following the single table optimizations.

For definitions of the technical terms used, see Terminology.

Single Predicate Optimization

The simplest form of Restriction optimization involves the use of a single Predicate. A predicate can be used for optimization if it meets all of the following conditions:

- The predicate is joined to the rest of the restriction by the AND operator.
- One operand of the predicate consists of a column reference which is a leading segment of an index and the other operand consists of an expression that does not contain a column reference (that is, the other operand contains only a literal value or dynamic parameter).
- The comparison operator is one of: <, <=, =, >=, >, LIKE, or IN.

For example, suppose an index exists with the first segment on column c1. The following predicates can be used for optimization:

```
c1 = 1
c1 IN (1,2)
c1 > 1
```

The LIKE operator is optimized only if the second operand starts with a character other than a wildcard. For example, C2 LIKE 'ABC%' can be optimized, but C2 LIKE '%ABC' will not be.

Closed Range Optimization

A Closed Range can be used for optimization if it satisfies all the requirements for Single Predicate Optimization.

For example, suppose an index exists with the first segment on column c1. The following closed range can be used for optimization:

```
c1 >= 1 AND c1 < 10
```

Modified Disjunct Optimization

A Modified Disjunct can be used for optimization if it satisfies all of the following conditions:

- It is joined to the rest of the Restriction by the AND operator.
- Each Predicate and Closed Range in the disjunct satisfies the requirements for Single Predicate Optimization and Closed Range Optimization.
- Each predicate or closed range references the same column as the others.

For example, suppose an index exists with the first segment on column c1. The following modified disjunct can be used for optimization:

```
c1 = 1 OR (c1 > 5 AND c1 < 10) OR c1 > 20
```

The following modified disjunct cannot be used for this type of optimization because the same column is not referenced in all predicates and closed ranges:

```
c1 = 1 OR (c1 > 5 AND c1 < 10) OR c2 = 1
```

Conjunct Optimization

A Conjunct can be used for optimization if it satisfies all of the following conditions:

- It is joined to the rest of the restriction by the AND operator.
- Each Predicate in the conjunct satisfies the requirements for Single Predicate Optimization.
- Each predicate optimizes on the leading segments of an index with only one predicate for each leading segment (that is, there are not two different predicates that use the same set of leading segments).
- All predicates, except for the predicate referencing the last segment used for optimization, use the equal (=) comparison operator.

For example, suppose an index exists with the first three segments on columns c1, c2 and c3, in that order. The following conjunct assignments can be used for optimization:

```
c1 = 1 AND c2 = 1 AND c3 = 1
c1 = 1 AND c2 = 1 AND c3 >= 1
c1 = 1 AND c2 > 1
```

The order of the predicates does not matter. For example, the following conjunct can be used for optimization:

```
c2 = 1 AND c3 = 1 AND c1 = 1
```

The following conjunct cannot be used for optimization because the second segment of the index is skipped (there is no reference to column c2):

```
c1 = 1 AND c3 = 1
```

In this case, the single predicate, `c1 = 1`, can still be used for optimization.

Disjunctive Normal Form Optimization

An expression in Disjunctive Normal Form (DNF) can be used for optimization if it satisfies all of the following conditions:

- It is joined to the rest of the restriction by the AND operator.
- Each conjunct in the expression satisfies the requirements for Conjunct Optimization with the additional limitation that all the predicates must contain the equal (=) comparison operator.
- All the conjuncts must use the same index and the same number of segments for optimization.

The database engine does not convert restrictions that are originally in DNF into modified CNF, because it can optimize on DNF.

For example, suppose an index exists with the first three segments on columns c1, c2 and c3, in that order. The following expression in DNF can be used for optimization:

```
(c1 = 1 AND c2 = 1 AND c3 = 1) OR (c1 = 1 AND c2 = 1 AND c3 = 2) OR (c1 = 2 AND c2 = 2 AND c3 = 2)
```

The following expression in DNF cannot be used for optimization because both conjuncts do not reference the same number of segments:

```
(c1 = 1 AND c2 = 1 AND c3 = 1) OR (c1 = 1 AND c2 = 2)
```

Modified Conjunctive Normal Form Optimization

An expression in Modified Conjunctive Normal Form (Modified CNF) can be used for optimization if it satisfies all of the following conditions:

- It is joined to the rest of the restriction by the AND operator.

- Each Modified Disjunct satisfies the requirements for Modified Disjunct Optimization except that each modified disjunct must reference a different index segment which together make up the Leading Segments (that is, taking all the disjuncts together, no segments can be skipped).
- All the modified disjuncts except for the one that references the last segment must contain at least one predicate that contains the equals (=) comparison operator.

Modified CNF optimization is similar to DNF optimization but allows combinations of predicates involving different comparison operations not supported by DNF optimization.

For example, suppose an index exists with the first three segments on columns c1, c2 and c3, in that order. The following expression in modified CNF can be used for optimization:

```
(c1 = 1 OR c1 = 2) AND (c2 = 1 OR (c2 > 2 AND c2 < 5)) AND (c3 > 1)
```

It may be easier to understand how the database engine uses this expression for optimization by looking at the equivalent expression in modified DNF:

```
(c1 = 1 AND c2 = 1 AND c3 > 1) OR (c1 = 1 AND (c2 > 2 AND c2 < 5) AND c3 > 1) OR (c1 = 2 AND c2 = 1
AND c3 > 1) OR (c1 = 2 AND (c2 > 2 AND c2 < 5) AND c3 > 1)
```

Closing Open-Ended Ranges through Modified CNF Optimization

Two Modified Disjuncts can be combined to form one or more Closed Ranges if the following conditions are satisfied:

- Both modified disjuncts satisfy the requirements for Modified Disjunct Optimization.
- Both modified disjuncts use the same segment in the same index.
- Both modified disjuncts contain open-ended ranges that can be combined to form one or more closed ranges.

For example, suppose an index exists with the first segment on column c1. The following expression in modified CNF can be used for optimization:

```
(c1 = 1 OR c1 > 2) AND (c1 < 5 OR c1 = 10)
```

It may be easier to understand how the database engine uses this expression for optimization by looking at an equivalent expression which is simply a modified disjunct:

```
c1 = 1 OR (c1 > 2 AND c1 < 5) OR c1 = 10
```

Single Join Condition Optimization

The simplest form of optimization involving two tables makes use of a single Join Condition. Single join condition optimization is similar to Single Predicate Optimization. A join condition can be used for optimization if it satisfies the requirements for single predicate optimization. The table that will be optimized through the use of the join condition will be processed after the other table referenced in the join condition. The table optimized through the use of the join condition uses an optimization value retrieved from a row in the other table referenced in the join condition.

For example, suppose an index exists on table t1 with the first segment on column c1. The following join conditions can be used for optimization:

```
t1.c1 = t2.c2
```

```
t1.c1 > t2.c2
```

During optimization, a row is retrieved from table t2. From this row, the value of column c2 is used to optimize on table t1 according to the join condition.

If, instead of an index on t1.c1, there is an index on t2.c2, then `t1.c1=t2.c2` could be used to optimize on table t2. In this case, table t1 would be processed first and the value for t1.c1 would be used to optimize on table t2 according to the join condition.

In the case that there is an index on t1.c1 as well as an index on t2.c2, the database engine query optimizer examines the size of both tables as well as the characteristics of the two indexes and chooses the table to optimize that will provide the best overall query performance.

Conjunct with Join Conditions Optimization

A Conjunct that consists of a mixture of join conditions and other Predicates can be used for optimization if it satisfies all of the following conditions:

- All the join conditions compare columns from the same two tables.
- The conjunct satisfies the requirements for regular Conjunct Optimization for one of the two tables.

The table that will be optimized through the use of the conjunct will be processed after the other table referenced.

For example, suppose an index exists on table t1 with the first three segments on columns c1, c2 and c3, in that order. The following conjuncts can be used for optimization:

```
t1.c1 = t2.c1 AND t1.c2 = t2.c2 AND t1.c3 = t2.c3
```

```
t1.c1 = t2.c1 AND t1.c2 > t2.c2
```

```
t1.c1 = t2.c1 AND t1.c2 = 1
```

```
t1.c1 = 1 AND t1.c2 = t2.c2
```

Modified Conjunctive Normal Form with Join Conditions Optimization

An Expression in Modified Conjunctive Normal Form (Modified CNF) that contains join conditions can be used for optimization if it satisfies all the following conditions:

- It satisfies the conditions for Modified Conjunctive Normal Form Optimization.
- In addition, all disjuncts but the disjunct optimizing on the last portion of the leading segment being used must contain only a single join condition or a single predicate and at least one of these is a single join condition.

For example, suppose an index exists on table t1 with the first three segments on columns c1, c2 and c3, in that order. The following expressions in modified CNF can be used for optimization:

```
(t1.c1 = t2.c1) AND (t1.c2 = t2.c2 OR
(t1.c2 > 2 AND t1.c2 < 5))

(t1.c1 = 1) AND (t1.c2 = t2.c2) AND
(t1.c3 > 2 AND t1.c3 < 5)
```

Closing Join Condition Open-Ended Ranges through Modified CNF Optimization

This type of optimization is exactly like Closing Open-Ended Ranges through Modified CNF Optimization except that the range being closed may be a Join Condition.

For example, suppose an index exists on table t1 with the first two segments on columns c1 and c2, in that order. The following expressions in modified CNF can be used for optimization:

```
(t1.c1 > t2.c1) AND (t1.c1 < t2.c2 OR t1.c1 = 10)

(t1.c1 = t2.c1) AND (t1.c2 > t2.c2) AND (t1.c2 < 10 OR t1.c2 = 100)
```

Multi-Index Modified Disjunct Optimization

A Modified Disjunct can be used for optimization through the use of more than one index if it satisfies all of the following conditions:

- Is joined to the rest of the restriction by the AND operator.
- Each Predicate and Closed Range in the disjunct satisfies the requirements for Single Predicate Optimization or Closed Range Optimization, respectively.

- Each predicate or closed range references a column that is the first segment in an index. If all predicates and closed ranges reference the same column, then this scenario is simply Modified Disjunct Optimization, as described previously.

For example, suppose an index exists with the first segment on column c1 and another index exists with the first segment on column c2. The following modified disjunct can be used for optimization:

```
c1 = 1 OR (c1 > 5 AND c1 < 10) OR c2 = 1
```

Push-Down Filters

Push-down filters are strictly an internal optimization technique. By taking advantage of high speed filtering capabilities, the database engine can efficiently identify certain rows to be rejected from the result set depending on characteristics of the restriction. Because rows are rejected from the result set before they are returned, the database engine has to analyze fewer rows and completes the operation faster than it would without push-down filters.

The database engine can use an expression or combination of expressions as a push-down filter if the following conditions are satisfied:

- A Predicate can be used in a push-down filter if it is joined to the rest of the Restriction by the AND operator.
- A Predicate can be used in a push-down filter if one operand consists of a column reference and the other operand consists of either a literal value or a dynamic parameter ("?"). Also, the referenced column must not be of one of the following data types: bit, float, double, real, longvarchar, longvarbinary, or binary.
- A Predicate can be used in a push-down filter if the comparison operator is one of the following: <, <=, =, >=, >, or <>.
- A Disjunct can be used in a push-down filter if it is joined to the rest of the restriction by the AND operator and all the predicates within the disjunct satisfy the requirements for a predicate to be used in a push-down filter, except for the condition that the predicate must be joined to the rest of the restriction by an AND operator. Only one disjunct may be included in the push-down filter.
- A push-down filter may combine a single disjunct with other predicates that satisfy the requirements for a predicate to be used in a push-down filter.

For definitions of the technical terms used, see Terminology.

Efficient Use of Indexes

Indexes can optimize on query characteristics other than the Restriction, such as a DISTINCT or ORDER BY clause.

For definitions of the technical terms used, see Terminology.

DISTINCT in Aggregate Functions

An index can be used to reduce the number of rows retrieved for queries with a selection list that consists of an Aggregate Function containing the DISTINCT keyword. To be eligible for this type of optimization, the expression on which the DISTINCT keyword operates must consist of a single column reference. Furthermore, the column must be the leading segment of an index.

For example, suppose an index exists on table t1 with the first segment on column c1. The index can be used to avoid retrieving rows with duplicate values of column c1:

```
SELECT COUNT(DISTINCT c1) FROM t1 WHERE c2 = 1
```

DISTINCT Preceding Selection List

An index can be used to reduce the number of rows retrieved for some queries with the DISTINCT keyword preceding the selection list. To be eligible for this type of optimization, the selection list must consist only of column references (no complex expressions such as arithmetic expressions or scalar functions), and the referenced columns must be the leading segments of a single index.

For example, suppose an index exists on table t1 with the first three segments on columns c1, c2 and c3, in any order. The index can be used to avoid retrieving rows with duplicate values for the selection list items:

```
SELECT DISTINCT c1, c2, c3 FROM t1 WHERE c2 = 1
```

Relaxed Index Segment Order Sensitivity

Whether an index can be used to optimize on an ORDER BY clause depends on the order in which the columns appear as segments in the index. Specifically, to be eligible for this type of optimization, the columns in the ORDER BY clause must make up the leading segments of an index, and the columns must appear in the ORDER BY clause in the same order as they appear as segments in the index.

In contrast, an index can be used to optimize on a DISTINCT preceding a selection list or on a GROUP BY clause as long as the selection list or GROUP BY clause consists of columns that are the leading segments of the index. This statement is true regardless of the order in which the columns appear as segments in the index.

For example, suppose an index exists on table t1 with the first three segments on columns c1, c2 and c3, in any order. The index can be used to optimize on the DISTINCT in the following queries:

```
SELECT DISTINCT c1, c2, c3 FROM t1
SELECT DISTINCT c2, c3, c1 FROM t1 WHERE c3 > 1
```

The index can be used to optimize on the GROUP BY in the following queries:

```
SELECT c1, c2, c3, count(*) FROM t1 GROUP BY c2, c1, c3
SELECT c2, c3, c1, count(*) FROM t1 GROUP BY c3, c2, c1
```

For the index to be used to optimize on the ORDER BY, however, the index segments must be in the order of c2, c1, c3:

```
SELECT c1, c2, c3 FROM t1 ORDER BY c2, c1, c3
```

Relaxed Segment Ascending Attribute Sensitivity

Whether an index can be used to optimize on an ORDER BY clause depends on several conditions.

Specifically, an index can be used for optimization of ORDER BY if all of the following conditions are satisfied:

- The DESC keyword follows the column in the ORDER BY clause.
- The corresponding index segment is defined as descending.
- The specified column is not nullable.

In addition, an index can be used for optimization of ORDER BY if all of the following converse conditions are satisfied (note that nullable columns are allowed for ascending ORDER BY):

- The ASC keyword or neither ASC nor DESC follows the column in the ORDER BY statement.
- The corresponding index segment is defined as ascending.

As well, an index can be used for optimization of ORDER BY if the ascending/descending attributes of all the involved segments are the exact opposite of each ASC or DESC keyword specified in the ORDER BY. Again, the segments defined as descending can only be used if the associated columns are not nullable.

Indexes can be used for any of the restriction optimizations, optimization on a DISTINCT, or optimization on a GROUP BY clause, regardless of the ascending/descending attribute of any of the segments.

For example, suppose an index exists on table t1 with the first two segments on columns c1 and c2, in that order, and both segments are ascending. The index can be used to optimize on the following queries:

```
SELECT c1, c2, c3 FROM t1 ORDER BY c1, c2
SELECT c1, c2, c3 FROM t1 ORDER BY c1 DESC, c2 DESC
SELECT DISTINCT c1, c2 FROM t1
SELECT DISTINCT c2, c1 FROM t1
SELECT * FROM t1 WHERE c1 = 1
```

Suppose an index exists on table t1 with the first two segments on columns c1 and c2, in that order, with the segment on c1 defined as ascending and the segment on c2 defined as descending. Suppose also that c2 is nullable. The second segment cannot be used to optimize on ORDER BY because the column is both descending and nullable. The index *can* be used to optimize on the following queries:

```
SELECT c1, c2, c3 FROM t1 ORDER BY c1
SELECT c1, c2, c3 FROM t1 ORDER BY c1 DESC
SELECT DISTINCT c1, c2 FROM t1
SELECT DISTINCT c2, c1 FROM t1
SELECT * FROM t1 WHERE c1 = 1
```

If column c2 is not nullable, then the index can also be used to optimize on the following queries:

```
SELECT c1, c2, c3 FROM t1 ORDER BY c1, c2 DESC
SELECT c1, c2, c3 FROM t1 ORDER BY c1 DESC, c2
```

Search Update Optimization

You may take advantage of search optimization when you update a leading segment index by using the same index in the WHERE clause for the search. The database engine uses one session (client ID) for the UPDATE and another session for the search.

The following statements benefit from search optimization.

```
CREATE TABLE t1 (c1 INT)
CREATE INDEX t1_c1 ON t1(c1)
INSERT INTO t1 VALUES(1)
INSERT INTO t1 VALUES(1)
INSERT INTO t1 VALUES(9)
INSERT INTO t1 VALUES(10)
INSERT INTO t1 VALUES(10)
UPDATE t1 SET c1 = 2 WHERE c1 = 10
UPDATE t1 SET c1 = c1 + 1 WHERE c1 >= 1
```

Temporary Table Performance

Performance improvements have been made to the implementation of temporary sort tables in this release. To process certain queries, the database engine must generate temporary tables for internal use. The performance for many of these queries has been improved.

In general, the database engine generates at least one temporary table to process a given query if any of the following conditions is true:

- The DISTINCT keyword precedes the selection list and the items in the selection list are not columns that are the leading segments of an index.

  For example, a temporary table is generated to process the following query unless an index exists with columns c1 and c2 as leading segments:

```
SELECT DISTINCT c1, c2 FROM t1
```

- A GROUP BY clause is used, and the items in the GROUP BY clause are not columns that are the leading segments of an index.

  For example, a temporary table is generated to process the following query unless an index exists with columns c1 and c2 as leading segments:

```
SELECT c1, c2, COUNT(*) FROM t1 GROUP BY c1, c2
```

- A static cursor is being used.

  For example, a temporary table is generated if an application calls the ODBC API SQLSetStmtOption specifying the SQL_CURSOR_TYPE option and the SQL_CURSOR_STATIC value prior to creation of the result set.

- The result set includes bookmarks.

  For example, if the ODBC API SQLSetStmtOption is called specifying the SQL_USE_BOOKMARKS option and the SQL_UB_ON value prior to generating the result set.

- A query contains a non-correlated subquery to the right of the IN or =ANY keywords.

  For example:

```
SELECT c1 FROM t1 WHERE c2 IN (SELECT c2 FROM t2)
```

Row Prefetch

Under certain circumstances, upon execution of a SELECT statement, this release of the database engine attempts to prefetch to the client the first two rows of the resulting rowset. This prefetch greatly improves the performance of fetching data from result sets that consist of zero or one row.

Prefetching rows can be a costly waste of time if the result set consists of more than one row and the first data retrieval operation requests a row other than the first row in the result set, such as the last row. Therefore, prefetching is limited to a maximum of two rows with the goal of improving performance for the cases that would benefit most while avoiding cases where prefetching would not provide significant benefits.

Prefetching occurs only if Array Fetch is enabled in the advanced connection attributes for client DSNs (see Advanced Connection Attributes in *ODBC Guide*). Array fetching is similar to prefetching except that an array fetch does not occur until the first explicit data retrieval operation is performed. This difference exists because the first explicit data retrieval operation may provide enough information to allow the database engine to extrapolate how the rest of the result set will be retrieved. For example, if the first data retrieval operation is a call to the ODBC API SQLFetch, then the database engine can assume with complete certainty that the entire result set will be retrieved one record at a time in the forward direction only. This assumption can be made because, according to the ODBC specification, a SQLFetch entails that the rest of the result set will be retrieved via SQLFetch as well. On the other hand, if a SQLExtendedFetch call is made, and the row set size is greater than one, then the client assumes that the developer-specified rowset size is optimal, and it does not override that setting with the array fetch.

Prefetching occurs only when all of the following conditions are satisfied:

- Array fetch is enabled.
- The result set does not include large variable length data. For example, the selection list does not contain a column of type LONGVARCHAR or LONGVARBINARY.
- The result set does not include bookmarks.

  For example, prefetching does not occur if the ODBC API SQLSetStmtOption is called prior to generating the result set, specifying the SQL_USE_BOOKMARKS option and the SQL_UB_ON value.
- A cursor with read-only concurrency is being used.

  For example, prefetching does not occur if the ODBC API SQLSetStmtOption is called, specifying the SQL_CONCURRENCY option and any value other than SQL_CONCUR_READ_ONLY, prior to generating the result set. By default, concurrency is read-only.

Terminology

This topic provides definitions and examples to help you understand the complex technical material presented here.

Aggregate Function

An aggregate function uses a group of values in the SELECT or HAVING clause of a query to produce a single value. Aggregate functions include: COUNT, AVG, SUM, STDEV, MAX, MIN, and DISTINCT.

Closed Range

A closed range is a pair of Open-Ended Ranges joined by an AND operator. Both open-ended ranges must reference the same column and one must contain the < or <= comparison operator and the other must contain the >= or > comparison operator. A BETWEEN clause also defines a closed range.

For example, the following expressions are closed ranges:

```
c1 > 1 AND c1 <= 10
```

```
c1 BETWEEN 1 AND 10
```

Conjunct

A conjunct is an expression in which two or more Predicates are joined by AND operators. For example, the following Restrictions are conjuncts:

```
c1=2 AND c2<5
```

```
c1>2 AND c1<5 AND c2= 'abc'
```

Conjunctive Normal Form (CNF)

An Expression is in Conjunctive Normal Form if it contains two or more Disjuncts joined by AND operators. For example, the following expressions are in CNF:

```
c1 = 2 AND c2 < 5
```

```
(c1 = 2 OR c1 = 5) AND (c2 < 5 OR c2 > 20) AND (c3 = 'abc' OR c3 = 'efg')
```

Disjunct

A disjunct is an Expression in which two or more Predicates are joined by OR operators. For example, the following expressions are disjuncts:

```
c1 = 2 OR c2 = 5
```

```
c1 = 2 OR c1 > 5 OR c2 = 'abc'
```

Disjunctive Normal Form (DNF)

An Expression is in disjunctive normal form if it contains two or more Conjuncts joined by OR operators. For example, the following expressions are in DNF:

```
c1 = 2 OR c2 < 5
```

```
(c1 = 2 AND c2 = 5) OR (c2 > 5 AND c2 < 10) OR c3 = 'abc'
```

Expression

An expression consists of any Boolean algebra allowed in a Restriction. An entire restriction or any part of the restriction that includes at least one or more complete Predicates is an expression.

Index

An index is a construct associated with one or more columns in a table that allows the database engine to perform efficient searches and sorts. The database engine can make use of indexes to improve search performance by reading only specific rows that will satisfy the search conditions rather than by examining all the rows in the table. The database engine can make use of indexes to retrieve rows in the order specified by a SQL query rather than having to use inefficient techniques to order the rows after retrieving them.

Join Condition

A join condition is a Predicate that compares a column in one table to a column in another table using any of the comparison operators: <, <=, =, >=, >.

For example, the following predicates are join conditions:

```
t1.c1 = t2.c1
```

```
t1.c1 > t2.c2
```

Leading Segments

A group of index segments are leading segments if they consist of the first *n* columns in an Index, where *n* is any number up to and including the total number of segments in the index. For example, if an index is defined with segments on columns c1, c2, and c4, then c1 is a leading segment, c1 and c2 together are leading segments, and all three together are leading segments. c2 alone is not a leading segment, because the segment c1 precedes c2 and is excluded. Columns c1 and c4 together are not leading segments, because c2 precedes c4 and is excluded.

Modified Conjunctive Normal Form (Modified CNF)

An Expression in Modified Conjunctive Normal Form is like an expression in Conjunctive Normal Form (CNF) except that each Disjunct may contain Closed Ranges as well as Predicates.

For example, the following expressions are in Modified CNF:

```
c1 = 2 AND c2 < 5
```

```
(c1 = 2 OR (c1 > 4 AND c1 < 6) OR c1 = 10) AND (c2 = 1 OR c3 = 'efg')
```

Modified Disjunct

A modified disjunct is like a Disjunct except that it may contain Closed Ranges as well as Predicates.

For example, the following expressions are modified disjuncts:

```
c1 = 2 OR (c1 > 4 AND c1 < 5)
(c1 = 2 OR (c1 > 4 AND c1 < 5)) OR c2 = 'abc'
```

Open-Ended Range

An open-ended range is a predicate that contains any of the following comparison operators: <, <=, >= or >. Furthermore, one of the predicate operands must consist entirely of a single column and the other operand must consist entirely of either a single column from another table or a literal.

For example, the following expressions are open-ended ranges:

```
c1 > 1
c1 <= 10
t1.c1 > t2.c1
```

Predicate

A predicate is a Boolean expression that does not include any AND or OR Boolean operators (with the exception of a BETWEEN predicate).

For example, the following expressions are predicates:

```
(c1 = 1)
```

```
(c1 LIKE 'abc')
```

```
(c1 BETWEEN 1 AND 2)
```

The following examples are *not* predicates:

```
(c1 > 1 AND c1 < 5)
```

```
(c1 = 1 OR c1 = 2)
```

Restriction

A restriction is defined as the entire WHERE clause of a SQL query.

System Catalog Functions

System catalog functions for retrieving metadata are covered in the following topics:

- Zen System Catalog Functions
- dbo.fSQLColumns
- dbo.fSQLForeignKeys
- dbo.fSQLPrimaryKeys
- dbo.fSQLProcedures
- dbo.fSQLProcedureColumns
- dbo.fSQLSpecialColumns
- dbo.fSQLStatistics
- dbo.fSQLTables
- dbo.fSQLDBTableStat
- String Search Patterns

Zen System Catalog Functions

System catalog functions allow you to obtain database metadata from the data dictionary files, also known as the catalog. The system catalog functions can be used only in a FROM clause.

Zen can also return metadata by calling appropriate catalog APIs or by using system stored procedures (see System Stored Procedures). These two methods, however, do not store the metadata in a view that can be joined or unioned with other tables. To provide JOIN and UNION capability with other tables, the system catalog functions are required.

Note that some access methods, such as ADO.NET, require system catalog functions for entity support so that JOIN and UNION capabilities are available.

A temporary view schema for each system catalog function is created during the prepare phase and data is stored in the view by calling a corresponding catalog API during the execute phase.

The following table lists the available system catalog functions.

Zen Function[1]	Returns
dbo.fSQLColumns	The list of columns and their corresponding information for a specified table, from the current database or the specified database
dbo.fSQLForeignKeys	The foreign key information for the specified table in the current database
dbo.fSQLPrimaryKeys	The primary key information for the specified table, from the current database or the database specified
dbo.fSQLProcedures	The names of stored procedures in the current database or the specified database
dbo.fSQLProcedureColumns	The list of input and output parameters and the columns that make up the result set for the specified procedure
dbo.fSQLSpecialColumns	Information about the optimal set of columns that uniquely identifies a row in a specified table, or the columns that are automatically updated when any value in the row is updated by a transaction.
dbo.fSQLStatistics	Statistics about a single table and the list of indexes associated with the table, from the current database or the specified database
dbo.fSQLTables	A list of tables along with their corresponding information, from the current database or the specified database

[1] Because the Zen catalog functions are based on ODBC, you may want to refer to ODBC documentation for additional information. The content presented here provides enough information to understand and use Zen catalog functions without exhaustive technical detail.

Return Status

Each system catalog function returns one of the following status values depending on execution results:

- SQL_SUCCESS
- SQL_SUCCESS_WITH_INFO
- SQL_STILL_EXECUTING
- SQL_ERROR
- SQL_INVALID_HANDLE

Summary

The system catalog functions have the following characteristics:

- They return metadata.
- They work in the same manner as views.
- They can be referenced only in the FROM clause of a SELECT statement.
- The parameters can be only in the form of constants or dynamic parameters.

Note: Most popular SQL editors do not use statement delimiters to execute multiple statements. However, SQL Editor in ZenCC requires them. If you wish to execute the examples in other environments, you may need to remove the pound sign or semicolon separators.

dbo.fSQLColumns

This function returns the list of column names in a specified table.

Syntax

```
dbo.fSQLColumns <'database_qualifier' | null>, <'table_name' | null>, <'column_name' | null>)
```

Arguments

Parameter	Type	Default Value	Description
database_qualifier	VARCHAR	Current database	Name of the database from which the details are to be obtained.
table_name	VARCHAR	(no default value)	Name of the table whose column information is required
column_name	VARCHAR	All columns for the specified table	Column name of the table specified.

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR	Name of the database. NULL if not applicable to the database.
TABLE_OWNER	VARCHAR	Schema name of the table. NULL if not applicable to the database.
TABLE_NAME	VARCHAR not NULL	Name of the table.
COLUMN_NAME	VARCHAR	Column name of the table or an empty string for a column that does not have a name.
DATA_TYPE	SMALLINT not NULL	SQL data type of the column. See Supported Data Types in *ODBC Guide*.
TYPE_NAME	VARCHAR	Name of the data type of the column corresponding to DATA_TYPE value
PRECISION	INTEGER	The precision of the column if the data type is Decimal, Numeric, and so forth. See Precision and Scale of Decimal Data Types. If DATA_TYPE is CHAR or VARCHAR, then this column contains the maximum length in characters of the column. For date time data types, this is the total number of characters required to display the value when it is converted to characters. For numeric data types, this is either the total number of digits or the total number of bits allowed in the column, according to the RADIX column.

Column Name	Data Type	Description
LENGTH	INTEGER	The length in bytes of data transferred on a SQLGetData, SQLFetch, or SQLFetchScroll operation if SQL_C_DEFAULT is specified. For numeric data, this size may differ from the size of the data stored in the database. This value might differ from COLUMN_SIZE column for character data.
SCALE	SMALLINT	The total number of significant digits to the right of the decimal point. For TIME, TIMESTAMP, and TIMESTAMP2, this column contains the number of digits in the fractional seconds component. For the other data types, this is the decimal digits of the column in the database. See Precision and Scale of Decimal Data Types.
RADIX	SMALLINT	Base for numeric data types For numeric data types, either 10 or 2. • 10 – the values in COLUMN_SIZE and DECIMAL_DIGITS give the number of decimal digits allowed for the column. • 2 – the values in COLUMN_SIZE and DECIMAL_DIGITS give the number of bits allowed in the column. NULL is returned for data types where RADIX is not applicable.
NULLABLE	SMALLINT	Indicates whether the procedure column accepts a NULL value: • 0 = NO_NULLS – the procedure column does not accept NULL values. • 1 = NULLABLE – the procedure column accepts NULL values. • 2 = NULLABLE_UNKNOWN – it is not known if the procedure column accepts NULL values.
REMARKS	VARCHAR	Remarks field

Column Name	Data Type	Description
COLUMN_DEF	VARCHAR	The default value of the column. If NULL was specified as the default value, this column is the word NULL, not enclosed in quotation marks. If the default value cannot be represented without truncation, this column contains TRUNCATED, with no enclosing single quotation marks. If no default value was specified, this column is NULL.
SQL_DATA_TYPE	SMALLINT not NULL	Value of the SQL data type as it appears in the SQL_DESC_TYPE field of the descriptor. This column is the same as the TYPE_NAME column, except for data types AUTOTIMESTAMP, DATE, DATETIME, TIME, TIMESTAMP, and TIMESTAMP2. For those data types, the SQL_DATA_TYPE field in the result set returns the following: SQL_DATE for DATE, SQL_TIME for TIME, and SQL_TIMESTAMP for AUTOTIMESTAMP, DATETIME, TIMESTAMP, and TIMESTAMP2.
SQL_DATETIME_SUB	SMALLINT	Subtype code for AUTOTIMESTAMP, DATE, DATETIME, TIME, TIMESTAMP, and TIMESTAMP2. For other data types, this column returns a NULL. • 1 = for DATE (SQL_CODE_DATE) • 2 = for TIME (SQL_CODE_TIME) • 3 = for AUTOTIMESTAMP, DATETIME, TIMESTAMP, and TIMESTAMP2 (SQL_CODE_TIMESTAMP)
CHAR_OCTET_ LENGTH	INTEGER	Maximum length in bytes of a character or binary data type column. For all other data types, this column returns a NULL.
ORDINAL_POSITION	INTEGER not NULL	For input and output parameters, the ordinal position of the parameter in the procedure definition (in increasing parameter order, starting at 1). For a return value (if any), 0 is returned. For result-set columns, the ordinal position of the column in the result set, with the first column in the result set being number 1.
IS_NULLABLE	VARCHAR	"NO" if the column does not include NULLs. "YES" if the column includes NULLs. This column returns a zero-length string if nullability is unknown. The value returned for this column differs from the value returned for the NULLABLE column.

Example

This example returns information for all columns in the Room table in the default Demodata sample database.

```
SELECT * FROM dbo.fSQLColumns ('Demodata', 'room', null);
```

Result Set (abbreviated for space considerations):

```
COLUMN_NAME     DATA_TYPE   LENGTH   ORDINAL_POSITION
==============  =========   ======   ================
Building_Name           1       25                  1
Number                  4        4                  2
Capacity                5        2                  3
Type                    1       20                  4
4 rows were affected.
```

dbo.fSQLForeignKeys

This functions returns the foreign key information for the specified table in the current database. Dbo.fSQLForeignKeys can return a list of foreign keys as a result set for either of the following:

- The specified table (columns in the specified table that refer to primary keys in other tables)
- Other tables that refer to the primary key in the specified table

Syntax

```
dbo.fSQLForeignKeys (<'table_qualifier' | null>, 'pkey_table_name' | null>, <'fkey_table_name' |
null>)
```

Arguments

Parameter	Type	Default Value	Description
table_qualifier	VARCHAR	Current database	Name of the database from which the details are to be obtained.
pkey_table_name	VARCHAR	(no default value)	Name of the table whose foreign key is associated with the primary key column. Pattern matching is supported (see String Search Patterns).

Parameter	Type	Default Value	Description
fkey_table_name	VARCHAR	(no default value)	Name of the table whose foreign key information needs to be obtained. Pattern matching is supported (see String Search Patterns).

Returned Result Set

Column Name	Data Type	Description
PKTABLE_QUALIFIER	VARCHAR	Database name of the primary key table. NULL if not applicable to the database.
PKTABLE_OWNER	VARCHAR	Name of the owner of the primary key table. NULL if not applicable to the database.
PKTABLE_NAME	VARCHAR not NULL	Name of the primary key table
PKCOLUMN_NAME	VARCHAR not NULL	Column name of the primary key column. An empty string is returned for a column that does not have a name.
FKTABLE_QUALIFIER	VARCHAR	Database name of the foreign key table. NULL if not applicable to the database.
FKTABLE_OWNER	VARCHAR	Name of the owner of the foreign key table. NULL if not applicable to the database.
FKTABLE_NAME	VARCHAR not NULL	Name of the foreign key table.
FKCOLUMN_NAME	VARCHAR not NULL	Column name of the foreign key column. An empty string is returned for a column that does not have a name.
KEY_SEQ	SMALLINT	Column sequence number in key (starting with 1). The value of this column corresponds to Xi$Part in X$Index. See X$Index.
UPDATE_RULE	SMALLINT	Action to be applied to the foreign key when the SQL operation is UPDATE. Can have one of the following values: • 0 = CASCADE • 1 = RESTRICT
DELETE_RULE	SMALLINT	Action to be applied to the foreign key when the SQL operation is DELETE. Can have one of the following values: • 0 = CASCADE • 1 = RESTRICT
FK_NAME	VARCHAR	Name of the foreign key. NULL if not applicable to the database.

Column Name	Data Type	Description
PK_NAME	VARCHAR	Name of the primary key. NULL if not applicable to the database.
DEFERRABILITY	SMALLINT	One of the following values: • 5 = INITIALLY_DEFERRED • 6 = INITIALLY_IMMEDIATE • 7 = NOT_DEFERRABLE

Example

This example creates three tables in the Demodata sample database. Primary keys and foreign keys are assigned to the tables. The dbo.fSQLForeignKeys function references the two primary key tables using a string search pattern. See also String Search Patterns.

```
CREATE TABLE primarykey1 (pk1col1 INT, pk1col2 INT, pk1col3 INT, pk1col4 INT, PRIMARY KEY (pk1col1, pk1col2));

ALTER TABLE primarykey1 ADD FOREIGN KEY (pk1col3, pk1col4) REFERENCES primarykey1 ON DELETE CASCADE;


CREATE TABLE primarykey2 (pk2col1 INT, pk2col2 INT, pk2col3 INT, pk2col4 INT, PRIMARY KEY (pk2col1, pk2col2));

ALTER TABLE primarykey2 ADD FOREIGN KEY (pk2col3, pk2col4) REFERENCES primarykey2 ON DELETE CASCADE;


CREATE TABLE foreignkey1 (fkcol1 INT, fkcol2 INT, fkcol3 INT, fkcol4 INT);

ALTER TABLE foreignkey1 ADD FOREIGN KEY (fkcol1, fkcol2) REFERENCES PRIMARYKEY1;

ALTER TABLE foreignkey1 ADD FOREIGN KEY (fkcol3, fkcol4) REFERENCES PRIMARYKEY2;


SELECT * FROM dbo.fSQLForeignKeys ('Demodata', 'primarykey%',  'foreignkey1');
```

Result Set (abbreviated for space considerations):

```
FKCOLUMN_NAME  DELETE_RULE   FK_NAME     PK_NAME
=============  ===========   ==========  ==========
fkcol1                   1   FK_0fkcol1  PK_pk1col1
fkcol2                   1   FK_0fkcol1  PK_pk1col1
fkcol3                   1   FK_0fkcol3  PK_pk2col1
fkcol4                   1   FK_0fkcol3  PK_pk2col1

4 rows were affected.
```

dbo.fSQLPrimaryKeys

This function returns as a result set the column names that make up the primary key for a table. Dbo.fSQLPrimaryKeys does not support returning primary keys from multiple tables in a single call.

Syntax

```
dbo.fSQLPrimaryKeys (<'pkey_table_qualifier' | null>, <'table_name' | null>)
```

Arguments

Parameter	Type	Default Value	Description
pkey_table_qualifier	VARCHAR	Current database	Name of the database from which the details are to be obtained.
table_name	VARCHAR	(no default value)	Name of the table whose primary key information is requested. Pattern matching is supported (see String Search Patterns).

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR	Name of the database. NULL if not applicable to the database.
TABLE_OWNER	VARCHAR	Name of the owner of the primary key table. NULL if not applicable to the database.
TABLE_NAME	VARCHAR not NULL	Name of the primary key table
COLUMN_NAME	VARCHAR not NULL	Name of the primary key column. An empty string is returned for a column that does not have a name.
COLUMN_SEQ	SMALLINT not NULL	Column sequence number in key (starting with 1).
PK_NAME	VARCHAR	Name of the primary key. NULL if not applicable to the database.

Example

This example creates two tables in the Demodata sample database. Primary keys and foreign keys are assigned to the tables. The dbo.fSQLPrimaryKeys function references the two tables using a string search pattern. See also String Search Patterns.

```
CREATE TABLE tblprimarykey3 ( tblpk3col1 INT, tblpk3col2 INT, tblpk3col3 INT, tblpk3col4 INT, PRIMARY KEY (tblpk3col1, tblpk3col2) );
```

```
ALTER TABLE tblprimarykey3 ADD FOREIGN KEY (tblpk3col3, tblpk3col4) REFERENCES tblprimarykey3 ON DELETE CASCADE;
```

```
CREATE TABLE tblprimarykey4 ( tblpk4col1 INT, tblpk4col2 INT, tblpk4col3 INT, tblpk4col4 INT, PRIMARY KEY (tblpk4col1, tblpk4col2) );
```

```
ALTER TABLE tblprimarykey4 ADD FOREIGN KEY (tblpk4col3, tblpk4col4) REFERENCES tblprimarykey4 ON DELETE CASCADE;
```

```
SELECT * FROM dbo.fsqlprimarykeys('Demodata', 'tbl%');
```

Result Set (abbreviated for space considerations):

```
TABLE_NAME        COLUMN_NAME   KEY_SEQ   PK_NAME
==============    ===========   =======   =============
tblprimarykey3    tblpk3col1          1   PK_tblpk3col1
tblprimarykey3    tblpk3col2          2   PK_tblpk3col1
tblprimarykey4    tblpk4col1          1   PK_tblpk4col1
tblprimarykey4    tblpk4col2          2   PK_tblpk4col1

4 rows were affected.
```

dbo.fSQLProcedures

This function returns as a result set the names of stored procedures and user-defined functions in the current database or the specified database. See also CREATE PROCEDURE and CREATE FUNCTION.

Syntax

```
dbo.fSQLProcedures (<'database_qualifier' | null>, <'procedure_name' | null>)
```

Arguments

Parameter	**Type**	**Default Value**	**Description**
database_qualifier	VARCHAR	Current database	Name of the database from which the details are to be obtained.
procedure_name	VARCHAR	(no default value)	Name of the stored procedure whose information is required.

Note: System stored procedures are defined in the internal PERVASIVESYSDB database, which Zen Control Center does not display.

Returned Result Set

Column Name	Data Type	Description
PROCEDURE_QUALIFIER	VARCHAR	Name of the database in which the procedure was created. NULL if not applicable to the database.
PROCEDURE_OWNER	VARCHAR	Procedure schema identifier. NULL if not applicable to the database.
PROCEDURE_NAME	VARCHAR not NULL	Procedure identifier
NUM_INPUT_PARAMS	none	Reserved for future use. Do not use for your application.
NUM_OUTPUT_PARAMS	none	Reserved for future use. Do not use for your application.
NUM_RESULT_SETS	none	Reserved for future use. Do not use for your application.
REMARKS	VARCHAR	The description of the procedure
PROCEDURE_TYPE	SMALLINT	Defines the procedure type: • 0 = PT_UNKNOWN—it cannot be determined whether the procedure returns a value. • 1 = PT_PROCEDURE—the returned object is a procedure and does not have a return value. • 2 = PT_FUNCTION—the returned object is a function and has a return value.

Example

By default, the Demodata database does not contain any stored procedures or user-defined functions. To provide output for the dbo.fSQLProcedures function (and for dbo.fSQLProcedureColumns), you can create the following stored procedures and user-defined function. They can all be called provided the required tables and parameter bindings are present. However, the point for this example is to include them as database objects rather than demonstrate their execution.

See also CREATE PROCEDURE and CREATE FUNCTION.

```
CREATE PROCEDURE curs1 (IN :Arg1 CHAR(4), IN :Arg2 INTEGER) AS BEGIN
```

```
DECLARE :alpha char(10) DEFAULT 'BA';
```

```
DECLARE :beta INTEGER DEFAULT 100;
DECLARE degdel CURSOR FOR

SELECT degree, cost_per_credit FROM tuition WHERE Degree = :Arg1 AND cost_per_credit = :arg2

FOR UPDATE;

OPEN degdel;

FETCH NEXT FROM degdel INTO :alpha, :beta

DELETE WHERE CURRENT OF degdel;

CLOSE degdel ;

END
```

```
CREATE PROCEDURE EnrollStudent2 (IN :Stud_id INTEGER, IN

:Class_Id INTEGER);

BEGIN

 INSERT INTO Enrolls VALUES (:Stud_id, :Class_Id, 0.0);

END
```

```
CREATE PROCEDURE AInsert

(IN :AGUID BINARY(16),

IN :APeriod INT,

IN :BBal UTINYINT,

IN :BDr DECIMAL(23,9),

IN :BCr DECIMAL(23,9),

IN :BNet DECIMAL(23,9),

IN :HTrx UTINYINT,

IN :PDr DECIMAL(23,9),

IN :PCr DECIMAL(23,9),

IN :PNet DECIMAL(23,9))

AS BEGIN

INSERT INTO "ASum" ("AID", "APeriod", "IBal", "BDr", "BCr", "BNet", "HTrx", "PDr", "PCr", "PNet")
VALUES (:AGUID,:APeriod,:BBal,:BDr,:BCr,:BNet,:HTrx, :PDr,:PCr,:PNet);

END
```

```
CREATE PROCEDURE AR (OUT :BIID SMALLINT, IN :BName CHAR(30))

AS BEGIN

SELECT MAX(BID) + 1 INTO :BIID FROM Br;
```

```
INSERT INTO Br (BID, FName) VALUES (:BIID, :BName);

END


CREATE FUNCTION CalInterest (IN :principle FLOAT,

IN :period REAL, IN :rate DOUBLE)

RETURNS DOUBLE

AS BEGIN

DECLARE :interest DOUBLE;

SET :interest = ((:principle * :period * :rate) /

100);

RETURN (:interest);

END;


SELECT * FROM dbo.fSQLProcedures ('Demodata', null);
```

Result Set (abbreviated for space considerations):

```
PROCEDURE_QUALIFIER  PROCEDURE_NAME     PROCEDURE_TYPE
===================  =================  ==============
Demodata             curs1                           1
Demodata             Enrollstudent2                  1
Demodata             AInsert                         1
Demodata             AR                              1
Demodata             CalInterest                     2

5 rows were affected.
```

dbo.fSQLProcedureColumns

This function returns the list of input and output parameters and the columns that make up the result set for the specified stored procedure or user-defined function. See also CREATE PROCEDURE and CREATE FUNCTION.

Syntax

```
dbo.fSQLProcedureColumns (<'database_qualifier' | null>, <'procedure_name' | null>,
<'procedure_column_name' | null>)
```

Arguments

Parameter	Type	Default Value	Description
database_qualifier	VARCHAR	Current database	Name of the database from which the details are to be obtained.
procedure_name	VARCHAR	(no default value)	Name of the stored procedure whose information is required.
procedure_column_name	VARCHAR	(no default value)	Name of the column in the procedure.

Note: System stored procedures are defined in the internal PERVASIVESYSDB database, which does not display in Zen Control Center.

Returned Result Set

Column Name	Data Type	Description
PROCEDURE_QUALIFIER	VARCHAR	Name of the database in which the procedure was created. NULL if not applicable to the database.
PROCEDURE_OWNER	VARCHAR	Procedure schema identifier. NULL if not applicable to the database.
PROCEDURE_NAME	VARCHAR not NULL	Procedure identifier
COLUMN_TYPE	SMALLINT not NULL	Defines the procedure column as a parameter or a result set column: • 0 = PARAM_TYPE_UNKNOWN—procedure column is a parameter whose type is unknown. • 1 = PARAM_INPUT—procedure column is an input parameter. • 2 = PARAM_INPUT_OUTPUT—procedure column is an input/output parameter. • 3 = RESULT_COL—procedure column is a result set column. • 4 = PARAM_OUTPUT—procedure column is an output parameter. • 5 = RETURN_VALUE—procedure column is the return value of the procedure.
DATA_TYPE	SMALLINT not NULL	SQL data type. See also Supported Data Types in *ODBC Guide*.
TYPE_NAME	VARCHAR not NULL	Relational data type name. See also Zen Supported Data Types.
PRECISION	INTEGER	Size of the procedure column in the database. NULL is returned for data types where column size is not applicable. See also Precision and Scale of Decimal Data Types.
LENGTH	INTEGER	Length in bytes of data transferred on a SQLGetData or SQLFetch operation if SQL_C_DEFAULT is specified. For numeric data, this size may be different than the size of the data stored in the database. See also Zen Supported Data Types.

Column Name	Data Type	Description
SCALE	SMALLINT	Number of decimal digits of the procedure column in the database. NULL is returned for data types where decimal digits is not applicable. See also Precision and Scale of Decimal Data Types.
RADIX	SMALLINT	For numeric data types, either 10 or 2. • 10—the values in COLUMN_SIZE and DECIMAL_DIGITS give the number of decimal digits allowed for the column. • 2—the values in COLUMN_SIZE and DECIMAL_DIGITS give the number of bits allowed in the column. NULL is returned for data types where RADIX is not applicable.
NULLABLE	SMALLINT not NULL	Indicates whether the procedure column accepts a NULL value: • 0 = NO_NULLS—the procedure column does not accept NULL values. • 1 = NULLABLE—the procedure column accepts NULL values. • 2 = NULLABLE_UNKNOWN—it is not known if the procedure column accepts NULL values.
REMARKS	VARCHAR	The description of the procedure column
COLUMN_DEF	VARCHAR	The default value of the column. If NULL was specified as the default value, this column is the word NULL, not enclosed in quotation marks. If the default value cannot be represented without truncation, this column contains TRUNCATED, with no enclosing single quotation marks. If no default value was specified, this column is NULL.

Column Name	Data Type	Description
SQL_DATA_TYPE	SMALLINT not NULL	Value of the SQL data type as it appears in the SQL_DESC_TYPE field of the descriptor. This column is the same as the TYPE_NAME column, except for data types AUTOTIMESTAMP, DATE, DATETIME, TIME, TIMESTAMP, and TIMESTAMP2. For those data types, the SQL_DATA_TYPE field in the result set returns the following: SQL_DATE for DATE, SQL_TIME for TIME, and SQL_TIMESTAMP for AUTOTIMESTAMP, DATETIME, TIMESTAMP, and TIMESTAMP2.
SQL_DATETIME_SUB	SMALLINT	Subtype code for AUTOTIMESTAMP, DATE, DATETIME, TIME, TIMESTAMP, and TIMESTAMP2. For other data types, this column returns a NULL. • 1 = for DATE (SQL_CODE_DATE) • 2 = for TIME (SQL_CODE_TIME) • 3 = for AUTOTIMESTAMP, DATETIME, TIMESTAMP, and TIMESTAMP2 (SQL_CODE_TIMESTAMP)
CHAR_OCTET_LENGTH	INTEGER	Maximum length in bytes of a character or binary data type column. For all other data types, this column returns a NULL.
ORDINAL_POSITION	INTEGER not NULL	For input and output parameters, the ordinal position of the parameter in the procedure definition (in increasing parameter order, starting at 1). For a return value (if any), 0 is returned. For result-set columns, the ordinal position of the column in the result set, with the first column in the result set being number 1.
IS_NULLABLE	VARCHAR	"NO" if the column does not include NULLs. "YES" if the column includes NULLs. This column returns a zero-length string if nullability is unknown. The value returned for this column differs from the value returned for the NULLABLE column.

Example

By default, the Demodata sample database does not contain any stored procedures or user-defined functions. To provide output for the dbo.fSQLProcedureColumns function, you can create the stored procedures and user-defined function provided in the example for dbo.fSQLProcedures. This example assumes that Demodata contains the stored procedures curs1, Enrollstudent2, AInsert, and AR, and the user-defined function CalInterest.

The following statement returns information for all columns in all stored procedures and user-defined functions in the Demodata sample database:

```
SELECT * FROM  dbo.fsqlprocedurecolumns ('Demodata', null, null)
```

Result Set (abbreviated for space considerations):

```
PROCEDURE_NAME  COLUMN_NAME  COLUMN_TYPE  DATA_TYPE
==============  ===========  ===========  =========
AInsert         :AGUID                 1         -2
AInsert         :APeriod               1          4
AInsert         :BBal                  1         -6
AInsert         :BCr                   1          3
AInsert         :BDr                   1          3
AInsert         :BNet                  1          3
AInsert         :HTrx                  1         -6
AInsert         :PCr                   1          3
AInsert         :PDr                   1          3
AInsert         :PNet                  1          3
AR              :BIID                  4          5
AR              :BName                 1          1
CalInterest     :period                1          7
CalInterest     :principle             1          8
CalInterest     :rate                  1          8
CalInterest     :RETURN_VALUE          5          8
curs1           :Arg1                  1          1
curs1           :Arg2                  1          4
Enrollstudent2  :Class_Id              1          4
Enrollstudent2  :Stud_id               1          4

20 rows were affected.
```

dbo.fSQLSpecialColumns

For a specified table, this function retrieves column information for the optimal set of columns that uniquely identifies a row in the table and columns that are automatically updated when any value in the row is updated by a transaction.

Syntax

```
dbo.fSQLSpecialColumns (<'database_qualifier' | null>, <'table_name' | null>, <'nullable' | null>)
```

Arguments

Parameter	Type	Default Value	Description
database_qualifier	VARCHAR	Current database	Name of the database from which the details are to be obtained
table_name	VARCHAR	(no default value)	Name of the table whose column information is required
nullable	SMALLINT	(no default value)	Determines whether to return special columns that can have a NULL value. Must be one of the following: • 0 = NO_NULLS—exclude special columns that can have NULL values. • 1 = NULLABLE—return special columns even if they can have NULL values.

Returned Result Set

Column Name	Data Type	Description
SCOPE	SMALLINT	Scope of the rowid. Contains one of the following values: • 0 = SCOPE_CURROW • 1 = SCOPE_TRANSACTION • 2 = SCOPE_SESSION NULL is returned when IdentifierType is SQL_ROWVER.
COLUMN_NAME	VARCHAR not NULL	Name of the column. An empty string is returned for a column that does not have a name.
DATA_TYPE	SMALLINT not NULL	SQL data type. See also Supported Data Types in *ODBC Guide*.
PRECISION	INTEGER	Size of the procedure column in the database. See also Precision and Scale of Decimal Data Types.
LENGTH	INTEGER	Length in bytes of data transferred on a SQLGetData or SQLFetch operation if SQL_C_DEFAULT is specified. For numeric data, this size may differ from that of the data stored in the database. See also Zen Supported Data Types.

Column Name	Data Type	Description
SCALE	SMALLINT	Number of decimal digits of the procedure column in the database. NULL is returned for data types where decimal digits is not applicable. See also Precision and Scale of Decimal Data Types.
PSEUDO_COLUMN	SMALLINT	Indicates whether the column is a pseudo-column. • 0 = PC_UNKNOWN Zen does not support pseudo-columns.

Example

This example creates a table with two columns that uniquely identify a row and are automatically updated when a transaction updates any value in the row.

```
CREATE TABLE t2 (c1 IDENTITY, c2 INTEGER, c3 SMALLINT NOT NULL, c4 TIMESTAMP NOT NULL)
```

```
ALTER TABLE t2 ADD PRIMARY KEY (c1, c4);
```

```
SELECT * FROM dbo.fSQLSpecialColumns ('Demodata' ,'t2' , 'null')
```

Result Set (abbreviated for space considerations):

```
COLUMN_NAME  DATA_TYPE  TYPE_NAME  PRECISION  LENGTH
===========  =========  =========  =========  ======
c1                   4  INTEGER            4       4
c4                  11  DATETIME          16      16

2 rows were affected.
```

dbo.fSQLStatistics

This function returns as a result set a list of statistics about a table and the indexes associated with the table.

Syntax

```
dbo.fSQLStatistics (<'database_qualifier' | null>, <'table_name' | null>, <'unique' | null>)
```

Arguments

Parameter	Type	Default Value	Description
database_qualifier	VARCHAR	Current database	Name of the database from which the details are to be obtained
table_name	VARCHAR	(no default value)	Name of the table whose column information is required. Pattern matching is supported (see String Search Patterns).
unique	SMALLINT	(no default value)	Type of index: 0 = INDEX_UNIQUE 1 = INDEX_ALL

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR	Name of the database containing the table to which the statistic or index applies. NULL if not applicable to the database.
TABLE_OWNER	VARCHAR	Schema name of the table to which the statistic or index applies. NULL if not applicable to the database.
TABLE_NAME	VARCHAR not NULL	Name of the table to which the statistic or index applies
NON_UNIQUE	SMALLINT	Indicates whether the index does not allow duplicate values: • 0 = FALSE if the index values must be unique. • 1 = TRUE if the index values can be nonunique. NULL is returned if TYPE is TABLE_STAT.
INDEX_QUALIFIER	VARCHAR	The identifier that is used to qualify the index name doing a DROP INDEX. NULL is returned if an index qualifier is not supported by the database or if TYPE is TABLE_STAT.
INDEX_NAME	VARCHAR	Index name. NULL is returned if TYPE is TABLE_STAT.
TYPE	SMALLINT not NULL	Type of information being returned: • 0 = TABLE_STAT • 3 = INDEX_OTHER

Column Name	Data Type	Description
SEQ_IN_INDEX	SMALLINT	Column sequence number in index (starting with 1). NULL is returned if TYPE is TABLE_STAT.
COLUMN_NAME	VARCHAR	Column name. If the column is based on an expression, such as PERSONID + NAME, the expression is returned. Iff the expression cannot be determined, an empty string is returned. NULL is returned if TYPE is TABLE_STAT.

COLLATION	CHAR	Sort sequence for the column:
		A = ascending
		D = descending
		NULL is returned if column sort sequence is not supported by the database or if TYPE is TABLE_STAT.

CARDINALITY	INTEGER	Cardinality of table or index. Number of rows in table if TYPE is TABLE_STAT. Number of unique values in the index if TYPE is not TABLE_STAT NULL is returned if the value is not available from the database.
PAGES	INTEGER	Number of pages used to store the index or table. Number of pages for the table if TYPE is TABLE_STAT. Number of pages for the index if TYPE is not TABLE_STAT NULL is returned if the value is not available from the database or if not applicable to the database.
FILTER_CONDITION	VARCHAR	If the index is a filtered index, this is the filter condition, such as CLASSID > 150. If the filter condition cannot be determined, this is an empty string. NULL if the index is not a filtered index, it cannot be determined whether the index is a filtered index, or TYPE is TABLE_STAT.

Example

This example returns statistics about all indexes for all tables that begin with the letter *c* in the default Demodata sample database. NULLs are excluded from INDEX_NAME. See also String Search Patterns.

```
SELECT * FROM dbo.fSQLStatistics ('Demodata', 'c%',  1) WHERE INDEX_NAME IS NOT NULL
```

Result Set (abbreviated for space considerations):

```
TABLE_NAME   INDEX_NAME          COLUMN_NAME
```

```
==========    ================    ====================
Class         UK_ID               ID
Class         Class_Name          Name
Class         Class_Name          Section
Class         Class_seg_Faculty   Faculty_ID
Class         Class_seg_Faculty   Start_Date
Class         Class_seg_Faculty   Start_Time
Class         Building_Room       Building_Name
Class         Building_Room       Room_Number
Class         Building_Room       Start_Date
Class         Building_Room       Start_Time
Course        Course_Name         Name
Course        DeptName            Dept_Name

12 rows were affected.
```

dbo.fSQLTables

The function returns the list of table, catalog, or schema names, and table types, stored in a database.

Syntax

```
dbo.fSQLTables (<'database_qualifier' | null>, <'table_name' | null>, <['type' | null>)
```

Arguments

Parameter	**Type**	**Default Value**	**Description**
database_qualifier	VARCHAR	Current database	Name of the database from which the details are to be obtained
table_name	VARCHAR	(no default value)	Name of the table whose information needs to be obtained.
type	VARCHAR	(no default value)	Must be one of the following: • TABLE returns only the user tables • SYSTEM TABLE returns all the system tables • VIEW returns only views • NULL returns all tables

Returned Result Set

Column Name	Data Type	Description
TABLE_QUALIFIER	VARCHAR	Name of the database. NULL if not applicable to the database.
TABLE_OWNER	VARCHAR	Name of the table owner. NULL if not applicable to the database.
TABLE_NAME	VARCHAR	Name of the table
TABLE_TYPE	VARCHAR	One of the following: • TABLE • VIEW • SYSTEM TABLE
REMARKS	VARCHAR	A description of the table.

Example

This example returns a list of the user tables and system tables in the default Demodata sample database.

```
SELECT * FROM dbo.fSQLTables ('Demodata', null, null)
```

Result Set (abbreviated for space considerations):

```
TABLE_NAME      TABLE_TYPE
=============   ==============
X$File          SYSTEM TABLE
X$Field         SYSTEM TABLE
X$Index         SYSTEM TABLE
X$View          SYSTEM TABLE
X$Proc          SYSTEM TABLE
X$Relate        SYSTEM TABLE
X$Trigger       SYSTEM TABLE
X$Attrib        SYSTEM TABLE
X$Occurs        SYSTEM TABLE
X$Variant       SYSTEM TABLE
Billing         TABLE
Class           TABLE
Course          TABLE
Dept            TABLE
Enrolls         TABLE
Faculty         TABLE
Person          TABLE
Room            TABLE
Student         TABLE
Tuition         TABLE
X$User          SYSTEM TABLE
X$Rights        SYSTEM TABLE

22 rows were affected.
```

dbo.fSQLDBTableStat

This function returns as a result set the basic information, including the details returned by a Btrieve Stat (15) operation, about a table or file in the current database.

Syntax

```
dbo.fSQLDBTableStat ('table_name')
```

Argument

Parameter	Type	Default Value	Description
table_name	VARCHAR	(no default value)	Name of the table in the current database for which to obtain information.

Returned Result Set

Column Name	Data Type	Description
Table Name	VARCHAR	Name of the table.
Table Location	VARCHAR	Full path name of the data file for the table.
Dictionary Path	VARCHAR	Dictionary path of the database.
File Version	VARCHAR	Btrieve version of the file in hexadecimal, such as "13.0" for version 13.
Record Length	SMALLINT	Fixed record length for the file, as returned by Stat (15).
Page Size	SMALLINT	Page size for the file, as returned by Stat (15).
Number of Records	BIGINT	Number of records in the file, as returned by Stat (15).
Number of Indexes	SMALLINT	Number of indexes, as returned by Stat (15).
Unused LinkedDup Ptr	SMALLINT	Number of unused duplicate pointers, as returned by Stat (15).
Unused PreAlloc Pages	SMALLINT	Number of unused empty pages in the file, as returned by Stat (15).
Variable Len Records	VARCHAR	YES or NO indicating whether the file contains variable length records.

Column Name	Data Type	Description
Blank Truncation	VARCHAR	YES or NO indicating whether variable length records use blank truncation.
Record Compression	VARCHAR	YES or NO indicating Btrieve data compression.
Page Compression	VARCHAR	YES or NO indicating Btrieve page compression.
Key Only File	VARCHAR	YES or NO indicating whether the file is a key-only file.
Index Balancing	VARCHAR	YES or NO indicating Btrieve index balancing.
Freespace Threshold	VARCHAR	Percentage indicating what the free space threshold is, if any.
Uses ACS	VARCHAR	YES or NO indicating whether the file uses an alternate collating sequence.
System Data	VARCHAR	YES or NO indicating whether the file has system data keys enabled.
Used LinkedDup Ptr	SMALLINT	Number of keys using linked duplicates.

For further information on these fields, see the Create (14) and Stat (15) in *Btrieve API Guide*.

Example

This example returns information for a table in the default Demodata sample database.

```
SELECT * FROM dbo.fSQLDBTableStat ('student')
```

Result Set (reformatted for space considerations):

```
Table Name            Student
Table Location        C:\PROGRAMDATA\ACTIAN\ZEN\DEMODATA\Student.mkd
Dictionary Path       C:\PROGRAMDATA\ACTIAN\ZEN\DEMODATA
File Version          9.5
Record Length         76
Page Size             4096
Number of Records     1288
Number of Indexes     2
Unused LinkedDup Ptr  0
Unused PreAlloc Pages 0
Variable Len Records  NO
Blank Truncation      NO
Record Compression    NO
Page Compression      NO
Key Only File         NO
Index Balancing       NO
Freespace Threshold   0%
Uses ACS              NO
System Data           YES
Used LinkedDup Ptr    0
```

String Search Patterns

The following system catalog functions support string search patterns:

- dbo.fSQLForeignKeys
- dbo.fSQLPrimaryKeys
- dbo.fSQLStatistics

Two wildcard characters can be used in a search pattern:

- Percent sign (%) represents any sequence of n characters.
- Underscore (_) represents a single character.

Examples

The following table lists examples of using string search patterns.

Example Statement	Returns
SELECT * FROM dbo.fSQLStatistics (null, '%', 0)	All tables with a unique index in current database
SELECT * FROM dbo.fSQLStatistics (null, 't%', 1)	All tables starting with 't' and an index in current database
SELECT * FROM dbo.fSQLPrimaryKeys (null, '%')	All tables with a primary key in current database
SELECT * FROM dbo.fSQLPrimaryKeys (null, 't%')	All tables starting with 't' and a primary key in current database
SELECT * FROM dbo.fSQLForeignKeys (null, '%' , '%')	All tables with a primary key and corresponding foreign key tables in current database

A. Data Types

This appendix describes the data types and data type mappings offered by Zen through the MicroKernel and relational engines.

- Zen Supported Data Types
- Notes on Data Types
- Legacy Data Types
- Btrieve Key Data Types
- Non-Key Data Types

Zen Supported Data Types

The following table maps the transactional and relational data types supported by Zen. It is useful for developers of SQL applications that access data in Btrieve data files.

Transactional Type (Size)	Relational Type	Metadata Type Code Value	Size (bytes)	Create/Add Parameters[1]	Data Type Notes
AUTOINCREMENT(2)	SMALLIDENTITY	15	2		
AUTOINCREMENT(4)	IDENTITY	15	4		
AUTOINCREMENT(8)	BIGIDENTITY	15	8		
AUTOTIMESTAMP	AUTOTIMESTAMP	32	8		11
BFLOAT(4)	BFLOAT4	9	4	not null	4
BFLOAT(8)	BFLOAT8	9	8	not null	4
BLOB	LONGVARBINARY	21	n/a[2]	not null	2, 3, 6
BLOB(2)	NLONGVARCHAR	21	n/a[2]	not null case insensitive	7
CLOB	LONGVARCHAR	21	n/a[2]	not null case insensitive	5, 6
CURRENCY	CURRENCY	19	8	not null	

Transactional Type (Size)	Relational Type	Metadata Type Code Value	Size (bytes)	Create/Add Parameters[1]	Data Type Notes
DATE	DATE	3	4	not null	
None	DATETIME	30	8	not null	10
DECIMAL	DECIMAL	5	1 - 64	precision scale not null	
FLOAT(4)	REAL	2	4	not null	
FLOAT(8)	DOUBLE	2	8	not null	
GUID	UNIQUEIDENTIFIER	27	16	not null	
INTEGER(1)	TINYINT	1	1	not null	
INTEGER(2)	SMALLINT	1	2	not null	
INTEGER(4)	INTEGER	1	4	not null	
INTEGER(8)	BIGINT	1	8	not null	
MONEY	DECIMAL	6	1 - 64	precision scale not null	
NUMERIC	NUMERIC	8	1 - 37	precision scale not null	4
NUMERICSA	NUMERICSA	18	1 - 37	precision scale not null	4
NUMERICSLB	NUMERICSLB	28	1 - 37	precision scale not null	4
NUMERICSLS	NUMERICSLS	29	1 - 37	precision scale not null	4
NUMERICSTB	NUMERICSTB	31	1 - 37	precision scale not null	4

Transactional Type (Size)	Relational Type	Metadata Type Code Value	Size (bytes)	Create/Add Parameters[1]	Data Type Notes
NUMERICSTS	NUMERICSTS	17	1 - 37	precision scale not null	4
STRING	BINARY	0	1 - 8,000	size not null case insensitive	2, 3
STRING	CHAR	0	1 - 8,000	size not null case insensitive	1
TIME	TIME	4	4	not null	
TIMESTAMP	TIMESTAMP	20	8	not null	
TIMESTAMP2	TIMESTAMP2	34	8	not null	11
UNSIGNED(1) BINARY	UTINYINT	14	1	not null	
UNSIGNED(2) BINARY	USMALLINT	14	2	not null	
UNSIGNED(4) BINARY	UINTEGER	14	4	not null	
UNSIGNED(8) BINARY	UBIGINT	14	8	not null	
WSTRING	NCHAR	25	2 - 8,000	size 1 - 4,000 not null case insensitive	12, 13
WZSTRING	NVARCHAR	26	2 - 8,000	size 1 - 4,000 not null case insensitive	12, 14
ZSTRING	VARCHAR	11	1 - 8,000	size not null case insensitive	5
none	BIT	16	1 bit		6, 8
LOGICAL(1)	BIT	7	1 bit		9
LOGICAL(2)	SMALLINT	1	2	not null	

Transactional Type (Size)	Relational Type	Metadata Type Code Value	Size (bytes)	Create/Add Parameters[1]	Data Type Notes
[1] The required parameters are precision and size. The optional parameters are case insensitive, not null, and scale. [2] "n/a" stands for "not applicable" **Data Type Notes** 1. Padded with spaces 2. Flag set in FIELD.DDF to tell SQL to use binary. See also COLUMNMAP Flags in *Distributed Tuning Interface Guide* and Column Flags in *Distributed Tuning Objects Guide*. 3. Padded with binary zeros 4. Cannot be used as variable or in stored procedures 5. Not padded 6. Cannot be indexed 7. Flag set in FIELD.DDF to tell SQL to use NLONGVARCHAR. See also COLUMNMAP Flags in *Distributed Tuning Interface Guide* and Column Flags in *Distributed Tuning Objects Guide*. 8. TRUEBITCREATE must be set to on (the default). 9. TRUEBITCREATE must be set to off. 10. Type code 30 is not a MicroKernel Engine code. It is the identifier for DATETIME within the Relational Engine metadata. 11. Sorts like UBIGINT. 12. For Unicode types, the column size represents the number of 2-byte UCS-2 units. 13. Padded with Unicode spaces (2 bytes) 14. Padded with Unicode NUL characters (2 bytes, binary zero)					

Data Type Ranges

The following table lists the value ranges for the Zen data types and their increments where appropriate.

Relational Data Type	Valid Value Range
AUTOTIMESTAMP	1970-01-01 00:00:00.000000000 to 2554-07-21 23:34:33.709551615 Initializing with zero causes the insert or the next update to use the current time and date.
BFLOAT4	-1.70141172e+38 – +1.70141173e+38 Smallest value by which you can increment or decrement a BFLOAT4 is 2.938736e-39

Relational Data Type	Valid Value Range
BFLOAT8	-1.70141173e+38 – +1.70141173e+38 Smallest value by which you can increment or decrement a BFLOAT8 is 2.93873588e-39.
BIGIDENTITY	-9223372036854775808 – +9223372036854775807
BIGINT	-9223372036854775808 – +9223372036854775807
BINARY	Range not applicable
BIT	Range not applicable
CHAR	Range not applicable
CURRENCY	-922337203685477.5808 – +922337203685477.5807
DATE	01-01-0001 to 12-31-9999 **Note:** 00-00-0000 is not a valid value. If you have legacy data that contains a 00-00-0000 value of type DATE, you can query it by using "is null" in the query.
DATETIME	1753-01-01 00:00:00.000 to 9999-12-31 23:59:59.999, to an accuracy of 1 millisecond
DECIMAL	Depends on the length and number of decimal places
DOUBLE	-1.7976931348623157e+308 – +1.7976931348623157e+308 The smallest value by which to increment or decrement a DOUBLE is 2.2250738585072014e-308.
FLOAT	-1.7976931348623157E+308 – +1.7976931348623157E+308 Smallest value by which you can increment or decrement a FLOAT is 2.2250738585072014e-308.
IDENTITY	-2147483648 – +2147483647
INTEGER	-2147483648 – +2147483647
LOGICAL	Range not applicable
LONGVARBINARY	Range not applicable
LONGVARCHAR	Range not applicable
MONEY	-99999999999999999.99 – +99999999999999999.99
NCHAR	Range not applicable
NLONGVARCHAR	Range not applicable

Relational Data Type	Valid Value Range
NUMERIC	Based on length and number of decimal places. See Precision and Scale of Decimal Data Types.
NUMERICSA	Based on length and number of decimal places. See Precision and Scale of Decimal Data Types.
NUMERICSLB	Based on length and number of decimal places. See Precision and Scale of Decimal Data Types.
NUMERICSLS	Based on length and number of decimal places. See Precision and Scale of Decimal Data Types.
NUMERICSTB	Based on length and number of decimal places. See Precision and Scale of Decimal Data Types.
NUMERICSTS	Based on length and number of decimal places. See Precision and Scale of Decimal Data Types.
NVARCHAR	Range not applicable
REAL	-3.4028234E+38 – +3.4028234e+38 Smallest value by which you can increment or decrement a REAL value is 1.4E-45.
SMALLIDENTITY	-32768 – +32767
SMALLINT	-32768 – +32767
TIME	00:00:00 – 23:59:59
TIMESTAMP	0001-01-01 00:00:00.0000000 – 9999-12-31 23:59:59.9999999 UTC Scale can vary. See Scale of Time Stamp Data Types and Returned Function Values.
TIMESTAMP2	1970-01-01 00:00:00.000000000 – 2554-07-21 23:34:33.709551615 UTC Scale can vary. See Scale of Time Stamp Data Types and Returned Function Values.
TINYINT	-128 – +127
UBIGINT	0 – 18446744073709551615
UINTEGER	0 – 4294967295
UNIQUEIDENTIFIER	Range not applicable
USMALLINT	0 – 65535
UTINYINT	0 – 255

Relational Data Type	Valid Value Range
VARCHAR	Range not applicable

Operator Precedence

Expressions may have multiple operators, which are performed in order of precedence. Zen uses the following order, with level 1 highest and level 9 lowest. A higher operator is evaluated before a lower one.

1. + (positive), - (negative), ~ (bitwise NOT)
2. * (multiply), / (divide), % (modulo)
3. + (add), (+ concatenate), - (subtract), & (bitwise AND)
4. =, >, <, >=, <=, <>, != (these comparison operators mean the following, respectively: equals, greater than, less than, greater than equal to, less than equal to, not equal, not equal)
5. ^ (bitwise Exclusive OR), | (bitwise OR)
6. NOT
7. AND
8. ALL, ANY, BETWEEN, IN, LIKE, OR, SOME
9. = (assignment)

In an expression, operators with equal precedence are evaluated left to right. For example, in `SET :Counter = 12 / 4 * 7`, the division is evaluated before the multiplication to return a result of 21.

Parentheses

You can use parentheses to override the precedence of operators in an expression. Everything within the parentheses is evaluated first to yield a value that is then used by an operator outside of the parentheses. For example, in the following statement, the division operator would ordinarily be evaluated before the addition operator. The result would be 12 (that is, 8 + 4). However, the addition is performed first because of the parentheses, so the procedure returns a result of 4.

```
SET :Counter = 32 / (4 + 4)
```

If an expression has nested parentheses, the deepest nested expression is evaluated first, followed by the next deepest, and so on. For example, in the following statement, the addition is performed first, then the multiplication, then the subtraction, and finally the division. The result is a value of 5.

```
SET :Counter = 100 / (40 - (2 * (5 + 5)));
```

Data Type Precedence

Data type precedence determines the result when two expressions of different types are combined by an operator. The data type with lower precedence is converted to the data type with higher precedence.

Note: Operations on incompatible data types return errors, such as adding an INTEGER to a CHAR.

Numeric Data Types

Relational numeric data types use the following precedence:

1. DOUBLE, FLOAT, BFLOAT8 (highest)
2. REAL, BFLOAT4
3. DECIMAL, NUMERIC, NUMERICSA, NUMERICSTS
4. NUMERICSLS, NUMERICSTB, NUMERICSLB
5. CURRENCY, MONEY
6. BIGINT, UBIGINT, BIGIDENTITY
7. INTEGER, UINTEGER, IDENTITY
8. SMALLINT, USMALLINT, SMALLIDENTITY
9. TINYINT, UTINYINT
10. BIT (lowest)

Character Data Types

Relational character data types use the following precedence:

1. NLONGVARCHAR
2. NCHAR, NVARCHAR
3. LONGVARCHAR
4. CHAR, VARCHAR

If you concatenate an NCHAR or NVARCHAR with a NLONGVARCHAR, the result is an NLONGVARCHAR.

If you concatenate an NCHAR with a LONGVARCHAR, the result is an NLONGVARCHAR.

If you concatenate a CHAR or VARCHAR with a LONGVARCHAR, the result is a LONGVARCHAR.

If you concatenate a CHAR with a VARCHAR, the result is the type of the first data type in the concatenation, moving left to right. For example, if c1 is a CHAR and c2 is a VARCHAR, the result of (c1 + c2) is a CHAR. The result of (c2 + c1) is a VARCHAR.

Data Types with No Precedence

The BINARY, LONGVARBINARY, and UNIQUEIDENTIFIER data types have no precedence because operations to combine them are not allowed.

No date and time data type may be combined with any other date and time data type.

Precision and Scale of Decimal Data Types

Precision is the number of digits in a number. Scale is the number of digits to the right of the decimal point in a number. The number 909.777 has a precision of 6 and a scale of 3, for instance.

The maximum precision of NUMERIC, NUMERICSA, and DECIMAL data types is 64. The maximum precision of NUMERICSTS and NUMERICSLS is 63 because it reserves one byte for the plus or minus sign.

Precision and scale are fixed for all numeric data types except DECIMAL. An arithmetic operation on two expressions of the same data type results in the same data type, with the precision and scale for that type. If the operation involves expressions with different data types, the precedence rules determine the data type of the result. The result has the precision and scale defined for its data type.

The result is a DECIMAL for operations under the following conditions:

- Both expressions are DECIMAL.
- One expression is DECIMAL and the other is a data type with a precedence lower than DECIMAL.

The following table defines how precision and scale are derived when the result of an operation is of data type DECIMAL. *Exp* stands for expression, *s* stands for scale, and *p* stands for precision.

Operation	Precision	Scale
Addition (exp1 + exp2)	max(s1, s2) + max(p1 - s1, p2 - s2) +1	max(s1, s2)
Subtraction (exp1 - exp2)	max(s1, s2) + max(p1 - s1, p2 - s2) +1	max(s1, s2)
Multiplication (exp1 * exp2)	p1 + p2 + 1	s1 + s2
Division (exp1 / exp2)	p1 - s1 + s2 + max(6, s1 + p2 +1)	max(6, s1 + p2 +1)
UNION (exp1 UNION exp2)	max(s1, s2) + max(p1 - s1, p2 - s2) +1	max(s1, s2)

For example, if you add or subtract two fields defined as DECIMAL(8,2) and DECIMAL(7,4), the resulting field is DECIMAL(11,4).

Scale of Time Stamp Data Types and Returned Function Values

In time stamp data types, scale is the number of digits to the right of the decimal point in the fractional second part of the time stamp. For instance, 2019-12-31 23:59:59.782 has a scale of 3, or milliseconds.

Starting in Zen 14.10, you can choose the scale for the TIMESTAMP and TIMESTAMP2 data types. For example, the following SQL script creates a table with four columns, the first two using TIMESTAMP and TIMESTAMP2 with default scale, and the second two setting the scale to one decimal point:

```
create table times
(ts timestamp default sysdatetime(),
 ts2 timestamp2 default sysdatetime(),
 ts_1 timestamp(1) default sysdatetime()
 ts2_1 timestamp2(1) default sysdatetime());
insert into times default values;
select * from times;
```

The SELECT statement returns the following row:

```
                     ts                            ts2                    ts-1                   ts2-1
=======================  =============================  =====================  =====================
2019-12-10 10:25:39.555  2019-12-10 10:25:39.555080200  2019-12-10 10:25:39.5  2019-12-10 10:25:39.5
```

Note that shortening the scale does not round fractional seconds.

The following table lists Zen data types that support date and time stamps with scale.

Data Type	Format with Default Scale	Scale
AUTOTIMESTAMP	yyyy-mm-dd hh:mm:ss.nnnnnnnnn (nanoseconds)	9
DATETIME	yyyy-mm-dd hh:mm:ss.nnn (milliseconds)	3
TIMESTAMP	yyyy-mm-dd hh:mm:ss.nnn (milliseconds)	3
TIMESTAMP(n)	yyyy-mm-dd hh:mm:ss.nnnnnnn (none up to septaseconds)	0–7
TIMESTAMP2	yyyy-mm-dd hh:mm:ss.nnnnnnnnn (nanoseconds)	9
TIMESTAMP2(n)	yyyy-mm-dd hh:mm:ss.nnnnnnnnn (none up to nanoseconds)	0–9

The following table lists Zen scalar functions that return date and time stamp values with scale.

Function	Format	Scale
CURRENT_TIMESTAMP()	yyyy-mm-dd hh:mm:ss.nnn (milliseconds)	3
NOW()	yyyy-mm-dd hh:mm:ss.nnn (milliseconds)	3
SYSDATETIME()	yyyy-mm-dd hh:mm:ss.nnnnnnnnn (nanoseconds)	9
SYSUTCDATETIME()	yyyy-mm-dd hh:mm:ss.nnnnnnnnn (nanoseconds)	9

If the time stamp returned by a function has smaller scale than the data type of the column to which it is written, then trailing decimal places are filled with zeros. For example, the value 2019-12-10 14:23:46.292000000 is returned by CURRENT_TIMESTAMP() in a TIMESTAMP2 column.

Truncation

If your application runs against different SQL DBMS products, you may encounter the following issues pertaining to truncation.

In certain situations, some SQL DBMS products prevent insertion of data because of truncation, while Zen allows the insertion of that same data. Additionally, reporting of SQL_SUCCESS_WITH_INFO and the information being truncated differs in Zen from some SQL DMBS products in certain scenarios based on when the message is reported.

Numeric string data and true numeric data are always truncated by Zen, whereas other SQL DBMS products round the data. For example, if you have a numeric string or true numeric value of 123.457 and you insert it into a 6-byte string column or precision 2 numeric column, Zen always inserts 123.45. Other DBMS products, by comparison, may insert a value of 123.46.

Notes on Data Types

This topic covers various behaviors and key information regarding the available data types.

CHAR, NCHAR, VARCHAR, NVARCHAR, LONGVARCHAR, and NLONGVARCHAR

- CHAR and NCHAR columns are padded with trailing blanks. These blanks are not counted in comparison operations (LIKE and =). However, in the LIKE case, if a space is explicitly entered in the query (like 'abc %'), then the space before the wild card is counted. In this example you are looking for 'abc<space><any other character>'.
- The CHAR types store characters using the database code page, that is, using one or more bytes per character. The NCHAR types store characters as UCS-2 two-byte values.
- VARCHAR, NVARCHAR, LONGVARCHAR, and NLONGVARCHAR values are not padded with trailing blanks. The significant data is terminated with a NULL character.
- Trailing blanks are significant in VARCHAR and NVARCHAR comparison operations. For example, c1 = 'Test ' does not find rows where c1 is a VARCHAR type containing the value 'Test'.

See also Limitations on LONGVARCHAR, NLONGVARCHAR and LONGVARBINARY.

BINARY and LONGVARBINARY

- BINARY columns are padded with trailing zeros.
- LONGVARBINARY columns are not padded with trailing blanks.
- The database engine does not compare LONGVARBINARY columns. The database engine does compare fixed-length BINARY data.

Zen supports multiple LONGVARCHAR and LONGVARBINARY columns per table. The data is stored according to the offset in the variable length portion of the record. The variable length portion of data can vary from the column order of the data depending on how the data is manipulated. Consider the following example:

```
CREATE TABLE BlobDataTest
(
Nbr   UINT,          // Fixed record (Type 14)
Clob1 LONGVARCHAR,   // Fixed record (Type 21)
Clob2 LONGVARCHAR,   // Fixed record (Type 21)
Blob1 LONGVARBINARY, // Fixed record (Type 21)
)
```

On disk, the physical record would normally look like this:

```
[Fixed Data (Nbr, Clob1header, Clob2header, Blob1header)][ClobData1][ClobData2][BlobData1]
```

Now alter column Nbr to a LONGVARCHAR column:

```
ALTER TABLE BlobDataTest ALTER Nbr LONGVARCHAR
```

On disk, the physical record now looks like this:

```
[Fixed Data (Nbrheader, Clob1header, Clob2header, Blob1header)][ClobData1][ClobData2][BlobData1]
[NbrClobData]
```

As you can see, the variable length portion of the data is not in the column order for the existing data.

For newly inserted records, however, the variable length portion of the data is in the column order for the existing data. This assumes that all columns have data assigned (the columns are not NULL).

```
[Fixed Data (Nbrheader, Clob1header, Clob2header, Blob1header)][NbrClobData][ClobData1][ClobData2]
[BlobData1]
```

See also Limitations on LONGVARCHAR, NLONGVARCHAR and LONGVARBINARY.

Limitations on LONGVARCHAR, NLONGVARCHAR and LONGVARBINARY

The following limitations apply to the LONGVARCHAR and LONGVARBINARY data types:

- The LIKE predicate operates on the first 65500 bytes of the column data.
- All other predicates operate on the first 256 bytes of the column data.
- SELECT statements with GROUP BY, DISTINCT, and ORDER BY return all the data but only order on the first 256 bytes of the column data.
- Though the maximum amount of data that can be inserted into a LONGVARCHAR/ LONGVARBINARY column is 2GB, using a literal in an INSERT statement reduces this amount to 15000 bytes. You can insert more than 15000 bytes by using a parameterized insert.
- The maximum number of bytes returned in a single call by Zen for a LONGVARCHAR, NLONGVARCHAR or LONGVARBINARY columns depends on the access method used by

the application. In most cases, the limit is 65500 bytes. For more information, see the documentation for your specific development environment.

DATETIME

The DATETIME data type represents a date and time value. This type is stored internally as two 4-byte integers. The first four bytes store the number of days before or after the base date of January 1, 1900. The other four bytes store the time of day, represented as the number of milliseconds after midnight.

The DATETIME data type can be indexed. The accuracy of DATETIME is 1 millisecond.

DATETIME is a relational data type only. No corresponding Btrieve data type is available.

Format of DATETIME

The format for DATETIME is YYYY-MM-DD HH:MM:SS.mmm. If you need to truncate the millisecond portion, the CONVERT function offers parameter to do so. The following table gives the data components and their range of values for DATETIME.

Component	Valid Values
Year (YYYY)	1753 to 9999
Month (MM)	01 to 12
Day (DD)	01 to 31
Hour (HH)	00 to 23
Minute (MM)	00 to 59
Second (SS)	00 to 59
Millisecond (mmm)	000 to 999

Compatibility of Date and Time Data Types

If you need to perform addition or subtraction involving date and time data types, we recommend using the scalar functions TIMESTAMPADD(), DATEADD(), TIMESTAMPDIFF(), and DATEDIFF(). The use of these functions is required if your expression includes the newer AUTOTIMESTAMP and TIMESTAMP2 data types. Other data types can in some cases be used directly in expressions with operators. For example, the following statements are valid:

```
SELECT "Start_Date" + 5 FROM "Class"
SELECT "Finish_Time" - "Start_Time" FROM "Class"
SELECT current_timestamp() – "Log" FROM "Billing"
```

Some queries may return "incompatible types" or "error in expression" messages if you try to add or subtract values that are not compatible, or if the result would not be valid. For example, the following statements return such errors:

```
SELECT "Start_Date" + 5.0 FROM "Class"
SELECT "Start_Time" + "Finish_Time" FROM "Class"
SELECT current_timestamp() + "Log" FROM "Billing"
```

The CONVERT and CAST functions can be used with DATE, DATETIME, TIME, and TIMESTAMP in the ways shown in the following tables.

CONVERT From	Permitted Resultant Data Type (to)
AUTOTIMESTAMP	SQL_CHAR, SQL_DATE, SQL_TIME, SQL_TIMESTAMP, SQL_VARCHAR
DATE	SQL_CHAR, SQL_DATE, SQL_TIMESTAMP, SQL_VARCHAR
DATETIME	Any of the supported CONVERT data types **except** for GUID, BINARY, and LONGVARBINARY. The *type* parameter for CONVERT requires a prefix of "SQL_." See CONVERT (exp, type [, style]).
TIME	SQL_CHAR, SQL_TIME, SQL_TIMESTAMP, SQL_VARCHAR
TIMESTAMP	SQL_CHAR, SQL_DATE, SQL_TIME, SQL_TIMESTAMP, SQL_VARCHAR
TIMESTAMP2	SQL_CHAR, SQL_DATE, SQL_TIME, SQL_TIMESTAMP, SQL_VARCHAR
VARCHAR	SQL_CHAR, SQL_DATE, SQL_TIME, SQL_TIMESTAMP, SQL_VARCHAR

Note: The CONVERT function contains an optional parameter that allows you to truncate the milliseconds portion of DATETIME. See the Convert function under Conversion Functions.

CAST From	Permitted Resultant Data Type (to)
AUTOTIMESTAMP	DATE, DATETIME, TIME, TIMESTAMP, TIMESTAMP2, VARCHAR
DATE	DATE, DATETIME, TIMESTAMP, VARCHAR
DATETIME	Any of the relational data types
TIME	TIME, DATETIME, TIMESTAMP, TIMESTAMP2, VARCHAR
TIMESTAMP	DATE, DATETIME, TIME, TIMESTAMP, TIMESTAMP2, VARCHAR

CAST From	Permitted Resultant Data Type (to)
TIMESTAMP2	DATE, DATETIME, TIME, TIMESTAMP, TIMESTAMP2, VARCHAR
VARCHAR	DATE, DATETIME, TIME, TIMESTAMP, TIMESTAMP2

UNIQUEIDENTIFIER

The UNIQUEIDENTIFIER data type is a 16-byte binary value known as a globally unique identifier (GUID). A GUID is useful when a row must be unique among other rows.

UNIQUEIDENTIFIER requires a file format of 9.5 or higher.

You can initialize a column or local variable of UNIQUEIDENTIFIER the following ways:

- By using the NEWID() scalar function. See NEWID().
- By providing a quoted string in the form `'xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx'` in which each `x` is a hexadecimal digit in the range 0-9 or A-F. For example, `'1129619D-772C-AAAB-B221-00FF00FF0099'` is a valid UNIQUEIDENTIFIER value.

If you provide a quoted string, all 32 digits are required. The database engine does not pad a partial string.

You may use only the following comparison operators with UNIQUEIDENTIFIER values:

Operator	Meaning
=	Equals
<> or !=	Not equal to
<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to
IS NULL	The value is NULL.
IS NOT NULL	The value is not NULL.

Note that ordering is not implemented by comparing the bit patterns of the two values.

Declaring Variables

You may declare variables of the UNIQUEIDENTIFIER data type and set the variable value with the SET statement.

```
DECLARE :Cust_ID UNIQUEIDENTIFIER DEFAULT NEWID()
DECLARE :ISO_ID uniqueidentifier
SET :ISO_ID = '1129619D-772C-AAAB-B221-00FF00FF0099'
```

Converting UNIQUEIDENTIFIER to Another Data Type

The UNIQUEIDENTIFER can be converted with the CAST or CONVERT scalar functions to any of the following data types:

- CHAR
- LONGVARCHAR
- VARCHAR

For conversion examples, see Conversion Functions.

Representation of Infinity

When Zen is required by an application to represent infinity, it can do so in either a 4-byte (C float type) or 8-byte (C double type) form, and in either a hexadecimal or character representation, as shown in the following table.

Value	Float Hexadecimal	Float Character	Double Hexadecimal	Double Character
Maximum Positive			0x7FEFFFFFFFFFFFFF	
Maximum Negative			0xFFEFFFFFFFFFFFFF	
Infinity Positive	0x7F800000	1E999	0x7FF0000000000000	1E999
Infinity Negative	0xFF800000	-1E999	0xFFF0000000000000	-1E999

Legacy Data Types

Some older (legacy) data types are not supported in the current release of Zen. The following table shows the new data type to use in place of the legacy data type.

Legacy Type	Type Code	Replaced by	Type Code
LOGICAL(1)	7	BIT	16
LOGICAL(2)	7	SMALLINT	14
LSTRING	10	VARCHAR	11
LVAR	13	LONGVARCHAR	21
NOTE	12	LONGVARCHAR	21

Existing databases that use these data types are supported and function correctly. To support these data types in a new database, execute a SET LEGACYTYPESALLOWED=ON statement before a CREATE TABLE or ALTER TABLE statement. Afterward, execute a SET LEGACYTYPESALLOWED=OFF statement or let the SET statement expire with the SQL session. For more information, see SET LEGACYTYPESALLOWED.

Btrieve Key Data Types

This topic discusses the Btrieve data types that can be indexed (key types). Internally, the MicroKernel compares string keys on a byte-by-byte basis, from left to right. By default, the MicroKernel sorts string keys according to their ASCII value. You may, however, define string keys to be case insensitive or to use an alternate collating sequence (ACS).

The MicroKernel compares unsigned binary keys one word at a time. It compares these keys from right to left because the Intel 8086 family of processors reverses the high and low bytes in an integer.

If a particular data type is available in more than one size (for example, both 4- and 8-byte FLOAT values are allowed), the Key Length parameter (used in the creation of a new key) defines the size that will be expected for all values of that particular key. Any attempt to define a key using a key length that is not allowed results in a status 29 (Invalid Key Length).

The following table lists the key types and their associated codes. Following the table is a discussion of the internal storage formats for each key type.

Data Type	Type Code	Data Type	Type Code
AUTOINCREMENT	15	NUMERIC	8
AUTOTIMESTAMP	32	NUMERICSA	18
BFLOAT	9	NUMERICSLB	28
STRING	0	NUMERICSLS	29
CURRENCY	19	NUMERICSTB	31
DATE	3	NUMERICSTS	17
DECIMAL	5	TIME	4
FLOAT	2	TIMESTAMP	20
GUID	27	TIMESTAMP2	34
INTEGER	1	UNSIGNED BINARY	14
LOGICAL	7	WSTRING	25
LSTRING	10	WZSTRING	26
MONEY	6	ZSTRING	11

AUTOINCREMENT

The AUTOINCREMENT key type is a signed Intel integer that can be either 2, 4, or 8 bytes long. Internally, autoincrement keys are stored in Intel binary integer format, with the high-order and low-order bytes reversed within a word. The MicroKernel sorts autoincrement keys by their absolute (positive) values, comparing the values stored in different records a word at a time from right to left. Autoincrement keys may be used to automatically assign the next highest value when a record is inserted into a file. Because the values are sorted by absolute value, the number of possible records is roughly half what you would expect given that the data type is signed.

Values that have been deleted from the file are not reused automatically. If you indicate that you want the database engine to assign the next value by entering a zero (0) value in an insert or update, the database simply finds the highest number, adds 1, and inserts the resulting value.

You can initialize the value of a field in all or some records to zero and later add an index of type AUTOINCREMENT. This feature allows you to prepare for an autoincrement key without actually building the index until it is needed.

When you add the index, the MicroKernel changes the zero values in each field appropriately, beginning its numbering with a value equal to the greatest value currently defined in the field, plus one. If nonzero values exist in the field, the MicroKernel does not alter them. However, the MicroKernel returns an error status code if nonzero duplicate values exist in the field.

The MicroKernel maintains the highest previously used autoincrement value associated with each open file containing an autoincrement key. This value is established and increments only when an INSERT operation occurs for a record with ASCII zeros in the autoincrement field. The value is used by all clients so that concurrent changes can take place, taking advantage of key page concurrency.

The next autoincrement value for a file is raised whenever any INSERT occurs that uses the previous autoincrement value. This happens whether or not the INSERT is in a transaction or the change is committed.

However, this value may be lowered during an INSERT if all of the following are true:

- The highest autoincrement value found in the key is lower than the next autoincrement value for the file.
- No other client has a pending transaction affecting the page that contains the highest autoincrement value.
- The key page containing the highest autoincrement value is not already pending by the client doing the INSERT.

In other words, only the first INSERT within a transaction can lower the next available autoincrement value. After that, the next available autoincrement value simply keeps incrementing.

An example helps clarify how an autoincrement value may be lowered. Assume an autoincrement file exists with records 1, 2, 3, and 4. The next available autoincrement value is 5.

Client1 begins a transaction and inserts two new records, raising the next available autoincrement value to 7. (Client1 gets values 5 and 6). Client2 begins a transaction and also inserts two new records. This raises the next available autoincrement value to 9. (Client 2 gets values 7 and 8).

Client1 the deletes records 4, 5, and 6. The next autoincrement value remains the same, since it is adjusted only on INSERT. Client1 then commits. The committed version of the file now contains records 1, 2, and 3.

For Client2, the file contains records 1, 2, 3, 7, and 8 (7 and 8 are not yet committed). Client2 then inserts another record, which becomes record 9. The next available autoincrement value is raised to 10. Client2 deletes records 3, 7, 8, and 9. For Client2, the file now contains only the committed records 1 and 2.

Next Client2 inserts another record, which becomes record 10. The next available autoincrement value is raised to 11. The next autoincrement value is *not* lowered to 3 since the page containing the change has other changes pending on it.

Client2 then aborts the transaction. The committed version of the file now contains records 1, 2, and 3, but the next available autoincrement value is still 11.

If either client inserts another record, whether or not in a transaction, the next available autoincrement value is *lowered* to 4. This occurs because all of the conditions required for lowering the value are true.

If a resulting autoincrement value is out of range, a Status Code 5 results. The database engine does not attempt to "wrap" the values and start again from zero. You may, however, insert unused values directly if you know of gaps in the autoincrement sequence where a previously inserted value has been deleted.

Restrictions

The following restrictions apply to keys of type AUTOINCREMENT:

- The key must be defined as unique.
- The key cannot be segmented. However, an autoincrement key can be included as an integer segment of another key, as long as the autoincrement key has been defined as a separate, single key first, and the autoincrement key number is lower than the segmented key number.
- The key cannot overlap another key.
- All keys must be ascending.

The MicroKernel treats autoincrement key values as follows when you insert records into a file:

- If you specify a value of binary 0 for the autoincrement key, the MicroKernel assigns a value to the key based on the following criteria:
  - If you are inserting the first record in the file, the MicroKernel assigns the value of 1 to the autoincrement key.
  - If records already exist in the file, the MicroKernel assigns the key a value that is one number higher than the highest existing absolute value in the file.

- If you specify a positive, nonzero value for the autoincrement key, the MicroKernel inserts the record into the file and uses the specified value as the key value. If a record containing that value already exists in the file, the MicroKernel returns an error status code and does not insert the record.

AUTOTIMESTAMP

The AUTOTIMESTAMP key type is an 8-byte unsigned integer for tracking time in nanoseconds based on the Unix epoch. A value of zero prompts the database engine to replace it automatically with the current time when a new record is inserted or the first time an existing record is updated. A nonzero value is allowed and is interpreted as a number of nanoseconds since 1970 UTC.

This key type is available starting in Zen v14 for file formats 9.5 and 13.0. Older database engines that attempt to open a file that has a record that uses this type will return status code 30 for an unrecognized Microkernel file.

The range of AUTOTIMESTAMP values is 1970-01-01 00:00:00.000000000 to 2554-07-21 23:34:33.709551615.

Current Linux and Android system clocks provide true nanosecond resolution. On Windows the highest resolution is septaseconds (10^{-7} second), and on macOS the highest is microseconds. When an AUTOTIMESTAMP key is written on systems that do not support nanosecond resolution, the value is padded with zeros. Accordingly, inserts or updates on these systems without nanosecond resolution can result in duplicate values. However, if the index is set to be unique and the database engine detects a match with the most recent previously generated time stamp, then it adds 1 nanosecond. Duplication can also result from a manually inserted time stamp value or from the resetting of the system clock. In both of these cases, Insert (2) or Update (3) fails with status code 5.

Inserts and Updates Using AUTOTIMESTAMP

Insert (2) and Update (3) operations handle a zero value for an AUTOTIMESTAMP key by retrieving the current time stamp from the system clock on the database engine server. The engine then uses this value in the current record for every AUTOTIMESTAMP key that contains a zero.

For Insert Extended (40), the engine retrieves a new time stamp value for each specified record in the operation. If the AUTOTIMESTAMP key is unique, the engine avoids time stamp duplication among the records by incrementing the generated value by 1 nanosecond if it matches a previously generated time stamp within the operation. As with Insert (2), the time stamp generated for each record is used for all AUTOTIMESTAMP keys in that record.

When an Update Chunk (53) operation attempts to write to the fixed portion of a record that includes an AUTOTIMESTAMP key, the engine does not retrieve a new time stamp. Instead, the provided key value is accepted as is and placed in the record. Therefore, using an Update Chunk operation with a zero value to update an AUTOTIMESTAMP key results in storing the zero value in the record, which is then interpreted as 1970 UTC. If you wish to update the key with an automatically generated time stamp, use the Update (3) operation to update the fixed portion of a record.

Restrictions

The following restrictions apply when you create a key of type AUTOTIMESTAMP:

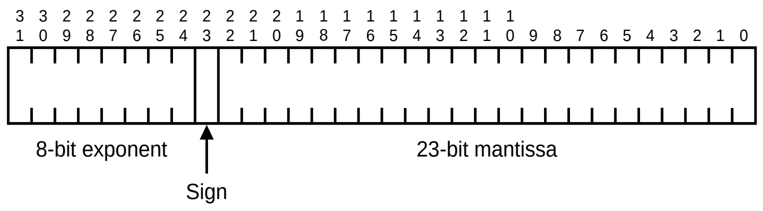
- The NOCASE flag cannot be applied to the key.
- NULL_KEY and MANUAL_KEY are not allowed, since the time stamp cannot be excluded from the index.

Usage in Function Executor and Maintenance Tools

The use of AUTOTIMESTAMP keys in Function Executor or the Maintenance tool is similar to AUTOINCREMENT keys. For the files that use them, the key type is listed as Atstamp, which also appears in the output of `butil <filename> -stat` and is used for the key type in the description file for a `butil -create` command.

BFLOAT

The BFLOAT key type is a single or double-precision real number. A single-precision real number is stored with a 23-bit mantissa, an 8-bit exponent biased by 128, and a sign bit. The internal layout for a 4-byte float is as follows:



The representation of a double-precision real number is the same as that for a single-precision real number, except that the mantissa is 55 bits instead of 23 bits. The least significant 32 bits are stored in bytes 0 through 3.

The BFLOAT type is commonly used in legacy BASIC applications. Microsoft refers to this data type as MBF (Microsoft Binary Format), and no longer supports this type in the Visual Basic environment. New database definitions should use FLOAT rather than BFLOAT.

STRING

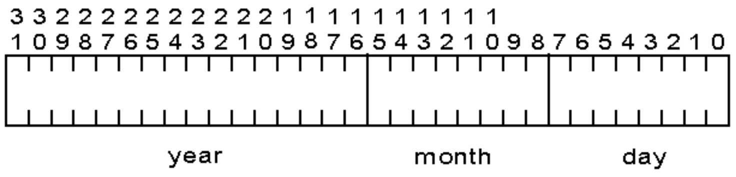
The STRING key type is a sequence of characters ordered from left to right. Each character is represented in ASCII format in a single byte, except when the MicroKernel is determining whether a key value is null. STRING data is expected to be padded with blanks to the full size of the key.

CURRENCY

The CURRENCY key type represents an 8-byte signed quantity, sorted and stored in Intel binary integer format. Therefore, its internal representation is the same as an 8-byte INTEGER data type. The CURRENCY data type has an implied four digit scale of decimal places, which represents the fractional component of the currency data value.

DATE

The DATE key type is stored internally as a 4-byte value. The day and the month are each stored in 1-byte binary format. The year is a 2-byte binary number that represents the entire year value. The MicroKernel places the day into the first byte, the month into the second byte, and the year into a two-byte word following the month.



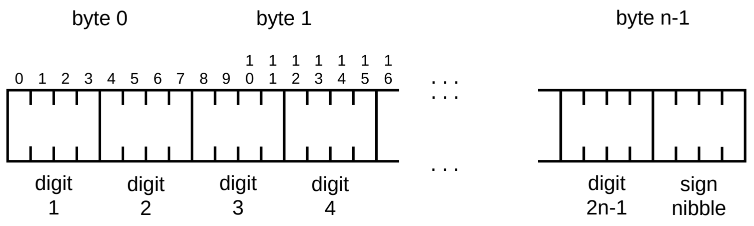
An example of C structure used for date fields would be:

```
TYPE dateField {
char day;
char month;
integer year;
}
```

The year portion of a date field is expected to be set to the integer representation of the entire year. For example, 2,001 for the year 2001.

DECIMAL

The DECIMAL key type is stored internally as a packed decimal number with two decimal digits per byte. The internal representation for an *n*-byte DECIMAL field is as follows:



The decimal point for DECIMAL is implied. No decimal point is stored in the DECIMAL field. Your application is responsible for tracking the location of the decimal point for the value in a DECIMAL field. All values for a DECIMAL key type must have the same number of decimal places for the database engine to collate the key correctly. The DECIMAL type is commonly used in COBOL applications.

An eight-byte decimal can hold 15 digits plus the sign. A ten-byte decimal can hold 19 digits plus the sign. The decimal value is expected to be left-padded with zeros.

The sign nibble is either 0xF or 0xC for positive numbers and 0xD for negative numbers. By default, the Relational Engine and the SDK access methods that use it always write 0xF as the positive sign nibble for a DECIMAL. They can interpret both 0xF and 0xC as being positive on a read operation.

A setting in the registry (Windows Registry and Zen Registry) controls what the database engine uses for the positive sign nibble for a DECIMAL. If you need to change the default positive sign nibble **to** 0xC, edit the registry as explained below.

Windows

In Registry Editor, change the value of CommonCOBOLDecimalSign to yes for the following key:

HKEY_LOCAL_MACHINE\SOFTWARE\Actian\Zen\SQL Relational Engine

In most Windows systems, the key is under HKEY_LOCAL_MACHINE\SOFTWARE\Actian\Zen. However, its location below HKEY_LOCAL_MACHINE\SOFTWARE can vary depending on the operating system.

Caution! Editing the registry is an advanced procedure. If done improperly, the editing could cause your operating system not to boot. If necessary, obtain the services of a qualified technician to perform the editing. Actian Corporation does not accept responsibility for a damaged registry.

Linux and macOS

For Linux 32-bit operating systems, run the psregedit utility as follows:

```
./psregedit -set -key PS_HKEY_CONFIG/SOFTWARE/Actian/Zen/"SQL Relational Engine" -value
"CommonCOBOLDecimalSign" -type PS_REG_STR "YES"
```

For Linux and macOS 64-bit operating systems, run the psregedit utility as follows:

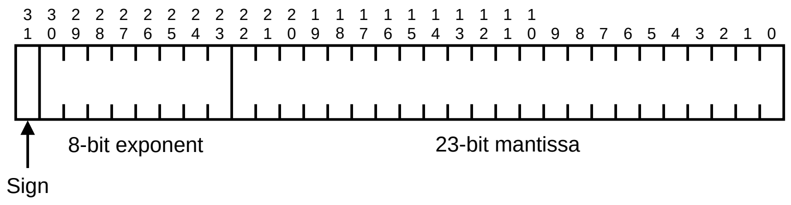
```
./psregedit -set -key PS_HKEY_CONFIG_64/SOFTWARE/Actian/Zen/"SQL Relational Engine" -value
"CommonCOBOLDecimalSign" -type PS_REG_STR "YES"
```

See also psregedit in *Zen User's Guide*.

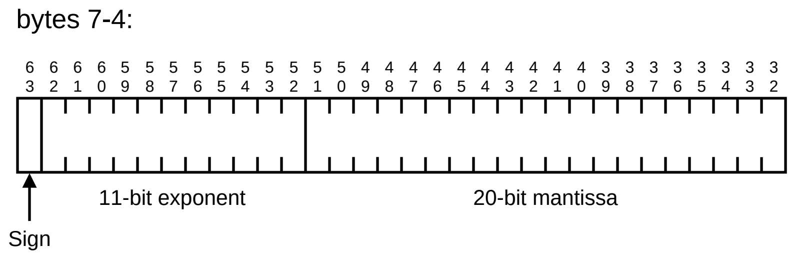
FLOAT

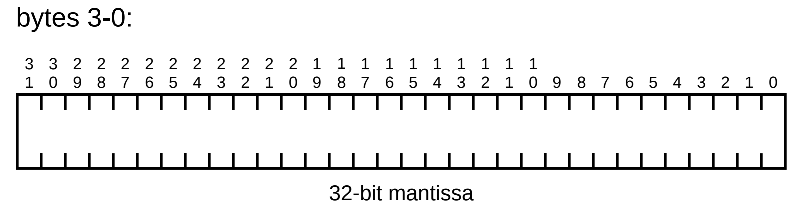
Caution! Precision beyond that supported by the C-language definitions for the FLOAT (4-byte) or DOUBLE (8-byte) data type will be lost. If you require precision to many decimal points, consider using the DECIMAL type.

The FLOAT key type is consistent with the IEEE standard for single and double-precision real numbers. The internal format for a 4-byte FLOAT consists of a 23-bit mantissa, an 8-bit exponent biased by 127, and a sign bit, as follows:



A FLOAT key with 8 bytes has a 52-bit mantissa, an 11-bit exponent biased by 1023, and a sign bit. The internal format is as follows:





GUID

The GUID key type is a 16-byte number that is stored internally as a 16-byte binary value. Its extended data type value is 27.

GUIDs are commonly used as globally unique identifiers. The corresponding data type for the Relational Engine is UNIQUEIDENTIFIER.

Note that GUID requires a file format of 9.5 or higher.

GUID Keys

The sort order for the bytes composing the GUID are compared in the following sequence: 10, 11, 12, 13, 14, 15, 8, 9, 6, 7, 4, 5, 0, 1, 2, 3.

The key segment length for a GUID must be 16 bytes. See Key Specification Block in *Btrieve API Guide*.

INTEGER

The INTEGER key type is a signed whole number and can contain any number of digits. Internally, INTEGER fields are stored in Intel binary integer format, with the high-order and low-order bytes reversed within a word. The MicroKernel evaluates the key from right to left. The sign must be stored in the high bit of the rightmost byte. The INTEGER type is supported by most development environments.

Length in Bytes	Value Ranges
1	0 – 255
2	-32768 – 32767
4	-2147483648 – 2147483647
8	-9223372036854775808 – 9223372036854775807

LOGICAL

The LOGICAL key type is stored as a 1 or 2-byte value. The MicroKernel collates LOGICAL key types as strings. Doing so allows your application to determine the stored values that represent true or false.

LSTRING

The LSTRING key type has the same characteristics as a regular STRING type, except that the first byte of the string contains the binary representation of the string length. The LSTRING key type is limited to a maximum size of 255 bytes. The length stored in byte 0 of an LSTRING key determines the number of significant bytes. The database engine ignores any values beyond the specified length of the string when sorting or searching for values. The LSTRING type is commonly used in legacy Pascal applications.

MONEY

The MONEY key type has the same internal representation as the DECIMAL type, with an implied two decimal places.

NUMERIC

Each digit of a NUMERIC key type occupies one byte. NUMERIC values are stored as ASCII strings right-aligned with leading zeros. The rightmost byte includes an embedded sign with an EBCDIC value. By default, the sign value for positive NUMERIC data types is an unsigned numeric number.

Optionally, you may specify that you want to shift the value of the sign for positive NUMERIC data types. The following table compares the sign values in the default (unshifted) and shifted states.

Digit	Default (unshifted) Sign Value		Shifted Sign Value	
	Positive	**Negative**	**Positive**	**Negative**
1	1	J	A	J
2	2	K	B	K
3	3	L	C	L
4	4	M	D	M
5	5	N	E	N
6	6	O	F	O
7	7	P	G	P
8	8	Q	H	Q
9	9	R	I	R
0	0	}	{	}

Enabling the Shifted Format

You must manually specify a setting on the machine running the Zen database engine to enable the shifted format. The setting **DBCobolNumeric** must be set to yes. The rest of this topic summarizes use of this setting on Windows 32-bit, Linux, and macOS platforms.

Windows 32-Bit

Using the Registry Editor, add the DBCobolNumeric setting as a string value to the following key:

HKEY_LOCAL_MACHINE\SOFTWARE\Actian\Zen\Database Names

Set the string value for DBCobolNumeric to `yes`.

In most Windows systems, the key is HKEY_LOCAL_MACHINE\SOFTWARE\Actian\Zen, but its location under HKEY_LOCAL_MACHINE\SOFTWARE varies depending on the operating system.

Caution! If the Windows registry is edited improperly, Windows may be unable to start. Only a trained IT person should do the editing. Actian Corporation does not accept responsibility for a damaged Windows registry.

Stop and restart the database engine or the engine services.

Linux and macOS

Add the DBCobolNumeric setting to **bti.ini** below the [Database Names] entry:

```
[Database Names]
DBCobolNumeric=yes
```

By default, bti.ini is located in the /usr/local/actianzen/etc directory.

Stop and restart the database engine.

Consistent Sign Values for Positive NUMERIC Data

You may already have positive NUMERIC data with the sign value in the default (unshifted) format. If you set DBCobolNumeric to yes and continue adding data to the same table, mixed formats result. Leaving your data with mixed formats for the sign value is not recommended.

To correct or prevent a condition of mixed formats, use the UPDATE statement to update NUMERIC columns to themselves. For example, suppose that table t1 contains column c1 that is a NUMERIC data type. After you set DBCobolNumeric to yes, update c1 as follows: UPDATE TABLE t1 SET c1 = c1.

NUMERICSA

The NUMERICSA key type (sometimes called NUMERIC SIGNED ASCII) is a COBOL data type identical to NUMERIC, except that the embedded sign has an ASCII instead of an EBCDIC value.

Digit	Default Sign Value	
	Positive	Negative
1	1 or Q	q
2	2 or R	r
3	3 or S	s
4	4 or T	t

Digit	Default Sign Value	
	Positive	Negative
5	5 or U	u
6	6 or V	v
7	7 or W	w
8	8 or X	x
9	9 or Y	y
0	0 or P	p

NUMERICSLB

The NUMERICSLB key type (sometimes called SIGN LEADING with COBOL compiler option -dcb) is a COBOL data type that has values resembling those of the NUMERIC data type. NUMERICSLB values are stored as ASCII strings and right justified with leading zeros.

Digit	Default Sign Value	
	Positive	Negative
1	1	A
2	2	B
3	3	C
4	4	D
5	5	E
6	6	F
7	7	G
8	8	H
9	9	I
0	0	@

NUMERICSLS

The NUMERICSLS key type (sometimes called SIGN LEADING SEPARATE) is a COBOL data type that has values resembling those of the NUMERIC data type. NUMERICSLS values are stored as ASCII strings and left justified with leading zeros. However, the leftmost byte of a NUMERICSLS string is either "+" (ASCII 0x2B) or "-" (ASCII 0x2D). This differs from NUMERIC values that embed the sign in the rightmost byte along with the value of that byte.

NUMERICSTB

The NUMERICSTB key type (sometimes called SIGN TRAILING with COBOL compiler option -dcb) is a COBOL data type that has values resembling those of the NUMERIC data type. NUMERICSTB values are stored as ASCII strings and right justified with leading zeros.

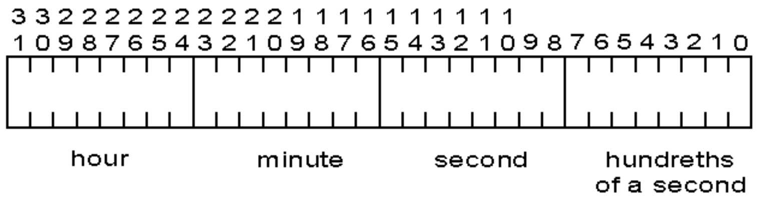
Digit	Default Sign Value	
	Positive	Negative
1	1	A
2	2	B
3	3	C
4	4	D
5	5	E
6	6	F
7	7	G
8	8	H
9	9	I
0	0	@

NUMERICSTS

The NUMERICSTS key type (sometimes called SIGN TRAILING SEPARATE) is a COBOL data type that has values resembling those of the NUMERIC data type. NUMERICSTS values are stored as ASCII strings and right justified with leading zeros. However, the rightmost byte of a NUMERICSTS string is either "+" (ASCII 0x2B) or "-" (ASCII 0x2D). This differs from NUMERIC values that embed the sign in the rightmost byte along with the value of that byte.

TIME

The TIME key type is stored internally as a 4-byte value. Hundredths of a second, second, minute, and hour values are each stored in 1-byte binary format. The MicroKernel places the hundredths of a second value in the first byte, followed respectively by the second, minute, and hour values. The data format is hh:mm:ss.nn. Supported values range from 00:00:00.00 to 23:59:59.99.



TIMESTAMP

The TIMESTAMP key type represents a time and date value. In SQL applications, use this data type to stamp a record with the current time and date of the last update to the record. TIMESTAMP values are stored in 8-byte unsigned values representing septaseconds (10^-7 second) since January 1, 0001 in a Gregorian calendar, Coordinated Universal Time (UTC). Supported values range from 0001-01-01 00:00:00.0000000 to 9999-12-31 23:59:59.9999999.

Unlike AUTOTIMESTAMP, a value of zero is not automatically replaced with the current time when a new record is inserted or the first time an existing record is updated.

Note: According to the ODBC standard, scalar functions such as CURRENT_TIMESTAMP() or NOW() ignore the portion of the data type that represents fractional seconds. It is important to note that when these functions are used, Zen does not ignore fractional seconds and displays three digits for milliseconds.

TIMESTAMP supports time and data values made up of the following components: year, month, day, hour, minute, second, and millisecond. The following table indicates the range of valid values for each of these components.

YEAR	0001 to 9999
MONTH	01 to 12
DAY	01 to 31, constrained by the value of MONTH and YEAR in the Gregorian calendar.
HOUR	00 to 23
MINUTE	00 to 59
SECOND	00 to 59
MILLISECOND	000 to 999. Default setting. Scale can be set to a value of 0 to 7 (septaseconds).

Each TIMESTAMP value contains a complete date and time value with the maximum scale supported by the local operating system, filled if needed with trailing zeros. When this value is returned, it uses the scale set for the time stamp. For example, the value is returned in milliseconds when the scale is 3 and microseconds when it is 6.

For more information about scale for date and time data types, see Scale of Time Stamp Data Types and Returned Function Values.

You provide the value of a TIMESTAMP in local time and the Relational Engine converts it to Coordinated Universal Time (UTC) before storing it in a record. When you request a TIMESTAMP value, the Relational Engine returns it converted back to local time.

Caution! It is critical that you correctly set time zone information on the computer where the database engine runs. If you move across time zones or change time zone information, the returned data will change when it is converted from UTC to local time. The local time and UTC conversions occur in the Relational Engine using the time zone information where the Relational Engine is running. The time zone information for sessions that are in time zones different from the Relational Engine engine are not used in the local time and UTC conversions.

Because time stamp data is converted to UTC before it is stored, the TIMESTAMP type is inappropriate for use with local time and local date data that reference events external to the database itself, particularly in time zones where seasonal time changes take place, such as Daylight Savings Time in the United States.

For example, assume it is October 15, and you enter a time stamp value to track an appointment on November 15 at 10 a.m. Assume you are in the U. S. Central Time Zone. When the Relational Engine stores the value, it converts it to UTC using current local time information (UTC-5 hours for CDT). So it stores the hour value 15. Assume, on November 1, you check the time of your appointment. Your computer is now in Standard Time, because of the switch that occurred in October, so the conversion is (UTC-6 hours). When you extract the appointment time, it will show 9 a.m. local time (15 UTC - 6 CST), which is not the correct appointment time.

The same type of issue will occur if a database engine is moved from one time zone to another.

Because the Relational Engine does not convert DATE and TIME values to UTC, you should almost always use DATE and TIME columns to record external data. The only reason to use a TIMESTAMP column is a need for the specific ability to determine the sequential time order of records entered into the database.

Usage in Function Executor and Maintenance Tools

The use of TIMESTAMP keys in Function Executor or the Maintenance tools is similar to AUTOINCREMENT keys. For the files that use them, the key type is listed as Tstamp, which also appears in the output of `butil <filename> -stat` and is used for the key type in the description file for a `butil -create` command.

TIMESTAMP2

The TIMESTAMP2 key type tracks time in nanoseconds based on the Unix epoch. In SQL applications, use this data type to stamp a record with the current time and date of the last update to the record. Values are stored in 8-byte unsigned values representing nanoseconds (10^-9 second) since January 1, 1970 in a Gregorian calendar, Coordinated Universal Time (UTC). Supported values range from 1970-01-01 00:00:00.000000000 to 2554-07-21 23:34:33.709551615.

Unlike AUTOTIMESTAMP, a value of zero is not automatically replaced with the current time when a new record is inserted or the first time an existing record is updated.

This key type is available starting in Zen v14 SP1 for file formats 9.5 and 13.0. Older database engines that attempt to open a file that has a record that uses this type will return status code 30 for an unrecognized Microkernel file.

Note: According to the ODBC standard, scalar functions such as CURRENT_TIMESTAMP() or NOW() ignore the portion of the data type that represents fractional seconds. It is important to note that when these functions are used, Zen does not ignore fractional seconds and displays nine digits for nanoseconds.

TIMESTAMP2 supports time and data values made up of the following components: year, month, day, hour, minute, second, and nanosecond. The following table indicates the range of valid values for each of these components.

YEAR	1970 to 2554
MONTH	01 to 12
DAY	01 to 31, constrained by the value of MONTH and YEAR in the Gregorian calendar.
HOUR	00 to 23
MINUTE	00 to 59
SECOND	00 to 59
NANOSECOND	000000000 to 999999999. Default setting.

Each TIMESTAMP2 value contains a complete date and time value with the maximum scale supported by the local operating system, filled if needed with trailing zeros. When this value is returned, it uses the scale set for the time stamp. For example, the value is returned in milliseconds when the scale is 3 and microseconds when it is 6.

For more information about scale for date and time data types, see Scale of Time Stamp Data Types and Returned Function Values.

You provide the value of a TIMESTAMP2 in local time and the Relational Engine converts it to Coordinated Universal Time (UTC) before storing it in a record. When you request a TIMESTAMP2 value, the Relational Engine returns it converted back to local time.

Caution! It is critical that you correctly set time zone information on the computer where the database engine runs. If you move across time zones or change time zone information, the returned data will change when it is converted from UTC to local time. The local time and UTC conversions occur in the Relational Engine using the time zone information where the Relational Engine is running. The time zone information for sessions that are in time zones different from the Relational Engine engine are not used in the local time and UTC conversions.

Because time stamp data is converted to UTC before it is stored, the TIMESTAMP2 type is inappropriate for use with local time and local date data that reference events external to the database itself, particularly in time zones where seasonal time changes take place (such as Daylight Savings Time in the United States).

For example, assume it is October 15, and you enter a time stamp value to track an appointment on November 15 at 10 a.m. Assume you are in the U. S. Central Time Zone. When the Relational Engine stores the value, it converts it to UTC using current local time information (UTC-5 hours for CDT). So it stores the hour value 15. Assume, on November 1, you check the time of your appointment. Your computer is now in Standard Time, because of the switch that occurred in October, so the conversion is (UTC-6 hours). When you extract the appointment time, it will show 9 a.m. local time (15 UTC - 6 CST), which is not the correct appointment time.

The same type of issue will occur if a database engine is moved from one time zone to another.

Because the Relational Engine does not convert DATE and TIME values to UTC, you should almost always use DATE and TIME columns to record external data. The only reason to use a TIMESTAMP2 column is a need for the specific ability to determine the sequential time order of records entered into the database.

Usage in Function Executor and Maintenance Tools

The use of TIMESTAMP2 keys in Function Executor or the Maintenance tools is similar to AUTOINCREMENT keys. For the files that use them, the key type is listed as TS2, which also appears in the output of `butil <filename> -stat` and is used for the key type in the description file for a `butil -create` command.

UNSIGNED BINARY

UNSIGNED BINARY keys can be any number of bytes up to the maximum key length of 255. UNSIGNED keys are compared byte-for-byte from the most significant byte to the least significant byte. The first byte of the key is the least significant byte. The last byte of the key is the most significant.

The database engine sorts UNSIGNED BINARY keys as unsigned INTEGER keys. The differences are that an INTEGER has a sign bit, while an UNSIGNED BINARY type does not, and an UNSIGNED BINARY key can be longer than 4 bytes.

WSTRING

WSTRING is a Unicode string that is not null-terminated. The length of the string is determined by the field length.

WZSTRING

WZSTRING is a Unicode string that is double null-terminated. The length of this string is determined by the position of the Unicode NULL (two null bytes) within the field. This corresponds to the ZSTRING type supported in Btrieve.

ZSTRING

The ZSTRING key type corresponds to a C string. It has the same characteristics as a regular string type except that a ZSTRING type is terminated by a binary 0. The MicroKernel ignores any values beyond the first binary 0 it encounters in the ZSTRING, except when the MicroKernel is determining whether a key value is null.

The maximum length of a ZSTRING type is 255 bytes, including the null terminator character. If used as a key for a nullable column, only the first 254 bytes of the string are used in the key. This minor limitation occurs because the key is limited to 255 bytes total length, and one byte is occupied by the null indicator for the column, leaving only 254 bytes for the key value.

Non-Key Data Types

This topic discusses the internal storage formats of data types that cannot be indexed (used as Btrieve keys).

BLOB

The Binary Large Object (BLOB) type provides support for binary data fields up to 2 GB in size. This type consists of 2 parts:

- an 8-byte header in the fixed-length portion of the record. The header contains a 4-byte integer that identifies the offset to the beginning of the data in the variable-length portion of the record, and a 4-byte integer that specifies the size of the data.
- the binary data itself is stored within the variable-length portion of the record. The size of all BLOB and CLOB fields must sum to 2 GB or less, because the offset pointer into the variable-length portion of the record is limited to 2 GB maximum offset. To store the maximum BLOB size of 2 GB, you may have only 1 BLOB or CLOB field defined in the record.

For additional information, see BINARY and LONGVARBINARY and Limitations on LONGVARCHAR, NLONGVARCHAR and LONGVARBINARY.

CLOB

The Character Large Object (CLOB) type provides support for character data fields up to 2 GB in size. This type consists of 2 parts:

- An 8-byte header in the fixed-length portion of the record. The header contains a 4-byte integer that identifies the offset to the beginning of the data in the variable-length portion of the record, and a 4-byte integer that specifies the size of the data in bytes.
- The character data itself is stored within the variable-length portion of the record. The size of all BLOB and CLOB fields must sum to 2 GB or less, because the offset pointer into the variable-length portion of the record is limited to 2 GB maximum offset. To store the maximum BLOB size of 2 GB, you may have only 1 BLOB or CLOB field defined in the record.

For additional information, see CHAR, NCHAR, VARCHAR, NVARCHAR, LONGVARCHAR, and NLONGVARCHAR and Limitations on LONGVARCHAR, NLONGVARCHAR and LONGVARBINARY.

B. SQL Reserved Words

Reserved words are SQL keywords and other symbols that have special meanings when they are processed by the Relational Engine. Reserved words are not recommended for use as database, table, column, variable or other object names. If a reserved word is used as an object name, it must be enclosed in double-quotes to notify the Relational Engine that the word is not being used as a keyword in the given context.

You can avoid having to worry about reserved words by always enclosing user-defined object names in double-quotes.

This appendix contains the following topic:

- Reserved Words
- Words to Avoid

Reserved Words

Each of the symbols or words listed below has a special meaning when processed by the Relational Engine unless it is delimited by double quotation marks. Using one of these words as a table or object name without the quotation marks will cause an error.

See also the next topic, Words to Avoid.

Symbols

#	;	:	@

A

ABORT	ACCELERATED	ADD
AFTER	ALL	ALTER
AND	ANSI_PADDING	ANY
AS	ASC	ATOMIC
AVG		

B

BEFORE	BEGIN	BETWEEN
BORDER	BY	

C

CALL	CACHED_PROCEDURES	CASCADE
CASE	CAST	CHECK
CLOSE	COALESCE	COLLATE
COLUMN	COMMIT	COMMITTED
CONSTRAINT	CONVERT	COUNT
CREATE	CREATESP	CREATETAB
CREATEVIEW	CROSS	CS
CURDATE	CURRENT	CURSOR
CURTIME		

D

DATA_PATH	DATABASE	DATETIMEMILLISECONDS
DBO	DBSEC_AUTHENTICATION	DBSEC_AUTHORIZATION

DCOMPRESS	DDF	DECIMALSEPARATORCOMMA
DECLARE	DEFAULT	DEFAULTCOLLATE
DELETE	DENY	DESC
DIAGNOSTICS	DICTIONARY	DICTIONARY_PATH
DISTINCT	DO	DROP
DSN		

E

EACH	ELSE	ENCODING
END	ENFORCED	EX
EXCLUSIVE	EXEC	EXECUTE
EXISTING	EXISTS	EXPR

F

FETCH	FILES	FN
FOR	FOREIGN	FROM
FULL	FUNCTION	

G

GLOBAL_QRYPLAN	GRANT	GROUP

H

HANDLER	HAVING

I

IF	IN	INDEX
INNER	INOUT	INSERT
INTEGRITY	INTERNAL	INTO
IS	ISOLATION	

J

JOIN

K

KEY

L

LEAVE	LEFT	LEGACYOWNERNAME
LEVEL	LIKE	LIMIT
LINKDUP	LOGIN	LOOP

M

MAX	MIN	MODE
MODIFIABLE	MODIFY	

N

NEW	NEXT	NO
NO_REFERENTIAL_INTEGRITY	NORMAL	NOT
NOW	NULL	

O

OF	OFF	OFFSET
OLD	ON	ONLY
OPEN	OPTINNERJOIN	OR
ORDER	OUT	OUTER
OVER	OWNER	

P

PAGESIZE	PARTIAL	PARTITION
PASSWORD	PCOMPRESS	PRECEDING
PRED	PRIMARY	PRINT
PROCEDURE	PROCEDURES_CACHE	PSQL_MOVE
PSQL_PHYSICAL	PSQL_POSITION	PUBLIC

Q

QRYPLAN	QRYPLANOUTPUT

R

READ	REFERENCES	REFERENCING
RELATIONAL	RELEASE	RENAME
REPEAT	REPEATABLE	REPLACE
RESTRICT	RETURN	RETURNS
REUSE_DDF	REVERSE	REVOKE
RIGHT	ROLLBACK	ROW
ROWS	ROWCOUNT	ROWCOUNT2

S

SAVEPOINT	SECURITY	SELECT
SERIALIZABLE	SESSIONID	SET
SIGNAL	SIZE	SPID
SQLSTATE	SSP_EXPR	SSP_PRED
START	STDEV	SUM
SVBEGIN	SVEND	

T

T	TABLE	THEN
TO	TOP	TRANSACTION
TRIGGER	TRIGGERSTAMPMISC	TRUEBITCREATE
TRUENULLCREATE	TRY_CAST	TS

U

UNBOUNDED	UNCOMMITTED	UNION

UNIQUE	UNIQUEIDENTIFIER	UNTIL
UPDATE	USER	USING

V

V1_METADATA	V2_METADATA	VALUES
VIEW		

W

WHEN	WHERE	WHILE
WITH	WORK	WRITE

Words to Avoid

The following table lists keywords from the SQL-92 and SQL-99 ANSI standards, as well as additional keywords recognized by Zen. We recommend you avoid using these words as names for tables, columns, or other objects unless you enclose them in double quotation marks. Actian Corporation reserves the right to add support for any of these keywords as well as any future ANSI SQL keywords in future releases, which would then cause them to be included in this list.

If you use double quotation marks to delimit all table, column, and user-defined object names, then you do not need to worry about possible future conflicts with reserved words.

See also the topic Reserved Words.

ABSOLUTE	ACTION	ADD
ALL	ALLOCATE	ALTER
AND	ANY	ARE
AS	ASC	ASSERTION
AT	AUTHORIZATION	AVG
BEGIN	BETWEEN	BIGIDENTITY
BIT	BIT_LENGTH	BOTH
BY	CASCADE	CASCADED
CASE	CAST	CATALOG
CHAR	CHARACTER	CHAR_LENGTH
CHARACTER_LENGTH	CHECK	CLOSE

COALESCE	COLLATE	COLLATION
COLUMN	COMMIT	CONNECT
CONNECTION	CONSTRAINT	CONSTRAINTS
CONTINUE	CONVERT	CORRESPONDING
COUNT	CREATE	CROSS
CURRENT	CURRENT_DATE	CURRENT_TIME
CURRENT_TIMESTAMP	CURRENT_USER	CURSOR
DATE	DAY	DEALLOCATE
DEC	DECIMAL	DECLARE
DEFAULT	DEFERRABLE	DEFERRED
DELETE	DESC	DESCRIBE
DESCRIPTOR	DIAGNOSTICS	DISCONNECT
DISTINCT	DOMAIN	DOUBLE
DROP	ELSE	END
END-EXEC	ESCAPE	EXCEPT
EXCEPTION	EXEC	EXECUTE
EXISTS	EXTERNAL	EXTRACT
FALSE	FETCH	FIRST
FLOAT	FOR	FOREIGN
FOUND	FROM	FULL
FUNCTION	GET	GLOBAL
GO	GOTO	GRANT
GROUP	HAVING	HOUR
IDENTITY	IMMEDIATE	IN
INDICATOR	INITIALLY	INNER
INPUT	INSENSITIVE	INSERT
INT	INTEGER	INTERSECT
INTERVAL	INTO	IS
ISOLATION	JOIN	KEY
LANGUAGE	LAST	LEADING
LEFT	LEVEL	LIKE
LIMIT	LOCAL	LOWER
MASK	MATCH	MAX
MIN	MINUTE	MODULE
MONTH	NAMES	NATIONAL

NATURAL	NCHAR	NEXT
NO	NOT	NLONGVARCHAR
NULL	NULLIF	NUMERIC
NVARCHAR	OCTET_LENGTH	OF
OFFSET	ON	ONLY
OPEN	OPTION	OR
ORDER	OUTER	OUTPUT
OVERLAPS	PAD	PARTIAL
PASSWORD	POSITION	PRECISION
PREPARE	PRESERVE	PRIMARY
PRIOR	PRIVILEGES	PROCEDURE
PUBLIC	READ	REAL
REFERENCES	RELATIVE	RESTRICT
REVERSE	REVOKE	RIGHT
ROLLBACK	ROWS	SCHEMA
SCROLL	SECOND	SECTION
SELECT	SESSION	SESSION_USER
SET	SIZE	SMALLIDENTITY
SMALLINT	SOME	SPACE
SQL	SQLCODE	SQLERROR
SQLSTATE	STDEV	SUBSTRING
SUM	SYSDATETIME	SYSUTCDATETIME
SYSTEM_USER	TABLE	TEMPORARY
THEN	TIME	TIMESTAMP
TIMESTAMP2	TIMEZONE_HOUR	TIMEZONE_MINUTE
TO	TRAILING	TRANSACTION
TRANSLATE	TRANSLATION	TRIM
TRUE	TRY_CAST	UNION
UNIQUE	UNKNOWN	UPDATE
UPPER	USAGE	USER
USING	VALUE	VALUES
VARCHAR	VARYING	VIEW
WHEN	WHENEVER	WHERE
WITH	WORK	WRITE
YEAR	ZONE	

C. System Tables

The following topics cover Zen system tables:

- Overview
- System Tables Structure

Overview

The information used by Zen and its components is stored in special tables called system tables.

Caution! Do not attempt to modify system tables with DELETE, UPDATE, or INSERT statements, or user-defined triggers. System tables should never be altered directly.

Do not write your applications to query system tables directly. Some columns in system tables may not be documented. Your application can retrieve information stored in system tables by using any of the following methods:

- System Stored Procedures
- Transact-SQL statements and functions
- Functions provided in the Zen APIs

The Zen APIs are documented in the developer documentation. The development components are designed to remain compatible with the database engine from release to release. The format of the system tables depends on the internal architecture of the database engine, which may change from release to release. Applications that directly access undocumented columns of system tables may have to be changed if the internal architecture of Zen changes.

The following list of system tables gives the names of associated files and identifies system table contents.

Note: Some data in the system tables cannot be displayed. User passwords, for example, are displayed in their encrypted form.

System Table	Dictionary File		Contents
	V1[1]	V2[2]	
X$Attrib	ATTRIB.DDF	PVATTRIB.DDF	Column attributes definitions.

System Table	Dictionary File		Contents
	V1[1]	V2[2]	
X$Depend	DEPEND.DDF	PVDEPEND.DDF	Trigger dependencies such as tables, views, and procedures
X$Field	FIELD.DDF	PVFIELD.DDF	Column and named index definitions.
X$File	FILE.DDF	PVFILE.DDF	Names and locations of the tables in your database.
X$Index	INDEX.DDF	PVINDEX.DDF	Index definitions.
X$Proc	PROC.DDF	PVPROC.DDF	Stored procedure definitions.
X$Relate	RELATE.DDF	PVRELATE.DDF	Referential integrity (RI) information.
X$Rights	RIGHTS.DDF	PVRIGHTS.DDF	User and group access rights definitions.
X$Trigger	TRIGGER.DDF	PVTRIG.DDF	Trigger information.
X$User	USER.DDF	PVUSER.DDF	User names, group names, and passwords.
X$View	VIEW.DDF	PVVIEW.DDF	View definitions.

[1]Applies to version 1 (V1) metadata. See Zen Metadata.

[2]Applies to version 2 (V2) metadata. See Zen Metadata.

Zen creates all of the system tables when you create a database.

Two other system tables that you may encounter are VARIANT.DDF and OCCURS.DDF (for a V1 database) and PVVARIANT.DDF and PVOCCURS.DDF (for a V2 database).These two system files are used for COBOL support and do not require any direct intervention by a user. Future versions of the utilities for COBOL may implement a different architecture, in which case these system tables may no longer be required. See also SQL Access for COBOL Applications.

System Tables Structure

This topic discusses the structure of the system tables:

- V1 Metadata System Tables
- V2 Metadata System Tables

V1 Metadata System Tables

X$Attrib

The X$Attrib system table is associated with the file ATTRIB.DDF. X$Attrib contains information about the column attributes of each column in the database. There is an entry for each column attribute you define. The structure of X$Attrib for V1 metadata is described in the following table.

Column Name	Type	Size	Case Insensitive	Description
Xa$Id	USMALLINT	2	not applicable	Corresponds to Xe$Id in X$Field.
Xa$Type	CHAR	1	No	D (default) L (logical positioning) O (column collation) C (character); H (heading); M (mask); R (range); or V (value)[1]
Xa$ASize	USMALLINT	2	not applicable	Length of text in Xa$Attrs.
Xa$Attrs	LONGVARCHAR (NOTE)	<=2048	not applicable	Text that defines the column attribute.

[1]Attribute type C, H, M, R and V are legacy validation types valid only in a Pervasive.SQL 7 or Scalable SQL environment. Zen releases newer than Pervasive.SQL 7 use only the D (default), L (logical positioning), and O (column collation) attributes.

When you define multiple attributes for a single column, the X$Attrib system table contains multiple entries for that column ID—one for each attribute you define. If you do not define column attributes for a particular column, that column has no entry in the X$Attrib table. The text in the Xa$Attrs column appears exactly as you define it with Zen. One index is defined for the X$Attrib table, as explained in the preceding table:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xa$Id	No	not applicable	Yes
0	1	Xa$Type	No	No	No

X$Depend

The X$Depend system table is associated with the file DEPEND.DDF. X$Depend contains information about trigger dependencies such as tables, views, and procedures. The structure of X$Depend is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xd$Trigger	CHAR	30	Yes	Name of trigger. It corresponds to Xt$Name in X$Trigger.
Xd$DependType	UNSIGNED	1	not applicable	1 for Table, 2 for View, 3 for Procedure.
Xd$DependName	CHAR	30	Yes	Name of dependency with which the trigger is associated. It corresponds to either Xf$Name in X$File, Xv$Name in X$View, or Xp$Name in X$Proc.

Two indexes are defined for the X$Depend table as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xd$Trigger	No	Yes	Yes
0	1	Xd$DependType	No	not applicable	Yes
0	2	Xd$DependName	No	Yes	No
1	0	Xd$DependType	Yes	not applicable	Yes
1	1	Xd$DependName	Yes	Yes	No

Index Number corresponds to the value stored in the Xi$Number column in the X$Index system table. Segment Number corresponds to the value stored in the Xi$Part column in the X$Index system table.

X$Field

The X$Field system table is associated with the file FIELD.DDF. X$Field contains information about all the columns and named indexes defined in the database. The structure of X$Field is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xe$Id	USMALLINT	2	not applicable	Internal ID assigned by Zen, unique for each field in the database
Xe$File	USMALLINT	2	not applicable	ID of table to which this column or named index belongs. It corresponds to Xf$Id in X$File.
Xe$Name	CHAR	20	Yes	Column name or index name
Xe$DataType	UTINYINT	1	not applicable	Control field: 0 through 26: column data type 227: constraint name 255: index name
Xe$Offset	USMALLINT	2	not applicable	Column offset in table. Index number if named index. Offsets are zero-relative. Index Number corresponds to the value stored in the Xi$Number column in the X$Index system table.
Xe$Size	USMALLINT	2	not applicable	Column size, representing the internal storage, in bytes, required for the field. Size does not include the NULL byte for TRUE NULL fields.
Xe$Dec	UTINYINT	1	not applicable	Column decimal place (for DECIMAL, NUMERIC, NUMERICSA, NUMERICSTS, MONEY, or CURRENCY types). Relative bit positions for contiguous bit columns**.** Fractional seconds for AUTOTIMESTAMP, TIMESTAMP, and TIMESTAMP2 data types.

Column Name	Type	Size	Case Insensitive	Description
Xe$Flags	USMALLINT	2	not applicable	Flags word. Bit 0 is the case flag for string data types. If bit 0 = 1, the field is case insensitive. If bit 2 = 1, the field allows null values. Bit 3 of Xe$flag is used to differentiate a Pervasive.SQL v7 1-byte TINYINT (B_TYPE_INTEGER unsigned) from Relational Engine's 1-byte TINYINT (B_TYPE_INTEGER, but signed). If bit 3 = 1 and Xe$datatype = 1 and Xe$size =1, then it means that TINYINT column is created by the Relational Engine and is a signed 1-byte TINYINT. If bit 3 = 0 and Xe$datatype = 1 and xe$size = 1 then it means that TINYINT column is created by the legacy SQL engine and is an unsigned 1-byte TINYINT. If bit 11 = 1, the field is interpreted as a wide character NLONGVARCHAR field rather than a character LONGVARCHAR field. If bit 12 = 1, the field is interpreted as BINARY. If bit 13 = 1, the field is interpreted as DECIMAL with even-digit precision.

Column Xe$File corresponds to column Xf$Id in the X$File system table and is the link between the tables and the columns they contain. For example, the following query returns all field definitions in order for the Billing table:

```
SELECT "X$Field".*
    FROM X$File,X$Field
    WHERE Xf$Id=Xe$File AND Xf$Name = 'Billing' AND Xe$DataType <= 26
ORDER BY Xe$Offset
```

The integer values in column Xe$DataType are codes that represent the Zen data types. See Zen Supported Data Types for the codes.

Five indexes are defined for the X$Field table as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xe$Id	No	not applicable	No
1	0	Xe$File	Yes	not applicable	No
2	0	Xe$Name	Yes	Yes	No
3	0	Xe$File	No	not applicable	Yes
3	1	Xe$Name	No	Yes	No
4	0	Xe$File	Yes	not applicable	Yes
4	1	Xe$Offset	Yes	not applicable	Yes
4	2	Xe$Dec	Yes	not applicable	No

X$File

The X$File system table is associated with the file FILE.DDF. For each table defined in the database, X$File contains the table name, the location of the associated table, and a unique internal ID number that Zen assigns. The structure of X$File is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xf$Id	USMALLINT	2	not applicable	Internal ID assigned by Zen
Xf$Name	CHAR	20	Yes	Table name
Xf$Loc	CHAR	64	No	File location (path name)
Xf$Flags	UTINYINT	1	not applicable	File flags. If bit 4=1, the file is a dictionary file. If bit 4=0, the file is user-defined. If bit 6=1, the table supports true nullable columns.
Xf$Reserved	CHAR	10	No	Reserved

Two indexes are defined for the X$File table.

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xf$Id	No	not applicable	No
1	0	Xf$Name	No	Yes	No

X$Index

The X$Index system table is associated with the file INDEX.DDF. X$Index contains information about all the indexes defined on the tables in the database. The structure of X$Index is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xi$File	USMALLINT	2	not applicable	Unique ID of the table to which the index belongs. It corresponds to Xf$Id in X$File.
Xi$Field	USMALLINT	2	not applicable	Unique ID of the index column. It corresponds to Xe$Id in X$Field.
Xi$Number	USMALLINT	2	not applicable	Index number (range 0 – 119).
Xi$Part	USMALLINT	2	not applicable	Segment number (range 0 – 119).
Xi$Flags	USMALLINT	2	not applicable	Index attribute flags.

The Xi$File column corresponds to the Xf$Id column in the X$File system table. The Xi$Field column corresponds to the Xe$Id column in the X$Field system table. Thus, an index segment entry is linked to a file and to a field.

The Xi$Flags column contains integer values that define the index attributes. The following table describes how Zen interprets each bit position when the bit has the binary value of 1. Bit position 0 is the rightmost bit in the integer.

Bit Position	Decimal Equivalent	Description
0	1	Index allows duplicates.

Bit Position	Decimal Equivalent	Description
1	2	Index is modifiable.
2	4	Indicates an alternate collating sequence.
3	8	Null values are not indexed (refers to Btrieve NULLs, not SQL true NULLS).
4	16	Another segment is concatenated to this one in the index.
5	32	Index is case-insensitive.
6	64	Index is collated in descending order.
7	128	Index is a named index if bit 0 is 0. If bit 0 is 1 and bit 7 is 1, the index uses the repeating duplicates key method. If bit 0 is 1 and bit 7 is 0, the index uses the linked duplicates key method. See also LINKDUP. For a detailed discussion of linked duplicates method and repeating duplicates method, see Methods for Handling Duplicate Keys in *Advanced Operations Guide*.
8	256	Index is a Btrieve extended key type.
9	512	Index is partial.
13	8192	Index is a foreign key.
14	16384	Index is a primary key referenced by some foreign key.

The value in the Xi$Flags column for a particular index is the sum of the decimal values that correspond to the index attributes. Three indexes are defined for the X$Index table as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xi$File	Yes	not applicable	No
1	0	Xi$Field	Yes	not applicable	No
2	0	Xi$File	No	not applicable	Yes
2	1	Xi$Number	No	not applicable	Yes
2	2	Xi$Part	No	not applicable	No

Index Number corresponds to the value stored in the Xi$Number column in the X$Index system table. Index numbering starts at zero. Segment Number corresponds to the value stored in the Xi$Part column in the X$Index system table.

To see the information about the index segments defined for the Billing table, for example, issue the following query:

```
SELECT Xe$Name,Xe$Offset, "X$Index".*

    FROM X$File,X$Index,X$Field

    WHERE Xf$Id=Xi$File and Xi$Field=Xe$Id and Xf$Name = 'Billing'

ORDER BY Xi$Number,Xi$Part
```

X$Proc

The X$Proc system table is associated with the file PROC.DDF. X$Proc contains the compiled structure information for every stored procedure defined. The structure of X$Proc is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xp$Name	CHAR	30	Yes	Stored procedure name.
Xp$Ver	UTINYINT	1	not applicable	Version ID. This is reserved for future use.
Xp$Id	USMALLINT	2	not applicable	0-based Sequence Number.
Xp$Flags	UTINYINT	1	not applicable	1 for stored statement, 2 for stored procedure or 3 for external procedure.
Xp$Misc	LONGVARCHAR (LVAR)	<=990	not applicable	Internal representation of stored procedure.

One index is defined for the X$Proc table as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xp$Name	No	Yes	Yes
0	1	Xp$Id	No	not applicable	No

A single stored procedure may be stored in multiple entries in X$Proc, linked by Xp$Name.

X$Relate

The X$Relate system table is associated with the file RELATE.DDF. X$Relate contains information about the referential integrity (RI) constraints defined on the database. X$Relate is automatically created when the first foreign key is created and a relationship is defined.

The structure of X$Relate is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xr$PId	USMALLINT	2	not applicable	Primary table ID.
Xr$Index	USMALLINT	2	not applicable	Index number of primary key in primary table.
Xr$FId	USMALLINT	2	not applicable	Dependent table ID.
Xr$FIndex	USMALLINT	2	not applicable	Index number of foreign key in dependent table.
Xr$Name	CHAR	20	Yes	Foreign key name.
Xr$UpdateRule	UTINYINT	1	not applicable	1 for restrict.
Xr$DeleteRule	UTINYINT	1	not applicable	1 for restrict, 2 for cascade.
Xr$Reserved	CHAR	30	No	Reserved.

Five indexes are defined for the X$Relate table as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xr$PId	Yes	not applicable	No
1	0	Xr$FId	Yes	not applicable	No
2	0	Xr$Name	No	Yes	No
3	0	Xr$Pld	No	not applicable	Yes
3	1	Xr$Name	No	Yes	No
4	0	Xr$Fld	No	not applicable	Yes
4	1	Xr$Name	No	Yes	No

X$Rights

The X$Rights system table is associated with the file RIGHTS.DDF. X$Rights contains access rights information for each user. Zen uses this table only when you enable the security option. The structure of X$Rights is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xr$User	USMALLINT	2	not applicable	User ID
Xr$Table	USMALLINT	2	not applicable	Table ID
Xr$Column	USMALLINT	2	not applicable	Column ID
Xr$Rights	UTINYINT	1	not applicable	Table or column rights flag

The Xr$User column corresponds to the Xu$Id column in the X$User table. The Xr$Table column corresponds to the Xf$Id column in the X$File table. The Xr$Column column corresponds to the Xe$Id column in the X$Field table.

Note: For any row in the system table that describes table rights, the value for Xr$Column is null.

The Xr$Rights column contains integer values whose rightmost 8 bits define the user access rights. The following table describes how Zen interprets the value. Values from this table may be combined into a single Xr$Rights value.

Hex Value	Decimal Equivalent	Description
1	1	Reorganization in progress.
0x90	144	References rights to table.
0xA0	160	Alter Table rights.
0x40	64	Select rights to table or column.
0x82	130	Update rights to table or column.
0x84	132	Insert rights to table or column.
0x88	136	Delete rights to table or column.

A decimal equivalent of 0 implies no rights.

The value in the Xr$Rights column for a particular user is the bit-wise intersection of the hex values corresponding to the access rights that apply to the user. It is not the sum of the decimal values.

For example, the value in Xr$Rights for a user with all rights assigned would be represented as follows:

144 | 160 | 64 | 130 | 132 | 136 = 254

Three indexes are defined for the X$Rights table as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xr$User	Yes	not applicable	No
1	0	Xr$User	No	not applicable	Yes
1	1	Xr$Table	No	not applicable	Yes
1	2	Xr$Column	No	not applicable	No
2	0	Xr$Table	Yes	not applicable	Yes
2	1	Xr$Column	Yes	not applicable	No

X$Trigger

The X$Trigger system table is associated with the file TRIGGER.DDF. X$Trigger contains information about the triggers defined for the database. The structure of X$Trigger is as follows :

Column Name	Type	Size	Case Insensitive	Description
Xt$Name	CHAR	30	Yes	Trigger name.
Xt$Version	USMALLINT	2	not applicable	Trigger version. A 4 indicates Scalable SQL v4.
Xt$File	USMALLINT	2	not applicable	File on which trigger is defined. Corresponds to Xf$Id in X$File.
Xt$Event	UNSIGNED	1	not applicable	0 for INSERT, 1 for DELETE, 2 for UPDATE.
Xt$ActionTime	UTINYINT	1	not applicable	0 for BEFORE, 1 for AFTER.

Column Name	Type	Size	Case Insensitive	Description
Xt$ForEach	UTINYINT	1	not applicable	0 for ROW (default), 1 for STATEMENT.
Xt$Order	USMALLINT	2	not applicable	Order of execution of trigger.
Xt$Sequence	USMALLINT	2	not applicable	0-based sequence number.
Xt$Misc	LONGVARCHAR (LVAR)	<=4054	not applicable	Internal representation of trigger.

A trigger that is long enough may require multiple entries in Trigger.DDF. Each entry has the same trigger name in the Xt$Name field, and is used in the order specified by the Xt$Sequence field.

Three indexes are defined for the X$Trigger table as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xt$Name	No	Yes	Yes
0	1	Xt$Sequence	No	not applicable	No
1	0	Xt$File	No	not applicable	Yes
1	1	Xt$Name	No	Yes	Yes
1	2	Xt$Sequence	No	not applicable	No
2	0	Xt$File	Yes	not applicable	Yes
2	1	Xt$Event	Yes	not applicable	Yes
2	2	Xt$ActionTime	Yes	not applicable	Yes
2	3	Xt$ForEach	Yes	not applicable	Yes
2	4	Xt$Order	Yes	not applicable	Yes
2	5	Xt$Sequence	Yes	not applicable	No

The trigger may be stored in more than one entry in X$Trigger, linked by Xt$Name and ordered by Xt$Sequence.

X$User

The X$User system table is associated with the file USER.DDF. X$User contains the name and password of each user and the name of each user group. Zen uses this table only when you enable the security option. The following table shows the structure of X$User.

Column Name	Type	Size	Case Insensitive	Description
Xu$Id	USMALLINT	2	not applicable	Internal ID assigned to the user or group.
Xu$Name	CHAR	30	Yes	User or group name.
Xu$Password	CHAR	9	No	User password (encrypted)
Xu$Flags	USMALLINT	2	not applicable	User or group flags.

Note: For any row in the X$User system table that describes a group, the column value for Xu$Password is NULL.

The Xu$Flags column contains integer values whose rightmost 8 bits define the user or group attributes. The following table describes how Zen interprets each bit position when the bit has the binary value of 1. Bit position 0 is the rightmost bit in the integer.

Bit Position	Decimal Equivalent	Description
0	1	Reserved.
1	2	Reserved.
2	4	Reserved.
3	8	Reserved.
4	16	Reserved.
5	32	Reserved.
6	64	Name is a group name.
7	128	User or group has the right to define tables in the dictionary.

The value in the Xu$Flags column for a particular user or group is the sum of the decimal values corresponding to the attributes that apply to the user or group.

Two indexes are defined for the X$User table, as shown in the following table.

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xu$Id	Yes	not applicable	No
1	0	Xu$Name	No	Yes	No

X$View

The X$View system table is associated with the file VIEW.DDF. X$View contains view definitions, including information about joined tables and the restriction conditions that define views. You can query the X$View table to retrieve the names of the views that are defined in the dictionary.

The first column of the X$View table contains the view name. The second and third columns describe the information found in the LVAR column, Xv$Misc. The structure of X$View is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xv$Name	CHAR	20	Yes	View name.
Xv$Ver	UTINYINT	1	not applicable	Version ID. This is reserved for future use.
Xv$Id	UTINYINT	1	not applicable	Sequence number.
Xv$Misc	LONGVARCHAR (LVAR)	<=2000	not applicable	Zen internal definitions.

Two indexes are defined for the X$View table as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xv$Name	Yes	Yes	No
1	0	Xv$Name	No	Yes	Yes
1	1	Xv$Ver	No	not applicable	Yes
1	2	Xv$Id	No	not applicable	No

A single view may be stored in multiple X$View entries, linked by Xv$Name and ordered by Xv$Id.

V2 Metadata System Tables

X$Attrib

The X$Attrib system table is associated with the file PVATTRIB.DDF. X$Attrib contains information about the column attributes of each column in the database. There is an entry for each column attribute you define. The following table shows the structure of X$Attrib.

Column Name	Type	Size	Case Insensitive	Description
Xa$Id	UINTEGER	4	not applicable	Corresponds to Xe$Id in X$Field
Xa$Type	CHAR	4	No	D (default) L (logical positioning) O (column collation)
Xa$ASize	USMALLINT	2	Not applicable	Length of text in Xa$Attrs
Xa$Attrs	LONGVARCHAR (NOTE)	32,763	not applicable	Text that defines the column attribute

When you define multiple attributes for a single column, the X$Attrib system table contains multiple entries for that column ID—one for each attribute you define. If you do not define column attributes for a particular column, that column has no entry in the X$Attrib table. The text in the Xa$Attrs column appears exactly as you define it with Zen. One index is defined for the X$Attrib table as shown in the next table.

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xa$Id	No	not applicable	Yes
0	1	Xa$Type	No	No	No

X$Depend

The X$Depend system table is associated with the file PVDEPEND.DDF. X$Depend contains information about trigger dependencies for such objects as tables, views, and procedures. The structure of X$Depend for V2 metadata is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xd$Trigger	CHAR	128	Yes	Name of trigger. It corresponds to Xt$Name in X$Trigger.
Xd$DependType	UTINYINT	1	not applicable	1 for Table, 2 for View, 3 for Procedure.
Xd$DependName	CHAR	128	Yes	Name of dependency with which the trigger is associated. It corresponds to either Xf$Name in X$File, Xv$Name in X$View, or Xp$Name in X$Proc.

Two indexes are defined for the X$Depend table for V2 metadata as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xd$Trigger	No	Yes	Yes
0	1	Xd$DependType	No	not applicable	No
1	0	Xd$DependType	Yes	not applicable	Yes
1	1	Xd$DependName	Yes	Yes	No

X$Field

The X$Field system table is associated with the file PVFIELD.DDF. X$Field contains information about all the columns and named indexes defined in the database. The structure of X$Field for V2 metadata is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xe$Id	UINTEGER	4	not applicable	Internal ID assigned by Zen, unique for each field in the database.

Column Name	Type	Size	Case Insensitive	Description
Xe$File	UINTEGER	4	not applicable	ID of table to which this column or named index belongs. It corresponds to Xf$Id in X$File.
Xe$Name	CHAR	128	Yes	Column name or index name.
Xe$Datatype	UTINYINT	1	not applicable	0 through 26: column data type 227: constraint name 255: index name
Xe$Offset	UINTEGER	4	not applicable	Column offset in table. Index number if named index. Offsets are zero-relative. Index Number corresponds to the value stored in the Xi$Number column in the X$Index system table.
Xe$Size	UINTEGER	4	not applicable	Column size, representing the internal storage, in bytes, required for the field.
Xe$Dec	USMALLINT	2	not applicable	Column decimal place (for DECIMAL, NUMERIC, NUMERICSA, NUMERICSTS, MONEY, or CURRENCY types). Relative bit positions for contiguous bit columns**.** Fractional seconds for AUTOTIMESTAMP, TIMESTAMP, and TIMESTAMP2 data types.

Column Name	Type	Size	Case Insensitive	Description
Xe$Flags	UINTEGER	4	not applicable	Flags word. Bit 0 is the case flag for string data types. If bit 0 = 1, the field is case insensitive. If bit 2 = 1, the field allows null values. Bit 3 of Xe$flag is used to differentiate a Pervasive.SQL v7 1-byte TINYINT (B_TYPE_INTEGER unsigned) from Relational Engine's 1-byte TINYINT (B_TYPE_INTEGER, but signed). If bit 3 = 1 and Xe$datatype = 1 and Xe$size =1, then it means that TINYINT column is created by the Relational Engine and is a signed 1-byte TINYINT. If bit 3 = 0 and Xe$datatype = 1 and xe$size = 1 then it means that TINYINT column is created by the legacy SQL engine and is an unsigned 1-byte TINYINT. If bit 11 = 1, the field is interpreted as a wide character NLONGVARCHAR field rather than a character LONGVARCHAR field. If bit 12 = 1, the field is interpreted as BINARY. If bit 13 = 1, the field is interpreted as DECIMAL with even-byte precision.

Column Xe$File corresponds to column Xf$Id in the X$File system table and is the link between the tables and the columns they contain. For example, the following query returns all field definitions in order for the Billing table:

```
SELECT "X$Field".*
    FROM X$File,X$Field
    WHERE Xf$Id=Xe$File AND Xf$Name = 'Billing' AND Xe$DataType <= 26
ORDER BY Xe$Offset
```

The integer values in column Xe$DataType are codes that represent the Zen data types. See Zen Supported Data Types for the codes.

Five indexes are defined for the X$Field table, as shown in the following table.

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xe$Id	No	not applicable	No
1	0	Xe$File	Yes	not applicable	No
2	0	Xe$Name	Yes	Yes	No
3	0	Xe$File	No	not applicable	Yes
3	1	Xe$Name	No	Yes	No
4	0	Xe$File	Yes	not applicable	Yes
4	1	Xe$Offset	Yes	not applicable	Yes
4	2	Xe$Dec	Yes	not applicable	No

X$File

The X$File system table is associated with the file PVFILE.DDF. For each table defined in the database, X$File contains the table name, the location of the associated table, and a unique internal ID number that Zen assigns. The structure of X$File for V2 metadata is shown in the following table.

Column Name	Type	Size	Case Insensitive	Description
Xf$Id	UINTEGER	4	not applicable	Internal ID assigned by Zen
Xf$Name	CHAR	128	Yes	Table name
Xf$Loc	CHAR	250	No	File location (path name)
Xf$Flags	UINTEGER	4	not applicable	File flags. If bit 4=1, the file is a dictionary file. If bit 4=0, the file is user-defined. If bit 6=1, the table supports true nullable columns.
Xf$Reserved	CHAR	16	No	Reserved

Two indexes are defined for the X$File table for V2 metadata.

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xf$Id	No	not applicable	No
1	0	Xf$Name	No	Yes	No

X$Index

The X$Index system table is associated with the file PVINDEX.DDF. X$Index contains information about all the indexes defined on the tables in the database. The structure of X$Index for V2 metadata is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xi$File	UINTEGER	4	not applicable	Unique ID of the table to which the index belongs. It corresponds to Xf$Id in X$File.
Xi$Field	UINTEGER	4	not applicable	Unique ID of the index column. It corresponds to Xe$Id in X$Field.
Xi$Number	UINTEGER	4	not applicable	Index number (range 0 – 119).
Xi$Part	UINTEGER	4	not applicable	Segment number (range 0 – 119).
Xi$Flags	UINTEGER	4	not applicable	Index attribute flags.

The Xi$File column corresponds to the Xf$Id column in the X$File system table. The Xi$Field column corresponds to the Xe$Id column in the X$Field system table. Thus, an index segment entry is linked to a file and to a field.

The Xi$Flags column contains integer values that define the index attributes. The following table describes how Zen interprets each bit position when the bit has the binary value of 1. Bit position 0 is the rightmost bit in the integer.

Bit Position	Decimal Equivalent	Description
0	1	Index allows duplicates.
1	2	Index is modifiable.
2	4	Indicates an alternate collating sequence.
3	8	Null values are not indexed (refers to Btrieve legacy nulls, not SQL true NULLs).
4	16	Another segment is concatenated to this one in the index.
5	32	Index is case-insensitive.
6	64	Index is collated in descending order.
7	128	Index is a named index if bit 0 is 0. If bit 0 is 1 and bit 7 is 1, the index uses the repeating duplicates key method. If bit 0 is 1 and bit 7 is 0, the index uses the linked duplicates key method. See also LINKDUP. For a detailed discussion of linked duplicates method and repeating duplicates method, see Methods for Handling Duplicate Keys in *Advanced Operations Guide*.
8	256	Index is a Btrieve extended key type.
13	8,192	Index is a foreign key.
14	16,384	Index is a primary key referenced by some foreign key.

The value in the Xi$Flags column for a particular index is the sum of the decimal values that correspond to the index attributes. Three indexes are defined for the X$Index table for V1 metadata as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xi$File	Yes	not applicable	No
1	0	Xi$Field	Yes	not applicable	No
2	0	Xi$File	No	not applicable	Yes
2	1	Xi$Number	No	not applicable	Yes
2	2	Xi$Part	No	not applicable	No

Index Number corresponds to the value stored in the Xi$Number column in the X$Index system table. Index numbering start at zero. Segment Number corresponds to the value stored in the Xi$Part column in the X$Index system table.

To see the information about the index segments defined for the Billing table, for example, issue the following query:

```
SELECT Xe$Name,Xe$Offset, "X$Index".*

   FROM X$File,X$Index,X$Field

   WHERE Xf$Id=Xi$File and Xi$Field=Xe$Id and Xf$Name = 'Billing'

ORDER BY Xi$Number,Xi$Part
```

X$Proc

The X$Proc system table is associated with the file PVPROC.DDF. X$Proc contains the compiled structure information for every stored procedure defined. The structure of X$Proc for V1 metadata is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xp$Name	CHAR	128	Yes	Stored procedure name
Xp$Ver	UTINYINT	1	not applicable	Version ID. This is reserved for future use.
Xp$Id	UINTEGER	4	not applicable	Internal ID assigned by Zen

Column Name	Type	Size	Case Insensitive	Description
Xp$Flags	UINTEGER	4	not applicable	1 for stored statement, 2 for stored procedure or 3 for external procedure
Xp$Trustee	INTEGER	4	not applicable	0 for a trusted stored procedure and -1 for a non-trusted stored procedure. See Trusted and Non-Trusted Objects.
Xp$Sequence	USMALLINT	2	not applicable	A sequence number. A procedure that exceeds 32,765 bytes requires multiple entries in PVPROC.DDF to handle the overflow. Each entry has the same procedure name in the Xp$Name field and is assigned a sequence number. The Xp$Sequence field is used to correctly order the multiple entries. The sequence starts at zero (the first sequence number is zero).
Xp$Misc	LONGVARCHAR (LVAR)	32,765	not applicable	Internal representation of stored procedure

Four indexes are defined for the X$Proc table in V2 metadata as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xp$Name	Yes	Yes	No
1	0	Xp$Name	No	Yes	Yes
1	1	Xp$Ver	No	not applicable	Yes
1	2	Xp$Sequence	No	not applicable	No
2	0	Xp$Id	Yes	not applicable	No
3	0	Xp$Id	No	not applicable	Yes
3	1	Xp$sequence	No	not applicable	No

X$Relate

The X$Relate system table is associated with the file PVRELATE.DDF. X$Relate contains information about the referential integrity (RI) constraints defined on the database. X$Relate is automatically created when the first foreign key is created, since this results in a relationship being defined.

The structure of X$Relate for V2 metadata is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xr$PId	UINTEGER	4	not applicable	Primary table ID.
Xr$Index	UINTEGER	4	not applicable	Index number of primary key in primary table.
Xr$FId	UINTEGER	4	not applicable	Dependent table ID.
Xr$FIndex	UINTEGER	4	not applicable	Index number of foreign key in dependent table.
Xr$Name	CHAR	128	Yes	Foreign key name.
Xr$UpdateRule	UTINYINT	1	not applicable	1 for restrict.
Xr$DeleteRule	UTINYINT	1	not applicable	1 for restrict, 2 for cascade.
Xr$Reserved	CHAR	250	No	Reserved.

Five indexes are defined for the X$Relate table for V2 metadata as follows:

Index Number	Segment Number	Column Name	Duplicates	Modifiable	Case Insensitive	Segmented
0	0	Xr$PId	Yes	No	not applicable	No
1	0	Xr$FId	Yes	No	not applicable	No
2	0	Xr$Name	No	No	Yes	No
3	0	Xr$Pld	No	Yes	not applicable	Yes
3	1	Xr$Name	No	Yes	Yes	No
4	0	Xr$Fld	No	Yes	not applicable	Yes
4	1	Xr$Name	No	Yes	Yes	No

X$Rights

The X$Rights system table is associated with the file PVRIGHTS.DDF. X$Rights contains access rights information for each user. Zen uses this table only when you enable the security option. The structure of X$Rights for V2 metadata is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xr$User	UINTEGER	4	not applicable	User ID
Xr$Object	UINTEGER	4	not applicable	Table identification corresponding to Xf$Id, view identification corresponding to Xv$Id or stored procedure identification corresponding to Xp$Id
Xr$Type	UINTEGER	4	not applicable	1 for Tables, 3 for Procedures and 4 for Views
Xr$Column	UINTEGER	4	not applicable	Column ID
Xr$Rights	UINTEGER	4	not applicable	Rights flag for table, column, views or stored procedures

The Xr$User column corresponds to the Xu$Id column in the X$User table. The Xr$Object column corresponds to one of the following:

- Xf$Id column in the X$File table
- Xv$Id column in X$Views table
- Xp$Id column in X$Proc table.

The Xr$Column column corresponds to the Xe$Id column in the X$Field table.

Note: For any row in the system table that describes table rights, view rights, or stored procedure rights, the value for Xr$Column is null.

The Xr$Rights column contains integer values whose rightmost 8 bits define the user access rights. The following table describes how Zen interprets the value. Values from this table may be combined into a single Xr$Rights for V2 metadata value.

Hex Value	Decimal Equivalent	Description
1	1	Object owner right
0x90	144	References rights to table
0xA0	160	Alter table rights
0x40	64	Select rights to view, table or column
0x82	130	Update rights to view, table or column
0x84	132	Insert rights to view, table or column
0x88	136	Delete rights to table or column
0xC0	192	Execute and call rights to a stored procedure

A decimal equivalent of 0 implies no rights.

The value in the Xr$Rights column for a particular user is the bit-wise intersection of the hex values corresponding to the access rights that apply to the user. It is not the sum of the decimal values.

For example, the value in Xr$Rights for a user with all rights assigned is represented as follows:

144 | 160 | 64 | 130 | 132 | 136 = 254

The value in Xr$Rights for a user with all rights assigned for a view is represented as follows:

64 | 130 | 132 | 136 = 206

The value in Xr$Rights for a user with all rights assigned for a stored procedure is represented as follows:

192 = 192

Three indexes are defined for the X$Rights table for V2 metadata as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xr$User	Yes	not applicable	No

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
1	0	Xr$User	No	not applicable	Yes
1	1	Xr$Object	No	not applicable	Yes
1	2	Xr$Type	No	not applicable	Yes
1	3	Xr$Column	No	not applicable	No
2	0	Xr$Object	Yes	not applicable	Yes
2	1	Xr$Type	Yes	not applicable	Yes
2	2	Xr$Column	Yes	not applicable	No

X$Trigger

The X$Trigger system table is associated with the file PVTRIG.DDF. X$Trigger contains information about the triggers defined for the database. The structure of X$Trigger for V2 metadata is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xt$Name	CHAR	128	Yes	Trigger name.
Xt$Version	UTINYINT	1	not applicable	Trigger version. A 4 indicates Scalable SQL v4.
Xt$File	UINTEGER	4	not applicable	File on which trigger is defined. Corresponds to Xf$Id in X$File.
Xt$Event	UTINYINT	1	not applicable	0 for INSERT, 1 for DELETE, 2 for UPDATE.
Xt$ActionTime	UTINYINT	1	not applicable	0 for BEFORE, 1 for AFTER.
Xt$ForEach	UTINYINT	1	not applicable	0 for ROW (default), 1 for STATEMENT.
Xt$Order	USMALLINT	2	not applicable	Order of execution of trigger.

Column Name	Type	Size	Case Insensitive	Description
Xt$Sequence	USMALLINT	2	not applicable	A sequence number. A trigger that exceeds 4,054 bytes requires multiple entries in PVTRIG.DDF to handle the overflow. Each entry has the same procedure name in the Xt$Name field and is assigned a sequence number. The Xt$Sequence field is used to correctly order the multiple entries. The sequence starts at zero (the first sequence number is zero).
Xt$Misc	LONGVARCHAR (LVAR)	4,054	not applicable	Internal representation of trigger.

Three indexes are defined for the X$Trigger table for V2 metadata.

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xt$Name	No	Yes	Yes
0	1	Xt$Sequence	No	not applicable	No
1	0	Xt$Name	No	Yes	Yes
1	1	Xt$File	No	not applicable	Yes
1	2	Xt$Sequence	No	not applicable	No
2	0	Xt$File	Yes	not applicable	Yes
2	1	Xt$Event	Yes	not applicable	Yes
2	2	Xt$ActionTime	Yes	not applicable	Yes
2	3	Xt$ForEach	Yes	not applicable	Yes
2	4	Xt$Order	Yes	not applicable	Yes
2	5	Xt$Sequence	Yes	not applicable	No

X$User

The X$User system table is associated with the file PVUSER.DDF. X$User contains the name and password of each user and the name of each user group. Zen uses this table only when you enable the security option. The structure of X$User is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xu$Id	UINTEGER	4	not applicable	Internal ID assigned to the user or group.
Xu$Name	CHAR	128	Yes	User or group name.
Xu$Password	CHAR	153	No	User password (encrypted)
Xu$Flags	UINTEGER	4	not applicable	User or group flags.

Note: For any row in the X$User system table that describes a group, the column value for Xu$Password is NULL.

The Xu$Flags column contains integer values whose rightmost 8 bits define the user or group attributes. The following table describes how Zen interprets each bit position when the bit has the binary value of 1. Bit position 0 is the rightmost bit in the integer.

Bit Position	Decimal Equivalent	Description
0	1	Reserved.
1	2	Reserved.
2	4	Reserved.
3	8	Reserved.
4	16	Reserved.
5	32	Reserved.
6	64	Name is a group name.
7	128	User or group has the right to define tables in the dictionary
8	256	User or group has the right to define view in the dictionary
9	512	User or group has the right to define stored procedures in the dictionary

The value in the Xu$Flags column for a particular user or group is the sum of the decimal values corresponding to the attributes that apply to the user or group.

Two indexes are defined for the X$User table for V2 metadata as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xu$Id	Yes	not applicable	No
1	0	Xu$Name	No	Yes	No

X$View

The X$View system table is associated with the file PVVIEW.DDF. X$View contains view definitions, including information about joined tables and the restriction conditions that define views. You can query the X$View table to retrieve the names of the views that are defined in the dictionary.

The first column of the X$View table contains the view name. The second and third columns describe the information found in the LVAR column, Xv$Misc. The structure of X$View for V2 metadata is as follows:

Column Name	Type	Size	Case Insensitive	Description
Xv$Name	CHAR	128	Yes	View name
Xv$Version	UTINYINT	1	not applicable	Version ID. Reserved for future use.
Xv$Id	UINTEGER	4	not applicable	Internal ID assigned by Zen
Xv$Trustee	INTEGER	4	not applicable	0 for a trusted view and -1 for a non-trusted view. See Trusted and Non-Trusted Objects.
Xv$Sequence	USMALLINT	2	not applicable	A sequence number. A view that exceeds 32,765bytes requires multiple entries in PVVIEW.DDF to handle the overflow. Each entry has the same view name in the Xv$Name field and is assigned a sequence number. The Xv$Sequence field is used to correctly order the multiple entries. The sequence starts at zero (the first sequence number is zero).
Xv$Misc	LONGVARCHAR (LVAR)	32,765	not applicable	Zen internal definitions.

Three indexes are defined for the X$View table for V2 metadata as follows:

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
0	0	Xv$Name	Yes	Yes	No
1	0	Xv$Name	No	Yes	Yes
1	1	Xv$Version	No	not applicable	Yes
1	2	Xv$Sequence	No	not applicable	No
2	0	Xv$Id	Yes	not applicable	No
3	0	Xv$Id	No	not applicable	Yes

Index Number	Segment Number	Column Name	Duplicates	Case Insensitive	Segmented
3	1	Xv$Sequence	No	not applicable	No

D. SQL Access for COBOL Applications

This appendix includes the following sections:

Overview of Zen Support for COBOL

The Zen Relational Engine includes support for COBOL OCCURS clauses, partial REDEFINES, and variable record layouts.

A partial REDEFINES clause identifies a portion of the data within a record (such as a 05 level within a 01 level). A variable record layout is also referred to as a REDEFINES because the entire record is being redefined. To avoid confusion with terminology, this topic refers to partial REDEFINES and to variable record layouts.

You do not need to change your COBOL application to take advantage of the SQL access.

You enable SQL access by describing the handling of data in your application to the Zen Relational Engine. In developer terms, you define the metadata to the Relational Engine.

Note that this topic applies only to COBOL applications that include OCCURS, partial REDEFINES, or variable record layouts.

Restrictions

The following restrictions currently apply to providing SQL access for COBOL applications.

- OCCURS cannot be nested within OCCURS.
- OCCURS cannot be nested within partial REDEFINES.
- Partial REDEFINES cannot be nested within partial REDEFINES.
- Partial REDEFINES cannot be nested within OCCURS.
- Only one index can be defined for an OCCURS. Additional indexes cannot be defined for the items within the OCCURS.

- The only data types supported are those defined for the MicroKernel and Relational engines. The data types are described in the XML control file by using only the transactional data types. See cobolschemaexec.xsd in the table under Components for a discussion of the XML control file. For a discussion of data types, see Zen Supported Data Types.

SQL Statements

The following table lists the use of SQL statements with data tables created from OCCURS, partial REDEFINES, or variable record layouts.

Statement	Use with OCCURs and partial REDEFINES	Use with Variable Record Layouts	Notes
ALTER TABLE	No	No	
CREATE INDEX	No	No	
CREATE INDEX IN DICTIONARY	No	Yes	
CREATE TRIGGER	No	No	
DELETE	No	Yes	
DROP TABLE	Yes	Yes	A DROP TABLE statement removes all of the entries from the system tables. The data file itself is not deleted or modified. Also, when you drop a main table, a message informs you to drop any dependent tables if any are detected. A dependent table depends on a main table and results from conditions such as an OCCURS that contains an index or from partial REDEFINES. Once you drop the dependent tables, you can drop the main table.
INSERT INTO	No	No	

Statement	Use with OCCURs and partial REDEFINES	Use with Variable Record Layouts	Notes
UPDATE	Yes	Yes	An UPDATE statement cannot update a column on which a table filter has been defined. A table filter is a logical expression associated with a table. Table filters are defined as part of your metadata in the XML files.
All other SQL statements listed in *SQL Engine Reference*.	Yes	Yes	See SQL Grammar in Zen.

Components

Zen installs the following components to provide SQL access for COBOL applications.

Component	Purpose	Location[1]
w3cobolschemaexec100.dll	32-bit library of routines used by Schema Executor	Windows server: *file_path*\Zen\bin\
w64cobolschemaexec.dll	64-bit library of routines used by Schema Executor	Windows server: *file_path*\Zen\bin\
Linux: libpsqlcobolschemaexec100.so macOS: libpsqlcobolschemaexec100.dylib	32-bit and 64-bit library of routines used by Schema Executor	Linux server: /usr/local/actianzen/lib
cobolschemexecmsgrb.dll	Message resource bundle used by 32-bit library of routines	Windows server: *file_path*\Zen\bin\
w64cobolschemaexecmsgrb.dll	Message resource bundle used by 64-bit library of routines	Windows server: *file_path*\Zen\bin\
Linux: libpsqlcobolschemaexecmsgrb.so macOS: libpsqlcobolschemaexecmsgrb.dylib	Message resource bundle used by 32-bit and 64-bit library of routines	Linux server: /usr/local/actianzen/lib

Component	Purpose	Location[1]
cobolschemaexec.xsd	Control file (document type definition) used by Schema Executor when processing XML files	Windows server: *file_path*\Zen\schemas Linux or macOS server: /user/local/actianzen/ schemas/
cobolschemaexec.log	Default logging file for messages produced by Schema Executor when processing of XML files	Window server: *file_path*\Zen\logs Linux or macOS server: /usr/local/actianzen/logs/
cobolschemaexec.exe	Utility that populates the system tables used by the Relational Engine to interpret the ISAM data as normalized SQL tables. Also referred to as Schema Executor.	*file_path*\Zen\bin\
cobolschemaexec	Utility that populates the system tables used by the Relational Engine to interpret the ISAM data as normalized SQL tables. Also referred to as Schema Executor.	Linux or macOS installation: /usr/local/actianzen/bin/
SampleMainTable.xml	Sample XML template that defines data for a simple table. See also Example of How to Execute a Sample XML File.	Windows server and client: *file_path*\Zen\samples\cobol schemaexec Linux or macOS installation: /usr/local/actianzen/samples/ cobolschemaexec
SampleMainWithOccurs.xml	Sample XML template used to define data that contains OCCURS constructs. See also Example of How to Execute a Sample XML File.	Windows server and client: *file_path*\Zen\samples\cobol schemaexec Linux or macOS installation: /usr/local/actianzen/samples/ cobolschemaexec

Component	Purpose	Location[1]
SampleMainWithRedefines.xml	Sample XML template used to define data that contains REDEFINES constructs. See also Example of How to Execute a Sample XML File.	Windows server and client: *file_path*\Zen\samples\cobolschemaexec Linux or macOS installation: /usr/local/actianzen/samples/cobolschemaexec
SampleVariantRecord.xml	XML template used to define data that contains variable record layouts. See also Example of How to Execute a Sample XML File.	Windows server and client: *file_path*\Zen\samples\cobolschemaexec Linux or macOS installation: /usr/local/actianzen/samples/cobolschemaexec
A log file on a Windows client or a Linux client is optional and may be specified when Schema Executor is run	See Schema Executor Command Format	Same as current directory if no path is specified. Otherwise, location depends on user-supplied path.

[1]For default locations of Zen files, see Where are the files installed? in *Getting Started with Zen*.

Using SQL Access

Complete the following tasks to take advantage of SQL access:

1. Manually edit the appropriate XML template to describe the data layout.
2. Copy the data files specified in the XML templates to the database folder.
3. Execute the utility to populate the system tables used by the Relational Engine (use the XML to create normalized data).
4. Optionally, if you are a COBOL applications developer, ensure that you deploy any new system tables created by Schema Executor.

Step 1: Modify the Sample XML Templates

Zen includes sample XML templates that you use to define the layout of data as required by your COBOL application. See the table under . In developer terms, you describe your metadata in the XML files.

To Modify an XML Template

1. Open the XML template in a text editor.
2. Modify the XML as described in the file comments.
3. Save the modified template with a path and file name of your choosing.

Step 2: Copy the Data File Specified in the XML Template

Copy the data files specified in the XML file to the data file location of the database before you run Schema Executor. The database is the one to which you need to add the tables.

For example, you want to add a table (specified in the XML as mytable.mkd) to a database test that has its data files under c:\data\test. Copy the data file mytable.mkd to c:\data\test before you run Schema Executor.

Step 3: Run the Schema Executor Utility

Zen includes a command line utility called the Schema Executor, also referred to as SchemaExec.

Schema Executor performs the following actions:

- Parses the XML files that you manually edited.
- Populates existing system tables that the Relational Engine uses to interpret the data as normalized SQL tables (a database created with Zen contains all of the required system tables to support SQL access)
- Creates additional system tables and populates them if you run the utility against a database created with a version of Zen prior to the current version.

To Process an XML File with Schema Executor

See also Example of How to Execute a Sample XML File.

1. Access a command prompt at the operating system.
2. Execute Schema Executor at the command line (see the table under for where this executable is installed by default).

   Provide the required options, XMLfilename and databasename, and any desired optional options. See Schema Executor Command Format.

If errors occur during the processing of the XML content, review the errors reported in the Schema Executor log file. See Log Messages. Execute the utility with the corrected XML until no errors result from the processing.

Schema Executor Command Format

cobolschemaexec *XMLfilename databasename* [-s *servername*] [-u *login_id*] [-p *password*] [-i *svr_loginid*] [-c *svr_password*] [-l *log_file*] [-h | -?]

The following table shows options for the schema executor utility.

Option	Meaning
XMLfilename	The file name of the XML schema that defines the layout of the data. Required option. See Step 1: Modify the Sample XML Templates.
databasename	The name of the Zen database accessed by your application. Required option. If the database specified does not exist, the utility prompts for a path and file name. See also Creating a New Database with Schema Executor.
-*s servername*	The name or IP address of the server running the Zen database engine. You may use "localhost" as the name if running SchemaExec on the same machine as the database engine. If *servername* is not specified, the local machine is assumed to be the server.
-u *login_id*	The user name required to access a secure database. See Zen Security in *Advanced Operations Guide* for a discussion of the Zen security models.
-p *password*	The password required to access a secure database. See Zen Security in *Advanced Operations Guide* for a discussion of the Zen security models.
-i *svr_loginid*	The login name required to access the operating system on a remote machine. This option is required if SchemaExec is processing an XML file located on a remote server.
-c *svr_password*	The password required to access the operating system on a remote machine. This option is required if SchemaExec is processing an XML file located on a remote server.
-l *log_file*	Log file to use for messages produced during processing of the XML file. If you execute SchemaExec on a machine running the Zen database engine, a default log is created automatically. You do not need to use the -l log_file option. The default log is named **cobolschemaexec.log**. If you execute SchemaExec on a client machine (a machine *not* running the Zen database engine), you can specify a log file for the client machine. See Log Messages.
-h or -?	Display command usage. Ignore all other options.

Note: The required options *XMLfilename* and *databasename* are positional and must appear in that order.

Example Usage

The following examples illustrate usage of Schema Executor.

For default locations of Zen files, see Where are the files installed? in *Getting Started with Zen*.

- Database already exists (with server running on local host):

```
    cobolschemaexec file_path\Zen\samples\cobolschemaexec\test.xml demodata\
```

- Database does not exist (with server running on local host):

```
    cobolschemaexec file_path\Zen\samples\cobolschemaexec\test.xml mytest
```

The utility prompts as follows:

```
CB103 : Could not connect to mytest
```

```
Do you want to create database (y/n) ?
```

If you press *y*, the utility prompts for a database path:

```
Please enter the Database Path:
```

Provide an existing path or the utility returns an error. Ensure that the database file (for example, a .MKD file) being used in the XML file is available in the path.

- Database exists on a remote server:

```
    cobolschemaexec file_path\Zen\samples\cobolschemaexec\test.xml demodata -s TestMachine -i
    testuser -c testuser
```

This example assumes that a user testuser (with password "testuser") exists on the remote machine (TestMachine) with administrative privileges, and that the database file being used in the XML file is available in the data file directory of the database on the remote machine.

- Database does not exist on a remote server:

```
    cobolschemaexec file_path\Zen\samples\cobolschemaexec\test.xml mytest -s RemoteMachine -i
    testuser -c testuser
```

This example assumes that a user testuser (with password "testuser") exists on the remote machine (TestMachine) with administrative privileges.

The utility prompts as follows:

```
CB103 : Could not connect to mytest
```

```
Do you want to create database (y/n) ?
```

If you press *y*, the utility prompts for a database path:

```
Please enter the Database Path:
```

Provide an existing path or the utility returns an error. Ensure that the database file (for example, a .MKD file) being used in the XML file is available in the path.

Creating a New Database with Schema Executor

If the utility option *databasename* specifies a database that does **not** exist, Schema Executor prompts you whether to create a new database. If you specify "yes," the utility prompts for a location of the new database. The location (path and folder name) must already exist for Schema Executor to create the database.

Note that Schema Executor also expects to find the data files for *databasename* in the default folder. The utility informs you if it finds no data files. Manually copy the data files to the default folder and run Schema Executor again to process the XML.

Log Messages

This section lists the codes that may appear in a log file after processing an XML file with Schema Executor.

The success code is **CB100 : Schemaexec completed successfully**.

The following table lists the error codes.

Error Code	Description
CB001	Unknown error
CB002	Property name attribute missing
CB003	Both MAINTABLE and VARIANTRECORDTABLES not supported
CB004	Occurs Table Name specified is invalid.
CB005	Occurs Count specified is invalid.
CB006	Occurs Mapping Index specified is invalid.
CB007	*TableName* - Duplicate table name
CB008	*FieldName* - Duplicate field name
CB009	*IndexName* - Duplicate index name
CB010	*TableName* parameter is not specified.
CB012	*Identifier* contains invalid characters.

Error Code	Description
CB013	Offset has to be a nonnegative integer.
CB014	Identifier length cannot exceed 20 characters.
CB016	Precision has to be greater than zero.
CB017	Invalid precision specified for *FieldName*
CB018	Scale cannot be greater than precision for *FieldName.*
CB019	Log and XML file names must be different.
CB022	*TableFilter* cannot have more than 255 characters.
CB023	*FieldName* is not a field of *TableName*.
CB024	TableFilters should be defined for all REDEFINES Table or for NONE.
CB025	Incorrect Parent Element
CB028	Identifier name *identifiername* should start with an alphabetic character.
CB029	Identifier name *identifiername* cannot be a keyword.
CB050	*DataFile* doesn't exist at DatabasePath.
CB051	OCCURS/REDEFINES length must be a nonnegative integer.
CB052	Length of Btrievefilename cannot exceed 64 characters.
CB057	No index specified for *ParentTableName*
CB099	Parser error
CB100	Schemaexec finished successfully.
CB101	Invalid value for command line argument *argument*
CB102	Value for *Password* cannot be specified without *Login*.
CB103	Could not connect to *DatabaseName*
CB105	Could not create database *DatabaseName* in the dictionary path *Databasepath*
CB106	Could not create the specified DSN
CB108	Could not close the database *databasename*
CB109	Could not read data from XML file
CB110	Could not drop the database

Step 4: Optionally, Deploy the System Tables

If you are a COBOL applications developer, ensure that you deploy all of the system tables with your application. Such deployment is nothing new and is mentioned only because you may have additional system tables. For example, Schema Executor creates additional system tables and populates them if you run the utility against a database created with a version of Zen prior to the current version. Therefore, you may have a few additional system tables (DDF files) to deploy.

Example of How to Execute a Sample XML File

The sample XML and data files are provided under *file_path*\Zen\samples\cobolschemaexec. For default locations of Zen files, see Where are the files installed? in *Getting Started with Zen*.

To execute the XML file SampleMainTable.xml using Schema Executor perform the following steps.

1. Copy `maintbl.mkd` to the data file folder of the database to which you wish to connect.

   For example, suppose that a database named test exists with a data file location of c:\data\test. Copy maintbl.mkd to c:\data\test.

2. Open a command prompt at the Zen\bin\ directory.

3. Execute the following command at a DOS prompt:

```
cobolschemaexec file_path\Zen\samples\cobolschemaexec\samplemaintable.xml test
```

4. On successful execution of Schema Executor, the table `maintbl` (as specified in the XML file) is created in the test database.

5. You man now perform SQL operations on table `maintbl` using ZenCC.

Additional Notes

This section provides notes pertaining to SELECT statements and table filters.

SELECT Statements

A SELECT query on an OCCURS table returns the following:

- Columns of the OCCURS table
- Column of the main table that comprises the mapping index
- OCCURS counter that indicates the number of occurrences of the OCCURS clause

For example, if you perform the query SELECT * FROM FIELD for the tables created by the execution of Schema Executor on the sample XML file:

file_path\Zen\samples\cobolschemaexec\ SampleMainWithOccurs.xml

Then the utility returns columns Id, OccursCounter, Field_1, Field_2, and Field_3.

A SELECT query on a REDEFINES table returns all of the columns of the parent table and the columns of the REDEFINES table.

For example, if you perform the query SELECT * FROM Redefined_group for the tables created by the execution of Schema Executor on the sample XML file

file_path\Zen\samples\ cobolschemaexec\SampleMainWithRedefines.xml

then the utility returns columns Id, Account_Num, Category, Redef_Struct_Num (all columns of the parent table), and Redefined_field_1 (column of the REDEFINES table).

Table Filters

A table filter is a filter condition for a particular table. In the sample XML files it is referred to as TABLEFILTER.

- A TABLEFILTER may have an expression with left and right operands, both being column names. For example, Cust_Num = My_Cust_Num, where both Cust_Num and My_Cust_Num are column names.

  Insert a space between the operands and the operator.
- If a constant value is used in the expression for a TABLEFILTER, the value must be specified within single quotes.

  Example: `Cust_Num = '100'` (where Cust_Num is the column name)
- Use the following XML entities when specifying a TABLEFILTER in an XML file.

XML Entity	Used For
&lt;	less than (<)
&gt;	greater than (>)
&amp;	ampersand (&) (AND)
&quot;	double quotes (")
&apos;	single quotes (')

Examples of Valid TABLEFILTER Usage

```
Cust_Num = '100' (equivalent to Cust_Num = 100)

Cust_Num &lt; '100' (equivalent to Cust_Num < 100)

Cust_Num &gt; '100' (equivalent to Cust_Num > 100)

Cust_Num &lt;&gt; '100'   (equivalent to Cust_Num <> 100)

'a' = Category | Account_Num &lt;= 'a123' (equivalent to 'a'=category OR account_num <= 'a123')

'a' = Category &amp; Account_Num = 'a123' (equivalent to 'a' = category AND account_num = 'a123')

Cust_Num = My_cust_Num (where both the operands are column names)
```

E. Query Plan Viewer

Perhaps the most complex aspect of SQL performance is query optimization. The database engine performs query optimization automatically, but the query structure itself can affect the overall performance and how the engine optimizes.

Nearly all queries can be written more than one way and yet return the same result set. For example, consider the simple query `SELECT * FROM table1`. Assume that table1 has five columns named col1, col2, and so forth. You could write the query as `SELECT col1, col2, col3, col4, col5 FROM table1` to give the same result set.

Visually comparing these two queries, SELECT * appears much simpler than listing each column by name. However, listing each column by name in the query delivers a very slight performance boost. The reason is that with SELECT *, the asterisk symbol must be parsed into the column names. Such parsing is not needed when the query itself has already performed that task.

The best way to improve performance is to minimize the time required to run queries against the database. This appendix cannot discuss every possible query optimization because queries can be quite complex and can vary tremendously in structure. However, you can better determine how to optimize your queries by using Query Plan Viewer.

Query Plan Viewer is a graphical utility with which you can view query plans selected by the database engine. A query plan can be viewed for a SELECT, INSERT, UPDATE, or DELETE statement. Query Plan Viewer is compatible with wide character data.

Query Plan Settings

Two SQL statements let you control whether you want to create a query plan and what name to give the plan. Both statements apply only to the SQL session.

You can execute the following statements in Zen Control Center or from any utility that can send SQL statements to the Zen database engine.

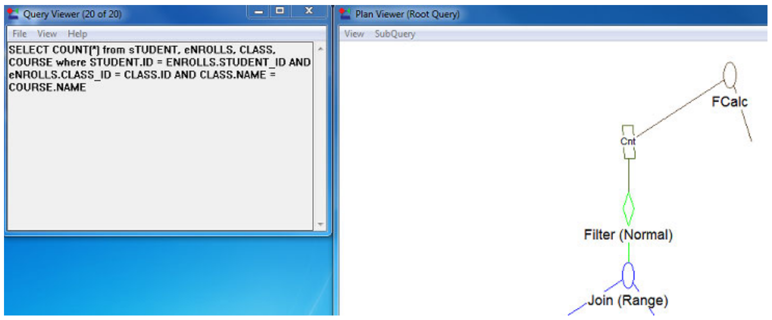
SQL Statement	Discussion
SET QRYPLAN=<on | off>	Instructs the database engine to create a query plan for use with Query Plan Viewer, or not.

SQL Statement	Discussion
SET QRYPLANOUTPUT=<NULL | *file_name*>	Sets the location and name of the query plan file. NULL specifies not to create a query plan file. A single query plan file can contain plans resulting from multiple queries. For your reference, the query plan file contains the code page identifier of the encoding used for *each* query. Regardless which database encoding a query used, Query Plan Viewer correctly displays wide character data. By default, Query Plan Viewer looks for the file name extension .qpf. You may use whatever file name extension you want, or omit one. Example: You want to create a query plan named select_salary and store the query plan file in a directory named mydirectory on drive D off of the root: SET QRYPLANOUTPUT='d:\mydirectory\select_salary.qpf' The database engine creates the query plan output file, so the path must be a location on the machine where the database engine is running. The path should not reference client-side locations or client drive mappings.

See also Examining Query Plans and Evaluating Query Performance.

Graphical User Interface

Query Plan Viewer contains two windows: the **Query Viewer** and the **Plan Viewer**.



```
SELECT COUNT(*) from sTUDENT, eNROLLS, CLASS,
COURSE where STUDENT.ID = ENROLLS.STUDENT_ID AND
eNROLLS.CLASS_ID = CLASS.ID AND CLASS.NAME =
COURSE.NAME
```

Query Viewer

The Query Viewer displays the SQL query. Only one query plan can be viewed at a time but multiple plans can be opened concurrently. The Query Viewer also contains menu commands to open a query plan file, to navigate to the desired query plan when two or more plans are open concurrently, and to export a query plan.

The Query Viewer can be resized as necessary. It includes a vertical scrollbar for ease in viewing the SQL query.

The Query Viewer window uses a font suitable for wide character data. Query Plan Viewer checks the system fonts available and chooses the first available one of the following:

- Consolas
- Lucida Console
- Andale Mono
- Courier New

Plan Viewer

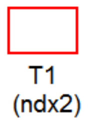
The Plan Viewer contains a graphical representation of the query plan in a tree form with nodes that represent different components of the query.

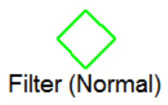
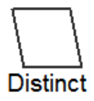
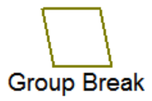
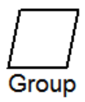
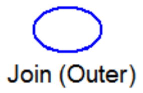
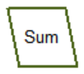
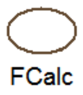
The Plan Viewer can be resized as necessary. It includes vertical and horizontal scrollbars for ease in viewing the query plan tree in different sizes. It contains menu commands and keyboard shortcuts to resize the tree as necessary and to zoom in and out on the tree.

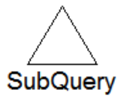
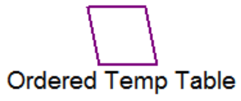
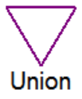
Different types of nodes appear in the Query Viewer depending on the query. Each node represents a step in the execution of a query. For example, nodes can represent selection from a base table, joining the results from two tables into a single result set, calculating an aggregate value, determining group break occurrences and combining group results into a single result set.

Nodes

The following table summarizes the nodes.

Node Symbol	Node Meaning
	Represents data coming from a table in the database. The name displayed under the rectangle is the name of the table. If present, the name shown under the table indicates the index used to retrieve data from the table. An asterisk to the right of the index name indicates that the index contains unique values.

Node Symbol	Node Meaning
	Represents a row selection operation. The word in parentheses can be either "Normal" or "Range:" • A Normal filter is applied after the row is returned from the downstream node. • A Range filter appears only directly above a base table. The Range filter causes a restricted record retrieval from the table based on an index value.
	Performs a distinct operation. This node normally appears at the top or close to the top of the plan tree. Eliminates duplicates from the result set before returning rows from the query.
	Detects group breaks based on a GROUP BY clause.
	Works with Group Break node to assist in correctly accumulating aggregates for SELECT and HAVING clauses.
	Performs a JOIN between two nodes. The value in parentheses indicates the type of JOIN performed: • "Outer" indicates left for right outer join without any indexes. • "OuterRange" indicates left or right outer join using an index. • "Normal" indicates a Cartesian join. • "Range" indicates an inner join using an index.
	Performs aggregate value accumulation. This node is used for MIN, MAX, AVG, COUNT, SUM, and STDEV, and for these aggregates when the DISTINCT clause is used with them. The word inside the node indicates the type of aggregate being accumulated. When an aggregate is accumulated in conjunction with a GROUP BY clause, the aggregate nodes appear between the group break and group nodes.
	Handles accumulating aggregates when no GROUP BY clause is present.

Node Symbol	Node Meaning
	Handles data retrieval from a single subquery of the main query. This node never appears when you view the root query plan, only when you view a subquery.
	Handles creation of temporary tables and data retrieval from temporary tables. References to the base table under this node are changed to reference columns of the temporary table.
	Processes the UNION and UNION ALL operations. Cycles through the underlying query execution plans to retrieve data for the UNION result set. The Plan Viewer displays unions with the first query as the root query, the second query as Subquery 1, and so forth.

Note: If you change the aspect ratio of the Plan Viewer while resizing it, the aspect ratio of the node symbols change accordingly. Consequently, they do not always look identical to the examples in the table.

Node Details

If you double-click the following query plan nodes, a pop-up window appears, showing more detailed information:

- Table
- Filter
- Subquery
- Ordered temporary table

Double-clicking the other nodes provides no detailed information for them. When you mouse over a node with additional available details, the cursor changes to a hand.

The following table explains the type of detailed information displayed.

Node Type	Detailed Information
Table	• Name of table • Total rows in table • Estimated number of rows to be read • Range information. Range information is used only when the base table is on the right side of a JOIN and the retrieval of data from the table can be optimized through the use of an index. Range information includes: • Column or columns retrieved • Value used to initiate range retrieval (the value normally comes from another table and column) and the value to terminate retrieval • Initial operations to perform, such as greater than (GT), greater than or equal to (GE), less than (LT), and so forth • Method of comparison to determine when to stop (GT, GE, and so forth)
Filter (Normal)	Text representation of conditions used to evaluate row. If present, wide character data is displayed correctly.
Filter (Range)	• Information about index used • How filter is reducing set of rows returned • Type of first read from table (GT, GE, and so forth) • Condition that must evaluate to TRUE to stop reading more records (GT, GE, and so forth)
Subquery	Type of subquery and optimizations being performed for subquery
Ordered temp table	• List of columns included in the temporary table • Column indication of whether column is used to order rows of the temporary table (a key) or is a value to pass up the tree

The Plan Viewer also contains menu commands to view the plan at different zoom levels and to display subqueries, if any.

Query Plan Viewer Tasks

This section discusses the following tasks:

- To create a query plan
- To start Query Plan Viewer
- To view a query plan

- To export a query plan to an XML file
- To adjust the display size of a query plan in the Plan Viewer
- To scroll through a query plan in the Plan Viewer
- To reload a changed query plan
- To view details of a query plan node
- To view a subquery on a query plan

To create a query plan

1. Execute **SET QRYPLAN = on** to turn on the creation of a query plan.
2. Execute the SET QRYPLANOUTPUT statement and specify the location and name of the query plan file.

   See Query Plan Settings.
3. Execute a SQL SELECT, INSERT, UPDATE, or DELETE statement (which creates its corresponding query plan).
4. Execute **SET QRYPLAN = off** to turn off the creation of query plans.

To start Query Plan Viewer

1. Do one of the following actions:
   - In Zen Control Center, click **Tools** > **Query Plan Viewer**.
   - Execute the file **w3sqlqpv.exe** located in the Zen\bin directory.

To view a query plan

1. In the Query Viewer, click **File** > **Open**.
2. Navigate to the location of the desired query plan file, then select the file and click **Open**.

   The title bar of the Query Viewer informs you how many query plans are open and which plan you are viewing.
3. If you have more than one query plan open, use the **View** menu commands to navigate among the plans:
   - **First** or Ctrl+F. Displays the earliest loaded query plan.
   - **Last** or Ctrl+L. Displays the latest loaded query plan.

- **Next** or Ctrl+N. Displays the next latest query plan.
- **Prev**(ious) or Ctrl+P. Displays the next earliest query plan.
- **Goto** or Ctrl+G. Displays the query plan based on the ordinal number of the loaded plans.

To export a query plan to an XML file

1. In the Query Viewer, select **File** > **Export XML**.
2. Navigate to the location of the desired query plan XML file, select the file then click **Open**.

Note: You can specify the name of a new XML file in the same dialog box.

Tip... The **Export XML** menu item is enabled only if the query plan is loaded into the viewer.

The following table explains the schema of an XML file derived from a SQL query.

Element and Attributes	Explanation	Parent Element	Child Elements
<QPF filename=*filename*> filename: path and name of QPF file	QPF file on which XML file is based, one per XML file	Header Information	<Query>
<Query number=*number*> number: query number displayed in Query Plan Viewer. First is 1, second is 2, and so forth.	Query in the <QPF> file, at least one per XML file	<QPF>	<SQL> <TreeRoot>
<SQL>	SQL statement used to generate plan. If your SQL scripts declare a Unicode character string literal prefixed with an uppercase N, the prefix appears in the <SQL> element. See also child <Properties> for <Filter>.	<Query>	

Element and Attributes	Explanation	Parent Element	Child Elements
<TreeRoot name=*name*> name: Root Query or Subquery *X*	Indicates root query or subquery	<Query>	All Node Elements: <Join> <Filter> <Base> <Distinct> <Set> <FCalc> <Group> <GroupBreak> <OrderedTempTable> <Union> <Subquery>
Node Elements	Each is a node in the query plan tree (a part of the SQL statement)	<TreeRoot> or the <Child>, <LeftChild>, or <RightChild> of another node element	
<Join>		<TreeRoot>	<Text> <Properties> <LeftChild> <RightChild>
<Filter>	If your SQL scripts declare a Unicode character string literal prefixed with an uppercase N, the prefix does **not** appear in the <Properties> child element. See also <SQL>.	<TreeRoot>	<Text> <Properties> <Child>
<Base>	Represents a leaf in diagram tree	<TreeRoot>	<Text> <Properties>
<Distinct>		<TreeRoot>	<Properties> <Child>

Element and Attributes	Explanation	Parent Element	Child Elements
<Set>		<TreeRoot>	<Text> <Properties> <SetString> <Child>
<FCalc>		<TreeRoot>	<Properties> <LeftChild> <RightChild>
<Group>		<TreeRoot>	<Properties> <Child>
<GroupBreak>		<TreeRoot>	<Properties> <Child>
<OrderedTempTable>		<TreeRoot>	<Properties> <Child>
<Union>		<TreeRoot>	<Properties> <Child>
<Subquery>		<TreeRoot>	<Properties> <Child>
Node Element Children	Varies. Provide additional information about node or link to child of node tag.	Varies	
<Text>		<Join> <Filter> <Set> Optionally, <Base>	
<Properties>		All node elements	
<SetString>		<Set>	

Element and Attributes	Explanation	Parent Element	Child Elements
<Child>		<Filter> <Distinct> <Set> <Group> <GroupBreak> <OrderedTempTable > <Union> <Subquery>	
<LeftChild >		<Join> <FCalc>	
<RightChild>		<Join> optionally, <FCalc>	

To adjust the display size of a query plan in the Plan Viewer

Click **View** then a desired sizing command:

- **Autofit**. Sizes the query plan so that the entire plan is viewable in the Plan Viewer. The view resizes if you resize the window. Autofit is the default when you view a query plan.
- **100%**, **50%**, or **25%**. Sizes the query plan to the specified percentage.
- **Percent**. Sizes the query plan to the percent you specify.
- **Zoom In** (-) or **Zoom Out (+)**. Enlarges the size of the query plan (zoom in) or reduces the size of the query plan (zoom out). You can zoom between 5% and 500%.

To scroll through a query plan in the Plan Viewer

Click **View** then a desired scroll command:

- Scroll Right or Right Arrow. Scrolls toward the right side of the pane.
- **Scroll Left** or Left Arrow. Scrolls toward the left side of the pane.
- **Scroll Up** or Up Arrow. Scrolls toward the top of the pane.
- **Scroll Down** or Down Arrow. Scrolls toward the bottom of the pane.

To reload a changed query plan

In the Query Viewer, click **File** > **Refresh** to reread the currently loaded query plan file.

To view details of a query plan node

In the Plan Viewer, double-click one of the following nodes:

- Table
- Filter
- Subquery
- Ordered temporary table

See Node Details.

To view a subquery on a query plan

In the Plan Viewer, click **Subquery** then the number of the subquery (the first subquery in the main query corresponds to Subquery 1, the second subquery corresponds to Subquery 2 and so forth). A query plan can contain any number of subqueries, or none. All subqueries for a query plan appear on the Subquery menu. When you select a subquery, its name appears in parentheses in the Plan Viewer title.

Examining Query Plans and Evaluating Query Performance

Query Plan Viewer is particularly useful in the development stage of a project for you to test your queries and see how the database engine executes them. You can prepare each of your queries, generate a query plan file and then examine each plan. Based on the information for each query, you can add or remove indexes and then see the affect of the changes. You can also modify the queries to see if a change in the syntax of the statement affects its performance.

Creating Example Query Plans for Comparison

As an example, you can demonstrate the use of Query Plan Viewer using the following steps and a few tables from the Demodata database sample database provided with Zen.

For comparison, you will delete an index from the Enrolls table, execute a query and create a query plan file, add the index back to Enrolls, then execute the query again and create a comparison query plan file.

1. In Zen Control Center (ZenCC), execute the SQL statements to turn on the creation of a query plan and specify the following name of the query plan file: **example1.qpf**. See Query Plan Settings.

2. In ZenCC, execute the following query for the Demodata database:

```
DROP INDEX Enrolls.ClassID
```

   Since Demodata is optimized when installed, you need to drop the index from the Class_ID column of the Enrolls table.

3. In ZenCC, execute the following query for the Demodata database:

```
SELECT Student.ID, Class.Name, Course.Credit_Hours FROM Student, Enrolls, Class, Course WHERE
Student.ID = Enrolls.Student_Id AND Enrolls.Class_ID = Class.ID AND Class.Name = Course.Name
```

   This query retrieves all enrolled students, the classes in which they are enrolled, and the credit hours for each course.

4. In ZenCC, specify the following name of the query plan file: **example2.qpf**. See Query Plan Settings.

5. In ZenCC, execute the following query for the Demodata database:

```
CREATE INDEX ClassID ON Enrolls(Class_ID)
```

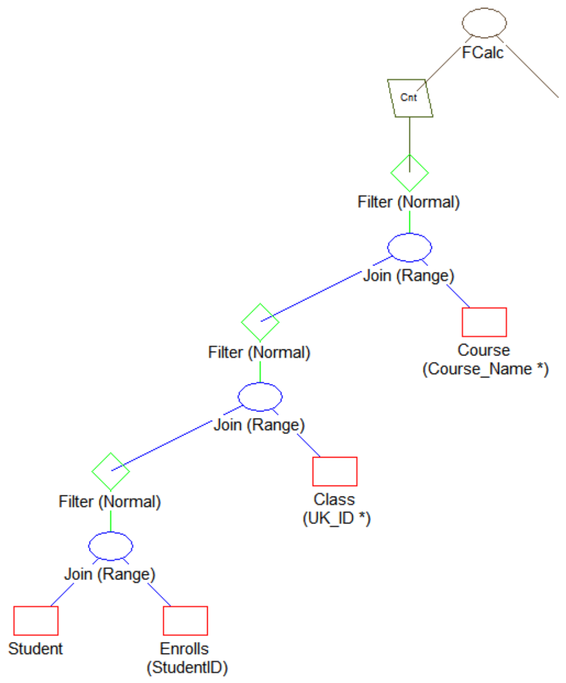
6. In ZenCC, execute the following query for the Demodata database:

```
SELECT Student.ID, Class.Name, Course.Credit_Hours FROM Student, Enrolls, Class, Course WHERE
Student.ID = Enrolls.Student_Id AND Enrolls.Class_ID = Class.ID AND Class.Name = Course.Name
```

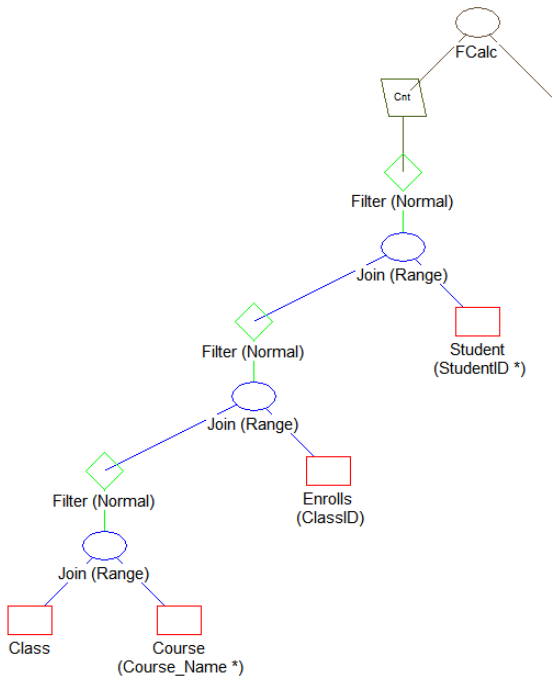
   Notice that the query runs faster.

Viewing the Example Query Plans

In Query Plan Viewer, use **File** > **Open** to open example1.qpf(). You should see something like the following:



For comparison, open example2.qpf in Query Plan Viewer. You should see something like the following:



Note the following about this plan:

- Records are scanned from the Class table.
- Records are retrieved from the Course table based on the Class.Name value using the Course.Course_Name index.
- Records are retrieved from the Enrolls table based on the Class.ID value scanning through the Enrolls table.
- Records are retrieved from the Student table based on the Enrolls.Student_Id using the Student.ID index.
- The selection of data from Enrolls uses the newly created index ClassID.

In a similar manner to this example, you can compare your own queries to determine which syntax and structure is right for your needs.