Altibase® Application Development

Stored Procedures Manual

Altibase Application Development Stored Procedures Manual

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Altibase Corp

10F, Daerung PostTower II, 306, Digital-ro, Guro-gu, Seoul 08378, Korea Telephone: +82-2-2082-1000 Fax: 82-2-2082-1099

Customer Service Portal: http://support.altibase.com/en/

Homepage: [http://www.altibase.com]

Preface

About This Manual

This manual explains how to use stored procedures with Altibase.

Audience

This manual has been prepared for the following Altibase users:

- Database administrators
- Performance administrators
- Database users
- Application developers
- Technical Supporters

It is recommended for those reading this manual possess the following background knowledge:

- Basic knowledge in the use of computers, operating systems, and operating system utilities
- Experience in using relational database and an understanding of database concepts
- Computer programming experience
- Experience in database server management, operating system management, or network administration

Organization

This manual is organized as follows:

- Chapter 1: Introduction to Stored Procedures
  This chapter explains the concept and structure of stored procedures, and the notes on using them.
- Chapter 2: SQL Statements for Managing Stored Procedures
  This chapter explains the SQL statements that are used to manage stored procedures.
- Chapter 3: Stored Procedure Blocks
  This chapter explains the concept of stored procedure blocks, how to define local variables within the body of stored procedures, and which statements can be used in stored procedures
- Chapter 4: Control Flow Statements
  This chapter explains the control flow statements that can be used to author a procedural program within the body of a stored procedure.
- Chapter 5: Using Cursors
  This chapter explains cursor-related statements, which are used to define and control cursors so that multiple records returned by a SELECT statement can be processed within a stored procedure.
- Chapter 6: User-Defined Types
  This chapter explains how to define and use records and associative arrays, which are user-defined types that can be used within stored procedures and functions.
- Chapter 7: Typesets
  This chapter explains how to define and use user-defined typesets.
- Chapter 8: Dynamic SQL
  This chapter explains dynamic SQL, which enables queries to be created and executed as desired by the user at runtime.
- Chapter 9: Exception Handlers

This chapter explains the exception handler, which handles exceptions when an error occurs while a stored procedure is being executed.

- Chapter 10: Pragma
  This chapter describes the pragma which has an impact on exection of stored procedure compile and how to use them.
- Chapter 11: Stored Packages
  This chapter describes how to create and use stored packages.
- Chapter 12: Altibase Stored Procedures and Built-in Function
  Altibase provides a variety of built-in stored procedures and functions. This chapter introduces these stored procedures and functions and explains their use.
- Chapter 13: Altibase System-defined Stored Packages
  This chapter discusses system-defined stored packages provided by Altibase.
- Appendix A. Examples
  This appendix explains the schema and sample program examples used in this manual.

Documentation Conventions

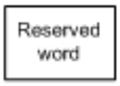
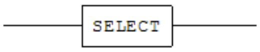
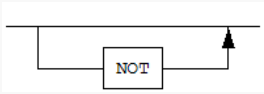
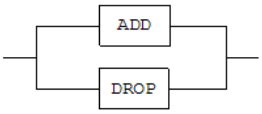
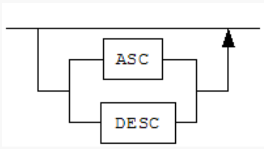
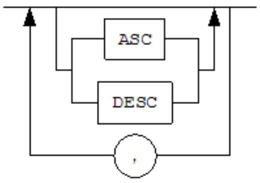
This section describes the conventions used in this manual. Understanding these conventions will make it easier to find information in this manual and in the other manuals in the series.

There are two sets of conventions:

- Syntax diagram convetions
- Sample code conventions

Syntax Diagram Conventions

This manual describes command syntax using diagrams composed of the following elements:

Elements	Meaning
	Indicates the start of a command. If a syntactic element starts with an arrow, it is not a complete command.
	Indicates that the command continues to the next line. If a syntactic element ends with this symbol, it is not a complete command.
	Indicates taht the command continues from the previous line. If a syntactic element starts witht his symbol, it is not a complete command.
	Indicates the end of a statement.
	Indicates a manatory element.
	Indicates an optional element.
	Indicates a mandatory element comprised of options. One, and only one, option must be specified.
	Indicates an optional element comprised of options.
	Indicates an optional element in which multiple elements may be specified. A comman must precede all but the first element.

Sample Code Conventions

The code examples explain SQL statements, stored procedures, iSQL statements, and other command line syntax.

The following table describes the printing conventions used in the code examples.

Rules	Meaning	Example
[ ]	Indicates an optional item	VARCHAR [(*size*)][[FIXED |] VARIABLE]
{ }	Indicates a mandatory field for which one or more items must be selected.	{ ENABLE | DISABLE | COMPILE }
|	A delimiter between optional or mandatory arguments.	{ ENABLE | DISABLE | COMPILE } [ENABLE | DISABLE | COMPILE]
. . .	Indicates that the previous argument is repeated, or that sample code has been omitted.	SQL> SELECT ename FROM employee; ENAME ----------------------- SWNO HJNO HSCHOI . . . 20 rows selected.
Other Symbols	Symbols other than those shown above are part of the actual code.Other Symbols	EXEC :p1 := 1; acc NUMBER(11,2);Symbols other than those shown above are part of the actual code.
Italics	Statement elements in italics indicate variables and special values specified by the user.	SELECT * FROM *table_name*; CONNECT *userID*/*password*;
Lower case words	Indicate program elements set by the user, such as table names, column names, file names, etc.	SELECT ename FROM employee;
Upper case words	Keywords and all elements provided by the system appear in upper case.	DESC SYSTEM.*SYS_INDICES*;

Sample Schema

Some of the examples in this manual are based on sample tables, including the employees, departments and orders tables. These tables can be created using the schema.sql file in the $ALTIBASE_HOME/sample/APRE/schema directory. For complete information on the sample schema, please refer to the Altibase *General Reference.*

Related Documentations

For more detailed information, please refer to the following documents.

- Installation Guide
- Getting Started Guide
- SQL Reference
- iSQL User’s Manual
- Error Message Reference

Altibase Welcomes Your Comments and Feedbacks

Please let us know what you like or dislike about our manuals. To help us with better future versions of our manuals, please tell us if there is any corrections or classifications that you would find useful.

Include the following information:

- The name and version of the manual that you are using
- Any comments about the manual
- Your name, address, and phone number

If you need immediate assistance regarding any errors, omissions, and other technical issues, please contact Altibase's Support Portal (http://altibase.com/support-center/en/).

Thank you. We always welcome your feedbacks and suggestions.

1. Introduction to Stored Procedures

Overview

A stored procedure is a kind of database object that consists of SQL statements, control statements, assignment statements, exception handlers, etc. Stored procedures are created in advance, compiled, and stored in a database, ready for execution. In that state, stored procedures can be simultaneously accessed by multiple SQL statements.

The term “stored procedure” is sometimes used to refer to stored procedures and stored functions collectively. Stored procedures and stored functions differ only in that stored functions return a value to the calling application, whereas stored procedures do not.

Stored procedures and stored functions can be created using the CREATE PROCEDURE and CREATE FUNCTION statements, respectively. For more information about these statements, please refer to the explanations of the CREATE PROCEDURE and CREATE FUNCTION statements in Chapter2: SQL Statements for Managing Stored Procedures of this manual.

Types of Stored Objects

Stored Procedures

Stored procedures are called, either by SQL statements or by other stored procedures, using IN parameters, OUT parameters, or IN/-OUT parameters. When a stored procedure is called, procedural statements defined in the body of the procedure are executed. A stored procedure has no return value, but can still pass values to the client or calling routine via OUT or IN/OUT parameters. However, because a stored procedure has no return value, it cannot be used as an operand in an expression in a SQL statement.

Stored Functions

A stored function is the same as a stored procedure with the exception that it has a return value, and thus can be used as an operand in an expression in a SQL statement.

Typesets

A typeset is a set of user-defined types that can be used in stored procedures. They are chiefly used for passing user-defined types between procedures in the form of parameters and return values.

For more information about typesets, please refer to Chapter 7: Typesets.

Features

Procedural Programming using SQL

The Altibase PSM (Persistent Stored Module) provides control flow statements and exception handlers so that procedural programming can be conducted using SQL statements.

Performance

When a client sequentially executes multiple SQL statements, it must send each SQL statement individually and wait for the result before sending the next statement. This increases the amount of time and expense that is required for communication between the server and client. In contrast, a program that is authored such that it uses stored procedures needs to communicate with the server only one time in order to execute multiple SQL statements, because the client only needs to call one stored procedure comprising several SQL statements.

Therefore, using stored procedures reduces communication expenses, and additionally reduces the burden associated with type conversion when different data types are used on the server and client applications.

Modularity

All of the SQL operations required to conduct one business action can be gathered together and modularized in the form of a single stored procedure.

Easily Maintained Source Code

Because stored procedures reside in the database server, when business logic changes, only the stored procedures need to be changed; there is no need to update client programs distributed among multiple machines.

Sharing and Productivity

Stored procedures are stored in the database, which means that one user can execute another user's stored procedures, as long as s/he has been granted suitable access privileges. Moreover, because stored procedures can be called from within other stored procedures, when the need arises for a new business process that is based on an existing business process, the stored procedure for the new business process has only to call the stored procedure for the existing business process, thereby eliminating redundancy and increasing productivity.

Integration with SQL

The conditions that are used in the WHERE clause of a SELECT statement can be used as conditions in control flow statements in stored procedures without change. This means that SQL-style functions that are not originally supported for use as conditions in control flow statements in host languages such as C/C++ can now be used. Furthermore, built-in functions that are supported in SQL statements can be used without change in stored procedures.

Error Handling in SQL

Because exception handlers are provided for use with stored procedures, appropriate action can be immediately taken on the server in response to errors that occur during the execution of SQL statements

Persistent Storage

Stored procedures are database objects, and thus are permanently stored in the database until explicitly dropped by a user. This means that business logic that supports business practices is also permanently preserved in the database

Enhanced Security

The altiwrap utility encrypts PSM code programs such as stored procedures and stored functions to prevent them from being exposed. For more detailed information about this utility, please refer to the *Utilities Manual*. Altibase can encrypt the following statements.

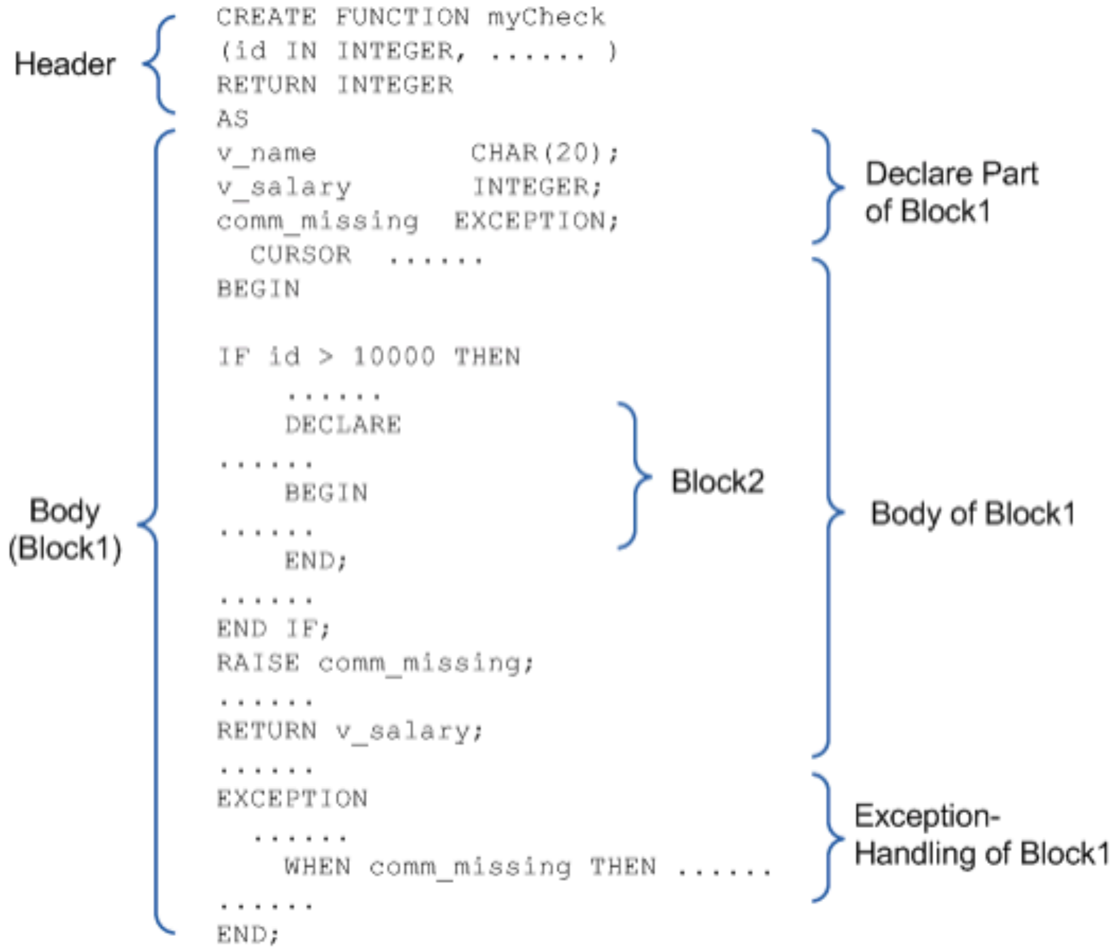
- CREATE [OR REPLACE] PROCEDURE
- CREATE [OR REPLACE] FUNCTION
- CREATE [OR REPLACE] TYPESET
- CREATE [OR REPLACE] PACKAGE
- CREATE [OR REPLACE] PACKAGE BODY

Structure of Stored Procedures

Stored procedures are a kind of block-structured language. The body of one stored procedure typically consists of several logical blocks.

A stored procedure consists of a header and a body. The body of a stored procedure is one large block that consists of a declare section, the actual body of the procedure, and an exception-handling section. The main block can have multiple sub-blocks.

The following is an example illustrating the structure of a stored procedure:



Block2 is a sub-block of Block1 and can have a structure just like that of Block1, including a DECLARE section, body and an exception-handling section.

A control flow statement is also a block, in that it has an explicit beginning and ending.

Considerations when using Stored Procedures

Transaction Management

The transaction control commands that can be used in stored procedures are COMMIT and ROLLBACK statements. The use of these commands within a stored procedure can affect tasks that are being conducted outside of the stored procedure.

For example, assume that the following commands are executed in NON-AUTOCOMMIT mode:

```
iSQL> INSERT INTO t1 values (1);
iSQL> INSERT INTO t1 values (2);
iSQL> EXECUTE proc1;
```

Suppose that proc1 contains the commands “Insert Into t1 values (3)” and “ROLLBACK”. When it is executed, the statement within the procedure that inserted the value of 3 is not the only statement that will be rolled back. Additionally, the INSERT statements that were executed directly from iSQL and inserted the values of 1 and 2 will also be rolled back. That is, the two INSERT statements are handled as part of the same transaction as the statements within the stored procedure.

Limitations

COMMIT and ROLLBACK commands can be executed while the cursor is OPEN. However, the user should note that if ROLLBACK is executed while the cursor is OPEN and not yet COMMITTED, the cursor will close.

Stored functions that are called from within SELECT statements cannot contain INSERT, UPDATE, or DELETE statements.

In addition, they cannot contain transaction control statements. Stored functions that are called from within INSERT, UPDATE or DELETE statements cannot contain transaction control statements.

Related Meta Tables

For information about the meta tables related to stored procedures, please refer to the Data Dictionary in the *General Reference.*

2. SQL Statements for Managing Stored Procedures

Overview

The SQL Statements that are used with Stored Procedures

This table lists the DDL statements that are used to create and manage stored procedures, stored functions, and typesets. The descriptions of the CREATE TYPESET and DROP TYPESET statements can be found in Chapter7: Typesets of this manual.

Statement Type	Statement	Description
Creationg	CREATE [OR REPLACE] PROCEDURE statement	This SQL statement is used to create a new stored procedure or change the definition of an existing stored procedure.
	CREATE [OR REPLACE] FUNCTION statement	This SQL statement is used to create a new stored function or change the definition of an existing stored function.
	CREATE [OR REPLACE] TYPESET statement	This SQL statement is used to create or alter a typeset.
Modification	ALTER PROCEDURE statement	This SQL statement is used to alter the stored procedure state by recompiling the stored procedure.
	ALTER FUNCTION statement	This SQL statement is used to alter the stored function state by recompiling the stored function.
Removal	DROP PROCEDURE statement	This SQL statement is used to remove a stored procedure.
	DROP FUNCTION statement	This SQL statement is used to remove a stored function.
	DROP TYPESET statement	This SQL statement is used to remove a TYPESET.
Execution	EXECUTE statement	This SQL statement is used to EXECUTE a stored procedure or stored function.
	function_name	Stored functions can be referenced by name within SQL statements.

Data Types

The following data types are supported for use with stored procedures:

- SQL data Types
- BOOLEAN Types
- FILE_TYPE
  FILE_TYPE can be used only in stored procedures, and is used to control files in stored procedures. For more information, please refer to Chapter 11: File Control in this manual.
- User-defined Types
  User-defined types can be used only in stored procedures: records and associative arrays are supported for use as user-defined types. For more information, please refer to Chapter 6: User-Defined Types in this manual.

SQL Data Types

Data types available for use in SQL statements can be used in both stored procedures and stored functions. For more detailed information on each data type, please refer to "Data Types" in *General Reference*.

The SQL data types listed in the following table have different maximum sizes in SQL statements and PSMs (stored procedures, stored functions).

Data Type	Maximum Size in SQL Statements	Maximum Size in PSMs
CHAR(M)	32000	65534
VARCHAR(M)	32000	65534
NCHAR(M)	16000 (UTF-16) 10666 (UTF-8)	32766 (UTF-16) 21843 (UTF-8)
NVARCHAR(M)	16000 (UTF-16) 10666 (UTF-8)	32766 (UTF-16) 21843 (UTF-8)
BLOB	2GB - 1	100MB Determined by the LOB_OBJECT_BUFFER_SIZE property (default value: 32KB)
CLOB	2GB - 1	100MB Determined by the LOB_OBJECT_BUFFER_SIZE property (default value: 32KB)

On omission, the size of the CHAR, VARCHAR, NCHAR and NVARCHAR types is 1 by default.

In case the data type of parameters or return values is set to CHAR, NCHAR, NVARCHAR or VARCHAR in the stored procedures or functions, the size of data type is set to the specified size of properties as follows:

- PSM_CHAR_DEFAULT_PRECISION
- PSM_NCHAR_UTF8_DEFAULT_PRECISION
- PSM_NCHAR_UTF16_DEFAULT_PRECISION
- PSM_NVARCHAR_UTF8_DEFAULT_PRECISION
- PSM_NVARCHAR_UTF16_DEFAULT_PRECISION
- PSM_VARCHAR_DEFAULT_PRECISION

Refer to the *General Reference* for in-depth information on each property.

BOOLEAN Types

A BOOLEAN type is only available for use in stored procedures or stored functions, and can only have the value, TRUE, FALSE or NULL.

A BOOLEAN variable can be declared as below.

```
variable_name BOOLEAN;
```

As the BOOLEAN type is not compatible with any other SQL data type, it has the following restrictions.

- A BOOLEAN value cannot be input to a table column.

- A table column value cannot be fetched into a BOOLEAN variable.
- A stored function or built-in function that returns a BOOLEAN type is not available for use in a SQL statement.
- A BOOLEAN value cannot be passed as the argument of an output function (e.g., PRINT, PUT, etc).

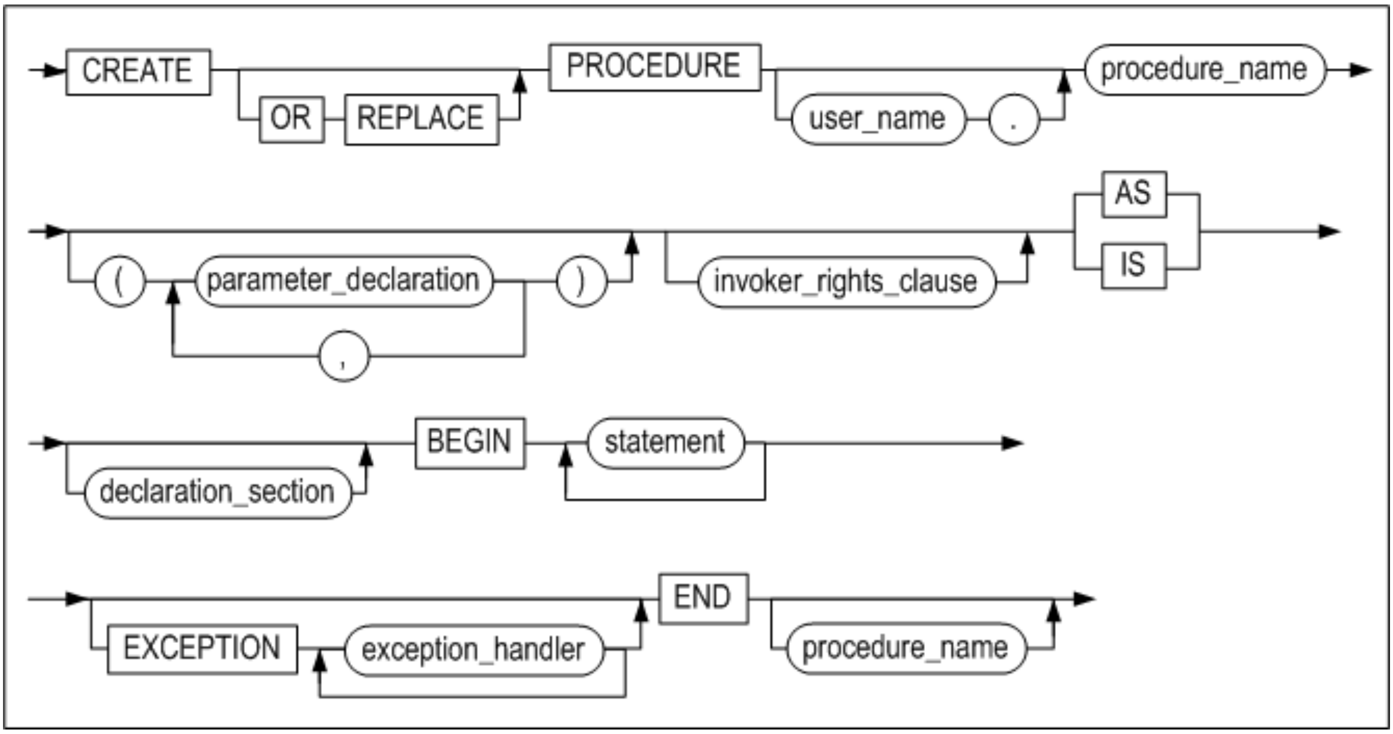
The BOOLEAN type can be used as below.

```
done BOOLEAN;
...
done := TRUE;
done := FALSE;
done := NULL;
...
IF done = TRUE THEN
...
IF done = FALSE THEN
...
IF done THEN
...
IF done is NULL THEN
...
```

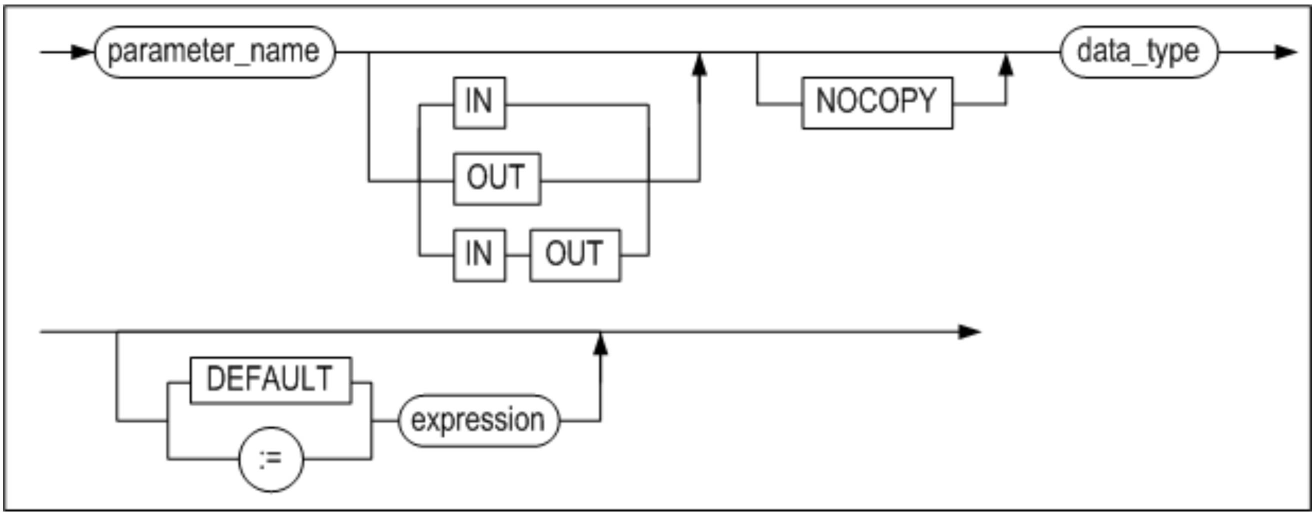
CREATE PROCEDURE

Syntax

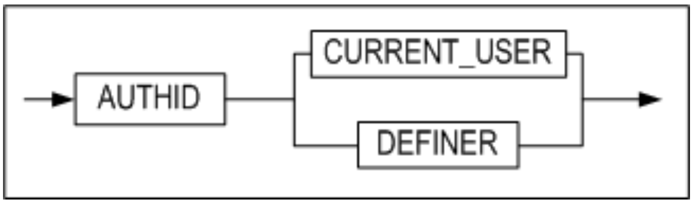
create_procedure::=



parameter_declaration::=



invoker_rights_clause::=



Purpose

This statement creates a new stored procedure, or replaces an existing stored procedure with a new stored procedure.

parameter_declaration

Arguments may be omitted. If an argument is specified, the name, data type, and input / output distinction must be specified. Available I / O classification value is one of the following three, and defaults to IN when omitted. If the argument is OUT or INOUT, the DEFAULT expression cannot be defined.

- IN: an input parameter for which the value is specified when the procedure is called
- OUT: an output parameter, which returns an output value after the procedure has executed
- INOUT: an input/output parameter, for which the value is specified when calling the procedure, and which also returns an output value, typically after some operations are performed thereon

If the parameter type is omitted, IN is the default type. If the parameter type is OUT or INOUT, DEFAULT expression cannot be used.

When a stored procedure is executed, values are passed to the stored procedure using IN parameters, and the procedure returns values to the calling routine using OUT parameters.

An IN parameter is handled as a constant within a stored procedure. This means that a value cannot be assigned to an IN parameter within a stored procedure. Additionally, an IN parameter cannot be used in an INTO clause of a SELECT statement.

There are two methods of specifying parameters. The first method would be substituting values, and another one is substituting reference values by using NOCOPY option, which only supports the ASSOCIATIVE ARAY type.

A parameter can have a default value. If no value is passed to a procedure for a parameter that has a default value, this default value will be used.

invoker_rights_clause

When executing a procedure, users can specify whether to refer to an object with the CREATE (DEFINER) permission or to execute the (CURRENT_USER) permission.

- AUTHID CURRENT_USER
  This executes a procedure by referencing an object owned by the user.
- AUTHID DEFINER
  This executes by the user who created the procedure (DEFINER) by referring to the object of the procedure constructor.

declaration_section

Please refer to Declaring Local Variables in Chapter 3 of this manual.

data_type

Please refer to Declaring Local Variables in Chapter 3 of this manual.

Exception Handler

Please refer to Exception Handlers in this in Chapter 9 of this manual.

Executing the CREATE PROCEDURE Statement

A stored procedure creation statement can be written in advance in a text editor and pasted into iSQL, or can be entered line-by-line directly using iSQL.

Use a semicolon (“;”) at the end of SQL statements, stored procedure control flow statements, and blocks (“END”).

On the line following the last END statement, be sure to use a slash (“/”) to indicate the end of the procedure creation statement when using iSQL. The procedure creation statement is now ready for execution. When the CREATE PROCEDURE statement is executed, if there are no compile errors and the block is successfully compiled, the message “Create success” is output. The elements that are used in the body of a stored procedure, namely blocks, control flow statements, cursors, and exception handlers, will be described individually in subsequent chapters.

Example

Example 1 (Using IN parameters)

```
CREATE TABLE t1 (i1 INTEGER UNIQUE, i2 INTEGER, i3 INTEGER);
INSERT INTO t1 VALUES (1,1,1);
INSERT INTO t1 VALUES (2,2,2);
INSERT INTO t1 VALUES (3,3,3);
INSERT INTO t1 VALUES (4,4,4);
INSERT INTO t1 VALUES (5,5,5);
SELECT * FROM t1;
```

```
CREATE OR REPLACE PROCEDURE proc1
(p1 IN INTEGER, p2 IN INTEGER, p3 IN INTEGER)
AS
  v1 INTEGER;
  v2 t1.i2%type;
  v3 INTEGER;
BEGIN
  SELECT *
  INTO v1, v2, v3
  FROM t1
  WHERE i1 = p1 AND i2 = p2 AND i3 = p3;

  IF v1 = 1 AND v2 = 1 AND v3 = 1 THEN
    UPDATE t1 SET i2 = 7 WHERE i1 = v1;
  ELSIF v1 = 2 AND v2 = 2 AND v3 = 2 THEN
    UPDATE t1 SET i2 = 7 WHERE i1 = v1;
  ELSIF v1 = 3 AND v2 = 3 AND v3 = 3 THEN
    UPDATE t1 SET i2 = 7 WHERE i1 = v1;
  ELSIF v1 = 4 AND v2 = 4 AND v3 = 4 THEN
    UPDATE t1 SET i2 = 7 WHERE i1 = v1;
  ELSE
    DELETE FROM t1;
  END IF;
  INSERT INTO t1 VALUES (p1+10, p2+10, p3+10);
END;
/

iSQL> EXEC proc1 (2,2,2);
Execute success.
iSQL> SELECT * FROM t1;
T1.I1        T1.I2        T1.I3
----------------------------------------
1            1            1
3            3            3
4            4            4
5            5            5
2            7            2
12           12           12
6 rows selected.
```

Example 2 (using parameters with default values)

```
CREATE TABLE t1 (i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE OR REPLACE PROCEDURE proc1
(p1 IN INTEGER DEFAULT 1, p2 IN INTEGER DEFAULT 1, p3 IN INTEGER DEFAULT 1)
AS
```

```
BEGIN
  INSERT INTO t1 VALUES (p1, p2, p3);
END;
/

EXEC proc1;
SELECT * FROM t1;
EXEC proc1(2);
SELECT * FROM t1;
EXEC proc1(3,3);
SELECT * FROM t1;
EXEC proc1(4,4,4);

iSQL> SELECT * FROM t1;
T1.I1       T1.I2       T1.I3
----------------------------------------
1           1           1
2           1           1
3           3           1
4           4           4
4 rows selected.
```

Example 3

```
CREATE OR REPLACE PROCEDURE proc1
(emp_id INTEGER, amount NUMBER(10,2))
AS
BEGIN
  UPDATE employees SET salary = salary + amount
  WHERE eno = emp_id;
END;
/

iSQL> EXEC proc1(15, '250');
Execute success.

iSQL> SELECT * FROM employees WHERE eno=15;
ENO         E_LASTNAME            E_FIRSTNAME           EMP_JOB
------------------------------------------------------------------------------
EMP_TEL          DNO         SALARY      SEX  BIRTH   JOIN_DATE    STATUS
-----------------------------------------------------------------------------------
15          Davenport             Jason                 webmaster
0119556884       1003        1250        M  901212              H
1 row selected.
```

Example 4 (Using OUT and IN/OUT parameters)

```
CREATE TABLE t4(i1 INTEGER, i2 INTEGER);
INSERT INTO t4 VALUES(1,1);
INSERT INTO t4 VALUES(1,1);
INSERT INTO t4 VALUES(1,1);
INSERT INTO t4 VALUES(1,1);
INSERT INTO t4 VALUES(1,1);

CREATE OR REPLACE PROCEDURE proc1(a1 OUT INTEGER, a2 IN OUT INTEGER)
AS
BEGIN
  SELECT COUNT(*) INTO a1 FROM t4 WHERE i2 = a2;
END;
/

iSQL> VAR t3 INTEGER;
iSQL> VAR t4 INTEGER;
iSQL> EXEC :t4 := 1;
Execute success.
iSQL> EXEC proc1(:t3, :t4);
Execute success.
iSQL> PRINT t3;
NAME                 TYPE                 VALUE
-----------------------------------------------
T3                   INTEGER              5
```

Example 5

```
CREATE OR REPLACE PROCEDURE proc1(p1 INTEGER, p2 IN OUT INTEGER, p3 OUT INTEGER)
AS
BEGIN
  p2 := p1;
  p3 := p1 + 100;
END;
/

iSQL> VAR v1 INTEGER;
iSQL> VAR v2 INTEGER;
iSQL> VAR v3 INTEGER;
iSQL> EXEC :v1 := 3;
Execute success.
iSQL> EXEC proc1(:v1, :v2, :v3);
Execute success.
iSQL> PRINT VAR;
[ HOST VARIABLE ]
-----------------------------------------------
```

```
NAME                    TYPE                    VALUE
-----------------------------------------------
V1                      INTEGER                 3
V2                      INTEGER                 3
V3                      INTEGER                 103
```

Example 6 (Using an IN/OUT parameter)

```
CREATE TABLE t3(i1 INTEGER);
INSERT INTO t3 VALUES(1);
INSERT INTO t3 VALUES(1);
INSERT INTO t3 VALUES(1);

CREATE OR REPLACE PROCEDURE proc1(a1 IN OUT INTEGER)
AS
BEGIN
  SELECT COUNT(*) INTO a1 FROM t3 WHERE i1 = a1;
END;
/

iSQL> VAR p1 INTEGER;
iSQL> EXEC :p1 := 1;
Execute success.
iSQL> EXEC proc1(:p1);
Execute success.
iSQL> PRINT p1;
NAME                    TYPE                    VALUE
-----------------------------------------------
P1                      INTEGER                 3
```

Example 7

```
CREATE OR REPLACE PROCEDURE proc1(p1 INTEGER, p2 IN OUT INTEGER, p3 OUT INTEGER)
AS
BEGIN
  p2 := p1 + p2;
  p3 := p1 + 100;
END;
/
iSQL> VAR v1 INTEGER;
iSQL> VAR v3 INTEGER;
iSQL> EXEC :v1 := 3;
Execute success.
iSQL> EXEC :v2 := 5;
Execute success.
```

```
iSQL> EXEC proc1(:v1, :v2, :v3);
Execute success.
iSQL> PRINT VAR;
[ HOST VARIABLE ]
-----------------------------------------------
NAME                 TYPE                 VALUE
-----------------------------------------------
V1                   INTEGER              3
V2                   INTEGER              8
V3                   INTEGER              103
```

Example 8(Using NOCOPU option in IN/OUT parameters)

```
iSQL> CREATE TYPESET TYPE1 AS
TYPE ARR_TYPE IS TABLE OF INTEGER INDEX BY INTEGER;
END;
/
Create success.
iSQL> CREATE OR REPLACE PROCEDURE PRINT_PROC( P1 IN NOCOPY TYPE1.ARR_TYPE )
AS
BEGIN
FOR I IN P1.FIRST() .. P1.LAST() LOOP
PRINTLN(P1[I]);
END LOOP;
END;
/
Create success.
iSQL> CREATE OR REPLACE PROCEDURE PROC1
AS
VAR1 TYPE1.ARR_TYPE;
BEGIN
FOR I IN 1 .. 10 LOOP
VAR1[I] := I;
END LOOP;
PRINT_PROC(VAR1);
END;
/
Create success.
iSQL> EXEC PROC1;
1
2
3
4
5
6
7
8
```

```
9
10
Execute success.
```

Example 9 (AUTHID CURRENT_USER)

```
create object: user1
iSQL> connect user1/user1;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 1 );
1 row inserted.

iSQL> create or replace procedure proc1 authid current_user as
     var1 integer;
     begin
     select c1 into var1 from t1;
     println( var1 );
     end;
     /
Create success.

iSQL> select proc_name , object_type , authid
     from system_.sys_procedures_
     where proc_name ='PROC1';

PROC_NAME
----------------------------------------------------
OBJECT_TYPE AUTHID
---------------------------------------------------
PROC1
0           1
1 row selected.

iSQL> connect user2/user2;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 100 );
1 row inserted.

create object: user2
```

```
iSQL> connect user2/user2;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 100 );
1 row inserted.

execute procedure: user1
iSQL> exec proc1;
1
Execute success.

execute procedure: user2
iSQL> exec user1.proc1;
100
Execute success.
```

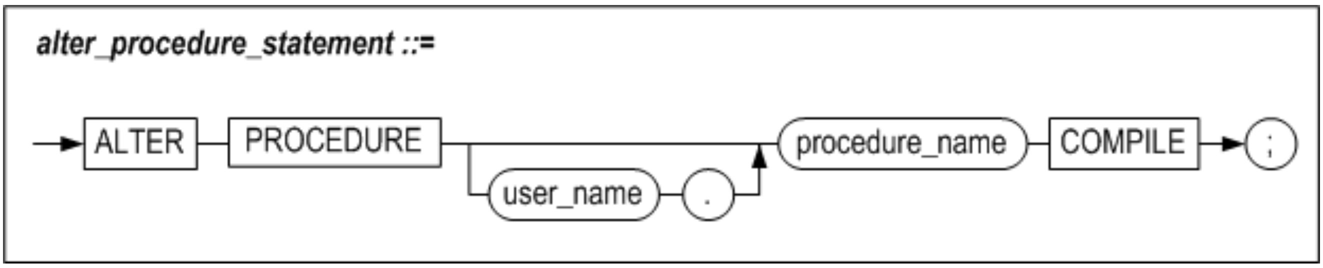
Example 10 (AUTHID DEFINER)

```
create object: user1iSQL> connect user1/user1;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 1 );
1 row inserted.

iSQL> create or replace procedure proc1 authid definer as
     var1 integer;
     begin
     select c1 into var1 from t1;
     println( var1 );
     end;
     /
Create success.

iSQL> select proc_name , object_type , authid
     from system_.sys_procedures_
     where proc_name ='PROC1';
PROC_NAME
----------------------------------------------------------------
OBJECT_TYPE AUTHID
---------------------------
```

```
PROC1
0           0
1 row selected.
iSQL> connect user2/user2;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 100 );
1 row inserted.

create object: user2
iSQL> connect user2/user2;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 100 );
1 row inserted.

execute procedure: user1
iSQL> exec proc1;
1
Execute success.

execute procedure: user2
iSQL> exec user1.proc1;
1
Execute success.
```

ALTER PROCEDURE

Syntax



Purpose

A stored procedure can access various database objects, such as tables, views, and sequences, and can also call other stored procedures and stored functions. After a procedure is created, if any of these objects are altered or changed, the stored procedure can enter what is known as an invalid state.

For example, suppose that an index that existed when a stored procedure was created is later deleted. In this case, because the execution plan for a SQL statement in the stored procedure used the index to access a table, it will become impossible to access the table using the stored procedure from the moment the index is deleted.

When an invalid procedure is called, it is automatically and immediately recompiled by the database. However, compiling at run time in this way can cause significant performance issues in some systems. Therefore, it is recommended that procedures be recompiled when they enter an invalid state.

The ALTER PROCEDURE statement is used to explicitly recompile a stored procedure under these circumstances

Example

Example 1

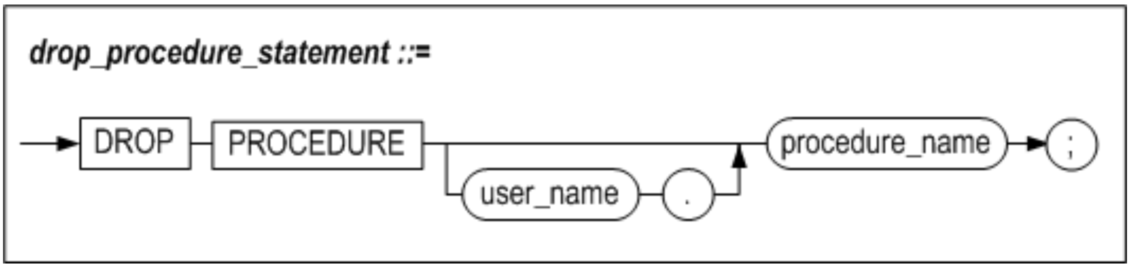
```
CREATE TABLE t1 (i1 NUMBER, i2 VARCHAR(10), i3 DATE);

CREATE OR REPLACE PROCEDURE proc1
(p1 IN NUMBER, p2 IN VARCHAR(10), p3 IN DATE)
AS
BEGIN
  IF p1 > 0 then
    INSERT INTO t1 VALUES (p1, p2, p3);
  END IF;
END;
/
iSQL> EXECUTE proc1 (1, 'seoul', '20-JUN-2002');
Execute success.
iSQL> EXECUTE proc1 (-3, 'daegu', '21-APR-2002');
Execute success.
iSQL> SELECT * FROM t1;
T1.I1       T1.I2       T1.I3
-----------------------------------------------
1           seoul       20-JUN-2002
1 row selected.
```

Example 2

```
CREATE TABLE t1 (i1 NUMBER, i2 VARCHAR(10), i3 DATE DEFAULT SYSDATE);

ALTER PROCEDURE proc1 COMPILE;

iSQL> EXECUTE proc1 (2, 'incheon', SYSDATE);
Execute success.
iSQL> SELECT * FROM t1;
T1.I1        T1.I2        T1.I3
-----------------------------------------------
2            incheon      28-DEC-2010
1 row selected.
```

DROP PROCEDURE

Syntax



Purpose

This statement removes a stored procedure from the database.

Note that this statement will execute successfully even if there are other stored procedures or stored functions that reference the procedure to be dropped.

When a stored procedure or stored function attempts to call a stored procedure or stored function that has already been dropped, an error is returned.

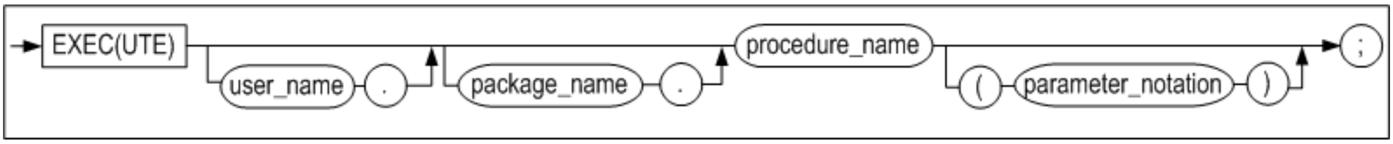
Example

```
DROP PROCEDURE proc1;
```

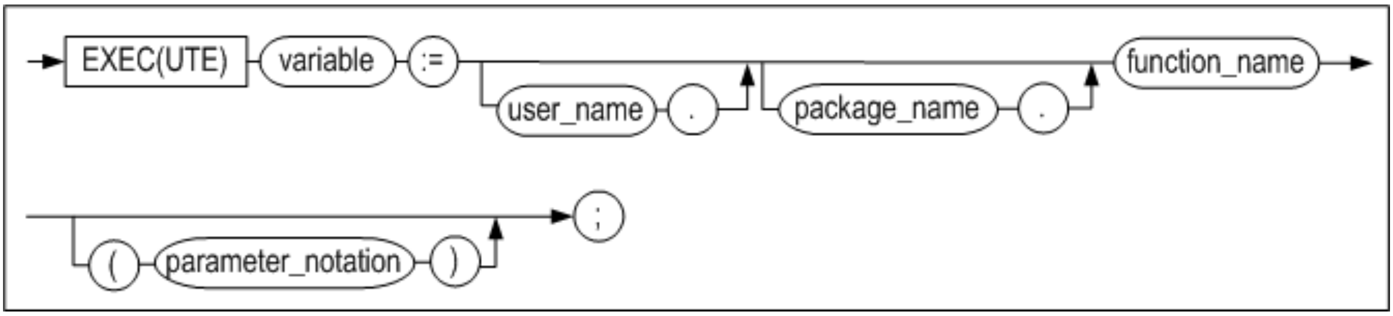
EXECUTE

Syntax

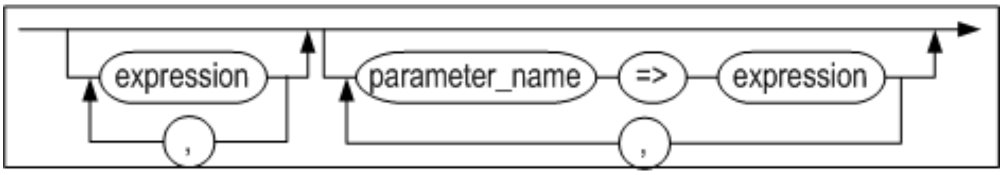
execute_procedure_statement::=



execute_function_statement::=



parameter_notation::=



Purpose

This statement is used to execute a stored procedure or stored function.

parameter_notation

The way to deliver a value to parameter is as follows:

- Position-based: By default, the values are entered according to the position of the defined parameter
- Name-based : The values are entered the name of the defined parameter and the value after the arrow (=>). Values can be delivered in any order of parameters.
- Mixed: Position-based and name-based approaches can be used together. However, the position-based delivery method must be entered first.

Example

<Query>

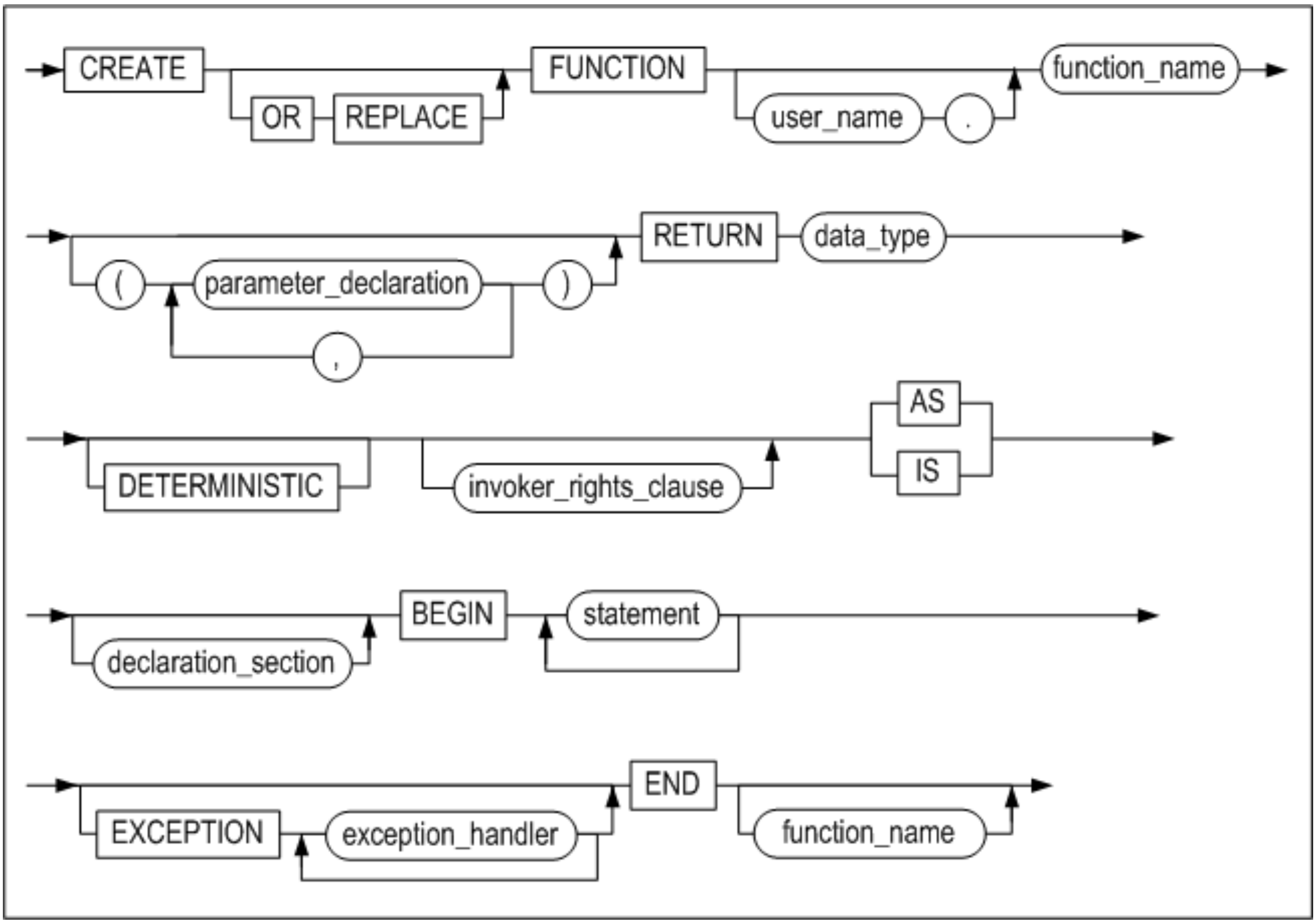
```
CREATE OR REPLACE PROCEDURE proc1(eid INTEGER, amount NUMBER(10,2))
AS
  current_salary NUMBER(10,2);
BEGIN
  SELECT salary
  INTO current_salary
  FROM employees
  WHERE eno = eid;
```

```
  UPDATE employees
  SET salary = salary + amount
  WHERE eno = eid;
END;
/

iSQL> SELECT * FROM employees WHERE eno = 15;
ENO         E_LASTNAME            E_FIRSTNAME           EMP_JOB
------------------------------------------------------------------------------
EMP_TEL          DNO         SALARY      SEX  BIRTH   JOIN_DATE    STATUS
-----------------------------------------------------------------------------------
15          Davenport             Jason                 webmaster
0119556884       1003        501000      M  901212               H
1 row selected.

iSQL> EXEC proc1(15, 333333);
Execute success.
iSQL> SELECT * FROM employees WHERE eno = 15;
ENO         E_LASTNAME            E_FIRSTNAME           EMP_JOB
------------------------------------------------------------------------------
EMP_TEL          DNO         SALARY      SEX  BIRTH   JOIN_DATE    STATUS
-----------------------------------------------------------------------------------
15          Davenport             Jason                 webmaster
0119556884       1003        834333      M  901212               H
1 row selected.
<질의>
iSQL> EXEC proc1(amount => 333333, eid => 15);
Execute success.

iSQL> SELECT * FROM employees WHERE eno = 15;
ENO         E_LASTNAME            E_FIRSTNAME           EMP_JOB
------------------------------------------------------------------------------
EMP_TEL          DNO         SALARY      SEX  BIRTH   JOIN_DATE    STATUS
-----------------------------------------------------------------------------------
15          Davenport             Jason                 webmaster
0119556884       1003        834333      M  901212               H
1 row selected.
```

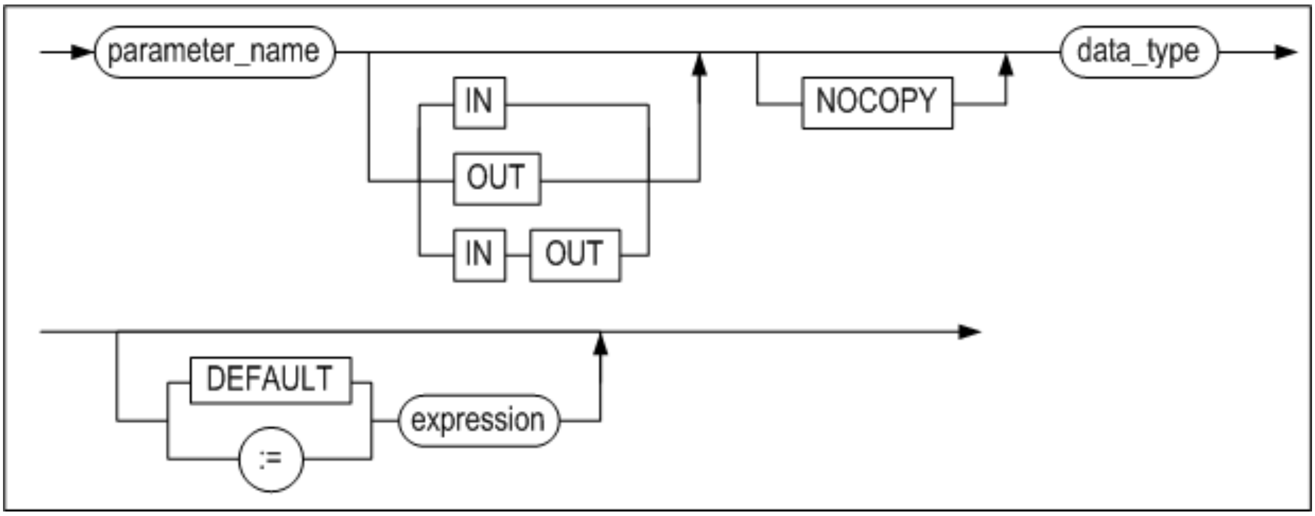
CREATE FUNCTION

Syntax

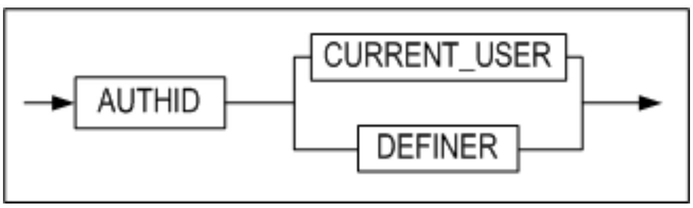
create_function::=



parameter_declaration::=



invoker_rights_clause::=



Purpose

This statement is used to create a new stored function or replace an existing function with a new function.

parameter_declaration

Refer to "parameter_declaration" in the explanation of the CREATE PROCEDURE

RETURN data_type

Unlike stored procedures, stored functions return a single value after they are executed. Therefore, the data type of the return value must be specified.

DETERMINISTIC

This function indicates that a function called by an identical parameter value always returns an identical result. Functions marked DETERMINSTIC can be used in function-based indexes along with Check Constraint. On omission, a non-deterministic function is marked.

invoker_rights_clause

When executing a function, it can be specified whether to refer to the object by the constructor (DEFINER) permission or the executer (CURRENT_USER) permission. If this clause is commited, the fucntion executes with constructor privileges.

- AUTHID CURRENT_USER
  This executes a function by referring to an object owned by the user.
- AUTHID DEFINER
  This executes a function with DEFINER permission by referring to the object of the funciton constructor.

Declaration Section

Please refer to Declaring Local Variables in Chapter 3 of this manual.

Data Types

Please refer to Declaring Local Variables in Chapter 3 of this manual.

Exception Handler

Please refer to Chapter 9: Exception Handlers in this manual

Executing the CREATE FUNCTION Statement

Refer to the corresponding description in Executing the CREATE PROCEDURE Statement.

Example

Example 1

```
CREATE TABLE t1(
  seq_no INTEGER,
  user_id VARCHAR(9),
  rate NUMBER,
```

```
  start_date DATE,
  end_date DATE);
INSERT INTO t1 VALUES(0, '000000500', 200.50, '23-May-2002', '23-Apr-2002');
INSERT INTO t1 VALUES(0, '000000501', 190, '23-Nov-2002', '23-Dec-2002');
INSERT INTO t1 VALUES(0, '000000523', 100, '12-Dec-2001', '12-Jan-2001');
INSERT INTO t1 VALUES(0, '000000532', 100, '11-Dec-2001', '11-Jan-2002');
INSERT INTO t1(seq_no, user_id, start_date, end_date) VALUES(0, '000000524', '30-Oct-
2001', '30-Nov-2001');
INSERT INTO t1 VALUES(0, '000000524', 200.50, '30-Apr-2002', '30-May-2002');
INSERT INTO t1 VALUES(0, '000000524', 200.50, '30-Apr-2002', '30-May-2002');
INSERT INTO t1 VALUES(1, '000000524', 100, '30-Apr-2002', '30-May-2002');
INSERT INTO t1 VALUES(1, '000000524', 115.0, '19-Jan-2002', '19-Mar-2002');
INSERT INTO t1 VALUES(0, '000000502', 120.0, '27-Jan-2002', '27-Feb-2002');
INSERT INTO t1 VALUES(1, '000000504', 150.0, '26-Nov-2001', '26-Dec-2001');

iSQL> SELECT * FROM t1;
T1.SEQ_NO   T1.USER_ID  T1.RATE     T1.START_DATE
------------------------------------------------------------
T1.END_DATE
-----------------------
0           000000500  200.5       2002/05/23 00:00:00
2002/04/23 00:00:00
0           000000501  190         2002/11/23 00:00:00
2002/12/23 00:00:00
0           000000523  100         2001/12/12 00:00:00
2001/01/12 00:00:00
0           000000532  100         2001/12/11 00:00:00
2002/01/11 00:00:00
0           000000524              2001/10/30 00:00:00
2001/11/30 00:00:00
0           000000524  200.5       2002/04/30 00:00:00
2002/05/30 00:00:00
0           000000524  200.5       2002/04/30 00:00:00
2002/05/30 00:00:00
1           000000524  100         2002/04/30 00:00:00
2002/05/30 00:00:00
1           000000524  115         2002/01/19 00:00:00
2002/03/19 00:00:00
0           000000502  120         2002/01/27 00:00:00
2002/02/27 00:00:00
1           000000504  150         2001/11/26 00:00:00
2001/12/26 00:00:00
11 rows selected.

CREATE OR REPLACE FUNCTION get_rate
(p1 IN CHAR(30), p2 IN CHAR(30), p3 IN VARCHAR(9))
RETURN NUMBER
AS
  v_rate NUMBER;
```

```
BEGIN
  SELECT NVL(SUM(rate), 0)
  INTO v_rate
  FROM (SELECT rate
        FROM t1
        WHERE start_date = TO_DATE(p1)
          AND end_date = TO_DATE(p2)
          AND user_id = '000000' || p3
          AND seq_no = 0);
  RETURN v_rate;
END;
/

iSQL> VAR res NUMBER;
iSQL> EXECUTE :res := get_rate('30-Apr-2002', '30-May-2002', '524');
Execute success.
iSQL> PRINT res;
NAME                 TYPE                 VALUE
-----------------------------------------------
RES                  NUMBER               401
```

Example (AUTHID CURRENT_USER)

Create object : user1

```
iSQL> connect user1/user1;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 1 );
1 row inserted.

iSQL> create or replace function func1 return integer authid current_user as
     cursor cur1 is select c1 from t1;
     var1 integer;
     begin
     open cur1;
     fetch cur1 into var1;
     close cur1;
     return var1;
     end;
     /
Create success.

iSQL> select proc_name , object_type , authid
    2 from system_.sys_procedures_
```

```
    3 where proc_name = 'FUNC1';
PROC_NAME

------------------------------------------------------------------------------------------------------------------------------------------------------------
OBJECT_TYPE AUTHID
---------------------------
FUNC1

1           1
1 row selected.
```

Create object: user2

```
iSQL> connect user2/user2;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 100 );
1 row inserted.
```

Execute function: user1

```
iSQL> var a integer;

iSQL> exec :a := func1;
Execute success.

iSQL> print a
NAME                    TYPE                    VALUE
-------------------------------------------------------
A                       INTEGER                 1


iSQL> select func1 from dual;
FUNC1
--------------
1
1 row selected.
```

Execute function: user2

```
iSQL> var a integer;

iSQL> exec :a := user1.func1;
Execute success.

iSQL> print a
NAME                 TYPE                 VALUE
-------------------------------------------------------
A                    INTEGER              100


iSQL> select user1.func1 from dual;
USER1.FUNC1
--------------
100
1 row selected.
```

Example 3 (AUTHID DEFINER)

Create object: user1

```
iSQL> connect user1/user1;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 1 );
1 row inserted.

iSQL> create or replace function func1 return integer authid definer as
      cursor cur1 is select c1 from t1;
      var1 integer;
      begin
      open cur1;
      fetch cur1 into var1;
      close cur1;
      return var1;
      end;
      /
Create success.

iSQL> select proc_name , object_type , authid
      from system_.sys_procedures_
```

```
      where proc_name ='FUNC1';
PROC_NAME

--------------------------------------------------------------------------------
OBJECT_TYPE AUTHID
---------------------------
FUNC1

1           0
1 row selected.
```

Create object: user2

```
iSQL> connect user2/user2;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 100 );
1 row inserted.
```

Execute function: user1

```
iSQL> var a integer;

iSQL> exec :a := func1;
Execute success.

iSQL> print a
NAME                 TYPE                 VALUE
-------------------------------------------------------
A                    INTEGER              1


iSQL> select func1 from dual;
FUNC1
--------------
1
1 row selected.
```

Execute function: user2

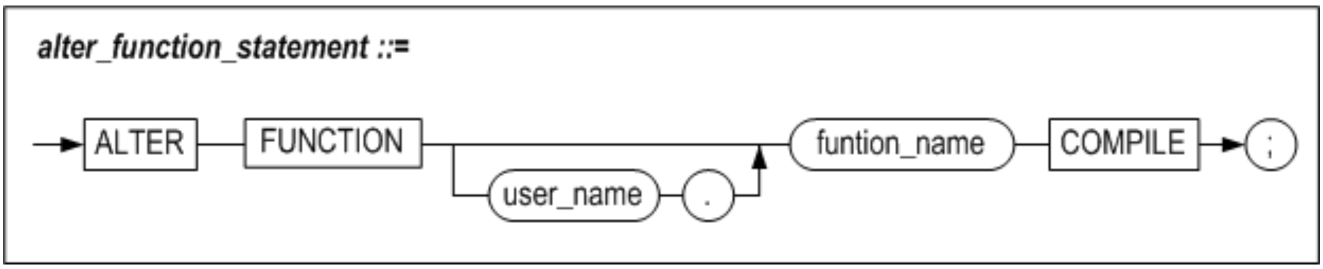
```
iSQL> var a integer;

iSQL> exec :a := user1.func1;
Execute success.


iSQL> print a
NAME                     TYPE                     VALUE
-------------------------------------------------------
A                        INTEGER                  1


iSQL> select user1.func1 from dual;
USER1.FUNC1
--------------
1
1 row selected.
```

Note

For functions used in constraints or function-based indexes, it is impossible to redefine functions since the return values of functions must not be modified. The user should also note that, if an invoked function within the function which the function-based indexes are built on is altered or deleted, DML operations can fail for the indexed table.

ALTER FUNCTION

Syntax



Purpose

As with a stored procedure, a stored function can enter what is known as an invalid state when one or more of the database objects that it references are changed after the function is created.

In such circumstances, the ALTER FUNCTION statement is used to explicitly recompile the stored function and create an execution plan that is valid and optimized.

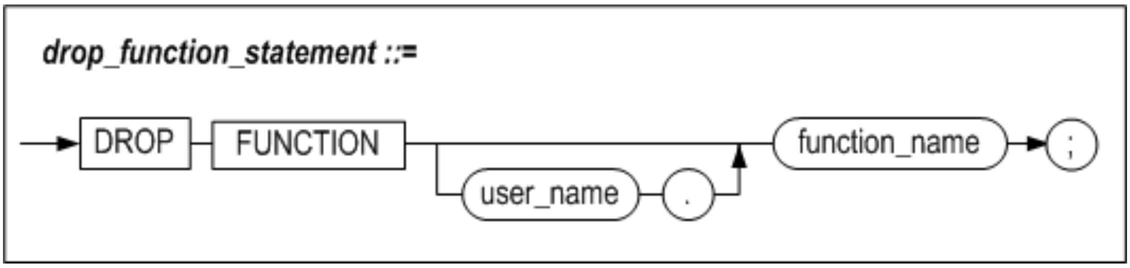
For a more detailed explanation, please refer to Purpose in the explanation of the ALTER PROCEDURE statement.

Example

```
ALTER FUNCTION get_dept_name COMPILE;
```

DROP FUNCTION

Syntax



Purpose

This statement removes a stored function from the database.

Note that this statement will execute successfully even if there are other stored procedures or stored functions that reference the stored function to be dropped.

When a stored procedure or stored function attempts to call a stored procedure or stored function that has already been dropped, an error is returned.

Example

```
DROP FUNCTION get_dept_name;
```

Note

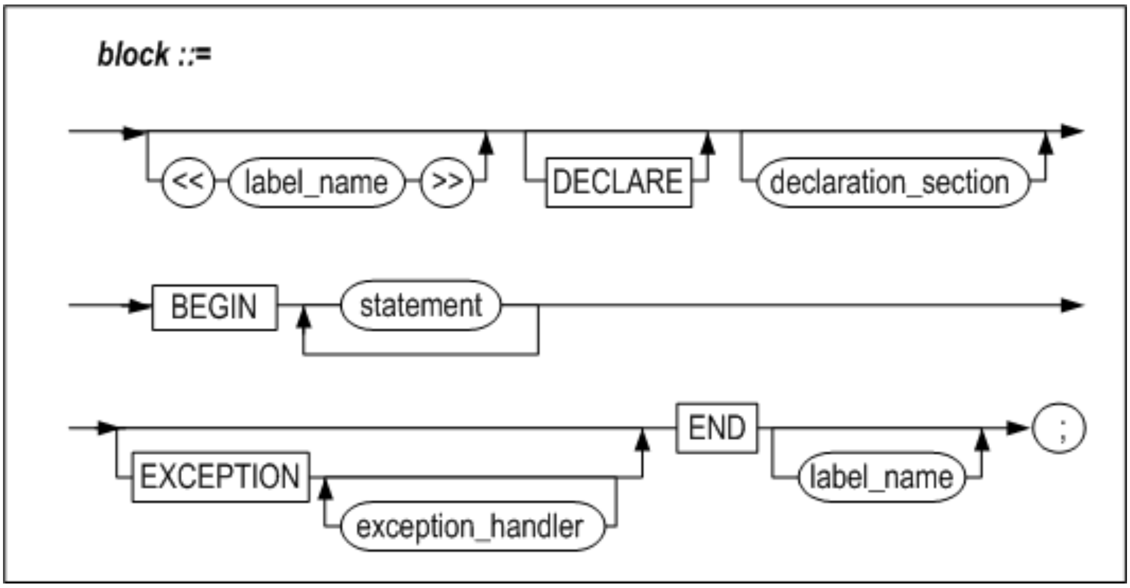
The deletion of functions referenced by the constraints or the function-based indexes is impossible.

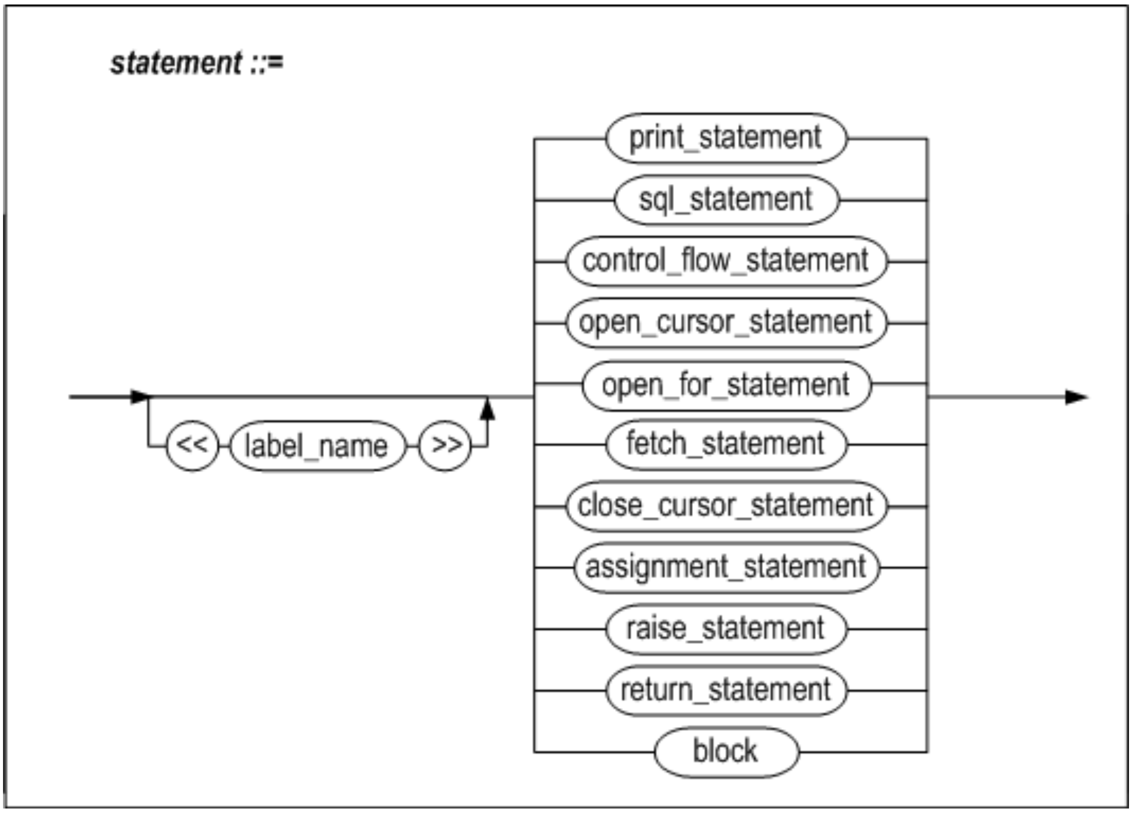
3. Stored Procedure Blocks

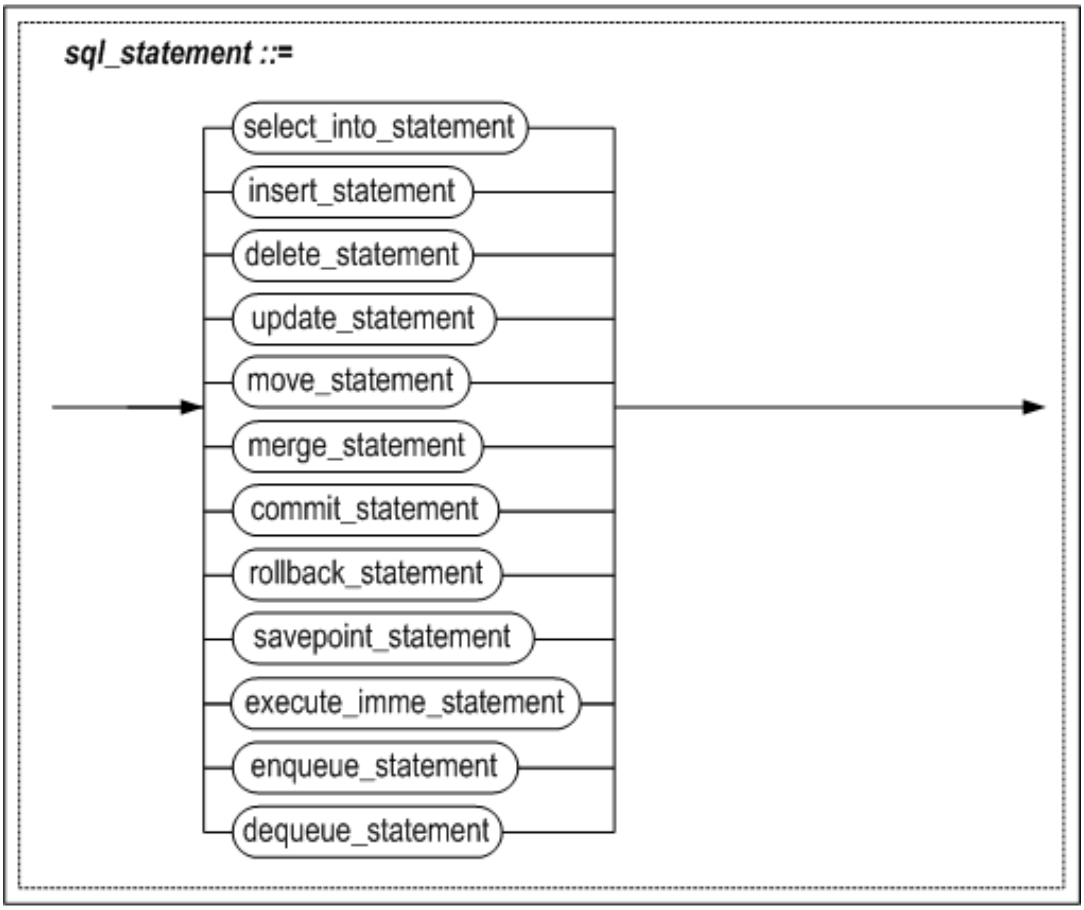
A stored procedure or function consists of one or more blocks. This chapter describes how to develop a procedural program within a stored procedure using blocks.

Stored Procedure Block

Syntax







A block can be broadly divided into a declaration section, a block body and an exception handler section.

A semicolon (“;”), which indicates the end of a statement, is not used after the DECLARE, BEGIN or EXCEPTION statements, but must be placed after the END statement and other commands in stored procedures. Comments can be used in stored procedures.

To comment out all or part of a single line, place two hyphen characters (“--”) at the beginning of the text to be commented out. To comment out multiple lines, place the C-style delimiters “/” *and* “/” around the text to be commented out.

In this chapter, the variable assignment statements, which can be used within the declaration section and block body, and the SELECT INTO, assignment statements, LABEL, PRINT and RETURN statements, which can be used only within the block body, will be described.

Information on the use of control flow statements, cursor-related statements and exception handlers in stored procedures can be found in subsequent chapters. For information on general SQL statements, please refer to the *SQL Reference.*

Declare Section

The declare section is delimited by the AS and BEGIN keywords for the main block, and by the DECLARE and BEGIN keywords for sub-blocks. Local variables, cursors, and user-defined exceptions for use in the current block are declared here.

In this chapter, only local variables will be described. Cursors and exception handlers will be described together with the related statements in Chapter5: Using Cursors and Chapter9: Exception Handlers, respectively.

Block Body

The block body is the part between the BEGIN and END keywords. It contains SQL statements and control flow statements.

The following SQL statements and control flow statements can be used within the block body:

- DML statements: SELECT/INSERT/DELETE/UPDATE/MOVE/MERGE/ENQUEUE/DEQUEUE
- Transaction statements: COMMIT/ROLLBACK/SAVEPOINT
- Control flow statements: IF, CASE, FOR, LOOP, WHILE, EXIT, CONTINUE, NULL
- Assignment statements
- Output statements: PRINT, RETURN
- Cursor statements: OPEN, FETCH, CLOSE, Cursor FOR LOOP
- Dynamic SQL statement: EXECUTE IMmedia/StoredProcedureTE
- Exception handling statements: RAISE, RAISE_APPLICATION_ERROR

One advantage of stored procedures compared to SQL statements is that it is possible to nest blocks. Anywhere that commands can be used, commands can be formed into blocks, which can be nested.

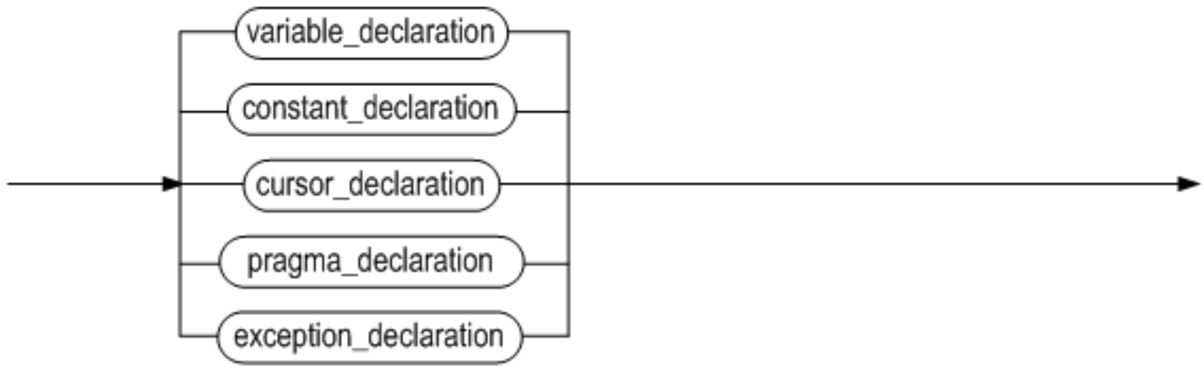
Exception Handler Section

The exception handler section is delimited by the EXCEPTION and END keywords. It contains a routine for handling particular errors that may arise during execution of the stored procedure or function

Declaring Local Variables

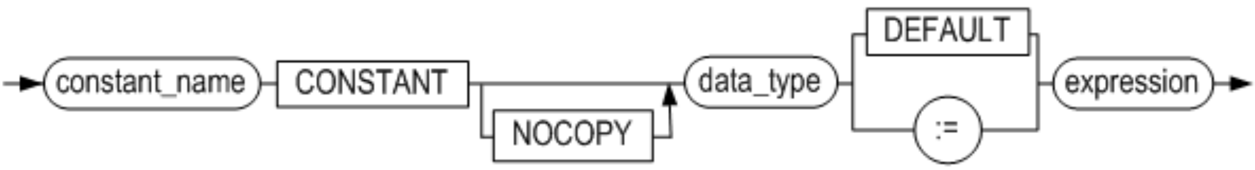
Syntax

declaration_section ::=

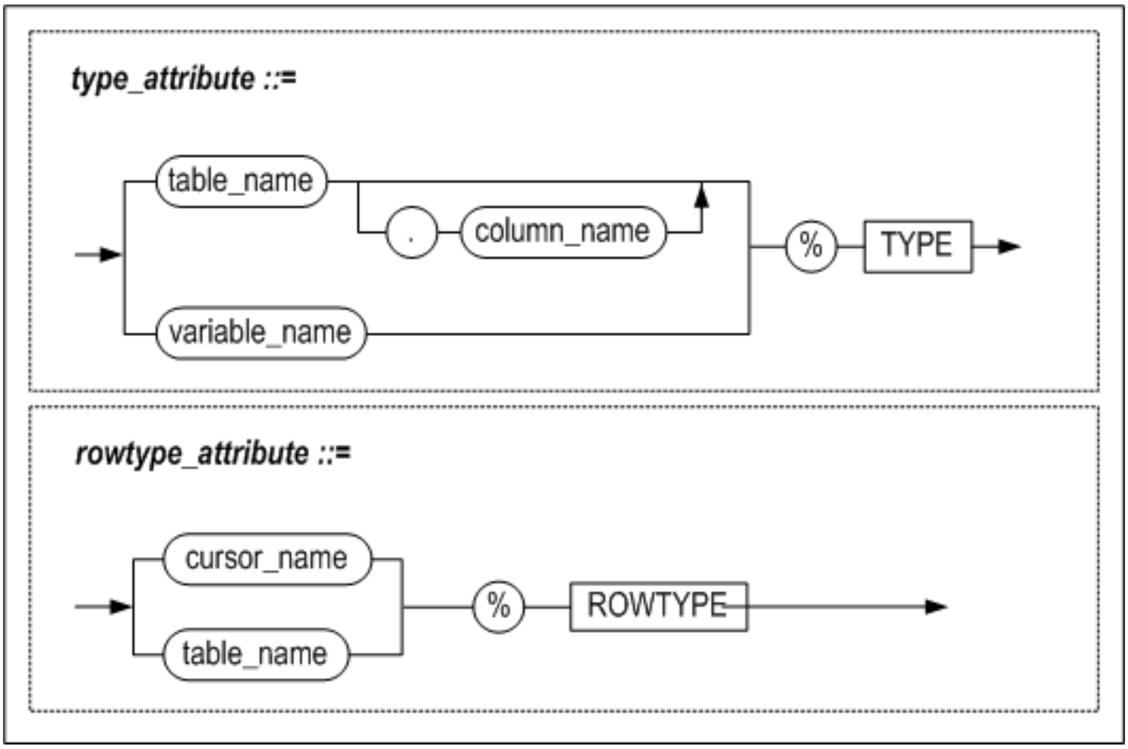


variable_declaration ::=

constant_declaration ::=



data_type ::=



Purpose

variable_name

This is used to specify the name of a variable.

The name of the variable must be unique within the block in which it is declared.

If a column and a variable have the same name, any reference to this name in a SQL statement will be interpreted to mean the column. In the following example, both instances of eno are interpreted to mean the column name, with the undesirable result that all of the records in the employees table will be deleted.

```
DECLARE
eno INTEGER := 100;
BEGIN
DELETE FROM employees WHERE eno = eno;
…
```

To overcome this ambiguity, use a label to assign a name to the block as follows:

```
<<del_block>>
DECLARE
eno INTEGER := 100;
BEGIN
DELETE FROM employees WHERE eno = del_block.eno;
```

For more information about naming blocks, please refer to LABEL in this chapter.

pragma declaration

Please refer to the Pragma section in chapter 10 of this chapter.

data_type

This is used to specify the data type of the variable. The following data types can be used within stored procedures:

- Data types available for use in SQL statements : please refer to Data Types in Chapter 2.
- BOOLEAN types: please refer to Data Types in Chapter 2.
- Any type which is defined for a column or variable and is referenced using the %TYPE attribute
- A RECORD type, comprising multiple columns, referenced using the %ROWTYPE attribute
- User-defined types: please refer to Chapter6: User-Defined Types.

The %TYPE and %ROWTYPE attributes obviate the necessity to change the code in stored procedures when table definitions change. That is, when the data type of a column in a table is changed, a variable defined using the %TYPE attribute will automatically take on the correct type, without any intervention. This helps realize data independence and lower maintenance expenses.

CONSTANT

This option is used when it is desired to use a particular variable as a constant, so that no other value can be assigned to it within the stored procedure. A variable defined in this way is read-only.

For example, when max_val is declared as shown below, it is handled as a constant having the value of 100, and no other value can be arbitrarily allocated thereto.

```
max_val CONSTANT integer := 100;
```

NOCOPY

The NOCOPY option of local variables operates is on equal terms with that of the parameters. Thus, only the address assigned to variables is copied if the NOCOPY option is specified when declaring variables.

DEFAULT

This is used as follows to set an initial value for a variable when it is declared:

```
curr_val INTEGER DEFAULT 100;
count_val INTEGER := 0;
```

Cursor Declaration

Please refer to the CURSOR section in Chapter 5 in this manual.

Exception Declaration

Please refer to the Exception Delacration section in Chapter 9 in this manual.

Nested Blocks and Variable Scope

The scope of a variable specified in the DECLARE section of a block starts at the BEGIN statement and finishes at the END statement in the block in which it was declared.

Suppose that block2 is declared inside block1, and that variables having the same name, v_result, are declared within each block, as shown below. When v_result is referenced outside of block2, the reference is interpreted to mean the variable declared in block1, whereas when v_result is referenced inside block2, it is interpreted to mean the variable declared in block2.

Meanwhile, both the variable x, which was declared in block1 (the outer block), and the variable y, which was declared in block2 (the inner block), can be referred to in the inner block, but only x can be referred to in the outer block.

```
/* start of block1 */
DECLARE
        v_result[1] integer;
        x integer;

BEGIN
        ....
        v_result[1] := 1;
        ....
        /* start of sub-block
        DECLARE
            v_result[2] integer;
            y number;

        BEGIN
```

Restrictions

The following are not supported when declaring variables:

- Variables defined within stored procedures cannot have NOT NULL constraints.
- Multiple variables cannot be declared at the same time. That is, statements such as the following are not possible:

```
i, j, k INTEGER;
```

Examples

Use of %TYPE

```
DECLARE
my_title books.title%TYPE;
```

In the above example, the variable my_title is declared such that it will have the same type as the title column in the books table.

Use of %ROWTYPE

```
DECLARE
dept_rec departments%ROWTYPE
```

In the above example, the variable *dept_rec*, which is a RECORD type variable, is declared such that it will be the same as the departments table or cursor.

Example 1

This example shows the declaration of constants and the use of the %ROWTYPE attribute.

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER);

CREATE OR REPLACE PROCEDURE proc1
AS
  v1 constant INTEGER := 1;
  v2 constant t1.i1%TYPE := 1;
BEGIN
  INSERT INTO t1 VALUES (v1, v2);
END;
/

EXEC proc1;
iSQL> SELECT * FROM t1;
T1.I1       T1.I2
---------------------------
1           1
1 row selected.

--DROP TABLE t1;
CREATE TABLE t1 (i1 INTEGER, i2 INTEGER, i3 INTEGER);
INSERT INTO t1 VALUES(1,1,1);

CREATE OR REPLACE PROCEDURE proc1
AS
  r1 t1%ROWTYPE;
BEGIN
  INSERT INTO t1 VALUES(3,3,3);
```

```
  <<s>>
  DECLARE
    r1 t1%ROWTYPE;

  BEGIN
    SELECT i1, i2, i3 INTO s.r1.i1, s.r1.i2, s.r1.i3 FROM t1 WHERE i1 = 1;
    INSERT INTO t1 VALUES (s.r1.i1, s.r1.i2, s.r1.i3);
  END;

END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t1;
T1.I1       T1.I2       T1.I3
----------------------------------------
1           1           1
3           3           3
1           1           1
3 rows selected.
```

Example 2

This example also shows the use of the %ROWTYPE attribute.

```
CREATE TABLE emp(
    eno INTEGER,
    ename CHAR(10),
    emp_job CHAR(15),
    join_date DATE,
    salary NUMBER(10,2),
    dno BYTE(2));

CREATE TABLE emp401(
    eno INTEGER,
    ename CHAR(10),
    emp_job CHAR(15),
    join_date DATE,
    leave_date DATE,
    salary NUMBER(10,2),
    dno BYTE(2),
    fund NUMBER(10,2) DEFAULT 0);

INSERT INTO emp VALUES (10, 'DKLEE', 'ENGINEER', '01-Jul-2000', 30000000, BYTE'D001');
INSERT INTO emp VALUES (20, 'SWMYUNG', 'MANAGER', '01-Nov-1999', 50000000, BYTE'C002');
```

```
CREATE OR REPLACE PROCEDURE proc1(p1 INTEGER)
AS
BEGIN
  DECLARE
    emp_rec emp%ROWTYPE;
  BEGIN
    SELECT * INTO emp_rec
    FROM emp
    WHERE eno = p1;
    INSERT INTO emp401(eno, ename, emp_job, join_date, leave_date, salary, dno)
      VALUES(emp_rec.eno, emp_rec.ename, emp_rec.emp_job, emp_rec.join_date, sysdate,
emp_rec.salary, emp_rec.dno);
  END;
END;
/

iSQL> EXEC proc1(10);
Execute success.
iSQL> SELECT * FROM emp401;
EMP401.ENO  EMP401.ENAME  EMP401.EMP_JOB   EMP401.JOIN_DATE
-----------------------------------------------
EMP401.LEAVE_DATE    EMP401.SALARY EMP401.DNO  EMP401.FUND
-----------------------------------------------
10          DKLEE       ENGINEER         2000/07/01 00:00:00
2005/01/27 16:26:26  30000000    D001  0
1 row selected.
```

Example 3

This is an example describing the use of NOCOPY option.

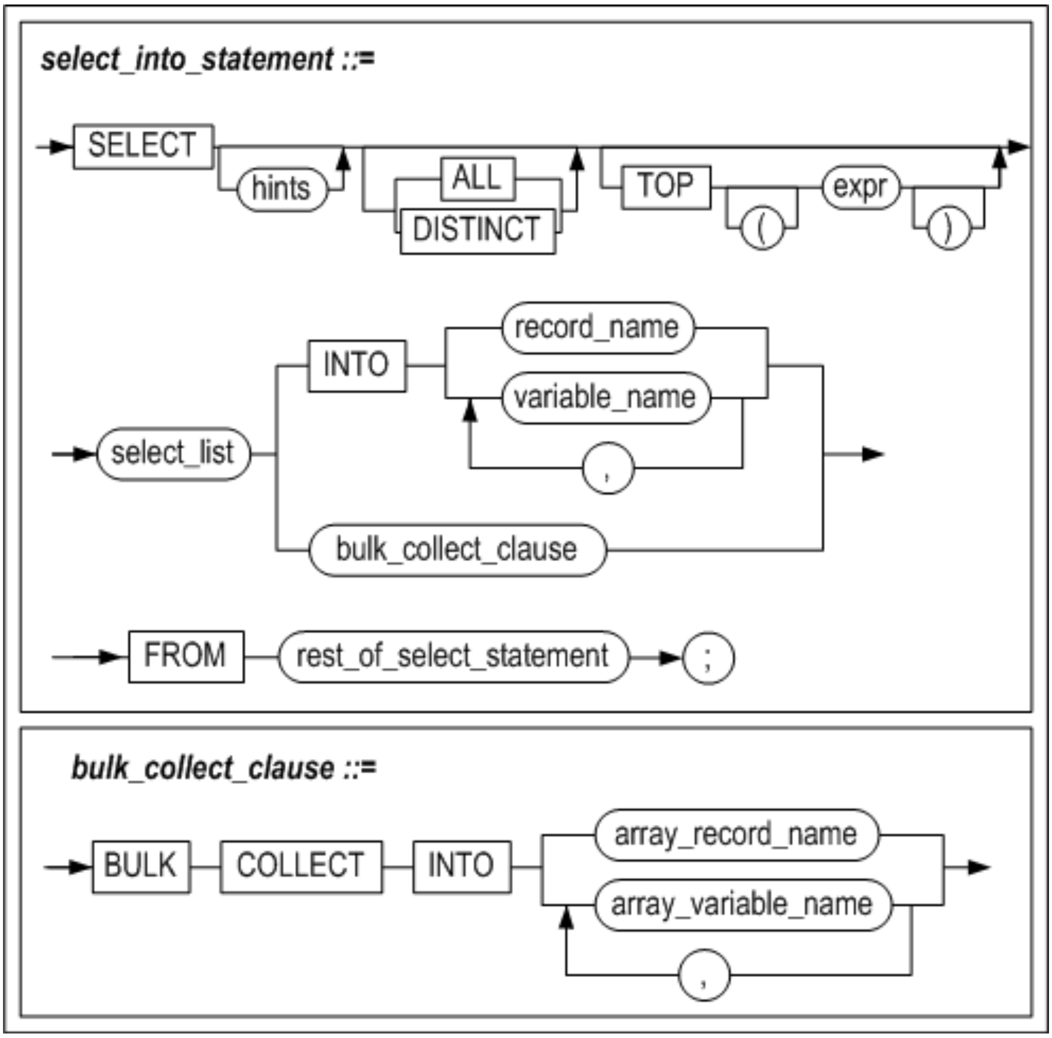
```
iSQL>create or replace procedure proc1
as
      type arr_type is table of INTEGER index by INTEGER;
      var1 arr_type;
      var2 arr_type;
      var3 NOCOPY arr_type;
    begin
      for i in 1 .. 5 loop
        var1[i] := i;
      end loop;
      var2 := var1;
      var3 := var1;
    end;
/
```

```
Create success.
iSQL>  exec proc1;
Execute success.
iSQL> create or replace procedure proc2
    as
      type arr_type_1d is table of INTEGER index by INTEGER;
      type arr_type_2d is table of arr_type_1d index by INTEGER;
      var_2d arr_type_2d;
      var_1d NOCOPY arr_type_1d;
    begin
      for i in 1 .. 5 loop
        var_1d := var_2d[i];
        for j in 1 .. 5 loop
          var_1d[j] := i * j;
        end loop;
      end loop;
      for i in 1 .. 5 loop
        var_1d := var_2d[i];
        for j in 1 .. 5 loop
          println(var_1d[j]);
        end loop;
      end loop;
    end;
    /
Create success.
iSQL> exec proc2;
1
2
3
4
5
2
4
6
8
10
3
6
9
12
15
4
8
12
16
20
5
10
15
```

```
20
25
Execute success.
```

SELECT INTO

Syntax



Because the syntax of select_list and rest_of_select_statement is the same as for a SELECT statement, please refer to the SQL Reference for more information on those elements.

Purpose

When a stored procedure includes a SELECT statement, the SELECT statement must contain an INTO clause.

A SELECT statement in a stored procedure or function must retrieve exactly one record. If the statement retrieves zero or multiple records, an error will be raised.

The number of columns in select_list in the SELECT clause must be the same as the number of variable_name in the INTO clause. Furthermore, the data types of corresponding columns and variables must be compatible. Similarly, when the %ROWTYPE attribute is used, the number of columns in the %ROWTYPE variable and the number of columns in select_list must be the same, and the data types of corresponding columns must be compatible.

When a standard exception occurs, the stored procedure raises an error. The NO_DATA_FOUND and TOO_MANY_ROW exceptions can be used to handle errors in the block's exception handler section. Please refer to Chapter9: Exception Handlers for more information about handling errors.

BULK COLLECT clause

Unlike the INTO clause that returns one record each time, the BULK COLLECT clause returns all of the execution results of the SELECT statement at once. Two types of bind variables as shown below can be specified to follow INTO:

- array_record_name
  This specifies the associative array variables of RECORD type that are to store the records that the SELECT statement returns.
- array_variable_name
  SThis specifies the array variables for each column of the SELECT list. Each data type of the array variables must be compatible with the data type of the corresponding column in the SELECT list, and the number of array variables must equal the number of columns of the SELECT list.

Returning all of the result sets of queries at once using the BULK COLLECT clause is more efficient than returning result rows one at a time using the loop statement.

Example

Example 1

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);
INSERT INTO t1 VALUES(1,1,1);

CREATE OR REPLACE PROCEDURE proc1
AS
  v1 INTEGER;
  r1 t1%ROWTYPE;
BEGIN
  INSERT INTO t1 VALUES (3,3,3);
  <<s>>
  DECLARE
    v1 proc1.r1.i1%TYPE;
    r1 t1%ROWTYPE;
  BEGIN
    SELECT i1,i2,i3
    INTO s.r1.i1, s.r1.i2, s.r1.i3
    FROM t1
    WHERE i1 = 1;

    INSERT INTO t1 VALUES(s.r1.i1, s.r1.i2, s.r1.i3);
```

```
  END;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t1;
T1.I1       T1.I2       T1.I3
----------------------------------------
1           1           1
3           3           3
1           1           1
3 rows selected.
```

Example 2

```
CREATE TABLE t1 (i1 INTEGER, i2 INTEGER, i3 INTEGER);
INSERT INTO t1 VALUES(100, 100, 100);

CREATE SEQUENCE seq1;

CREATE SEQUENCE seq2;

CREATE SEQUENCE seq3;

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
  <<seq1>>
  DECLARE
   nextval INTEGER;
  BEGIN
   nextval := 10;
    INSERT INTO t1 VALUES (seq1.NEXTVAL,0,0);
  END;
END;
/

CREATE OR REPLACE PROCEDURE proc2
AS
BEGIN
  INSERT INTO t1 VALUES (seq1.NEXTVAL, seq2.NEXTVAL, seq3.NEXTVAL);
  INSERT INTO t1 VALUES (seq1.NEXTVAL, seq2.NEXTVAL, seq3.NEXTVAL);
  INSERT INTO t1 VALUES (seq1.NEXTVAL, seq2.NEXTVAL, seq3.NEXTVAL);
END;
/
```

```
CREATE OR REPLACE PROCEDURE proc3
AS
  v1 INTEGER;
  v2 INTEGER;
  v3 INTEGER;
BEGIN
  SELECT seq1.currval, seq2.NEXTVAL, seq3.NEXTVAL
  INTO v1, v2, v3 FROM t1 WHERE i1 = 100;
  INSERT INTO t1 VALUES (v1, v2, v3);

  SELECT seq1.currval, seq1.NEXTVAL, seq1.currval
  INTO v1, v2, v3 FROM t1 WHERE i1 = 100;
  INSERT INTO t1 VALUES (v1, v2, v3);

  SELECT seq1.currval, seq2.NEXTVAL, seq3.NEXTVAL
  INTO v1, v2, v3 FROM t1 WHERE i1 = 100;
  INSERT INTO t1 VALUES (v1, v2, v3);
END;
/

EXEC proc1;
SELECT * FROM t1;
EXEC proc2;
SELECT * FROM t1;
EXEC proc3;
SELECT * FROM t1;
EXEC proc2;
SELECT * FROM t1;
EXEC proc3;

iSQL> SELECT * FROM t1;
T1.I1       T1.I2       T1.I3
----------------------------------------
100         100         100
10          0           0
1           1           1
2           2           2
3           3           3
3           4           4
4           4           4
4           5           5
5           6           6
6           7           7
7           8           8
7           9           9
8           8           8
8           10          10
14 rows selected.
```

```
```

Example 3

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE TABLE t2(i1 INTEGER, i2 INTEGER, i3 INTEGER);
INSERT INTO t1 VALUES (1,1,1);
INSERT INTO t1 VALUES (2,2,2);

CREATE OR REPLACE PROCEDURE proc1
AS
  v1 INTEGER;
  r1 t1%ROWTYPE;
BEGIN
  SELECT i1 INTO v1 FROM t1 WHERE i1 = 1;
  SELECT * INTO r1 FROM t1 WHERE i1 = 1;
  INSERT INTO t2 VALUES (v1, r1.i2, r1.i3);
  <<s>>
  DECLARE
    r1 t1%ROWTYPE;
  BEGIN
    SELECT i1, i2, i3 INTO s.r1.i1, s.r1.i2, s.r1.i3
    FROM t1 WHERE i1 = 2;
    INSERT INTO t2 VALUES (s.r1.i1, s.r1.i2, s.r1.i3);
  END;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t2;
T2.I1       T2.I2       T2.I3
----------------------------------------
1           1           1
2           2           2
2 rows selected.
```

Example 4

```
CREATE TABLE t3(i1 INTEGER);

CREATE OR REPLACE PROCEDURE proc1
AS
```

```
  max_qty orders.qty%TYPE;
BEGIN
  SELECT MAX(qty)
  INTO max_qty
  FROM orders;

  INSERT INTO t3 VALUES(max_qty);
END;
/

iSQL> exec proc1;
Execute success
iSQL> SELECT * FROM t3;
T3.I1
--------------
10000
1 row selected.
```

Example 5

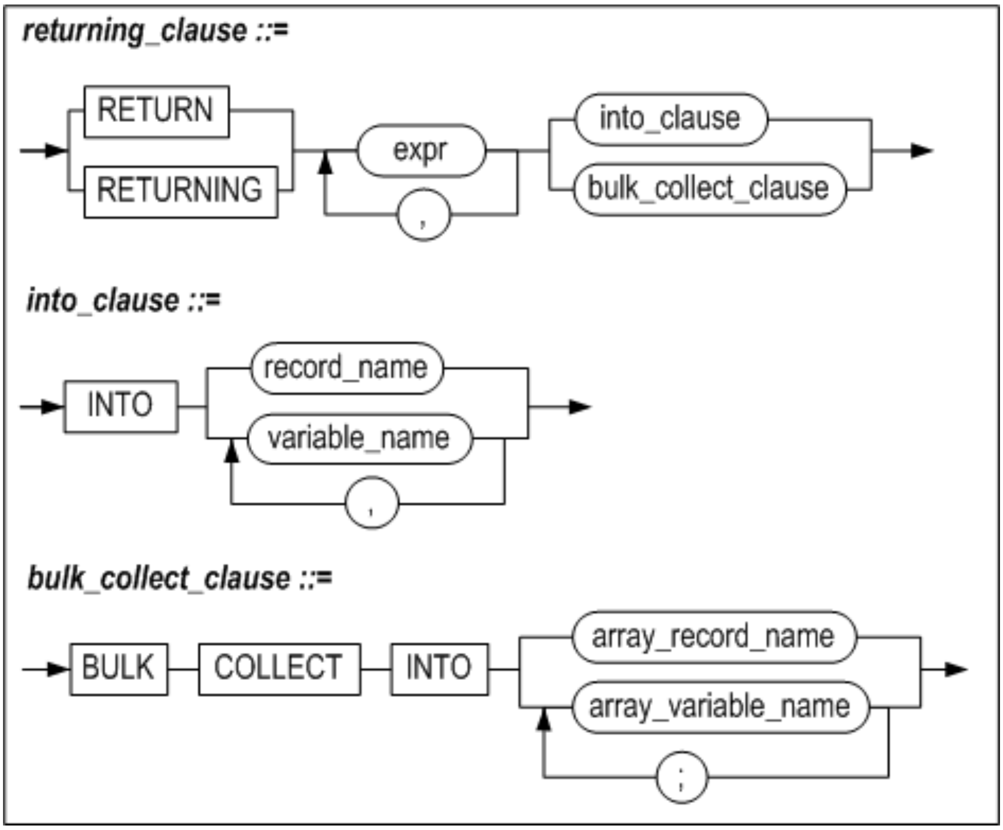
```
CREATE TABLE delayed_processing(
  cno CHAR(14),
  order_date DATE);

CREATE OR REPLACE PROCEDURE proc1
AS
  de_cno CHAR(14);
  de_order_date DATE;
BEGIN
  INSERT INTO delayed_processing

  SELECT cno, order_date
  INTO de_cno, de_order_date
  FROM orders
  WHERE processing = 'D';

END;
/
iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM delayed_processing;
DELAYED_PROCESSING.CNO  DELAYED_PROCESSING.ORDER_DATE
-----------------------------------------------
7610011000001  2000/11/29 00:00:00
7001011001001  2000/11/29 00:00:00
2 rows selected.
```

Example 6

```
create table t1(i1 int,i2 int);
insert into t1 values(1,1);
insert into t1 values(2,2);
insert into t1 values(3,3);

CREATE OR REPLACE PROCEDURE proc1
AS
  type myvarchararr is table of varchar(10) index by integer;
  v2 myvarchararr;
BEGIN
  SELECT i2 BULK COLLECT INTO v2 FROM t1;
  FOR i IN v2.first() .. v2.last() LOOP
    println('v2['||i||']='||v2[i]);
  END LOOP;
END;
/

iSQL> EXEC proc1();
v2[1]=1
v2[2]=2
v2[3]=3
Execute success.
```

RETURNING INTO Clause

Syntax



Function

The RETURNING INTO clause specifies the variables which are to store the record values affected by the execution of DELETE, INSERT, or UPDATE statements that have this clause. The variables can be individual variables or array variables.

expr

Each expr must be a column name affected by DML statements or a data expression compatible with column types.

into_clause

The INTO clause commands modified record values to be respectively stored as variable_name variables.

variable_name

Each variable_name is a PSM variable in which queried expr values are to be stored. Unless using record type variables, the number of variables must equal the number of expr of the expr list. PSM variable types must be compatible with relevant expr types.

record_name

This is the name of the RECORD type variable which is to store the row returned by the statement.

bulk_collect_clause

Unlike the INTO clause which retrieves one record at a time, the BULK COLLECT clause retrieves all of the rows returned by the statement at once. Two types of bind variables as shown below can be specified to follow INTO:

- array_record_name

This specifies the associative array variables of RECORD.

- array_variable_name
  This specifies the array variables for each column of the *expr* list. Each data type of the array variables must be compatible with the data type of the corresponding column in the expr list, and the number of array variables must equal the number of columns of the *expr* list.

Example

Example 1

```
iSQL> create table employees ( eno integer, ename varchar(20));
Create success.

iSQL> create or replace procedure proc1
as
  x1 integer;
  x2 varchar(30);
begin
      insert into employees values (1, 'jake') return eno, ename into x1, x2;
      println( 'x1='||x1||', x2='||x2);
end;
/
Create success.

iSQL> exec proc1;
x1=1, x2=jake
Execute success.
```

Example 2

```
iSQL> create table employees ( eno integer, ename varchar(20));
Create success.
iSQL> create or replace procedure proc1
as
  type myintarr is table of integer index by integer;
  type myvarchararr is table of varchar(30) index by integer;

  v1 myintarr;
  v2 myvarchararr;

begin
      insert into employees values (1, 'jake') return eno, ename bulk collect into v1,
v2;
      for i in v1.first() .. v1.last() loop
      println( 'v1['||i||']='||v1[i] );
      end loop;
```

```
      for i in v2.first() .. v2.last() loop
      println( 'v2['||i||']='||v2[i] );
      end loop;
end;
/
Create success.
iSQL> exec proc1;
v1[1]=1
v2[1]=jake
Execute success.
```

Example 3

```
iSQL> create table employees ( eno integer, ename varchar(20));
Create success.
iSQL> create or replace procedure proc1
as
  type myrec is record( i1 integer, i2 varchar(30) );
  type myrecarr is table of myrec index by integer;

  r1 myrecarr;
  s1 myrec;

begin
    insert into employees values (1, 'jake') return eno, ename bulk collect into r1;
    for i in r1.first() .. r1.last() loop
    s1 := r1[i];
    println( 'r1['||i||'].eno='||s1.i1||', r1['||i||'].ename='||s1.i2 );
    end loop;
end;
/
Create success.
iSQL> exec proc1;
r1[1].eno=1, r1[1].ename=jake
Execute success.
```

Example 4

```
create table employees ( eno integer, ename varchar(20));
insert into employees values (1, 'jake');
insert into employees values (2, 'nikita');
insert into employees values (3, 'dana');
```

```
iSQL> create or replace procedure proc1
as
  x1 integer;
  x2 varchar(30);
begin
      delete from employees where eno = 1 return eno, ename into x1, x2;
      println( 'x1='||x1||', x2='||x2);
end;
/
Create success.
iSQL> exec proc1;
x1=1, x2=jake
Execute success.
```

Example 5

```
create table employees ( eno integer, ename varchar(20));
insert into employees values (1, 'no1.jake');
insert into employees values (1, 'no2.jake');
insert into employees values (1, 'no3.jake');

iSQL> create or replace procedure proc1
as
  type myintarr is table of integer index by integer;
  type myvarchararr is table of varchar(30) index by integer;

  v1 myintarr;
  v2 myvarchararr;

begin
      delete from employees where eno = 1 return eno, ename bulk collect into v1, v2;

      for i in v1.first() .. v1.last() loop
      println( 'v1['||i||']='||v1[i] );
      end loop;
      for i in v2.first() .. v2.last() loop
      println( 'v2['||i||']='||v2[i] );
      end loop;

end;
/
Create success.
iSQL> exec proc1;
v1[1]=1
v1[2]=1
v1[3]=1
```

```
v2[1]=no1.jake
v2[2]=no2.jake
v2[3]=no3.jake
Execute success.
```

Example 6

```
create table employees ( eno integer, ename varchar(20));
insert into employees values (1, 'no1.jake');
insert into employees values (1, 'no2.jake');
insert into employees values (1, 'no3.jake');

iSQL> create or replace procedure proc1
as
  type myrec is record( i1 integer, i2 varchar(30) );
  type myrecarr is table of myrec index by integer;

  r1 myrecarr;
  s1 myrec;

begin
    delete from employees where eno = 1 return eno, ename bulk collect into r1;
    for i in r1.first() .. r1.last() loop
    s1 := r1[i];
    println( 'r1['||i||'].eno='||s1.i1||', r1['||i||'].ename='||s1.i2 );
    end loop;
end;
/
Create success.
iSQL> exec proc1;
r1[1].eno=1, r1[1].ename=no1.jake
r1[2].eno=1, r1[2].ename=no2.jake
r1[3].eno=1, r1[3].ename=no3.jake
Execute success.
```

Example 7

```
create table employees ( eno integer, ename varchar(20));
insert into employees values (1, 'jake');
insert into employees values (2, 'nikita');
insert into employees values (3, 'dana');

iSQL> create or replace procedure proc1
```

```
as
  x1 integer;
  x2 varchar(30);
begin
      update employees set ename = 'mikhaila' where eno = 1 return eno, ename into x1,
x2;
      println( 'x1='||x1||', x2='||x2);
end;
/
Create success.
iSQL> exec proc1;
x1=1, x2=mikhaila
Execute success.
```

Example 8

```
create table employees ( eno integer, ename varchar(20));
insert into employees values (1, 'no1.jake');
insert into employees values (1, 'no2.jake');
insert into employees values (1, 'no3.jake');

iSQL> create or replace procedure proc1
as
  type myintarr is table of integer index by integer;
  type myvarchararr is table of varchar(30) index by integer;

  v1 myintarr;
  v2 myvarchararr;

begin
      update employees set eno = 5, ename = 'mikhaila' where eno = 1 return eno, ename
bulk collect into v1, v2;

      for i in v1.first() .. v1.last() loop
      println( 'v1['||i||']='||v1[i] );
      end loop;
      for i in v2.first() .. v2.last() loop
      println( 'v2['||i||']='||v2[i] );
      end loop;

end;
/
Create success.
iSQL> exec proc1;
v1[1]=5
v1[2]=5
```

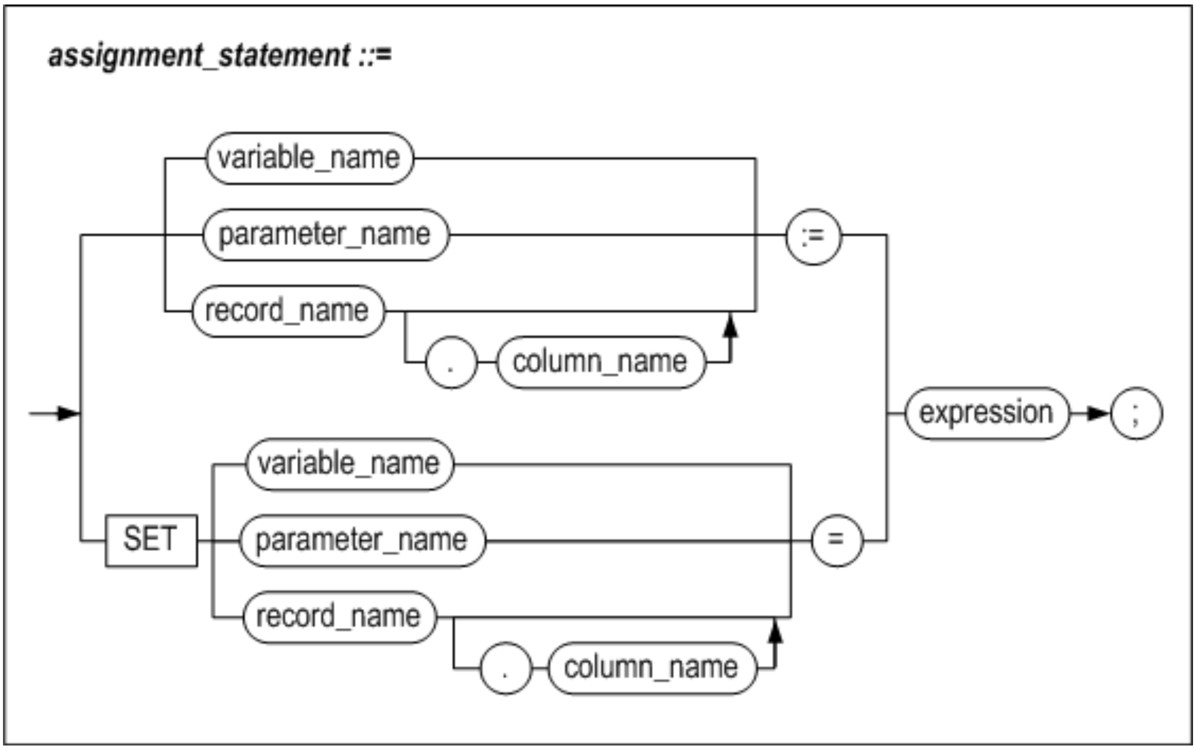
```
v1[3]=5
v2[1]=mikhaila
v2[2]=mikhaila
v2[3]=mikhaila
Execute success.
```

Example 9

```
create table employees ( eno integer, ename varchar(20));
insert into employees values (1, 'no1.jake');
insert into employees values (1, 'no2.jake');
insert into employees values (1, 'no3.jake');

iSQL> create or replace procedure proc1
as
  type myrec is record( i1 integer, i2 varchar(30) );
  type myrecarr is table of myrec index by integer;

  r1 myrecarr;
  s1 myrec;

begin
    update employees set eno = 5, ename = 'mikhaila' where eno = 1 return eno, ename
bulk collect into r1;
    for i in r1.first() .. r1.last() loop
    s1 := r1[i];
    println( 'r1['||i||'].eno='||s1.i1||', r1['||i||'].ename='||s1.i2 );
    end loop;
end;
/
Create success.
iSQL> exec proc1;
r1[1].eno=5, r1[1].ename=mikhaila
r1[2].eno=5, r1[2].ename=mikhaila
r1[3].eno=5, r1[3].ename=mikhaila
Execute success.
```

Assignment Statements

Syntax



Purpose

These statements are used to assign a value to a local variable or to an OUT or IN/OUT parameter.

Values can be assigned to variables and parameters using either of the two following statements:

- Using the assignment operator ":="
  variable_name := value;
  parameter_name := value;
- Using the "SET" expression
  SET *variable_name* = value;
  SET *parameter_name* = value;

Refer to each of the individual values in a RECORD type variable that was declared using the %ROWTYPE attribute in this way:

Example

Example 1

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE OR REPLACE PROCEDURE proc1
AS
  i INTEGER;
BEGIN
  i := 5;

  WHILE i <= 10 LOOP
    INSERT INTO t1 VALUES (i, i+1, i+2);
```

```
    i := i + 1;
  END LOOP;

END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t1;
T1.I1        T1.I2        T1.I3
----------------------------------------
5            6            7
6            7            8
7            8            9
8            9            10
9            10           11
10           11           12
6 rows selected.
```

Example 2

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE OR REPLACE FUNCTION plus20(p1 IN INTEGER)
RETURN INTEGER
AS
  v1 INTEGER;
BEGIN
  v1 := p1 + 20;
  RETURN v1;
END;
/

CREATE OR REPLACE PROCEDURE proc1
AS
  v1 INTEGER;
  in_arg INTEGER;
BEGIN
  in_arg := 80;
  v1 := plus20(in_arg);
  INSERT INTO t1 VALUES (v1, v1, v1);
END;
/

iSQL> EXEC proc1;
Execute success.
```

```
iSQL> SELECT * FROM t1;
T1.I1        T1.I2        T1.I3
----------------------------------------
100          100          100
1 row selected.
```

LABEL

The LABEL statement is used to name a particular point within a stored procedure. A label can be specified within a block using the delimiters shown below:

<< User_defined_label_name >>

Purpose

User-defined labels are used in the following three situations:

- To limit the scope of multiple variables having the same name, or to overcome ambiguity that occurs when a variable and a column have the same name
- To exit a nested loop
- For use with the GOTO statement

Limitations

1. The same label cannot be used more than once within the same block. In the following example, a compilation error will occur, because LABEL1 appears twice within the same block:

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 INTEGER;
BEGIN
    <<LABEL1>>
    V1 := 1;
    <<LABEL1>>
    V1 := V1 + 1;
…
```

2. In order to use labels to limit the scope of variables having the same name, the labels must be declared immediately before DECLARE statements. Note that it is possible to declare more than one label before a single DECLARE statement. In the following example, there are two references to the variable V1 denoted by (1):

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 INTEGER;
BEGIN
    <<LABEL1>>    --- LABLE 지정
```

```
    <<LABEL2>>
     DECLARE
            V1 INTEGER; .......(1)
     BEGIN
            <<LABEL3>>
            DECLARE
                V1 INTEGER; ......(2)
            BEGIN
                LABEL1.V1 := 1;   -- (1)의 V1 참조
                LABEL2.V1 := 2;   -- (1)의 V1 참조
                LABEL3.V1 := 3;   -- (2)의 V1 참조
            END;
       END;
END;
/
In the following example, because the label declaration does not immediately precede
the DECLARE statement, an error results:
AS
    V1 INTEGER;
BEGIN
    <<LABEL1>>
     V1 := 1;
     DECLARE
         V1 INTEGER;
      BEGIN
          LABEL1.V1 := 1;   --- ERROR.
```

2. Similarly, when using a label to exit nested loops, the label must be declared immediately before the loop. Note again that it is possible to declare more than one label before the loop.

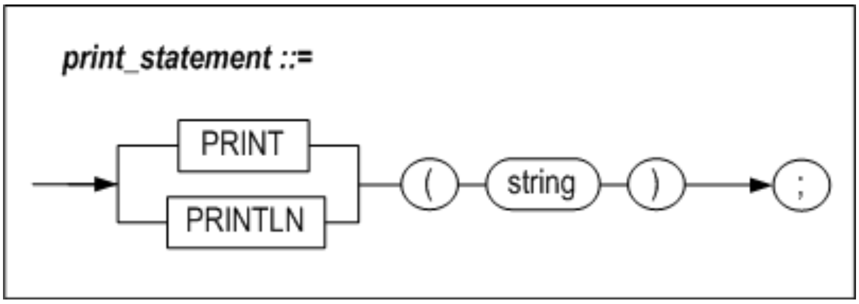
```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 INTEGER;
BEGIN
     V1 := 0;
    <<LABEL1>>
    <<LABEL2>>
     FOR I IN 1 .. 10 LOOP
          V1 := V1 + 1;
           FOR I IN 1 .. 10 LOOP
                V1 := V1 + 1;
                EXIT LABEL1 WHEN V1 = 30;
            END LOOP;
      END LOOP;
END;
/
```

In the following example, one of the labels is not declared immediately before the loop. Because this label cannot be used to exit from the nested loops, an error is raised during the attempt to compile the stored procedure.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 INTEGER;
BEGIN
    <<LABEL1>>
     V1 := 0;
    <<LABEL2>>
     FOR I IN 1 .. 10 LOOP
          V1 := V1 + 1;
           FOR I IN 1 .. 10 LOOP
               V1 := V1 + 1;
             EXIT LABEL1 WHEN V1 = 30; -- ERROR
          END LOOP;
      END LOOP;
END;
/
```

PRINT

Syntax



Purpose

The PRINT statement is used to output desired text to the calling client or routine. PRINT is a system procedure that is provided within Altibase, and is typically used for debugging and testing. PRINTLN differs from PRINT only in that it outputs the appropriate newline sequence ("\n" in Unix) after the string. The owner of PRINT and PRINTLN is the SYSTEM_user.

It is possible to specify the SYSTEM_ user when using these routines, as follows:

```
SYSTEM_.PRINTLN('Hello World');
```

However, it is not necessary to specify the SYSTEM_ user in this way, because a public synonym exists for these procedures.

String

This is the string to be output to the client.

As seen in Example 2 below, the double-vertical-bars concatenation operator ("||") can be used to combine the values of variables, query results, etc. with text to create a single line of text to be output to the client.

Example

Example 1

```
CREATE OR REPLACE PROCEDURE proc1
AS
  v1 BIGINT;
BEGIN
  v1 := BIGINT'9223372036854775807';
  system_.println ('1');
  system_.println (v1);
  system_.println ('2');
END;
/

iSQL> EXEC proc1;
1
9223372036854775807
2
Execute success.
```

Example 2

```
CREATE OR REPLACE PROCEDURE proc1
AS
  eno_count INTEGER;
BEGIN
  SELECT COUNT(eno) INTO eno_count FROM employees;
  println('The NUMBER of Employees: ' || eno_count);
END;
/

iSQL> EXEC proc1;
The NUMBER of Employees: 20
Execute success.
```

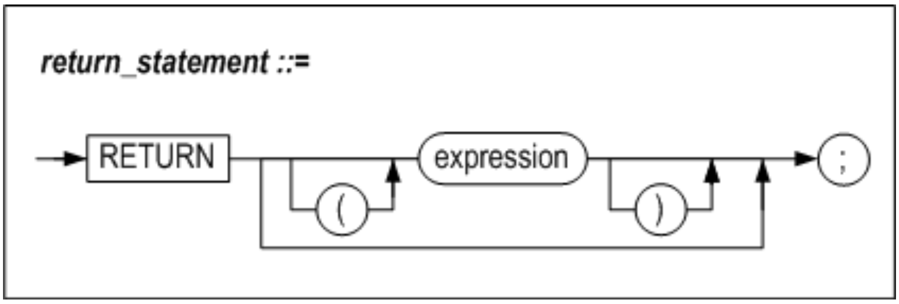
Example 3

The following example illustrates how to use a loop with PRINT and PRINTLN to output formatted query results.

```
CREATE OR REPLACE PROCEDURE showProcedures
AS
  CURSOR c1 IS
    SELECT SYSTEM_.sys_procedures_.proc_name,
decode(SYSTEM_.sys_procedures_.object_TYPE, 0, 'Procedure',1,'Function')
    FROM system_.sys_procedures_ ;

  v1 CHAR(40);
  v2 CHAR(20);
BEGIN
  OPEN c1;
  SYSTEM_.PRINTLN('--------------------------');
  SYSTEM_.PRINT('Proc_Name');
  SYSTEM_.PRINTLN('    Procedure/Function');
  SYSTEM_.PRINTLN('--------------------------');

LOOP
    FETCH C1 INTO v1, v2;
    EXIT WHEN C1%NOTFOUND;
    PRINT(' ');
    PRINT(v1);
    PRINTLN(v2);
END LOOP;

  PRINTLN('------------------------');
  CLOSE c1;
END;
/

iSQL> EXEC showProcedures;
-----------------------------------------------
Proc_Name                           Procedure/Function
-----------------------------------------------

 PRINT                                   Procedure
 PRINTLN                                 Procedure
.
.

 SHOWPROCEDURES                          Procedure
-----------------------------------------------
Execute success.
```

RETURN

Syntax



Purpose

This statement is used to interrupt the execution of a stored procedure. When used with a stored function, it is additionally used to specify the return value.

Because stored procedures do not return values, an error will be raised in response to an attempt to compile a stored procedure that specifies a return value. In contrast, because a function must always return a value, it is necessary to specify a return value when creating a function.

expression

expression is used to specify the return value for a stored function. It is possible to perform operations in *expression*.

Example

Example 1

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

INSERT INTO t1 VALUES(1,1,1);

CREATE OR REPLACE FUNCTION times_half(p1 IN INTEGER)
RETURN INTEGER
AS
BEGIN
  RETURN p1 / 2;
END;
/

iSQL> SELECT times_half(times_half(8)) FROM t1;
TIMES_HALF(TIMES_HALF(8))
----------------------------
2
1 row selected.
```

Example 2

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

INSERT INTO t1 VALUES(1,1,1);
INSERT INTO t1 VALUES(10,10,10);
INSERT INTO t1 VALUES(100,100,100);

CREATE OR REPLACE FUNCTION max_all_val
RETURN INTEGER
AS
  v1 INTEGER;
BEGIN
  SELECT MAX(i1) INTO v1 FROM t1;
  RETURN v1;
END;
/

iSQL> SELECT max_all_val FROM t1;
MAX_ALL_VAL
--------------
100
100
100
3 rows selected.
```

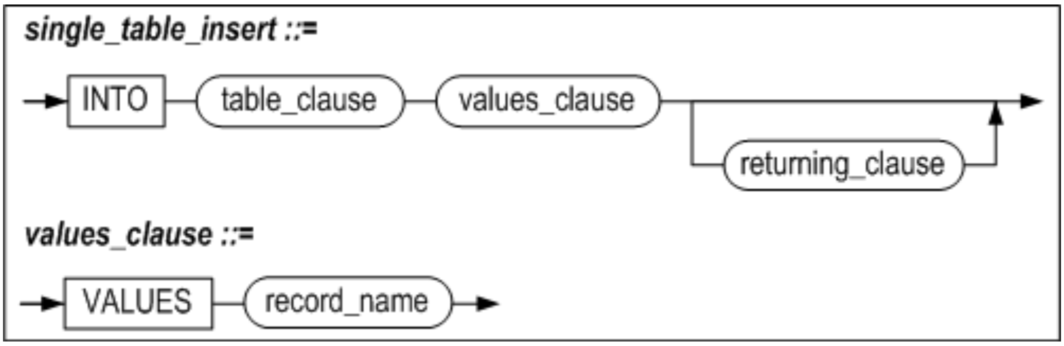
Example 3

```
CREATE TABLE t4(i1 INTEGER, i2 INTEGER);

INSERT INTO t4 VALUES(3, 0);
INSERT INTO t4 VALUES(2, 0);
INSERT INTO t4 VALUES(1, 0);
INSERT INTO t4 VALUES(0, 0);

CREATE OR REPLACE FUNCTION func_plus_10(p1 INTEGER)
RETURN INTEGER
AS
BEGIN
  RETURN p1+10;
END;
/

iSQL> SELECT func_plus_10(i1) FROM t4;
FUNC_PLUS_10(I1)
--------------------
13
```

```
12
11
10
4 rows selected.
```

INSERT Extension

Syntax



Purpose

This is a stored procedure extension of the INSERT

The following example inserts the value of a record type variable when inserting a new record into a table or a specific partition withn a stored procedure.

The extension can be executed by replacing the single_table_insert clause and the values_clause clause with the syntax defined above in the SQL reference INSERT.

single_table_insert

The single_table_insert clause is used to insert one record into one table.

Note that the INSERT extension cannot specify the column name to insert.

record_name

This is a name of the record variable to insert into the specified table. This specifies variables of the RECORD type and the ROWTYPE type.

The number of columns in the record variable and the number of columns in the table must be the same. Also, the columns defined inside the record type must be exactly matched or compatible in the order of the column type. If there is a NOT NULL constraint on a column of the table, NULL values cannot be used for the column of the corresponding record.

Example

Example 1

This example inserts the record type variable r1 into the table t1 in the procedure.

```
CREATE TABLE t1(
    i1 INTEGER,
    i2 INTEGER,
    i3 INTEGER );

CREATE OR REPLACE PROCEDURE proc1
AS
    r1 t1%ROWTYPE;
BEGIN
    FOR i IN 1 .. 5 LOOP
        r1.i1 := i+10;
        r1.i2 := i+20;
        r1.i3 := i+30;
        INSERT INTO t1 VALUES r1;
    END LOOP;
END;
/

iSQL> EXEC proc1();
Execute success.
iSQL> SELECT * FROM t1;
I1          I2          I3
----------------------------------------
11          21          31
12          22          32
13          23          33
14          24          34
15          25          35
5 rows selected.
```

Example 2

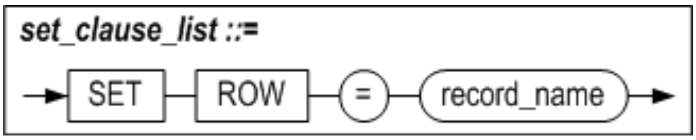
The following example inserts the value of the OLD ROW record type variable into the log_tbl table when deleting rows of the ORDER table.

```
CREATE TABLE log_tbl (
  ONO             BIGINT,
  ORDER_DATE      DATE,
  ENO             INTEGER,
  CNO             BIGINT,
  GNO             CHAR(10),
  QTY             INTEGER,
  ARRIVAL_DATE    DATE,
  PROCESSING      CHAR(1) );
```

```
CREATE TRIGGER del_trigger
AFTER DELETE ON orders
REFERENCING OLD ROW old_row
FOR EACH ROW
AS BEGIN
INSERT INTO log_tbl VALUES old_row;
END;
/

iSQL> DELETE FROM orders WHERE processing = 'D';
2 rows deleted.

iSQL> SELECT * FROM log_tbl;
ONO                  ORDER_DATE   ENO         CNO
------------------------------------------------------------------------
GNO         QTY         ARRIVAL_DATE PROCESSING
------------------------------------------------------
11290011             29-NOV-2011  12          17
E111100001  1000        05-DEC-2011  D
11290100             29-NOV-2011  19          11
E111100001  500         07-DEC-2011  D
2 rows selected.
```

UPDATE Extension

Syntax



Purpose

This is a stored procedure extension of the UPDATE statement.

The following example shows changing a record of a table or a specific partition into the value of a record type variable within a stored procedure.

The extension can excuted by replacing the set_clause_list clause with the statement defined above in the SQL Reference UPDATE.

record_name

This is a name of the record variable to change. This specifies a variable of type RECORD and ROWTYPE.

The number of columns in the record variable and the number of columns in the specified table must be the same. In addition, the columns defined inside the record type must be exactly matched or compatible in the order of the specified table column type. If there is a NOT NULL constraint on a column of the table, NULL values cannot be used for the column of the corresponding record.

Example

Example 1

Update the salary of employees with programmer job. This example inserts the value of a record type variable inside a procedure.

```
CREATE OR REPLACE PROCEDURE proc1 as
    TYPE TYPE_REC IS RECORD( eno INTEGER, SALARY NUMBER(10,2) );
    TYPE TYPE_ARR IS TABLE OF TYPE_REC INDEX BY INTEGER;
    emps TYPE_ARR;
    idx  INTEGER;
BEGIN
    SELECT ENO, SALARY BULK COLLECT INTO emps FROM EMPLOYEES WHERE EMP_JOB =
'programmer';

    FOR idx IN emps.FIRST() .. emps.LAST() LOOP
        emps[idx].SALARY := emps[idx].SALARY * 1.02;

        UPDATE (SELECT ENO, SALARY FROM EMPLOYEES)
            SET ROW = emps[idx]
            WHERE ENO = emps[idx].eno;
    END LOOP;
END;
/

iSQL> SELECT * FROM EMPLOYEES WHERE EMP_JOB = 'programmer';
ENO         E_LASTNAME            E_FIRSTNAME           EMP_JOB
------------------------------------------------------------------------------
EMP_TEL          DNO         SALARY      SEX  BIRTH   JOIN_DATE    STATUS
-----------------------------------------------------------------------------------
6           Momoi                 Ryu                   programmer
0197853222       1002        1700        M  790822  09-SEP-2010  H
10          Bae                   Elizabeth             programmer
0167452000       1003        4000        F  710213  05-JAN-2010  H
2 rows selected.
iSQL> EXEC PROC1();
Execute success.

iSQL> SELECT * FROM EMPLOYEES WHERE EMP_JOB = 'programmer';
ENO         E_LASTNAME            E_FIRSTNAME           EMP_JOB
```

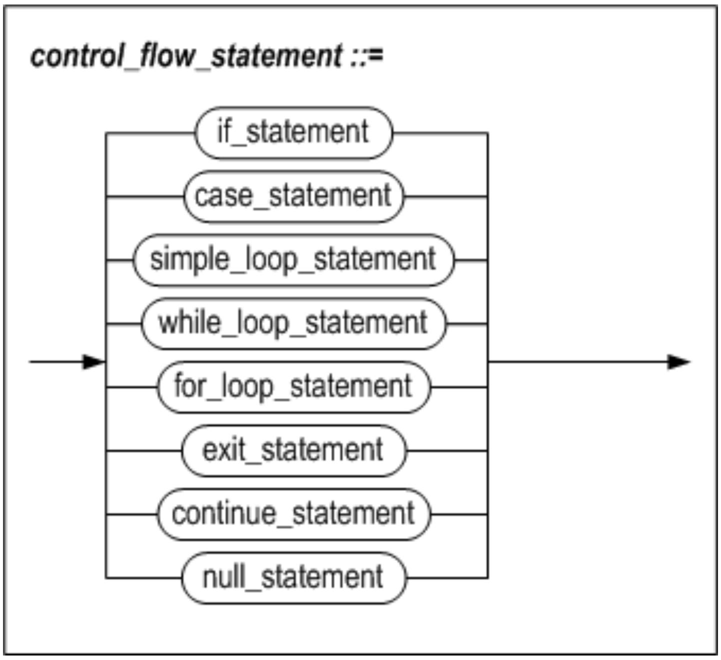
```
------------------------------------------------------------------------------
EMP_TEL          DNO         SALARY      SEX  BIRTH   JOIN_DATE    STATUS
-----------------------------------------------------------------------------------
6           Momoi                 Ryu                   programmer
0197853222       1002        1734        M  790822  09-SEP-2010  H
10          Bae                   Elizabeth             programmer
0167452000       1003        4080        F  710213  05-JAN-2010  H
2 rows selected.
```

4. Control Flow Statement

Overview

This chapter describes how to use control flow statements in a stored procedure body.

Syntax



Altibase supports the use of the following control flow statements in stored procedures:

- The IF and CASE conditional statements
- The LOOP, WHILE and FOR loop constructs, which cause multiple statements to be repeatedly executed
- The EXIT and CONTINUE statements, which are used to control the iteration of loops
- The NULL statement, which indicates that nothing is to be executed
- The GOTO statement, which is used to transfer control to a particular point

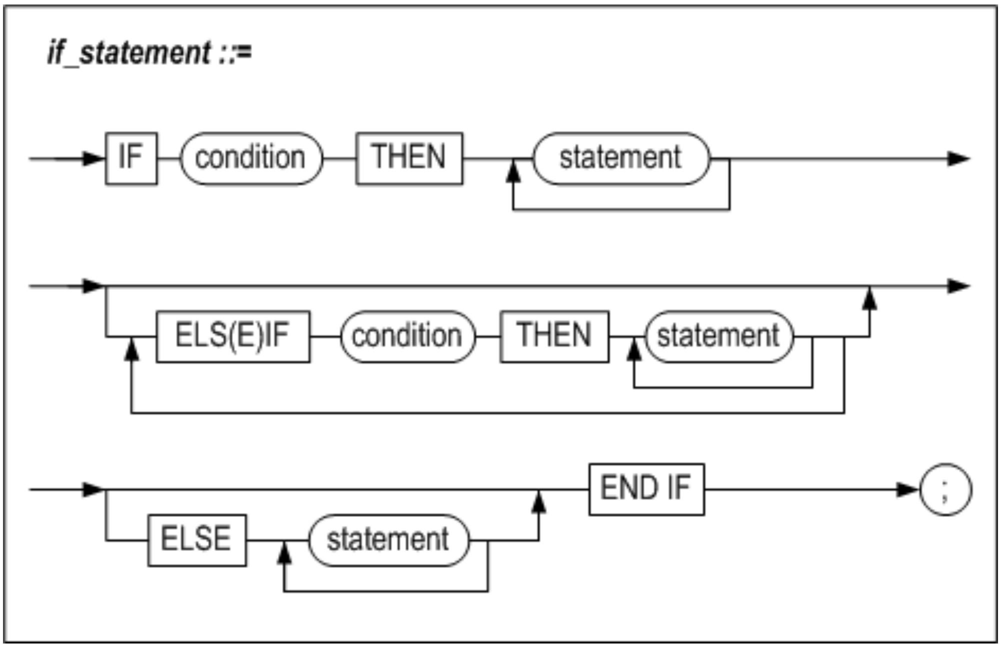
Restrictions

Any expressions containing subqueries cannot be used for condition of IF statement and CASE statement. However followings are exceptions of the rule:

- EXIST (subquery)
- NOT EXIST (subquery)

IF

Syntax



Purpose

This is a conditional construct that determines where execution continues depending on whether or not a given condition is satisfied. The IF clause checks the condition and passes control to the THEN clause if the condition is true, or to the ELSE clause if the condition is false or NULL.

condition

All conditions that are available for use in the WHERE clause of SQL statements can be used here. For more information about the conditions that are supported in SQL, please refer to the *SQL Reference.*

ELS(E)IF

Use this clause to specify another condition to be checked when the previous IF condition is FALSE.

One IF clause can have multiple ELS(E)IF clauses. The ELS(E)IF clause is optional..

ELSE

This clause is used to specify what to do when all of the preceding IF and ELS(E)IF conditions are FALSE. One IF clause can have only one corresponding ELSE clause. The ELSE clause can be omitted.

Nested IF Constructs

IF constructs can be nested within other IF constructs. That is, one IF construct can be located within a series of statements that are executed depending on the outcome of another IF, ELS(E)IF, or ELSE clause. An END IF clause must be provided for every IF clause.

Examples

Example 1

```
CREATE OR REPLACE PROCEDURE proc1
AS
  CURSOR c1 IS SELECT eno, emp_job, salary FROM employees;
  emp_id employee.eno%TYPE;
  e_job employee.emp_job%TYPE;
  e_salary employee.salary%TYPE;
BEGIN
  OPEN c1;
  LOOP
    FETCH c1 INTO emp_id, e_job, e_salary;
    EXIT WHEN c1%NOTFOUND;

    IF e_salary IS NULL THEN
      IF e_job = 'CEO' THEN
        e_salary := 5000;
      ELSIF e_job = 'MANAGER' THEN
        e_salary := 4500;
      ELSIF e_job = 'ENGINEER' THEN
        e_salary := 4300;
      ELSIF e_job = 'PROGRAMMER' THEN
        e_salary := 4100;
      ELSE
        e_salary := 4000;
      END IF;

      UPDATE employees SET salary = e_salary WHERE eno = emp_id;
    END IF;

  END LOOP;
  CLOSE c1;
END;
/

iSQL> SELECT eno, emp_job FROM employees WHERE salary IS NULL;
ENO         EMP_JOB
--------------------------------
1           CEO
8           manager
20          sales rep
3 rows selected.
```

```
iSQL> EXEC proc1;
Execute success.
iSQL> SELECT eno, emp_job, salary FROM employees
WHERE eno=1 OR eno=8 OR eno=20;
ENO         EMP_JOB          SALARY
---------------------------------------------
1           CEO              5000
8           manager          4500
20          sales rep         4000
3 rows selected.
```

Example 2

```
CREATE TABLE t1 (i1 VARCHAR(20), i2 NUMBER, i3 DATE);
CREATE TABLE t2 (i1 VARCHAR(20), i2 NUMBER, i3 DATE);

INSERT INTO t1 VALUES ('21-JUL-2001', 2, '01-JUL-2000');
INSERT INTO t2 VALUES (NULL,NULL,'01-FEB-1990');
INSERT INTO t2 VALUES (NULL,NULL,'02-FEB-1990');

CREATE OR REPLACE FUNCTION func2
(p1 IN DATE, p2 IN CHAR(30))
RETURN NUMBER
AS
BEGIN
  RETURN (TO_NUMBER(TO_CHAR(p1, 'dd')) + TO_NUMBER(p2));
END;
/
CREATE OR REPLACE FUNCTION func1
(p1 IN DATE, p2 IN DATE)
RETURN DATE
AS
BEGIN
  IF p1 >= p2 THEN
    RETURN add_months(p1, 3);
  ELSE
    RETURN add_months(p1, 4);
  END IF;
END;
/

CREATE OR REPLACE PROCEDURE proc1
AS
  v1  VARCHAR(20);
  v2  NUMBER;
  v3  DATE;
BEGIN
```

```
  SELECT i1, func2(TO_DATE(i1), TO_CHAR(i3, 'yyyy')), i3
  INTO v1,v2,v3 FROM t1 WHERE i2 = 2;
  INSERT INTO t2 VALUES (v1,v2,v3);

  IF v2 not in (2001, 2002, 2003) AND v1 = '21-JUL-2001' THEN
    UPDATE t2
    SET i1 = func1(v1, '17-JUL-2001'),
        i2 = nvl(i2, 10)
    WHERE i3 = '01-FEB-1990';

    UPDATE t2
    SET i1 = func1(v1, '27-JUL-2001'),
        i2 = nvl(i2, 10*2)
    WHERE i3 = '02-FEB-1990';
  END IF;

END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t2;
T2.I1                 T2.I2       T2.I3
-----------------------------------------------
21-JUL-2001           2021        2000/07/01 00:00:00
21-OCT-01             10          1990/02/01 00:00:00
21-NOV-01             20          1990/02/02 00:00:00
3 rows selected.
```

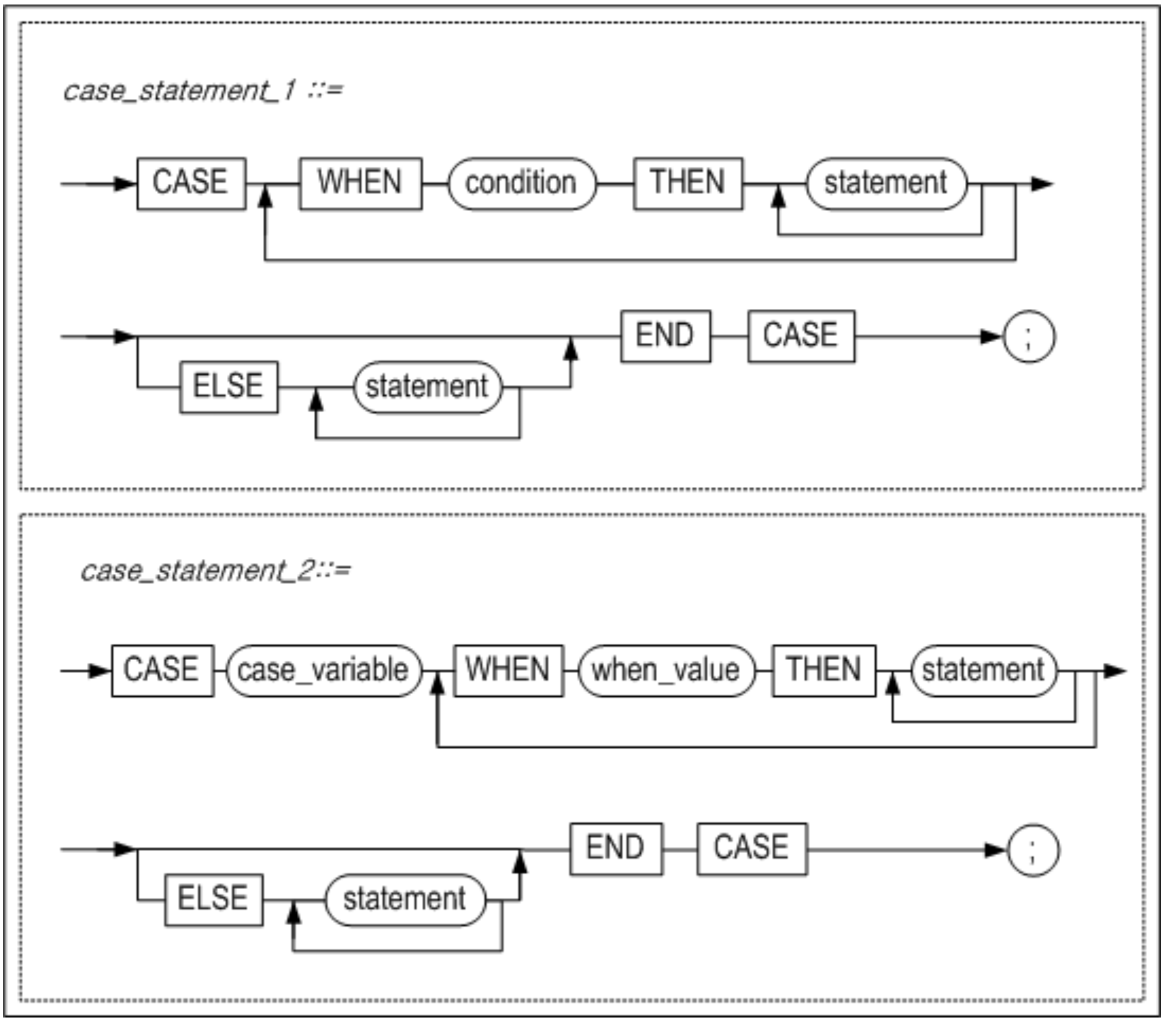
Example 3

```
CREATE TABLE payroll(
  eno INTEGER,
  bonus NUMBER(10, 2));

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
  DECLARe
    CURSOR c1 IS
      SELECT DISTINCT(eno), SUM(qty) FROM orders GROUP BY eno;
      emp_id orders.eno%TYPE;
      sum_qty orders.qty%TYPE;
      bonus NUMBER(10, 2);
    BEGIN
      OPEN c1;
```

```
      IF c1%ISOPEN THEN
        LOOP
          FETCH c1 INTO emp_id, sum_qty;
          EXIT WHEN c1%NOTFOUND;
          IF sum_qty > 25000 THEN
            bonus := 1000;
          ELSIF sum_qty > 15000 THEN
            bonus := 500;
          ELSE
            bonus := 200;
          END IF;

        INSERT INTO payroll VALUES(emp_id, bonus);
      END LOOP;
    END IF;
  END;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT DISTINCT(eno), SUM(qty) sum FROM orders GROUP BY eno;
ENO         SUM
------------------------------------
12          17870
19          25350
20          13210
3 rows selected.
iSQL> SELECT * FROM payroll;
PAYROLL.ENO PAYROLL.BONUS
-----------------------------
12          500
19          1000
20          200
3 rows selected.
```

CASE

Syntax



Purpose

CASE is a conditional construct that determines the flow of execution on the basis of the value of some variable. Its functionality is similar to that of the IF statement, however, it is more easily legible.

As can be seen in the above diagram, the CASE statement can have one of two forms:

- *case_statement_1*: The first is used to execute a desired statement or series of statements when the specified condition is satisfied
- *case_statemen_2*: The second is used to execute a desired statement or series of statements when the variable has the specified value.

Note that both methods cannot be used together within a single CASE construct.

If none of the conditions specified in the case construct are satisfied, then the statements following the ELSE clause are executed. If the ELSE clause is omitted and none of the conditions are satisfied, then nothing is executed.

condition

This is used to specify the condition to check. It has the same form as the condition in the WHERE clause of a SELECT SQL statement.

case_variable

This is used to specify the name of the variable that is checked to determine procedural flow within the stored procedure.

when_value

This is the value with which case_variable is compared. If they are the same, the statement or statements following the THEN statement will be executed.

ELSE

If none of the WHEN conditions are satisfied in the case of case_statement_1, or if case_variable does not match any when_value in the case of case_statement_2, the statements following the ELSE clause will be executed.

The ELSE clause can be omitted, and only one ELSE clause can be specified for one CASE construct. If there is no ELSE clause and none of the conditions are satisfied, no statement will be executed.

Example

Example 1

```
CREATE OR REPLACE PROCEDURE proc1
AS
  CURSOR c1 IS SELECT eno, emp_job, salary FROM employees;
  emp_id employees.eno%TYPE;
  e_job employees.emp_job%TYPE;
  e_salary employees.salary%TYPE;
BEGIN
  OPEN c1;

  LOOP
    FETCH c1 INTO emp_id, e_job, e_salary;
    EXIT WHEN c1%NOTFOUND;

    IF e_salary IS NULL THEN
      CASE
        WHEN e_job = 'CEO' THEN e_salary := 5000;
        WHEN e_job = 'MANAGER' THEN e_salary := 4500;
        WHEN e_job = 'ENGINEER' THEN e_salary := 4300;
        WHEN e_job = 'PROGRAMMER' THEN e_salary := 4100;
        ELSE e_salary := 4000;
      END CASE;
      UPDATE employees SET salary = e_salary WHERE eno = emp_id;
    END IF;

  END LOOP;

  CLOSE c1;
END;
```

```
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT eno, emp_job, salary FROM employees
WHERE eno=1 OR eno=8 OR eno=20;
ENO         EMP_JOB          SALARY
---------------------------------------------
1           CEO              5000
8           manager          4500
20          sales rep         4000
3 rows selected.
```

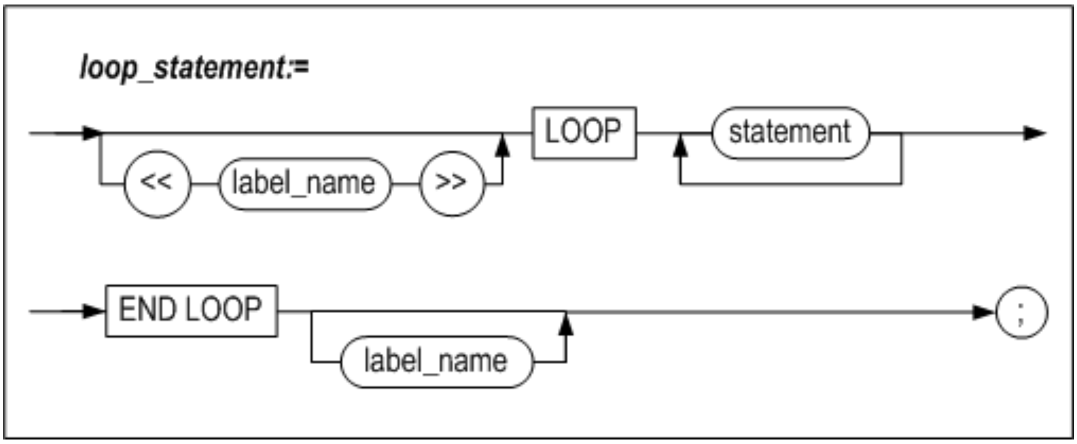
Example 2

```
@SCHEMA.SQL

CREATE OR REPLACE PROCEDURE PROC1
AS
  CURSOR C1 IS SELECT ENO, EMP_JOB, SALARY FROM EMPLOYEES;
  EMP_ID EMPLOYEES.ENO%TYPE;
  E_JOB EMPLOYEES.EMP_JOB%TYPE;
  E_SALARY EMPLOYEES.SALARY%TYPE;
BEGIN
  OPEN C1;

  LOOP
    FETCH C1 INTO EMP_ID, E_JOB, E_SALARY;
    EXIT WHEN C1%NOTFOUND;

    IF E_SALARY IS NULL THEN
      CASE E_JOB
        WHEN 'CEO' THEN E_SALARY := 5000;
        WHEN 'MANAGER' THEN E_SALARY := 4500;
        WHEN 'ENGINEER' THEN E_SALARY := 4300;
        WHEN 'PROGRAMMER' THEN E_SALARY := 4100;
        ELSE E_SALARY := 4000;
      END CASE;
      UPDATE EMPLOYEES SET SALARY = E_SALARY WHERE ENO = EMP_ID;
    END IF;

  END LOOP;

  CLOSE C1;
END;
/
```

```
ISQL> SELECT ENO, EMP_JOB FROM EMPLOYEES WHERE SALARY IS NULL;
ENO          EMP_JOB
--------------------------------
1            CEO
8            MANAGER
20           SALES REP
3 ROWS SELECTED.
ISQL> EXEC PROC1;
EXECUTE SUCCESS.
ISQL> SELECT ENO, EMP_JOB, SALARY FROM EMPLOYEES WHERE ENO=1 OR ENO=8 OR ENO=20;
ENO          EMP_JOB          SALARY
---------------------------------------------
1            CEO              5000
8            MANAGER          4500
20           SALES REP         4000
3 ROWS SELECTED.
```

LOOP

Syntax



Purpose

The LOOP construct is used to repeatedly execute a desired statement or series of statements without using a particular condition to control execution.

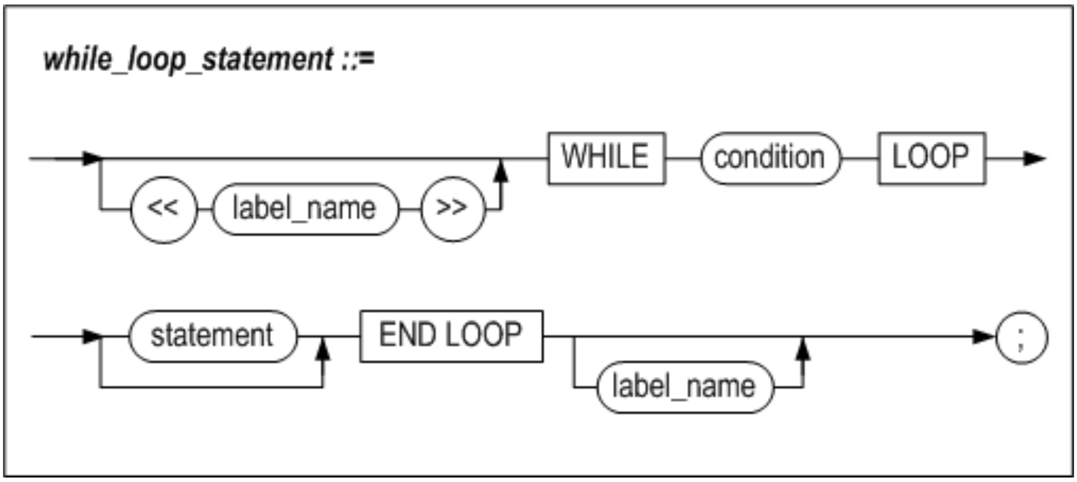
Bear in mind that using the LOOP construct without an EXIT statement or some other way of exiting the loop can create an infinite loop, which can cause system problems.

Example

```
CREATE TABLE item(id INTEGER, counter NUMBER(2));

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
  DECLARE
    v_id item.id%TYPE := 501;
    v_counter NUMBER(2) := 1;
  BEGIN
    LOOP
      INSERT INTO item VALUES(v_id, v_counter);
      v_counter := v_counter + 1;
      EXIT WHEN v_counter > 10;
    END LOOP;
  END;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM item;
ITEM.ID     ITEM.COUNTER
----------------------------
501         1
501         2
…
501         9
501         10
10 rows selected.
```

WHILE LOOP

Syntax



Purpose

The WHILE LOOP construct iterates the statements in the loop body as long as the condition remains true. If this condition is not true the first time it is executed, the statements in the loop will not be executed even once, and control will pass to the statement following the loop.

condition

This specifies a condition clause that determines whether or not to execute a LOOP. Conditional clauses can use all the predicates available in the WHERE clause of SQL statements.

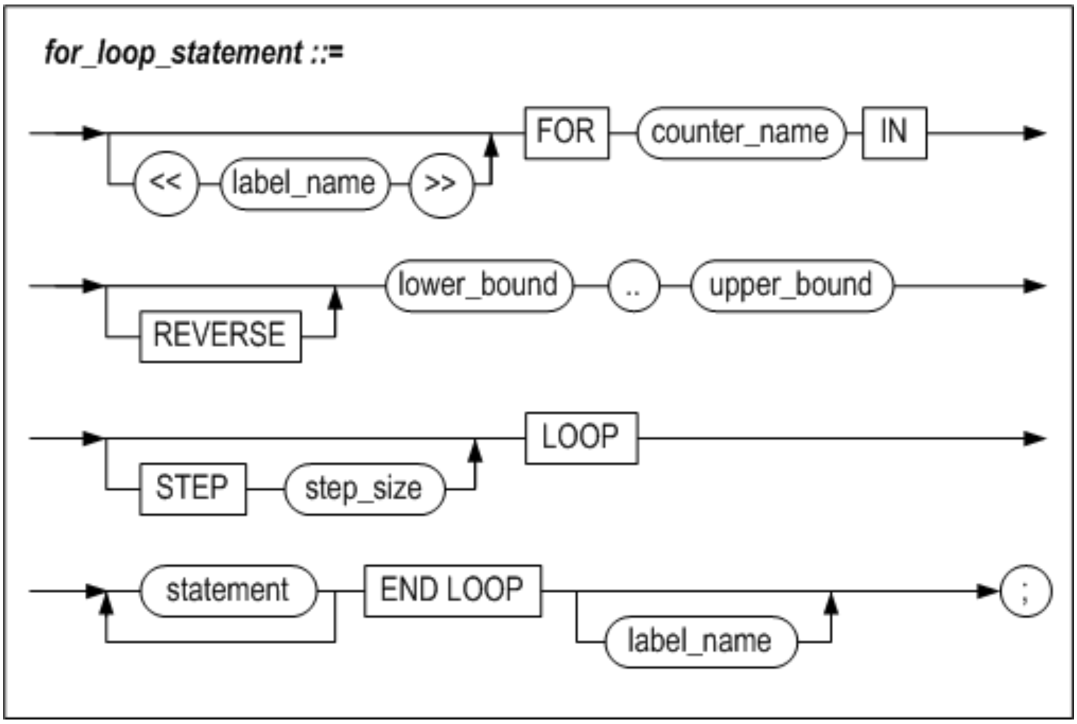
Example

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE OR REPLACE PROCEDURE proc1
AS
  v1 INTEGER;
BEGIN
  v1 := 1;

  WHILE v1 < 3 LOOP
    v1 := v1 + 1;
    INSERT INTO t1 VALUES (v1, v1, v1);
    IF v1 = 2 THEN
      CONTINUE;
    END IF;
  END LOOP;

END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t1;
T1.I1       T1.I2       T1.I3
----------------------------------------
```

```
2              2              2
3              3              3
2 rows selected.
```

FOR LOOP

Syntax



Purpose

The FOR LOOP construct is used to repeatedly execute a desired statement or series of statements a predetermined number of times. The range is specified using two periods (".."), and is only evaluated once, before entering the FOR loop. If the lower and higher bounds are set to the same value, the loop body is iterated only one time.

counter_name

This loop construct uses an integer variable that increases or decreases to a fixed final value. This variable does not need to be expressly declared. The scope of this variable is limited to the statements between the LOOP and END LOOP clauses. No other value can be assigned to this variable.

REVERSE

This statement is optionally used to specify that the counter is to decrease from *upper_bound* to *lower_bound*.

lower_bound

This is the minimum value that the counter can have. It must take the form of an integer, or an expression that is compatible with the INTEGER type.

lower_bound can be a local variable. Note however that the value of the variable is determined and stored only once, at the beginning of the first iteration of the FOR loop. This means that subsequently changing the value of this local variable during execution of the FOR loop will have no effect on the number of iterations.

If *lower_bound* is a non-integer number, it is rounded to the nearest integer.

upper_bound

This is the maximum value that the *counter_name* can have. Like *lower_bound*, it must take the form of an integer, or an expression that is compatible with the INTEGER type. If it is a non-integer number, it is rounded to the nearest integer.

If the value of *upper_bound* is lower than that of *lower_bound* upon first execution of the FOR statement, no error is raised; the entire FOR loop is skipped, and control is passed to the following statement

As with *lower_bound, upper_bound* can be a local variable, but as the value of the variable is determined and stored only at the beginning of the first iteration of the FOR loop, subsequently changing the value of this local variable will have no effect on the number of iterations.

step_size

step_size is used to set the amount by which the value of the counter is incremented or decremented. If it is omitted, 1 is the default value.

Note that *step_size* cannot be set to a value less than 1. Additionally, if it is a non-integer number, it is rounded to the nearest integer.

Example

Example 1

```
CREATE TABLE t6(i1 INTEGER, sum INTEGER);

CREATE OR REPLACE PROCEDURE proc1
AS
  v1 INTEGER;
  sum INTEGER := 0;
BEGIN
  FOR i IN 1 .. 50 LOOP
    v1 := 2 * i - 1;
    sum := sum + v1;
    INSERT INTO t6 VALUES(v1, sum);
  END LOOP;
END;
/

iSQL> EXEC proc1;
Execute success.
```

```
iSQL> SELECT * FROM t6;
T6.I1       T6.SUM
---------------------------
1           1
3           4
5           9
…
97          2401
99          2500
50 rows selected.
```

Example 2

```
CREATE OR REPLACE PROCEDURE proc1
AS
  eno_count INTEGER;
BEGIN
  SELECT COUNT(eno) INTO eno_count FROM employees;
  FOR i IN 1 .. eno_count LOOP
    UPDATE employees SET salary = salary * 1.2 WHERE eno = i;
  END LOOP;
END;
/

iSQL> SELECT eno, salary FROM employees WHERE eno in (11,12,13);
ENO         SALARY
---------------------------
11          2750
12          1890
13          980
3 rows selected.

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT eno, salary FROM employees WHERE eno IN (11,12,13);
ENO         SALARY
---------------------------
11          3300
12          2268
13          1176
3 rows selected.
```

Example 3

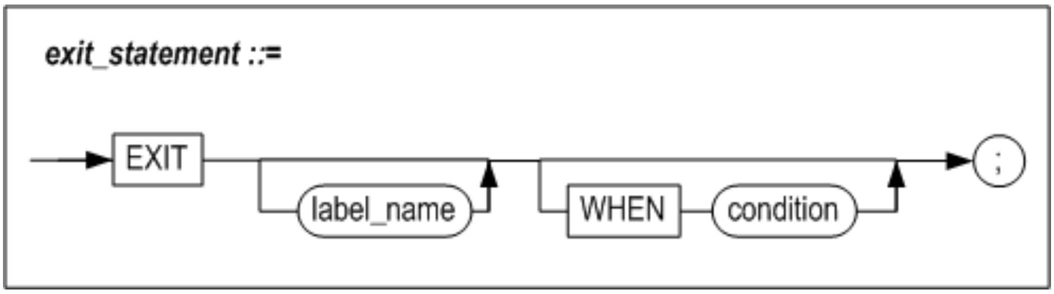
```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
  <<a>>
  INSERT INTO t1 VALUES (1,1,1);
  IF 1 = 1 THEN
    NULL;
  END IF;
  <<b>>
  FOR v1 IN 1 .. 3 LOOP
    <<c>>
    FOR v1 IN 1 .. 3 LOOP
      INSERT INTO t1 VALUES (b.v1, b.v1, c.v1);
    END LOOP;
  END LOOP;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t1;
T1.I1       T1.I2       T1.I3
----------------------------------------
1           1           1
1           1           1
1           1           2
1           1           3
2           2           1
2           2           2
2           2           3
3           3           1
3           3           2
3           3           3
10 rows selected.

--####################
--  reverse
--####################

CREATE TABLE t6(i1 INTEGER, sum INTEGER);

CREATE OR REPLACE PROCEDURE proc1
AS
  sum INTEGER := 0;
BEGIN
```

```
  FOR i IN reverse 1 .. 100 LOOP
    sum := sum + i;
    INSERT INTO t6 VALUES(i, sum);
  END LOOP;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t6;
T6.I1       T6.SUM
---------------------------
100         100
99          199
98          297
…
3           5047
2           5049
1           5050
100 rows selected.

--#####################
--  step
--#####################

CREATE TABLE t6(i1 INTEGER, sum INTEGER);

CREATE OR REPLACE PROCEDURE proc1
AS
  sum INTEGER := 0;
BEGIN
  FOR i IN 1 .. 100 STEP 2 LOOP
    sum := sum + i;
    INSERT INTO t6 VALUES(i, sum);
  END LOOP;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t6;
T6.I1       T6.SUM
---------------------------
1           1
3           4
5           9
…
97          2401
99          2500
```

```
50 rows selected.
```

EXIT

Syntax



Purpose

The EXIT statement is used to terminate the iteration of a loop. If label_name is specified, iteration of the loop specified using label_name is terminated. If label_name is not specified, iteration of the innermost loop is terminated.

If the EXIT statement is used anywhere other than inside a LOOP, an error will occur.

```
<<outer>>
LOOP
  ...
  LOOP
    ...
    EXIT outer WHEN ...   -- EXIT both LOOPs
  END LOOP;
  ...
END LOOP outer;

EXIT WHEN count > 100;

IF count > 100 THEN
  EXIT;
END IF;
```

The EXIT statement can be used inside any of the following LOOP statements:

- LOOP
- WHILE LOOP
- FOR LOOP
- CURSOR FOR LOOP

label_name

To exit a loop other than the innermost loop, define a label immediately before the corresponding loop, and specify the name here.

WHEN condition

A conditional expression can be specified in the WHEN clause, to make it possible to exit the loop only when a certain condition is satisfied. All conditions that are available for use in the WHERE clause of a SELECT statement can be used in this expression.

When an EXIT statement is encountered, if the condition specified in the WHEN clause is true, iteration of the innermost loop (or the loop identified using the label) terminates, and control is passed to the next statement.

Using EXIT WHEN is akin to using a simple IF construct. The following are logically identical:

```
EXIT WHEN count > 100;

IF count > 100 THEN
   EXIT;
END IF;
```

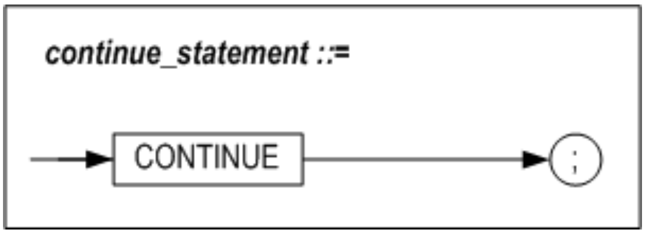
Example

```
CREATE TABLE stock(
  gno BYTE(5) primary key,
  stock INTEGER,
  price numeric(10,2));

CREATE OR REPLACE PROCEDURE proc1
AS
  CURSOR c1 IS SELECT gno, stock, price FROM goods;
  rec1 c1%ROWTYPE;
BEGIN
  OPEN c1;
  LOOP
    FETCH c1 INTO rec1;
    IF c1%found THEN
      IF rec1.stock > 0 AND rec1.stock < 1000 THEN
        INSERT INTO stock VALUES(rec1.gno, rec1.stock, rec1.price);
      END IF;
    ELSIF c1%NOTFOUND THEN
      EXIT;
    END IF;
  END LOOP;
  CLOSE c1;
END;
```

```
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM stock;
STOCK.GNO   STOCK.STOCK STOCK.PRICE
----------------------------------------
A111100002  100         98000
B111100001  780         35800
D111100003  650         45100
E111100001  900         2290.54
E111100006  900         2338.62
5 rows selected.

--#####################
--  EXIT WHEN
--#####################

CREATE OR REPLACE PROCEDURE proc1
AS
  CURSOR c1 IS SELECT gno, stock, price FROM goods;
  rec1 c1%ROWTYPE;
BEGIN
  OPEN c1;
  IF c1%ISOPEN THEN
    LOOP
      FETCH c1 INTO rec1;
      EXIT WHEN c1%NOTFOUND;
      IF rec1.stock > 0 AND rec1.stock < 1000 THEN
        INSERT INTO stock VALUES(rec1.gno, rec1.stock, rec1.price);
      END IF;
    END LOOP;
  END IF;
  CLOSE c1;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM stock;
STOCK.GNO   STOCK.STOCK STOCK.PRICE
----------------------------------------
A111100002  100         98000
B111100001  780         35800
D111100003  650         45100
E111100001  900         2290.54
E111100006  900         2338.62
5 rows selected.
```

CONTINUE

Syntax



Purpose

The CONTINUE statement causes subsequent statements in the loop in which it is found to be ignored, and passes control to the beginning of the loop. That is, it terminates the current iteration of the loop. The CONTINUE statement can be used inside any of the following loop statements:

- WHILE
- FOR
- CURSOR FOR

If the CONTINUE statement is used anywhere other than inside a loop, an error will occur.

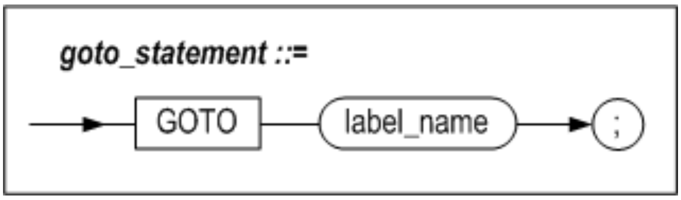
Example

```
CREATE TABLE t8(i1 INTEGER, mathpower INTEGER default 0);

INSERT INTO t8(i1) VALUES(7);
INSERT INTO t8(i1) VALUES(3);
INSERT INTO t8(i1) VALUES(20);
INSERT INTO t8(i1) VALUES(15);
INSERT INTO t8(i1) VALUES(6);
INSERT INTO t8(i1) VALUES(1);
INSERT INTO t8(i1) VALUES(9);

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
  DECLARE
    CURSOR c1 IS SELECT i1 FROM t8;
    rec c1%ROWTYPE;
  BEGIN
    OPEN c1;
    LOOP
      FETCH c1 INTO rec;
      EXIT WHEN c1%NOTFOUND;

      IF power(rec.i1, rec.i1) > 50000 THEN
        continue;
```

```
      ELSE
        UPDATE t8 SET mathpower = power(rec.i1, rec.i1)
        WHERE i1 = rec.i1;
      END IF;
    END LOOP;
    CLOSE c1;
  END;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t8;
T8.I1       T8.MATHPOWER
----------------------------
7           0
20          0
15          0
9           0
3           27
6           46656
1           1
7 rows selected.
```

GOTO

Syntax



Purpose

This statement passes control to the specified label.

label_name

This is the name of the label to which control will be transferred.

Limitations

The use of the GOTO statement is limited as follows:

- When used within an IF or CASE block, it cannot be used to transfer control from one of the alternative execution paths, that is, one of the statement blocks preceded by a THEN, ELS(E)IF, ELSE or WHEN statement, to another. If this is attempted, an error will occur when attempting to compile the procedure, as seen below:

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 INTEGER;
BEGIN
    V1 := 1;
    IF V1 = 1 THEN
        GOTO LABEL1;
    ELSE
        <<LABEL1>>
        PRINTLN(V1);
    END IF;
END;
/
[ERR-3120F : Illegal GOTO statement.
In PROC1
0007 :     GOTO LABEL1;
               ^     ^
]
```

- It cannot be used to transfer control from an external block to an internal block. This limitation applies to all BEGIN/END blocks and all loop constructs.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 INTEGER;
BEGIN
    V1 := 1;
    DECLARE
        V2 INTEGER;
    BEGIN
        <<LABEL1>>
        V2 := 1;
    END;
    GOTO LABEL1;
END;
/
[ERR-3120F : Illegal GOTO statement.
In PROC1
0012 :   GOTO LABEL1;
             ^     ^
]
```

Example

<Example 1> It cannot be used to pass control from within an exception handler to another location within the block to which the exception handler pertains. Therefore, in the following example, an error is returned.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    E1 EXCEPTION;
BEGIN
    RAISE E1;
    <<LABEL1>>
    PRINTLN('END');
    EXCEPTION
        WHEN E1 THEN
        GOTO LABEL1;
END;
/
[ERR-3120F : Illegal GOTO statement.
In PROC1
0010 :       GOTO LABEL1;
                 ^     ^
]
```

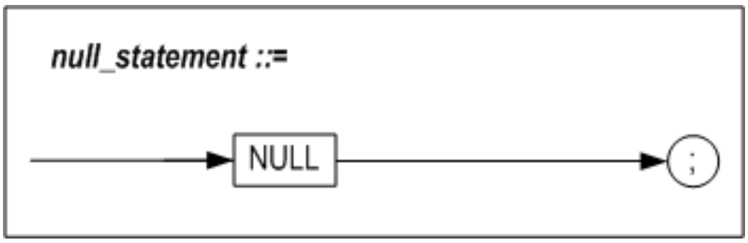
<Example 2> However, it is acceptable to use a GOTO statement to pass control from an exception handler in one block to the body of an outer block. In the following example, before the value of V1 reaches 5, four exceptions occur. After that, execution terminates normally.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    E1 EXCEPTION;
    V1 INTEGER;
BEGIN
    V1 := 1;
    <<LABEL1>>
    V1 := V1 + 1;
    PRINTLN('BLOCK1');
    BEGIN
        PRINTLN('BLOCK2');
        PRINTLN(V1);
        IF V1 = 5 THEN
            PRINTLN('goto label2 '||v1);
            GOTO LABEL2;
        ELSE
            RAISE E1;
        END IF;
        EXCEPTION
            WHEN E1 THEN
```

```
            PRINTLN('goto label1 '|| v1);
            GOTO LABEL1;
    END;
    <<LABEL2>>
    PRINTLN('BLOCK1 AFTER BLOCK2');
END;
/

iSQL> EXEC PROC1;
BLOCK1
BLOCK2
2
goto label1 2
BLOCK1
BLOCK2
3
goto label1 3
BLOCK1
BLOCK2
4
goto label1 4
BLOCK1
BLOCK2
5
goto label2 5
BLOCK1 AFTER BLOCK2
Execute success.
```

NULL

Syntax



Purpose

The NULL statement does nothing. It is used to expressly pass control to the next statement. This is used to improve program readability.

Example

```
CREATE OR REPLACE PROCEDURE bonus (amount NUMBER(10,2))
AS
  CURSOR c1 IS SELECT eno, sum(qty) FROM orders group by eno;
  order_eno orders.eno%TYPE;
  order_qty orders.qty%TYPE;
BEGIN
  OPEN c1;
  LOOP
    FETCH c1 INTO order_eno, order_qty;
    EXIT WHEN c1%NOTFOUND;
    IF order_qty > 20000 THEN
      UPDATE employees SET salary = salary + amount
      WHERE eno = order_eno;
    ELSE
      NULL;
    END IF;
  END LOOP;
  CLOSE c1;
END;
/

iSQL> SELECT e.eno, salary, sum(qty)
FROM employees e, orders o
WHERE e.eno = o.eno
group by e.eno, salary;
ENO         SALARY      SUM(QTY)
-----------------------------------------------
12          1890        17870
19          1800        25350
20                      13210
3 rows selected.
iSQL> EXEC bonus(75);
Execute success.
iSQL> SELECT eno, salary FROM employees WHERE eno = 19;
ENO         SALARY
---------------------------
19          1875
1 row selected.
```

5. Using Cursors

This chapter describes how to manage and use cursors.

Overview

There are two ways of reading table records within a stored procedure: using the SELECT INTO statement.

The SELECT INTO statement can be used to read only a single record. If more than one record is returned by a SELECT INTO statement, an error will be raised. Therefore, in situations where it can be expected that more than one record will be returned, it is necessary to use a cursor

Declaring a Cursor

A cursor must be explicitly declared in the declare section of a stored procedure block, along with the SELECT statement with which it is used. After it has been declared, a cursor can be managed in one of the following two ways:

- Cursor Management Using OPEN, FETCH, CLOSE
- Cursor management Using a Cursor FOR LOOP

Cursor Management Using OPEN, FETCH, and CLOSE

A cursor can be controlled in the block body using the OPEN, FETCH, and CLOSE statements. The OPEN statement is used to initialize the cursor. The FETCH statement is then executed repeatedly to retrieve rows. Finally, the cursor is released using the CLOSE statement.

OPEN

This statement is used to initialize all of the resources that are necessary in order to use a cursor. If user-defined parameters were specified when the cursor was defined, they are passed to the cursor using the OPEN statement.

FETCH

The FETCH statement is used to retrieve one record at a time from the set of results that satisfy the cursor's SELECT statement and store it in one or more variables. Each column can be stored in a separate variable, or the entire row can be stored in a RECORD type variable, typically declared using %ROWTYPE, having the same number and type of fields as the retrieved record.

For an explanation of RECORD type variables, please refer to the Chapter 6: User-Defined Types.

CLOSE

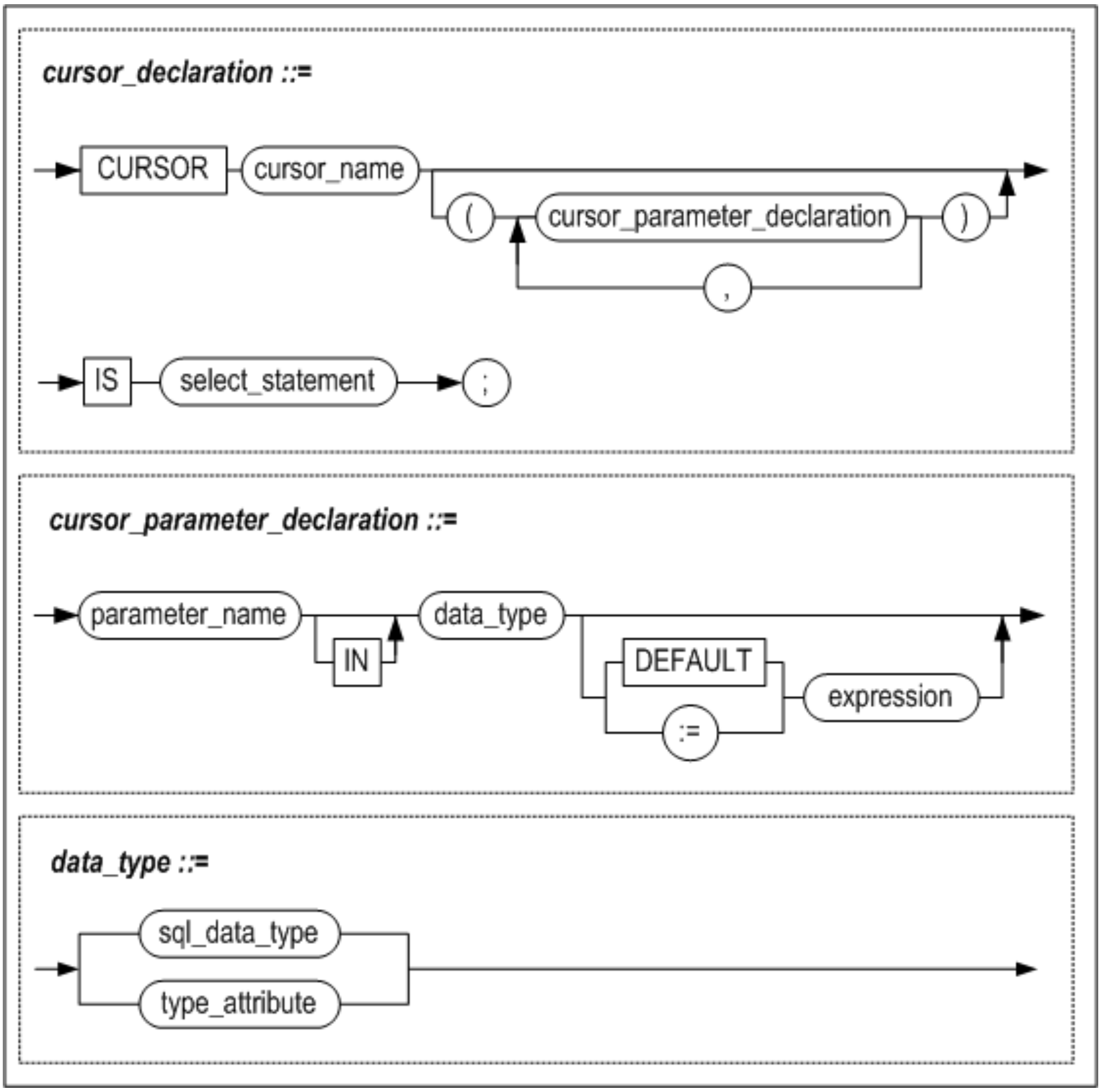
This is the step of releasing the resources allocated to a cursor that is no longer in use. A cursor must be closed before the procedure or function in which the cursor was declared is terminated.

Cursor Management Using a Cursor FOR LOOP

This is the type of loop that executes all of the OPEN, FETCH, and CLOSE statements. Iteration of the loop continues until there are no more records left to process. This statement is convenient to use because it obviates the need to use explicit OPEN and CLOSE statements.

CURSOR

Syntax



Purpose

The CURSOR statement is used to declare a cursor. It must specify the name of the cursor and the SELECT statement that the cursor uses to retrieve records.

cursor_name

This is the name of the cursor, which is referenced in the OPEN, FETCH, CLOSE, and Cursor FOR LOOP statements.

cursor_parameter_declaration

In cases where it is necessary to use parameters with a cursor's SELECT statement, they can be defined for the cursor in the same way that they are for stored procedures.

The following limitations apply to the use of parameters with cursors:

- Cursor parameters can be used only within SELECT statements
- The use of %ROWTYPE is not supported.
- Cursor parameters cannot be OUT or IN/OUT parameters

A value is assigned to a cursor parameter using an OPEN CURSOR or CURSOR FOR statement. This value is used when the cursor's SELECT statement is executed.

```
DECLARE
  CURSOR c1 IS
    SELECT empno, ename, job, sal
    FROM emp
    WHERE sal > 2000;
  CURSOR c2
    (low INTEGER DEFAULT 0,
    high INTEGER DEFAULT 99) IS
    SELECT ......;
```

data_type

Please refer to "Declaring Local Variables" "in Chapter 3 of this manual.

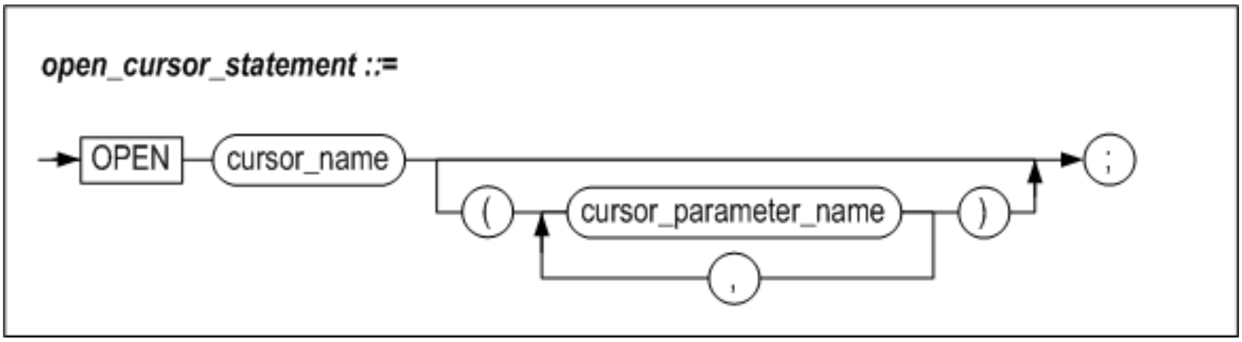
Example

```
CREATE TABLE highsal
 (eno INTEGER, e_firstname CHAR(20), e_lastname CHAR(20), salary NUMBER(10,2));

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
  DECLARE
   CURSOR c1 IS
     SELECT eno, e_firstname, e_lastname, salary FROM employees
   WHERE salary IS not NULL
   ORDER BY salary desc;
   emp_first CHAR(20);
   emp_last CHAR(20);
   emp_no INTEGER;
   emp_sal NUMBER(10,2);
  BEGIN
   OPEN c1;
   FOR i IN 1 .. 5 LOOP
     FETCH c1 INTO emp_no, emp_first, emp_last, emp_sal;
     EXIT WHEN c1%NOTFOUND;
     INSERT INTO highsal VALUES(emp_no, emp_first, emp_last, emp_sal);
   END LOOP;
   CLOSE c1;
 END;
END;
```

```
/
iSQL> EXEC proc1;
EXECUTE success.
iSQL> SELECT * FROM highsal;
ENO         E_FIRSTNAME           E_LASTNAME            SALARY
-------------------------------------------------------------------------
10          Elizabeth             Bae                   4000
11          Zhen                  Liu                   2750
5           Farhad                Ghorbani              2500
16          Wei-Wei               Chen                  2300
14          Yuu                   Miura                 2003
5 rows selected.
```

OPEN

Syntax



Purpose

This statement is used to initialize a cursor, execute the query, and determine the result set, so that data can be retrieved using the FETCH statement. When this statement is executed, the system will allocate all resources required to use the cursor. If an attempt is made to open a cursor that is already opened, a CURSOR_ALREADY_OPEN error will be raised.

cursor_name

This is the name of the cursor to open

A cursor having this name must have been declared in the declare section of the current block or an outer block.

cursor_parameter_name

Parameters can be optionally specified for a cursor. These parameters can be used in the associated query in place of constants or local variables.

If the cursor has parameters, they are declared as shown below:

```
DECLARE
 CURSOR c1(pname VARCHAR(40), pno INTEGER) IS
  SELECT empno, ename, job, sal
  FROM emp
  WHERE eame = pname;
BEGIN
 OPEN c1;
 ......
END;
```

The OPEN statement is used as follows when parameter values are passed to a cursor.

```
OPEN c1(emp_name, 100);
OPEN c1('mylee', 100);
OPEN c1(emp_name, dept_no);
```

Example

Example 1

```
CREATE TABLE mgr
(mgr_eno INTEGER, mgr_first CHAR(20), mgr_last CHAR(20), mgr_dno SMALLINT);

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
 DECLARE
  CURSOR emp_cur IS
   SELECT eno, e_firstname, e_lastname, dno FROM employees
   WHERE emp_job = 'manager';
   emp_no employees.eno%TYPE;
   emp_first employees.e_firstname%TYPE;
   emp_last employees.e_lastname%TYPE;
   emp_dno employees.dno%TYPE;
 BEGIN
  OPEN emp_cur;
  LOOP
   FETCH emp_cur INTO emp_no, emp_first, emp_last, emp_dno;
   EXIT WHEN emp_cur%NOTFOUND;
   INSERT INTO mgr VALUES(emp_no, emp_first, emp_last, emp_dno);
  END LOOP;
  CLOSE emp_cur;
 END;
END;
/
iSQL> EXEC proc1;
```

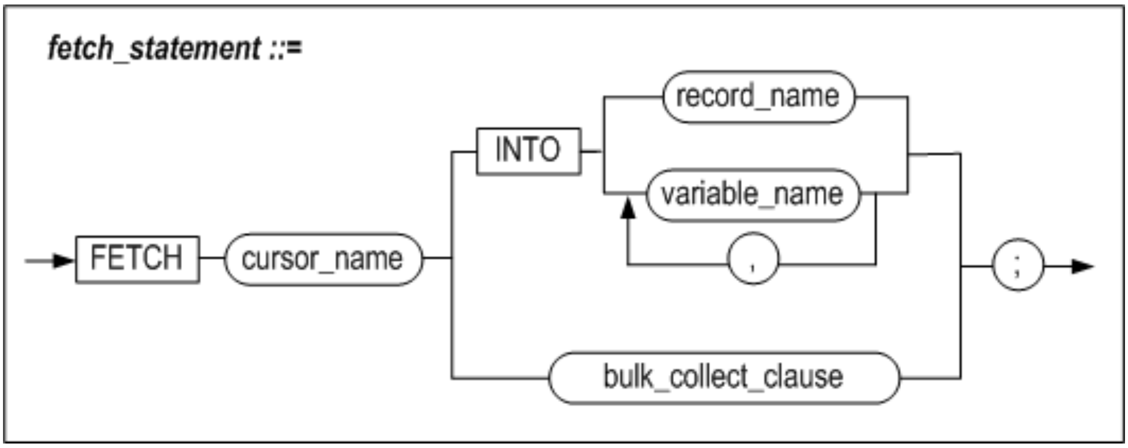
```
Execute success.
iSQL> select * from mgr;
MGR.MGR_ENO MGR.MGR_FIRST         MGR.MGR_LAST          MGR.MGR_DNO
-------------------------------------------------------------------------
7           Gottlieb              Fleischer             4002
8           Xiong                 Wang                  4001
16          Wei-Wei               Chen                  1001
3 rows selected.
```

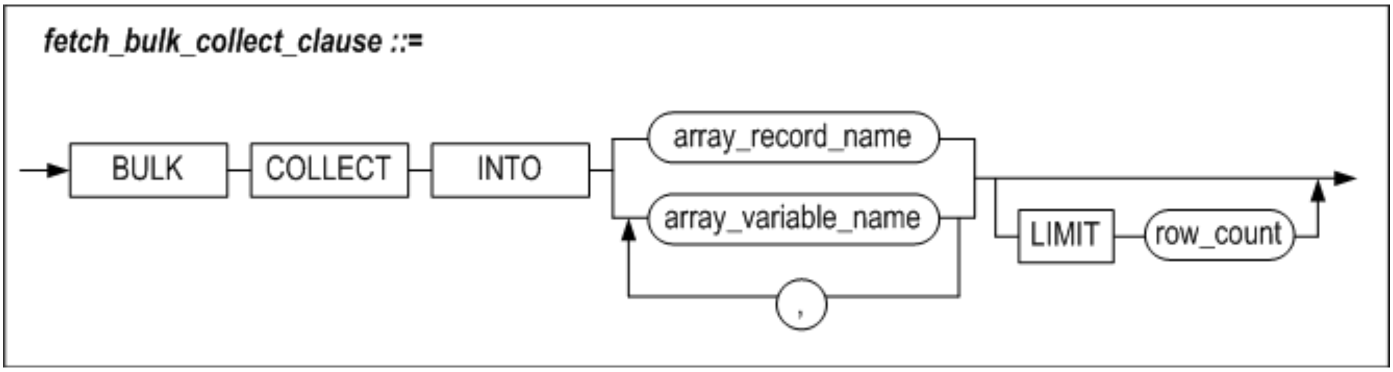
Example 2

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE TABLE t2(i1 INTEGER, i2 INTEGER, i3 INTEGER);

INSERT INTO t1 VALUES(1,1,1);
INSERT INTO t1 VALUES(2,2,2);
INSERT INTO t1 VALUES(30,30,30);
INSERT INTO t1 VALUES(50,50,50);

CREATE OR REPLACE PROCEDURE proc1
AS
 CURSOR c1(k1 INTEGER, k2 INTEGER, k3 INTEGER) IS
  SELECT * FROM t1
  WHERE i1 <= k1 AND i2 <= k2 AND i3 <= k3;
BEGIN
 FOR rec1 IN c1(2,2,2) LOOP
  INSERT INTO t2 VALUES (rec1.i1, rec1.i2, rec1.i3);
 END LOOP;
END;
/
iSQL> SELECT * FROM t2;
T2.I1      T2.I2      T2.I3
----------------------------------------
No rows selected.
iSQL> EXEC proc1;
EXECUTE success.
iSQL> SELECT * FROM t2;
T2.I1      T2.I2      T2.I3
----------------------------------------
1          1          1
2          2          2
2 rows selected.
```

FETCH

Syntax





Purpose

This statement is used to obtain one row from an open cursor and store the value(s) in the variable(s) specified in the INTO clause of the SELECT statement.

A list of variables that match the column types specified in the cursor's SELECT statement is specified. Alternatively, the name of a RECORD type variable is specified, and the row retrieved from the cursor is saved in the RECORD type variable.

The use of RECORD type varialbe in FETCH statement has the following restrictions:

- Only one RECORD type variable can be used to store one retrieved row.
- It must be possible to save all of the columns retrieved by the SELECT statement into the RECORD type variable.
- RECORD type variables cannot be combined with regular variables.

If an attempt is made to fetch results from a cursor that is not open, an INVALID_CURSOR error will occur.

cursor_name

This is the name of the cursor to use to fetch records. A cursor having this name must have been declared in the declare section of the current block or an outer block.

record_name

This is used to specify the name of the RECORD type variable into which the cursor's SELECT statement retrieves records. The RECORD type variable that is used must have the same number of columns as the SELECT statement's select list, and the column types must be compatible and specified in the corresponding order.

When retrieving all columns from a table, it is convenient to declare a RECORD type variable using the %ROWTYPE attribute for the table from which the records are to be retrieved.

variable_name

This is the name of the variable into which a value will be stored. The number of such variables must be the same as the number of columns specified in the cursor's SELECT statement. Furthermore, the order of the variables must be set such that their types correspond with the respective types of the columns in the select list.

```
LOOP
  FETCH c1 INTO my_name, my_empno, my_deptno;
  EXIT WHEN c1%NOTFOUND;
END LOOP;
```

fetch_bulk_collect_clause

Using a LIMIT clause enables adjusting the amount of lines returned in the BULK COLLECTION. Refer to the BULKC OLLECTION clause of the SELECT INTO statement for further information on the BULK COLLECT clause.

Example

Example 1

```
CREATE TABLE emp_temp(eno INTEGER, e_firstname CHAR(20), e_lastname CHAR(20));
CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
 DECLARE
 CURSOR c1 IS SELECT eno, e_firstname, e_lastname FROM employees;
  emp_rec c1%ROWTYPE;
 BEGIN
  OPEN c1;
  LOOP
   FETCH c1 INTO emp_rec;
   EXIT WHEN c1%NOTFOUND;
   INSERT INTO emp_temp
   VALUES(emp_rec.eno, emp_rec.e_firstname, emp_rec.e_lastname);
  END LOOP;
  CLOSE c1;
 END;
```

```
END;
/
iSQL> select eno, e_firstname, e_lastname from emp_temp;
ENO         E_FIRSTNAME           E_LASTNAME
------------------------------------------------------------
1           Chan-seung            Moon
2           Susan                 Davenport
3           Ken                   Kobain
.
.
.
18          John                  Huxley
19          Alvar                 Marquez
20          William               Blake
20 rows selected.
```

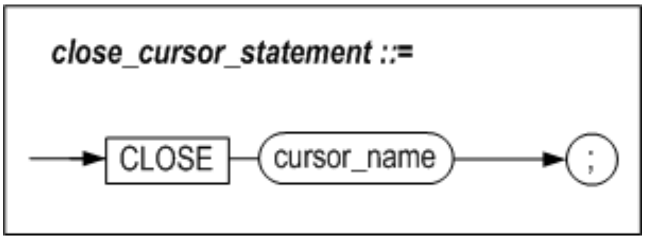
Example 2

```
iSQL> create table emp_temp(eno integer, e_firstname char(20), e_lastname char(20));
Create success.iSQL> select * from emp_temp;
EMP_TEMP.ENO EMP_TEMP.E_FIRSTNAME  EMP_TEMP.E_LASTNAME
-------------------------------------------------------------
1             Chan-seung              Moon
2             Susan                    Davenport
3             Ken                      Kobain
4             John                     Huxley
5             Alvar                    Marquez
6             William                  Blake
6 rows selected.

iSQL> create or replace procedure proc1 as
type emp_rec is record(eno integer, e_firstname char(20), e_lastname char(20));
type emp_arr is table of emp_rec index by integer;
cursor c1 is select * from emp_temp;
arr1 emp_arr;
begin
open c1;
loop
fetch c1 bulk collect into arr1 limit 4;
exit when c1%NOTFOUND;
println('count : '|| arr1.count());
end loop;
close c1;
end;
/
iSQL>exec proc1;
count : 4
```

```
count : 2
Execute success.
```

CLOSE

Syntax



Purpose

This statement is used to close an open cursor and free all associated resources.

A cursor that has already been closed can be reopened using the OPEN statement. If an attempt is made to close a cursor that is already closed, a INVALID_CURSOR error will be raised.

If the user doesn't expressly close a cursor using this statement, the cursor is automatically closed upon exiting the block in which the cursor was declared. However, it is recommended that the user use this statement to expressly close a cursor immediately after the user has finished using it in order to return all associated resources to the system as early as possible.

cursor_name

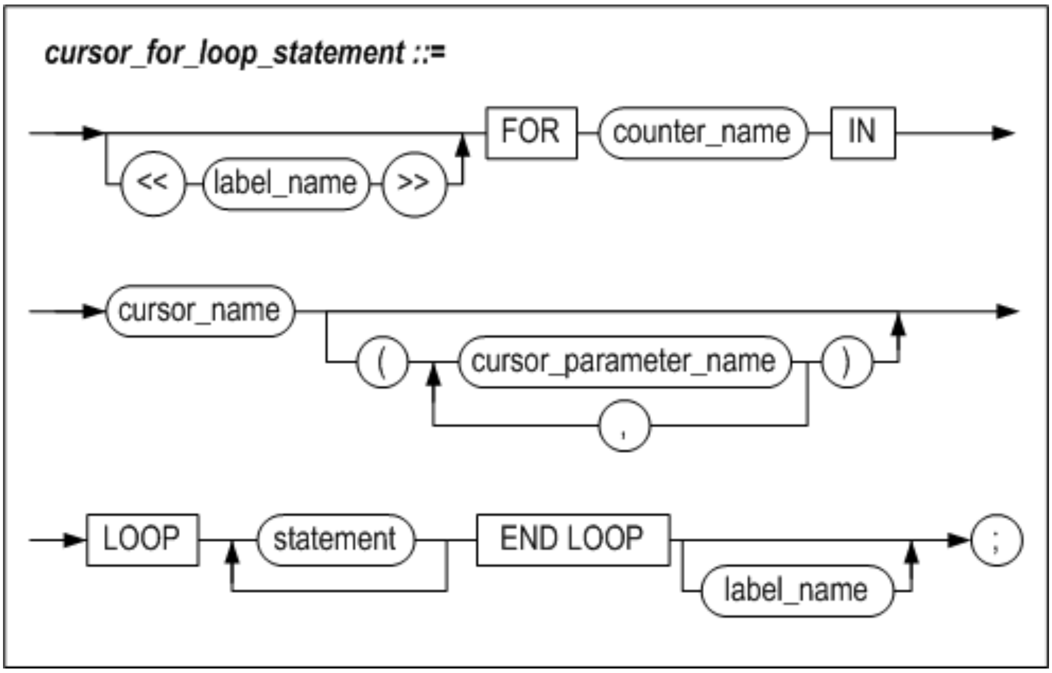
This is the name of the cursor to close.

Example

```
CLOSE c1;
```

Cursor FOR LOOP

Syntax



Purpose

The Cursor FOR LOOP construct automatically opens a cursor, fetches results, and closes the cursor.

A cursor FOR LOOP uses a cursor declared in the declare section of the block, and returns one of the rows retrieved by the query every time the loop iterates. The current record is saved in a RECORD type variable that can be accessed from within the loop.

label_ name

This is used to specify a label for the loop, which will be necessary in order to designate the loop in an EXIT or CONTINUE statement.

counter_name

This is used to specify the name of the RECORD type variable in which one row that was fetched using the cursor will be stored. This variable does not need to be declared in the declare section of the block, because it is automatically created such that the number of columns and the types of the columns match those of the fetched rows.

A variable created in this way is referenced using the syntax “*counter_name.column_name*”. When referencing a variable in this way, *column_name* is the name of a column in the select list of the cursor's SELECT statement. Therefore, when an expression is used in the select list, an alias must be specified for the expression in the select list in order to allow the expression to be referenced in this way.

cursor_name

This is used to specify the name of the cursor to use in the loop. This cursor must have been declared in the declare section of the current block or an outer block.

cursor_parameter_name

Please refer to "cursor_parameter_name" in this chapter.

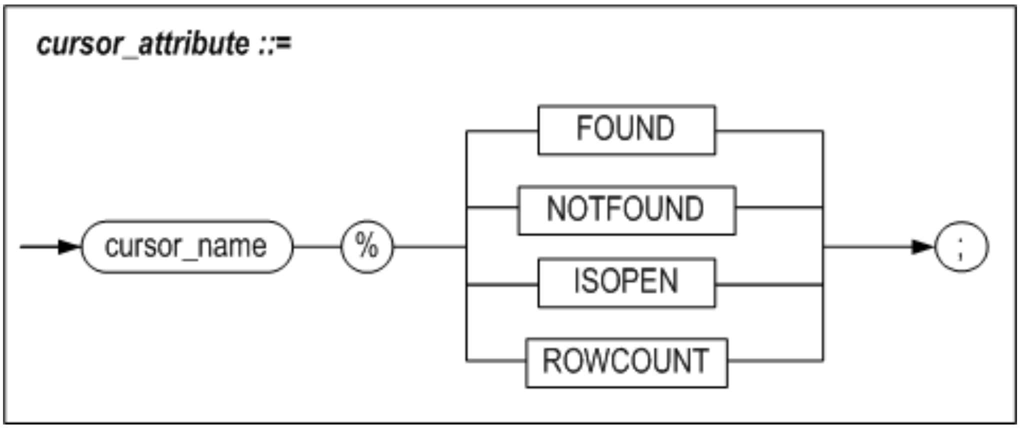
Example

```
CREATE TABLE emp_temp(eno INTEGER, e_firstname CHAR(20), e_lastname CHAR(20));

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
  DECLARE
    CURSOR c1 IS SELECT eno, e_firstname, e_lastname FROM employees;
  BEGIN
    FOR emp_rec IN c1 LOOP
      INSERT INTO emp_temp VALUES(emp_rec.eno, emp_rec.e_firstname,
emp_rec.e_lastname);
    END LOOP;
  END;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM emp_temp;
ENO         E_FIRSTNAME           E_LASTNAME
------------------------------------------------------------
1           Chan-seung            Moon
2           Susan                 Davenport
.
.
.
19          Alvar                 Marquez
20          William               Blake
20 rows selected.
```

Cursor Attributes

Refer to attribute values managed by Altibase to understand the state of cursors during the execution of the cursor.

Purpose



Purpose

Cursor attributes are user-accessible. With the exception of ROWCOUNT, which returns an integer, cursor attributes are Boolean type expressions that provide information about the state of a cursor.

Based on the current state of the cursor, the value of each attribute can be TRUE or FALSE.

The user can check the values of attributes of cursors declared using the DECLARE statement, and can additionally check those of implicit cursors declared within the system. Implicit cursors exist for DELETE, UPDATE, and INSERT statements, as well as for the SELECT INTO statement, which returns one record. They contain the attribute values for the cursor pertaining to the most recently executed SQL statement.

%FOUND

This attribute indicates whether any rows satisfying the condition in the cursor's SELECT statement have been found. Note however that the value of %FOUND is always FALSE in the following cases, regardless of whether or not any rows that satisfy the condition actually exist:

- A cursor that has not been opened
- A cursor for which a FETCH statement has never been executed
- A cursor that has been closed

For implicit cursors, if one or more records are affected by the execution of a DELETE, UPDATE, or INSERT statement, or if a SELECT INTO statement returns at least one record, the value of %FOUND for the associated cursor is TRUE.

However, if a SELECT INTO statement returns two or more records, the TOO_MANY_ROWS exception will occur before it is possible to check the value of the %FOUND attribute. Such a case should be handled as an exception rather than by referring to the %FOUND cursor attribute.

The value of the %FOUND attribute can be checked as follows:

```
DELETE FROM emp;
  IF SQL%FOUND THEN     -- delete succeeded
    INSERT INTO emp VALUES ( ...... );
  ......
  END IF;
```

%NOTFOUND

This attribute is also used to check whether any rows that satisfy the condition in the cursor's SELECT statement have been found. It always has the opposite value of %FOUND.

If no records are affected by the result of execution of a DELETE, UPDATE or INSERT statement, or if a SELECT INTO statement does not return any records, the value of the %NOTFOUND attribute for the associated implicit cursor is TRUE.

However, if a SELECT INTO statement returns no records, the NO_DATA_FOUND exception will occur before it is possible to check the value of the %NOTFOUND attribute. Such a case should be handled as an exception rather than by referring to the %NOTFOUND cursor attribute.

The value of the %NOTFOUND attribute can be checked as follows:

```
DELETE FROM emp;
  IF SQL%NOTFOUND THEN
  ......
  END IF;
```

%ISOPEN

The %ISOPEN attribute is used to check whether the cursor is open. If the cursor is closed, this value will be FALSE.

The value of the %ISOPEN attribute can be checked as follows:

```
OPEN c1;  -- CURSOR OPEN
  IF c1%ISOPEN THEN
  ......
  END IF;
```

%ROWCOUNT

%ROWCOUNT indicates how many rows have been fetched by the cursor at the present point in time.

Note that %ROWCOUNT does not indicate the number of records that satisfy the conditions in the cursor's SELECT statement. Rather, it increases by 1 whenever one row is fetched. If not even one row has been fetched, the value of %ROWCOUNT will be zero.

If this attribute is checked before a cursor is opened, or after it has been closed, an INVALID_CURSOR error will be returned.

```
DELETE FROM emp;
  IF SQL%ROWCOUNT > 10 THEN
  ......
  END IF;
```

Example

Example 1

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE TABLE t3(i1 INTEGER);
INSERT INTO t1 VALUES(2,2,2);

CREATE OR REPLACE PROCEDURE proc1
AS
  v1 INTEGER;
BEGIN
  SELECT i1 INTO v1 FROM t1 WHERE i1 = 2;
  IF SQL%found THEN
    INSERT INTO t1 SELECT * FROM t1;

    v1 := SQL%ROWCOUNT;
    INSERT INTO t3 VALUES(v1);
  END IF;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t3;
T3.I1
--------------
1
1 row selected.
```

Example 2

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE TABLE t2(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE TABLE t3(i1 INTEGER);
INSERT INTO t1 VALUES(1,1,1);
INSERT INTO t1 VALUES(1,1,1);
INSERT INTO t1 VALUES(1,1,1);

CREATE OR REPLACE PROCEDURE proc1
AS
  CURSOR c1 IS SELECT * FROM t1;
```

```
  v1 INTEGER;
  v2 INTEGER;
  v3 INTEGER;
BEGIN
  OPEN c1;

  IF c1%ISOPEN  THEN
    LOOP
      FETCH c1 INTO v1, v2, v3;
        IF c1%FOUND THEN
          INSERT INTO t2 VALUES (v1, v2, v3);
        ELSIF c1%NOTFOUND THEN
          EXIT;
        END IF;
    END LOOP;
  END IF;

    v1 := c1%ROWCOUNT;
    INSERT INTO t3 VALUES (v1);
  CLOSE c1;
END;
/

iSQL> EXEC proc1;
Execute success.
iSQL> SELECT * FROM t1;
T1.I1       T1.I2       T1.I3
----------------------------------------
1           1           1
1           1           1
1           1           1
3 rows selected.
iSQL> SELECT * FROM t2;
T2.I1       T2.I2       T2.I3
----------------------------------------
1           1           1
1           1           1
1           1           1
3 rows selected.
iSQL> SELECT * FROM t3;
T3.I1
--------------
3
1 row selected.
```

Example 3

```
CREATE TABLE emp_temp(eno INTEGER, e_firstname CHAR(20), e_lastname CHAR(20));

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
 DECLARE
  CURSOR c1 IS SELECT eno, e_firstname, e_lastname FROM employees;
   emp_rec c1%ROWTYPE;
 BEGIN
  OPEN c1;

  LOOP
   FETCH c1 INTO emp_rec;
   EXIT WHEN c1%ROWCOUNT > 10 OR c1%NOTFOUND;
   INSERT INTO emp_temp
   VALUES(emp_rec.eno, emp_rec.e_firstname, emp_rec.e_lastname);
  END LOOP;

  CLOSE c1;
 END;
END;
/
iSQL> EXEC proc1;
EXECUTE success.
iSQL> SELECT * FROM emp_temp;
ENO         E_FIRSTNAME           E_LASTNAME
------------------------------------------------------------
1           Chan-seung            Moon
2           Susan                 Davenport
3           Ken                   Kobain
4           Aaron                 Foster
5           Farhad                Ghorbani
6           Ryu                   Momoi
7           Gottlieb              Fleischer
8           Xiong                 Wang
9           Curtis                Diaz
10          Elizabeth             Bae
10 rows selected.
```

6. User-Defined Types

In this chapter, the user-defined types that can be used with stored procedures and functions will be described.

Overview

RECORD types and associative arrays, the user-defined types provided for use with store procedures, make it possible to organize data into logical units for processing. They can also be used as parameters or return values when stored procedures and functions call other stored procedures and functions. Note however that values that have user-defined types cannot be passed to clients.

RECORD Types

A RECORD type is a user-defined type that consists of a set of columns. It can be used to configure data of different types into logical units for processing. For example, different data types corresponding to “Name”, “Salary” and “Department” can be combined into a single data type called “Employee”, which is easy to process. A RECORD type defined in a block is local in scope; that is, it is available only in the block in which the type is defined.

For information on defining RECORD types, please refer to "Defining a User-Defined Type" in Chapter 6. Aside from the difference in how they are declared, the use of a RECORD type variable declared using the %ROWTYPE keyword is the same as for other RECORD type variables.

Associative Arrays

An associative array is similar to a hash table. An associative array is a set of key-value pairs. The keys are unique indexes that are used to locate the associated values with the syntax:

```
variable_name[index] 또는 variable_name(index)
```

The data type of index can be either VARCHAR or INTEGER. It can be used to combine data items of the same type into a single data item for processing, regardless of the amount of data. For example, suppose that it is desired to process the data pertaining to employees having employee numbers from 1 to 100. These 100 data items can be processed using an associative array.

Refer to "Defining a User-Defined Type" in Chapter 6 for in-depth information on defining associative arrays.

Square brackets “[ ]“ or parenthesis “()“ are used to access the elements in an associative array variable, as shown below:

Example 1) V1[1] := 1;

Example 2) V2(1) := 1;

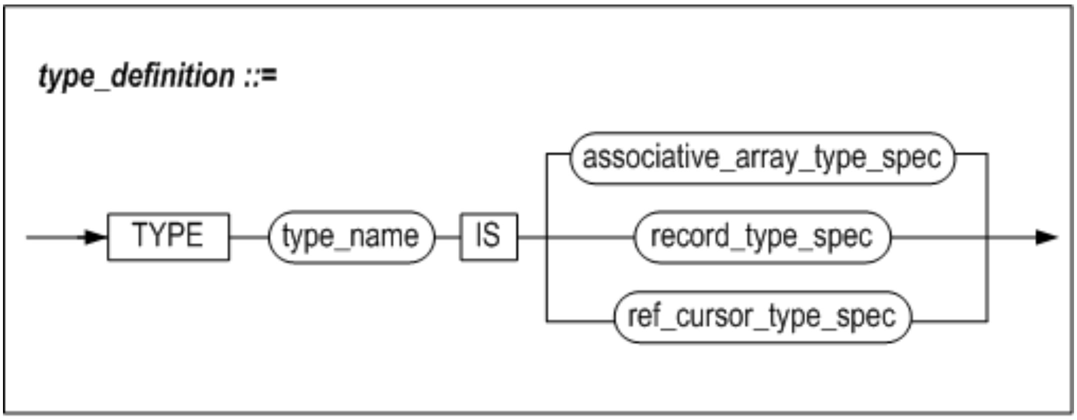
REF CURSOR (Cursor Variable)

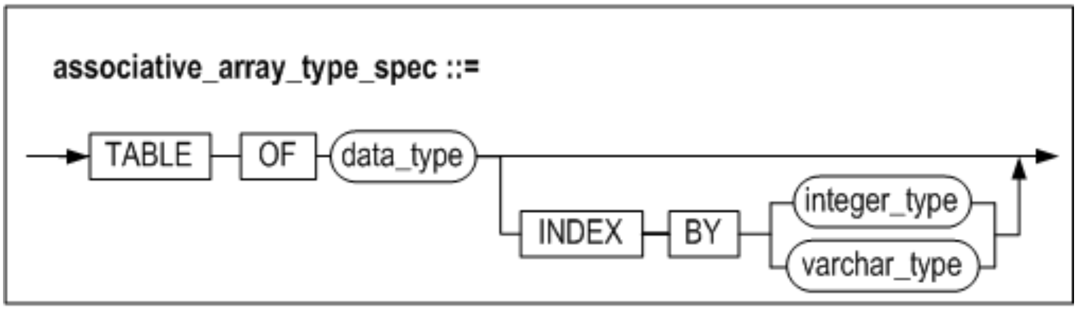
A cursor variable is intended for use with dynamic SQL statements that are expected to return multiple records. A cursor variable is more flexible than a regular cursor (i.e. an explicit cursor) because it is not associated with a particular query. Cursor variables can be passed as parameters between stored procedures and functions, and can even be passed to clients.

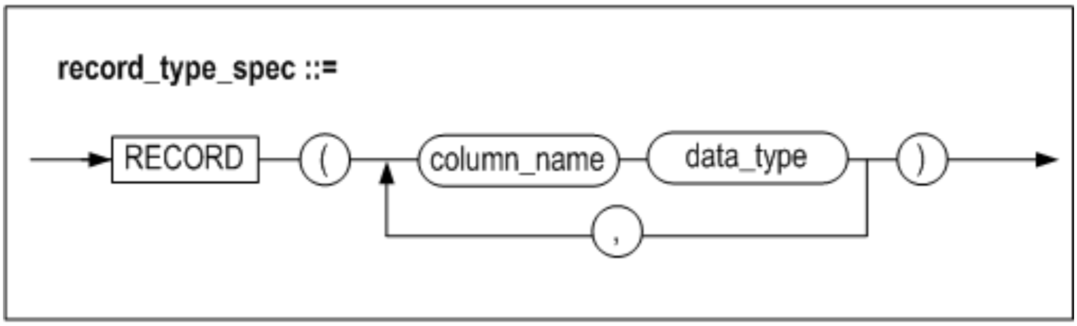
The difference between a cursor variable and a regular cursor is that a cursor variable, while it is open, can refer to different queries, while a regular cursor can only refer to the query with which it was declared.

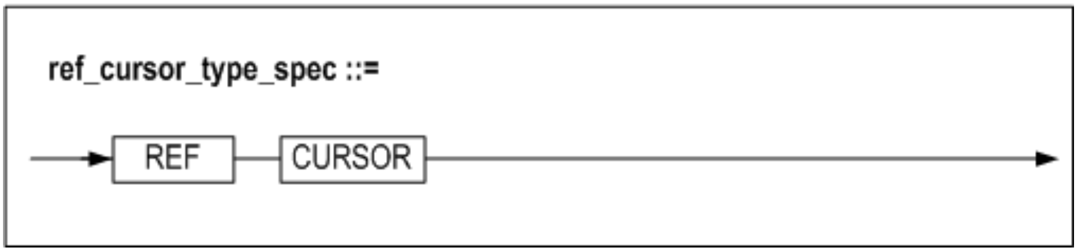
Defining a User-Defined Type

Syntax









type_name

The name of the user-defined type is specified here.

associative_array_type_spec

The associative_array_type_spec defines the type of Associative Array comprised of data_type. The basic data type is an integer if INDEX BY clause was omitted.

record_type_spec

This defines a RECORD type that consists of multiple columns, each having its own sql_data_type. sql_data_type can be any data type that is available for use in SQL statements. Note that sql_data_type cannot be an associative array or another RECORD type.

ref_cursor_type_spec

This clause defines RECORD type, which is comprised of data_type. Any data type applicable to SQL statements can be associated with data_type

Example

Exampl 1

Define a RECORD type called employee that consists of the name (VARCHAR(20)), department (INTEGER) and salary (NUMBER(8)) elements.

```
DECLARE
TYPE employee IS RECORD( name VARCHAR(20),
 dept  INTEGER,
 salary  NUMBER(8));
…
BEGIN
…
```

Example 2

Define an associative array called “namelist” that uses the VARCHAR(20) type for its elements and has an INTEGER type index.

```
DECLARE
TYPE namelist IS TABLE OF VARCHAR(20)
 INDEX BY INTEGER;
…
BEGIN
…
```

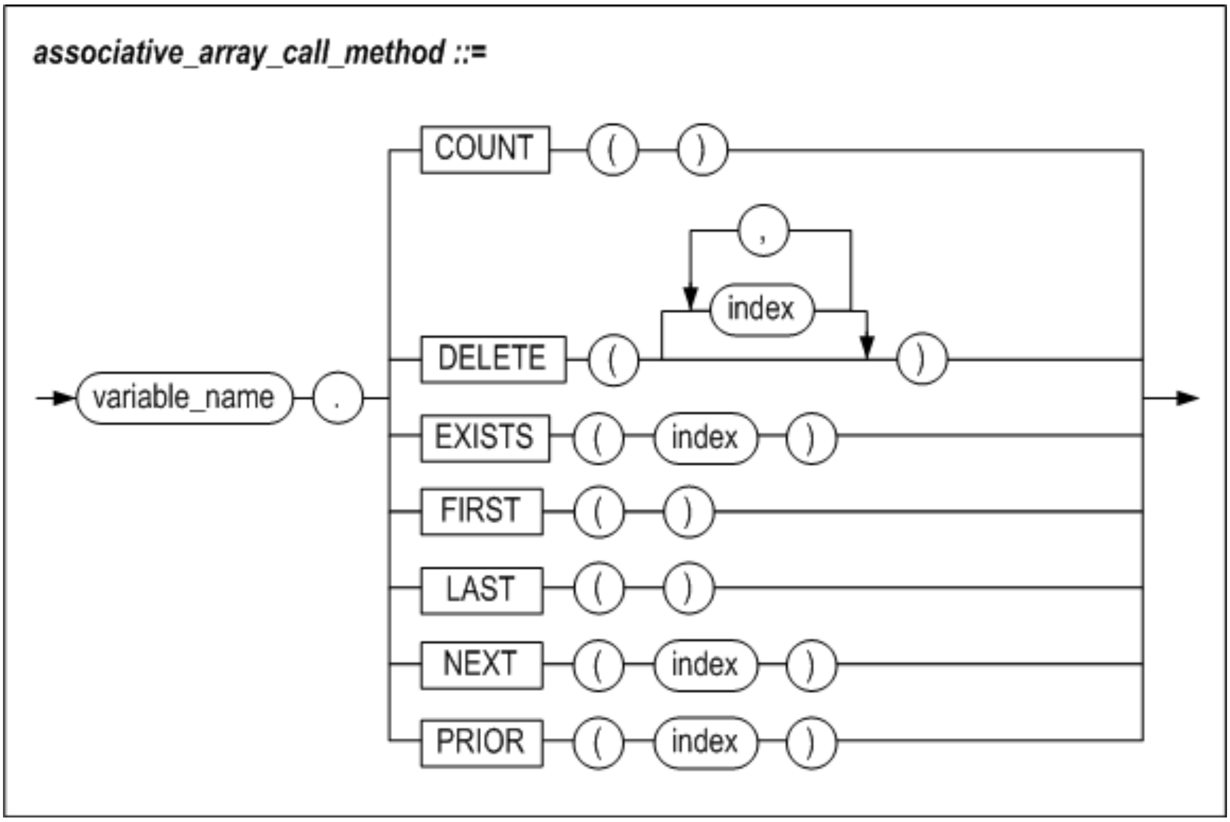
Example 3

Define an associative array called employeelist that uses the employee user-defined record type for its elements and has a VARCHAR(10) type index.

```
DECLARE
TYPE employee IS RECORD( name VARCHAR(20),
  dept INTEGER,
  salary NUMBER(8));
TYPE employeelist IS TABLE OF employee
  INDEX BY VARCHAR(10));
…
BEGIN
…
```

Functions for Use with Associative Arrays

Syntax



Purpose

Various functions are provided for manipulating associative array elements. Unlike SQL functions, parentheses “()“ cannot be omitted when using these functions.

COUNT

This returns the number of elements in an associative array.

DELETE

DELETE() removes all elements and returns the number of elements that were removed.

DELETE(n) removes the element whose index is n, and returns the number of element(s) that were removed, i.e. 0 or 1.

DELETE(m, n) removes all elements whose indexes are in the range from m to n inclusive and returns the number of the elements that were removed. Note that if the value of m is greater than the value of n, then no elements will be removed. If they are the same, then only that element will be removed.

EXISTS

EXISTS(n) checks whether the element whose index is n exists. Returns the boolean value TRUE if it exists, or FALSE if it does not.

FIRST

For an array indexed by integers, FIRST returns the smallest index number. For an array indexed by strings, FIRST returns the lowest key value. If the array does not contain any elements, it returns NULL.

LAST

For an array indexed by integers, LAST returns the largest index number. For an array indexed by strings, LAST returns the highest key value. If the array does not contain any elements, it returns NULL.

NEXT

NEXT(n) returns the index number that follows index n. For associative arrays with VARCHAR keys, NEXT returns the next key value. The binary values of the characters in the string determine the order. If there is no index at this position, it returns NULL.

PRIOR

PRIOR(n) returns the index number that precedes index n. For associative arrays with VARCHAR keys, PRIOR returns the preceding key value. The binary values of the characters in the string determine the order. If there is no index at this position, it returns NULL.

Examples

Example 1

Delete elements from the associative array variable “V1”.

```
CREATE OR REPLACE PROCEDURE PROC1(
    P1 IN VARCHAR(10),
    P2 IN VARCHAR(10) )
AS
    TYPE MY_ARR IS TABLE OF INTEGER
    INDEX BY VARCHAR(10);
    V1 MY_ARR;
    V2 INTEGER;
BEGIN
    V1['FSDGADS'] := 1;
```

```
    V1['AA'] := 2;
    V1['7G65'] := 3;
    V1['N887K'] := 4;
    V1['KU'] := 5;
    V1['34'] := 6;

    PRINTLN( 'V1 COUNT IS : '||V1.COUNT() );

    V2 := V1.DELETE(P1, P2);
    PRINTLN( 'DELETED COUNT IS : '||V2);
    PRINTLN( 'V1 COUNT IS : '||V1.COUNT() );
END;
/
```

The result of execution:

EXEC PROC1('005T34', 'BC35'); -- The elements whose indexes fall in this range are V1['34'], V1['7G65'] and V1['AA']. Three elements will be deleted.

```
V1 COUNT IS : 6
DELETED COUNT IS : 3
V1 COUNT IS : 3
Execute success.
```

Example 2

Output the elements in the associative array variable “V1” in ascending and descending order.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
  TYPE MY_ARR1 IS TABLE OF INTEGER INDEX BY INTEGER;
  V1 MY_ARR1;
V1_IDX INTEGER;
 BEGIN

  V1[435754] := 1;
  V1[95464]  := 2;
  V1[38]     := 3;
  V1[57334]  := 4;
  V1[138]    := 5;
  V1[85462]  := 6;

  PRINTLN( 'ASCENDING ORDER V1');

  V1_IDX := V1.FIRST();

  LOOP
```

```
    IF V1_IDX IS NULL
    THEN
      EXIT;
    ELSE
      PRINTLN( 'V1 IDX IS : '||V1_IDX||' VALUE IS : '||V1[V1_IDX] );
      V1_IDX := V1.NEXT(V1_IDX);
    END IF;
  END LOOP;

  PRINTLN( 'DESCENDING ORDER V1');

  V1_IDX := V1.LAST();

  LOOP
    IF V1_IDX IS NULL
    THEN
      EXIT;
    ELSE
      PRINTLN( 'V1 IDX IS : '||V1_IDX||' VALUE IS : '||V1[V1_IDX] );
      V1_IDX := V1.PRIOR(V1_IDX);
    END IF;
  END LOOP;
END;
/
```

The result of execution:

```
EXEC PROC1;

ASCENDING ORDER V1
V1 IDX IS : 38 VALUE IS : 3
V1 IDX IS : 138 VALUE IS : 5
V1 IDX IS : 57334 VALUE IS : 4
V1 IDX IS : 85462 VALUE IS : 6
V1 IDX IS : 95464 VALUE IS : 2
V1 IDX IS : 435754 VALUE IS : 1
DESCENDING ORDER V1
V1 IDX IS : 435754 VALUE IS : 1
V1 IDX IS : 95464 VALUE IS : 2
V1 IDX IS : 85462 VALUE IS : 6
V1 IDX IS : 57334 VALUE IS : 4
V1 IDX IS : 138 VALUE IS : 5
V1 IDX IS : 38 VALUE IS : 3
Execute success.
```

Using RECORD Type Variables and Associative Array Variables

This section outlines the rules governing the use of user-defined types in stored procedures, with reference to examples. For information on using user-defined types as parameters and return values, please refer to Chapter7: Typesets.

Compatibility between User-Defined Types

```
L_VALUE := R_VALUE;
```

The inter-compatibility between user-defined types when used in assignment statements such as that shown above is set forth in the following table:

Type of L_VALUE	Type of R_VALUE	Compatibility
RECROD Type	RECORD Type	Only RECORD type variables that are the same user-defined type (i.e. that have the same type name) are compatible. Two different record types are not inter-compatible even when they have the same internal structure.
RECORD Type	%ROWTYPE	Compatible, as long as they comprise the same number and type of columns.
%ROWTYPE	RECORD Type	Compatible, as long as they comprise the same number and type of columns.
Associative Array	Associative Array	Only associative array variables that are the same user-defined type (i.e. that have the same type name) are compatible.

In the following example, the last assignment statement fails even though the two user-defined types have the same internal structure.

Example 1

Assigning values to RECORD type variables.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
TYPE emp_rec_type1 IS RECORD (
                 name    VARCHAR(20),
                 job_id  VARCHAR(10),
                 salary  NUMBER(8) );

TYPE emp_rec_type2 IS RECORD (
                 name    VARCHAR(20),
                 job_id  VARCHAR(10),
                 salary  NUMBER(8) );
```

```
v_emp1 emp_rec_type1;
v_emp2 emp_rec_type2;
BEGIN
     v_emp1.name := 'smith';
     v_emp1.job_id := 'RND1069';
     v_emp1.salary := '10000000';

     v_emp2 := v_emp1;    -- failed.
```

Even though the two variables have the same structure, the assignment operation fails because they refer to different user-defined types. However, assignment operations between individual elements whose types match, as shown below, will be successful:

v_emp2.name := v_emp1.name;

RECORD Type Variable Example

Example 1

Create a RECORD type for storing the name, salary, and department of employees.

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
AS
TYPE emp_rec_type IS RECORD (
name VARCHAR(20),
job_id VARCHAR(10),
salary NUMBER(8) );
v_emp emp_rec_type;
BEGIN
v_emp.name := 'smith';
v_emp.job_id := 'RND1069';
v_emp.salary := '10000000';
PRINTLN('NAME : '||v_emp.name||' '||
          'JOB ID : '||v_emp.job_id||' '||
          'SALARY : '||v_emp.salary );
END;
/
```

Associative Array Type Examples

Example 1

Output the last names of all employees whose ID numbers range from 1 to 20 inclusive.

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
AS
TYPE emp_array_type IS TABLE OF VARCHAR(20) INDEX BY INTEGER;
v_emp emp_array_type;
```

```
BEGIN
FOR I IN 1 .. 20 LOOP
SELECT e_lastname INTO v_emp[I] FROM employees WHERE eno = I;
END LOOP;
FOR I IN v_emp.FIRST() .. v_emp.LAST() LOOP
PRINTLN( v_emp[I] );
END LOOP;
END;
/
iSQL>  EXEC PROC1;
Moon
Davenport
Kobain
Foster
Ghorbani
Momoi
Fleischer
Wang
Diaz
Bae
Liu
Hammond
Jones
Miura
Davenport
Chen
Fubuki
Huxley
Marquez
Blake
Execute success.
```

Example 2

Output the name, salary and department of all employees whose ID numbers range from 1 to 20 inclusive.

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
AS
TYPE emp_rec_type IS RECORD (
         first_name VARCHAR(20),
         last_name VARCHAR(20),
                emp_job VARCHAR(15),
         salary NUMBER(8) );
TYPE emp_array_type IS TABLE OF emp_rec_type
 INDEX BY INTEGER;
v_emp emp_array_type;
BEGIN
```

```
FOR I IN 1 .. 20 LOOP
 SELECT e_firstname, e_lastname, emp_job, salary INTO v_emp[I]
 FROM employees
 WHERE eno = I;
END LOOP;
FOR I IN v_emp.FIRST() .. v_emp.LAST() LOOP
PRINTLN( v_emp[I].first_name||' '||
v_emp[I].last_name||' '||
v_emp[I].emp_job||' '||
v_emp[I].salary );
END LOOP;
END;
/
Create success.
iSQL> EXEC PROC1;
Chan-seung           Moon                 CEO
Susan                Davenport            designer 1500
Ken                  Kobain               engineer 2000
Aaron                Foster               PL 1800
Farhad               Ghorbani             PL 2500
Ryu                  Momoi                programmer 1700
Gottlieb             Fleischer            manager 500
Xiong                Wang                 manager
Curtis               Diaz                 planner 1200
Elizabeth            Bae                  programmer 4000
Zhen                 Liu                  webmaster 2750
Sandra               Hammond              sales rep 1890
Mitch                Jones                PM 980
Yuu                  Miura                PM 2003
Jason                Davenport            webmaster 1000
Wei-Wei              Chen                 manager 2300
Takahiro             Fubuki               PM 1400
John                 Huxley               planner 1900
Alvar                Marquez              sales rep 1800
William              Blake                sales rep
Execute success.
```

Overlapping RECORD Type Variables

Example

Create a RECORD type storing the name of employees, and then create a overlapping RECORD type variable storing its type, department, and salary.

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
AS
TYPE emp_name_type IS RECORD ( first_name VARCHAR(20),last_name VARCHAR(20) );
TYPE emp_rec_type IS RECORD ( name emp_name_type,d_num NUMBER(8),salary NUMBER(8) );
```

```
TYPE emp_array_type IS TABLE OF emp_rec_type INDEX BY INTEGER;
v_emp emp_array_type;
v_emp_name emp_name_type;
BEGIN
FOR I IN 1 .. 10 LOOP
SELECT e_firstname, e_lastname INTO v_emp_name FROM employees WHERE eno = I;
SELECT dno, salary INTO v_emp[i].d_num, v_emp[I].salary FROM employees WHERE eno = I;
v_emp[I].name := v_emp_name;
END LOOP;
FOR I IN v_emp.FIRST() .. v_emp.LAST() LOOP
v_emp_name := v_emp[I].name;
PRINTLN( v_emp_name.first_name || ' ' ||
v_emp_name.last_name || ' ' ||
v_emp[I].d_num || ' ' ||
v_emp[I].salary );
END LOOP;
END;
/
Create success.
iSQL> EXEC PROC1;
Chan-seung          Moon                3002
Susan               Davenport            1500
Ken                 Kobain              1001 2000
Aaron               Foster              3001 1800
Farhad              Ghorbani            3002 2500
Ryu                 Momoi               1002 1700
Gottlieb            Fleischer           4002 500
Xiong               Wang                4001
Curtis              Diaz                4001 1200
Elizabeth           Bae                 1003 4000
Execute success.
```

Multidimensional ASSOCIATIVE ARRAY Type Variables

Example

Create variables of multidimensional associative array type storing the customer name and order number.

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
AS
TYPE order_array_type IS TABLE OF INTEGER INDEX BY INTEGER;
TYPE customer_order_rec_type IS RECORD ( first_name VARCHAR(20), last_name VARCHAR(20),
orders order_array_type );
TYPE customer_order_array_type IS TABLE OF customer_order_rec_type;
v_cust_order customer_order_array_type;
v_order_array NOCOPY order_array_type;
BEGIN
FOR I IN 1 .. 5 LOOP
```

```
v_order_array := v_cust_order[I].orders;
SELECT c_firstname, c_lastname INTO v_cust_order[I].first_name,
v_cust_order[I].last_name FROM customers WHERE cno = I;
SELECT ono BULK COLLECT INTO v_order_array FROM orders WHERE cno = I;
END LOOP;
FOR i in 1 .. 5 LOOP
println ( v_cust_order[I].first_name || ' ' || v_cust_order[I].last_name );
v_order_array := v_cust_order[I].orders;
FOR J IN v_order_array.FIRST() .. v_order_array.LAST() LOOP
PRINTLN ( '   order no : ' || v_order_array[J] );
END LOOP;
END LOOP;
END;
/
Create success.
iSQL> EXEC PROC1;
Estevan              Sanchez
   order no : 12300001
   order no : 12310008
   order no : 12310012
Pierre               Martin
   order no : 12300002
   order no : 12310006
Gabriel              Morris
   order no : 11290007
   order no : 12300012
Soo-jung             Park
   order no : 12300005
James                Stone
   order no : 12100277
   order no : 12310004
   order no : 12310009
Execute success
```

REF CURSOR

A stored procedure can pass a result set, resulting from execution of a SQL statement, to a client using a cursor variable (REF CURSOR).

Opening a cursor variable with the OPEN FOR statement and then passing the cursor to a client using an OUT parameter makes it possible for the client to access the result set. If multiple cursors are sent, the client can access multiple result sets. Except for the fact that the OPEN FOR statement is used to open a cursor variable, the use of cursor-related statements is the same as for regular cursors.

A cursor variable can only be passed as an OUT or IN/OUT parameter of a stored procedure. It cannot be returned with the RETURN statement.

In order for a client to be able to fetch a result set, a cursor variable must be open when it is passed from the stored procedure to the client. In other words, if the cursor is closed when it is passed, it will be impossible to fetch the result set.

When an UPDATE or INSERT statement is executed inside a stored procedure, the number of affected records (the affected row count) is not passed to the client.

The way that the client receives the result set using the cursor variable varies depending on the type of client. Using a cursor variable to pass the result set to a client is possible only in ODBC and JDBC. It is not possible in embedded SQL (Precompiler, APRE).

Examples

Create a stored procedure that uses a REF CURSOR

1. Create emp and staff tables, and insert values into them

```
CREATE TABLE EMP (ENO INTEGER, ENAME CHAR(20), DNO INTEGER);
CREATE TABLE STAFF (NAME CHAR(20), DEPT CHAR(20), JOB CHAR(20), SALARY INTEGER);

INSERT INTO EMP VALUES (10, 'DULGI PAPA', 100);
INSERT INTO EMP VALUES (20, 'KUNHAN' , 200);
INSERT INTO EMP VALUES (30, 'OKASA' , 300);

INSERT INTO STAFF VALUES ('DULGI PAPA' , '100' , 'PAPA', 100);
INSERT INTO STAFF VALUES ('SHINCHA' , '200' , 'ENGINEER' , 200);
INSERT INTO STAFF VALUES ('JI HYUNG', '300', '', 0);
```

2. Create the user-defined type MY_CUR, which is a REF CURSOR, and create a typeset called MY_TYPE containing type MY_CUR

```
   CREATE TYPESET MY_TYPE
   AS
     TYPE MY_CUR IS REF CURSOR;
   END;
   /
```

3. Create the stored procedure PROC1, which has two OUT parameters, P1 and P2, of type MY_CUR, and one IN parameter, SAL, of type INTEGER.

```
   CREATE OR REPLACE PROCEDURE PROC1 (P1 OUT MY_TYPE.MY_CUR, P2 OUT MY_TYPE.MY_CUR, SAL 
IN INTEGER)
   AS
     SQL_STMT  VARCHAR2(200);
   BEGIN
     SQL_STMT := 'SELECT NAME,DEPT,JOB FROM STAFF WHERE SALARY > ?';
     OPEN P1 FOR 'SELECT ENO, ENAME, DNO FROM EMP';
     OPEN P2 FOR SQL_STMT USING SAL;
   END;
   /
```

4. After connecting to the database, execute procedure PROC1.

```
SQLRETURN execute_proc()
{
  SQLCHAR errMsg[MSG_LEN];
  char sql[1000];
  SQLHSTMT     stmt = SQL_NULL_HSTMT;

  int sal;
  int sal_len;
  int eno;
  int eno_len;
  int dno;
  int dno_len;
  SQLCHAR ename[ENAME_LEN+1];
  SQLCHAR name[NAME_LEN+1];
  SQLCHAR dept[DEPT_LEN+1];
  SQLCHAR job[JOB_LEN+1];

  int job_ind;

  SQLRETURN rc = SQL_SUCCESS;

  if (SQL_ERROR == SQLAllocStmt(dbc, &stmt))
  {
      printf("SQLAllocStmt error!!\n");
      return SQL_ERROR;
  }

/* Prepare SQL statements for execution */
  sprintf(sql, "EXEC proc1(?)");
  if ( SQLPrepare(stmt,(SQLCHAR *)sql,SQL_NTS) == SQL_ERROR )
  {
    printf("ERROR: prepare stmt\n");
  }
  else
  {
```

```
    printf("SUCCESS: prepare stmt\n");
  }

/* Specify sal as 100. */
  sal = 100;

  /* Bind sal as a parameter into SQL statements. */
  if ( SQLBindParameter( stmt,
                         1,
                         SQL_PARAM_INPUT,
                         SQL_C_SLONG,
                         SQL_INTEGER,
                         0,
                         0,
                         &sal,
                         0,
                         NULL) == SQL_ERROR )
  {
    printf("ERROR: Bind Parameter\n");
  }
  else
  {
    printf("SUCCESS: 1 Bind Parameter\n");
  }

/* Execute the SQL statements (execute procedure PROC1). The procedure passes the
results of 'SELECT eno,
ename, dno FROM emp' and those of 'SELECT name,dept,job FROM staff WHERE salary >
?'(USING SAL) using OUT parameters, p1 and p2, to the client.  */
if (SQL_ERROR == SQLExecute(stmt))
  {
    printf("ERROR: Execute Procedure\n");
  }

/*  Store the results of 'SELECT eno, ename, dno FROM emp' in variables (eno, ename and
dno).  */
  if (SQL_ERROR == SQLBindCol(stmt, 1, SQL_C_SLONG, &eno, 0, (long *)&eno_len))
  {
    printf("ERROR: Bind 1 Column\n");
  }
  if (SQL_ERROR == SQLBindCol(stmt, 2, SQL_C_CHAR, ename, sizeof(ename), NULL))
  {
    printf("ERROR: Bind 2 Column\n");
  }
  if (SQL_ERROR == SQLBindCol(stmt, 3, SQL_C_SLONG, &dno, 0, (long *)&dno_len))
  {
    printf("ERROR: Bind 3 Column\n");
  }
```

```
/* Retrieve the results and then display them on the screen while they exist in P1. */
  while (SQL_SUCCESS == rc)
  {
    rc = SQLFetch(stmt);
    if (SQL_SUCCESS == rc)
    {
      printf("Result Set 1 : %d,%s,%d\n" ,eno, ename, dno);
    }
    else
    {
      if (SQL_NO_DATA == rc)
      {
  break;
      }
      else
      {
         printf("ERROR: SQLFetch [%d]\n", rc);
         execute_err(dbc, stmt, sql);
         break;
      }
    }
  }

/* Move to the next result (P2) */
  rc = SQLMoreResults(stmt);
  if (SQL_ERROR == rc)
  {
    printf("ERROR: SQLMoreResults\n");
  }
  else
{

/* Store the results of 'SELECT name,dept,job FROM staff WHERE salary > ?'(USING SAL)
in variables(name, dept and job). */

   if (SQL_ERROR == SQLBindCol(stmt, 1, SQL_C_CHAR, name, sizeof(name), NULL))
   {
  printf("ERROR: Bind 1 Column\n");
   }
   if (SQL_ERROR == SQLBindCol(stmt, 2, SQL_C_CHAR, dept, sizeof(dept), NULL))
   {
  printf("ERROR: Bind 2 Column\n");
   }
   if (SQL_ERROR == SQLBindCol(stmt, 3, SQL_C_CHAR, job, sizeof(job), (long
*)&job_ind))
   {
  printf("ERROR: Bind 3 Column\n");
   }
```

```
/* Retrieve the results and then display them on the screen while they exist in P2. */
   while (SQL_SUCCESS == rc)
   {
  rc = SQLFetch(stmt);
  if (SQL_SUCCESS == rc)
  {
    if( job_ind == -1 )
       printf("Result Set 2 : %s,%s,NULL\n" ,name, dept);
    else
       printf("Result Set 2 : %s,%s,%s\n" ,name, dept, job);
  }
  else
  {
    if (SQL_NO_DATA == rc)
    {
     break;
    }
    else
    {
    printf("ERROR: SQLFetch [%d]\n", rc);
    execute_err(dbc, stmt, sql);
    break;
    }
  }
   }
  }

  if (SQL_ERROR == SQLFreeStmt( stmt, SQL_DROP ))
  {
    printf("sql free stmt error\n");
  }
}
```

7. Typesets

This chapter describes how to define and use typesets.

Overview

A typeset is a database object that allows the user-defined types used in stored procedures to be stored and managed in one place.

Features

Sharing User-Defined Types

When a typeset is used, all user-defined types can be managed in one place. This means that it is not necessary to repeatedly declare user-defined types having identical structures in respective stored procedures.

Use of User-Defined Types as Parameters or Return Values

Types belonging to the same typeset can be passed as parameters or return values between different procedures. Note however that individual types cannot be passed to clients without using a REF CURSOR.

Integration of Data Types in Logical Units

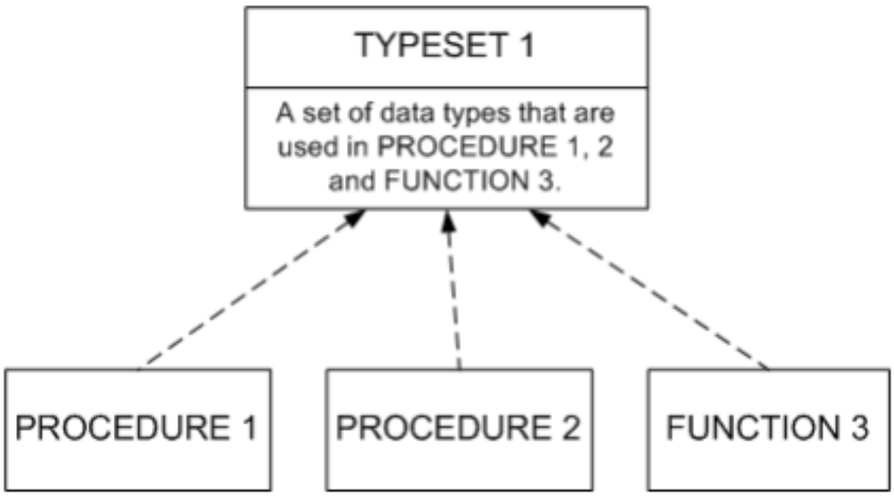
Typesets can be used to integrate data types into logical units for easier management within stored procedures and stored functions.

Passing Result Sets to Client Applications

A result set returned by a SQL statement that is executed within a stored procedure can be passed to a client using a REF CURSOR type variable in a typeset.

Structure

As shown in the following diagram and sample code, using a typeset allows user-defined types to be shared and managed by different procedures, facilitating data transfer.



TYPESET 1

The emp_rec_type and emp_arr_type types are defined within typeset_1.

```
CREATE TYPESET typeset_1
AS
TYPE emp_rec_type IS RECORD (
                  name    VARCHAR(20),
                  job_id  VARCHAR(10),
                  salary  NUMBER(8) );

TYPE emp_arr_type IS TABLE OF emp_rec_type
       INDEX BY INTEGER;
END;
/
```

PROCEDURE 1

procedure_1 calls procedure_2 using emp_arr_type as an OUT parameter.

```
CREATE PROCEDURE procedure_1
AS
V1 typeset_1.emp_arr_type;
BEGIN
  procedure_2( V1 );
  PRINTLN(V1[1].name);
PRINTLN(V1[1].job_id);
PRINTLN(V1[1].salary);

END;
/
```

PROCEDURE 2

procedure_2 assigns the value returned by function_3 to its OUT parameter.

```
CREATE PROCEDURE procedure_2
( P1 OUT typeset_1.emp_arr_type )
AS
V1 typeset_1.emp_rec_type;
BEGIN
V1 := function_3();
P1[1] := V1;
END;
/
```

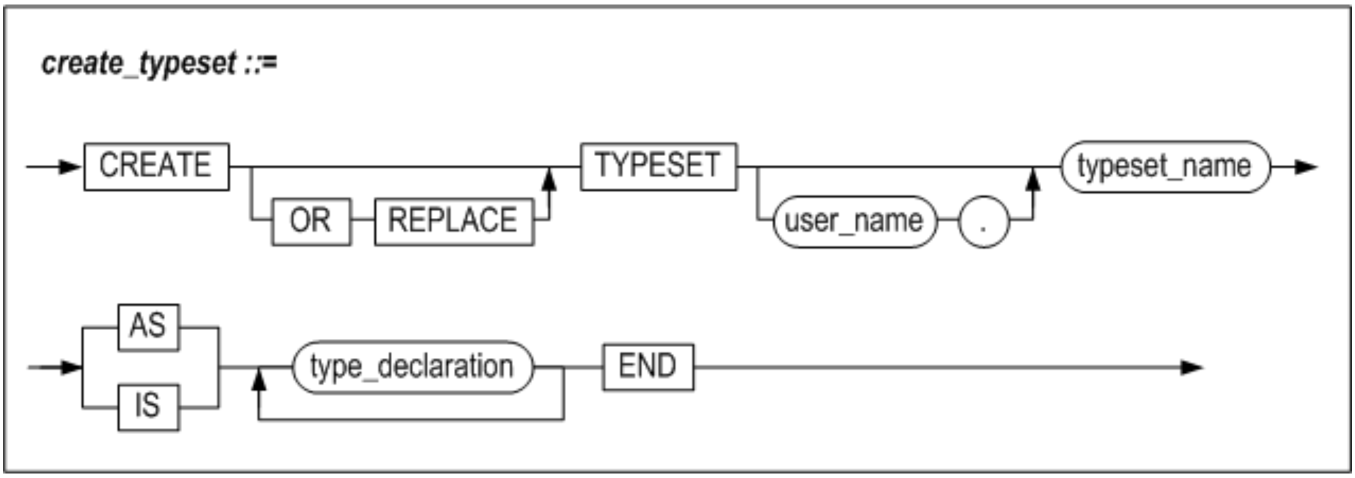
FUNCTION 3

function_3 returns a value whose type is typeset_1.emp_rec_type

```
CREATE FUNCTION function_3
RETURN typeset_1.emp_rec_type
AS
  V1 typeset_1.emp_rec_type;
BEGIN
V1.name := 'Smith';
V1.job_id := 1010;
V1.salary := 200;

RETURN V1;
END;
/
```

CREATE TYPESET

Syntax



Prerequisites

Only the SYS user and users having the CREATE PROCEDURE or CREATE ANY PROCEDURE system privilege can execute the CREATE TYPESET statement.

Description

This statement defines a user-defined typeset for use in a stored procedure or stored function. The individual types defined in a typeset can also be used as stored procedure INPUT/OUTPUT parameters.

user_name

This is used to specify the name of the owner of the typeset to be created. If it is omitted, Altibase will create the typeset in the schema of the user who is connected via the current session.

typeset_name

This is used to specify the name of the typeset.

type_declaration

Please refer to "Defining a User-Defined Type" in Chapter 6, User-Defined Types.

Example

Example 1

Create a typeset named my_typeset.

```
CREATE TYPESET my_typeset
AS
TYPE emp_rec_type IS RECORD(
      name VARCHAR(20), id INTEGER );
TYPE emp_arr_type IS TABLE OF emp_rec_type
       INDEX BY INTEGER;
END;
/
```

Example 2

Create a procedure my_proc1, which uses my_typeset.

```
CREATE PROCEDURE my_proc1
AS
V1 my_typeset.emp_rec_type;
V2 my_typeset.emp_arr_type;
BEGIN
V1.name := 'jejeong';
V1.id    := 10761;
V2[1]    := V1;

V1.name := 'ehkim';
V1.id    := 11385;
V2[2]    := V1;

V1.name := 'mslee';
V1.id    := 13693;
V2[3]    := V1;

PRINTLN('NAME : '||V2[1].name||
```

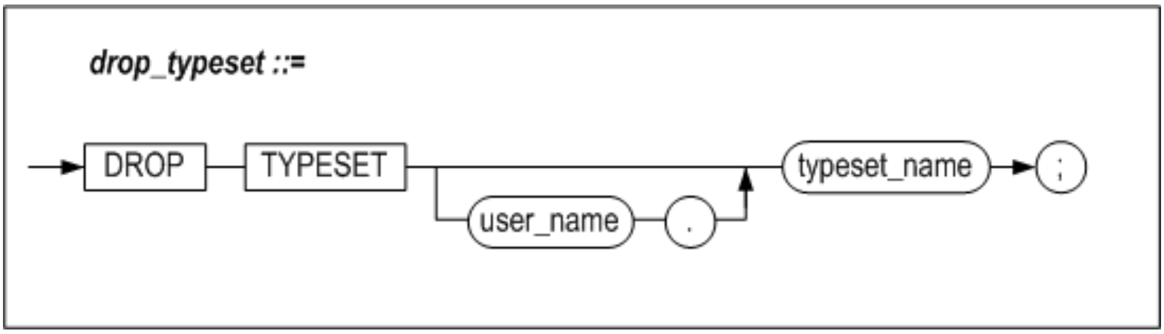
```
           '  ID : '||V2[1].id );
PRINTLN('NAME : '||V2[2].name||
           '  ID : '||V2[2].id );
PRINTLN('NAME : '||V2[3].name||
           '  ID : '||V2[3].id );
END;
/
```

The Result

```
iSQL> exec my_proc1;
NAME : jejeong  ID : 10761
NAME : ehkim  ID : 11385
NAME : mslee  ID : 13693
Execute success.
```

DROP TYPESET

Syntax



Prerequisites

Only the SYS user, the owner of the typeset to be dropped, and users having the DROP ANY PROCEDURE system privilege can execute the DROP TYPESET statement.

Description

This statement is used to remove the specified typeset. Once the typeset has been removed, any stored procedures that use the typeset will be invalid.

user_name

This is used to specify the name of the owner of the typeset to be removed. If it is omitted, Altibase will assume that the typeset to be removed is in the schema of the user who is connected via the current session.

typeset_name

This specifies the name of the typeset to remove.

Example

Remove a typeset named my_typeset.

```
DROP TYPESET my_typeset;
```

8. Dynamic SQL

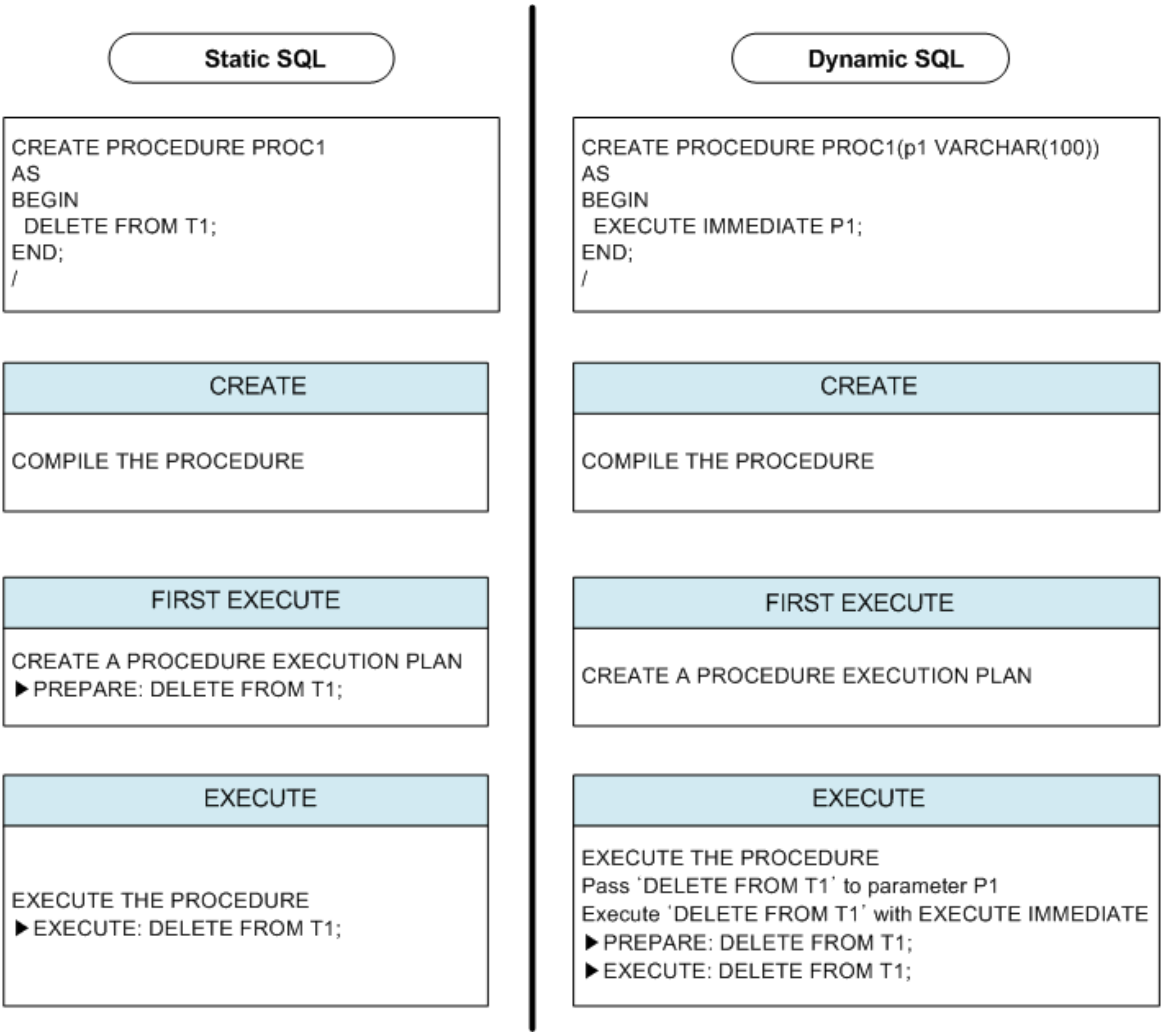
This chapter describes how to use dynamic SQL in stored procedures and functions.

Overview

With dynamic SQL, the user can create queries as desired at runtime and then execute them. In static execution, which is the standard way to execute SQL statements in stored procedures, an execution plan for all SQL statements in a stored procedure is created when the stored procedure is executed for the first time. Using dynamic SQL is the only way to execute SQL statements that did not exist when the stored procedure was compiled.

Executing Dynamic SQL

The following diagram compares the tasks involved in executing static vs. dynamic SQL statements in stored procedures.



[Figure 8-1] Execution of Static SQL vs. Dynamic SQL

[In Figure 8-1, the stored procedure on the left processes the 'DELETE FROM T1' statement statically, whereas the stored procedure on the right uses the EXECUTE IMMEDIATE statement to processes the same DELETE statement dynamically at runtime.

For the stored procedure on the left side, an execution plan for the DELETE statement is created at the time point that the procedure is executed for the first time, stored in the Plan Cache, queried and executed on repeated invocations. Likewise, an execution plan for the DELETE statement is created at the time point that the procedure is executed for the first time and stored in the Plan Cache for the stored procedure on the right side as well.

Features

The advantage of dynamic SQL is that it allows the user to freely change SQL statements as desired during runtime. Furthermore, the user can execute almost any type of SQL statement, as long as it is supported by the DBMS.

Dynamic SQL is useful in the following cases:

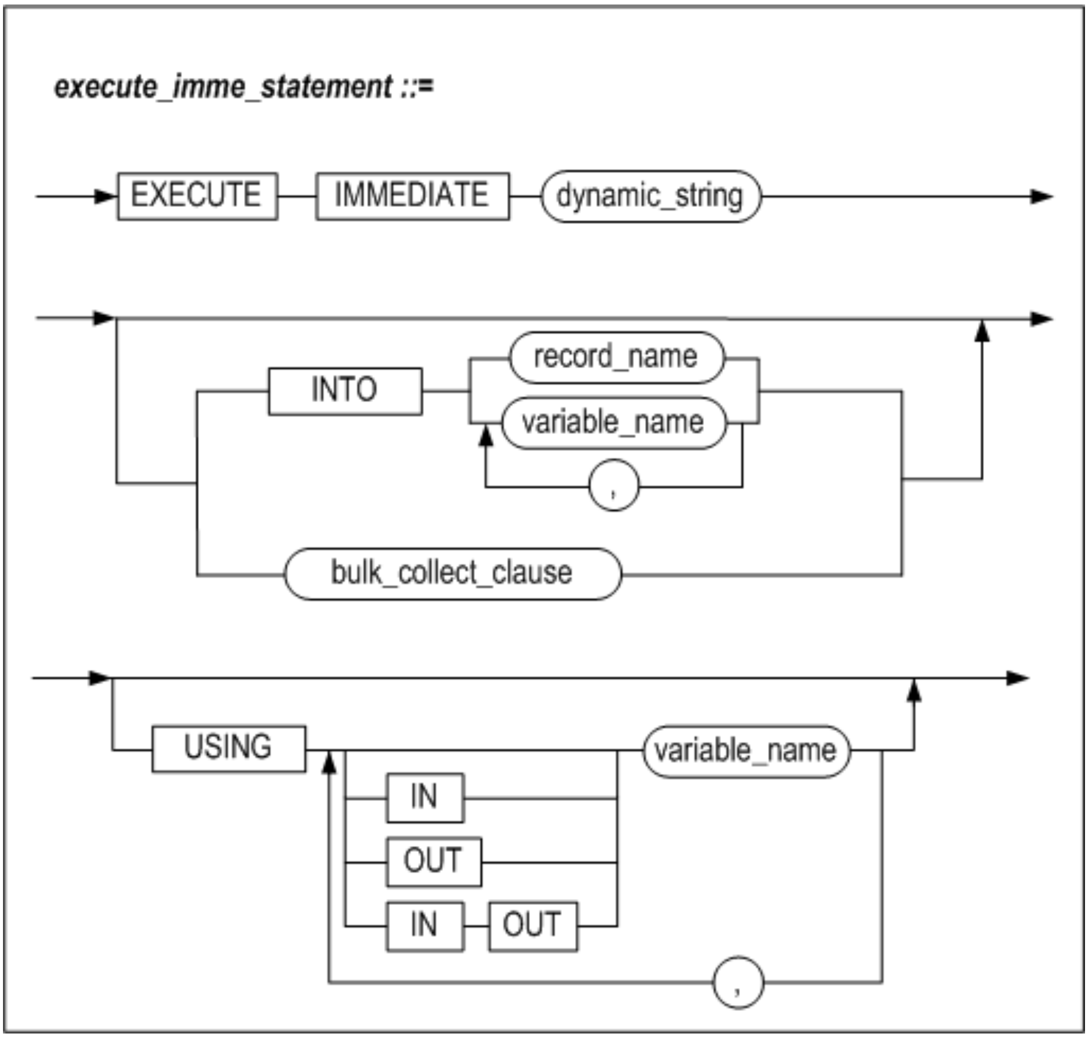
- When the name of the table to be queried can vary during runtime
- When it is appropriate to change a query hint depending on the circumstances, or when it is necessary to change a conditional operator for a condition clause
- When SQL statements that are used in stored procedures and functions need to be optimized frequently due to the frequent execution of DDL and DML statements
- When it is necessary to frequently execute SQL statements for which the execution cost exceeds the optimization cost. When it is desired to create versatile, reusable stored procedures

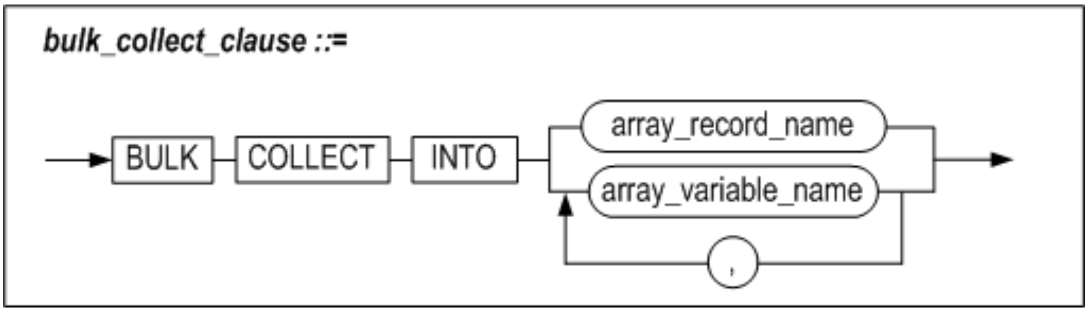
However, in some situations, using dynamic SQL may realize lower performance than using static SQL. This is attributable to the high cost of creating and deleting statements and binding variables to them. Although the use of dynamic SQL statements permits greater flexibility when designing applications, it may result in reduced performance.

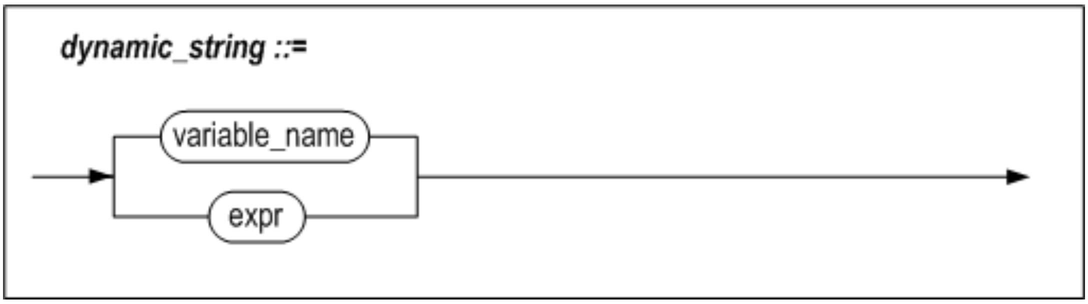
EXECUTE IMMEDIATE

This statement is used to dynamically execute a DDL, DCL or DML statement, including a SELECT query that returns a single record.

Syntax







Description

dynamic_string

This is the string containing the query statement to be executed.

INTO

The optional INTO clause indicates the variables in which to store the retrieved result set, in the same manner as a SELECT ... INTO statement.

bulk_collect_clause

BULK COLLECT clause retrieves the execution results of the SELECT statement at once. The array of host variables corresponding to the number of columns in the array of host variable should come immediately after the INTO clause in order to store the records returned by the SELECT statement.

Retrieving the result set of a query as arrays by using the BULK COLLECT clause is much more effective, rather than retrieving the result row by using the LOOP statement at a time.

USING

The optional USING clause is used to specify parameters to bind to the SQL statement at runtime. The parameters are bound to the statement at the positions indicated by question marks ("?") in the order in which they appear. IN, OUT and IN/OUT parameters can all be specified.

Example

The following is an example of the use of dynamic SQL to execute a DML statement.

```
CREATE PROCEDURE fire_emp(v_emp_id INTEGER) AS
BEGIN
  EXECUTE IMMEDIATE
  'DELETE FROM employees WHERE eno = ?'
    USING v_emp_id;
END;
```

```
/

CREATE PROCEDURE insert_table (
      table_name  VARCHAR(100),
      dept_no     NUMBER,
      dept_name   VARCHAR(100),
      location    VARCHAR(100))
AS
      stmt    VARCHAR2(200);
BEGIN
   stmt := 'INSERT INTO ' || table_name ||
           ' values (?, ?, ?)';
   EXECUTE IMMEDIATE stmt
           USING dept_no, dept_name, location;
END;
/
```

The syntax “EXECUTE IMMEDIATE dynamic_string” is used to execute a query in Direct-Execute mode. The variables that follow USING are binding parameters. In addition to DML statements, DDL and DCL statements can also be executed using EXECUTE IMMEDIATE.

Restrictions

The following SQL statements are supported for execution as dynamic SQL in stored procedures:

- DML
  SELECT, INSERT, UPDATE, DELETE, MOVE, MERGE, LOCK TABLE, ENQUEUE, DEQUEUE
- DDL
  CREATE, ALTER, DROP
- DCL
  ALTER SYSTEM, ALTER SESSION, COMMIT, ROLLBACK

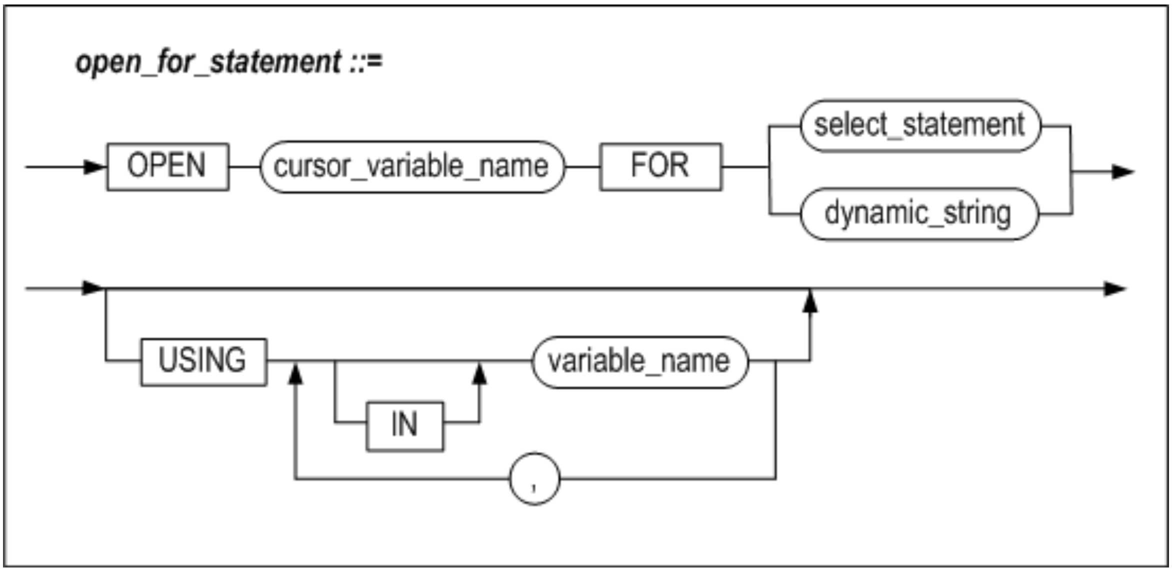
The following statements are not supported for use with dynamic SQL:

- Statements that can only be executed from iSQL
- SELECT * FROM tab;
- DESC table_name
- SET TIMING
- SET AUTOCOMMIT
- CONNECT
- DISCONNECT

OPEN FOR

This statement is used to initialize a cursor variable (REF CURSOR), execute the query, and determine the result set, so that data can be retrieved using the FETCH statement or can be passed to a client using stored procedure parameters. The USING clause is used to bind parameters.

Syntax



Description

cursor_variable_name

This is used to specify the name of a REF CURSOR-type cursor variable.

select_statement

The select_statement is a query statement which will be executed. No other than the SELECT statement can be used, and it cannot be used along with the USING clause.

dynamic_string

dynamic_string is the query to be executed. This can only be a SELECT statement in the form of a string.

USING

The optional USING clause is used to specify parameters to bind to the SQL statement at runtime. The parameters are bound to the statement at the positions indicated by question marks ("?") in the order in which they appear.

Example

The following example illustrates how to open a cursor variable within a stored procedure in order to fetch multiple rows resulting from the execution of a dynamic SQL statement.

For information on how to fetch a result set using an open cursor variable in a client program, please refer to the *Precompiler User's Manual*, *ODBC Reference*, and *API User's Manual*.

```
CREATE OR REPLACE PROCEDURE fetch_employee
AS
  TYPE MY_CUR IS REF CURSOR;
  emp_cv MY_CUR;
  emp_rec employees%ROWTYPE;
  stmt VARCHAR2(200);
```

```
  v_job VARCHAR2(10) := 'webmaster';
BEGIN
  stmt := 'SELECT * FROM employees WHERE emp_job = ?';
  OPEN emp_cv FOR stmt USING v_job;
  LOOP
    FETCH emp_cv INTO emp_rec;
    EXIT WHEN emp_cv%NOTFOUND;
    PRINTLN('[Name]: ' || emp_rec.e_firstname || emp_rec.e_lastname ||
            ' [Job Id]: ' || emp_rec.emp_job);
  END LOOP;
  CLOSE emp_cv;
END;
/
```

9. Exception Handlers

Overview

Execeptions that occur while a stored procedure is executing can be managed by appropriately declaring exceptions and managing them using exception handlers.

Types

Two types of exceptions can occur within stored procedures in Altibase.

- System-defined Exception
- User-defined Exception

Execeptions supported by stored procedures include

System-Defined Exceptions

System-defined exceptions are already defined within the system, and thus do not need to be declared in the DECLARE section of a stored procedure or block.

Some of the system-defined exceptions that can occur within stored procedures are as follows:

Exception Name	Cause
CURSOR_ALREADY_OPEN	This exception is raised when an attempt is made to open a cursor that is already open without first closing it. In the case of a Cursor FOR LOOP, because the cursor is implicitly opened, this exception will be raised if an attempt is made to explicitly open the cursor using the OPEN statement within the loop.
DUP_VAL_ON_INDEX	This exception is raised when an attempt is made to insert a duplicate value into a column designated as a unique index.
INVALID_CURSOR	This exception is raised when the operation cannot be completed with the cursor in its current state, such as when an attempt is made to use a cursor that is not open to perform a FETCH or CLOSE operation.
NO_DATA_FOUND	This exception is raised when no records are returned by a SELECT statement.
TOO_MANY_ROWS	A SELECT INTO statement can return only one row. This occurs when mroe than one row is returned.

User-defined Exceptions

User-defined exceptions are expressly declared by the user and intentionally raised using the RAISE statement.

An example is shown below:

```
DECLARE
  comm_missing  EXCEPTION;    -- DECLARE user defined EXCEPTION
BEGIN
  ......
  RAISE comm_missing;   -- raising EXCEPTION
  ......
  EXCEPTION
    WHEN comm_missing THEN ......
```

If a user-defined exception has the same name as a system-defined exception, the user-defined exception will take precedence over the system-defined exception.

Declaring an Exception

The names of system-defined exceptions are defined inside the system, so there is no need to explicitly declare them.

In contrast, user-defined exceptions must be explicitly declared in the DECLARE section of a block or stored procedure.

Raising an Exception

There is no need to explicitly raise system-defined exceptions. If a system-defined exception occurs during the execution of a stored procedure, whether an exception handler exists for the system-defined exception is checked. If such an exception handler exists, control is automatically diverted to the exception handler, and the tasks defined therein are undertaken.

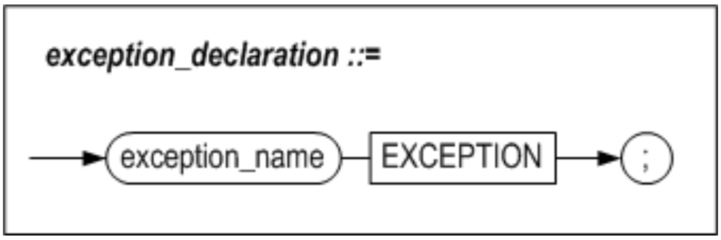
In contrast, user-defined exceptions must be explicitly raised in a stored procedure. User-defined exceptions are raised during the execution of a stored procedure using the RAISE statement.

The Exception Handler

The tasks to perform in the event of a system-defined or user-defined exception are defined here.

EXCEPTION

Syntax



Description

To define the user-defined exception.

exception_name

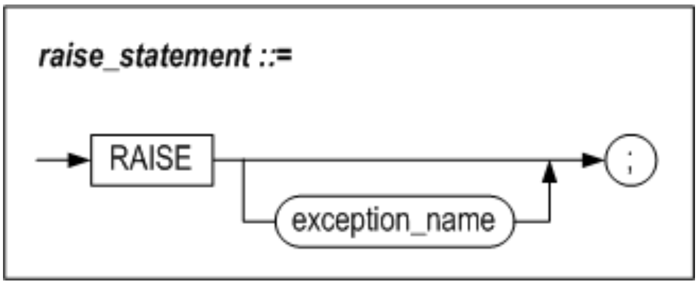
The scope of an exception is from the BEGIN statement to the END statement of the block in which it is declared. The name of the exception must be unique within the block.

Example

```
DECLARE
  error_1   EXCEPTION;
  error_2   EXCEPTION;
  error_3   EXCEPTION;
```

RAISE

Syntax



Description

This statement is used to expressly raise an exception and pass control to the routine defined for the corresponding exception handler.

exception_name

The name of the exception to raise is specified here. exception_name must be either the name of an exception declared in the declare section of the block or a system-defined exception.

If the exception specified here has not been declared, it will be impossible to compile the stored procedure. If the exception has been declared but no corresponding exception handler exists in the exception handler section, execution of the stored procedure will stop and an “unhandled exception” error will be returned.

User exceptions having the same name can be declared in inner and outer blocks. To avoid ambiguity in such cases, label each block and then reference the appropriate exception by specifying the label before the exception name in the RAISE statement.

An exception declared for an outer block can be raised within the handler for an exception declared for an inner block.

An exception name can be omitted only when the RAISE statement is used in the exception handler section, in which case it raises the exception that occurred previously.

Example

Example 1

In the following example, the VALUE_ERROR exception is handled in the exception handler, and the same exception is raised from the exception handler.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
BEGIN
  RAISE VALUE_ERROR;
  EXCEPTION
    WHEN VALUE_ERROR THEN
      PRINTLN('VALUE ERROR CATCHED. BUT RE-RAISE.');
      RAISE;
END;
/
iSQL> EXEC PROC1;
VALUE ERROR CATCHED. BUT RE-RAISE.
[ERR-3116F : Value error
```

```
0004 :   RAISE VALUE_ERROR;
        ^                  ^
]
```

Example 2

In the following example, the exception raised from PROC1 of Example 1 is handled.

```
CREATE OR REPLACE PROCEDURE PROC2
AS
BEGIN
  PROC1;
  EXCEPTION
    WHEN OTHERS THEN
    PRINTLN('EXCEPTION FROM PROC1 CATCHED.');
    PRINTLN('SQLCODE : '||SQLCODE);
END;
/
iSQL> EXEC PROC2;
VALUE ERROR CATCHED. BUT RE-RAISE.
EXCEPTION FROM PROC1 CATCHED.
SQLCODE : 201071
Execute success.
```

RAISE_APPLICATION_ERROR

The use of up to 1001 user-defined error codes, specifically the error codes ranging from 990000 to 991000, is supported.

Syntax

```
RAISE_APPLICATION_ERROR (
  errcode INTEGER,
    errmsg VARCHAR(2047) );
```

Parameter

Name	In/Output	Data Type	Description
errcode	IN	INTEGER	User-defined Error Code (in the range from 990000 to 991000)
errmsg	IN	VARCHAR	User-defined Error Message Text

Description

This procedure is used to raise an exception having a user-defined error code and message.

Example

The following example shows how to raise user-defined errors. Note that in iSQL, error codes are displayed as hexadecimal values.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
BEGIN
    RAISE_APPLICATION_ERROR( 990000,
   'This is my error msg. ' );
END;
/
iSQL> EXEC PROC1;
[ERR-F1B30 : This is my error msg.
at "SYS.PROC1", line 4]
```

User-defined Exceptions

There are two kinds of situations in which the user might want to use the RAISE statement to generate an exception:

- To handle a user-defined exception
- To handle a system-defined exception

User-defined Exception Codes

When handling user-defined exceptions, the error code is always **201232**, which can be verified by checking the value of SQLCODE.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    E1 EXCEPTION;
BEGIN
    RAISE E1;
EXCEPTION
WHEN E1 THEN
    PRINTLN('SQLCODE: ' || SQLCODE);  -- output error code
    PRINTLN('SQLERRM: ' || SQLERRM);  -- output error message
END;
/

iSQL> EXEC PROC1;
SQLCODE: 201232
SQLERRM: User-Defined Exception.
```

```
Execute success.
```

If the exception is not handled as a user-defined exception in the exception handler section, the following error occurs. This message means that there is no user-defined exception handler for the exception.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    E1 EXCEPTION;
BEGIN
    RAISE E1;
END;
/

iSQL> EXEC PROC1;
[ERR-31157 : Unhandled exception : E1]
```

The following error code is always output (in either decimal or hexadecimal form) for user-defined exceptions:

Exception Name	Error Code(integer)	Error Code(hexadecimal)	Error Section
	201232	31210	qpERR_ABORT_QSX_USER_DEFINED_EXCEPTION

System-defined Exception Codes

When a system-defined exception occurs, the corresponding system-defined error code is returned, as shown below:

```
CREATE OR REPLACE PROCEDURE PROC1
AS
BEGIN
    RAISE NO_DATA_FOUND;
EXCEPTION
WHEN NO_DATA_FOUND THEN
    PRINTLN('SQLCODE: ' || SQLCODE);  -- output error code
    PRINTLN('SQLERRM: ' || SQLERRM);  -- output error message
END;
/
iSQL> EXEC PROC1;
SQLCODE: 201066
SQLERRM: No data found.
at "SYS.PROC1", line 4
Execute success.
```

For exceptional instances of the system-defined exception, as in the following, the outputs of predefined error codes can be seen even though additional exception is not handled by the exception handler.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
BEGIN
    RAISE NO_DATA_FOUND;
END;
/

iSQL> EXEC PROC1;
[ERR-3116A : No data found.
at "SYS.PROC1", line 4]
```

For convenience, the most commonly used system-defined exception codes are listed in the following table. For information on the cause of each exception, please refer to "System-Defined Exceptions".

Exception Name	Error Code (integer)	Error Code (hexadecimal)	Error Section
"CURSOR_ALREADY_OPEN"	201062	31166	qpERR_ABORT_QSX_CURSOR_ALREADY_OPEN
"DUP_VAL_ON_INDEX"	201063	31167	qpERR_ABORT_QSX_DUP_VAL_ON_INDEX
"INVALID_CURSOR"	201064	31168	qpERR_ABORT_QSX_INVALID_CURSOR
"NO_DATA_FOUND"	201066	3116A	qpERR_ABORT_QSX_NO_DATA_FOUND
"TOO_MANY_ROWS	201070	3116E	qpERR_ABORT_QSX_TOO_MANY_ROWS
"INVALID_PATH"	201237	31215	qpERR_ABORT_QSX_FILE_INVALID_PATH
"INVALID_MODE"	201235	31213	qpERR_ABORT_QSX_INVALID_FILEOPEN_MODE
"INVALID_FILEHANDLE"	201238	31216	qpERR_ABORT_QSX_FILE_INVALID_FILEHANDLE
"INVALID_OPERATION"	201239	31217	qpERR_ABORT_QSX_FILE_INVALID_OPERATION
"READ_ERROR"	201242	3121A	qpERR_ABORT_QSX_FILE_READ_ERROR
"WRITE_ERROR"	201243	3121B	qpERR_ABORT_QSX_FILE_WRITE_ERROR
"ACCESS_DENIED"	201236	31214	qpERR_ABORT_QSX_DIRECTORY_ACCESS_DENIED
"DELETE_FAILED"	201240	31218	qpERR_ABORT_QSX_FILE_DELETE_FAILED
"RENAME_FAILED"	201241	31219	qpERR_ABORT_QSX_FILE_RENAME_FAILED

For the complete list of all error codes, please refer to the *Error Message Reference.*

SQLCODE and SQLERRM

SQLCODE and SQLERRM are used in an exception handler to obtain the error code and message for an exception that occurs during the execution of a SQL statement so that the exception can be responded to in a suitable manner.

The contents of SQLCODE and SQLERRM are set in the following cases:

- When an error occurs during the execution of a stored procedure
- When a user-defined exception occurs
- When a system-defined exception occurs
- When RAISE_APPLICATION_ERROR is used to raise a user-defined error (code and message)
- When another exception is raised within an exception handler

In all of the above cases, the current contents of SQLCODE and SQLERRM are replaced with the error code and message corresponding to the newly raised exception.

Additionally, after an exception handler is executed without raising another exception, the contents of SQLCODE and SQLERRM are restored to the state before the exception occurred, in the manner of a LIFO (last in, first out) stack.

Therefore, once the contents of SQLCODE and SQLERRM have been set in response to an exception, they will remain unchanged until control is passed to an outer block of the stored procedure, regardless of whether the exception is handled within the block in which it was raised..

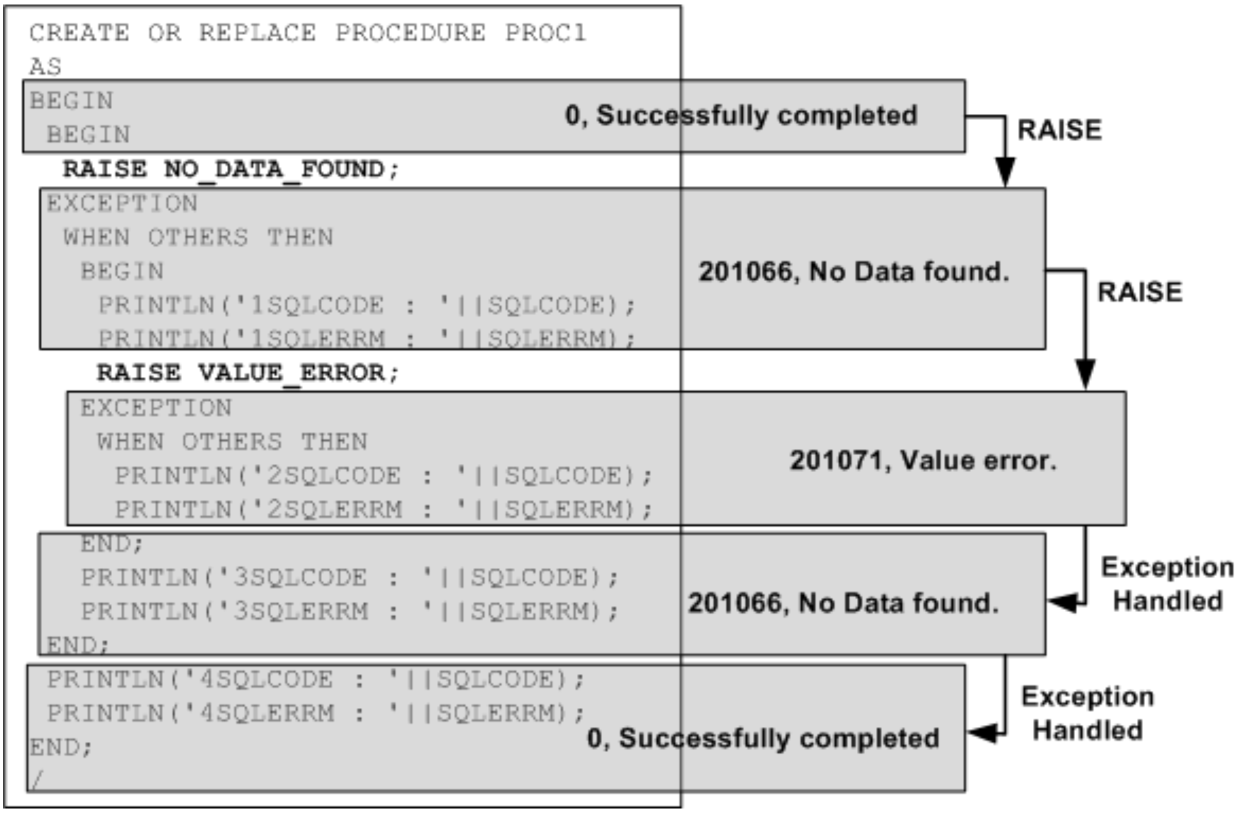
The following is an example:

```
CREATE OR REPLACE PROCEDURE PROC1
AS
BEGIN
  BEGIN
    RAISE NO_DATA_FOUND;
  EXCEPTION
    WHEN OTHERS THEN
      BEGIN
        PRINTLN('1SQLCODE : '||SQLCODE);
        PRINTLN('1SQLERRM : '||SQLERRM);
        RAISE VALUE_ERROR;
      EXCEPTION
        WHEN OTHERS THEN
          PRINTLN('2SQLCODE : '||SQLCODE);
          PRINTLN('2SQLERRM : '||SQLERRM);
      END;
    PRINTLN('3SQLCODE : '||SQLCODE);
    PRINTLN('3SQLERRM : '||SQLERRM);
  END;
  PRINTLN('4SQLCODE : '||SQLCODE);
 PRINTLN('4SQLERRM : '||SQLERRM);
END;
/
```

The output of the above example is as follows:

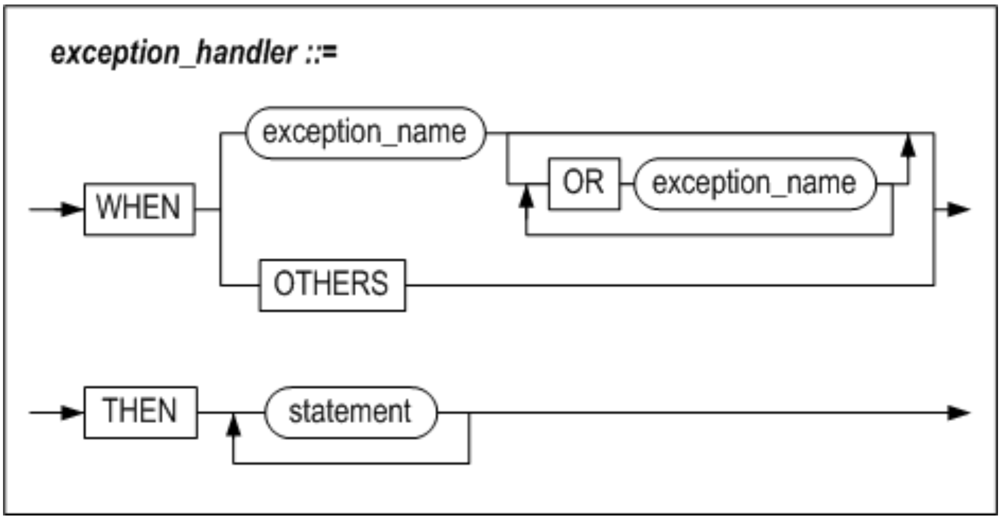
```
iSQL> EXEC PROC1;
1SQLCODE : 201066
1SQLERRM : No data found.
at "SYS.PROC1", line 5
2SQLCODE : 201071
2SQLERRM : Value error
at "SYS.PROC1", line 11
3SQLCODE : 201066
3SQLERRM : No data found.
at "SYS.PROC1", line 5
4SQLCODE : 0
4SQLERRM : Successfully completed
Execute success.
```

The scope of SQLCODE and SQLERRM in the above example is illustrated in the following figure:



Exception Handler

Syntax



Purpose

Exception handlers are used to specify the actions to take in response to exceptions.

When an exception occurs, Altibase looks for an exception handler to which to pass control. The rules that are followed when looking for an exception handler are as follows:

- Starting with the current block and progressing successively outwards to blocks that contain the current block, Altibase looks for a handler for the exception. During this process, if an OTHERS exception handler is found in any block, that OTHERS handler will be used to handle the exception.

- If no exception handler is found even in the outermost block, an “Unhandled Exception” error is raised, and execution of the stored procedure or function stops immediately.

SQLCODE and SQLERRM can be used in an exception handler to check which kind of error occurred and return the related error message. In other words, SQLCODE returns the Altibase error number and SQLERRM returns the corresponding error message.

SQLCODE and SQLERRM cannot be directly used in SQL statements. Instead, assign their values to local variables and use these variables within SQL statements.

exception name

This is used to specify the name of the system-defined or user-defined exception to handle.

Multiple exceptions to be handled in the same way can be combined using "Or" and processed using the same routine.

others

If an exception that is not handled by any other exception handlers is raised, it will ultimately be handled by the OTHERS routine if present.

Example

Example 1

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE TABLE t2(i1 INTEGER, i2 INTEGER, i3 INTEGER);
INSERT INTO t1 VALUES(1,1,1);
INSERT INTO t1 VALUES(2,2,2);

CREATE OR REPLACE PROCEDURE proc1
AS
BEGIN
  DECLARE
    CURSOR c1 IS SELECT * FROM t1;
      v1 INTEGER;
      v2 INTEGER;
      v3 INTEGER;
  BEGIN
    -- OPEN c1;

    FETCH c1 INTO v1, v2, v3;
    INSERT INTO t2 VALUES (v1, v2, v3);

    CLOSE c1;

  EXCEPTION
    WHEN INVALID_CURSOR THEN
    INSERT INTO t2 VALUES (-999, -999, -999);
```

```
  END;

END;
/

iSQL> EXEC proc1;
Execute success.

iSQL> SELECT * FROM t2;
T2.I1       T2.I2       T2.I3
----------------------------------------
-999        -999        -999
1 row selected.
```

Example 2

```
CREATE TABLE t1(i1 INTEGER, i2 INTEGER, i3 INTEGER);

CREATE OR REPLACE PROCEDURE proc1(p1 IN INTEGER)
AS
  v1 INTEGER;
  err1 EXCEPTION;
BEGIN
  IF p1 < 0 THEN
    RAISE err1;
  END IF;

  SELECT i1 INTO v1 FROM t1;

EXCEPTION
  WHEN NO_DATA_FOUND OR TOO_MANY_ROWS THEN
    INSERT INTO t1 VALUES(1,1,1);
  WHEN OTHERS THEN
    INSERT INTO t1 VALUES(0,0,0);

END;
/

iSQL> EXEC proc1(1);
Execute success.
iSQL> SELECT * FROM t1;
T1.I1       T1.I2       T1.I3
----------------------------------------
1           1           1
1 row selected.
iSQL> EXEC proc1(-8);
Execute success.
```

```
iSQL> SELECT * FROM t1;
T1.I1        T1.I2        T1.I3
---------------------------------------
1            1            1
0            0            0
2 rows selected.
```

Example 3

```
CREATE TABLE t1(i1 INTEGER NOT NULL);

CREATE OR REPLACE PROCEDURE proc1
AS
  code INTEGER;
  errm VARCHAR(200);
BEGIN
  INSERT INTO t1 VALUES(NULL);
EXCEPTION
WHEN OTHERS THEN

-- 변수 code에 SQLCODE 에러코드 값 대입
 code := SQLCODE;

-- 변수 errm에 SQLERRM 에러 메시지 저장

errm := SUBSTRING(SQLERRM, 1, 200);
  system_.println('SQLCODE : ' || code);
  system_.println('SQLERRM : ' || errm);
END;
/

iSQL> EXEC proc1;
SQLCODE : 200820
SQLERRM : Unable to insert (or update) NULL into NOT NULL column.
at "SYS.PROC1", line 6
Execute success.
```

10. Pragma

Overview

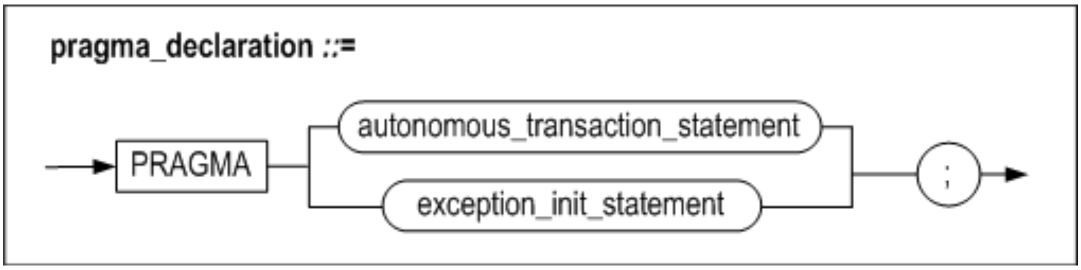
Compile operation can be varied depending on the types of pragma in case of using pragma. The pragma can be used within stored procedures, stored functions, and stored packages.

Types of Pragma

The following pragmas can be used in Altibase. Thorough information on each pragma will be delineated in the next section.

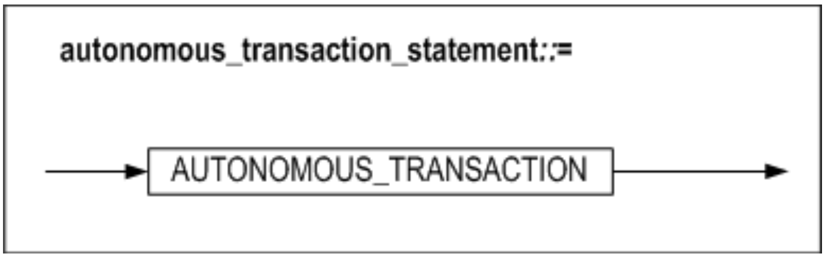
- Autonomous Transaction Pragma(Autonomous_Transaction Pragma)
- Exception(Exception_Init Pragma)

Syntax



Autonomous Transaction Pragma

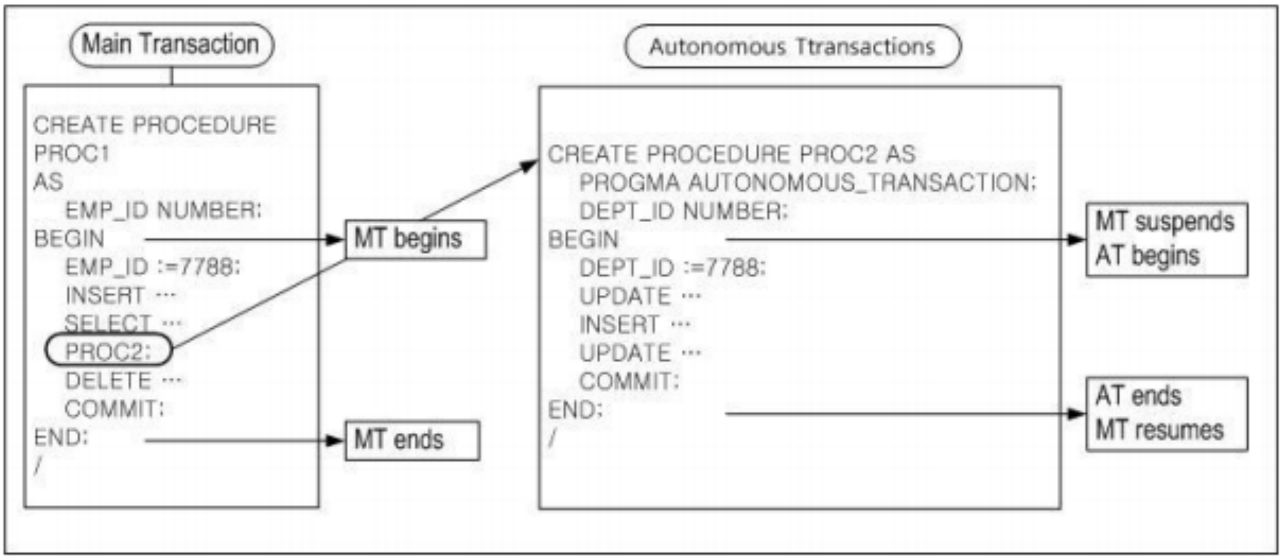
Syntax



Function

Autonomous transaction pragma is used to modify PSM object operation carried out within a transaction. The autonomous transaction pragma is configured when compiling PSM object creation.

The PSM object specified with the autonomous transaction pragma independently operates, and it does not share transaction sources with the main transaction. In particular, the autonomous transaction pragma is highly efficient for writing a program which is module-centric or contains high reusability.



The location in which the autonomous transaction pragma should be defined is as follows:

- The top stored procedures
- The top stored functions
- The top stored package subprograms
- psm_body of triggers

The differences between Autonomous and nested transactions is as follows:

	Autonomous Transaction	**Nested Transaction**
Exception Handling	Transaction unit exception handling-(transaction-level recovery when an error occurs in an autonomous transaction)	Exception handling per statement
Transaction Dependecy	Independent transacaction	Relevant transaction and dependency
sVisibility	Checking the session status from another session when terminating an autonomous transaction.	Unable to check the session status if commit execution was performed after terminating a nested transaction.
Availability whether the source is shared or not.	Source is not shared with other transactions. (lock, savepoint , rollback , commit independently operates)	Source is shared with relevant transactions (lock, savepoint , rollback , commit dependently operates)

Note

Since autonomous transactions do not share lock, source use, commit dependency with the main transaction, even if the main transaction is rolled back, the contents of the autonomous transaction are not rolled back.

A deadlock might be encountered when accessing an object referenced in the main transaction since the autonomous transaction separately operates from the main transaction.

Example

Declaring pragma autonomous_transaction in Stored Procedures

```
iSQL> create table t1(c1 integer);
Create success.
iSQL> create or replace procedure proc1 as
pragma autonomous_transaction;
begin
insert into t1 values ( 1 );
commit;
end;
/
Create success.
```

Declaring pragma autonomous_transaction in Stored Functions

```
iSQL> create table t1(c1 integer);
Create success.
iSQL> create or replace function sub2 return integer as
pragma autonomous_transaction;
begin
insert into t1 values ( 100 );
commit;
return 100;
end;
/
Create success
```

Declaring pragma autonomous_transaction in Package Subprograms

```
iSQL> create table t1(c1 integer);
Create success.
iSQL> create or replace package pkg1 as
procedure sub1;
function sub2 return integer;
end;
```

```
/
Create success.
iSQL> create or replace package body pkg1 as
procedure sub1 as
pragma autonomous_transaction;
begin
insert into t1 values ( 1 );
commit;
end;
function sub2 return integer as
pragma autonomous_transaction;
begin
insert into t1 values ( 100 );
commit;
return 100;
end;
end;
/
Create success.
```

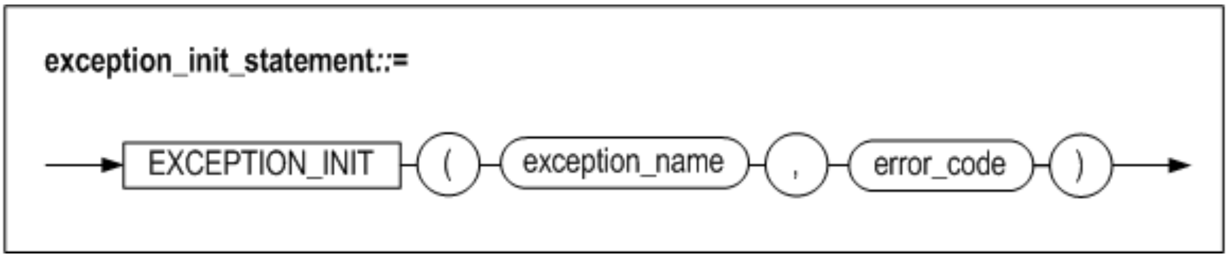
Declaring pragma autonomous_transaction in Triggers.

```
iSQL>create table t1( c1 integer );
Create success.
iSQL>create table t2( c1 integer );
Create success.
iSQL>insert into t1 values(1);
1 row inserted.
iSQL>create or replace trigger tri1
after insert on t1
for each row
pragma autonomous_transaction;
var1 integer;
var2 integer;
begin
var1 := 1;
select c1 into var2 from t1 where c1 = var1;
insert into t2 values( var2 + var1 );
commit;
end;
/
Create success.
iSQL>insert into t1 values ( 2 );
1 row inserted.
iSQL> select * from t1;
C1
--------------
```

```
1
2
2 rows selected.
iSQL> select * from t2;
C1
--------------
2
1 row selected.
```

Exception Initialization Pragma

Syntax



Function

Excepton initialization pragma enables the user to initialize exception variables with Altibase error codes.

The user can use the excepton variables initialized by Altibase error codes in place of other handler in the exception handling.

The location in which exception initialzation pragram can be defined is as follows:

- The declarative part of stored procedures
- The declarative part of stored functions
- The declarative part of stored package
- The declarative part of stored package subprograms

exception_name

excepton_name is used to specify the exception variable to initialize. The exception variable should be declared within the identitcal block as pragma.

error_code

error_code is used to specify Altibae error code when an error occurrs which was not set in exception_name. Refer to the *Error Message Reference* for in-depth infomration on Altibae error code.

Example

Specific Error Occurrence

Initialize stored procedure error messages occurring with the error number 201070 as "Too many rows".

```
iSQL> create table t1(c1 integer);
Create success.
iSQL> insert into t1 values ( 1 );
1 row inserted.
iSQL> insert into t1 values ( 2 );
1 row inserted.
iSQL> select * from t1;
C1
--------------
1
2
2 rows selected.
iSQL> create or replace procedure proc1 as
v1 integer;
e1 exception;
pragma exception_init(e1, 201070 );
begin
select c1 into v1 from t1;
exception
when e1 then
println(SQLERRM);
println('catch exception');
end;
/
Create success.
iSQL> exec proc1;
Too many rows
at "SYS.PROC1", line 6
catch exception
Execute success.
```

The stored procedure modified exception handlers to others in above example.

```
iSQL> create table t1(c1 integer);
Create success.
iSQL> insert into t1 values ( 1 );
1 row inserted.
iSQL> insert into t1 values ( 2 );
1 row inserted.
iSQL> select * from t1;
C1
--------------
1
```

```
2
2 rows selected.
iSQL> create or replace procedure proc1 as
    v1 integer;
    e1 exception;
    begin
    select c1 into v1 from t1;
    exception
    when others then
    println(SQLERRM);
    println('catch exception');
    end;
    /
Create success.
iSQL> exec proc1;
Too many rows
at "SYS.PROC1", line 5
catch exception
Execute success.
```

In case of occuring a different error other than initialized exception in the exception variable e1:

The initialized exception is "Too many rows", and the error actually occurred was "No data found".

```
iSQL> create or replace procedure proc2 as
v1 integer;
e1 exception;
pragma exception_init(e1, 201070 );
begin
select c1 into v1 from t1 where c1 = 3;
end;
/
Create success.
iSQL> exec proc2;
[ERR-3116A : No data found.
at "SYS.PROC2", line 6]
```

11. Stored Packages

This chapter describes how to create and use stored packages.

Overview

A package is a grouped object of user-defined types, variables, constants, subprograms(procedures or functions), cursors and exceptions used for stored procedures. The package is composed of a package specification and a package body. Every package has a specification which defines user-defined types, or declares variables, constants, subprograms(procedures or functions), cursors, and exceptions. Objects declared in this manner can be referenced from outside the package. Moreover, the subprograms of packages can be utilized with overloading. Hence, the package specification is equivalent to the Application Programming Interface (API).

If cursors or subprograms are declared in the package specification, a package body must be created for the given package. The package body must define queries for cursors and code for subprograms. The package body can also declare and define objects; however, objects declared in this manner cannot be referenced from outside the package.

The package body can have an initialization part and an exception-handling part. The initialization part runs only once per session, when the package is executed for the first time. The user cannot directly access the package body, and its alteration does not affect the package specification. The package body is the part which is actually processed when a package object is referenced, and the package specification is the part which hides this from the outside. The package is loaded into memory on its first run per session, and is maintained until the given session is terminated.

Features

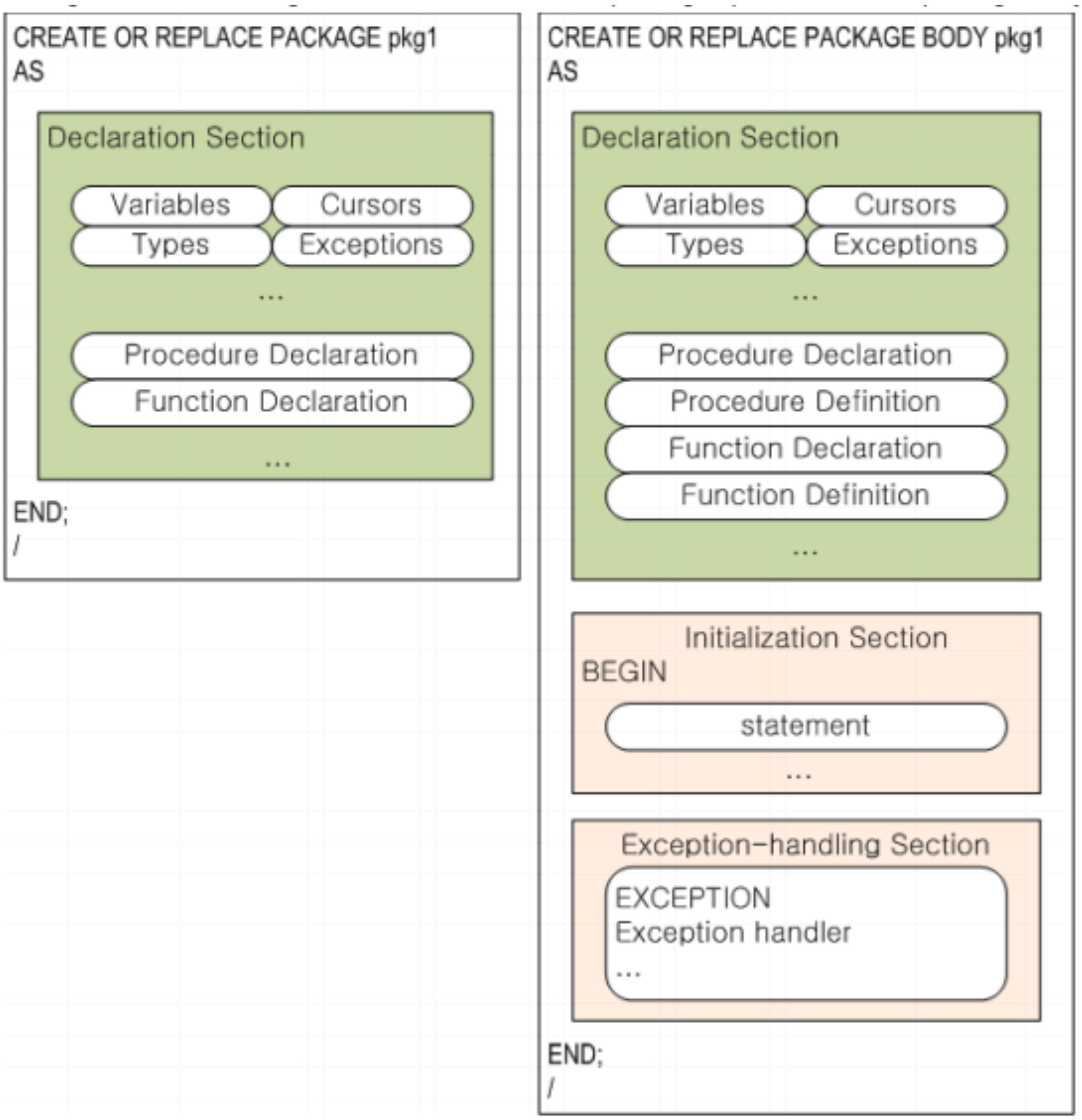
- Modularity
  Stored packages enable the user to modularize objects associated with a given operation, such as types, variables, constants, cursors, exceptions and subprograms.
- Easy applicaiton program writing
  The writing and maintenance of application programs are made easy with modularization.
- Information security
  Since the package body is only accessible via the package specification, implementation details can be hidden. Therefore, information can be secured by blocking access to the package body from the outside.
- Performance enhancement
  Since the package is loaded into the session on its first run, processing speed is fast for repeated calls made in the same session.

Structure

A package is composed of a package specification and a package body. Types, variables, constants, cursors, exceptions, subprograms, etc. can be declared in the declaration section of the package specification and package body; objects declared in the package specification can be further defined in the body.

The initialization part of the package body is an optional feature, and runs only once per session, when the package is executed for the first time. The initialization part is mainly used to set the values of variables declared or referenced inside a package. The package body can also write an exception-handling part.

The figure below is a diagram of the structure of the package specification and package body.



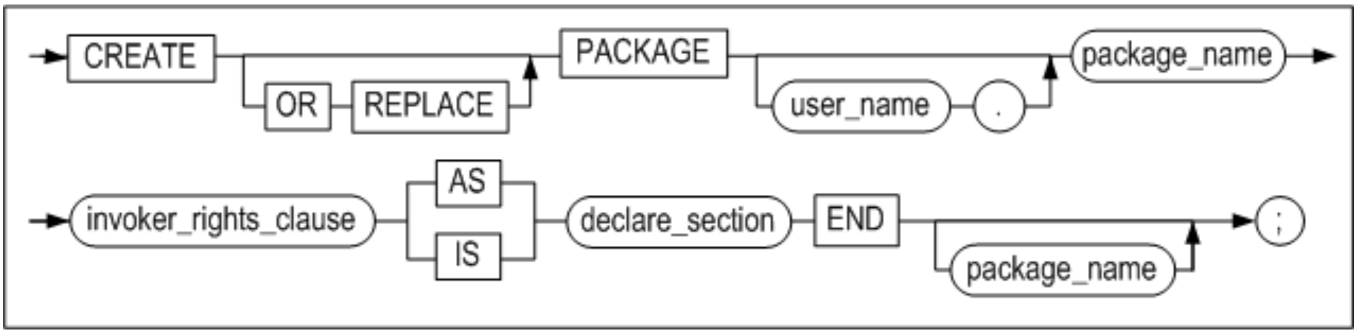
Restriction

- Cursors defined inside a package stay open while subprograms are being executed; cursors are implicitly closed when subprograms have completed execution.

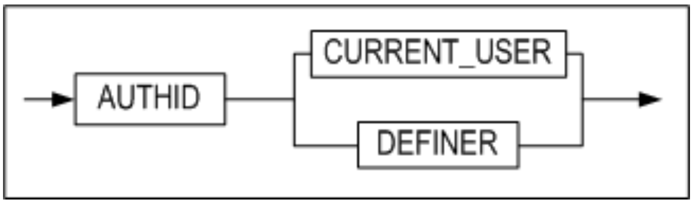
CREATE PACKAGE

Syntax

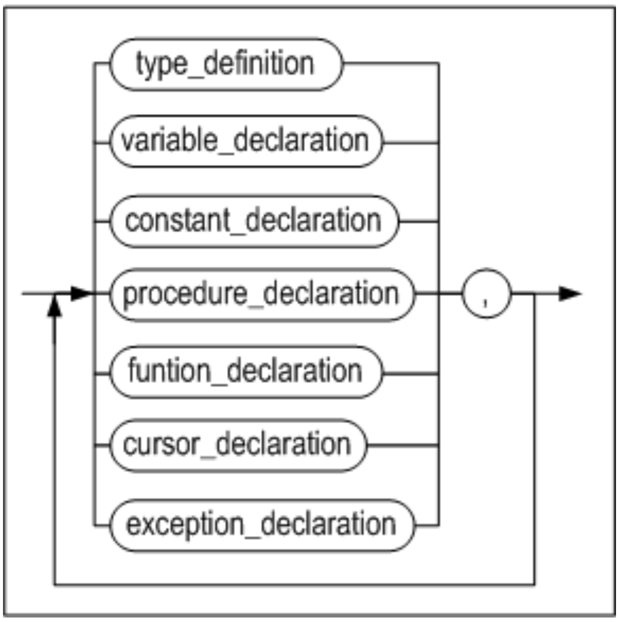
create_package ::=



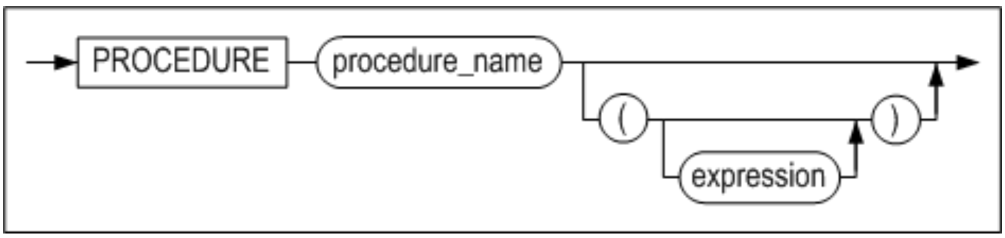
invoker_rights_clause::=



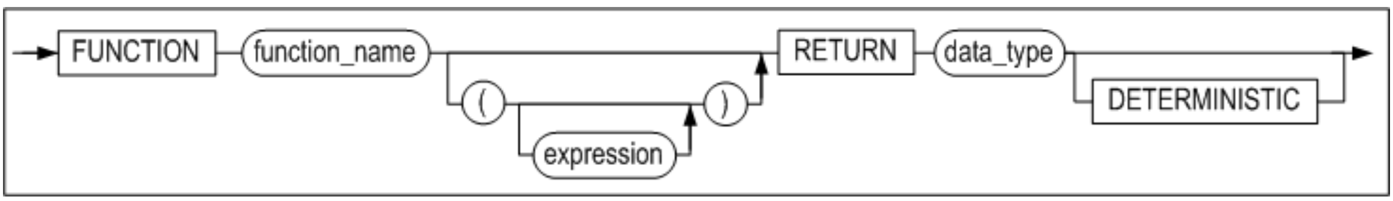
declare_section ::=



procedure_declaration ::=



function_declaration ::=



Purpose

This statement creates a package specification or substitutes a previously existing package specification.

invoker_rights_clause

When executing a package, it can be specified whether to execute with the DEFINER or the CURRENT_USER privileges. If this clause is omitted, the package is run with constructor privileges

- AUTHID CURRENT_USER
  This executes a package by referencing an object owned by the package user.
- AUTHID DEFINER
  This executes with creator privilege by referring to the object of package creator (DEFINER).

declare_section

Defines user-defined types or declares variables, constants, subprograms (procedures or functions), cursors and exceptions. For further information on the syntax of type_definition, refer to the "Defining a User-Defined Type" section of Chapter 6, and for further information on the syntax of the declare clause for variables, constants, cursors and exceptions, refer to the "Declaring Local Variables" section of Chapter 3.

Example

Example 1

This example creates a package specification which contains user-defined types, variables, procedures and functions.

```
CREATE OR REPLACE PACKAGE pkg1 AS
TYPE rec1 IS RECORD(c1 INTEGER, c2 INTEGER);
v1 rec1;
v2 INTEGER;
PROCEDURE proc1;
FUNCTION func1 RETURN INTEGER;
END;
/
```

Example 2 (AUTHID CURRENT_USER)

Create object: user1

```
iSQL> connect user1/user1;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 1 );
1 row inserted.
```

```
iSQL> create or replace package pkg1 authid current_user as
     var1 integer;
     procedure sub1;
     end;
     /
Create success.

iSQL> create or replace package body pkg1 as
     procedure sub1 as
     begin
     select c1 into var1 from t1;
     println( var1 );
     end;
     end;
     /
Create success.

iSQL> select package_name , package_type , authid
      from system_.sys_packages_
      where package_name = 'PKG1';
PACKAGE_NAME
----------------------------
PACKAGE_TYPE AUTHID
----------------------------
PKG1

6           1
PKG1

7           1
2 rows selected.
```

Create object : user2

```
iSQL> connect user2/user2;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 100 );
1 row inserted.
```

Execute package: user1**

```
iSQL> exec pkg1.sub1;
1
Execute success.
```

Execute package: user2

```
iSQL> exec user1.pkg1.sub1;
100
Execute success.
```

Example 3 (AUTHID DEFINER)

create object: user1

```
iSQL> connect user1/user1;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 1 );
1 row inserted.


iSQL> create or replace package pkg1 authid definer as
     var1 integer;
     procedure sub1;
     end;
     /
Create success.

iSQL> create or replace package body pkg1 as

     procedure sub1 as
     begin
     select c1 into var1 from t1;
     println( var1 );
     end;

     end;
     /
Create success.
```

```
iSQL> select package_name , package_type , authid
    2 from system_.sys_packages_
    3 where package_name = 'PKG1';
PACKAGE_NAME

-----------------------------------------------------------------------------------------
----------------------------------------------
PACKAGE_TYPE AUTHID
----------------------------
PKG1

6            0
PKG1

7            0
2 rows selected.
```

Create object: user2

```
iSQL> connect user2/user2;
Connect success.

iSQL> create table t1( c1 integer );
Create success.

iSQL> insert into t1 values ( 100 );
1 row inserted.
```

Execute package: user1

```
iSQL> exec pkg1.sub1;
1
Execute success.
```

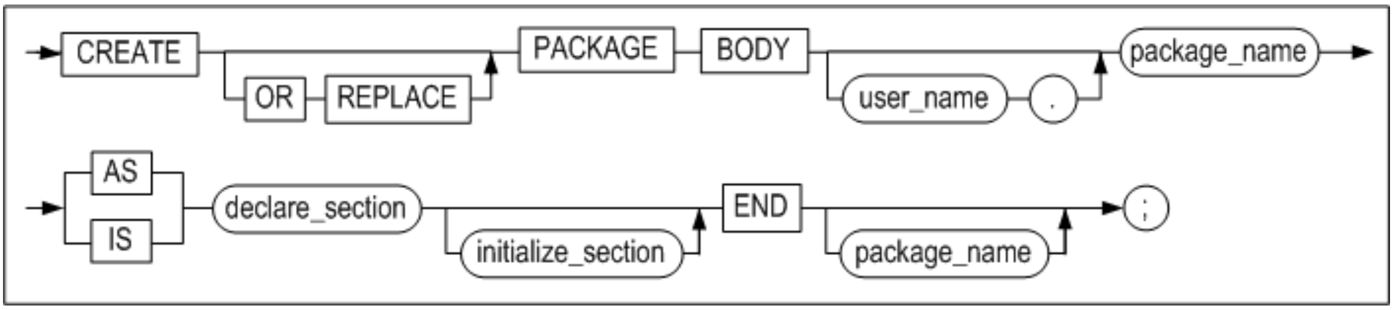
Execute package: user2

```
iSQL> exec user1.pkg1.sub1;
1
Execute success.
```

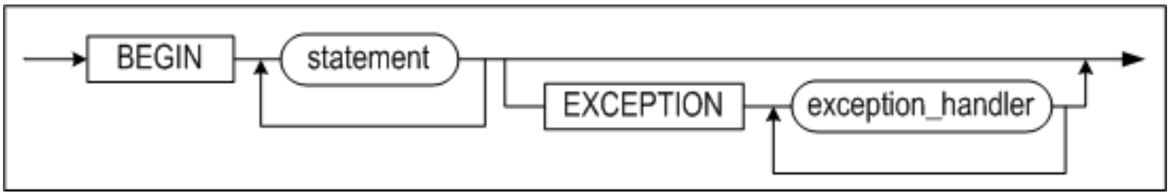
CREATE PACKAGE BODY

Syntax

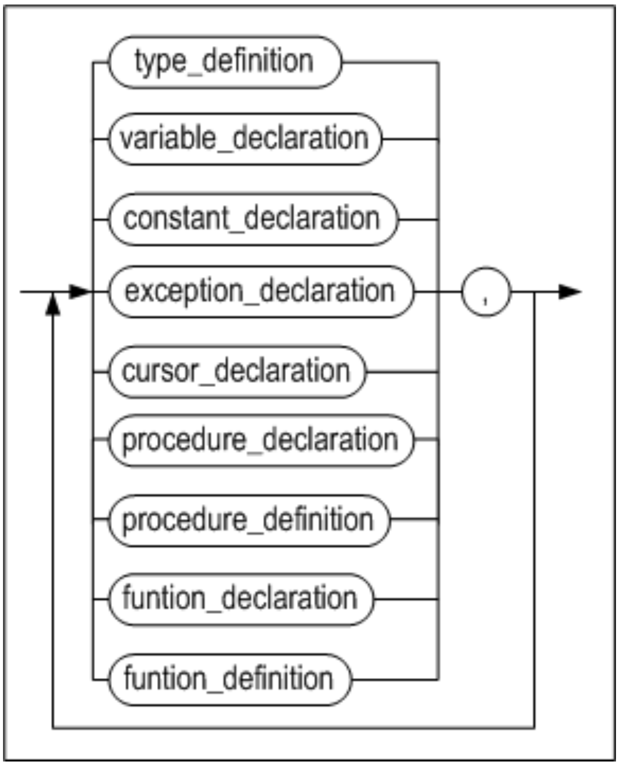
create_package_body ::=



initialize_section::=



declare_section ::=



Purpose

This statement creates the package body or substitutes a previously existing package body.

declare_section

Defines all cursors and subprograms declared in the package specification. Each subprogram declaration of the package specification must be identical to the corresponding definition of the package body.

Declares an object which can be referenced only within the package; it can also define such an object.

For more detailed information on the syntax of *type_definition*, refer to the "Defining a User-Defined Type" section of Chapter 6, and for further information on the syntax of the declare clause for variables, constants, cursors and exceptions, refer to the "Declaring Local Variables" section of Chapter 3. For further information on the syntax of procedure and function definitions, refer to the "CREATE PROCEDURE" and "CREATE FUNCTION" section of Chapter 2.

initialize_section

This writes the package initialization and exception-handling parts of the package. *initialize_section* is executed at the initial invocation of the package during a session; if the package is repeatedly called on the same session, this section is not executed.

Example

<Example 1> This example shows an error being raised, due to the package body being created without the package specification.

```
iSQL> select * from system_.sys_packages_ where package_name = 'PKG2';
No rows selected.

iSQL> create or replace package body pkg2 as
      v1 integer;
      procedure proc1 as
      begin
      v1 := 1;
      end;
      end;
      /
[ERR-313BE : Package specification not found. ]
```

<Example 2> This example successfully creates the package specification and the package body.

```
CREATE OR REPLACE PACKAGE pkg1 AS
TYPE rec1 IS RECORD(c1 INTEGER, c2 INTEGER);
v1 rec1;
v2 INTEGER;
PROCEDURE proc1;
FUNCTION func1 RETURN INTEGER;
END;
/

iSQL> create or replace package body pkg1 as
type rec2 is record(c3 integer, c4 integer);
```

```
v3 rec1;
v4 rec2;
v5 integer;
procedure proc1 as
  begin
  v5 := 1;
  v2 := 2;
end;
function func1 return integer as
  begin
  return v2;
end;
end;
/
Create success.
```

<Example 3> This example creates the package body with the initialize_section and executes it. This example shows the initialize_section being executed on the initial call only.

```
create or replace package pkg1 as
v1 integer;
procedure proc1;
end;
/
create or replace package body pkg1 as
v2 integer;
procedure proc1 as
v3 integer;
begin
  v3 := v1 + v2;
  println(v3);
  println('statement 1');
end;
begin
  v1 := 100;
  v2 := 31;
  println('statement 2');
end;
/

iSQL> exec pkg1.proc1;
statement 2
131
statement 1
Execute success.
iSQL> exec pkg1.proc1;
131
statement 1
Execute success.
```

<Example 4> This is the usage of package overloading with the same name of package subprorams but different data types.

```
iSQL> create or replace package pkg1 as
function func return varchar(10);
function func(p1 in varchar ) return varchar(10);
function func(p1 in number ) return varchar(10);
function func(p1 in date ) return varchar(10);
end;
/
Create success.

iSQL> create or replace package body pkg1 as
function func return varchar(10) is
begin
return 'none';
end;
function func(p1 in varchar ) return varchar(10) is
begin
return 'varchar';
end;
function func(p1 in number ) return varchar(10) is
begin
return 'number';
end;
function func(p1 in date ) return varchar(10) is

begin
return 'date';
end;
end;
/
Create success.
```

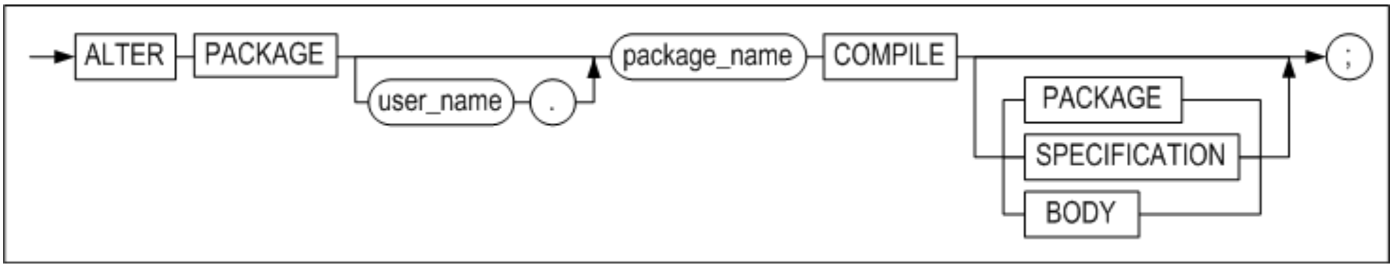
Note

- The package specification must be created at first in order to create the package body.
- Not a single procedure or function specified in the package specification should be omitted at all and it must be included in the package body.
- Data types can be matched by using functions, such as CAST and TO_DATE in order to prevent unwanted execution of subprogram with overloading of subprogram package.

ALTER PACKAGE

Syntax

alter_package ::=



Purpose

This statement explicitly recompiles the package specification, the package body or the package. When the package is recompiled, variables, cursors, user-defined types and subprograms that compose the package are also recompiled.

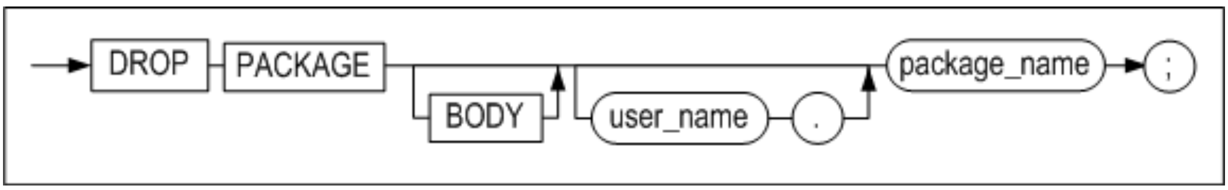
Examples

```
iSQL> alter package pkg1 compile;
Alter success.

iSQL> alter package pkg1 compile specification;
Alter success.

iSQL> alter package pkg1 compile body;
Alter success.

iSQL> alter package pkg1 compile package;
Alter success.
```

DROP PACKAGE

Syntax

drop_package ::=



Purpose

This statement drops the package. This statement can selectively drop only the package body or the whole package.

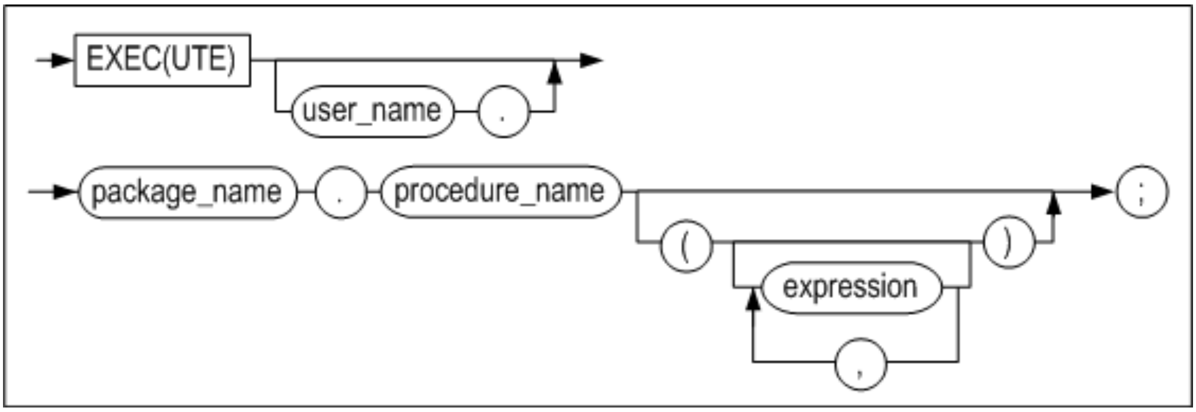
Examples

```
iSQL> drop package body pkg1;
Drop success.

iSQL> drop package pkg1;
Drop success.
```

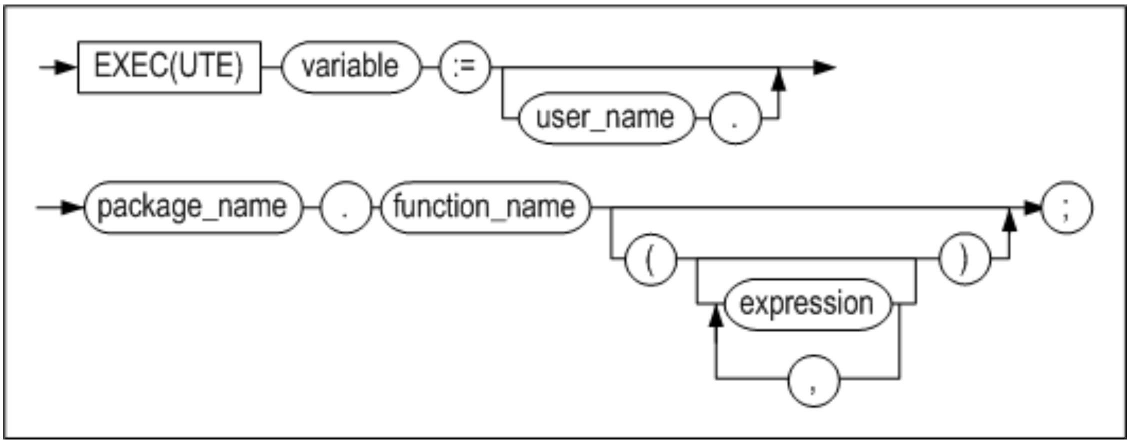
EXECUTE

Syntax

execute_procedure_statement ::=



execute_function_statement ::=



Purpose

This statement executes procedures or functions inside the package

Examples

```
create or replace package pkg1 as
v1 integer;
procedure proc1;
function func1 return integer;
end;
/

create or replace package body pkg1 as
procedure proc1 as
begin
println(v1);
end;

function func1 return integer as
begin
return 1;
end;
end;
/

iSQL> exec pkg1.v1 := pkg1.func1;
Execute success.

iSQL> exec pkg1.proc1;
1
Execute success.
```

12. Altibase Stored Procedures and Built-in Functions

Altibase provides a variety of built-in stored procedures and functions, including file control functions. This chapter introduces these stored procedures and functions and describes how to use them.

This chapter contains the following topics:

- File Control
- TCP Connection Control
- DBMS Stats

File Control

The file control functionality of stored procedures enables users to read from and write to text files in the file system. This functionality allows users to perform a wide variety of tasks, including maintaining their own logs, recording the results of tasks, and inserting data read from text files into database tables.

This functionality is described in detail in this section.

Managing Directories

In order for stored procedures to be able to create and manage text files, it is first necessary to use DML to create a directory object that corresponds to the actual directory in which the files are to be saved.

Creating a Directory Object

The CREATE DIRECTORY statement is used to create a database object corresponding to each directory in which it is desired to store and maintain files.

When the CREATE DIRECTORY statement is executed, information about the directory is recorded in the SYS_DIRECTORIES_ meta table. However, this statement does not actually create the physical directory in the file system. Therefore, the user must first manually perform the additional tasks of creating the physical directory and granting suitable permissions for the directory.

In the CREATE DIRECTORY statement, the user must specify the name and the absolute path of the directory to be accessed by the database.

Consider the following example. First, a physical directory named alti_dir1 is created in the /home/altibase/altibase_home/psm_msg directory.

```
$ mkdir /home/altibase/altibase_home/psm_msg/alti_dir1
```

Then, a corresponding directory object is created within the database to make it possible to manipulate the files in the alti_dir1 directory.

```
iSQL> create directory alti_dir1 as '/home/altibase/altibase_home/psm_msg';
Create success.
```

Changing a Directory Object

It is possible to use the CREATE OR REPLACE DIRECTORY statement to change the absolute path to which an existing directory object refers:

```
iSQL> create or replace directory alti_dir1 as
'/home/altibase/altibase_home/psm_result';
Create success.
```

The effect of the above statement will vary depending on whether the alti_dir1 directory object already exists in the database. If a directory object having that name already exists, the path to which it refers will be changed to the one specified. If the alti_dir1 directory object does not exist in the database, it will be created.

Dropping a Directory Object

Directory objects can be removed from the database using the DROP DIRECTORY statement.

Note that the DROP DIRECTORY statement merely removes the directory object from the database. It does not actually delete the physical directory from the file system.

Therefore, the user must manually delete unnecessary directories and files from the file system using operating system commands.

The following example shows the use of the DROP DIRECTORY statement to remove a directory object from the database.

```
iSQL> DROP DIRECTORY alti_dir1;
Drop success.
```

File Control

FILE_TYPE

To enable stored procedures to control files, Altibase support a data type called “FILE_TYPE”.

FILE_TYPE contains file identifiers and other information; however, this information is not directly accessible by users.

Local variables having the FILE_TYPE data type can be used within stored procedures as parameters for file control-related system stored procedures and stored functions.

The following is an example of the declaration of a FILE_TYPE variable:

```
CREATE OR REPLACE PROCEDURE WRITE_T1
AS
  V1  FILE_TYPE;
  ID  INTEGER;
  NAME  VARCHAR(40);
BEGIN
……
END;
/
```

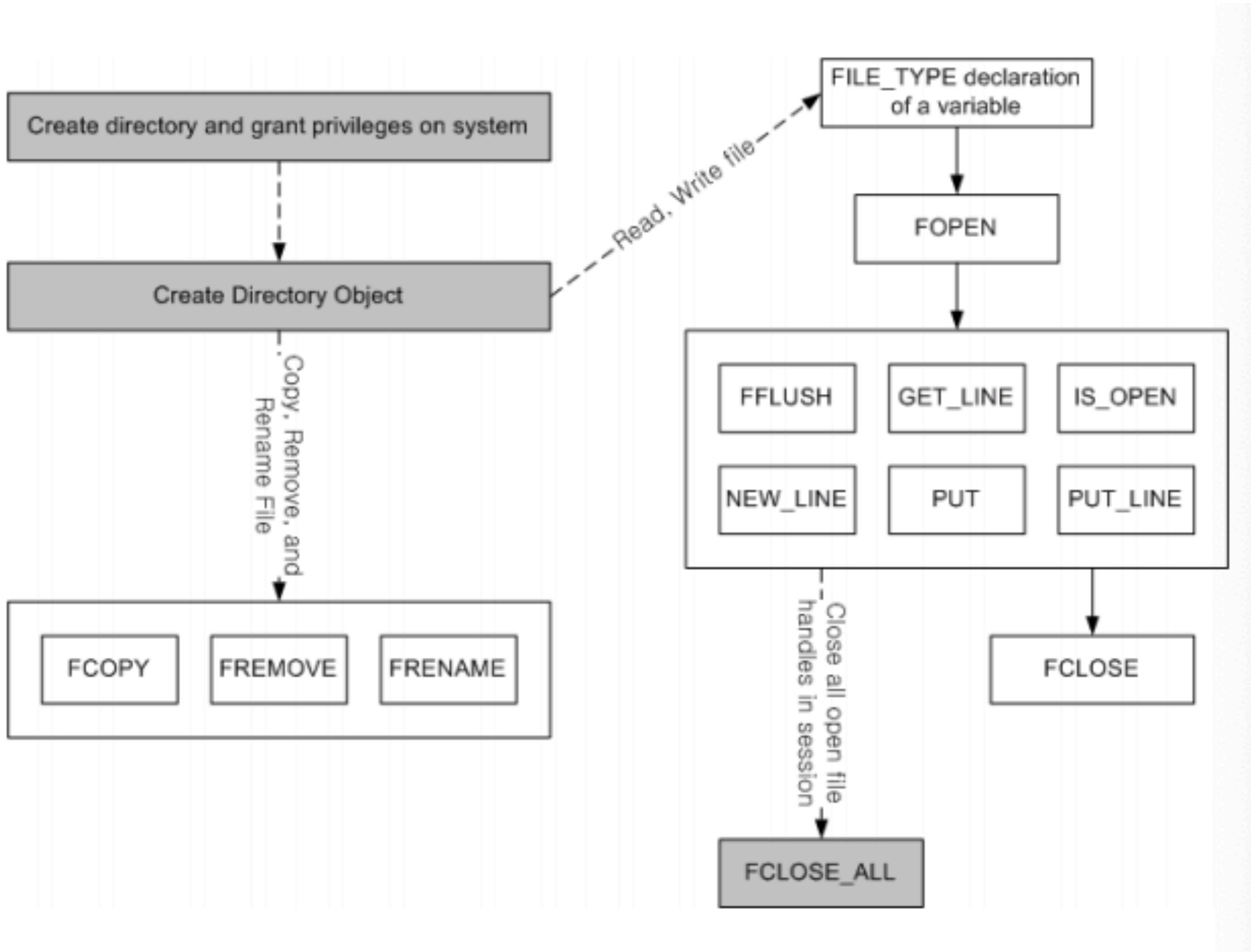
System-Provided Stored Procedures and Stored Functions for Handling Files

Altibase provides the following 12 system stored procedures and stored functions for managing files:

Name	Description
FCLOSE	Closes an open file
FCLOSE_ALL	Closes all files that were opened in the current session
FCOPY	Copies a file
FFLUSH	Physically writes data to a file
FOPEN	Opens a file for reading or writing
FREMOVE	Removes a file
FRENAME	Renames a file
GET_LINE	Reads one line from a file
IS_OPEN	Checks whether a file is open
NEW_LINE	Outputs an OS-specific carriage return character or sequence
PUT	Writes a string of text to a file
PUT_LINE	Writes a line of text, followed by a carriage return character or sequence, to a file (=PUT+NEW_LINE)

The system stored procedures and functions listed above are automatically created in the system when the CREATE DATABASE statement is executed. Additionally, PUBLIC synonyms are defined for these procedures and functions so that any user can use them to handle files within stored procedures.

The process of managing files using system procedures and functions is illustrated in the following figure:



Limitations

The following may cause errors during the execution of file control-related system stored procedures and stored functions:

Directory Name

When using a file control function, the directory parameter must be specified in upper-case letters, and must be the name of a directory object that was created using the CREATE DIRECTORY statement.

For example,

```
CREATE DIRECTORY alti_dir AS '…';
```

After creating a directory object as shown above, use a statement like the following in the stored procedure:

```
file = FOPEN( 'ALTI_DIR', 'a.txt', 'r' );
```

Even if the name of the directory object was specified in lower-case letters, the names of all objects are stored in upper-case letters in the database. Therefore when specifying the name of a directory object as a parameter for a system procedure or function, it is necessary to use upper-case letters.

The length of one line of text

The maximum length of one line of text within a file cannot exceed 32767 bytes. An error will occur if this maximum length is exceeded.

File data types

Users cannot read or arbitrarily change the value of a FILE_TYPE variable. FILE_TYPE variables can be used only as parameters for system stored procedures and stored functions.

File Control-Related System Stored Procedures and Stored Functions

The system stored procedures and stored functions provided to manage files may generate exceptions other than system exceptions.

For example, when there is not enough disk space, or when there are not enough file handles, system stored procedures and functions will raise unforeseeable errors such as INVALID_OPERATION.

If an invalid parameter is passed to a file control-related system stored procedure or stored function, a VALUE_ERROR exception will occur.

FCLOSE

This stored procedure closes and reinitializes a file handle

Syntax

```
FCLOSE ( file IN OUT FILE_TYPE );
```

Parameters

Name	Input/Output	Data Type	Description
file	IN OUT	FILE_TYPE	File handle

Return Value

Because it is a stored procedure, there is no return value.

Exception

This stored procedure never raises an error, even when it is executed on a file handle that is already closed.

Example

After executing FOPEN and performing actions on files, FCLOSE is called to close the file handle, as shown below:

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 FILE_TYPE;
    V2 VARCHAR(1024);
BEGIN
    V1 := FOPEN( 'ALTI_DIR', 'schema.sql', 'r' );
    GET_LINE( V1, V2, 100 );
    PRINTLN(V2);
    FCLOSE(V1);
END;
/
```

FCLOSE_ALL

This stored procedure closes all of the file handles that were opened in the current session. It is commonly used within exception handlers to ensure that files are closed properly even when exceptions are raised within stored procedures.

Syntax

```
FCLOSE_ALL;
```

Parameter

This is stored procedure have no parameter.

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

The following example shows the use of FCLOSE_ALL to close all opened file handles when handling an exception.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 FILE_TYPE;
    V2 VARCHAR(1024);
BEGIN
    V1 := FOPEN( 'ALTI_DIR', 'schema.sql', 'r' );
    GET_LINE( V1, V2, 100 );
    PRINTLN(V2);
```

```
FCLOSE(V1);
EXCEPTION
    WHEN READ_ERROR THEN
         PRINTLN('READ ERROR!!!');
         FCLOSE_ALL;
END;
/
```

FCOPY

This stored procedure is used to copy individual lines of text from one file to another. If the destination file does not exist in the specified destination directory, it is created, and the specified contents are copied from the source file to the new file. If the destination file already exists, the contents of the existing file are replaced with the specified contents from the source file.

Syntax

```
FCOPY (
location IN VARCHAR(40),
filename IN VARCHAR(256),
dest_dir IN VARCHAR(40),
dest_file IN VARCHAR(256),
start_line IN INTEGER DEFAULT 1,
end_line IN INTEGER DEFAULT NULL);
```

Parameters

Name	Input/Output	Data Type	Description
location	IN	VARCHAR(40)	The directory object corresponding to the path in which the source file is located
filename	IN	VARCHAR(256)	The name of the source file
dest_dir	IN	VARCHAR(40)	The directory object corresponding to the path in which the destination file is located
dest_file	IN	VARCHAR(256)	The name of the destination file
start_line	IN	INTEGER	The first line to copy Default: 1
end_line	IN	INTEGER	The last line to copy. Copies to the end of the file if set to NULL or not specified. Default: NULL

Return Values

Because it is a stored procedure, there is no return value.

Example

FCOPY can raise the following system-defined exceptions.

- INVALID_PATH
- ACCESS_DENIED
- INVALID_OPERATION
- READ_ERROR
- WRITE_ERROR

For a detailed explanation of how to handle exceptions, please refer to "Handling File Control-Related Exceptions" in this chapter.

Example

In the following example, the entire contents of a.txt are copied to b.txt.

```
iSQL> EXEC FCOPY( 'ALTI_DIR', 'a.txt', 'ALTI_DIR', 'b.txt' );
Execute success.

$ cat a.txt
1-ABCDEFG
2-ABCDEFG
3-ABCDEFG
4-ABCDEFG
5-ABCDEFG
6-ABCDEFG
7-ABCDEFG
8-ABCDEFG
9-ABCDEFG
10-ABCDEFG

$ cat b.txt
1-ABCDEFG
2-ABCDEFG
3-ABCDEFG
4-ABCDEFG
5-ABCDEFG
6-ABCDEFG
7-ABCDEFG
8-ABCDEFG
9-ABCDEFG
10-ABCDEFG
```

In the following example, only the specified lines are copied from a.txt to b.txt.

```
iSQL> EXEC FCOPY( 'ALTI_DIR', 'a.txt', 'ALTI_DIR2', 'b.txt', 4, 9 );
```

```
Execute success.

$ cat a.txt
1-ABCDEFG
2-ABCDEFG
3-ABCDEFG
4-ABCDEFG
5-ABCDEFG
6-ABCDEFG
7-ABCDEFG
8-ABCDEFG
9-ABCDEFG
10-ABCDEFG

$ cat b.txt
4-ABCDEFG
5-ABCDEFG
6-ABCDEFG
7-ABCDEFG
8-ABCDEFG
9-ABCDEFG
```

FFLUSH

A stored procedure that physically writes data on the file.

Syntax

```
FFLUSH ( file IN FILE_TYPE );
```

Parameter

Name	Input/Output	Data Type	Description
file	IN	FILE_TYPE	A file handle

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

FFLUSH can raise the following system-defined exceptions:

- INVALID_FILEHANDLE
- WRITE_ERROR

For a detailed explanation of how to handle exceptions, please refer to "Handling File Control-Related Exceptions" in this chapter.

Example

In the following example, all of the data in column I1 of table T1 are written to a file at one time. The last PUT_LINE parameter, *autoflush*, is set to FALSE. This prevents the data from being flushed to the file every time PUT_LINE is called. Instead, the data is flushed at the end using FFLUSH.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
   V1 FILE_TYPE;
   R2 T1%ROWTYPE;
   CURSOR C1 IS SELECT I1 FROM T1;
BEGIN
   V1 := FOPEN( 'ALTI_DIR', 'a.txt', 'w' );
   FOR R2 IN C1 LOOP
       PUT_LINE( V1, R2.I1, FALSE );
   END LOOP;
   FFLUSH(V1);
   FCLOSE(V1);
EXCEPTION
   WHEN INVALID_PATH THEN
       PRINTLN('CANNOT OPEN FILE.');
   WHEN NO_DATA_FOUND THEN
       PRINTLN('NO DATA FOUND.');
       FCLOSE( V1 );
END;
/
```

FOPEN

This stored function opens a file and returns a file handle.

Syntax

```
FILE_TYPE variable :=
FOPEN (
         location IN VARCHAR(40),
         filename IN VARCHAR(256),
         open_mode IN VARCHAR(4) );
```

Parameters

Name	Input/Output	Data Type	Description
location	IN	VARCHAR(40)	The directory object corresponding to the path in which the file is located
filename	IN	VARCHAR(256)	The name of the file to open
open_mode	IN	VARCHAR(4)	Can be set to one of the following three options: r: Read w: Write a: Append * Note: Only one option can be specified for open_mode. That is, combinations of two (or more) options, such as “rw” and “wa”, cannot be used.

Return Value

When this function is executed successfully, it returns a file handler of which the data type is FILE_TYPE (an opened file handle).

Exception

FOPEN can raise the following system-defined exceptions.

- INVALID_PATH
- ACCESS_DENIED
- INVALID_OPERATION
- INVALID_MODE

For a detailed explanation of how to handle exceptions, please refer to "Handling File Control-Related Exceptions" in this chapter.

Example

The following example shows that before a file can be read from or written to, it is first necessary to open the file in the appropriate mode using FOPEN:

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 FILE_TYPE;
    V2 VARCHAR(1024);
BEGIN
    V1 := FOPEN( 'ALTI_DIR', 'schema.sql', 'r' );
    GET_LINE( V1, V2, 100 );
    PRINTLN(V2);
    FCLOSE(V1);
END;
/
```

FREMOVE

This stored procedure deletes the specified file.

Syntax

```
FREMOVE (
  location IN VARCHAR(40),
  filename IN VARCHAR(256));
```

Parameters

Name	Input/Output	Data Type	Description
location	IN	VARCHAR(40)	The directory object corresponding to the path in which the file is located.
filename	IN	VARCHAR(256)	The file name

Return Value

As it is a stored procedure, no result value is returned.

Exceptions

FREMOVE can raise the following system-defined exceptions.

- INVALID_PATH
- ACCESS_DENIED
- DELETE_FAILED

For a detailed explanation of how to handle exceptions, please refer to "Handling File Control-Related Exceptions" in this chapter.

Example

The following example shows how to use FREMOVE to delete files:

```
--## Current directory information
$ ls
a.sql       a.txt       b.txt       schema.sql

--##  FREMOVE Execution
iSQL> EXEC FREMOVE('ALTI_DIR','b.txt');
Execute success.

--# Directory information after the stored procedure is executed
$ ls
a.sql       a.txt       schema.sql
```

FRENAME

This stored procedure is used to change the name of a file or move the file to a different location. Its functionality is similar to that of the Unix mv command.

Syntax

```
FRENAME (
location IN VARCHAR(40),
filename IN VARCHAR(256),
dest_dir IN VARCHAR(40),
dest_file IN VARCHAR(256),
overwrite IN BOOLEAN DEFAULT FALSE );
```

Parameters

Name	Input/Output	Date Type	Description
location	IN	VARCHAR(40)	The directory object corresponding to the original location of the file
filename	IN	VARCHAR(256)	The original name of the file
dest_dir	IN	VARCHAR(40)	The directory object corresponding to the direcotry to which the file is to be moved.
dest_file	IN	VARCHAR(256)	The new name for the file
overwrite	IN	BOOLEAN	If a file having the new name or location already exists, indicates whether to overwrite the existing file. TRUE: overwrite the file FALSE: do not overwrite the file. Default: FALSE

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

FRENAME can raise the following system-defined exceptions.

- INVALID_PATH
- ACCESS_DENIED
- RENAME_FAILED

For a detailed explanation of how to handle exceptions, please refer to "Handling File Control-Related Exceptions" in this chapter.

Example

The following example shows how to change the name of a file from “a.txt” to “result.txt”.

```
--## Current directory information
$ ls
a.sql       a.txt       schema.sql

--## FRENAME execution
iSQL> EXEC FRENAME('ALTI_DIR','a.txt','ALTI_DIR','result.txt',TRUE);
Execute success.

--# Direcotry information after the stored procedure is executed
$ ls
a.sql       result.txt  schema.sql
```

GET_LINE

This stored procedure reads one line from the specified file.

Syntax

```
GET_LINE (
   file IN FILE_TYPE,
   buffer OUT VARCHAR(32768),
   len IN INTEGER DEFAULT NULL);
```

Parameters

Name	Input/Output	Data Type	Description
file	IN	FILE_TYPE	The file handle
buffer	OUT	VARCHAR(32768)	The buffer to store one line read from the file
len	IN	INTEGER	The maximum number of bytes to read from one line of the file. If this value is not specified, a maximum of 1024 bytes will be read from each line. Default: NULL

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

GET_LINE can raise the following system-defined exceptions.

- NO_DATA_FOUND
- READ_ERROR
- INVALID_FILEHANDLE

For a detailed explanation of how to handle exceptions, please refer to "Handling File Control-Related Exceptions" in this chapter.

Example

In the following example, 100 bytes are read from one line of the file.

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
    2 AS
    3     V1 FILE_TYPE;
    4     V2 VARCHAR(1024);
    5 BEGIN
    6     V1 := FOPEN( 'ALTI_DIR', 'schema.sql', 'r' );
    7     GET_LINE( V1, V2, 100 );
    8     PRINTLN(V2);
    9     FCLOSE(V1);
    10 END;
    11 /
Create success.
iSQL> EXEC PROC1;
create table t1 (i1 integer, i2 integer, i3 integer);
Execute success.
```

IS_OPEN

This stored function checks whether or not the specified file is open.

Syntax

```
BOOLEAN variable :=
IS_OPEN ( file IN FILE_TYPE );
```

Parameter

Name	Input/Output	Data Type	Description
file	IN	FILE_TYPE	The file handle

Return Value

The return type is BOOLEAN. This stored function returns TRUE if the specified file is open and FALSE if the file is not open.

Exceptions

If the specified file handle is open, TRUE is returned. In all other circumstances, FALSE is returned. Therefore, this function never returns an error.

Example

The following example shows how to check whether a file handle is open.

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 FILE_TYPE;
BEGIN
    IF IS_OPEN(V1) = FALSE THEN
        PRINTLN('V1 IS NOT OPENED.');
    ELSE
        PRINTLN('V1 IS OPENED.');
    END IF;
    V1 := FOPEN( 'ALTI_DIR', 'a.txt', 'w' );
    PRINTLN('FOPEN FUNCTION CALLED.');
    IF IS_OPEN(V1) = FALSE THEN
        PRINTLN('V1 IS NOT OPENED.');
    ELSE
        PRINTLN('V1 IS OPENED.');
    END IF;
    FCLOSE( V1 );
    PRINTLN('FCLOSE FUNCTION CALLED.');
    IF IS_OPEN(V1) = FALSE THEN
        PRINTLN('V1 IS NOT OPENED.');
    ELSE
        PRINTLN('V1 IS OPENED.');
    END IF;
END;
/
```

NEW_LINE

This store procedure writes an OS-specific carriage return character or sequence the specified number of times in the file.

Syntax

```
NEW_LINE  (
file IN FILE_TYPE,
lines IN INTEGER DEFAULT 1 );
```

Parameters

Name	Input/Output	Data Type	Description
file	IN	FILE_TYPE	The file handle
lines	IN	INTEGER	The number of lines to write in the file. Default: 1

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

NEW_LINE can raise the following system-defined exceptions.

- INVALID_FILEHANDLE
- WRITE_ERROR

For a detailed explanation of how to handle exceptions, please refer to "Handling File Control-Related Exceptions" in this chapter.

Example

The following example shows the use of NEW_LINE to insert blank lines in a file:

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 FILE_TYPE;
BEGIN
    V1 := FOPEN( 'ALTI_DIR', 'a.txt', 'w' );
    PUT_LINE( V1, 'REPORT', TRUE );
    NEW_LINE( V1, 3 );
    PUT_LINE( V1, '------', TRUE );
    FCLOSE( V1 );
END;
/

--##  a.txt file after the above-described stored procedure is executed
$ cat a.txt
REPORT
```

```
------
$
```

PUT

This stored procedure is used to write a character string to a file.

Syntax

```
PUT (
  file IN FILE_TYPE,
  buffer IN VARCHAR(32768));
```

Parameters

Name	Input/Output	Data Type	Description
file	IN	FILE_TYPE	The file handler
buffer	IN	VARCHAR(32768)	The buffer in which to store the character string to be written to the file

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

PUT can raise the following system-defined exceptions:

- INVALID_FILEHANDLE
- WRITE_ERROR

For a detailed explanation of how to handle exceptions, please refer to "Handling File Control-Related Exceptions" in this chapter.

Example

The following example shows how to write text to a file:

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 FILE_TYPE;
BEGIN
    V1 := FOPEN( 'ALTI_DIR', 'a.txt', 'w' );
    PUT( V1, 'REPORT');
    PUT( V1, '-->');
```

```
    PUT_LINE( V1, 'SUCCESS', TRUE );
    FCLOSE( V1 );
END;
/
--## a.txt file result after the above-described stored procedure is executed
$ cat a.txt
REPORT-->SUCCESS
$
```

PUT_LINE

This stored procedure writes one line of text, including a carriage return character or sequence, to a file.

Syntax

```
PUT_LINE (
file IN FILE_TYPE,
buffer IN VARCHAR(32767),
autoflush IN BOOLEAN DEFAULT FALSE);
```

Parameters

Ma,e	Input/Out	Data Type	Description
file	IN	FILE_TYPE	The file handle
Buffer	IN	VARCHAR(32767)	The buffer containing the line of text to be written to the file
autoflush	IN	BOOLEAN	Whether to flush to the file automatically Default: FALSE

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

PUT_LINE can raise the following system-defined exceptions.

- INVALID_FILEHANDLE
- WRITE_ERROR

For a detailed explanation of how to handle exceptions, please refer to "Handling File Control-Related Exceptions" in this chapter.

Example

The following example shows how to write a line of text to a file:

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 FILE_TYPE;
BEGIN
    V1 := FOPEN('ALTI_DIR', 'a.txt', 'w');
    PUT_LINE(V1, '1-ABCDEFG');
    PUT_LINE(V1, '2-ABCDEFG');
    PUT_LINE(V1, '3-ABCDEFG');
    PUT_LINE(V1, '4-ABCDEFG');
    PUT_LINE(V1, '5-ABCDEFG');
    PUT_LINE(V1, '6-ABCDEFG');
    PUT_LINE(V1, '7-ABCDEFG');
    PUT_LINE(V1, '8-ABCDEFG');
    PUT_LINE(V1, '9-ABCDEFG');
    PUT_LINE(V1, '10-ABCDEFG');
    FCLOSE(V1);
END;
/
```

After the above stored procedure is performed, the contents of the file will be as follows:

```
$ cat a.txt
1-ABCDEFG
2-ABCDEFG
3-ABCDEFG
4-ABCDEFG
5-ABCDEFG
6-ABCDEFG
7-ABCDEFG
8-ABCDEFG
9-ABCDEFG
10-ABCDEFG
```

Handling File Control-Related Exceptions

The following is an explanation of some considerations to keep in mind when handling file control-related exceptions that may occur during the execution of a stored procedure or function.

The exceptions that may occur during the execution of file control-related stored procedures and functions are set forth in the following table. These exceptions can be handled using user-defined exception handlers, just like other system-defined exceptions.

Exception Name	Description
INVALID_PATH	The specified directory object does not exist (i.e. the specified object is not a directory object created using the CREATE DIRECTORY statement).
INVALID_MODE	The file open mode is not valid. (A value other than “r”, “w”, or “a” was specified for the file open mode.)
INVALID_FILEHANDLE	The file handle is invalid. (The specified file could not be opened.)
INVALID_OPERATION	The actual directory or file does not exist in the file system, or else access to the file system was denied.
READ_ERROR	There is no opened file to read from, access to the file has been denied.
WRITE_ERROR	There is no opened file to write to, write access to the file has been denied, or the file was not opened in write mode.
ACCESS_DENIED	The user was denied access to the directory object. Sufficient privileges must be granted to the user using the GRANT statement.
DELETE_FAILED	The file to be deleted does not exist, or access to the file has been denied.
RENAME_FAILED	A file having the specified name already exists and the overwrite option was not specified, or another file system error has occurred.

Examples

Example 1

The following procedure takes the directory and file names as input parameters, opens the corresponding file, and reads and echoes the contents of the file. The directory or file name may not be properly specified, or the file might be empty. Therefore, this stored procedure includes respective exception handlers for the INVALID_PATH and NO_DATE_FOUND system-defined exceptions.

```
--# CREATE VERIFY PROCEDURE
CREATE OR REPLACE PROCEDURE PROC2( PATH VARCHAR(40), FILE VARCHAR(40) )
AS
   V1 FILE_TYPE;
   V2 VARCHAR(100);
BEGIN
   V1 := FOPEN( PATH, FILE, 'r' );
   LOOP
       GET_LINE( V1, V2, 100 );
       PRINT( V2 );
   END LOOP;
EXCEPTION
   WHEN INVALID_PATH THEN
       PRINTLN('CANNOT OPEN FILE.');
   WHEN NO_DATA_FOUND THEN
       PRINTLN('NO DATA FOUND.');
```

```
      FCLOSE( V1 );
END;
/
```

Example 2

The following example shows how to write the contents of the table to a file or read from a file.

Create a user and assign suitable privileges to the user.

```
CONNECT SYS/MANAGER;
CREATE USER MHJEONG IDENTIFIED BY MHJEONG;
GRANT CREATE ANY DIRECTORY TO MHJEONG;
GRANT DROP ANY DIRECTORY TO MHJEONG;
```

Create and populate a table and create a directory object.

```
CONNECT MHJEONG/MHJEONG;
CREATE TABLE T1( ID INTEGER, NAME VARCHAR(40) );
INSERT INTO T1 VALUES( 1, 'JAKIM' );
INSERT INTO T1 VALUES( 2, 'PEH' );
INSERT INTO T1 VALUES( 3, 'KUMDORY' );
INSERT INTO T1 VALUES( 4, 'KHSHIM' );
INSERT INTO T1 VALUES( 5, 'LEEKMO' );
INSERT INTO T1 VALUES( 6, 'MHJEONG' );
CREATE DIRECTORY MYDIR AS '/home1/mhjeong';
```

Create a procedure that reads all of the records in table T1 and writes the data to t1.txt

```
CREATE OR REPLACE PROCEDURE WRITE_T1
AS
  V1 FILE_TYPE;
  ID INTEGER;
  NAME VARCHAR(40);
BEGIN
  DECLARE
    CURSOR T1_CUR IS
    SELECT * FROM T1;
  BEGIN
    OPEN T1_CUR;
    V1 := FOPEN( 'MYDIR', 't1.txt', 'w' );
    LOOP
      FETCH T1_CUR INTO ID, NAME;
      EXIT WHEN T1_CUR%NOTFOUND;
      PUT_LINE( V1, 'ID : '||ID||' NAME : '||NAME);
    END LOOP;
    CLOSE T1_CUR;
```

```
    FCLOSE(V1);
  END;
END;
/
```

Create a procedure that reads the contents of t1.txt and displays the contents on the screen.

```
CREATE OR REPLACE PROCEDURE READ_T1
AS
  BUFFER VARCHAR(200);
  V1 FILE_TYPE;
BEGIN
  V1 := FOPEN( ‘MYDIR’, ‘t1.txt’, ‘r’ );
  LOOP
    GET_LINE( V1, BUFFER, 200 );
    PRINT( BUFFER );
  END LOOP;
  FCLOSE( V1 );
EXCEPTION
  WHEN NO_DATA_FOUND THEN
    FCLOSE( V1 );
END;
/
```

Result

When the stored procedures created above are executed, the following result will be displayed:

```
iSQL> exec write_t1;
EXECUTE success.
iSQL> exec read_t1;
ID : 1 NAME : JAKIM
ID : 2 NAME : PEH
ID : 3 NAME : KUMDORY
ID : 4 NAME : KHSHIM
ID : 5 NAME : LEEKMO
ID : 6 NAME : MHJEONG
EXECUTE success.
```

The following file will be visible in the corresponding directory in the file system.

```
$ cd /home1/mhjeong
$ cat t1.txt
ID : 1 NAME : JAKIM
ID : 2 NAME : PEH
ID : 3 NAME : KUMDORY
ID : 4 NAME : KHSHIM
ID : 5 NAME : LEEKMO
ID : 6 NAME : MHJEONG
```

TCP Access Control

Data Type

The CONNECT_TYPE is a data type which is supported in a stored procedure in order to control TCP access.

The CONNECT_TYPE internally contains stored TCP socket information, however, users cannot access to the internal data

Functions of CONNECT_TYPE

The local variables of CONNECT_TYPE in the stored procedures can be treated as parameters or return values of the following functions.

Function Name	Description
CLOSEALL_CONNECT	Closes all the connection handles connected to a session
CLOSE_CONNECT	Closes a connection handle connected to a session
IS_CONNECTED	Confirms the connection status of a CONNECT_TYPE connection handle
OPEN_CONNECT	Opens a file with the purpose of reading or writing
WRITE_RAW	Tranmits RAW(VARBYTE) type materials to a network through a connected connection handle

CLOSEALL_CONNECT

The CLOSEALL_CONNECT is a function closing all the connection handle accessed to a current session.

Syntax

```
CONNECT_TYPE variable :=
CLOSEALL_CONNECT();
```

Return Value

0 is returned when successfully executed.

Exception

There is no exception.

Example

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 INTEGER;
BEGIN
    V1 := CLOSEALL_CONNECT();
END;
/
```

CLOSE_CONNECT

The CLOSE_CONNECT is a function which closes a connection handle accessed to the current session.

Syntax

```
CONNECT_TYPE variable :=
CLOSE_CONNECT(
         coon IN CONNECT_TYPE);
```

Parameters

Name	Input/Output	Data Type	Descritpion
coon	IN	CONNECT_TYPE	A connection handle

Return value

0 is returned when successfully executed.

Exception

There is no exception.

Example

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 CONNECT_TYPE;
    V2 INTEGER;
BEGIN
    V1 := OPEN_CONNECT('127.0.0.1', 22007, 1000, 3000);
    V2 := WRITE_RAW(V1, TO_RAW('MESSAGE'), RAW_SIZEOF('MESSAGE'));
    V2 := CLOSE_CONNECT(V1);
END;
/
```

IS_CONNECTED

The CLOSEALL_CONNECT is a function closing all the connection handle accessed to a current session.

Syntax

```
CONNECT_TYPE variable :=
IS_CONNECTED(
         coon IN CONNECT_TYPE);
```

Parameter

Name	Input/Output	Data Type	Description
coon	IN	CONNECT_TYPE	A connection handle

Return Value

0 is returned when a connection handled is connected; otherwise it returns -1.

Example

```
CREATE OR REPLACE PROCEDURE PROC1
    AS
    V1 CONNECT_TYPE;
    V2 INTEGER;
BEGIN
    V1 := OPEN_CONNECT('127.0.0.1', 22007, 1000, 3000);
    V2 := IS_CONNECTED(V1);
    IF V2 = 0 THEN
        PRINTLN('CONNECTD');
        V2 := WRITE_RAW(V1, TO_RAW('MESSAGE'), RAW_SIZEOF('MESSAGE'));
        V2 := CLOSE_CONNECT(V1);
    ELSE
        PRINTLN('NOT CONNECTD');
```

```
    END IF;
END;
/
```

OPEN_CONNECT

The OPEN_CONNECT is a stored function which creates TCP sockets and accesses to the remote server with an inserted IP and PORT.

Syntax

```
CONNECT_TYPE variable :=
OPEN_CONNECT(
         ip IN VARCHAR(64),
         port IN INTEGER,
         connect_timeout IN INTEGER,
         tx_buffersize IN INTEGER);
```

Parameters

Name	Input/Output	Data Type	Description
ip	IN	VARCHAR(64)	The IP address of a remote server
port	IN	INTEGER	Port number of a remote server.
connect_timeout	IN	INTEGER	The time allowing access(microseconds). It waits until it is accessed if 0 or Null is input.
tx_buffersize	IN	INTEGER	The size of transmission buffer can be specified. It can be specified from 2048 to 32767 bytes, Null or the value less than 2048 is specified 2048 bytes.

Return Value

A connection handle of which data type is CONNECT_TYPE would be returned when successfully executed.

Exceptions

If the connection handle is not normally connected to a network, the CONNECT_TYPE returns NULL values. The connection status can be verified through returned values of the CONNECT_TYPE by using a IS_CONNECTED() function.

Example

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 CONNECT_TYPE;
    V2 INTEGER;
BEGIN
    V1 := OPEN_CONNECT('127.0.0.1', 22007, 1000, 3000);
    V2 := WRITE_RAW(V1, TO_RAW('MESSAGE'), RAW_SIZEOF('MESSAGE'));
    V2 := CLOSE_CONNECT(V1);
END;
/
```

WRITE_RAW

This is a function that transfers data of type RAW (VARBYTE) to the network through the connected handle.

Syntax

```
CONNECT_TYPE variable :=
WRITE_RAW (
         coon IN CONNECT_TYPE,
         data IN VARBYTE,
         length IN INTEGER );
```

Parameters

Name	Input/Output	Data Type	Description
coon	IN	CONNECT_TYPE	A connection Handle
data	IN	VARBYTE	The data which will be transmitted
length	IN	INTEGER	The length of data which will be transmitted

Return Value

The length of data transmitted to a network would be returned when successfully implemented.

Exception

-1 is returned when an error is incurred during the execution.

If a connection handle is lost, it can be verified through returning result value of -1 by the IS_CONNECTED() function.

Example

```
CREATE OR REPLACE PROCEDURE PROC1
AS
    V1 CONNECT_TYPE;
    V2 INTEGER;
BEGIN
    V1 := OPEN_CONNECT('127.0.0.1', 22007, 1000, 3000);
    V2 := WRITE_RAW(V1, TO_RAW('MESSAGE'), RAW_SIZEOF('MESSAGE'));
    V2 := CLOSE_CONNECT(V1);
END;
```

DBMS Stats

DBMS Stats is a feature which collects, alters (sets) and deletes statistics pertaining to an Altibase database. This feature is provided in the form of multiple system-defined stored procedures.

Overview

Statistics pertaining to objects in a database are used for the query optimizer to create an optimized execution plan. These statistics can be constructed and updated, , and statistics can be set or deleted for individual columns, indexes, tables or systems with the DBMS Stats stored procedure.

DBMS Stats Procedures

The stored procedures that comprise DBMS Stat are listed in the following table. These procedures can be used to gather statistics and reconstruct execution plans.

Name	Description
GATHER_SYSTEM_STATS	Gathers statistics about the database system
GATHER_DATABASE_STATS	Gathers statistics about all of the tables in the database
GATHER_TABLE_STATS	Gathers statistics about a particular table
GATHER_INDEX_STATS	Gathers statistics about a particular index

The stored procedures which alter statistics pertaining to individual columns, indexes, tables or systems are listed in the following table

Name	Description
SET_SYSTEM_STATS	Alters statistics pertaining to the database system
SET_TABLE_STATS	Alters statistics pertaining to a particular table
SET_INDEX_STATS	Alters statistics pertaining to a particular index
SET_COLUMN_STATS	Alters statistics pertaining to columns of a particular table

The following stored procedures retrieve statistics pertaining to individual columns, indexes, tables, or the system.

Name	Description
GET_SYSTEM_STATS	Retrieves statistics pertaining to the database system
GET_TABLE_STATS	Retrieves statistics pertaining to a particular table
GET_INDEX_STATS	Retrieves statistics pertaining to a particular index
GET_COLUMN_STATS	Retrieves statistics pertaining to columns of a particular table

The stored procedures which delete or copy statistics pertaining to individual columns, indexes, tables or the system are listed in the following table.

Name	Description
COPY_TABLE_STATS	Copies statistics to the new partition.
DELETE_SYSTEM_STATS	Deletes statistics pertaining to the database system
DELETE_DATABASE_STATS	Deletes statistics pertaining to all tables
DELETE_TABLE_STATS	Deletes statistics pertaining to a particular table
DELETE_INDEX_STATS	Deletes statistics pertaining to a particular index
DELETE_COLUMN_STATS	Deletes statistics pertaining to columns of a particular table

Notes

- The process of gathering statistics imposes an additional workload on the Altibase server.
- The statistics that are gathered in this way should be considered approximate.
- After statistics are gathered, Altibase reconstructs the execution plans for all queries that reference any of the objects for which the statistical information was gathered. During this process, the performance of the Altibase server can suffer somewhat

COPY_TABLE_STATS

The COPY_TABLE_STATS copies the stats information of original partition to a new partition. However, it does not copy when the stats information of orginial partition does not exist.

Syntax

```
COPY_TABLE_STATS(
  ownname IN VARCHAR(128),
  tabname IN VARCHAR(128),
  srcpartname IN VARCHAR(128),
  dstpartname IN VARCHAR(128));
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The owner name of the original and target partition table.
tabname	IN	VARCHAR(128)	The table name of the original partition and the table name of target partition.
srcpartname	IN	VARCHAR(128)	The name of original partition.
dstpartname	IN	VARCHAR(128)	The name of target parition.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC COPY_TABLE_STATS('SYS','T1','P3','P4');
Execute success.
```

GATHER_DATABASE_STATS

This procedure gathers statistics about the database system. Only the SYS user can execute this procedure. Only the SYS user can execute this procedure.

Syntax

```
GATHER_DATABASE_STATS (
  estimate_percent   FLOAT   DEFAULT 0,
  degree                  INTEGER DEFAULT 0,
  gather_system_stats BOOLEAN DEFAULT FALSE,
  no_invalidate       BOOLEAN DEFAULT FALSE);
```

Parameters

Name	Input/Output	Data Type	Description
estimate_percent	IN	FLOAT	This is the ratio of the amount of data to be sampled (for the purpose of estimating statistics) to the total amount of data available for the target object. It can be set anywhere in the range from 0 (zero) to 1. If estimate_percent is not specified, or if it is set to NULL, this value is automatically determined depending on the size of the object
degree	IN	INTEGER	This is the number of threads that work in parallel to gather statistics. If degree is not specified, the default value is 0.
gather_system_stats	IN	BOOLEAN	Whether or not to gather statistics pertaining to the database system as well. The default value is FALSE; in this case, the user can use GATHER_SYSTEM_STATS or SET_SYSTEM_STATS.
no_invalidate	IN	BOOLEAN	This determines whether to reconstruct the execution plans for queries pertaining to the objects for which statistics are gathered. Setting no_invalidate to TRUE disables reconstruction of the execution plans. If set to FALSE, which is the default value, the execution plans are reconstructed.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC GATHER_DATABASE_STATS();
SYSTEM_.SYS_TABLES_
SYSTEM_.SYS_COLUMNS_
SYSTEM_.SYS_DATABASE_
SYSTEM_.SYS_USERS_
.
.
.
Execute success.
```

GATHER_INDEX_STATS

This procedure gathers statistics about a specific index.

Syntax

```
GATHER_INDEX_STATS (
  ownname             VARCHAR(128),
  idxname             VARCHAR(128),
  estimate_percent    FLOAT   DEFAULT 0,
  degree              INTEGER DEFAULT 0,
  no_invalidate       BOOLEAN DEFAULT FALSE);
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the index for which statistics are gathered
idxname	IN	VARCHAR(128)	The name of the index for which statistics are gathered
estimate_percent	IN	FLOAT	This is the ratio of the amount of data to be sampled (for the purpose of estimating statistics) to the total amount of data available for the target object. It can be set anywhere in the range from 0 (zero) to 1. If estimate_percent is not specified, or if it is set to NULL, this value is automatically determined depending on the size of the object.
degree	IN	INTEGER	This is the number of threads that work in parallel to gather statistics. If degree is not specified, the default value is 0.
no_invalidate	IN	BOOLEAN	This determines whether to reconstruct the execution plans for queries pertaining to the objects for which statistics are gathered. Setting no_invalidate to TRUE disables reconstruction of the execution plans. If set to FALSE, which is the default value, the execution plans are reconstructed.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC GATHER_INDEX_STATS( 'SYS','T1_IDX');
Execute success.
```

GATHER_SYSTEM_STATS

This procedure gathers statistics about the database system. Only the SYS user can execute this procedure. Only the SYS user can execute this procedure.

Syntax

```
GATHER_SYSTEM_STATS ( );
```

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC GATHER_SYSTEM_STATS();
Execute success.
```

GATHER_TABLE_STATS

This procedure gathers statistics about a specific table and the indexes that are defined on the basis of that table.

Syntax

```
GATHER_TABLE_STATS (
  ownname              VARCHAR(128),
  tabname              VARCHAR(128),
  partname             VARCHAR(128) DEFAULT NULL,
  estimate_percent     FLOAT   DEFAULT 0,
  degree               INTEGER DEFAULT 0,
  no_invalidate        BOOLEAN DEFAULT FALSE );
```

Parameter

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the table for which statistics are gathered
tabname	IN	VARCHAR(128)	The name of the table for which statistics are gathered
partname	IN	VARCHAR(128)	The name of a partition. If specified, only statistics pertaining to that partition are gathered. If not specified, it defaults to NULL, and statistics about all of the partitions in the specified table are gathered
estimate_percent	IN	FLOAT	This is the ratio of the amount of data to be sampled (for the purpose of estimating statistics) to the total amount of data available for the target object. It can be set anywhere in the range from 0 (zero) to 1. If estimate_percent is not specified, or if it is set to NULL, this value is automatically determined depending on the size of the object.
degree	IN	INTEGER	This is the number of threads that work in parallel to gather statistics. If degree is not specified, the default value is 0.
no_invalidate	IN	BOOLEAN	This determines whether to reconstruct the execution plans for queries pertaining to the objects for which statistics are gathered. Setting no_invalidate to TRUE disables reconstruction of the execution plans. If set to FALSE, which is the default value, the execution plans are reconstructed.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC GATHER_TABLE_STATS( 'SYS','T1');
Execute success.
```

SET_COLUMN_STATS

This procedure alters statistics pertaining to columns of a table.

Syntax

```
SET_COLUMN_STATS (
  ownname          VARCHAR(128),
  tabname          VARCHAR(128),
  colname          VARCHAR(128),
  partname         VARCHAR(128) DEFAULT NULL,
  numdist          BIGINT  DEFAULT NULL,
  numnull          BIGINT  DEFAULT NULL,
  avgclen          BIGINT  DEFAULT NULL,
  minvalue         VARCHAR(48) DEFAULT NULL,
  maxvalue         VARCHAR(48) DEFAULT NULL,
  no_invalidate    BOOLEAN DEFAULT FALSE );
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the table
tabname	IN	VARCHAR(128)	The name of the table for which statistics are to be altered
colname	IN	VARCHAR(128)	The name of the column for which statistics are to be altered
partname	IN	VARCHAR(128)	The name of the partition of the table. On specification, only statistics pertaining to that partition are altered. The default value is NULL and statistics pertaining to all partitions in the table are altered
numdist	IN	BIGINT	The number of distinct values in the column
numnull	IN	BIGINT	The number of NULLs in the column
avgclen	IN	BIGINT	The average length of the column
minvalue	IN	VARCHAR(48)	The minimum value in the column. The DATE type must use the “YYYY-MM-DD HH:MI:SS” format.
maxvalue	IN	VARCHAR(48)	The maximum value in the column. The DATE type must use the “YYYY-MM-DD HH:MI:SS” format.
no_invalidate	IN	BOOLEAN	This determines whether to reconstruct all the execution plans for queries pertaining to the tables for which statistics are gathered. The default value is FALSE and reconstructs the execution plans. To not reconstruct, input TRUE.

Return Value

Because it is a stored procedure, no result value is returned.

Example

```
iSQL> EXEC SET_COLUMN_STATS('SYS', 'T1', 'I1', NULL, 1000);
Execute success.
```

SET_INDEX_STATS

This procedure alters statistics pertaining to an index.

Syntax

```
SET_INDEX_STATS (
  ownname          VARCHAR(128),
  index            VARCHAR(128),
  keycnt           BIGINT DEFAULT NULL,
  numpage          BIGINT DEFAULT NULL,
  numdist          BIGINT DEFAULT NULL,
  clusfct          BIGINT DEFAULT NULL,
  idxheight        BIGINT DEFAULT NULL,
  avgslotcnt       BIGINT DEFAULT NULL,
  no_invalidate    BOOLEAN DEFAULT FALSE );
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the index
index	IN	VARCHAR(128)	The name of the index for which statistics are to be altered
keycnt	IN	BIGINT	The number of records in the index
numpage	IN	BIGINT	The number of pages in the index
numdist	IN	BIGINT	The number of distinct keys in the index
clusfct	IN	BIGINT	The degree to which data is sorted in accordance with the index
idxheight	IN	BIGINT	The height from the root to the leaf node of the index
avgslotcnt	IN	BIGINT	The average number of records in the index leaf nodes
no_invalidate	IN	BOOLEAN	This determines whether to reconstruct all the execution plans for queries pertaining to the indexes for which statistics are gathered. The default value is FALSE and reconstructs the execution plans. To not reconstruct, input TRUE.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC SET_INDEX_STATS('SYS', 'IDX1', 1000);
Execute success.
```

SET_SYSTEM_STATS

This procedure alters statistics pertaining to the database system. Only the SYS user can execute this procedure. Only the use SYS can execute this procedure.

Syntax

```
SET_SYSTEM_STATS (
  statname            VARCHAR(100),
  statvalue           DOUBLE);
```

Parameters

Name	Input/Output	Data Type	Description
statname	IN	VARCHAR(100)	The name of the database system for which statistics are to be altered. A value among the following must be input SPREAD_TIME: The average amount of time spent on reading one page. MREAD_TIME: The average amount of time spent on reading several pages. MREAD_PAGE_COUNT: The number of pages retrieved at once. HASH_TIME: The average amount of time spent on hashing. COMPARE_TIME : The average amount of time spent on comparing. STORE_TIME : The average amount of time spent on storing memory temporary tables.
statvalue	IN	DOUBLE	The statistical value of the database system

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC SET_SYSTEM_STATS('SREAD_TIME', 100);
Execute success.
```

SET_TABLE_STATS

This procedure alters statistics pertaining to a table.

Syntax

```
SET_TABLE_STATS (
  ownname         VARCHAR(128),
  tabname         VARCHAR(128),
  partname        VARCHAR(128) DEFAULT NULL,
  numrow          BIGINT  DEFAULT NULL,
  numblk          BIGINT  DEFAULT NULL,
  avgrlen         BIGINT  DEFAULT NULL,
  onerowreadtime  DOUBLE  DEFAULT NULL,
  no_invalidate   BOOLEAN DEFAULT FALSE );
```

Parameters

Name	Input/Out	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the table
tabname	IN	VARCHAR(128)	The name of the table for which statistics are to be altered
partname	IN	VARCHAR(128)	The name of the partition of the table. On specification, only statistics pertaining to that partition are altered. On omission, the default value is NULL, and statistics pertaining to all partitions in the specified table are altered.
numrow	IN	BIGINT	The number of records in the table
numblk	IN	BIGINT	The number of pages in the table
avgrlen	IN	BIGINT	The average length of the records in the table
onerowreadtime	IN	DOUBLE	The amount of time spent reading one record in the table
no_invalidate	IN	BOOLEAN	This determines whether to reconstruct all the execution plans for queries pertaining to the tables for which statistics are gathered. The default value is FALSE and reconstructs the execution plans. To not reconstruct, input TRUE.

Returned Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC SET_TABLE_STATS('SYS', 'T1', NULL, 1000);
Execute success.
```

GET_COLUMN_STATS

This procedure retrieves statistics pertaining to a table column.

Syntax

```
GET_COLUMN_STATS (
  ownname          VARCHAR(128),
  tabname          VARCHAR(128),
  colname          VARCHAR(128),
  partname         VARCHAR(128) DEFAULT NULL,
  numdist          BIGINT,
  numnull          BIGINT,
  avgrlen          BIGINT,
  minvalue         VARCHAR(48),
  maxvalue         VARCHAR(48) );
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the table
tabname	IN	VARCHAR(128)	The name of the table for which statistics are to be retrieved
colname	IN	VARCHAR(128)	The name of the column for which statistics are to be retrieved
partname	IN	VARCHAR(128)	The name of the partition of the table. On specification, only statistics pertaining to that partition are retrieved. On omission, the default value is NULL, and statistics pertaining to all partitions in the specified table are retrieved.
numdist	OUT	BIGINT	The number of unique values in the column. NULL is returned if no statistics have been gathered.
numnull	OUT	BIGINT	The number of NULL values in the column. NULL is returned if no statistics have been gathered.
avgrlen	OUT	BIGINT	The average length of the column. NULL is returned if no statistics have been gathered.
minvalue	OUT	VARCHAR(48)	The minimum value of the column. NULL is returned if no statistics have been gathered.
maxvalue	OUT	VARCHAR(48)	The maximum value of the column. NULL is returned if no statistics have been gathered.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC GET_COLUMN_STATS('SYS', 'T1', 'I1', NULL, :v1,:v2,:v3,:v4,:v5);
Execute success.
```

GET_INDEX_STATS

This procedure retrieves statistics pertaining to an index.

Syntax

```
GET_INDEX_STATS (
  ownname          VARCHAR(128),
  index            VARCHAR(128),
  partname         VARCHAR(128) DEFAULT NULL,
  keycnt           BIGINT,
  numpage          BIGINT,
  numdist          BIGINT,
  clstfct          BIGINT,
  idxheight        BIGINT,
  cachedpage       BIGINT,
  avgslotcnt       BIGINT );
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the index
index	IN	VARCHAR(128)	The name of the index for which statistics are to be retrieved
partname	IN	VARCHAR(128)	The name of a partition. If specified, only statistics pertaining to that partition are gathered. If not specified, it defaults to NULL.
keycnt	OUT	BIGINT	The number of records in the index. NULL is returned if no statistics have been gathered.
numpage	OUT	BIGINT	The number of pages in the index. NULL is returned if no statistics have been gathered.
numdist	OUT	BIGINT	The number of unique keys in the index. NULL is returned if no statistics have been gathered.
clstfct	OUT	BIGINT	The degree to which the order of data matches the index. NULL is returned if no statistics have been gathered.
idxheight	OUT	BIGINT	The depth of the root to leaf node in the index. NULL is returned if no statistics have been gathered.
cachedpage	OUT	BIGINT	The number of pages cached in the database buffer. NULL is returned if no statistics have been gathered.
avgslotcnt	OUT	BIGINT	The average length of the records stored in the index leaf node. NULL is returned if no statistics have been gathered.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC GET_INDEX_STATS('SYS', 'IDX1' null,:v1,:v2,:v3,:v4,:v5,:v6,:v7);
Execute success.
```

GET_SYSTEM_STATS

This procedure retrieves statistics pertaining to the database system.

Syntax

```
GET_SYSTEM_STATS (
  statname            VARCHAR(100),
  statvalue           DOUBLE);
```

Parameters

Name	Input/Output	Data Type	Description
statname	IN	VARCHAR(100)	The name of the system for which statistics are to be retrieved. A value for one of the following must be input: SREAD_TIME: The average amount of time taken to read one page MREAD_TIME: The average amount of time taken to read several pages MREAD_PAGE_COUNT: The number of pages read at one time. HASH_TIME : The average amount of time taken hashing COMPARE_TIME : The average amount of time taken comparing STORE_TIME: The average amount of time taken to save memory temporary tables
statvalue	IN	DOUBLE	The statistical value for the system. NULL is returned if no statistics have been gathered.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC GET_SYSTEM_STATS('SREAD_TIME', :v1);
Execute success.
```

GET_TABLE_STATS

This procedure retrieves statistics pertaining to a table.

Syntax

```
GET_TABLE_STATS (
ownname          VARCHAR(128),
tabname          VARCHAR(128),
partname         VARCHAR(128) DEFAULT NULL,
numrow            BIGINT,
numpage           BIGINT,
avgrlen           BIGINT,
cashedpage       BIGINT,
onerowreadtime   DOUBLE );
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the index
tabname	IN	VARCHAR(128)	The name of the table for which statistics are to be retrieved
partname	IN	VARCHAR(128)	The name of the partition of the table. On specification, only statistics pertaining to that partition are retrieved. On omission, the default value is NULL, and statistics pertaining to all partitions in the specified table are retrieved.
numrow	OUT	BIGINT	The number of table records. NULL is returned if no statistics have been gathered.
numpage	OUT	BIGINT	The number of pages in the table. NULL is returned if no statistics have been gathered.
avgrlen	OUT	BIGINT	The average length of the table records. NULL is returned if no statistics have been gathered.
cashedpage	OUT	BIGINT	The number of pages cached in the database buffer. NULL is returned if no statistics have been gathered.
onerowreadtime	OUT	DOUBLE	The average amount of time taken reading table records. NULL is returned if no statistics have been gathered.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC GET_TABLE_STATS('SYS', 'T1', NULL, :v1,:v2,:v3,:v4,:v5);
Execute success.
```

DELETE_COLUMN_STATS

This procedure deletes statistics pertaining to columns of a table.

Syntax

```
DELETE_COLUMN_STATS (
ownname          VARCHAR(128),
tabname          VARCHAR(128),
colname          VARCHAR(128),
partname         VARCHAR(128) DEFAULT NULL,
cascade_part    BOOLEAN DEFAULT TRUE,
no_invalidate   BOOLEAN DEFAULT FALSE );
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the table
tabname	IN	VARCHAR(128)	The name of the table which contains the column for which statistics are to be deleted
colname	IN	VARCHAR(128)	The name of the column for which statistics are to be deleted
partname	IN	VARCHAR(128)	The name of the table partition for which statistics are to be deleted. On specification, statistics pertaining only to the specified column of that specified partition are deleted, regardless of the *cascade_part* value. If the value is NULL, the *cascade_part* value determines which column statistics are to be deleted.
cascade_part	IN	BOOLEAN	If a partitioned table is specified for *tabname* and *partname* is NULL, this value determines which column statistics are to be deleted. If this value is TRUE, the global column statistics of the partitioned table, as well as the column statistics for all partitions of the table are deleted. If this value is FALSE, only the global column statistics of the partitioned table are deleted. The default value is TRUE.
no_invalidate	IN	BOOLEAN	This specifies whether or not to reconstruct the execution plans for queries pertaining to the tables for which statistics are to be deleted. The default value is FALSE and reconstructs the execution plans. If this value is TRUE, the execution plans are not reconstructed.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC DELETE_COLUMN_STATS('SYS', 'T1', 'I1');
Execute success.
```

DELETE_DATABASE_STATS

This procedure deletes statistics pertaining to all of the tables that exist in the database.

Syntax

```
DELETE_DATABASE_STATS (
no_invalidate       BOOLEAN DEFAULT FALSE);
```

Parameters

Name	Input/Output	Data Type	Description
no_invalidate	IN	BOOLEAN	The default value is FALSE and reconstructs the execution plans. To not reconstruct, input TRUE.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC DELETE_DATABASE_STATS();
SYSTEM_.SYS_TABLES_
SYSTEM_.SYS_COLUMNS_
SYSTEM_.SYS_DATABASE_
SYSTEM_.SYS_USERS_
.
.
.
Execute success.
```

DELETE_INDEX_STATS

This procedure deletes statistics pertaining to a particular index.

Syntax

```
DELETE_INDEX_STATS (
ownname              VARCHAR(128),
idxname              VARCHAR(128),
no_invalidate        BOOLEAN DEFAULT FALSE);
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the index
idxname	IN	VARCHAR(128)	The name of the index for which statistics are to be deleted
no_invalidate	IN	BOOLEAN	This specifies whether or not to reconstruct the execution plans for queries pertaining to the tables for which statistics are to be deleted. The default value is FALSE and reconstructs the execution plans. If this value is TRUE, the execution plans are not reconstructed.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC DELETE_INDEX_STATS('SYS','T1_IDX');
Execute success.
```

DELETE_SYSTEM_STATS

This procedure deletes statistics pertaining to the database system. Only the SYS user can execute this procedure.

Syntax

```
DELETE_SYSTEM_STATS ( );
```

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC DELETE_SYSTEM_STATS();
Execute success.
```

DELETE_TABLE_STATS

This procedure deletes statistics pertaining to a particular table, and the columns and indexes defined in the table.

Syntax

```
DELETE_TABLE_STATS (
ownname            VARCHAR(128),
tabname            VARCHAR(128),
partname           VARCHAR(128) DEFAULT NULL,
cascade_part       BOOLEAN DEFAULT TRUE,
cascade_column     BOOLEAN DEFAULT TRUE,
cascade_index      BOOLEAN DEFAULT TRUE,
no_invalidate      BOOLEAN DEFAULT FALSE );
```

Parameters

Name	Input/Output	Data Type	Description
ownname	IN	VARCHAR(128)	The name of the user who owns the index
tabname	IN	VARCHAR(128)	The name of the table for which statistics are to be deleted
partname	IN	VARCHAR(128)	The name of the table partition for which statistics are to be deleted. On specification, statistics pertaining only to the specified partition are deleted, regardless of the *cascade_part* value. If the value is NULL, the *cascade_part* value determines which statistics are to be deleted.
cascade_part	IN	BOOLEAN	If a partitioned table is specified for tabname and partname is NULL, this value determines which statistics are to be deleted. If this value is TRUE, the global table statistics of the partitioned table, as well as the table statistics for all partitions of the table are deleted. If this value is FALSE, only the global table statistics of the partitioned table are deleted. The default value is TRUE.
cascade_column	IN	BOOLEAN	This specifies whether to delete statistics pertaining only to the specified table, or statistics pertaining to all of the columns in the specified table as well. The default value is TRUE and deletes statistics pertaining to all of the columns in the specified table as well as statistics pertaining to the specified table. If this value is FALSE, statistics pertaining to only the specified table are deleted.
cascade_index	IN	BOOLEAN	This specifies whether to delete statistics pertaining to all of the indexes in the specified table, as well as statistics pertaining to the specified table. The default value is TRUE and deletes statistics pertaining to all of the indexes in the specified table as well as statistics pertaining to the specified table. If this value is FALSE, statistics pertaining to only the specified table are deleted.
no_invalidate	IN	BOOLEAN	This specifies whether or not to reconstruct the execution plans for queries pertaining to the tables for which statistics are to be deleted. The default value is FALSE and reconstructs the execution plans. If this value is TRUE, the execution plans are not reconstructed.

Return Value

Because it is a stored procedure, there is no return value.

Example

```
iSQL> EXEC DELETE_TABLE_STATS( 'SYS','T1');
Execute success.
```

Miscellaneous Functions

REMOVE_XID

This procedure forcibly deletes old XID information which was heuristically rolled back or committed in an XA environment.

Syntax

```
REMOVE_XID (xidname     IN VARCHAR(256));
```

Parameter

Name	Input/Output	Data Type	Description
xidname	IN	VARCHAR(256)	The name of the XID to be removed

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

REMOVE_XID can raise the following system-defined exceptions.

- NOT_EXIST_XID
- InvalidXaState

REFRESH_MATERIALIZED_VIEW

This is a stored procedure that reflects the base table data changes to the materialized view. By executing this stored procedure, data of the materialized view is updated accordingly to the base table.

If the user is not the owner of the materialized view to be refreshed, the following privileges are required to execute this stored procedure:

- ALTER ANY MATERIALIZED VIEW system privilege
- SELECT ANY TABLE system privilege or SELECT object privilege of the automatically created view for the materialized view.
- INSERT ANY TABLE and DELETE ANY TALBE system privileges, or INSERT AND DELETE object privileges of the automatically created view for the materialized view.

Syntax

```
REFRESH_MATERIALIZED_VIEW (
owner_name        IN VARCHAR(128),
mview_name        IN VARCHAR(128));
```

Parameters

Name	Input/Out	Data Type	Description
owner_name	IN	VARCHAR(128)	The owner name of the materialized view
mview_name	IN	VARCHAR(128)	The name of the materialized view

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

- SELECT, DELETE or INSERT failures due to absence of privilege.
- Tablespace space deficiency, excess of maximum rows for the materialized view, etc.
- Issues related to the following notes.

Notes

Refresh failure can be due to the following reasons:

- The user has altered the definition of the base table or deleted the table.
- The user has altered the definition of the table automatically created for the materialized view using the ALTER TABLE statement.
- Occurrence of Lock Timeout.
- Violation of table constraints.

SET_CLIENT_INFO

The SET_CLIENT_INFO configures a CLIENT_APP_INFO column and CLIENT_INFO column information in V$SESSION.

Syntax

```
SET_CLIENT_INFO (client_info IN VARCHAR(128));
```

Parameters

Name	Input/Output	Data Type	Description
*client_info *	IN	VARCHAR(128)	Client information

Return Value

Because it is a stored procedure, there is no return value.

Exception

This procedure does not ingenerate exceptions.

SET_MODULE

The SET_MODULE sets a MODULE column and an ACTION column information in V$SESSION.

Syntax

```
SET_MODULE (module IN VARCHAR(128),action IN VARCHAR(128));
```

Parameters

Name	Input/Output	Data Type	Description
module	IN	VARCHAR(128)	Module information
action	IN	VARCHAR(128)	Information of module activity

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

There is no exception

SLEEP

This procedure makes the session sleep for the number of seconds specified in the *seconds* argument.

Syntax

```
SLEEP (seconds IN INTEGER);
```

Parameter

Name	Input/Output	Data Type	Description
seconds	IN	INTEGER	The amount of time to sleep, in seconds

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

13. Altibase System-defined Stored Packages

This chapter discusses system-defined stored packages provided by Altibase.

System-defined Stored Packages

The system-defined Stored packages are the fundamental packages provided by Altibase, and they are owned by the SYS user

Types of System-difined Stored Packages

Altibase provides the system-defined Stored packages as follows.

Packages	Description
DBMS_APPLICATION_INFO	Configures the performance view in order to manage information of client application.
DBMS_ALERT	Notifies other users of events that occur in the database.
DBMS_CONCURRENT_EXEC	Allows procedures to be concurrently executed.
DBMS_LOCK	Offers an interface in which the user can request lock or unlock.
DBMS_METADATA	Provides the ability to extract object creation DDL statements or privileged GRANT statements from the database dictionary.
DBMS_OUPUT	allows the user to print a character string stored in buffer to a client.
DBMS_RANDOM	Creates arbitrary numbers.
DBMS_RECYCLEBIN	Can completely purge the tables which has been dropped and managed in the recycle bin.
DBMS_SQL	Provides procedures and functions utilizing dynamic SQL.
DBMS_STATS	Package views and modifies the stats information
DBMS_UTILITY	Provides various utility subprograms.
STANDARD	In addition to the basic data types, it defines the types that can be used without declaration in PSM.
UTL_COPYSWAP	Online DDL is supported by COPY & SWAP method
UTL_FILE	Can read and write text files managed by an operating system.
UTL_RAW	Can modify or alter RAW(VARBYTE) type data into a different type.
UTL_TCP	Controls TCP access in a stored procedure.

DBMS_APPLICATION_INFO

The DBMS_APPLICATION_INFO package tracks and manages the performance of the application by setting or getting values for the V$SESSION performance view.

The procedures and functions which are comprised of the DBMS_APPLICATION_INFO package are listed in the following table below.

Procedures/Functions	Description
READ_CLIENT_INFO	Imports MODULE and ACTION values specified in V$SESSION.
READ_MODULE	Imports MODULE and ACTION values specified in V$SESSION.
SET_ACTION	Configures values of ACTION in V$SESSION.
SET_CLIENT_INFO	Configures values of CLIENT_INFO in V$SESSION.
SET_MODULE	Configures MODULE and ACTION values of V$SESSION.

READ_CLIENT_INFO

The READ_CLIENT_INFO imports application information of client accessed to the current session.

Syntax

```
DBMS_APPLICATION_INFO.READ_CLIENT_INFO(client_info OUT VARCHAR(128));
```

Parameter

Name	Input/Output	Data Type	Description
client_info	OUT	VARCHAR(128)	Information of configured client applicaiton

Return Value

The number of records processed by executing a cursor are returned.

Exception

There is no exception.

Example

Import values of currently executing client information in the current session then print.

```
iSQL> var v1 varchar(128);
iSQL> EXEC DBMS_APPLICATION_INFO.READ_CLIENT_INFO(:v1);
iSQL> EXEC PRINTLN(:v1);
```

READ_MODULE

The READ_MODULE imports values of MODULE and ACTION specified in the V$SESSION performance view.

Syntax

```
DBMS_APPLICATION_INFO.READ_MODULE(module_name OUT VARCHAR(128), action_name OUT
VARCHAR(128));
```

Parameter

Name	In/Output	Data Type	Description
module_name	OUT	VARCHAR(128)	Specified values in the module.
action_name	OUT	VARCHAR(128)	Specified action values.

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

Import module name and action value of the procedure which is currently being executed then print.

```
iSQL> var v1 varchar(128);
iSQL> var v2 varchar(128)
iSQL> EXEC DBMS_APPLICATION_INFO.READ_MODEUL(:v1, :v2);
iSQL> EXEC PRINTLN(:v1);
iSQL> EXEC PRINTLN(:v2);
```

SET_ACTION

The SET_ACTION is a procedure configuring values of the ACTION column in V$SESSION performance view.

Syntax

```
DBMS_APPLICATION_INFO.SET_ACTION (action_name VARCHAR(128));
```

Parameter

Nameq	In/Output	Data Type	Description
action_name	IN	VARCHAR(128)	The values of ACTION column that will be specified.

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

The SET_ACTION sets the status of currently operating procedure to stop.

```
iSQL> EXEC DBMS_APPLICATION_INFO.SET_ACTION( 'stop');
```

SET_CLIENT_INFO

The SET_CLIENT_INFO configures the client information which is accessed to V$SESSION performance view.

Syntax

```
DBMS_APPLICATION_INFO.SET_CLIENT_INFO(client_info VARCHAR(128));
```

Parameter

Name	In/Output	Data Type	Description
client_info	IN	VARCHAR(128)	Client application information

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

This sets the client information to test_application.

```
iSQL> EXEC DBMS_APPLICATION_INFO.SET_CLIENT_INFO('test_application');
```

SET_MODULE

The SET_MODULE procedure configures MODULE and values of ACTION column(s) in V$SESSION performance view.

Syntax

```
DBMS_APPLICATION_INFO.SET_MODULE(module_name VARCHAR(128), action_name
VARCHAR(128));
```

Parameters

Name	In/Output	Data Type	Description
module_name	IN	VARCHAR(128)	The module values which will be configured
action_name	IN	VARCHAR(128)	The value of ACTION column which will be configured

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

The SET_MODULE procedure modifies the module name of currently running procedure to altibase_module, and sets the status to be running.

```
iSQL> EXEC DBMS_APPLICATION_INFO.SET_MODULE('altibase_module', 'running');
```

DBMS_ALERT

The DBMS_ALERT package informs and provides an alert to other users with the support of an interface form in regards to various database events.

The DBMS_ALERT package consists of the following procedures and functions.

Procedures/Fucntions	Description
REGISTER	Registers for an alert
REMOVE_EVENT	Removes a specific alert
REMOVEALL	Removes all the alerts
SET_DEFAULTS	Configures the standby time of an alert
SIGNAL	Delivers signals to alerts
WAITANY	Stands by for all the alerts
WAITONE	Awaits a certain alert

REGISTER

알람을 등록한다.

Syntax

```
DBMS_ALERT.REGISTER (name);
```

Parameter

Name	In/Output	Data Type	Description
name	IN	VARCHAR2(30)	The alert name

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
iSQL> EXEC DBMS_ALERT.REGISTER (‘S1’);
```

REMOVE_EVENT

This procedure removes a specific alert. The unregistered alert cannot be able to receive signals.

Syntax

```
DBMS_ALERT.REMOVE_EVENT( name );
```

Parameter

Name	In/Output	Data Type	Description
name	IN	VARCHAR2(30)	The alert name

Return Value

None

Exception

There is no exception.

Example

```
iSQL> EXEC DBMS_ALERT.REMOVE_EVENT ('S1');
```

REMOVEALL

This procedure removes all the alerts which have been already registered. The unregistered alerts cannot be able to receive signals.

Syntax

```
DBMS_ALERT.REMOVEALL();
```

Parameter

None

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
EXEC DBMS_ALERT.REMOVEALL ();
```

SET_DEFAULTS

This procedure sets the standby time for an alert.

Syntax

```
DBMS_ALERT.SET_DEFAULTS( poll_interval );
```

Parameter

Name	In/Output	Data Type	Description
poll_interval	IN	INTEGER	The standby time for an alert (Unit: seconds)

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
EXEC DBMS_ALERT.SET_DEFAULTS (5);
```

SIGNAL

This procedure sends a message included signal to an alert, and multiple signals can be sent; however, only the registered alerts can receive the signals.

Syntax

```
DBMS_ALERT.SIGNAL( name, message );
```

Parameters

Name	In/Output	Data Type	Description
name	IN	VARCHAR2(30)	An alert name
message	IN	VARCHAR2(1800)	Message

Return Value

None

Exception

There is no exception.

Example

```
EXEC DBMS_ALERT.SIGNAL (‘S1’, 'MESSAGE 001’);
```

WAITANY

This procedure is called to await signals. Only the registered alerts are able to receive the signals, and the procedure is terminated after a certain time(timeout) has passed in a condition of not being received signals.

Syntax

```
DBMS_ALERT.WAITANY( name, message, status, timeout );
```

Parameters

Name	In/Output	Data Type	Description
name	OUT	VARCHAR2(30)	An alert name
message	OUT	VARCHAR2(1800)	Message
status	OUT	INTEGER	Status (Success: 0, Fail: 1)
timeout	IN	INTEGER	The standby time for an alert(Timeout) (Unit: seconds)

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
VAR MESSAGE VARCHAR (1800);
VAR STATUS INTEGER;
EXEC DBMS_ALERT.WAITANY ( :NAME, :MESSAGE, :STATUS, 5 );
```

WAITONE

This procedure awaits a certain alert, and only the registered alerts can receive signals.

Syntax

```
DBMS_ALERT.WAITONE( name, message, status, timeout );
```

Parameters

Name	In/Output	Data Type	Description
name	OUT	VARCHAR2(30)	An alert name
message	OUT	VARCHAR2(1800)	Message
status	OUT	INTEGER	Status (Success: 0, Fail: 1)
timeout	IN	INTEGER	The standby time for an alert(Timeout) (Unit: seconds)

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
VAR NAME VARCHAR (30);
VAR MESSAGE VARCHAR (1800);
VAR STATUS INTEGER;
EXEC :name := 'S1';
EXEC DBMS_ALERT.WAITONE ( :NAME, :MESSAGE, :STATUS, 5 );
```

DBMS_CONCURRENT_EXEC Package

The DBMS_CONCURRENT_EXEC package allows the concurrent execution of procedures. This is a system-defined package.

DBMS_CONCURRENT_EXEC Procedures and Functions

The DBMS_CONCURRENT_EXEC package consists of the following procedures and functions.

Procedures/Functions	Description
INITIALIZE	Initializes the DBMS_CONCURRENT_EXEC package and specifies the number of procedures that can be executed concurrently.
REQUEST	Requests the DBMS_CONCURRENT_EXEC package to run a procedure.
WAIT_ALL	Waits for the execution of all procedures, that were requested by the DBMS_CONCURRENT_EXEC package, to finish.
WAIT_REQ	Waits for the procedure corresponding to Request ID to finish.
GET_ERROR_COUNT	Returns the number of errors that occurred on the requested procedure.
GET_ERROR	Fetches the syntax, error code, and error message of the procedure corresponding to Request ID.
PRINT_ERROR	Prints the syntax, error code, and error message of the procedure corresponding to Request ID.
GET_LAST_REQ_ID	Returns the most recently executed Request ID that was successful.
GET_REQ_TEXT	Returns the procedure syntax corresponding to Request ID.
FINALIZE	Frees the memory that executed the DBMS_CONCURRENT_EXEC package, and initializes the package.

Related Properties

Properties related to the DBMS_CONCURRENT_EXEC package can be set in the altibase.properties file.

- CONCURRENT_EXEC_DEGREE_MAX
- CONCURRENT_EXEC_DEGREE_DEFAULT
- CONCURRENT_EXEC_WAIT_INTERVAL

For more detailed information, please refer to the *General Reference*.

Restrictions

The DBMS_CONCURRENT_EXEC package has the following restrictions.

- Only procedures that do not return results can be executed; functions that do not return results cannot be executed.
- Procedures with output parameters cannot be executed.
- Procedures or functions cannot make recursive calls. If a recursive call is made, the RECURSIVE_CALL_IS_NOT_ALLOWED exception is raised.
- Cannot be used in parallel queries.
- Executed procedures cannot be printed to the screen with PRINT or PRINTLN. Logs are written in $ALTIBASE_HOME/trc/altibase_qp.log.

INITIALIZE

INITIALIZE initializes the DBMS_CONCURRENT_EXEC package and sets the number of procedures allowed to be executed in parallel. On omission, the value set for the CONCURRENT_EXEC_DEGREE_DEFAULT property is applied.

The maximum number of procedures allowed to be executed in parallel cannot exceed the value set for the CONCURRENT_EXEC_DEGREE_MAX property. If a number of procedures corresponding to CONCURRENT_EXEC_DEGREE_MAX is being executed in another session, 0 is returned and the function does not execute.

Syntax

```
INTERGER variable :=
  DBMS_CONCURRENT_EXEC.INITIALIZE (in_degree INTEGER DEFAULT NULL );
```

Parameter

Name	In/Output	Data Type	Description
in_dgree	IN	INTEGER	The number of procedures to be executed in parallel

Return Value

If successful, the number of procedures (DEGREE) that were set is returned. If the server failed to allocate resources, 0 is returned.

Exception

The following exception may occur when a procedure executed in the DBMS_CONCURRENT_EXEC package requests INTIALIZE.

```
RECURSIVE_CALL_IS_NOT_ALLOWED
```

Example

Initialize the DBMS_CONCURRENT_EXEC package and set the number of procedures to be executed in parallel to 4.

```
VARIABLE OUT_DEGREE INTEGER;
EXEC :OUT_DEGREE := DBMS_CONCURRENT_EXEC.INITIALIZE(4);
```

REQUEST

REQUEST requests the DBMS_CONCURRENT_EXEC package to execute a procedure.

Syntax

```
INTERGER variable :=
  DBMS_CONCURRENT_EXEC.REQUEST(text VARCHAR(8192) );
```

Parameter

Name	In/Output	Data Type	Description
text	IN	VARCHAR(8192)	The procedure and procedure arguments

Return Value

If successful, Request ID is returned. Request ID is managed in the DBMS_CONCURRENT_EXEC package.

If unsuccessful, -1 is returned. However, it is still possible to fetch Request ID, and errors can be checked with the GET_ERROR function.

Exception

The following exception may occur when a procedure executed in the DBMS_CONCURRENT_EXEC package requests this function.

```
RECURSIVE_CALL_IS_NOT_ALLOWED
```

Example

Request procedures in the DBMS_CONCURRENT_EXEC package to be executed in parallel.

```
VARIABLE REQ_ID1 INTEGER;
VARIABLE REQ_ID2 INTEGER;
VARIABLE REQ_ID3 INTEGER;
VARIABLE REQ_ID4 INTEGER;
EXEC :REQ_ID1 := DBMS_CONCURRENT_EXEC.REQUEST('PROC1');
EXEC :REQ_ID2 := DBMS_CONCURRENT_EXEC.REQUEST('PROC2(1, 1, 3)');
EXEC :REQ_ID3 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''ABC'', 3, 3)');
EXEC :REQ_ID4 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''DEF'', 3, 3)');
```

WAIT_ALL

WAIT_ALL waits until the execution of procedures to be executed in parallel are finished.

Syntax

```
INTERGER variable :=
  DBMS_CONCURRENT_EXEC.WAIT_ALL(  );
```

Return Value

If successful, 1 is returned. If unsuccessful, -1 is returned.

Exception

The following exception can occur when requesting WAIT_ALL from a procedure executed by the DBMS_CONCURRENT_EXEC package.

```
RECURSIVE_CALL_IS_NOT_ALLOWED
```

Example

The following is an example of waiting for all the procedures requested by the DBMS_CONCURRENT_EXEC package to complete.

```
VARIABLE RC INTEGER;
VARIABLE REQ_ID1 INTEGER;
VARIABLE REQ_ID2 INTEGER;
VARIABLE REQ_ID3 INTEGER;
VARIABLE REQ_ID4 INTEGER;
EXEC :REQ_ID1 := DBMS_CONCURRENT_EXEC.REQUEST('PROC1');
EXEC :REQ_ID2 := DBMS_CONCURRENT_EXEC.REQUEST('PROC2(1, 1, 3)');
EXEC :REQ_ID3 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''ABC'', 3, 3)');
EXEC :REQ_ID4 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''DEF'', 3, 3)');
EXEC :RC := DBMS_CONCURRENT_EXEC.WAIT_ALL( );
```

WAIT_REQ

This procedure waits until the operation of a specific procedure being processed in parallel to be completed in the DBMS_CONCURRENT_EXEC package.

Syntax

```
INTERGER variable :=
  DBMS_CONCURRENT_EXEC.WAIT_REQ( req_id INTEGER);
```

Parameter

Name	In/Output	Data Type	Description
req_id	IN	INTEGER	The Request ID corresponding to the procedure executed by packages.

Return Value

1 is returned when successfully executed.

If a request ID does not exist, -1 is returned.

Exception

If a procedure executed in the DBMS_CONCURRENT_EXEC package requests this function, the following exception can be occurred.

```
RECURSIVE_CALL_IS_NOT_ALLOWED
```

Example

This is an example of waiting until the procedure requested by 'REQ_ID1' to be completed in the DBMS_CONCURRENT_EXEC package.

```
VARIABLE RC INTEGER;
VARIABLE REQ_ID1 INTEGER;
VARIABLE REQ_ID2 INTEGER;
VARIABLE REQ_ID3 INTEGER;
VARIABLE REQ_ID4 INTEGER;
EXEC :REQ_ID1 := DBMS_CONCURRENT_EXEC.REQUEST('PROC1');
EXEC :REQ_ID2 := DBMS_CONCURRENT_EXEC.REQUEST('PROC2(1, 1, 3)');
EXEC :REQ_ID3 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''ABC'', 3, 3)');
EXEC :REQ_ID4 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''DEF'', 3, 3)');
EXEC :RC := DBMS_CONCURRENT_EXEC.WAIT_REQ(:REQ_ID1);
```

GET_ERROR_COUNT

GET_ERROR_COUNT returns the number of errors that occurred during the execution of a requested procedure. To get an accurate count, call WAIT_ALL and then GET_ERROR_COUNT.

Syntax

```
INTERGER variable :=
  DBMS_CONCURRENT_EXEC.GET_ERROR_COUNT( );
```

Return Value

If successful, the number of errors is returned.

0 means that the execution of all requested procedures was successful.

Example

The following exception may occur when a procedure executed in DBMS_CONCURRENT_EXEC package requests this functon.

```
RECURSIVE_CALL_IS_NOT_ALLOWED
```

Example

Get the number of errors that occurred during the execution of a procedure.

```
VARIABLE ERR_COUNT INTEGER;
VARIABLE RC INTEGER;
VARIABLE REQ_ID1 INTEGER;
VARIABLE REQ_ID2 INTEGER;
VARIABLE REQ_ID3 INTEGER;
VARIABLE REQ_ID4 INTEGER;
EXEC :REQ_ID1 := DBMS_CONCURRENT_EXEC.REQUEST('PROC1');
EXEC :REQ_ID2 := DBMS_CONCURRENT_EXEC.REQUEST('PROC2(1, 1, 3)');
EXEC :REQ_ID3 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''ABC'', 3, 3)');
EXEC :REQ_ID4 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''DEF'', 3, 3)');
EXEC :RC := DBMS_CONCURRENT_EXEC.WAIT_ALL( );
EXEC :ERR_COUNT := DBMS_CONCURRENT_EXEC.GET_ERROR_COUNT( );
```

GET_ERROR

GET_ERROR fetches the syntax, error code, and error message of the procedure corresponding to Request ID. To get accurate information, call WAIT_ALL, and then GET_ERROR.

Syntax

```
INTERGER variable :=
  DBMS_CONCURRENT_EXEC.GET_ERROR(
     req_id IN INTEGER,
     text OUT VARCHAR(8192),
     err_code OUT INTEGER,
     err_msg OUT VARCHAR(8192));
```

Parameters

Name	In/Output	Data Type	Description
req_id	IN	INTEGER	The Request ID corresponding to the procedure for which error information is to be fetched
text	OUT	VARCHAR(8192)	The syntax of the procedure
err_code	OUT	INTEGER	The error code
err_msg	OUT	VARCHAR(8192)	The error message

Return Value

If successful, Request ID is returned.

If neither Request ID exists nor an error occurred, -1 is returned.

Exception

The following exception may occur when a procedure executed in DBMS_CONCURRENT_EXEC package requests this functon.

```
RECURSIVE_CALL_IS_NOT_ALLOWED
```

Example

Fetch the error that occurred during the execution of a procedure.

```
VARIABLE RC INTEGER;
VARIABLE TEXT VARCHAR(8192);
VARIABLE ERR_CODE INTEGER;
VARIABLE ERR_MSG VARCHAR(8192);
VARIABLE REQ_ID INTEGER;
EXEC :REQ_ID := DBMS_CONCURRENT_EXEC.REQUEST('PROC1');
EXEC :RC := DBMS_CONCURRENT_EXEC.WAIT_REQ(:REQ_ID);
EXEC :REQ_ID := DBMS_CONCURRENT_EXEC.GET_ERROR( :REQ_ID, :TEXT, :ERR_CODE, :ERR_MSG);
```

PRINT_ERROR

PRINT_ERROR prints the syntax, error code, and error message of the procedure corresponding to Request ID.

Syntax

```
INTERGER variable :=
  DBMS_CONCURRENT_EXEC.PRINT_ERROR(req_id IN INTEGER);
```

Parameter

Name	In/Out	Data Type	Description
req_id	IN	INTEGER	The Request ID corresponding to the procedure to be printed

Example

The following exception may occur when a procedure executed in the DBMS_CONCURRENT_EXEC package requests this function.

```
RECURSIVE_CALL_IS_NOT_ALLOWED
```

Example

Print an error that occurred during the execution of a procedure.

```
VARIABLE RC INTEGER;
VARIABLE REQ_ID1 INTEGER;
VARIABLE REQ_ID2 INTEGER;
VARIABLE REQ_ID3 INTEGER;
VARIABLE REQ_ID4 INTEGER;
EXEC :REQ_ID1 := DBMS_CONCURRENT_EXEC.REQUEST('PROC1');
EXEC :REQ_ID2 := DBMS_CONCURRENT_EXEC.REQUEST('PROC2(1, 1, 3)');
EXEC :REQ_ID3 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''ABC'', 3, 3)');
EXEC :REQ_ID4 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''DEF'', 3, 3)');
EXEC :RC := DBMS_CONCURRENT_EXEC.WAIT_ALL();
EXEC DBMS_CONCURRENT_EXEC.PRINT_ERROR(:REQ_ID1);
EXEC DBMS_CONCURRENT_EXEC.PRINT_ERROR(:REQ_ID2)
EXEC DBMS_CONCURRENT_EXEC.PRINT_ERROR(:REQ_ID3);
EXEC DBMS_CONCURRENT_EXEC.PRINT_ERROR(:REQ_ID4);
```

GET_LAST_REQ_ID

GET_LAST_REQ_ID returns the most recently executed Request ID that was successful.

Syntax

```
INTERGER variable :=
  DBMS_CONCURRENT_EXEC.GET_LAST_REQ_ID( );
```

Return Value

If successful, the most recently executed Request ID is returned.

Exception

There is no exception.

Example

The following is an example of obtaining the ID of the procedure operation last requested through the DBMS_CONCURRENT_EXEC package.

```
VARIABLE LAST_REQ_ID INTEGER;
VARIABLE REQ_ID1 INTEGER;
VARIABLE REQ_ID2 INTEGER;
VARIABLE REQ_ID3 INTEGER;
VARIABLE REQ_ID4 INTEGER;
EXEC :REQ_ID1 := DBMS_CONCURRENT_EXEC.REQUEST('PROC1');
EXEC :REQ_ID2 := DBMS_CONCURRENT_EXEC.REQUEST('PROC2(1, 1, 3)');
EXEC :REQ_ID3 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''ABC'', 3, 3)');
EXEC :REQ_ID4 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''DEF'', 3, 3)');
EXEC :LAST_REQ_ID := DBMS_CONCURRENT_EXEC.GET_LAST_REQ_ID( );
```

GET_REQ_TEXT

GET_REQ_TEXT returns the syntax of the requested procedure.

Syntax

```
VARCHAR(8192) variable :=
  DBMS_CONCURRENT_EXEC.GET_REQ_TEXT(req_id IN INTEGER);
```

Parameter

Name	In/Out	Data Type	Description
req_id	IN	INTEGER	The Request ID corresponding to theprocedure for which syntax is to be returned

Return Value

If successful, the syntax of the procedure is returned.

If the Request ID does not exist, NULL is returned.

Exception

There is no exception.

Example

The following is an example of obtaining the procedure operation syntax requested through the DBMS_CONCURRENT_EXEC package.

```
VARIABLE REQ_ID1 INTEGER;
VARIABLE REQ_ID2 INTEGER;
VARIABLE REQ_ID3 INTEGER;
VARIABLE REQ_ID4 INTEGER;
EXEC :REQ_ID1 := DBMS_CONCURRENT_EXEC.REQUEST('PROC1');
EXEC :REQ_ID2 := DBMS_CONCURRENT_EXEC.REQUEST('PROC2(1, 1, 3)');
EXEC :REQ_ID3 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''ABC'', 3, 3)');
EXEC :REQ_ID4 := DBMS_CONCURRENT_EXEC.REQUEST('PROC3(''DEF'', 3, 3)');
EXEC PRINTLN(DBMS_CONCURRENT_EXEC.GET_REQ_TEXT(:REQ_ID1));
EXEC PRINTLN(DBMS_CONCURRENT_EXEC.GET_REQ_TEXT(:REQ_ID2));
EXEC PRINTLN(DBMS_CONCURRENT_EXEC.GET_REQ_TEXT(:REQ_ID3));
EXEC PRINTLN(DBMS_CONCURRENT_EXEC.GET_REQ_TEXT(:REQ_ID4));
```

FINALIZE

FINALIZE initializes the DBMS_CONCURRENT_EXEC package and frees used resources.

Syntax

```
INTERGER variable :=
  DBMS_CONCURRENT_EXEC.FINALIZE( );
```

Return Value

If successful, 1 is returned.

Exception

The following exception may occur when a procedure executed in the DBMS_CONCURRENT_EXEC package requests this function.

```
RECURSIVE_CALL_IS_NOT_ALLOWED
```

Example

The following is an example of initializing the DBMS_CONCURRENT_EXEC package and returning the used system resources.

```
VARIABLE RC INTEGER;
VARIABLE REQ_ID INTEGER;
EXEC :REQ_ID := DBMS_CONCURRENT_EXEC.REQUEST('PROC1');
EXEC :RC := DBMS_CONCURRENT_EXEC.FINALIZE( );
```

DBMS_LOCK

The DBMS_LOCK package provides an interface managing lock and unlock which can be requested.

The following table demonstrates the procedures and functions comprised of the DBMS_LOCK package.

Procedures/Functions	Description
RELEASE	Unlocks the user.
REQUEST	Requests the user lock.
SLEEP	Makes the session to rest for a certain period of time as it is set.
SLEEP2	Makes the session to rest for a certain period of time as it is set.

Related Properties

DBMS_LOCK properties can be set in altibase.properties.

- USER_LOCK_POOL_INIT_SIZE
- USER_LOCK_REQUEST_CHECK_INTERVAL
- USER_LOCK_REQUEST_LIMIT
- USER_LOCK_REQUEST_TIMEOUT

For more detailed information, please refer to the *General Reference*.

RELEASE

The RELEASE is a function which unlocks the user account.

Syntax

```
INTEGER variable :=
  DBMS_LOCK.RELEASE(id IN INTEGER);
```

Parameters

Name	In/Output	Data Type	Description
id	IN	INTEGER	Lock ID 0 ~ 1073741823

Result Values

The result values are as follows.

- 0 : Success
- 3 : Parameter error
- 4: Already own lock specified by id

Exception

There is no exception in this function; however, if it fails, other values, rather than 0, are returned.

Example

Unlocks ID which is 0.

```
iSQL> var v1 integer;
iSQL> v1 := dbsm_lock.release(0);
```

REQUEST

The REQUEST is a function requesting the user lock.

Syntax

```
INTEGER variable :=
  DBMS_LOCK.REQUEST(
    id IN INTEGER,
    lockmode IN INTEGER DEFAULT x_mode,
    timeout IN INTEGER DEFAULT MAXWAIT,
    release_on_commit IN BOOLEAN DEFAULT FALSE);
```

Parameters

Name	In/Output	Data Type	Description
id	IN	INTEGER	Lock ID 0 ~ 1073741823
lockmode	IN	INTEGER	This is the parameter only for compatibility. x_mode (exclusive lock) is supported.
timeout	IN	INTEGER	This is the parameter only for compatibility. The default value is MAXWAIT.
release_on_commit	IN	INTEGER	This is a parameter only for compatibility. The default value is FALSE.

Result Values

The result values are as follows.

- 0 : Success
- 1 : Timeout
- 3 : Parameter error
- 4: Already own lock specified by id

Exception

There is no exception in this function; however, if it fails, other values, rather than 0, are returned.

Example

Requests lock on the ID which is 0.

```
iSQL> var v1 integer;
iSQL> v1 := dbsm_lock.request(0);
```

SLEEP

The SLEEP is a procedure putting the procedure into to sleep for a specific time.

Syntax

```
DBMS_LOCK.SLEEP(seconds IN INTEGER);
```

Parameter

Name	In/Output	Data Type	Description
second	IN	INTEGER	Sleep for a specific seconds. There is no maximum.

Result Value

Because it is a stored procedure, there is no result value.

Exception

There is no exception.

SLEEP2

The SLEEP is a procedure putting the procedure into to sleep for a specific time.

Syntax

```
DBMS_LOCK.SLEEP2(seconds IN INTEGER, microseconds IN INTEGER);
```

Parameter

Name	In/Output	Data Type	Description
seconds	IN	INTEGER	Sleep for a specific seconds. There is no maximum.
microseconds	IN	INTEGER	Maximum amount of time, in microseconds, that a session is idle is 999999

Result Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

DBMS_METADATA

The DBMS_METADATA package provides the ability to extract object creation DDL statements or privileged GRANT statements from the database dictionary. The following table shows the procedures and functions that make up the DBMS_METADATA package.

Procedures/Functions	Description
GET_DDL	Returns DDL statement for specified object
GET_DEPENDENT_DDL	Returns DDL statement for objects that depend on the specified object
GET_GRANTED_DDL	Returns GRANT statement for privileges granted to specified user
SET_TRANSFORM_PARAM	Whether to include specific items in the returned DDL statement
SHOW_TRANSFORM_PARAMS	Outputs the currently set transform parameter value.

GET_DDL

This returns DDL statement for specified object.

Syntax

```
DBMS_METADATA.GET_DDL (
   object_type      IN VARCHAR(20),
   object_name      IN VARCHAR(128),
   schema           IN VARCHAR(128) DEFAULT NULL)
RETURN VARCHAR(65534);
```

Parameter

Name	In/Output	Data Type	Description
object_type	IN	VARCHAR(20)	Object type
object_name	IN	VARCHAR(128)	Object name (case sensitive)
schema	IN	VARCHAR(128)	Object owner (case sensitive) If object_type is a schema object, the default value is the currently connected user; if it is a non-schema object, the default value is NULL.

object_type

Schema objects

- CONSTRAINT
- DB_LINK
- FUNCTION
- INDEX
- LIBRARY
- MATERIALIZED_VIEW
- PACKAGE
- PACKAGE_SPEC
- PACKAGE_BODY
- PROCEDURE
- QUEUE
- REF_CONSTRAINT
- SEQUENCE
- SYNONYM
- TABLE
- TRIGGER
- TYPESET
- VIEW

Non-schema objects

- DIRECTORY
- JOB
- REPLICATION
- ROLE
- TABLESPACE: Memory system tablespaces do not return DDL statements, and disk system tablespaces return ALTER statements.
- USER

Return Value

DDL Statement

Exception

invalid_argval
not_supported_obj_type
schema_not_found
object_not_found
not_supported_ddl

Example

The following example shows how to create the DDL statement for all tables owned by the connection user.

```
set vertical on;
SELECT TO_CHAR(dbms_metadata.get_ddl('TABLE', table_name, null)) as ddl
FROM system_.sys_tables_
WHERE table_type = 'T' AND user_id = user_id()
ORDER BY table_name;
```

GET_DEPENDENT_DDL

This returns DDL statement for objects that depend on the specified object

Syntax

```
DBMS_METADATA.GET_DEPENDENT_DDL (
   object_type          IN VARCHAR(20),
   base_object_name     IN VARCHAR(128),
   base_object_schema   IN VARCHAR(128) DEFAULT NULL)
RETURN VARCHAR(65534);
```

Parameters

Name	In/Output	Data Type	Description
object_type	IN	VARCHAR(20)	Object type
base_object_name	IN	VARCHAR(128)	Base object name (case sensitive)
base_object_schema	IN	VARCHAR(128)	Base object owner (case sensitive). Default is the currently connected user.

object_type

- COMMENT
- CONSTRAINT
- INDEX
- OBJECT_GRANT

- REF_CONSTRAINT
- TRIGGER

Return Value

DDL statement

Exceptions

invalid_argval
not_supported_obj_type
schema_not_found
object_not_found

Example

The following example shows how to get all object privileges for the T1 table of the connecting user.

```
set vertical on;
SELECT TO_CHAR(dbms_metadata.get_dependent_ddl('OBJECT_GRANT', 'T1')) as ddl
FROM dual;
```

GET_GRANTED_DDL

This returns the DDL statement for creating privileges granted to the specified user.

Syntax

```
DBMS_METADATA.GET_GRANTED_DDL (
   object_type          IN VARCHAR(20),
   grantee              IN VARCHAR(128) DEFAULT NULL)
RETURN VARCHAR(65534);
```

Parameters

Name	In/Output	Data Type	Description
object_type	IN	VARCHAR(20)	Object type
grantee	IN	VARCHAR(128)	grantee (case sensitive). Default is the current user.

object_type

- OBJECT_GRANT
- ROLE_GRANT
- SYSTEM_GRANT

Return Value

DDL statement

Exceptions

invalid_argval
not_supported_obj_type
grantee_not_found
object_not_found

Example

This example shows how to get all system privileges granted to user USER1.

```
set vertical on;
SELECT TO_CHAR(dbms_metadata.get_granted_ddl('SYSTEM_GRANT', 'USER1')) as ddl
FROM dual;
```

SET_TRANSFORM_PARAM

Option to include specific items in the returned DDL statement. Parameter settings apply only within the same session.

Syntax

```
DBMS_METADATA.SET_TRANSFORM_PARAM (
   name           IN VARCHAR(40),
   value          IN CHAR(1));
```

Parameter

Name	In/Output	Data Type	Description
name	IN	VARCHAR(40)	Parameter name
value	IN	CHAR(1)	Value

Applied Parameters by Object Type

Object Type	Name	Description	Default
모든 객체	SQLTERMINATOR	Specifies whether to append an SQL terminator to the DDL statement. T: appends an SQL terminator F: does not append an SQL terminator	F
TABLE INDEX CONSTRAINT	SEGMENT_ATTRIBUTES	Specifies whether segment attributes (physical attributes, storage clause, tablespace, logging) are included. T: With F: Without	T
	STORAGE	storage clause 포함 여부를 지정한다. T: 포함 F: 미포함	T
	TABLESPACE	Specifies whether the storage clause is included. T: With F: Without	T
TABLE	CONSTRAINTS	Specifies whether to include constraint (primary key, unique, check) except foreign key. T: With F: Without	T
	REF_CONSTRAINTS	Specifies whether or not to include a foreign key. T: With F: Without	

Return Value

None

Exception

invalid_argval

Example

This example configures the SQL terminator to be appended to the returned DDL statement.

```
exec dbms_metadata.set_transform_param('SQLTERMINATOR', 'T');
```

SHOW_TRANSFORM_PARAMS

This outputs the currently set transform parameter value.

Syntax

```
DBMS_METADATA.SHOW_TRANSFORM_PARAMS;
```

Return Value

None

Exception

There is no exception.

DBMS_OUTPUT

The DBMS_OUTPUT package provides an interface in which the user can print the stored character strings in the buffer to clients.

The procedure and functions comprised of the DBMS_OUTPUT package are as shown in the following table.

Procedures/Functions	Description
NEW_LINE	Prints a character string stored in the buffer along with new-line characters.
PUT	Stores a character string in the buffer.
PUT_LINE	Prints a character string stored in the buffer.

NEW_LINE

The NEW-LINE procedure prints new-line characters(\n for Unix).

Syntax

```
DBMS_OUTPUT.NEWLINE;
```

Parameter

None

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

PUT

The PUT is a function storing a characteristic string in the buffer.

Syntax

```
DBMS_OUTPUT.PUT(str IN VARCHAR(65534));
```

Parameter

Name	In/Output	Data Type	Description
str	IN	VARCHAR(65534)	The buffer in which the character string to store read from a file

Result Values

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

PUT_LINE

The PUT_LINE is function which outputs by attaching the new-line characters (\n for Unix) to the character strings printed in the buffer.

Syntax

```
DBMS_OUTPUT.PUT_LINE(str IN VARCHAR(65533));
```

Parameter

Name	In/Output	Data Type	Description
str	IN	VARCHAR(65534)	The buffer in which the character string to store read from a file.

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

DBMS_RANDOM

The DBMS_RANDOM packages enables creating arbitrarily numbers.

The following table explicates the procedures and functions that are comprised of the DBMS_RANDOM package.

Procedures/Functions	Description
INITIALIZE	Executes initialization of the DBMS_RANDOM package.
SEED	Sets given values or a character string to seed.
STRING	The STRING procedure creates arbitrary numbers.
VALUE	Procedure creates arbitrary values within a specific range.
RANDOM	Generates a random number

INITIALIZE

The INITIALIZE is a procedure which initializes the DBMS_RANDOM package.

Syntax

```
DBMS_RANDOM.INITIALIZE(val IN INTEGER);
```

Parameter

Name	In/Output	Data Type	Description
val	IN	INTEGER	The value specified by seed.

Return Values

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

SEED

The SEED is a procedure creating values for arbitrary sequence by setting given values or a character string to seed.

Syntax

```
DBMS_RANDOM.SEED(seedval IN INTEGER);
DBMS_RANDOM.SEED(seedval IN VARCHAR(2000));
```

Parameters

Name	In/Output	Data Type	Description
seedval	IN	INTEGER or VARCHAR(200 0)	The character string or values that will be specified seed.

Return Values

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

STRING

The STRING procedure creates an arbitrary character string.

Syntax

```
DBMS_RANDOM.STRING(opt IN CHAR, len IN NUMBER);
```

Parameter

Name	In/Output	Data Type	Description
opt	IN	CHAR	The character string which will be created.
len	IN	NUMBER	The length of the character string which will be created.

Description

opt can specifies one of the following parameters listed as below.

- 'u', 'U': Create arbitrary capital letters of alphabet.
- 'l', 'L' : Create arbitrary small letters of alphabet.
- 'a', 'A' :Create alphabet letters regardless of capital or small letters.
- 'x', 'X' : Create capital letters of alphabet and numbers

- 'p', 'P' : Create all the character strings that can be printable.

len(gth) indicates the length of an arbitrary character string and available input rages from 0 to 4000.

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

VALUE

The VALUE is a procedure which creates arbitrary values within a specified range. If the range is not specified, arbitrary numbers from 0 to 1is returned.

Syntax

```
NUMBER variable := DBMS_RANDOM.VALUE(low IN NUMBER, high IN NUMBER);
```

Parameters

Name	In/Output	Data Type	Description
low	IN	NUMBER	The minimum value of the range for creating arbitrary values.
high	IN	NUMBER	The maximum value of the range for creating arbitrary values.

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

RANDOM

This function is a procedure for generating arbitrary integer values.

Syntax

DBMS_RANDOM. RANDOM();

Parameter

None

Return Value

On successful execution, it returns a random integer value.

Exception

There is no exception.

Example

Output a random number.

```
iSQL> select dbms_random.random() from dual;
```

DBMS_RECYCLEBIN Package

The DBMS_RECYCLEBIN package allows the user to completely eliminate a table that was dropped and moved to the recycle bin. This feature is provided as a system-defined stored package.

DBMS_RECYCLEBIN Procedures and Functions

The DBMS_RECYCLEBIN package consists of the following procedures and functions.

Procedures/Functions	Description
PURGE_USER_RECYCLEBIN	Drops tables in the recycle bin from the system, for each user.
PURGE_ALL_RECYCLEBIN	Drops all tables in the recycle bin.
PURGE_TABLESPACE	Drops all tables from the specified tablespace.
PURGE_ORIGINAL_NAME	Drop all duplicate tables in the recycle bin, by the name they had before they were moved.

Related Properties

DBMS_RECYCLEBIN properties can be set in altibase.properties.

- RECYCLEBIN_DISK_MAX_SIZE
- RECYCLEBIN_MEM_MAX_SIZE
- RECYCLEBIN_ENABLE

For more detailed information, please refer to the *General Reference.*

PURGE_USER_RECYCLEBIN

PURGE_USER_RECYCLEBIN completely eliminates tables in the recycle bin from the database system, for each user

Syntax

```
EXEC DBMS_RECYCLEBIN.PURGE_USER_RECYCLEBIN;
```

Example

Drop the tables in the recycle bin that were moved to the recycle bin by the user who is currently connected.

```
EXEC DBMS_RECYCLEBIN.PURGE_USER_RECYCLEBIN;
```

PURGE_ALL_RECYCLEBIN

PURGE_ALL_RECYCLEBIN drops all tables in the recycle bin from the database system.

Syntax

```
EXEC DBMS_RECYCLEBIN.PURGE_ALL_RECYCLEBIN;
```

Example

Drop all tables from the recycle bin.

```
EXEC DBMS_RECYCLEBIN.PURGE_ALL_RECYCLEBIN;
```

PURGE_TABLESPACE

PURGE_TABLESPACE drops all specified tables in the recycle bin from the system.

Syntax

```
EXEC DBMS_RECYCLEBIN.PURGE_TABLESPACE(
  tablespace_name IN VARCHAR(64));
```

Parameter

Name	In/Output	Data Type	Description
tablespace_name	IN	VARCHAR(64)	The tablespace name

Example

Drop the tables that exist in the TBS_DISK_DATA tablespace from the recycle bin.

```
EXEC DBMS_RECYCLEBIN.PURGE_TABLESPACE('TBS_DISK_DATA');
```

PURGE_ORIGINAL_NAME

Drops tables from the recycle bin by the names the tables had before they were dropped. Tables with identical names can be dropped several times, and dropped all at once from the recycle bin.

Syntax

```
EXEC DBMS_RECYCLEBIN.PURGE_ORIGINAL_NAME(
  original_table_name IN VARCHAR(128));
```

Parameter

Name	In/Output	Data Type	Description
original_table_name	IN	VARCHAR(128)	The name of the table before it was dropped.

Example

Drop all tables that had the name 'TABLE1' before they were dropped, from the system.

```
EXEC DBMS_RECYCLEBIN.PURGE_ORIGINAL_NAME('TABLE1');
```

DBMS_SQL

The DBMS_SQL provides procedures and functions which utilize dynamic SQL as shown in the table below.

Procedures/Functions	Description
OPEN_CURSOR	Opens a cursor. The maximum number of cursors, which can be open, is be specified in the PSM_CURSOR_OPEN_LIMIT property. (Default Value: 32)
IS_OPEN	Checks on the status of cursor to see if it is open or not in order to return the results.
PARSE	Execute parsing SQL statements.
BIND_VARIABLE	Binds variables which are included in the SQL statement.
EXECUTE_CURSOR	Executes the cursor.
DEFINE_COLUMN	Defines the columns which will be fetched in the cursor.
FETCH_ROWS	Imports a row which is supposed to fetch. It is only used in the SELECT statement.
COLUMN_VALUE	Imports the value of a column which is a variable of the cursor. It is only used in the SELECT statement.
CLOSE_CURSOR	Closes the cursor.
LAST_ERROR_POSITION	Returns the location of the error that occurred when parsing.

Related Properties

DBMS_SQL package related properties can be set in altibase.properties.

- PSM_CURSOR_OPEN_LIMIT

For more detailed information, please refer to the *General Reference.*

BIND_VARIABLE

The BIND_VARIABLE procedure execute binding of variables which are included in the SQL statement.

Syntax

```
DBMS_SQL.BIND_VARIABLE(c, name, value);
```

Parameters

Name	In/Output	Data Type	Description
c	IN	INTEGER	The cursor number
name	IN	VARCHAR2(128)	The variable name starting with a colon (;).
value	IN	VARCHAR2(32000), CHAR(32000), INTEGER, BIGINT, SMALLINT, DOUBLE, REAL, NUMERIC(38), DATE	The language option(It is not supported so that it can be neglected regardless of any value).

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
as
c integer;
b1 integer;
begin
c := dbms_sql.open_cursor;
println( c );
dbms_sql.parse( c, 'insert into t1 values ( :b1 )', dbms_sql.native );
b1 := 999;
dbms_sql.bind_variable( c, ':b1', b1 );
end;
/
Create success.

iSQL> exec proc1;
0
Execute success.
```

CLOSE_CURSOR

The CLOSE_CURSOR procedure closes a cursor. If the cursor cannot be closed, it is closed when the session is terminated.

Syntax

```
DBMS_SQL.CLOSE_CURSOR(c);
```

Parameter

Name	In/Output	Data Type	Descritption
c	IN	INTEGER	Cursor number

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
as
c integer;
b1 integer;
c1 integer;
rc bigint;
begin
c := dbms_sql.open_cursor;
println( c );
dbms_sql.close_cursor( c );
end;
/
Create success.

iSQL> exec proc1;
0
Execute success.
```

COLUMN_VALUE

The COLUMN_VALUE procedure imports the value of a column which is the binding variables of cursor.

Syntax

```
DBMS_SQL.COLUMN_VALUE(c, position, column_value);
```

Parameters

Name	In/Output	Data Type	Descritpion
c	IN	INTEGER	The cursor number
position	IN	INTEGER	The relational position when fetching a column. It starts with 1.
column_value	OUT	VARCHAR2(32000), CHAR(32000), INTEGER, BIGINT, SMALLINT, DOUBLE, REAL, NUMERIC(38), DATE	Store the value of a column

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
as
c integer;
b1 integer;
c1 integer;
rc bigint;
begin
c := dbms_sql.open_cursor;
println( c );
dbms_sql.parse( c, 'select i1 from t1 where i1 = :b1', dbms_sql.native );
b1 := 999;
dbms_sql.bind_variable( c, ':b1', b1 );
rc := dbms_sql.execute_cursor( c );
```

```
dbms_sql.define_column( c, 1, c1 );
loop
exit when dbms_sql.fetch_rows( c ) = 0;
dbms_sql.column_value(c, 1, c1);
println( 'fetch -> ' || c1 );
end loop;
end;
/
Create success.

iSQL> exec proc1;
0
fetch -> 999
Execute success.
```

DEFINE_COLUMN

The DEFINE_COLUMN procedure defines the type of column which will be fetched. It is only used in the SELECT statement.

Syntax

```
DBMS_SQL.DEFINE_COLUMN(c, position, column_value);
```

Parameters

Name	In/Output	Data Type	Description
c	IN	INTEGER	Cursor number
position	IN	INTEGER	The location of a column. It starts with 1.
column_value	IN	VARCHAR2(32000), CHAR(32000), INTEGER, BIGINT, SMALLINT, DOUBLE, REAL, NUMERIC(38), DATE	The definition of column type

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
as
c integer;
b1 integer;
c1 integer;
rc bigint;
begin
c := dbms_sql.open_cursor;
println( c );
dbms_sql.parse( c, 'select i1 from t1 where i1 = :b1', dbms_sql.native );
b1 := 999;
dbms_sql.bind_variable( c, ':b1', b1 );
rc := dbms_sql.execute_cursor( c );
dbms_sql.define_column( c, 1, c1 );
end;
/
Create success.

iSQL> exec proc1;
0
Execute success.
```

EXECUTE_CURSOR

The EXECUTE_CURSOR function implements a cursor.

Syntax

```
BIGINT variable:=DBMS_SQL.EXECUTE_CURSOR(c);
```

Parameter

Name	In/Output	Data Type	Description
c	IN	INTEGER	The cursor number

Result Value

This function returns the number of records by executing a cursor.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
as
c integer;
b1 integer;
rc bigint;
begin
c := dbms_sql.open_cursor;
println( c );
dbms_sql.parse( c, 'insert into t1 values ( :b1 )', dbms_sql.native );
b1 := 999;
dbms_sql.bind_variable( c, ':b1', b1 );
rc := dbms_sql.execute_cursor( c );
println( rc );
end;
/
Create success.

iSQL> exec proc1;
0
1
Execute success.
```

FETCH_ROWS

The FETCH_ROWS imports the row which will be fetched in a cursor. It is only used in the SELECT statement.

Syntax

```
INTEGER variable:=DBMS_SQL.FETCH_ROWS(c);
```

Parameters

Name	In/Output	Data Type	Description
c	IN	INTEGER	The cursor number

Result Value

0 is returned if there is no row to fetch; otherwise, it returns 1.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
as
c integer;
b1 integer;
c1 integer;
rc bigint;
begin
c := dbms_sql.open_cursor;
println( c );
dbms_sql.parse( c, 'select i1 from t1 where i1 = :b1', dbms_sql.native );
b1 := 999;
dbms_sql.bind_variable( c, ':b1', b1 );
rc := dbms_sql.execute_cursor( c );
dbms_sql.define_column( c, 1, c1 );
rc := dbms_sql.fetch_rows( c );
println( rc );
end;
/
Create success.

iSQL> exec proc1;
0
1
Execute success.
```

IS_OPEN

The IS_OPEN is a function which returns the result whether the cursor is open or not.

Syntax

```
BOOLEAN variable:=DBMS_SQL.IS_OPEN(c);
```

Parameter

Name	In/Output	Data Type	Description
c	IN	INTEGER	Cursor number

Result Value

True is returned when the cursor is open, and FALSE is returned when the cursor is not open.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
as
c integer;
begin
c := dbms_sql.open_cursor;
println( c );
if dbms_sql.is_open( c ) = TRUE
then
println( 'cursor opened' );
else
println( 'invalid cursor' );
end if;
end;
/
Create success.

iSQL> exec proc1;
0
cursor opened
Execute success.
```

LAST_ERROR_POSITION

The LAST_ERROR_POSITION returns the location of error that occurred when parsing

This function should be used immediately after calling the PARSE procedure to get the correct result

Syntax

```
DBMS_SQL.LAST_ERROR_POSITION;
```

Result Value

Returns the error locaiton.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1( a varchar(128) )
as
c integer;
begin
c := dbms_sql.open_cursor;
dbms_sql.parse( c, a, dbms_sql.native );
exception
 when others
  then
    println( dbms_sql.last_error_position );
    dbms_sql.close_cursor( c );
end;
/
Create success.
iSQL> exec proc1( 'select empno, ^a from emp' );
14
Execute success.
```

OPEN_CURSOR

The OPEN_CURSOR opens the cursor.

Syntax

```
INTEGER variable:=DBMS_SQL.OPEN_CURSOR;
```

Result Value

If is successfully executed, the number of cursor is returned.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
as
c integer;
begin
c := dbms_sql.open_cursor;
println( c );
end;
/
Create success.

iSQL> exec proc1;
0
Execute success
```

PARSE

The PARSE procedure parses SQL statements.

Syntax

```
DBMS_SQL.PARSE(c, sql, language_flag);
```

Parameters

Name	In/Output	Data Type	Description
c	IN	INTEGER	The cursor number
sql	IN	VARCHAR2(32000)	SQL which will be parsed
language_flag	IN	INTEGER	The language option(it is not supported so that it is neglected regardless of specifying any values).

Result Value

Since it is a stored procedure, there is no result value.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
as
c integer;
begin
c := dbms_sql.open_cursor;
println( c );
dbms_sql.parse( c, 'insert into t1 values ( 1 )', dbms_sql.native );
end;
/
Create success.

iSQL> exec proc1;
0
Execute success.
```

DBMS_STATS

The DBMS_STATS package provides an interface which can view and modifies the stats information. By using stored procedures and functions, the stats information can be established and updated, also it can configure or delete the stats information for each column, index, and table or per each system

The procedures and functions comprised of the DBMS_STATS package are in the following table below. Refer to DBMS Stats of *Stored Procedures Manual* for in-depth information on each procedure and function.

Procedures/Functions	Description
COPY_TABLE_STATS	Copies stats information of a partition to a new partition.
DELETE_COLUMN_STATS	Deletes stats information in column(s) of specific tables.
DELETE_DATABASE_STATS	Deletes stats information of all tables.
DELETE_INDEX_STATS	Used to dlete stats information of specific indexes.
DELETE_TABLE_STATS	Delete stats information of specific tables.
DELETE_SYSTEM_STATS	Deletes stats information of the database system.
GATHER_DATABASE_STATS	Gathers stats information of all tables.
GATHER_INDEX_STATS	Gathers stats information of specific indexes.
GATHER_SYSTEM_STATS	Gathers stats information of database system.
GATHER_TABLE_STATS	Gathers stats information of specific tables.
GET_COLUMN_STATS	Views stats information of column(s) in specific tables.
GET_INDEX_STATS	Views stats information of specific indexes.
GET_SYSTEM_STATS	View stats information of database system.
GET_TABLE_STATS	Views stats information of specific tables.
SET_COLUMN_STATS	Views stats information of column(s) in specific tables.
SET_INDEX_STATS	Alters stats information of specific indexes.
SET_PRIMARY_KEY_STATS	Alters stats information of PRIMARY KEY INDEX of a specific table.
SET_SYSTEM_STATS	Alters stats infomration of the datebase system.
SET_TABLE_STATS	Alters stats information of (a) specific tables.
SET_UNIQUE_KEY_STATS	Alter stats information of UNIQUE KEY INDEX of (a) specific tables.

SET_PRIMARY_KEY_STATS

This procedure alters stats information of PRIMARY KEY INDEX of a specific table.

Syntax

```
SET_PRIMARY_KEY_STATS (
  ownname   VARCHAR(128),
  tabname   VARCHAR(128),
  keycount      BIGINT DEFAULT NULL,
  numpage   BIGINT DEFAULT NULL,
  numdist   BIGINT DEFAULT NULL,
  clusteringfactor BIGINT DEFAULT NULL,
  indexheight BIGINT DEFAULT NULL,
  avgslotcnt  BIGINT DEFAULT NULL,
  no_invalidate BOOLEAN DEFAULT FALSE );
```

Parameters

Name	In/Output	Data Type	Description
ownname	IN	VARCHAR(128)	Name of the index owner
tablename	IN	VARCHAR(128)	Name of the table for which statistics to be changed
keycount	IN	BIGINT	Number of records in the index
numpage	IN	BIGINT	Number of pages in the index
numdist	IN	BIGINT	Number of unique keys in the index
clusteringfactor	IN	BIGINT	Degree to which the data is aligned with the index
indexheight	IN	BIGINT	Depth from the root of the index to the leaf node
avgslotcnt	IN	BIGINT	Average number of records stored in the index leaf node.
no_invalidate	IN	BOOLEAN	Whether to rebuild execution plans for all queries related to the indexes for which statistics were collected. The default is FALSE, which rebuilds the execution plan. If do not want to rebuild, enter TRUE.

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
iSQL> EXEC DBMS_STATS.SET_PRIMARY_KEY_STATS( 'SYS', 'T1', 1, 2, 3, 4, 5, 6, TRUE );
__SYS_IDX_ID_148 c integer;
Execute success.
```

SET_UNIQUE_KEY_STATS

This procedure alters stats information of UNIQUE KEY INDEX

Syntax

```
SET_UNIQUE_KEY_STATS (
  ownname     VARCHAR(128),
  tabname     VARCHAR(128),
  colnamelist   VARCHAR(32000),
  keycount    BIGINT DEFAULT NULL,
  numpage     BIGINT DEFAULT NULL,
  numdist     BIGINT DEFAULT NULL,
  clusteringfactor BIGINT DEFAULT NULL,
  indexheight   BIGINT DEFAULT NULL,
  avgslotcnt  BIGINT DEFAULT NULL,
  no_invalidate   BOOLEAN DEFAULT FALSE );
```

Parameters

Name	In/Out	Data Type	Description
ownname	IN	VARCHAR(128)	Name of the index owner
tablename	IN	VARCHAR(128)	Name of the table for which statistics to be changed
colnamelist	IN	VARCHAR(32000)	List of column names to change statistics for. If DESC is specified in a column when creating a UNIQUE KEY INDEX, it must also be specified in uppercase in the colnamelist.
keycount	IN	BIGINT	Number of records in the index
numpage	IN	BIGINT	Number of pages in the index
numdist	IN	BIGINT	Number of unique keys in the index
clusteringfactor	IN	BIGINT	Degree to which the data is aligned with the index
indexheight	IN	BIGINT	Depth from the root of the index to the leaf node
avgslotcnt	IN	BIGINT	Average number of records stored in the index leaf node.
no_invalidate	IN	BIGINT	Whether to rebuild execution plans for all queries related to the indexes for which statistics were collected. The default is FALSE, which rebuilds the execution plan. If do not want to rebuild, enter TRUE.

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
iSQL> EXEC DBMS_STATS.SET_UNIQUE_KEY_STATS( 'SYS', 'T1', 'C1,C2', 1, 2, 3, 4, 5, 6,
TRUE );
__SYS_IDX_ID_149
Execute success.
```

DBMS_UTILITY

The DBMS_UTILITY package provides diverse utility subprograms.

The procedures and functions organizing the DBMS_UTILITY package are provided as shown in the table below.

Procedures/Functions	Description
FORMAT_CALL_STACK	Calls current stack information.
FORMAT_ERROR_BACKTRACE	Calls the stack information of an error occurring point.
FORMAT_ERROR_STACK	Calls information which is identical with the FORMAT_ERROR_BACKTRACE function.

FORMAT_CALL_STACK

The FORMAT_CALL_STACK is a function which display stack information at the call point and bring it to a character string.

Syntax

```
VARCHAR variable := DBMS_UTILITY.FORMAT_CALL_STACK;
```

Result Value

It returns the stack information at the call point.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
is
  a integer;
begin
  a := 1;
  println( dbms_utility.format_call_stack );
end;
/
Create success.

iSQL> create or replace procedure proc2 as begin
  proc1;
end;
/
Create success.

iSQL> exec proc2;
object     line       object
handle     number     name
6261376    6          procedure "SYS.PROC1"
6258720    2          procedure "SYS.PROC2"
Execute success.
```

FORMAT_ERROR_BACKTRACE

The FORMAT_ERROR_BACKTRACE is a function which retrieves stack information at the point in which an exception was occurred. If no exception had been incurred, NULL value would be returned.

Syntax

```
VARCHAR variable := DBMS_UTILITY.FORMAT_ERROR_BACKTRACE;
```

Result Value

It returns the stack information at the point in which an exception was occurred. If no exception had been incurred, NULL value would be returned.

Exception

There is no exception.

Example

```
iSQL> create or replace procedure proc1
is
  a integer;
begin
  a := 'aaaaa';
end;
/
Create success.

iSQL> create or replace procedure proc2 as begin
  proc1;
exception
when others then
  println( dbms_utility.format_error_backtrace );
end;
/
Create success.

iSQL> exec proc2;
ERR-21011 : Invalid literal
at "SYS.PROC1", line 5
at "SYS.PROC2", line 2
Execute success.
```

STANDARD

The STANDARD package defines the types that can be used in the PSM without any additional declarations other than the basic data types. The STANDARD package provides the types listed in the table below.

STANADARD Package Type Name	Type
SYS_REFCURSOR	REF CURSOR

Example

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1 AS
CUR1 SYS_REFCURSOR;
VAR1 INTEGER;
BEGIN
OPEN CUR1 FOR 'SELECT ROWNUM FROM DUAL';
FETCH CUR1 INTO VAR1;
 PRINTLN(VAR1);
CLOSE CUR1;
END;
/
```

UTL_COPYSWAP

The UTL_COPYSWAP package provides table schema copy, data replication, and table exchange interfaces.

The procedures and functions that make up the UTL_COPYSWAP package are shown in the table below.

Refer to the the description of CHECK_PRECONDITION for the prerequisites for using UTL_COPYSWAP.

Procedures/Functions	Description
CHECK_PRECONDITION	Checks privileges, session properties, system properties, and replication constraints
COPY_TABLE_SCHEMA	Copies the table schema. Afterwards, execute the DDL the user wants on the copied table.
REPLICATE_TABLE	Replicates the data.
SWAP_TABLE	Swaps the table.
SWAP_TABLE_PARTITION	Swaps the table partition.
FINISH	Cleans up what was generated by COPY_TABLE_SCHEMA_REPLICATE_TABLE.

CHECK_PRECONDITION

This procedure checks prerequisites such as privileges, session properties, system properties, and replication constraints for using UTL_COPYSWAP.

The prerequisites to be examined are:

- Privilege
  Must be the SYS user.
- Session Properties
  The AUTOCOMMIT property must be FALSE.
  The REPLICATION property must be TRUE.
- System Properties
  The REPLICATION_PORT_NO property must not be zero.
  The REPLICATION_DDL_ENABLE property must be 1.
  The REPLICATION_ALLOW_DUPLICATE_HOSTS property must be 1.
- Replication Constraints
  Compressed columns are not supported.

There should be no related Eager Sender/Receiver thread.

Syntax

```
UTL_COPYSWAP.CHECK_PRECONDITION(
  source_user_name IN VARCHAR(128),
  source_table_name IN VARCHAR(128) );
```

Parameters

Name	In/Output	Data Type	Description
source_user_name	IN	VARCHAR2(128)	Owner name of the source table
source_table_name	IN	VARCHAR2(128)	Name of the source table

Return Value

Because it is a stored procedure, there is no return value.

Exception

If a parameter is entered incorrecly, an exception will be occurred.

Example

```
iSQL> CREATE TABLE T1 ( I1 INTEGER PRIMARY KEY, V1 VARCHAR(1024) );
Create success.
iSQL> EXEC UTL_COPYSWAP.CHECK_PRECONDITION( 'SYS', 'T1' );
[SESSION PROPERTY] AUTOCOMMIT property value must be FALSE.
[SYSTEM PROPERTY] REPLICATION_PORT_NO property value must be larger than 0.
[SYSTEM PROPERTY] REPLICATION_DDL_ENABLE property value must be 1.
[SYSTEM PROPERTY] REPLICATION_ALLOW_DUPLICATE_HOSTS property value must be 1.
Execute success.
```

COPY_TABLE_SCHEMA

The procedure to copy Table Schema. After that, execute the DDL the user want on the copied table. The copy destination is as follows.

- Table basic infromation
- Column
- Index
- Constraint
- Trigger
- Comment
- Partition

Syntax

```
UTL_COPYSWAP.COPY_TABLE_SCHEMA(
  target_user_name IN VARCHAR(128),
  target_table_name IN VARCHAR(128),
  source_user_name IN VARCHAR(128),
  source_table_name IN VARCHAR(128) );
```

Parameters

Name	In/Output	Data Type	Description
target_user_name	IN	VARCHAR2(128)	Owner name of the target table
target_table_name	IN	VARCHAR2(128)	Name of the target table
source_user_name	IN	VARCHAR2(128)	Owner name of the source table
source_table_name	IN	VARCHAR2(128)	Name of the source table

Return Value

Because it is a stored procedure, there is no return value.

Example

If a parameter is entered incorrecly, an exception will be occurred.

Example

```
iSQL> CREATE TABLE T1 ( I1 INTEGER PRIMARY KEY, V1 VARCHAR(1024) );
Create success.
iSQL> INSERT INTO T1 VALUES ( 1, 'ABC' );
1 row inserted.
iSQL> ALTER SESSION SET AUTOCOMMIT = FALSE;
Alter success.
iSQL> ALTER SYSTEM SET REPLICATION_DDL_ENABLE = 1;
Alter success.
iSQL> ALTER SYSTEM SET REPLICATION_ALLOW_DUPLICATE_HOSTS = 1;
Alter success.
iSQL> EXEC UTL_COPYSWAP.COPY_TABLE_SCHEMA( 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
0
1 row selected.
iSQL> ALTER TABLE T1_COPY ALTER TABLESPACE SYS_TBS_DISK_DATA;
Alter success.
```

REPLICATE_TABLE

The procedure to replicate data using replication.

Syntax

```
UTL_COPYSWAP.REPLICATE_TABLE(
  replication_name IN VARCHAR(35),
  target_user_name IN VARCHAR(128),
  target_table_name IN VARCHAR(128),
  source_user_name IN VARCHAR(128),
  source_table_name IN VARCHAR(128),
  sync_parallel_factor IN INTEGER DEFAULT 8,
  receiver_applier_count IN INTEGER DEFAULT 8 );
```

Parameters

Name	In/Output	Data Type	Description
replication_name	IN	VARCHAR2(35)	Name of the replication
target_user_name	IN	VARCHAR2(128)	Owner name of the target table
target_table_name	IN	VARCHAR2(128)	Name of the target table
source_user_name	IN	VARCHAR2(128)	Owner name of the source table
source_table_name	IN	VARCHAR2(128)	Name of the source table
sync_parallel_factor	IN	INTEGER	Parallel factor to apply to initial synchronization
receiver_applier_count	IN	INTEGER	Parallel factor to apply to incremental synchronization

Return Value

Because it is a stored procedure, there is no return value.

Exception

If a parameter is entered incorrecly, an exception will be occurred.

Example

```
iSQL> CREATE TABLE T1 ( I1 INTEGER PRIMARY KEY, V1 VARCHAR(1024) );
Create success.
iSQL> INSERT INTO T1 VALUES ( 1, 'ABC' );
1 row inserted.
iSQL> ALTER SESSION SET AUTOCOMMIT = FALSE;
Alter success.
iSQL> ALTER SYSTEM SET REPLICATION_DDL_ENABLE = 1;
Alter success.
```

```
iSQL> ALTER SYSTEM SET REPLICATION_ALLOW_DUPLICATE_HOSTS = 1;
Alter success.
iSQL> EXEC UTL_COPYSWAP.COPY_TABLE_SCHEMA( 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
0
1 row selected.
iSQL> ALTER TABLE T1_COPY ALTER TABLESPACE SYS_TBS_DISK_DATA;
Alter success.
iSQL> EXEC UTL_COPYSWAP.REPLICATE_TABLE( 'REP_LOCAL', 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
1
1 row selected.
```

SWAP_TABLE

This is a procedure to complete synchronization using replication and exchange tables.

The exchange target is as follows.

- Table basic information
- Column
- Index
- Constraint
- Trigger
- Comment
- Partition

Syntax

```
UTL_COPYSWAP.SWAP_TABLE(
  replication_name IN VARCHAR(35),
  target_user_name IN VARCHAR(128),
  target_table_name IN VARCHAR(128),
  source_user_name IN VARCHAR(128),
  source_table_name IN VARCHAR(128),
  force_to_rename_encrypt_column IN BOOLEAN DEFAULT FALSE,
  ignore_foreign_key_child IN BOOLEAN DEFAULT FALSE );
```

Parameters

Name	In/Output	Data Type	Description
replication_name	IN	VARCHAR2(35)	Name of the replicaiton
target_user_name	IN	VARCHAR2(128)	Owner name of the target table
target_table_name	IN	VARCHAR2(128)	Name of the target table
source_user_name	IN	VARCHAR2(128)	Owner name of the source table
source_table_name	IN	VARCHAR2(128)	Name of the source table
force_to_rename_encrypt_column	IN	BOOLEAN	Set to TRUE if there is an encryption column and the encryption module supports Rename.
ignore_foreign_key_child	IN	BOOLEAN	Set to TRUE if there is a table referencing the source table.

Result Value

Because it is a stored procedure, there is no result value.

Exception

If a parameter is entered incorrecly, an exception will be occurred.

Example

```
iSQL> CREATE TABLE T1 ( I1 INTEGER PRIMARY KEY, V1 VARCHAR(1024) );
Create success.
iSQL> INSERT INTO T1 VALUES ( 1, 'ABC' );
1 row inserted.
iSQL> ALTER SESSION SET AUTOCOMMIT = FALSE;
Alter success.
iSQL> ALTER SYSTEM SET REPLICATION_DDL_ENABLE = 1;
Alter success.
iSQL> ALTER SYSTEM SET REPLICATION_ALLOW_DUPLICATE_HOSTS = 1;
Alter success.
iSQL> EXEC UTL_COPYSWAP.COPY_TABLE_SCHEMA( 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
0
1 row selected.
iSQL> ALTER TABLE T1_COPY ALTER TABLESPACE SYS_TBS_DISK_DATA;
Alter success.
iSQL> EXEC UTL_COPYSWAP.REPLICATE_TABLE( 'REP_LOCAL', 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
1
1 row selected.
```

```
iSQL> INSERT INTO T1 VALUES ( 2, 'XYZ' );
1 row inserted.
iSQL> COMMIT;
Commit success.
iSQL> EXEC UTL_COPYSWAP.SWAP_TABLE( 'REP_LOCAL', 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
2
1 row selected.
```

SWAP_TABLE_PARTITION

The procedure to complete synchronization using replication and exchange table partitions. The exchange target is as follows.

- Partition

Syntax

```
PROCEDURE swap_table_partition(
  replication_name IN VARCHAR(35),
  target_user_name IN VARCHAR(128),
  target_table_name IN VARCHAR(128),
  source_user_name IN VARCHAR(128),
  source_table_name IN VARCHAR(128),
  table_partition_name IN VARCHAR(128) );
```

Parameters

Name	In/Output	Data Type	Description
replication_name	IN	VARCHAR2(35)	Name of the replication
target_user_name	IN	VARCHAR2(128)	Owner name of the target table
target_table_name	IN	VARCHAR2(128)	Name of the target table
source_user_name	IN	VARCHAR2(128)	Owner name of the source table
source_table_name	IN	VARCHAR2(128)	Name of the source table
table_partition_name	IN	VARCHAR2(128)	Table partition to be exchanged

Return Value

Because it is a stored procedure, there is no return value.

Exception

If a parameter is entered incorrectly, an exception will be occurred.

Example

```
iSQL> create table t1 (i1 int, i2 int)
partition by range (i1)
(
    partition p1 values less than (10),
    partition p2 values less than (20),
    partition p3 values default
)tablespace sys_tbs_disk_data;
Create success.

iSQL> alter table t1 add constraint pk_t1 primary key(i1) using index local
(
    partition  pk_p1 on p1 tablespace SYS_TBS_DISK_DATA,
    partition  pk_p2 on p2 tablespace SYS_TBS_DISK_DATA,
    partition  pk_p3 on p3 tablespace SYS_TBS_DISK_DATA
);
Alter success.
iSQL> INSERT INTO T1 VALUES ( 15, 15 );
1 row inserted.
iSQL> ALTER SESSION SET AUTOCOMMIT = FALSE;
Alter success.
iSQL> ALTER SYSTEM SET REPLICATION_DDL_ENABLE = 1;
Alter success.
iSQL> ALTER SYSTEM SET REPLICATION_ALLOW_DUPLICATE_HOSTS = 1;
Alter success.
iSQL> EXEC UTL_COPYSWAP.COPY_TABLE_SCHEMA( 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
0
1 row selected.
iSQL> ALTER TABLE T1_COPY ALTER TABLESPACE SYS_TBS_MEM_DATA;
Alter success.
iSQL> EXEC UTL_COPYSWAP.REPLICATE_TABLE( 'REP_LOCAL', 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
1
1 row selected.
```

```
iSQL> INSERT INTO T1 VALUES ( 16, 16 );
1 row inserted.

iSQL> commit ;
iSQL> EXEC UTL_COPYSWAP.SWAP_TABLE_PARTITION( 'REP_LOCAL', 'SYS', 'T1_COPY', 'SYS',
'T1','P2' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
2
1 row selected.
```

FINISH

Cleans up what was generated by COPY_TABLE_SCHEMA_REPLICATE_TABLE.

Syntax

```
UTL_COPYSWAP.FINISH(
  replication_name IN VARCHAR(35),
  target_user_name IN VARCHAR(128),
  target_table_name IN VARCHAR(128),
  print_all_errors IN BOOLEAN DEFAULT FALSE );
```

Parameters

Name	In/Output	Data Type	Description
replication_name	IN	VARCHAR2(35)	Name of the replication
target_user_name	IN	VARCHAR2(128)	Owner name of the target table
target_table_name	IN	VARCHAR2(128)	Name of the target table
print_all_errors	IN	BOOLEAN	Set to TRUE to display replication-related errors.

Result Value

Because it is a stored procedure, there is no return value.

Exception

If a parameter is entered incorrecly, an exception will be occurred.

Example

```
iSQL> CREATE TABLE T1 ( I1 INTEGER PRIMARY KEY, V1 VARCHAR(1024) );
Create success.
iSQL> INSERT INTO T1 VALUES ( 1, 'ABC' );
1 row inserted.
iSQL> ALTER SESSION SET AUTOCOMMIT = FALSE;
Alter success.
iSQL> ALTER SYSTEM SET REPLICATION_DDL_ENABLE = 1;
Alter success.
iSQL> ALTER SYSTEM SET REPLICATION_ALLOW_DUPLICATE_HOSTS = 1;
Alter success.
iSQL> EXEC UTL_COPYSWAP.COPY_TABLE_SCHEMA( 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
0
1 row selected.
iSQL> ALTER TABLE T1_COPY ALTER TABLESPACE SYS_TBS_DISK_DATA;
Alter success.
iSQL> EXEC UTL_COPYSWAP.REPLICATE_TABLE( 'REP_LOCAL', 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
1
1 row selected.
iSQL> INSERT INTO T1 VALUES ( 2, 'XYZ' );
1 row inserted.
iSQL> COMMIT;
Commit success.
iSQL> EXEC UTL_COPYSWAP.SWAP_TABLE( 'REP_LOCAL', 'SYS', 'T1_COPY', 'SYS', 'T1' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
COUNT
-----------------------
2
1 row selected.
iSQL> EXEC UTL_COPYSWAP.FINISH( 'REP_LOCAL', 'SYS', 'T1_COPY' );
Execute success.
iSQL> SELECT COUNT(*) FROM T1_COPY;
[ERR-31031 : Table or view was not found :
0001 : SELECT COUNT(*) FROM T1_COPY
^       ^
```

Notes

- To replicate data using the REPLICATE_TABLE procedure, free space is required in the tablespace in proportion to the size of the source table. Log files created by the REPLICATE_TABLE procedure are not removed by Checkpoint until the REPLICATE_TABLE procedure is terminated.
- While using the UTL_COPYSWAP package, replication must be able to resolve the DML that applies to the source table. DML that cannot be analyzed in replication may be lost.
  - When executing DML on the source table, the REPLICATION session property must be TRUE.
  - If the source table is replication target table, replication must be stopped at the remote server that corresponds to the source table so that replication does not reflect the data in the source table.
- When dropping a target table using the FINISH procedure, if the RECYCLEBIN_ENABLE property value is 1, then it is moved to the recycle bin.

UTL_FILE

The UTL_FILE package enables writing and reading by accessing the text tiles which are managed by the operation system.

The procedures and functions which are comprised of the UTL_FILE package are listed in the following table below.

Procedures/Functions	Description
FCLOSE	Closes a file
FCLOSE_ALL	Closes all open files in the current session
FCOPY	Copies a file
FFLUSH	Physically archives the data into a file
FOPEN	Opens a file with the object of writing or reading
FREMOVE	Deletes a file
FRENAME	Changes a file name
GET_LINE	Searches for a single line in a file
IS_OPEN	Checks if the file is opened
NEW_LINE	Prints the new-line characters
PUT	Records a character string into a file
PUT_LINE	Records a character string by attaching the new-line characters(= PUT+NEW_LINE)

Refer to File Control in Altibase Stored Procedures manual for in-depth information on each procedure and function pertaining to the UTL_FILE prcedures and packages.

FCLOSE

The FCLOSE is a procedure providing a function of closing and re-initializing the file handle which is open

Syntax

```
UTL_FILE.FCLOSE(file IN OUT FILE_TYPE);
```

Parameter

Name	In/Output	Data Type	Description
file	IN OUT	FILE_TYPE	File handle

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

FCLOSE_ALL

The FCLOSE_ALL is a procedure providing a function of closing all the file handles that are open in the current session.

Syntax

```
UTL_FILE.FCLOSE_ALL;
```

Parameter

None

Return Value

Because it is a stored procedure, there is no return value.

Exception

It always succeeds unless an error occurs during the execution.

FCOPY

The FCOPY is a procedure providing a function of copying a file by line unit. If the result file does not exist in the related directory, the contents of source file is copied when creating a file. If the result file exits, the contents of source file are overwritten.

Syntax

```
UTL_FILE.FCOPY (
  location IN VARCHAR(40),
  filename IN VARCHAR(256),
  dest_dir IN VARCHAR(40),
  dest_file IN VARCHAR(256),
  start_line IN INTEGER DEFAULT 1,
  end_line IN INTEGER DEFAULT NULL);
```

Parameters

Name	In/Output	Data Type	Description
location	IN	VARCHAR(40)	The directory name in which the original file, the target of copy, is located.
filename	IN	VARCHAR(256)	The name of the source file
dest_dir	IN	VARCHAR(40)	The directory name in which result files are located
dest_file	IN	VARCHAR(256)	The name of the result file
start_line	IN	INTEGER	The startling line number to copy (Default value: 1)
end_line	IN	INTEGER	The last line number to copy. If it is default value, the file is copied to the end of the file. (Default value: NULL)

Return Value

Because it is a stored procedure, there is no return value.

Exception

The FCOPY might cause the following system-defined exceptions.

- INVALID_PATH
- ACCESS_DENIED
- INVALID_OPERATION
- READ_ERROR
- WRITE_ERROR

FFLUSH

The FFLUSH is a procedure which physically archives the data existing in the buffer into a file.

Syntax

```
UTL_FILE.FFLUSH(file IN FILE_TYPE);
```

Parameter

Name	In/Output	Data Type	Description
file	IN	FILE_TYPE	The file handle

Return Value

Because it is a stored procedure, there is no return value.

Exception

The FFLUSH might cause the following system-defined exceptions.

- INVALID_FILEHANDLE
- WRITE_ERROR

FOPEN

The FOPEN procedure opens a file to read or write.

Syntax

```
UTL_FILE.FOPEN(
  location IN VARCHAR(40),
  filename IN VARCHAR(256),
  open_mode IN VARCHAR(4),
  max_linesize IN INTEGER DEFAULT NULL);
```

Parameters

Name	In/Output	Data Type	Description
location	IN	VARCHAR(40)	The name of a directory object located in a file
filename	IN	VARCHAR(256)	The file name
open_mode	IN	VARCHAR(4)	The input available options are as follows. r: Read w: Write a: Subsequent writing * Caution: Such options cannot be combined to use. (e.g., rw, wa)
max_linesize	IN	INTEGER	This is the parameter only for Integer compatibility which can be neglected.

Return Value

The file handle with FILE_TYPE data type are returned if successfully executed.

Exception

The FOPEN might cause the following system-defined exceptions.

- INVALID_PATH
- ACCESS_DENIED
- INVALID_OPERATION
- INVALID_MODE

FREMOVE

The FREMOVE is a procedure deleting a file.

Syntax

```
UTL_FILE.FREMOVE (
  location IN VARCHAR(40),
  filename IN VARCHAR(256));
```

Parameters

Name	In/Output	Data Type	Description
location	IN	VARCHAR(40)	The directory name in which a file is located
filename	IN	VARCHAR(256)	The file name

Return Value

Because it is a stored procedure, there is no return value.

Exception

The FREMOVE might cause the following system-defined exceptions.

- INVALID_PATH
- ACCESS_DENIED
- DELETE_FAILED

FRENAME

The FRENAME is a stored procedure which can modifies the file name, or transfer the file to a different location. It is the same with UNIX mv command.

Syntax

```
UTL_FILE.FRENAME (
  location IN VARCHAR(40),
  filename IN VARCHAR(256),
  dest_dir IN VARCHAR(40),
  dest_file IN VARCHAR(256),
  overwrite IN BOOLEAN DEFAULT FALSE );
```

Parameters

Name	In/Out	Data Type	Description
location	IN	VARCHAR(40)	The directory in which the source file is situated.
filename	IN	VARCHAR(256)	The name of source file.
dest_dir	IN	VARCHAR(40)	The directory in which the result file is situated.
dest_file	IN	VARCHAR(256)	The name of result file.
overwrite	IN	BOOLEAN	Update option when the result file already exists. TRUE: Update as a new file FALSE(Default Value): Not to update.

Return Value

Because it is stored procedure, there is no return value.

Exception

The FRENAME might cause the following system-defined exceptions.

- INVALID_PATH
- ACCESS_DENIED
- RENAME_FAILED

GET_LINE

The GET_LINE is a stored procedure reading every other line from a file.

Syntax

```
UTL_FILE.GET_LINE(
  file IN FILE_TYPE,
  buffer OUT VARCHAR(32768),
  len IN INTEGER DEFAULT NULL);
```

Parameters

Name	In/Output	Data Type	Description
file	IN	FILE_TYPE	The file handle
buffer	OUT	VARCHAR(32768)	The buffer to store the every other line from a file.
len	IN	INTEGER	The maximum bytes which can read a line form a file. 1024bytes are read unless otherwise specified. Default Value: NULL

Return Value

Because it is a stored procedure, there is no return value.

Exception

The GET_LINE might cause the following system-defined exceptions.

- NO_DATA_FOUND
- READ_ERROR
- INVALID_FILEHANDLE

IS_OPEN

The IS_OPEN function checks on the file whether it is open or not.

Syntax

```
UTL_FILE.IS_OPEN(file IN FILE_TYPE);
```

Parameter

Name	In/Out	Data Type	Description
file	IN	FILE_TYPE	The file handle

Return Value

It returns TRUE when it is open, but FALSE is returned when it is closed.

Exception

There is no exception.

NEW_LINE

The NEW_LINE is a procedure which archives the new-line characters to a file(\n for Unix).

Syntax

```
UTL_FILE.NEW_LINE(
  file IN FILE_TYPE,
  lines IN INTEGER DEFAULT 1);
```

Parameters

Name	In/Output	Data Type	Description
file	IN	FILE_TYPE	The file handle
lines	IN	INTEGER	The number of line to record. Default Value: 1

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception

PUT

The PUT is a procedure storing a character string which is read from a file in the buffer.

Syntax

```
UTL_FILE.PUT(
  file IN FILE_TYPE,
  buffer IN VARCHAR(32768));
```

Parameters

Name	In/Output	Data Type	Description
file	IN	FILE_TYPE	The file handle
buffer	IN	VARCHAR(32768)	The buffer to store a file from the read character strings

Return Value

Because it is a stored procedure, there is no return value.

Exceptions

The PUT might cause the following system-defined exceptions.

- INVALID_FILEHANDLE
- WRITE_ERROR

PUT_LINE

The PUT_LINE is a stored procedure archiving a line including a character string to a file.

Syntax

```
UTL_FILE.PUT_LINE(
  file IN FILE_TYPE,
  buffer IN VARCHAR(32768)
  autoflush IN BOOLEAN DEFAULT FALSE);
```

Parameters

Name	In/Output	Data Type	Description
file	IN	FILE_TYPE	The file handle
buffer	IN	VARCHAR(32768)	The buffer storing a character string which is read from a file
autoflush	IN	BOOLEAN	Options to empty the buffer. Default Value: FALSE (Not to empty)

Return Value

No return value exists since it is a stored procedure.

Exceptions

The PUT_LINE might cause the following system-defined exceptions.

- INVALID_FILEHANDLE
- WRITE_ERROR

UTL_RAW

The UTL_RAW package is a function which can convert or control RAW(VARBYTE) type data into a different data type.

The procedures and functions which are comprised of the UTL_RAW package are listed in the following table below.

Procedures/Functions	Description
CAST_FROM_BINARY_INTEGER	Converts INTERGER type of data into RAW data type
CAST_FROM_NUMBER	Converts NUMERIC type of data into RAW data type
CAST_TO_BINARY_INTEGER	Converts RAW type of data into BINARY_INTEGER data type
CAST_TO_NUMBER	Converts RAW type of data into NUMERIC data type
CAST_TO_RAW	Converts VARCHAR type of data into RAW type
CAST_TO_VARCHAR2	Converts Raw type of data into VARCHAR data type
CONCAT	Connects RAW type of data
LENGTH	Returns the length of data which has been input
SUBSTR	Returns some of character string data which have been input.

CAST_FROM_BINARY_INTEGER

The CAST_FROM_BINARY_INTEGER is a function converting INTEGER data type into RAW data type.

Syntax

```
UTL_RAW.CAST_FROM_BINARY_INTEGER(
  n IN INTEGER,
  endianess IN INTEGER DEFAULT 1);
```

Parameters

Name	In/Output	Data Type	Description
n	IN	INTEGER	The data which will be converted
endianess	IN	INTEGER	This parameter is only for compatibility, and the value of this parameter can be neglected.

Return Value

The entered INTEGER type of data is returned as RAW type.

Exception

There is no exception.

Example

Output 123456, which is INTEGER type by converting into RAW type.

```
iSQL> select utl_raw.cast_from_binary_integer(123456) from dual;
CAST_FROM_BINARY_INTEGER(123456)
------------------------------------
40E20100
1 row selected.
```

CAST_FROM_NUMBER

The CAST_FROM_NUMBER is a function which returns NEMERIC type of data by converting into RAW type.

Syntax

```
UTL_RAW.CAST_FROM_NUMBER(n IN NUMBER);
```

Parameter

Name	In/Output	Data Type	Description
n	IN	NUMBER	The data which will be converted into RAW type

Return Value

The entered NUMERIC type of data is returned by converting into RAW type

Exception

There is no exception.

Example

Output NUMBER type data 1.123456789 by converting into RAW type.

```
iSQL> select utl_raw.cast_from_number(1.123456789) from dual;
CAST_FROM_NUMBER(1.123456789)
-----------------------------------------------------------------------------------
07C1010C22384E5A
1 row selected.
```

CAST_TO_BINARY_INTEGER

The CAST_TO_BINARY_INTEGER is a function which returns RAW type of data by converting into INTEGER type.

Syntax

```
UTL_RAW.CAST_TO_BINARY_INTEGER(
  r IN RAW(8),
  endianess IN INTEGER DEFAULT 1);
```

Parameters

Name	In/Output	Data Type	Description
r	IN	RAW(8)	The data which will be converted as INTEGER type.
endianess	IN	INTEGER	This parameter is only for compatibility, and the value is neglected.

Return Value

The entered RAW type of data is returned as INTEGER type.

Exception

There is no exception.

Example

Output 40E20100, which is RAW type by converting into INTEGER.

```
iSQL> select utl_raw.cast_to_binary_integer('40E20100') from dual;
CAST_TO_BINARY_INTEGER('40E20100')
-------------------------------------
123456
1 row selected.
```

CAST_TO_NUMBER

The CAST_TO_NUMBER is a function which returns RAW type of data by converting it into NUMERIC type.

Syntax

```
UTL_RAW.CAST_TO_NUMBER(r IN RAW(32767));
```

Parameter

Name	IN/Output	Data Type	Description
r	IN	RAW(32767)	The data which will be converted into NUMERIC type

Return Value

The entered RAW type of data is returned as NUMERIC type.

Exception

There is no exception.

Example

Output RAW type 07C1010C22384E5A by converting NUMBER.

```
iSQL> select utl_raw.cast_to_number('07C1010C22384E5A') from dual;
CAST_TO_NUMBER('07C1010C22384E5A')
-------------------------------------
1.12345679
1 row selected.
```

CAST_TO_RAW

The CAST_TO_RAW is a function returning VARCHAR type of data by converting into RAW(VARBYTE) type.

Syntax

```
UTL_RAW.CAST_TO_RAW(c IN VARCHAR(32767));
```

Parameter

Name	In/Output	Data Type	Description
c	IN	VARCHAR(32767)	The data which will be converted into RAW type.

Return Value

The entered data is returned as RAW type.

Exception

There is no exception.

Emample

Output 'altibase' with RAW.

```
iSQL> select cast(utl_raw.cast_to_raw('altibase') as raw(10)) from dual;
CAST(UTL_RAW.CAST_TO_RAW('altibase') as RA
----------------------------------------------
0800616C746962617365
1 row selected.
```

CAST_TO_VARCHAR2

The CAST_TO_VARCHAR2 is a function which returns RAW type of data by converting it into VARCHAR type.

Syntax

```
UTL_RAW.CAST_TO_VARCHAR2(c IN RAW(32767));
```

Parameter

Name	In/Out	Data Type	Description
c	IN	RAW(32767)	The data which will be converted into VARCHAR type

Return Value

The entered data is returned by converting it into VARCHAR type.

Exception

There is no exception.

Example

Output 0800616C746962617365, the RAW type of data, by converting it into VARCHAR type.

```
iSQL> select cast(utl_raw.cast_to_varchar2('0800616C746962617365') as varchar(8)) from
dual;
CAST(UTL_RAW.CAST_TO_VARCHAR2('0800616C746
----------------------------------------------
altibase
1 row selected.
```

CONCAT

The CONCAT is a function returning the RAW(VARBYTE) data which has been input in parameters by concatenating.

Syntax

```
UTL_RAW.CONCAT(
  r1 IN RAW(32767) DEFAULT NULL,
  r2 IN RAW(32767) DEFAULT NULL,
  r3 IN RAW(32767) DEFAULT NULL,
  r4 IN RAW(32767) DEFAULT NULL,
  r5 IN RAW(32767) DEFAULT NULL,
  r6 IN RAW(32767) DEFAULT NULL,
  r7 IN RAW(32767) DEFAULT NULL,
  r8 IN RAW(32767) DEFAULT NULL,
  r9 IN RAW(32767) DEFAULT NULL,
  r10 IN RAW(32767) DEFAULT NULL,
  r11 IN RAW(32767) DEFAULT NULL,
  r12 IN RAW(32767) DEFAULT NULL);
```

Parameter

Name	In/Output	Data Type	Description
r1...r12	IN	RAW(32767)	RAW type data The data can input from r1 to r12.

Return Value

The data connected from r1 to r12 is returned.

Exception

There is no exception.

Example

Output the RAW type by concatenating AA and BB.

```
iSQL> select cast(utl_raw.concat(raw'aa', raw'bb') as raw(4)) from dual;
CAST(UTL_RAW.CONCAT(RAW'aa', RAW'bb') as R
----------------------------------------------
AABB
1 row selected.
```

LENGTH

The LENGTH is a function returning the length of input RAW type data.

Syntax

```
UTL_RAW.LENGTH(r IN RAW(32767));
```

Parameter

Name	In/Output	Data Type	Description
c	IN	RAW(32767)	The RAW type data which will return the length

Return Value

The length of RAW data, which has been input, is returned.

Exception

There is no exception.

Example

Output characteristic 'altibase' with the length of RAW data type.

```
iSQL> select utl_raw.length(utl_raw.cast_to_raw('altibase')) from dual;
LENGTH(UTL_RAW.CAST_TO_RAW('altibase'))
-------------------------------------------
12
1 row selected.
```

SUBSTR

The SUBSTR is a function which returns some parts of a character string in RAW type data which has been input.

Syntax

```
UTL_RAW.SUBSTR(
  r IN RAW(32767),
  pos IN INTEGER,
  len IN INTEGER);
```

Parameters

Name	In/Output	Data Type	Description
r	IN	RAW(32767)	The input data
pos	IN	INTEGER	The position in which begins returning data. If the value is a positive number, it begins from the front of the input data whereas it begins at the end of data if the value is a negative number.
len	IN	INTEGER	The length of the data which will be returned. If omitted, all the character string is returned to the end of data.

Return Value

The specified length from the beginning point of input data of RAW data is returned

Exception

There is no exception

Example

Return the length which is the second from the first of 0102030405 RAW type data.

```
iSQL> select cast(utl_raw.substr('0102030405',1,2) as raw(2)) from dual;
CAST(UTL_RAW.SUBSTR('0102030405',1,2) as R
-----------------------------------------------
0102
```

UTL_TCP

The UTL_TCP package controls TCP access in a stored procedure.

The procedures and functions which are comprised of the UTL_TCP package are listed in the following table below.

Procedures/Functions	Description
CLOSE_ALL_CONNECTIONS	Procedure closes all the handles connected to the session.
CLOSE_CONNECTION	Closes the access handle which is connected.
IS_CONNECT	Checks on the connection status of access handle.
OPEN_CONNECTION	Accesses to remote server by creating a socket.
WRITE_RAW	Transmits RAW type data to the remote server

CLOSE_ALL_CONNECTIONS

The CLOSE_ALL_CONNECTIONS is a procedure which closes all the connection handles currently being accessed.

Syntax

```
UTL_TCP.CLOSE_ALL_CONNECTIONS;
```

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
AS
BEGIN
UTL_TCP.CLOSE_ALL_CONNECTIONS();
END;
/
```

CLOSE_CONNECTION

The CLOSE_CONNECTION is a procedure closing the accessed connection handle.

Syntax

```
UTL_TCP.CLOSE_CONNECTION(c IN CONNECT_TYPE);
```

Parameter

Name	In/Output	Data Type	Description
c	IN	CONNECT_TYPE	Connection handle

Return Value

Because it is a stored procedure, there is no return value.

Exception

There is no exception.

Example

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
 AS
 V1 CONNECT_TYPE;
 V2 INTEGER;
 BEGIN
 V1 := UTL_TCP.OPEN_CONNECTION('127.0.0.1', 22007, NULL, NULL, 1024);
 V2 := UTL_TCP.WRITE_RAW(V1, TO_RAW('MESSAGE'), RAW_SIZEOF('MESSAGE'));
 UTL_TCP.CLOSE_CONNECTION(V1);
 END;
 /
```

IS_CONNECT

The IS_CONNECT procedure verifies the connection status of connection handle.

Syntax

```
UTL_TCP.IS_CONNECT(c IN CONNECT_TYPE);
```

Parameter

Name	In/Output	Data Type	Description
c	IN	CONNECT_TYPE	The connection handle

Return Value

1 is returned If it is successfully executed and when it fails, it returns -1.

Exception

There is no exception.

Example

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
    AS
    V1 CONNECT_TYPE;
    V2 INTEGER;
    BEGIN
    V1 := UTL_TCP.OPEN_CONNECTION('127.0.0.1', 22007, NULL, NULL, 1000);
    V2 := UTL_TCP.IS_CONNECT(V1);
    IF V2 = 0 THEN
        PRINTLN('CONNECTED');
        V2 := UTL_TCP.WRITE_RAW(V1, TO_RAW('MESSAGE'), RAW_SIZEOF('MESSAGE'));
        UTL_TCP.CLOSE_CONNECTION(V1);
    ELSE
        PRINTLN('NOT CONNECTD');
    END IF;
    END;
    /
```

OPEN_CONNECTION

The OPEN_CONNECTION is a procedure which creates a socket in order to access the remote server.1

Syntax

```
UTL_TCP.OPEN_CONNECTION(
  remote_host IN VARCHAR(64),
  remote_port IN INTEGER,
  local_host IN VARCHAR(64) DEFAULT NULL,
  local_port IN INTEGER DEFAULT NULL,
  in_buffer_size IN INTEGER DEF DEFAULT NULL,
  out_buffer_size IN INTEGER DEF DEFAULT NULL,
  charset IN VARCHAR(16) DEFAULT NULL,
  newline IN VARCHAR(2) DEFAULT CRLF,
  tx_timeout IN INTEGER DEF DEFAULT NULL,
  wallet_path IN VARCHAR(256) DEFAULT NULL,
  wallet_password IN VARCHAR DEFAULT NULL));
```

Parameters

Name	In/Output	Data Type	Description
remote_host	IN	VARCHAR(64)	The IP address of remote server
remote_port	IN	INTEGER	The port number of remote server
local_host	IN	VARCHAR(64)	This is parameter only for compatibility and it is neglected.
local_port	IN	INTEGER	This is parameter only for compatibility and it is neglected.
in_buffer_size	IN	INTEGER	This is parameter only for compatibility and it is neglected.
out_buffer_size	IN	INTEGER	This parameter sets the size of internal transmission buffer. The minimum value is 2048 bytes whereas 32767 is the maximum value. Null is set to be the minimum value.
charset	IN	VARCHAR(16)	This is parameter only for compatibility and it is neglected.
newline	IN	VARCHAR(2)	This is parameter only for compatibility and it is neglected.
tx_timeout	IN	INTEGER	This is parameter only for compatibility and it is neglected.
wallet_path	IN	VARCHAR(256)	This is parameter only for compatibility and it is neglected.
wallet_password	IN	VARCHAR	This is parameter only for compatibility and it is neglected.

Return Value

If it is successfully executed, the CONNECT_TYPE connection handle is returned.

Exception

If exception occurs, such as network connection failure, NULL value is returned with CONNECT_TYPE. The connection status of access handle can be confirmed through the UTL_TCP.IS_CONNECT()function.

Example

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
 AS
 V1 CONNECT_TYPE;
 V2 INTEGER;
 BEGIN
 V1 := UTL_TCP.OPEN_CONNECTION('127.0.0.1', 22007, NULL, NULL, 1024);
 V2 := UTL_TCP.WRITE_RAW(V1, TO_RAW('MESSAGE'), RAW_SIZEOF('MESSAGE'));
 UTL_TCP.CLOSE_CONNECTION(V1);
 END;
 /
```

WRITE_RAW

The handle accessed to the network transmits the inserted RAW type data to the remote server through the WRITE_RAW function.

Syntax

```
UTL_TCP.WRITE_RAW(
  c IN CONNECT_TYPE,
  data IN RAW(65534),
  len IN INTEGER DEFAULT NULL);
```

Parameters

Name	In/Output	Data Type	Description
c	IN	CONNECT_TYPE	The connection handle
data	IN	RAW(65534)	The transmitting data
len	IN	INTEGER	This parameter is only for compatibility, and the value of this parameter can be neglected.

Return Value

If successfully executes, the length of data which has been transmitted to the network is returned. If it fails, -1 is returned.

Exception

The status of accessed connection handle can be checked by using the UTL_TCP.IS_CONNECT() function if the connection of the connection handle is lost.

Example

```
iSQL> CREATE OR REPLACE PROCEDURE PROC1
    AS
    V1 CONNECT_TYPE;
    V2 INTEGER;
    BEGIN
    V1 := UTL_TCP.OPEN_CONNECTION('127.0.0.1', 22007, NULL, NULL, 1024);
    V2 := UTL_TCP.WRITE_RAW(V1, TO_RAW('MESSAGE'), RAW_SIZEOF('MESSAGE'));
    UTL_TCP.CLOSE_CONNECTION(V1);
    END;
    /
```

Appendix A. Examples

Stored Procedure Examples

Example 1

Create a stored procedure called *dumpReplScript*, which outputs a script for creating a replication object.

The tables to be replicated are the *employees* table and the *departments* table, the local server's IP address and port number are 192.168.1.12 and 35524, and the remote server's IP address and port number are 192.168.1.60 and 25524.

On the remote server:

```
iSQL> CREATE REPLICATION rep1 WITH '192.168.1.12',35524 FROM SYS.EMPLOYEES TO
SYS.EMPLOYEES, FROM SYS.DEPARTMENTS TO SYS.DEPARTMENTS;
Create success.

iSQL> ALTER REPLICATION rep1 START;
Alter success.
```

On the local server:

```
iSQL> CREATE REPLICATION rep1 WITH '192.168.1.60',25524 FROM SYS.EMPLOYEES TO
SYS.EMPLOYEES, FROM SYS.DEPARTMENTS TO SYS.DEPARTMENTS;
Create success.
iSQL> ALTER REPLICATION rep1 START;
Alter success.

iSQL> create or replace procedure dumpReplScript
(p1 varchar(40))
as
cursor c1 is
select  system_.sys_replications_.replication_name,
```

```
system_.sys_replications_.host_ip,
system_.sys_replications_.port_no,
system_.SYS_REPLICATIONS_.ITEM_COUNT
from system_.sys_replications_
where system_.sys_replications_.replication_name = UPPER(P1);
r_name varchar(40);
r_ip varchar(40);
r_port varchar(20);
r_item_cnt integer;
r_local_user_name varchar(40);
r_local_table_name varchar(40);
r_remote_user_name varchar(40);
r_remote_table_name varchar(40);
cursor c2 is
select system_.SYS_REPL_ITEMS_.LOCAL_USER_NAME,
system_.SYS_REPL_ITEMS_.LOCAL_TABLE_NAME,
system_.SYS_REPL_ITEMS_.REMOTE_USER_NAME,
system_.SYS_REPL_ITEMS_.REMOTE_TABLE_NAME
from system_.sys_repl_items_
where system_.SYS_REPL_ITEMS_.replication_name = r_name;
begin
open c1;
SYSTEM_.PRINTLN('---------------------------------------');
SYSTEM_.PRINTLN('');
loop
fetch C1 into r_name, r_ip, r_port, r_item_cnt;
exit when C1%NOTFOUND;
SYSTEM_.PRINT(' CREATE REPLICATION ');
SYSTEM_.PRINT(r_name);
SYSTEM_.PRINT(' WITH ''');
SYSTEM_.PRINT(r_ip);
SYSTEM_.PRINT(''',');
SYSTEM_.PRINT(r_port);
SYSTEM_.PRINTLN(' ');
open c2;
        for i in 1 .. r_item_cnt loop
fetch c2 into r_local_user_name,
r_local_table_name,
r_remote_user_name,
r_remote_table_name;
SYSTEM_.PRINT(' FROM ');
SYSTEM_.PRINT(r_local_user_name);
SYSTEM_.PRINT('.');
SYSTEM_.PRINT(r_local_table_name);
SYSTEM_.PRINT(' TO ');
SYSTEM_.PRINT(r_remote_user_name);
SYSTEM_.PRINT('.');
SYSTEM_.PRINT(r_remote_table_name);
if i <> r_item_cnt then
```

```
SYSTEM_.PRINTLN(',');
else
SYSTEM_.PRINTLN(';');
end if;
        end loop;
close c2;
end loop;
close c1;
SYSTEM_.PRINTLN('');
SYSTEM_.PRINTLN('---------------------------------------');
end;
/
```

The following is output by the *dumpReplScript* stored procedure on the local server.

```
iSQL> exec dumpReplScript('rep1');
----------------------------------------------------------
 CREATE REPLICATION REP1 WITH '192.168.1.60',25524
 FROM SYS.DEPARTMENTS TO SYS.DEPARTMENTS,
 FROM SYS.EMPLOYEES TO SYS.EMPLOYEES;
----------------------------------------------------------
Execute success.
```

Example 2

Create a stored procedure called *showReplications*, which outputs the name and other information about replication objects.

```
create or replace procedure showReplications
as
cursor c1 is select system_.sys_replications_.replication_name,
system_.sys_replications_.host_ip, system_.sys_replications_.port_no,
decode(system_.sys_replications_.is_started,1,'Running',0,'Not Running')
from system_.sys_replications_;
r_name varchar(40);
r_ip varchar(40);
r_port varchar(20);
r_status varchar(20);
r_local_user_name varchar(40);
r_local_table_name varchar(40);
r_remote_user_name varchar(40);
r_remote_table_name varchar(40);
cursor c2 is select system_.SYS_REPL_ITEMS_.LOCAL_USER_NAME,
system_.SYS_REPL_ITEMS_.LOCAL_TABLE_NAME, system_.SYS_REPL_ITEMS_.REMOTE_USER_NAME
system_.SYS_REPL_ITEMS_.REMOTE_TABLE_NAME
from system_.sys_repl_items_
where system_.SYS_REPL_ITEMS_.replication_name
```

```
= r_name;
begin
open c1;
SYSTEM_.PRINTLN('-----------------------------------------');
SYSTEM_.PRINTLN('     Replications   Infos');
SYSTEM_.PRINTLN('-----------------------------------------');
SYSTEM_.PRINTLN(' Name          Ip            Port       Status');
SYSTEM_.PRINTLN('-----------------------------------------');
SYSTEM_.PRINTLN('');
loop
fetch C1 into r_name, r_ip, r_port, r_status;
exit when C1%NOTFOUND;
SYSTEM_.PRINT(' ');
SYSTEM_.PRINT(r_name);
SYSTEM_.PRINT('              ');
SYSTEM_.PRINT(r_ip);
SYSTEM_.PRINT('        ');
SYSTEM_.PRINT(r_port);
SYSTEM_.PRINT('      ');
SYSTEM_.PRINTLN(r_status);
SYSTEM_.PRINTLN('+++++++++++++++++++++++++++++++++++++');
SYSTEM_.PRINTLN(' Local Table Name   Remote Table Name');
SYSTEM_.PRINTLN('+++++++++++++++++++++++++++++++++++++');
open c2;
loop
fetch c2 into r_local_user_name, r_local_table_name, r_remote_user_name,
r_remote_table_name;
exit when C2%NOTFOUND;
SYSTEM_.PRINT('         ');
SYSTEM_.PRINT(r_local_user_name);
SYSTEM_.PRINT('.');
SYSTEM_.PRINT(r_local_table_name);
SYSTEM_.PRINT('                          ');
SYSTEM_.PRINT(r_remote_user_name);
SYSTEM_.PRINT('.');
SYSTEM_.PRINTLN(r_remote_table_name);
end loop;
close c2;
end loop;
close c1;
SYSTEM_.PRINTLN('');
SYSTEM_.PRINTLN('-----------------------------------------');
end;
/
```

The following is output by the *showReplications* stored procedure.

```
iSQL> exec showReplications;
----------------------------------------------------------
```

```
 Replication Info
----------------------------------------------------------
 Name      IP              Port        Status
----------------------------------------------------------
 REP1      192.168.1.60    25524       Running
 ++++++++++++++++++++++++++++++++++++++++++++++++++++
 Local Table Name      Remote Table Name
 ++++++++++++++++++++++++++++++++++++++++++++++++++++
 SYS.DEPARTMENTS        SYS.DEPARTMENTS
 SYS.EMPLOYEES          SYS.EMPLOYEES
----------------------------------------------------------
EXECUTE success.
```

Example 3

Create a stored procedure called *showTables*, which outputs the names of all of a given user's tables.

```
create or replace procedure SHOWTABLES(p1 in varchar(40))
as
cursor c1 is select SYSTEM_.SYS_TABLES_.TABLE_NAME
from SYSTEM_.SYS_TABLES_
where SYSTEM_.SYS_TABLES_.USER_ID =
(select SYSTEM_.SYS_USERS_.USER_ID
from SYSTEM_.SYS_USERS_
where SYSTEM_.SYS_USERS_.USER_NAME =
upper(p1)
AND system_.SYS_TABLES_.TABLE_TYPE = 'T');
v1 CHAR(40);
begin
open c1;
SYSTEM_.PRINTLN('-------------------');
SYSTEM_.PRINT(p1);
SYSTEM_.PRINTLN(' Table');
SYSTEM_.PRINTLN('-------------------');
loop
fetch C1 into v1;
exit when C1%NOTFOUND;
SYSTEM_.PRINT(' ');
SYSTEM_.PRINTLN(v1);
end loop;
SYSTEM_.PRINTLN('-------------------');
close c1;
end;
/
```

The following is output by the *showTables* stored procedure.

```
iSQL> exec showTables('SYS');
--------------------
SYS Table
--------------------
 CUSTOMERS
 GOODS
 DUMMY
 ORDERS
 EMPLOYEES
 DEPARTMENTS
--------------------
Execute success.
```

Example 4

Create a stored procedure called *showProcBody*, which outputs the contents of a desired stored procedure

```
create or replace procedure showProcBody(p1 in varchar(40))
as
cursor c1 is
    select system_.sys_proc_parse_.parse
    from system_.sys_proc_parse_
    where system_.sys_proc_parse_.proc_oid = (
    select SYSTEM_.sys_procedures_.proc_oid
    from system_.sys_procedures_
    where SYSTEM_.sys_procedures_.proc_name = upper(p1))
order by system_.sys_proc_parse_.seq_no;
v1 varchar(4000);
begin
open c1;
    SYSTEM_.PRINTLN('---------------------------------');
    system_.print(p1);
    SYSTEM_.PRINTLN(' Procedure');
    SYSTEM_.PRINTLN('---------------------------------');
    SYSTEM_.PRINTLN('');
    loop
      fetch C1 into v1;
    exit when C1%NOTFOUND;
    SYSTEM_.PRINTLN(v1);
    end loop;
  close c1;
  SYSTEM_.PRINTLN('');
  SYSTEM_.PRINTLN('---------------------------------');
end;
/
```

The following is the result of querying the SYS_PROC_PARSE_ meta table, which contains the actual text of stored procedure creation statements.

```
select system_.sys_proc_parse_.proc_oid, system_.sys_proc_parse_.parse
from system_.sys_proc_parse_
where system_.sys_proc_parse_.proc_oid = (
select SYSTEM_.sys_procedures_.proc_oid
from system_.sys_procedures_
where SYSTEM_.sys_procedures_.proc_name = upper('proc1'));
PROC_OID
-----------------------
PARSE

------------------------------------------------------------
7695216

create or replace procedure PROC1
(P1 in NUMBER, P2 in VARCHAR(10), P3 in DATE)
as
begin
    if P1 >
7695216
 0 then
        insert into T1 values (P1, P2, P3);
    end if;
end
2 rows selected.
```

The following is output by the *showProcBody* stored procedure.

```
iSQL> exec showProcBody('proc1');
---------------------------------
proc1 Procedure
---------------------------------

create or replace procedure PROC1
(P1 in NUMBER, P2 in VARCHAR(10), P3 in DATE)
as
begin
    if P1 >
0 then
        insert into T1 values (P1, P2, P3);
    end if;
end

---------------------------------
Execute success.
```

Example 5

Create a stored procedure that uses a cursor variable. When this procedure is executed, a cursor variable is opened and used to read data via ODBC.

```
CREATE OR REPLACE TYPESET MY_TYPE
AS
  TYPE MY_CUR IS REF CURSOR;
END;
/

CREATE OR REPLACE PROCEDURE OPENCURSOR2
( P1 OUT MY_TYPE.MY_CUR, P2 IN INTEGER )
AS
BEGIN
  OPEN P1 FOR 'SELECT C1 FROM T1 WHERE C1 <= ?' USING P2;
END;
/

iSQL> EXEC OPENCURSOR2(4);
C1
--------------
1
2
3
4
4 rows selected.

/* ODBC program */
    ...
    SQLINTEGER c1;
    SQLINTEGER param1;

    /* allocate Statement handle */
    if (SQL_ERROR == SQLAllocStmt(dbc, &stmt))
    {
        printf("SQLAllocStmt error!!\n");
        return SQL_ERROR;
    }

    sprintf(query,"EXEC OPENCURSOR2(?)");

    if (SQLPrepare(stmt, (SQLCHAR *) query, SQL_NTS)== SQL_ERROR)
    {
       printf("ERROR: prepare stmt\n");
       execute_err(dbc, stmt, query);
       return SQL_ERROR;
```

```
    }

    if (SQLBindParameter(stmt, 1, SQL_PARAM_INPUT, SQL_C_SLONG,
                 SQL_INTEGER, 0, 0, &param1, 0, NULL) == SQL_ERROR)
    {
       printf("ERROR: Bind Parameter 1\n");
       execute_err(dbc, stmt, query);
       return SQL_ERROR;
    }

    param1 = 4;
    if (SQLExecute( stmt ) != SQL_SUCCESS)
    {
        execute_err(dbc, stmt, query);
        SQLFreeStmt(stmt, SQL_DROP);
        return SQL_ERROR;
    }

   if (SQL_ERROR ==
SQLBindCol(stmt, 1, SQL_C_SLONG, &c1, 0, NULL))
   {
     printf("ERROR: Bind 1 Column\n");
   }

   while ( (rc = SQLFetch(stmt)) != SQL_NO_DATA)
    {
        if ( rc != SQL_SUCCESS )
        {
            execute_err(dbc, stmt, query);
            break;
        }
        printf(" Result Set : [ %d ] \n", c1 );
    }

    SQLFreeStmt(stmt, SQL_DROP);

    ....

$ refcursor
============================================================
 Result Set : [ 1 ]
 Result Set : [ 2 ]
 Result Set : [ 3 ]
 Result Set : [ 4 ]
```

File Control Example

Example 1

Create a user and grant appropriate privileges to the user.

```
CONNECT SYS/MANAGER;
CREATE USER JEJEONG IDENTIFIED BY JEJEONG;
GRANT CREATE ANY DIRECTORY TO JEJEONG;
GRANT DROP ANY DIRECTORY TO JEJEONG;
```

Create a table and a directory object.

```
CONNECT JEJEONG/JEJEONG;
CREATE TABLE T1( ID INTEGER, NAME VARCHAR(40) );
INSERT INTO T1 VALUES( 1, 'JEJEONG');
INSERT INTO T1 VALUES( 2, 'EJPARK' );
INSERT INTO T1 VALUES( 3, 'WSKIM'  );
INSERT INTO T1 VALUES( 4, 'KKSHIM' );
INSERT INTO T1 VALUES( 5, 'CSKIM'  );
INSERT INTO T1 VALUES( 6, 'KDHONG' );
CREATE DIRECTORY MYDIR AS '/home/JEJEONG';
```

Create a stored procedure that reads all of the records from the table and writes them to the t1.txt file.

```
CREATE OR REPLACE PROCEDURE WRITE_T1
AS
  V1 FILE_TYPE;
  ID INTEGER;
  NAME VARCHAR(40);
BEGIN
  DECLARE
    CURSOR T1_CUR IS
      SELECT * FROM T1;
  BEGIN
    OPEN T1_CUR;
    V1 := FOPEN( 'MYDIR', 't1.txt', 'w' );
    LOOP
      FETCH T1_CUR INTO ID, NAME;
      EXIT WHEN T1_CUR%NOTFOUND;
      PUT_LINE( V1, 'ID : '||ID||' NAME : '||NAME);
    END LOOP;
    CLOSE T1_CUR;
    FCLOSE(V1);
  END;
END;
/
```

Create a stored procedure that reads all of the records from the t1.txt file and outputs them to the screen.

```
CREATE OR REPLACE PROCEDURE READ_T1
AS
  BUFFER VARCHAR(200);
  V1 FILE_TYPE;
BEGIN
  V1 := FOPEN('MYDIR', 't1.txt', 'r' );
  LOOP
    GET_LINE( V1, BUFFER, 200 );
    PRINT( BUFFER );
  END LOOP;
  FCLOSE( V1 );
EXCEPTION
  WHEN NO_DATA_FOUND THEN
    FCLOSE( V1 );
END;
/
```

When the stored procedures created as described above are executed, the output is as follows:

```
iSQL> exec write_t1;
Execute success.
iSQL> exec read_t1;
ID : 1    NAME : JEJEONG
ID : 2    NAME : EJPARK
ID : 3    NAME : WSKIM
ID : 4    NAME : KKSHIM
ID : 5    NAME : CSKIM
ID : 6    NAME : KDHONG
Execute success.
```

The contents of the actual directory in the file system are as shown below:

```
$ cd /home/JEJEONG
$ cat t1.txt
ID : 1    NAME : JEJEONG
ID : 2    NAME : EJPARK
ID : 3    NAME : WSKIM
ID : 4    NAME : KKSHIM
ID : 5    NAME : CSKIM
ID : 6    NAME : KDHONG
```