PL/SQL Basic Structure

In this section, we will discuss the Basic Syntax of PL/SQL which is a **block-structured** language; this means that the PL/SQL programs are divided and written in logical blocks of code. Each block consists of three sub-parts −

|  |  |
| --- | --- |
| **S.No** | **Sections & Description** |
| 1 | **Declarations**  This section starts with the keyword **DECLARE**. It is an optional section and defines all variables, cursors, subprograms, and other elements to be used in the program. |
| 2 | **Executable Commands**  This section is enclosed between the keywords **BEGIN** and **END** and it is a mandatory section. It consists of the executable PL/SQL statements of the program. It should have at least one executable line of code, which may be just a **NULL command** to indicate that nothing should be executed. |
| 3 | **Exception Handling**  This section starts with the keyword **EXCEPTION**. This optional section contains **exception(s)** that handle errors in the program. |

Every PL/SQL statement ends with a semicolon (;). PL/SQL blocks can be nested within other PL/SQL blocks using **BEGIN** and **END**. Following is the basic structure of a PL/SQL block −

DECLARE

<declarations section>

BEGIN

<executable command(s)>

EXCEPTION

<exception handling>

END;

**The 'Hello World' Example**

DECLARE

message varchar2(20):= 'Hello, World!';

BEGIN

dbms\_output.put\_line(message);

END;

/

The **end;** line signals the end of the PL/SQL block. To run the code from the SQL command line, you may need to type / at the beginning of the first blank line after the last line of the code. When the above code is executed at the SQL prompt, it produces the following result −

Hello World

PL/SQL procedure successfully completed.

**PL/SQL Program Units**

A PL/SQL unit is any one of the following −

* PL/SQL block
* Function
* Package
* Package body
* Procedure
* Trigger
* Type
* Type body

Each of these units will be discussed in the following chapters.

**Variables**

In this section, we will discuss Variables in Pl/SQL. A variable is nothing but a name given to a storage area that our programs can manipulate. Each variable in PL/SQL has a specific data type, which determines the size and the layout of the variable's memory; the range of values that can be stored within that memory and the set of operations that can be applied to the variable.

The name of a PL/SQL variable consists of a letter optionally followed by more letters, numerals, dollar signs, underscores, and number signs and should not exceed 30 characters. By default, variable names are not case-sensitive. You cannot use a reserved PL/SQL keyword as a variable name.

PL/SQL programming language allows to define various types of variables, such as date time data types, records, collections, etc. which we will cover in subsequent chapters. For this chapter, let us study only basic variable types.

**Conditional Statements**

In this section, we will discuss conditions in PL/SQL. Decision-making structures require that the programmer specify one or more conditions to be evaluated or tested by the program, along with a statement or statements to be executed if the condition is determined to be true, and optionally, other statements to be executed if the condition is determined to be false.

Following is the general form of a typical conditional (i.e., decision making) structure found in most of the programming languages −



PL/SQL programming language provides following types of decision-making statements. Click the following links to check their detail.

|  |  |
| --- | --- |
| **S.No** | **Statement & Description** |
| 1 | [IF - THEN statement](https://www.tutorialspoint.com/plsql/plsql_if_then.htm)  The **IF statement** associates a condition with a sequence of statements enclosed by the keywords **THEN** and **END IF**. If the condition is true, the statements get executed and if the condition is false or NULL then the IF statement does nothing. |
| 2 | [IF-THEN-ELSE statement](https://www.tutorialspoint.com/plsql/plsql_if_then_else.htm)  **IF statement** adds the keyword **ELSE** followed by an alternative sequence of statement. If the condition is false or NULL, then only the alternative sequence of statements get executed. It ensures that either of the sequence of statements is executed. |
| 3 | [IF-THEN-ELSIF statement](https://www.tutorialspoint.com/plsql/plsql_if_then_elsif.htm)  It allows you to choose between several alternatives. |
| 4 | [Case statement](https://www.tutorialspoint.com/plsql/plsql_case_statement.htm)  Like the IF statement, the **CASE statement** selects one sequence of statements to execute.  However, to select the sequence, the CASE statement uses a selector rather than multiple Boolean expressions. A selector is an expression whose value is used to select one of several alternatives. |
| 5 | [Searched CASE statement](https://www.tutorialspoint.com/plsql/plsql_searched_case.htm)  The searched CASE statement **has no selector**, and it's WHEN clauses contain search conditions that yield Boolean values. |
| 6 | [nested IF-THEN-ELSE](https://www.tutorialspoint.com/plsql/plsql_nested_if.htm)  You can use one **IF-THEN** or **IF-THEN-ELSIF** statement inside another **IF-THEN** or **IF-THEN-ELSIF** statement(s). |

**LOOPS**

In this section we will discuss Loops in PL/SQL. There may be a situation when you need to execute a block of code several number of times. In general, statements are executed sequentially: The first statement in a function is executed first, followed by the second, and so on.

Programming languages provide various control structures that allow for more complicated execution paths.

A loop statement allows us to execute a statement or group of statements multiple times and following is the general form of a loop statement in most of the programming languages −



PL/SQL provides the following types of loop to handle the looping requirements. Click the following links to check their detail.

|  |  |
| --- | --- |
| **S.No** | **Loop Type & Description** |
| 1 | [PL/SQL Basic LOOP](https://www.tutorialspoint.com/plsql/plsql_basic_loop.htm)  In this loop structure, sequence of statements is enclosed between the LOOP and the END LOOP statements. At each iteration, the sequence of statements is executed and then control resumes at the top of the loop. |
| 2 | [PL/SQL WHILE LOOP](https://www.tutorialspoint.com/plsql/plsql_while_loop.htm)  Repeats a statement or group of statements while a given condition is true. It tests the condition before executing the loop body. |
| 3 | [PL/SQL FOR LOOP](https://www.tutorialspoint.com/plsql/plsql_for_loop.htm)  Execute a sequence of statements multiple times and abbreviates the code that manages the loop variable. |
| 4 | [Nested loops in PL/SQL](https://www.tutorialspoint.com/plsql/plsql_nested_loops.htm)  You can use one or more loop inside any another basic loop, while, or for loop. |

**Subprogram**

In this section we will discuss Procedures in PL/SQL. A **subprogram** is a program unit/module that performs a particular task. These subprograms are combined to form larger programs. This is basically called the 'Modular design'. A subprogram can be invoked by another subprogram or program which is called the **calling program**.

PL/SQL subprograms are named PL/SQL blocks that can be invoked with a set of parameters. PL/SQL provides two kinds of subprograms −

* **Functions** − These subprograms return a single value; mainly used to compute and return a value.
* **Procedures** − These subprograms do not return a value directly; mainly used to perform an action.

## Parts of a PL/SQL Subprogram

Each PL/SQL subprogram has a name, and may also have a parameter list. Like anonymous PL/SQL blocks, the named blocks will also have the following three parts −

|  |  |
| --- | --- |
| **S.No** | **Parts & Description** |
| 1 | **Declarative Part**  It is an optional part. However, the declarative part for a subprogram does not start with the DECLARE keyword. It contains declarations of types, cursors, constants, variables, exceptions, and nested subprograms. These items are local to the subprogram and cease to exist when the subprogram completes execution. |
| 2 | **Executable Part**  This is a mandatory part and contains statements that perform the designated action. |
| 3 | **Exception-handling**  This is again an optional part. It contains the code that handles run-time errors. |

## Procedure

## Creating a Procedure

A procedure is created with the **CREATE OR REPLACE PROCEDURE** statement. The simplified syntax for the CREATE OR REPLACE PROCEDURE statement is as follows −

CREATE [OR REPLACE] PROCEDURE procedure\_name

[(parameter\_name [IN | OUT | IN OUT] type [, ...])]

{IS | AS}

BEGIN

< procedure\_body >

END procedure\_name;

Where,

* *procedure-name* specifies the name of the procedure.
* [OR REPLACE] option allows the modification of an existing procedure.
* The optional parameter list contains name, mode and types of the parameters. **IN** represents the value that will be passed from outside and OUT represents the parameter that will be used to return a value outside of the procedure.
* *procedure-body* contains the executable part.
* The AS keyword is used instead of the IS keyword for creating a standalone procedure.

### Example

The following example creates a simple procedure that displays the string 'Hello World!' on the screen when executed.

CREATE OR REPLACE PROCEDURE greetings

AS

BEGIN

dbms\_output.put\_line('Hello World!');

END;

/

When the above code is executed using the SQL prompt, it will produce the following result −

Procedure created.

**Function**

In this section, we will discuss the functions in PL/SQL. A function is same as a procedure except that it returns a value. Therefore, all the discussions of the previous chapter are true for functions too.

## Creating a Function

A standalone function is created using the **CREATE FUNCTION** statement. The simplified syntax for the **CREATE OR REPLACE PROCEDURE** statement is as follows −

CREATE [OR REPLACE] FUNCTION function\_name

[(parameter\_name [IN | OUT | IN OUT] type [, ...])]

RETURN return\_datatype

{IS | AS}

BEGIN

< function\_body >

END [function\_name];

Where,

* *function-name* specifies the name of the function.
* [OR REPLACE] option allows the modification of an existing function.
* The optional parameter list contains name, mode and types of the parameters. IN represents the value that will be passed from outside and OUT represents the parameter that will be used to return a value outside of the procedure.
* The function must contain a **return** statement.
* The *RETURN* clause specifies the data type you are going to return from the function.
* *function-body* contains the executable part.
* The AS keyword is used instead of the IS keyword for creating a standalone function.

**Cursors**

In this section, we will discuss the cursors in PL/SQL. Oracle creates a memory area, known as the context area, for processing an SQL statement, which contains all the information needed for processing the statement; for example, the number of rows processed, etc.

A **cursor** is a pointer to this context area. PL/SQL controls the context area through a cursor. A cursor holds the rows (one or more) returned by a SQL statement. The set of rows the cursor holds is referred to as the **active set**.

You can name a cursor so that it could be referred to in a program to fetch and process the rows returned by the SQL statement, one at a time. There are two types of cursors −

* Implicit cursors
* Explicit cursors

## Implicit Cursors

Implicit cursors are automatically created by Oracle whenever an SQL statement is executed, when there is no explicit cursor for the statement. Programmers cannot control the implicit cursors and the information in it.

Whenever a DML statement (INSERT, UPDATE and DELETE) is issued, an implicit cursor is associated with this statement. For INSERT operations, the cursor holds the data that needs to be inserted. For UPDATE and DELETE operations, the cursor identifies the rows that would be affected.

## Explicit Cursors

Explicit cursors are programmer-defined cursors for gaining more control over the **context area**. An explicit cursor should be defined in the declaration section of the PL/SQL Block. It is created on a SELECT Statement which returns more than one row.

The syntax for creating an explicit cursor is −

CURSOR cursor\_name IS select\_statement;

**Exceptions**

In this chapter, we will discuss Exceptions in PL/SQL. An exception is an error condition during a program execution. PL/SQL supports programmers to catch such conditions using **EXCEPTION** block in the program and an appropriate action is taken against the error condition. There are two types of exceptions −

* System-defined exceptions
* User-defined exceptions

## Syntax for Exception Handling

The general syntax for exception handling is as follows. Here you can list down as many exceptions as you can handle. The default exception will be handled using ***WHEN others THEN*** −

DECLARE

<declarations section>

BEGIN

<executable command(s)>

EXCEPTION

<exception handling goes here >

WHEN exception1 THEN

exception1-handling-statements

WHEN exception2 THEN

exception2-handling-statements

WHEN exception3 THEN

exception3-handling-statements

........

WHEN others THEN

exception3-handling-statements

END;

**Triggers**

In this section, we will discuss Triggers in PL/SQL. Triggers are stored programs, which are automatically executed or fired when some events occur. Triggers are, in fact, written to be executed in response to any of the following events −

* A **database manipulation (DML)** statement (DELETE, INSERT, or UPDATE)
* A **database definition (DDL)** statement (CREATE, ALTER, or DROP).
* A **database operation** (SERVERERROR, LOGON, LOGOFF, STARTUP, or SHUTDOWN).

Triggers can be defined on the table, view, schema, or database with which the event is associated.

### Benefits of Triggers

Triggers can be written for the following purposes −

* Generating some derived column values automatically
* Enforcing referential integrity
* Event logging and storing information on table access
* Auditing
* Synchronous replication of tables
* Imposing security authorizations
* Preventing invalid transactions

## Creating Triggers

The syntax for creating a trigger is −

CREATE [OR REPLACE ] TRIGGER trigger\_name

{BEFORE | AFTER | INSTEAD OF }

{INSERT [OR] | UPDATE [OR] | DELETE}

[OF col\_name]

ON table\_name

[REFERENCING OLD AS o NEW AS n]

[FOR EACH ROW]

WHEN (condition)

DECLARE

Declaration-statements

BEGIN

Executable-statements

EXCEPTION

Exception-handling-statements

END;

Where,

* CREATE [OR REPLACE] TRIGGER trigger\_name − Creates or replaces an existing trigger with the *trigger\_name*.
* {BEFORE | AFTER | INSTEAD OF} − This specifies when the trigger will be executed. The INSTEAD OF clause is used for creating trigger on a view.
* {INSERT [OR] | UPDATE [OR] | DELETE} − This specifies the DML operation.
* [OF col\_name] − This specifies the column name that will be updated.
* [ON table\_name] − This specifies the name of the table associated with the trigger.
* [REFERENCING OLD AS o NEW AS n] − This allows you to refer new and old values for various DML statements, such as INSERT, UPDATE, and DELETE.
* [FOR EACH ROW] − This specifies a row-level trigger, i.e., the trigger will be executed for each row being affected. Otherwise the trigger will execute just once when the SQL statement is executed, which is called a table level trigger.
* WHEN (condition) − This provides a condition for rows for which the trigger would fire. This clause is valid only for row-level triggers.

**Packages**

In this section, we will discuss the Packages in PL/SQL. Packages are schema objects that groups logically related PL/SQL types, variables, and subprograms.

A package will have two mandatory parts −

* Package specification
* Package body or definition