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PL/SQL Practical Guide

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1. PL / SQL:

1 PL/SQL is a procedural extension to a non – procedural language SQL.

2 PL/SQL is a Database Language restricted only to do the database activities. (Unlike Other General Purpose Languages like C, C++, Java, Etc)

3 PL/SQL Can Have Any Number of Statements, Which Reduces The Network Traffic.

4 PL/SQL Program can reside either at the front end or within Oracle Database Server as Stored Subprogram.

5 Named PL/SQL Sub-Programs that can be stored within the database are Procedures, Functions, Triggers and Packages.

Valid SQL Statements in PL/SQL:

1 All DML Statements (Insert, Update, Delete)
2 All TCL (Commit, Rollback)
3 All SQL Functions (Single & Group function)
4 All SQL Predicates (Where, Having, Group By, Order by)

Invalid SQL Statements in PL/SQL Are:

1 DDL Statements (Create, Alter, Etc)
2 DCL Statements (Grant, Revoke)

Types of Procedural Statements in PL/SQL:

1 Flow Control Statements: If, Exit, Goto, Raise.
2 Iterative Statements: Simple Loop, While Loop, For Loop.

Benefits of PL/SQL

1 Integration.
2 Modularized Application Development.
3 Improved Performance.
4 Provides Exception / Error Handling Capability.
5 Reusability of Code.
6 Provides Encapsulation, Overloading, etc.

PL/SQL Block

Declare (Optional)

Variables, Cursors and User defined Exception.

Begin (Mandatory)

SQL, PL/SQL Statements

Exception (Optional)

Action to perform when exception occurs.

End;

Data Types in PL/SQL:

Data Types

Scalar Data Types   Composite Data Types

Scalar Data Types:

- Holds Single Value.
- Has No Internal Components.

1. Char [Max Length]
2. Varchar2 [Max Length]
3. Long
4. Long Raw
5. Number [Precision, Scale]
6. Binary_Integer
7. Boolean.

Note*: Data Types can be declared with Not Null Constraints. These must be initialized.

The %type Attribute:

1. %type Attribute is used to declare a variable as per the data type of an underling table's column.

2. A Variable Declared with the %Type attribute contains the same data type as that of the columns upon which it is declared.

Composite Data Types:

1 Composite Data Types Have Internal Components.
2 Hence, Composite Data Types can store multiple values that can be manipulated individually.
3 Composite Data Types are also knows as Collections.

Examples of Composite Date Type:

1 *Index by* Table
2 Record
3 Table of Records

Flow Control Statements:

1. If
2. If … Elsif
3. goto
4. Raise

Iterative Statements:

1. Simple Loop.
2. While Loop.
3. For Loop.

Guide Lines for Using Loops:

- Use the Simple Loop when the statements inside the blocks are to be executed at least once.

- Use the WHILE Loop if the condition need to be evaluated before each iteration.

- Use the FOR Loop if the number of iteration is known.

Examples:

```
Declare

      v_name     Char(20);
      v_course   Varchar2(20);
      v_duration  Number(3):= 30;
Begin

     v_name :='Sachin';
     v_course := 'Oracle';
     dbms_output.put_line(v_name);
     dbms_output.put_line(v_course);
     dbms_output.put_line(v_duration);
End;
```

```
Declare

          v_name      emp.ename%type;
          v_job       emp.job%type;
          v_sal       emp.sal%type;
 Begin
         select ename,job,sal
         into   v_name, v_job, v_sal
         from emp
         where empno =7902;
         dbms_output.put_line(v_name||′ ‘||v_job||′  ‘||v_sal);
 End;
```

/* IF DEMO */

```
Declare
            a number(2) :=&value_of_a;
            b number(2) :=&value_of_b;
Begin
  if a<b then
       dbms_output.put_line(' Smaller Value is '||a);
  elsif a>b then
        dbms_output.put_line(' Smaller Value is '||b);
  else
     dbms_output.put_line(' Both no.  are equal ');
  end if;
END;
```

/* SIMPLE LOOP */

```
DECLARE
             i NUMBER(2):= 1;
BEGIN
             LOOP
              dbms_output.put_line(i);
              EXIT WHEN i >= 10;
              i := i+1;
             END LOOP;
END;
```

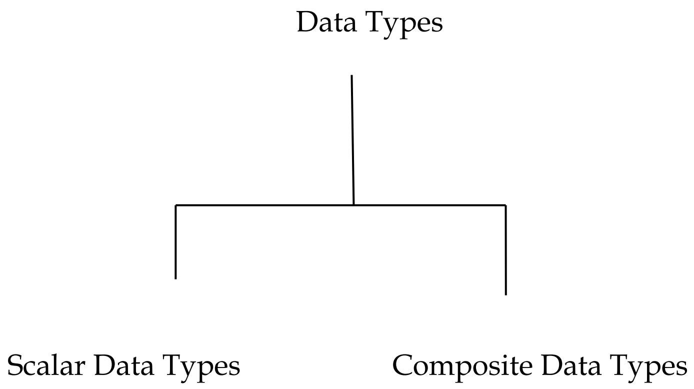
/* WHILE LOOP */

```
DECLARE
            a number := 1;
BEGIN
     WHILE a<=10
      LOOP
       dbms_output.put_line(a);
       a:= a + 1;
      END LOOP;
END;
```

/* FOR DEMO*/

```
Begin
      for i in 1..10 Loop
       dbms_output.put_line(i);
      end Loop;
END;
```

2. DATA TYPES IN PL/SQL



Composite Data Types:

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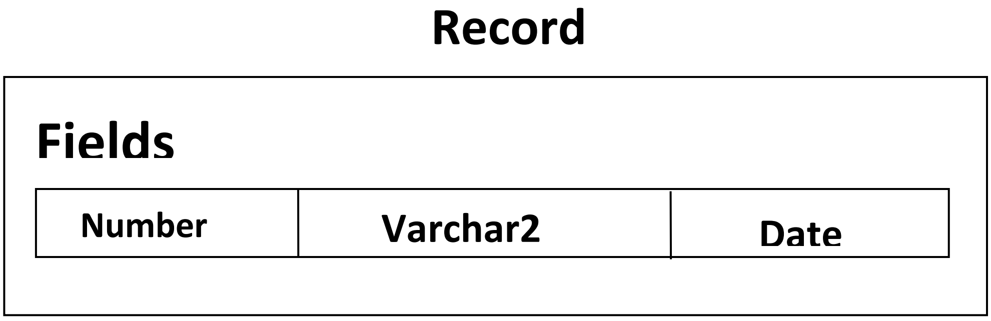
-

Examples of Composite Date Type:

- *Index by* Table
- Record
- Table of Records

Records:

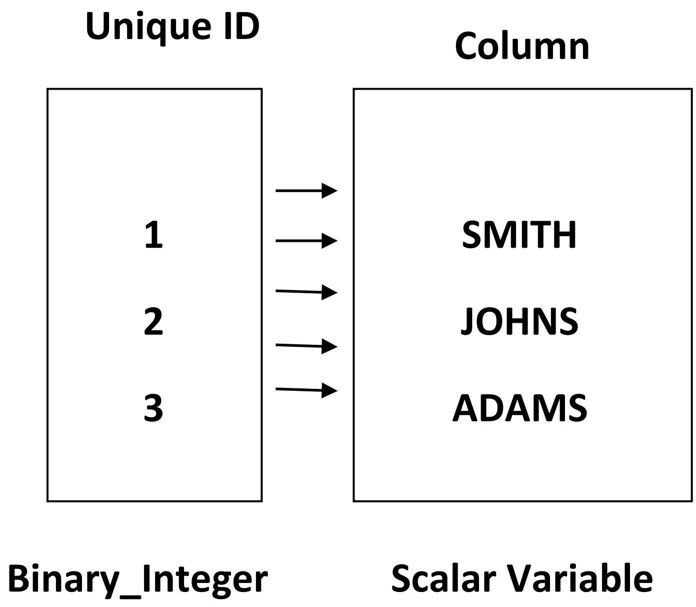
A Record is a collection of logically related data items of dissimilar data types. It is similar to a row in a table or Structures in C Language.



The %RowType Attribute:

The %rowtype Attribute declares a variable according to the number and data types of a database table or view.

Index by Table:



- *Index by* Table is Similar to Arrays.
- Consist of two components*:*
- A Primary Key of Binary_Integer data type that indexes the Index by Table Elements.
- A Column of Scalar or Record Data Type that stores the elements value.
- Can Increase Dynamically.

Index by Table of Records:

- Records can store a Row from a Table.
- *Index by* Table can store a Column from a table.

Index by Table of Records is a combination of both. Hence it can Store an entire table.

Examples:

/* Record Demo */

```
Declare
     TYPE emp_rec is RECORD
       ( name varchar2(20),
        hiredate date,
        sal  number(7)
       );
    v_emp emp_rec;
 BEGIN
    select ename, hiredate, sal into v_emp
    from emp  where empno=&Emp_No;
    dbms_output.put_line(v_emp.name||''||v_emp.sal||' ‘||v_emp.hiredate);
 END;
```

/* Record %type */

```
Declare
     e emp%rowtype;
 BEGIN
    select * into e from emp
    where empno=&Emp_No;
    dbms_output.put_line(e.empno||''||e.ename||''||e.sal||''||e.hiredate);
END;
```

/* Index by Table */

```
Declare
     Type t_name is TABLE of VARCHAR2(20)
     index by binary_integer;
     v_name t_name;
     dno number :=10;

 BEGIN
    FOR i in 1..4
    LOOP
         select dname into v_name(i)
        from dept
        where deptno = dno;
        dno:=dno+10;
    END LOOP;
 FOR i in 1..4
     LOOP
        dbms_output.put_line(v_name(i));
     END LOOP;
END;
```

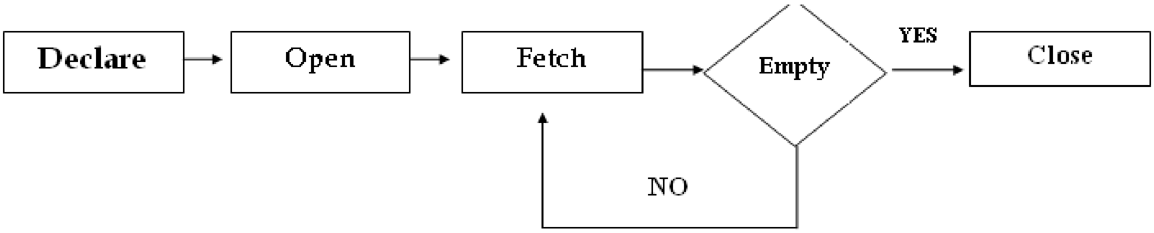
/* Index By Table of Records */

```
Declare
  Type type_dept is TABLE of dept%rowtype
  index by binary_integer;
       v_dept type_dept;
       dno number :=10;
  BEGIN
       FOR i in 1..4
        LOOP
                 select * into v_dept(i)
            from dept
            where deptno = dno;
            dno:=dno+10;
     END LOOP;
    FOR i in 1..4

     LOOP

dbms_output.put_line(v_dept(i).deptno

 ||' '||v_dept(i).dname||' '||v_dept(i).loc);

     END LOOP;

END;
```

3. CURSORS

- Whenever you issue a SQL Statement, Oracle opens an area of memory in which the command is parsed and executed. This Area is called CONTEXT AREA.
- The information (Rows) retrieved from the database table, which is available in context area, is known as the ACTIVE SET.
- A Cursor is a pointer to the current row in the ACTIVE SET.
- There are two types of Cursors:
  1. Implicit Cursors: Created, Managed & Erased by Oracle Automatically.
  2. Explicit Cursors: Created & Named by the Programmer.

Controlling Explicit Cursor:



Steps Involved in Creating a Cursor:

1. **Create** the context area
   Syntax: *Cursor <cursor_name> is <SQL Query>.*

2. **Opening** the CURSOR
   Syntax: *OPEN <cursor_name>;*

3. **Fetch** the record into a cursor variable.
   Syntax: *FETCH <cursor name> into <cursor variable>;*

4. **CLOSE** the cursor.
   Syntax: *CLOSE <cursor name>;*

Cursor Attributes:

- <cursor name> %isopen

- <cursor name> %found

- <cursor name> %notfound

- <cursor name> %rowcount

```
/* CURSOR DEMO */

Declare
 v_ename varchar2(10);
 v_job varchar2(10);
 v_sal number(4);
 cursor c1 is
 select ename,job,sal from emp;--Declareing Cursor
BEGIN
 openc1; -- Opening Cursor.
 loop
   fetch c1 into v_ename,v_job, v_sal;--Fetching
   exit when c1%notfound;
   dbms_output.put_line(v_ename||' '||v_job||' '||v_sal);
 end loop;
 close c1;    --Closing.
end;

/* CURSOR WITH RECORD DATA TYPE */
Declare
 cursor empcur is
  select * from emp;
 v_emp_cur empcur%rowtype;
 BEGIN
    OPEN empcur;
    LOOP
              Fetch empcur into v_emp_cur;
             EXIT When empcur%notfound;
             dbms_output.put_line
             (v_emp_cur.empno||v_emp_cur.ename||v_emp_cur.job||v_emp_cur.sal);
    END LOOP;
   dbms_output.put_line(empcur%rowcount||' records retrived');
CLOSE empcur;
END;

/* CURSOR WITH PARAMETERS */
Declare
 cursor c1(dno number) is
      select ename,sal from emp where deptno=dno;
 empcur c1%rowtype;
BEGIN
 open c1(&dno);
 loop
   fetch c1 into empcur;
  exit when c1%notfound;
  dbms_output.put_line(empcur.ename||' '||empcur.sal);
 end loop;
 close c1;

end;



 /* CURSOR FOR LOOP */

Declare

     cursor c1 is

     select empno, job from emp;


BEGIN

  for empcur in c1   --auto open and fetch

  LOOP

   dbms_output.put_line

   (empcur.empno||' '||empcur.job);

  END LOOP; -- auto close

END;
```

4. EXCEPTIONS

```
/* PRE DEFINED NAMED EXCEPTIONS */
Declare
          e emp%rowtype;
BEGIN
        select * into e from emp
        where empno=&empno;
EXCEPTION
      when no_data_found then
      dbms_output.put_line(' So such Emp Exist ');
      when invalid_column_name then
      dbms_output.put_line(' Datatype mismatch ');
      when others then
      dbms_output.put_line(' some error occured ');
END;
```

```
/* PRE DEFINED UN-NAMED EXCEPTION */
Declare
         exp_intigrity exception;
         pragma exception_init
         (exp_intigrity, -02292);
 begin
     delete from dept where deptno=&deptno;
 exception
     when exp_intigrity then
     dbms_output.put_line(' cant delete dept records, child records exist ');
     when others then
     dbms_output.put_line(' Some Error Occured ');
 end;
```

5. Types of Named Sub Programs

1> Procedures
2> Functions
3>

Procedures:

- A Procedure is a named PL/SQL Block, stored in the database.
- A Procedure is generally used to perform an action.
- A Procedure may or may not return a value.
- When a procedure is first created, it is compiled and stored with in the database in compiled form. This compiled code allows reusability and performance benefits.
- Parameter can have three modes in a procedure, IN, OUT & INOUT mode.

Privileges:

```
SQL> grant create procedure to user_name; (DBA)

SQL> Grant Execute on <procedure_name> to user_name (owner)
```

Data Dictionary Views:

- User_procedures (General Info)
- User_source (the text of pl/sql procedure)
- Desc procedure_name (IN, OUT, INOUT parameters list)
- User_errors (to see all the compilation errors in a procedure).

OR

```
SQL> show error;

     Show err;
```

```
/* PROCEDURE TO ADD A Record in Dept Table */

create or replace procedure add_dept

               (p_dno in number default 10,

                p_name in varchar2 default 'IT',

                p_loc  in varchar2 default 'HYD')

as

begin

     insert into dept values(p_dno, p_name, p_loc);

end;
```

```
/* PROC To Fetch Data From Emp Table */
create or replace procedure get_emp
                (p_eno in number,
                 p_name out varchar2,
                 p_job out varchar2,
                 p_sal out number
                 )
is
begin
     select ename, job, sal  into
     p_name,p_job, p_sal from emp
     where empno = p_eno;
end;
```

6. FUNCTIONS

- Function is a named PL/SQL Block that returns a value.
- A Function can be stored in the database as a schema object for repeated execution.
- A function is called as part of an expression.
- Functions and Procedures are structured alike. Procedures are used to perform a task and Functions are used to compute values.

Location to call User-Defined Functions:

- Select Command.
- Where, Group by, Having & Order by Clauses.
- In an Insert Statement.
- In Update Statement.

Restrictions On Functions:

- Functions Called from a SQL Statements cannot have DML statements.
- Functions called from an update / delete statement on a table XYZ cannot perform DML on the same table XYZ.
- Functions called from a DML statement on a table cannot query the same table.
- Functions called from a SQL statement cannot contain COMMIT or ROLLBACK statement.

Getting Function Info:

USER_OBJECTS:

```
SQL> Select object_name from user_objects where object_type = 'FUNCTION';
```

USER_SOURCE:

```
SQL> Select text from user_source where name ='FUNC_NAME';
```

Dropping a Function:

```
SQL > Drop Function Function_Name;
```

```
CREATE OR REPLACE FUNCTION get_annsal (p_id number) return number
 as
    v_salary number(10);
 BEGIN
    select sal*12 into v_salary from emp
    where empno = p_id;
    return v_salary;
 END;
```

```
CREATE OR REPLACE FUNCTION  tax (p_sal number) return number

 as

      v_tax number(8,2) :=0;

 BEGIN

      if p_sal between 0 and 2000 then

      v_tax := p_sal * 0.10;

      elsif p_sal between 2001 and 4000 then

      v_tax := p_sal *0.15;

      else

      v_tax := p_sal * 0.25;

      end if;

      return v_tax;

 END;

CREATE OR REPLACE FUNCTION  emp_exp (p_eno number) return number

as

      hdate date;

      e number;

BEGIN

      select hiredate into hdate

      from emp

      where empno = p_eno;

      e := months_between(sysdate, hdate) / 12;

      return round(e);

end;
```

7. PACKAGES

- Packages are used to bundle together a group of logically related Sub-Programs.
- A Package Consist of two parts:
    - Package Specification &
    - Package Body
- Both of which are stored independently in the Data Dictionary.
- The Constructs (sub programs) mentioned in the package specification are PUBLIC constructs. The Constructs described in the package body, but not mentioned in the specification are PRIVATE constructs.
- A Package itself can't be invoked, parameterizes or nested.
- When one Sub-Program from the packages is called, the entire package is loaded in the memory providing faster access to other Sub-Programs.

Advantages of Package:

- Modularity
- Encapsulation
- Overloading
- Better Performance

Privileges:

Create Procedure (DBA).

Execute (owner)

Data Dictionary View:

User_procedures, User_objects, User_source.

```
CREATE OR REPLACE PACKAGE my_pack is

 FUNCTION   get_annsal(p_id number)return number;

 FUNCTION   tax(p_id number)return number;

 PROCEDURE  get_emp(p_eno in number,

                p_name out varchar2,

                p_job out varchar2,

                p_sal out number);

end my_pack;
```

```
CREATE OR REPLACE PACKAGE BODY my_pack
 is
  /* GET_ANNSAL FUNCTION */
 FUNCTION get_annsal(p_id number)
 return number
 as
       v_salary emp.sal%type;
 BEGIN
       select sal*12 into v_salary from emp
       where empno = p_id;
       return v_salary;
 END;
  /* TAX FUNCTION */
 FUNCTION tax(p_id number)
 return number
 as
       v_tax number(8,2) :=0;
       v_salary number(6);
 BEGIN
       select sal*12 into v_salary from emp
       where empno=p_id;
       if v_salary between 0 and 2000 then
       v_tax := v_salary * 0.10;
       elsif v_Salary between 2001 and 4000 then
       v_tax := v_salary *0.15;
       else
       v_tax := v_salary * 0.25;
       end if;
       return v_tax;
 END;
 /* GET_EMP */
 PROCEDURE get_emp(p_eno in number,
                   p_name out varchar2,
                   p_job out varchar2,
                   p_sal out number
                   )
 is
 begin
       select ename, job, sal  into
             p_name,p_job, p_sal from emp
       where empno = p_eno;
 end;
 end my_pack;
```

```
/* Function Overloading in a Package */
create or replace package operation
is
 function add(x number, y number) return number;
 function add(x varchar2, y varchar2) return varchar2;
 function add(x date, y number) return date;
end operation;
create or replace package body operation
is
   function add(x number, y number) return number
   is
          v_ans number;
   Begin
          v_ans := x + y;
          return v_ans;
   End;
   function add(x varchar2, y varchar2) return varchar2
   is
         v_ans varchar2(40);
   Begin
         v_ans := x||y;
         return v_ans;
   End;
   function add(x date, y number) return date
   is
      v_ans date;
   Begin
         v_ans := x + y;
         return v_ans;
   End;
end operation;
/* An Anonymous PL/SQL Block To Call Operation.add */
Declare
        a number;
        b varchar2(30);
        c date;
begin
       a := operation.add(23,3);
       dbms_output.put_line('the value of a is '||a);
       b :=operation.add('Active','Net');
       dbms_output.put_line('the value of b is '||b);
       c :=operation.add(sysdate,8);
       dbms_output.put_line('the value of c is '||c);
end;
```

8. DATABASE TRIGGERS

- A Database Trigger is a PL/SQL Block, which is associated with a table, view, schema or the entire database.
- Executes Implicitly (Automatically) whenever a particular event takes place.
- Can be of Two types:
  1. Schema Level Trigger: Fires of each event (DML) for that particular user.
  2. System Trigger: Fires for each event for all users.

Schema Level Triggers:

Based on Tables and Views in a Schema.

Triggering Event:

Event upon which the trigger will be fired

i.e. body of the trigger will be executed.

Eg: Insert, update, Delete, Instead of (views).

Trigger Timing:

When should the trigger fire. Before or After the EVENT.

Trigger Types:

Statement Level: (default for tables)

Executed once for the Entire DML Operation.

Row Level: (default for views)

Executed once for each row affected by the event.

Note: Triggers Cannot Contain Commit, Savepoint or Rollback Statements.

```
SQL> Alter Trigger Trigger_Name Disable | Enable;

SQL> Alter Table EMP Disable | Enable All Triggers;

SQL> Drop Trigger Trigger_Name;

SQL> DESC user_triggers;
```

Note: When a table is dropped all trigger on that table are also dropped.

INSTEAD OF *Trigger*

- A View consisting of Group Function, Group by Clause, Join Condition, etc is called a complex view.
- DML Operations cannot be performed directly on a Complex view.
- Def: To Perform DML operations through a complex view, we can use an INSTEAD of Trigger. The DML operation is targeted at the Base Table the view refers to.
- Instead of Triggers can only be ROW LEVEL Triggers.

Database Trigger / System Triggers

1. Create. (DB or Schema Level)
2. Alter. "
3. Drop. "
4. Log on. "
5. Log Off. "
6. Startup. (DB Level Only).
7. Shut Down. "
8. A Specific Error or Any Error Being Raised. "

```
/* Dept Backup Trigger */
create or replace trigger dept_backup
before delete
on dept
for each row
Begin
    insert into dept_backup values
    (:old.deptno, :old.dname, :old.loc);
end;
/* Sal Check Trigger – With User Defined Exception */
create or replace trigger sal_check
before update
on emp
for each row
begin
      if :new.sal < :old.sal then
      raise_application_error(-20006,'You Cannot Decrease an emp''s Sal');
      end if;
End;

/* Day & Time Check Trigger – With User Defined Exception */

CREATE  or REPLACE TRIGGER day_time_check
BEFORE
```

```
INSERT OR UPDATE OR DELETE
ON EMP
DECLARE
        d varchar2(3);
        t number(2);
BEGIN
        d :=to_char(sysdate,'DY');
        t := to_char(sysdate, 'HH24');

        if d in ('SAT','SUN')  then
            raise_application_error
            (-20005, ' Today is  Saturday / Sunday. Transactions  are not allowed on weekends.
');
      end if;

      if t NOT between 09 AND 17 Then
            raise_application_error
            (-20006, ' Tx Allowed Between 09 AM Till 6 PM Only ');
      end if;

end;

/* Database Level Logon Trigger – To Be Create By Sys */
create or replace trigger logon_trig
after
logon  ON Database
Declare

begin

       insert into log values(user, sysdate);
end;
```