

EXERCISE-17

TRIGGER

DEFINITION

A trigger is a statement that is executed automatically by the system as a side effect of a modification to the database. The parts of a trigger are,

- **Trigger statement:** Specifies the DML statements and fires the trigger body. It also specifies the table to which the trigger is associated.
- **Trigger body or trigger action:** It is a PL/SQL block that is executed when the triggering statement is used.
- **Trigger restriction:** Restrictions on the trigger can be achieved

The different uses of triggers are as follows,

- *To generate data automatically*
- *To enforce complex integrity constraints*
- *To customize complex securing authorizations*
- *To maintain the replicate table*
- To audit data modifications

TYPES OF TRIGGERS

The various types of triggers are as follows,

- **Before:** It fires the trigger before executing the trigger statement.
- **After:** It fires the trigger after executing the trigger statement
- **For each row:** It specifies that the trigger fires once per row
- **For each statement:** This is the default trigger that is invoked. It specifies that the trigger fires once per statement.

VARIABLES USED IN TRIGGERS

- `:new`
- `:old`

These two variables retain the new and old values of the column updated in the database. The values in these variables can be used in the database triggers for data manipulation

SYNTAX

```
create or replace trigger triggername [before/after] {DML statements}
on [tablename] [for each row/statement]
begin
```


exception
end;

USER DEFINED ERROR MESSAGE

The package "raise_application_error" is used to issue the user defined error messages

Syntax: raise_application_error(error number,'error message');

The error number can lie between -20000 and -20999.

The error message should be a character string.

TO CREATE THE TABLE 'ITEMPLS'

SQL> create table itempls (ename varchar2(10), eid number(5), salary number(10));
Table created.

SQL> insert into itempls values('xxx',11,10000);
1 row created.

SQL> insert into itempls values('yyy',12,10500);
1 row created.

SQL> insert into itempls values('zzz',13,15500);
1 row created.

SQL> select * from itempls;
ENAME EID SALARY

xxx 11 10000
yyy 12 10500
zzz 13 15500

TO CREATE A SIMPLE TRIGGER THAT DOES NOT ALLOW INSERT UPDATE AND DELETE OPERATIONS ON THE TABLE

SQL> create trigger ittrigg before insert or update or delete on itempls for each row
2 begin
3 raise_application_error(-20010,'You cannot do manipulation');
4 end;
5
6 /
Trigger created.

SQL> insert into itempls values('aaa',14,34000);
insert into itempls values('aaa',14,34000)
*
ERROR at line 1:
ORA-20010: You cannot do manipulation
ORA-06512: at "STUDENT.ITTRIGG", line 2
ORA-04088: error during execution of trigger 'STUDENT.ITTRIGG'

```
SQL> delete from itempls where ename='xxx';
delete from itempls where ename='xxx'
*
ERROR at line 1:
ORA-20010: You cannot do manipulation
ORA-06512: at "STUDENT.ITTRIGG", line 2
ORA-04088: error during execution of trigger 'STUDENT.ITTRIGG'
```

```
SQL> update itempls set eid=15 where ename='yyy';
update itempls set eid=15 where ename='yyy'
*
ERROR at line 1:
ORA-20010: You cannot do manipulation
ORA-06512: at "STUDENT.ITTRIGG", line 2
ORA-04088: error during execution of trigger 'STUDENT.ITTRIGG'
```

TO DROP THE CREATED TRIGGER

```
SQL> drop trigger ittrigg;
```

Trigger dropped.

TO CREATE A TRIGGER THAT RAISES AN USER DEFINED ERROR MESSAGE AND DOES NOT ALLOW UPDATION AND INSERTION

```
SQL> create trigger ittriggs before insert or update of salary on itempls for each row
 2 declare
 3   triggsal itempls.salary%type;
 4 begin
 5   select salary into triggsal from itempls where eid=12;
 6   if(:new.salary>triggsal or :new.salary<triggsal) then
 7     raise_application_error(-20100,'Salary has not been changed');
 8   end if;
 9 end;
10 /
```

Trigger created.

```
SQL> insert into itempls values ('bbb',16,45000);
insert into itempls values ('bbb',16,45000)
*
ERROR at line 1:
ORA-04098: trigger 'STUDENT.ITTRIGGS' is invalid and failed re-validation
```

```
SQL> update itempls set eid=18 where ename='zzz';
update itempls set eid=18 where ename='zzz'
*
ERROR at line 1:
ORA-04298: trigger 'STUDENT.ITTRIGGS' is invalid and failed re-validation
```

- Cursor for loop
- Explicit cursor

□ Implicit cursor

TO CREATE THE TABLE 'SSEMPP'

```
SQL> create table ssempp( eid number(10), ename varchar2(20), job varchar2(20), sal number(10), dno number(5));  
Table created.
```

```
SQL> insert into ssempp values(1,'nala','lecturer',34000,11);  
1 row created.
```

```
SQL> insert into ssempp values(2,'kala','seniorlecturer',20000,12);  
1 row created.
```

```
SQL> insert into ssempp values(5,'ajay','lecturer',30000,11);  
1 row created.
```

```
SQL> insert into ssempp values(6,'vijay','lecturer',18000,11);  
1 row created.
```

```
SQL> insert into ssempp values(3,'nila','professor',60000,12);  
1 row created.
```

```
SQL> select * from ssempp;
```

EID	ENAME	JOB	SAL	DNO
1	nala	lecturer	34000	11
2	kala	seniorlecturer	20000	12
5	ajay	lecturer	30000	11
6	vijay	lecturer	18000	11
3	nila	professor	60000	12

EXTRA PROGRAMS

TO WRITE A PL/SQL BLOCK TO DISPLAY THE EMPLOYEE ID AND EMPLOYEE NAME USING CURSOR FOR LOOP

```
SQL> set serveroutput on;  
SQL> declare  
2 begin  
3 for emy in (select eid,ename from ssempp)  
4 loop  
5 dbms_output.put_line('Employee id and employee name are'|| emy.eid 'and'|| emy.ename);  
6 end loop;  
7 end;  
8 /
```

```
Employee id and employee name are 1 and nala  
Employee id and employee name are 2 and kala  
Employee id and employee name are 5 and ajay  
Employee id and employee name are 6 and vijay  
Employee id and employee name are 3 and nila
```

PL/SQL procedure successfully completed.

TO WRITE A PL/SQL BLOCK TO UPDATE THE SALARY OF ALL EMPLOYEES WHERE DEPARTMENT NO IS 11 BY 5000 USING CURSOR FOR LOOP AND TO DISPLAY THE UPDATED TABLE

```
SQL> set serveroutput on;
SQL> declare
2 cursor cem is select eid,ename,sal,dno from ssempp where dno=11;
3 begin
4 --open cem;
5 for rem in cem
6 loop
7 update ssempp set sal=rem.sal+5000 where eid=rem.eid;
8 end loop;
9 --close cem;
10 end;
11 /
```

PL/SQL procedure successfully completed.

```
SQL> select * from ssempp;
```

EID	ENAME	JOB	SAL	DNO
1	nala	lecturer	39000	11
2	kala	seniorlecturer	20000	12
5	ajay	lecturer	35000	11
6	vijay	lecturer	23000	11
3	nila	professor	60000	12

TO WRITE A PL/SQL BLOCK TO DISPLAY THE EMPLOYEE ID AND EMPLOYEE NAME WHERE DEPARTMENT NUMBER IS 11 USING EXPLICIT CURSORS

```
1 declare
2 cursor cenl is select eid,sal from ssempp where dno=11;
3 ecode ssempp.eid%type;
4 esal empp.sal%type;
5 begin
6 open cenl;
7 loop
8 fetch cenl into ecode,esal;
9 exit when cenl%notfound;
10 dbms_output.put_line(' Employee code and employee salary are' || ecode 'and'|| esal);
11 end loop;
12 close cenl;
13* end;
```

```
SQL> /
Employee code and employee salary are 1 and 39000
Employee code and employee salary are 5 and 35000
Employee code and employee salary are 6 and 23000
```

PL/SQL procedure successfully completed.

TO WRITE A PL/SQL BLOCK TO UPDATE THE SALARY BY 5000 WHERE THE JOB IS LECTURER , TO CHECK IF UPDATES ARE MADE USING IMPLICIT CURSORS AND TO DISPLAY THE UPDATED TABLE

```
SQL> declare
2  county number;
3 begin
4  update ssemp set sal=sal+10000 where job='lecturer';
5  county:= sql%rowcount;
6  if county > 0 then
7    dbms_output.put_line('The number of rows are'|| county);
8  end if;
9  if sql%found then
10   dbms_output.put_line('Employee record modification successful');
11 else if sql%notfound then
12   dbms_output.put_line('Employee record is not found');
13 end if;
14 end if;
15 end;
16 /
```

The number of rows are 3

Employee record modification successful

PL/SQL procedure successfully completed.

```
SQL> select * from ssemp;
```

EID	ENAME	JOB	SAL	DNO
1	nala	lecturer	44000	11
2	kala	seniorlecturer	20000	12
5	ajay	lecturer	40000	11
6	vijay	lecturer	28000	11
3	nila	professor	60000	12

PROGRAMS

TO DISPLAY HELLO MESSAGE

```
SQL> set serveroutput on;
SQL> declare
2  a varchar2(20);
3 begin
4  a:='Hello';
5  dbms_output.put_line(a);
6 end;
7 /
Hello
```

PL/SQL procedure successfully completed.

TO INPUT A VALUE FROM THE USER AND DISPLAY IT

```
SQL> set serveroutput on;
SQL> declare
2 a varchar2(20);
3 begin
4 a:=&a;
5 dbms_output.put_line(a);
6 end;
7 /
```

```
Enter value for a: 5
old 4: a:=&a;
new 4: a:=5;
5
```

PL/SQL procedure successfully completed.

GREATEST OF TWO NUMBERS

```
SQL> set serveroutput on;
```

```
SQL> declare
2 a number(7);
3 b number(7);
4 begin
5 a:=&a;
6 b:=&b;
7 if(a>b) then
8 dbms_output.put_line ('The greater of the two is'|| a);
9 else
10 dbms_output.put_line ('The greater of the two is'|| b);
11 end if;
12 end;
13 /
```

```
Enter value for a: 5
old 5: a:=&a;
new 5: a:=5;
Enter value for b: 9
old 6: b:=&b;
new 6: b:=9;
The greater of the two is9
```

PL/SQL procedure successfully completed.

GREATEST OF THREE NUMBERS

```
SQL> set serveroutput on;
```

```
SQL> declare
2 a number(7);
3 b number(7);
4 c number(7);
5 begin
6 a:=&a;
7 b:=&b;
8 c:=&c;
```

```
9 if(a>b and a>c) then
10 dbms_output.put_line (' The greatest of the three is '|| a);
11 else if (b>c) then
12 dbms_output.put_line (' The greatest of the three is '|| b);
13 else
14 dbms_output.put_line (' The greatest of the three is '|| c);
15 end if;
16 end if;
17 end;
18 /
Enter value for a: 5
old 6: a:=&a;
new 6: a:=5;
Enter value for b: 7
old 7: b:=&b;
new 7: b:=7;
Enter value for c: 1
old 8: c:=&c;
new 8: c:=1;
The greatest of the three is 7
```

PL/SQL procedure successfully completed.

PRINT NUMBERS FROM 1 TO 5 USING SIMPLE LOOP

```
SQL> set serveroutput on;
```

```
SQL> declare
2 a number:=1;
3 begin
4 loop
5 dbms_output.put_line (a);
6 a:=a+1;
7 exit when a>5;
8 end loop;
9 end;
10 /
1
2
3
4
5
```

PL/SQL procedure successfully completed.

PRINT NUMBERS FROM 1 TO 4 USING WHILE LOOP

```
SQL> set serveroutput on;
```

```
SQL> declare
2 a number:=1;
3 begin
```

```
4 while(a<5)
5 loop
6 dbms_output.put_line (a);
7 a:=a+1;
8 end loop;
9 end;
10 /
```

1
2
3
4

PL/SQL procedure successfully completed.

PRINT NUMBERS FROM 1 TO 5 USING FOR LOOP

SQL> set serveroutput on;

```
SQL> declare
2 a number:=1;
3 begin
4 for a in 1..5
5 loop
6 dbms_output.put_line (a);
7 end loop;
8 end;
9 /
```

1
2
3
4
5

PL/SQL procedure successfully completed.

PRINT NUMBERS FROM 1 TO 5 IN REVERSE ORDER USING FOR LOOP

SQL> set serveroutput on;

```
SQL> declare
2 a number:=1;
3 begin
4 for a in reverse 1..5
5 loop
6 dbms_output.put_line (a);
7 end loop;
8 end;
9 /
```

5
4
3
2
1

PL/SQL procedure successfully completed.

TO CALCULATE AREA OF CIRCLE

SQL> set serveroutput on;

```
SQL> declare
2 pi constant number(4,2):=3.14;
3 a number(20);
4 r number(20);
5 begin
```

```

6 r:=&r;
7 a:= pi* power(r,2);
8 dbms_output.put_line (' The area of circle is ' || a);
9 end;
10 /

```

Enter value for r: 2

```

old 6: r:=&r;
new 6: r:=2;

```

The area of circle is 13

PL/SQL procedure successfully completed.

TO CREATE SACCOUP TABLE

```
SQL> create table saccount ( accno number(5), name varchar2(20), bal number(10));
```

Table created.

```
SQL> insert into saccount values ( 1,'mala',20000);
```

1 row created.

```
SQL> insert into saccount values (2,'kala',30000);
```

1 row created.

```
SQL> select * from saccount;
```

ACCNO	NAME	BAL
1	mala	20000
2	kala	30000

```
SQL> set serveroutput on;
```

```
SQL> declare
```

```

2 a_bal number(7);
3 a_no varchar2(20);
4 debit number(7):=2000;
5 minamt number(7):=500;
6 begin
7 a_no:=&a_no;
8 select bal into a_bal from saccount where accno= a_no;
9 a_bal:= a_bal-debit;
10 if(a_bal > minamt) then
11 update saccount set bal=bal-debit where accno=a_no;
12 end if;
13 end;
14
15 /

```

Enter value for a_no: 1

```

old 7: a_no:=&a_no;
new 7: a_no:=1;

```

PL/SQL procedure successfully completed.

```
SQL> select * from saccount;
```

ACCNO	NAME	BAL
1	mala	18000
2	kala	30000

TO CREATE TABLE SROUTES

```
SQL> create table sroutes ( rno number(5), origin varchar2(20), destination varchar2(20), fare
numbe
```

```
r(10), distance number(10));
```

Table created.

```

SQL> insert into sroutes values ( 2, 'chennai', 'dindugal', 400,230);
1 row created.
SQL> insert into sroutes values ( 3, 'chennai', 'madurai', 250,300);
1 row created.
SQL> insert into sroutes values ( 6, 'thanjavur', 'palani', 350,370);
1 row created.
SQL> select * from sroutes;

```

RNO	ORIGIN	DESTINATION	FARE	DISTANCE
2	chennai	dindugal	400	230
3	chennai	madurai	250	300
6	thanjavur	palani	350	370

```
SQL> set serveroutput on;
```

```

SQL> declare
2 route sroutes.rno % type;
3 fares sroutes.fare % type;
4 dist sroutes.distance % type;
5 begin
6 route:=&route;
7 select fare, distance into fares , dist from sroutes where rno=route;
8 if(dist < 250) then
9 update sroutes set fare=300 where rno=route;
10 else if dist between 250 and 370 then
11 update sroutes set fare=400 where rno=route;
12 else if (dist > 400) then
13 dbms_output.put_line('Sorry');
14 end if;
15 end if;
16 end if;
17 end;
18 /

```

Enter value for route: 3
old 6: route:=&route;
new 6: route:=3;

PL/SQL procedure successfully completed.

```
SQL> select * from sroutes;
```

RNO	ORIGIN	DESTINATION	FARE	DISTANCE
2	chennai	dindugal	400	230
3	chennai	madurai	400	300
6	thanjavur	palani	350	370

TO CREATE SCALAR TABLE

```

SQL> create table scalculate ( radius number(3), area number(5,2));
Table created.

```

```
SQL> desc scalculate;
```

Name	Null?	Type
------	-------	------

```
RADIUS          NUMBER(3)
AREA            NUMBER(5,2)
```

```
SQL> set serveroutput on;
```

```
SQL> declare
  2  pi constant number(4,2):=3.14;
  3  area number(5,2);
  4  radius number(3);
  5  begin
  6  radius:=3;
  7  while (radius <=7)
  8  loop
  9  area:= pi* power(radius,2);
 10 insert into scalculate values (radius,area);
 11 radius:=radius+1;
 12 end loop;
 13 end;
 14 /
```

PL/SQL procedure successfully completed.

```
SQL> select * from scalculate;
```

```
RADIUS AREA
```

```
-----  
3 28.26  
4 50.24  
5 78.5  
6 113.04  
7 153.86
```

TO CALCULATE FACTORIAL OF A GIVEN NUMBER

```
SQL> set serveroutput on;
```

```
SQL> declare
  2  f number(4):=1;
  3  i number(4);
  4  begin
  5  i:=&i;
  6  while(i>=1)
  7  loop
  8  f:=f*i;
  9  i:=i-1;
 10 end loop;
 11 dbms_output.put_line('The value is ' || f);
 12 end;
 13 /
```

Enter value for i: 5
old 5: i:=&i;
new 5: i:=5;
The value is 120

PL/SQL procedure successfully completed.

Program 1

Write a code in PL/SQL to develop a trigger that enforces referential integrity by preventing the deletion of a parent record if child records exist.

```
CREATE OR REPLACE TRIGGER prevent-parent-delete
BEFORE DELETE ON parent-table
FOR EACH ROW
DECLARE
    v_child_count NUMBER;
BEGIN
    SELECT COUNT(*)
    INTO v_child_count
    FROM child-table
    WHERE Parent-id = :old.parent, Primary-key;
    IF v_child_count > 0 THEN
        RAISE_APPLICATION_ERROR(-20001, 'cannot delete parent
now: child
records exist.');
    END IF;
END;
```

Program 2

Write a code in PL/SQL to create a trigger that checks for duplicate values in a specific column and raises an exception if found.

```
CREATE OR REPLACE TRIGGER check-duplicate-value
BEFORE INSERT OR UPDATE ON yourtable
FOR EACH ROW
DECLARE
    v_Count Number;
BEGIN
    SELECT COUNT(*)
    INTO v_Count
    FROM your-table
    WHERE some-unique-column = :new.some-unique-column;
    IF v_Count > 1 THEN
        RAISE_APPLICATION_ERROR(-20002, 'Duplicate value:
        This value already exists.');
    END IF;
END;
```

Program 3

Write a code in PL/SQL to create a trigger that restricts the insertion of new rows if the total of a column's values exceeds a certain threshold.

```
CREATE or replace trigger check_total_threshold  
after insert on your_table  
declare  
    v_total number;  
    v_threshold number := 100000;  
begin  
    select sum(column_name)  
    into v_total  
    from your_table;  
    if v_total > v_threshold then  
        raise_application_error(-20003, 'insertion failed:  
            total exceeds threshold');  
    end if;  
end;
```

Program 4

Write a code in PL/SQL to design a trigger that captures changes made to specific columns and logs them in an audit table.

`CREATE table column.audit-log`

`log-id number generated as identity,`
`table-audited varchar2(30),`
`column-audited varchar2(30),`
`row-pk varchar2(1000),`
`old-value varchar2(1000),`
`new-value varchar2(1000),`
`changed-by varchar2(30),`
`change-date timestamp);`

`CREATE or replace trigger log-column-changes`
after update on your-table
for each row

`begin`

`if :old.salary != :new.salary then`
`insert into column.audit-log(table-audited, column-row-pk,`
`old-value, new-value, changed-by, change-date) values(`
`'your-table', 'salary', :old-primary-key, :old.salary,`
`:new.salary, user, systimestamp);`

`end if;`

`if old-job != new-job-id then`

`insert into column.audit-log(table-audited, column-row-pk,`
`old-values, new-values, changed-by, change-date)`
`values ('your-table', 'job-id', :old-primary-key,`
`:old-job-id, :new.job-id, user, systimestamp);`

`end; end if;`

Program 5

Write a code in PL/SQL to implement a trigger that records user activity (inserts, updates, deletes) in an audit log for a given set of tables.

```
CREATE OR REPLACE TRIGGER log-user-activity
AFTER INSERT OR UPDATE OR DELETE ON your-table
FOR EACH ROW
DECLARE
    v_action VARCHAR2(10);
BEGIN
    IF INSERTING THEN
        v_action := 'INSERT';
        INSERT INTO activity-audit-log (table-audited, dml-action,
                                         row-pk, action-by, action-date)
        VALUES ('your-table', v_action, :new.primary-key, user,
                systimestamp);
    ELSEIF UPDATING THEN
        v_action := 'UPDATE';
        INSERT INTO activity-audit-log (table-audited, dml-action,
                                         row-pk, action-by, action-date)
        VALUES ('your-table', v_action, :old.primary-key, user,
                systimestamp);
    ELSEIF DELETING THEN
        v_action := 'DELETE';
        INSERT INTO activity-audit-log (table-audited, dml-action,
                                         row-pk, action-by, action-date)
        VALUES ('your-table', v_action, :old.primary-key, user,
                systimestamp);
    END IF;
END;
```

Program 7

Write a code in PL/SQL to implement a trigger that automatically calculates and updates a running total column for a table whenever new rows are inserted.

```
CREATE OR REPLACE TRIGGER update_running-
total
AFTER INSERT ON orders
FOR EACH ROW
BEGIN
UPDATE sales-summary
SET total_sales = total_sales + :new.amount
WHERE summary_id = 1; -- Assuming a single row
for the summary
END;
```

Program 8

Write a code in PL/SQL to create a trigger that validates the availability of items

before allowing an order to be placed, considering stock levels and pending orders.

```
CREATE OR REPLACE TRIGGER validate_stock_level
BEFORE INSERT ON order_items
FOR EACH ROW
DECLARE
    v_stock number;
BEGIN
    SELECT stock_level
    INTO v_stock
    FROM Products
    WHERE Product_id = :new.Product_id;
    IF v_stock < :new.quantity THEN
        RAISE_APPLICATION_ERROR(-2004, 'cannot place order: '
        || 'Insufficient stock for product ' || :new.product_id);
    ELSE
        UPDATE products
        SET stock_level = stock_level - :new.quantity
        WHERE Product_id = :new.product_id;
    END IF;
END;
```

Evaluation Procedure	Marks awarded
PL/SQL Procedure(5)	
Program/Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	