DATABASE MANGEMENT SYSTEMS

2016-2017 FALL SEMESTER

LABORATORY MANUAL

Experiment 7

Triggers

Triggers are a specialized type of stored procedure that can be written to act on a table action such as an INSERT, UPDATE, or DELETE. The main difference between a trigger and a stored procedure is that the former is attached to a table and is only fired when an INSERT, UPDATE or DELETE occurs. You specify the modification action(s) that fire the trigger when it is created. If overused, they can potentially lead to performance issues such as blocking and, if they're not written correctly, you could be losing data.

Types Of Triggers

There are three action query types that you use in SQL which are INSERT, UPDATE and DELETE. So, there are three types of triggers and hybrids that come from mixing and matching the events and timings that fire them. Basically, triggers are classified into two main types:

- After Triggers (For Triggers)
- Instead Of Triggers

After Triggers

These triggers run after an insert, update or delete on a table. They are not supported for views. AFTER TRIGGERS can be classified further into three types as:

- AFTER INSERT Trigger.
- AFTER UPDATE Trigger.
- AFTER DELETE Trigger.

Let’s create After triggers. First of all, let’s create a table and insert some sample data.

```
CREATE TABLE Employee_Test
(
Emp_ID INT Identity,
Emp_name Varchar(100),
Emp_Sal Decimal (10,2)
)
```

```
INSERT INTO Employee_Test VALUES ('Anees',1000);
INSERT INTO Employee_Test VALUES ('Rick',1200);
INSERT INTO Employee_Test VALUES ('John',1100);
INSERT INTO Employee_Test VALUES ('Stephen',1300);
INSERT INTO Employee_Test VALUES ('Maria',1400);
```

AFTER INSERT TRIGGER will insert the rows inserted into the table into another audit table. The main purpose of this audit table is to record the changes in the main table. This can be thought of as a generic audit trigger.

Now, create the audit table as:

```
CREATE TABLE Employee_Test_Audit
(
Emp_ID int,
Emp_name varchar(100),
Emp_Sal decimal (10,2),
Audit_Action varchar(100),
Audit_Timestamp datetime
)
```

- After Insert Trigger

This trigger is fired after an INSERT on the table. Let's create the trigger as:

```
CREATE TRIGGER trgAfterInsert ON [dbo].[Employee_Test]
FOR INSERT
AS
        declare @empid int;
        declare @empname varchar(100);
        declare @empsal decimal(10,2);
        declare @audit_action varchar(100);

        select @empid=i.Emp_ID from inserted i;
        select @empname=i.Emp_Name from inserted i;
        select @empsal=i.Emp_Sal from inserted i;
        set @audit_action='Inserted Record -- After Insert Trigger.';

        insert into Employee_Test_Audit
            (Emp_ID,Emp_Name,Emp_Sal,Audit_Action,Audit_Timestamp)
        values(@empid,@empname,@empsal,@audit_action,getdate());
```

```
	PRINT 'AFTER INSERT trigger fired.'
GO
```

The CREATE TRIGGER statement is used to create the trigger. THE ON clause specifies the table name on which the trigger is to be attached. The FOR INSERT specifies that this is an AFTER INSERT trigger. In place of FOR INSERT, AFTER INSERT can be used. Both of them mean the same.

In the trigger body, table named inserted has been used. This table is a logical table and contains the row that has been inserted. The fields are selected from the logical inserted table from the row that has been inserted into different variables, and finally inserted those values into the Audit table.

To see the newly created trigger in action, lets insert a row into the main table as:

```
insert into Employee_Test values('Chris',1500);
```

- AFTER UPDATE Trigger

This trigger is fired after an update on the table. Let's create the trigger as:

```
CREATE TRIGGER trgAfterUpdate ON [dbo].[Employee_Test]
FOR UPDATE
AS
	declare @empid int;
	declare @empname varchar(100);
	declare @empsal decimal(10,2);
	declare @audit_action varchar(100);

	select @empid=i.Emp_ID from inserted i;
	select @empname=i.Emp_Name from inserted i;
	select @empsal=i.Emp_Sal from inserted i;

	if update(Emp_Name)
		set @audit_action='Updated Record -- After Update Trigger.';
	if update(Emp_Sal)
		set @audit_action='Updated Record -- After Update Trigger.';
```

```
	insert into
Employee_Test_Audit(Emp_ID,Emp_Name,Emp_Sal,Audit_Action,Audit_Timestamp)
	values(@empid,@empname,@empsal,@audit_action,getdate());

	PRINT 'AFTER UPDATE Trigger fired.'
GO
```

The AFTER UPDATE Trigger is created in which the updated record is inserted into the audit table. There is no logical table updated like the logical table inserted. We can obtain the updated value of a field from the update(column_name) function. In our trigger, we have used, if update(Emp_Name) to check if the column Emp_Name has been updated. We have similarly checked the column Emp_Sal for an update.

Let's update a record column and see what happens.

```
update Employee_Test set Emp_Sal=1550 where Emp_ID=6
```

- AFTER DELETE Trigger

This trigger is fired after a delete on the table. Let's create the trigger as:

```
CREATE TRIGGER trgAfterDelete ON [dbo].[Employee_Test]
AFTER DELETE
AS
	declare @empid int;
	declare @empname varchar(100);
	declare @empsal decimal(10,2);
	declare @audit_action varchar(100);

	select @empid=d.Emp_ID from deleted d;
	select @empname=d.Emp_Name from deleted d;
	select @empsal=d.Emp_Sal from deleted d;
	set @audit_action='Deleted -- After Delete Trigger.';

	insert into Employee_Test_Audit
(Emp_ID,Emp_Name,Emp_Sal,Audit_Action,Audit_Timestamp)
	values(@empid,@empname,@empsal,@audit_action,getdate());
```

```
	PRINT 'AFTER DELETE TRIGGER fired.'
GO
```

In this trigger, the deleted record's data is picked from the **logical deleted table** and inserted into the audit table. Let's fire a delete on the main table.

All the triggers can be enabled/disabled on the table using the statement:

```
ALTER TABLE Employee_Test ENABLE TRIGGER ALL

ALTER TABLE Employee_Test DISABLE TRIGGER ALL
```

Specific Triggers can be enabled or disabled as:

```
ALTER TABLE Employee_Test DISABLE TRIGGER trgAfterDelete
```

This disables the After Delete Trigger named trgAfterDelete on the specified table.

Instead Of Triggers

These can be used as an interceptor for anything that anyone tried to do on our table or view. If you define an *Instead Of trigger* on a table for the Delete operation, they try to delete rows, and they will not actually get deleted (unless you issue another delete instruction from within the trigger)

INSTEAD OF TRIGGERS can be classified further into three types as:

- INSTEAD OF INSERT Trigger.
- INSTEAD OF UPDATE Trigger.
- INSTEAD OF DELETE Trigger.

Let's create an Instead Of Delete Trigger as:

```
CREATE TRIGGER trgInsteadOfDelete ON [dbo].[Employee_Test]
INSTEAD OF DELETE
AS
	declare @emp_id int;
	declare @emp_name varchar(100);
	declare @emp_sal int;
```

```
        select @emp_id=d.Emp_ID from deleted d;
        select @emp_name=d.Emp_Name from deleted d;
        select @emp_sal=d.Emp_Sal from deleted d;

        BEGIN
                if(@emp_sal>1200)
                begin
                        RAISERROR('Cannot delete where salary > 1200',16,1);
                        ROLLBACK;
                end
                else
                begin
                        delete from Employee_Test where Emp_ID=@emp_id;
                        COMMIT;
                        insert into
Employee_Test_Audit(Emp_ID,Emp_Name,Emp_Sal,Audit_Action,Audit_Timestamp)
                        values(@emp_id,@emp_name,@emp_sal,'Deleted -- Instead Of Delete
Trigger.',getdate());
                        PRINT 'Record Deleted -- Instead Of Delete Trigger.'
                end
        END
GO
```

This trigger will prevent the deletion of records from the table where Emp_Sal > 1200. If such a record is deleted, the Instead Of Trigger will rollback the transaction, otherwise the transaction will be committed. Now, let's try to delete a record with the Emp_Sal >1200 as:

```
delete from Employee_Test where Emp_ID=4
```

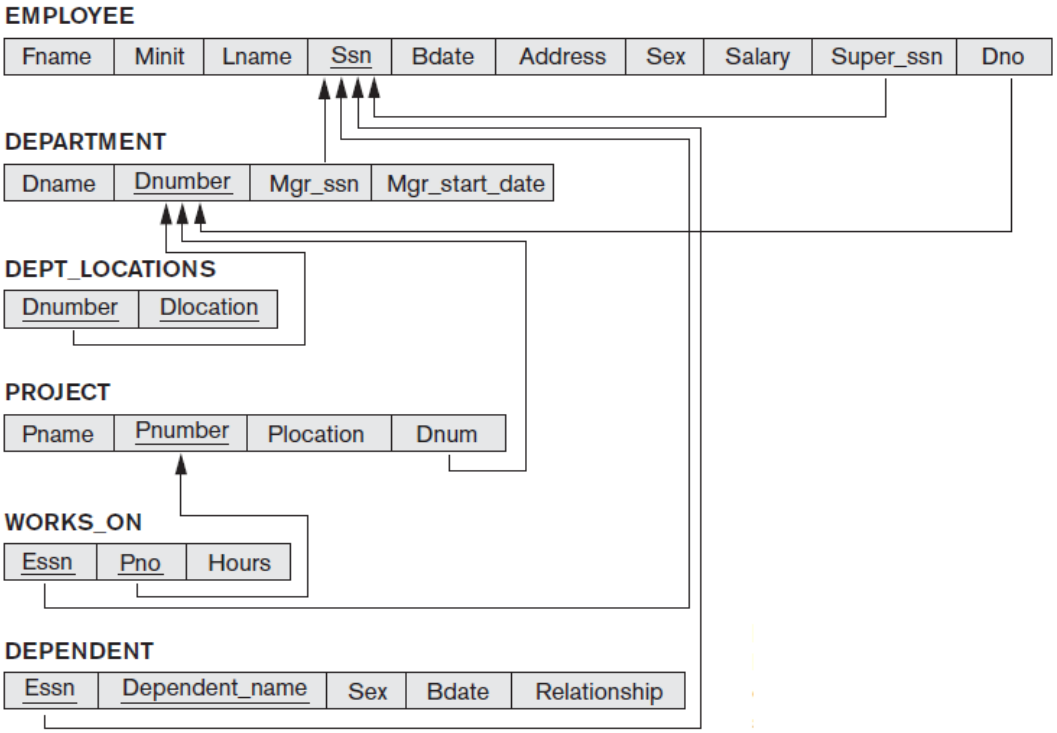
This will print an error message as defined in the RAISE ERROR statement as:

```
Server: Msg 50000, Level 16, State 1, Procedure trgInsteadOfDelete, Line 15
Cannot delete where salary > 1200
```

And this record will not be deleted.

In a similar way, you can code Instead of Insert and Instead Of Update triggers on your tables.

Exercises :



1. Create the tables that given above and insert at least 5 records inside the tables.
2. Write SQL codes for following questions according to tables above.
    a. Select the name and address of all employees who work for the 'ARGE' department.
    b. Retrieve the project number, the controlling department number, and the department manager's last name, address, and birthdate for every project located in ‘Eskişehir’.
    c. Select the name of each employee who has a dependent with the same first name as the employee.
    d. Select the employees and the projects each works in, ordered by the employee's department, and within each department ordered alphabetically by employee last name.
    e. Find the maximum salary, the minimum salary, and the average salary among employees who work for the ‘ARGE’ department.
    f. For each project, list the project number, project name, and the number of employees who work on that project.
    g. Create AFTER INSERT TRIGGER on the Department table. This trigger also insert records into Dept_Locations.

h. Create AFTER DELETE TRIGGER on the Employee table. This trigger also delete corresponding records from Dependent table.

i. Create AFTER UPDATE TRIGGER on the Project table. This trigger print message which column is updated, i.e. when Pname column is updated “Project name is updated” is displayed. The messages and updated record Pnumber is stored in a table named as ProjectLog table.