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| **National University of Computer and Emerging Sciences** |
| Lab Manual 9  “Triggers” |
|  |
| Database Systems |
| Spring 2023 |

Department of Computer Science

FAST-NU, Lahore, Pakistan

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# **Objectives**

The purpose this lab is to know how the triggers work, types of triggers, how to create a trigger and what are the uses of triggers.

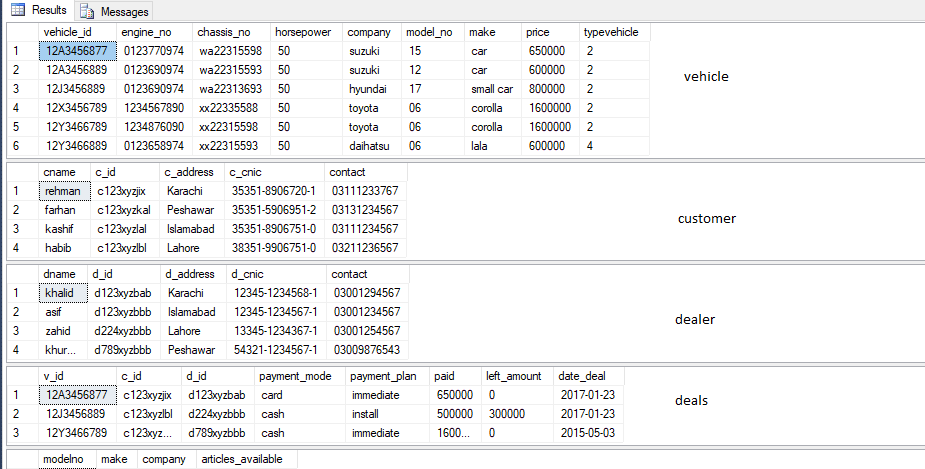
# **Triggers**

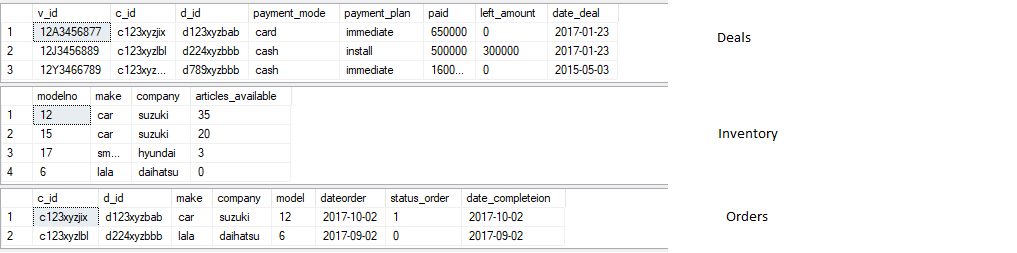
Triggers are special kind of stored procedures that automatically execute when a DML or DDL statement associated with the trigger is executed. Each trigger will be associated with one DML or DDL statement. Unlike stored procedure triggers cannot be executed directly by application/user, they will ONLY be executed by DBMS in reaction to DML or DDL statement with which the trigger was associated.

Triggers can be divided in two categories depending on the type of statement they are associated with as follow:

* DML triggers
* DDL triggers

We shall use the schema from the last lab’s manual. Which is as follows.





# DML Triggers:

DML is the data modification language that uses queries like INSERT, UPDATE, DELETE. The DML triggers are used to handle these kind of queries.

# Syntax of (DML) Triggers:

CREATE [ OR ALTER ] TRIGGER [ schema\_name . ]trigger\_name

ON { table }

[ WITH <dml\_trigger\_option> [ ,...n ] ]

{ (FOR | AFTER) | Instead of }

{ [ INSERT ] [ , ] [ UPDATE ] [ , ] [ DELETE ] }

AS { sql\_statement [ ; ] [ ,...n ] }

<dml\_trigger\_option> ::=

[ NATIVE\_COMPILATION ]

[ SCHEMABINDING ]

[ EXECUTE AS Clause ]

# ‘Instead of’ and ‘After’ Triggers:

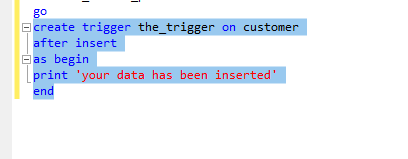
You must have noticed the word after and instead of in the syntax of the trigger creation given above.

The instead of trigger is shot by stopping the action on which the trigger is created. However, the after (or for) trigger is shot after the action on which the trigger is created is complete.

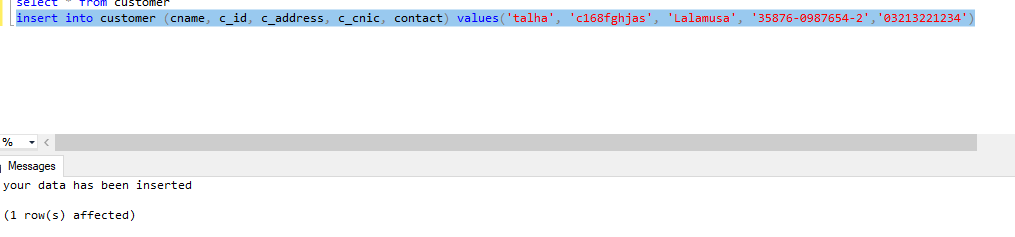
## DML trigger Option:

The DML trigger option given in the above syntax is used to specify the action on which the trigger is to be shot.

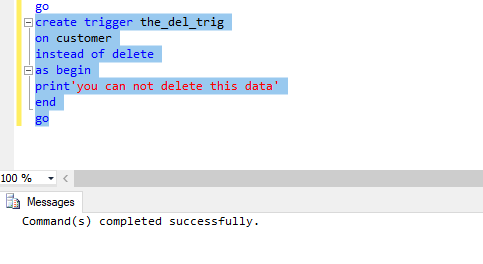
Now let us look at the triggers a little closely how they practically work.



The trigger has been made as to be shot on the insert query on the customer table. Now if we insert anything in the customer table as soon as a new customer has been added in the table this trigger shall be shot.



In the above example you can clearly see that we have just inserted a new entry in the table customer but the trigger has been shot that too after the trigger has been shot.



# Getting the affected tables inside the triggers:

The triggers we have seen above are simple one, what if you want the value of effect rows from DML and use them in triggers.

*Example: Whenever a customer is inserted in, it should automatically convert that name of that instructor in Upper Case.*

*For example: customer with Name “ali ahmed” should be inserted as “ALI AHMED”*

For that we use special table “DELETED” and “INSERTED” designed for DML triggers.

DML triggers use the **deleted** and **inserted** logical (conceptual) tables. They are structurally similar to the table on which the trigger is defined, that is, the table on which the user action is tried. The **deleted** and **inserted** tables hold the old values or new values of the rows that may be changed by the DML action.

NOTE: These tables are only accessible in triggers

# **For Trigger or After Trigger:**

A For or After trigger is fired after the intended action takes place.

## **Insert Trigger**

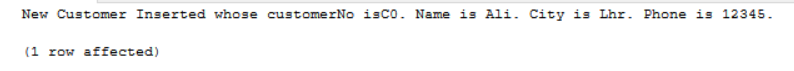
A for trigger defined on a table for insert operation is fired after the insert statement is executed. Consider the following For trigger for insert operation on Customers Table.

|  |
| --- |
| Create Trigger ForTriggerForInsertCustomer  On Customers  For Insert  AS  Begin  declare @customerNo varchar(2),  @name varchar(30),  @city varchar(3),  @phone varchar(11)  Select @customerNo= Inserted.customerNo, @name=Inserted.name, @city=Inserted.city, @phone= Inserted.phone  From Inserted  print ('New Customer Inserted whose customerNo is '+@customerNo+'. Name is '+@name+'. City is '+@city+'. Phone is '+@phone+'.')  End |

The above trigger will be called after the insert operation on customers. The insert operation will be carried out as usual and after that the trigger will be called.

Insert into Customers values('C0', 'Ali', 'Lhr', '12345')

When the above insert statement is executed, we get the following output:



## **Delete Trigger**

A for trigger defined on a table for delete operation is fired when the delete statement is executed. Consider the following For trigger for delete operation on Customers Table:

|  |
| --- |
| Create Trigger ForTriggerForDeleteCustomer  On Customers  For Delete  AS  Begin  declare @customerNo varchar(2),  @name varchar(30),  @city varchar(3),  @phone varchar(11)  Select @customerNo= Deleted.customerNo,  @name=Deleted.name,  @city=Deleted.city,  @phone= Deleted.phone  From Deleted  print ('A Customer deleted whose customerNo is '+@customerNo+'. Name is '+@name+'. City is '+@city+'. Phone is '+@phone+'.  ')  End |

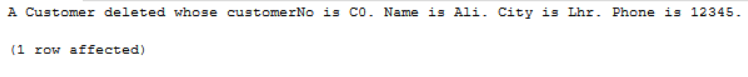
The above trigger will be called after the delete operation on customers. The delete operation will be carried out as usual and after that the trigger will be called.

When the following delete operation is called:

Delete From Customers

where CustomerNo='C0'

We get the output as follows:



## **Update Trigger**

A for trigger defined on a table for update operation is fired when the update statement is executed. Consider the following For trigger for update operation on Customers Table:

|  |
| --- |
| Create Trigger ForTriggerForUpdateCustomer  On Customers  For Update  AS  Begin  declare @oldCustomerNo varchar(2),  @oldName varchar(30),  @oldCity varchar(3),  @oldPhone varchar(11),  @newCustomerNo varchar(2),  @newName varchar(30),  @newCity varchar(3),  @newPhone varchar(11)  Select @oldCustomerNo= Deleted.customerNo,  @oldName=Deleted.name,  @oldCity=Deleted.city,  @oldPhone= Deleted.phone  From Deleted  Select @newCustomerNo= Inserted.customerNo,  @newName=Inserted.name,  @newCity=Inserted.city,  @newPhone= Inserted.phone  From Inserted  declare @messageString varchar(100)  set @messageString='The record of a customer updated. The fields that have been updated are: '    if @oldCustomerNo!=@newCustomerNo  Begin  set @messageString=@messageString+'Customer No,'  End  if @oldName!= @newName  Begin  set @messageString= @messageString+'Name, '  End  if @oldPhone!= @newPhone  Begin  set @messageString= @messageString+'Phone, '  End  if @oldCity!= @newCity  Begin  set @messageString= @messageString+'City'  End  print (@messageString)  End |

When the following update statement is run:

Update Customers

set Name='Imran', city='Khr'

where CustomerNo='C2'

We get the output as follows:



# **Instead of Trigger**

AS the name suggest, this type of trigger, when defined on insert, update, or delete operation, is called instead of the insert, update, and delete operation itself. So if we want the original insert, update or delete operation to be carried out successfully, we must do it in the trigger.

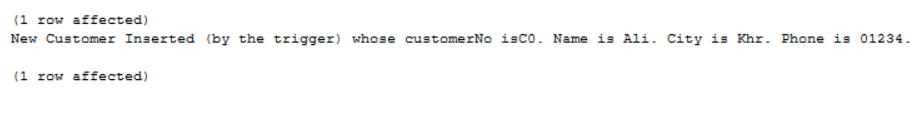
## **Insert Trigger**

|  |
| --- |
| Create Trigger InsteadTriggerForInsertCustomer  On Customers  Instead of Insert  AS  Begin  declare @customerNo varchar(2),  @name varchar(30),  @city varchar(3),  @phone varchar(11)  Select @customerNo= Inserted.customerNo, @name=Inserted.name, @city=Inserted.city, @phone= Inserted.phone  From Inserted  Insert into Customers values (@customerNo, @name, @city, @phone)  print ('New Customer Inserted (by the trigger) whose customerNo is '+@customerNo+'. Name is '+@name+'. City is '+@city+'. Phone is '+@phone+'.')  End |

When we run the following insert statement:

Insert into Customers values ('C0', 'Ali', 'Khr', '01234')

The output we get is as follows:



## **Delete Trigger**

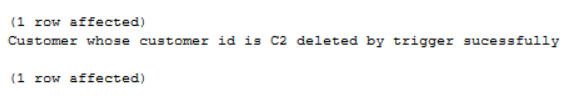
|  |
| --- |
| create Trigger InsteadTriggerForDeleteCustomer  On Customers  Instead of Delete  AS  Begin  declare @customerNo varchar(2),  @name varchar(30),  @city varchar(3),  @phone varchar(11)  Select @customerNo= Deleted.customerNo,  @name=Deleted.name,  @city=Deleted.city,  @phone= Deleted.phone  From Deleted  delete from Customers  where CustomerNo=@customerNo  print('Customer whose customer id is '+@customerNo+' deleted by trigger sucessfully')  End |

When we run the following statement:

Delete From Customers

where CustomerNo='C2'

The output we get is as follows (The actual insert will be carried out by trigger itself):



## **Update Trigger**

|  |
| --- |
| Create Trigger InsteadTriggerForUpdateCustomer  On Customers  Instead of Update  AS  Begin  declare @oldCustomerNo varchar(2),  @oldName varchar(30),  @oldCity varchar(3),  @oldPhone varchar(11),  @newCustomerNo varchar(2),  @newName varchar(30),  @newCity varchar(3),  @newPhone varchar(11)  Select @oldCustomerNo= Deleted.customerNo,  @oldName=Deleted.name,  @oldCity=Deleted.city,  @oldPhone= Deleted.phone  From Deleted  Select @newCustomerNo= Inserted.customerNo,  @newName=Inserted.name,  @newCity=Inserted.city,  @newPhone= Inserted.phone  From Inserted  update Customers  set CustomerNo=@newCustomerNo, Name=@newName, city= @newCity, Phone= @newPhone  where CustomerNo= @oldCustomerNo  declare @messageString varchar(100)  set @messageString='The record of a customer updated by the trigger. The fields that have been updated are: '    if @oldCustomerNo!=@newCustomerNo  Begin  set @messageString=@messageString+'Customer No,'  End  if @oldName!= @newName  Begin  set @messageString= @messageString+'Name, '  End  if @oldPhone!= @newPhone  Begin  set @messageString= @messageString+'Phone, '  End  if @oldCity!= @newCity  Begin  set @messageString= @messageString+'City'  End  print (@messageString)  End |

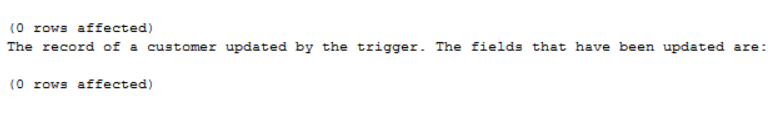
When the following update statement is called:

Update Customers

set Name='Imran', city='Khr'

where CustomerNo='C2'

We get the output as follows (The actual update will be done by the trigger itself)



# **Rollback in For Trigger**

If you do not want to carry out the insert, update or delete operation due to any reason. Then you can either write an instead trigger which will do the insert, update or delete operation only when the conditions are met. Alternatively, you can do rollback in for trigger if the conditions are not met.

|  |
| --- |
| Create Trigger ForTriggerOnInsertCustomer  on Customers  For Insert  AS  Begin  declare @name varchar(10)  Select @name=name from Inserted  if @name is NULL  Begin  rollback  End  End |

The above trigger does not allow inserting the customer whose name is null. So, when the following insert statement is run, the insert operation will be rolled back by the trigger:

Insert into Customers values('C0', NULL, 'Lhr', '123')

We get the output as follows: 

# **Same Trigger For All three Actions (Insert, Update and Delete)**

So far we have seen triggers on a single action a single trigger can be used to cater multiple actions.

Before moving forward you must know that only one trigger can be made on a particular action on a table so in order to make a new trigger on the same action we should either alter the previous trigger or drop the previous trigger or disable it. The syntax for these are as follows.

ALTER <TriggerName>

On <view/table>

After/Instead of <insert/update/delete>

As

begin

<Body>

end

Create Trigger DisallowChangeOnCustomers

On Customers

Instead of Insert, Update, Delete

As

Begin

print ('Customer table is not allowed to be modified')

End

# **Drop, Enable and Disable a Trigger**

Drop trigger <TriggerName>

Enable trigger <TriggerName> on <ObjectName>

Disable trigger <TriggerName> on <ObjectName>

disable trigger InsteadTriggerForInsertCustomer on Customers

# **DDL Triggers**

DDL triggers, fire in response to a DDL statement to which they are associated. DDL event primarily correspond to SQL statements that start with the keywords CREATE, ALTER, and DROP. These triggers are current databases.

There triggers are also of two types, FOR and AFTER, first one executes instead of the DDL statement it is associated with and second one executes after the DDL statement, it is associate with is successfully executed.

(For in DML FOR is same as Instead of in DDL)

Use DDL triggers when you want to do the following:

* You want to prevent certain changes to your database schema.
* You want something to occur in the database in response to a change in your database schema.
* You want to record changes or events in the database schema.

## Syntax Of DDL

CREATE TRIGGER *trigger\_name*

ON DATABASE

{ FOR | AFTER } { *event\_type*} [ **,**...*n* ]

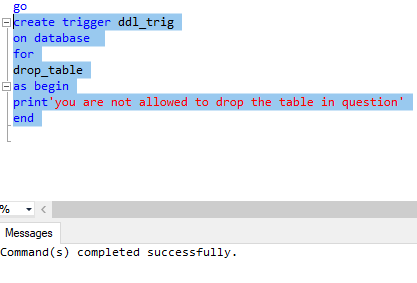
AS

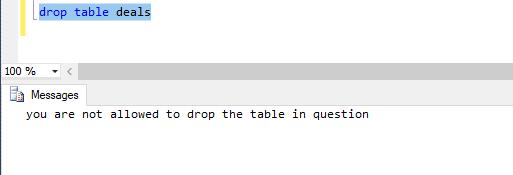
Begin

<Body>

End

## Triggers:





# References:

<https://msdn.microsoft.com/en-us/library/bb522542.aspx>