

Deleting and altering triggers

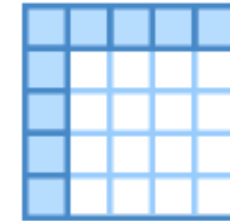
BUILDING AND OPTIMIZING TRIGGERS IN SQL SERVER



Florin Angelescu
Instructor

Deleting table and view triggers

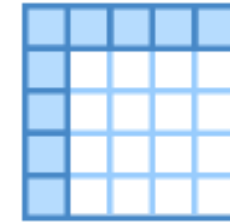
```
DROP TRIGGER PreventNewDiscounts;
```



Deleting database triggers

```
DROP TRIGGER PreventNewDiscounts;
```

```
DROP TRIGGER PreventViewsModifications  
ON DATABASE;
```

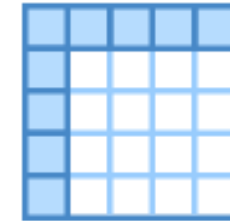


Deleting server triggers

```
DROP TRIGGER PreventNewDiscounts;
```

```
DROP TRIGGER PreventViewsModifications  
ON DATABASE;
```

```
DROP TRIGGER DisallowLinkedServers  
ON ALL SERVER;
```

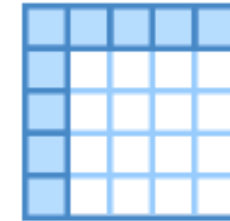


Disabling triggers

```
DISABLE TRIGGER PreventNewDiscounts  
ON Discounts;
```

```
DISABLE TRIGGER PreventViewsModifications  
ON DATABASE;
```

```
DISABLE TRIGGER DisallowLinkedServers  
ON ALL SERVER;
```

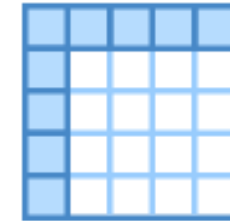


Enabling triggers

```
ENABLE TRIGGER PreventNewDiscounts  
ON Discounts;
```

```
ENABLE TRIGGER PreventViewsModifications  
ON DATABASE;
```

```
ENABLE TRIGGER DisallowLinkedServers  
ON ALL SERVER;
```



Altering triggers

```
CREATE TRIGGER PreventDiscountsDelete
ON Discounts
INSTEAD OF DELETE
AS
```

```
    PRINT 'You are not allowed to data from the Discounts table.';
```

```
DROP TRIGGER PreventDiscountsDelete;
```

```
CREATE TRIGGER PreventDiscountsDelete
ON Discounts
INSTEAD OF DELETE
AS
```

```
    PRINT 'You are not allowed to remove data from the Discounts table.';
```

Altering triggers

```
CREATE TRIGGER PreventDiscountsDelete
```

```
ON Discounts
```

```
INSTEAD OF DELETE
```

```
AS
```

```
    PRINT 'You are not allowed to data from the Discounts table.';
```

```
ALTER TRIGGER PreventDiscountsDelete
```

```
ON Discounts
```

```
INSTEAD OF DELETE
```

```
AS
```

```
    PRINT 'You are not allowed to remove data from the Discounts table.';
```


Let's practice!

BUILDING AND OPTIMIZING TRIGGERS IN SQL SERVER

Trigger management

BUILDING AND OPTIMIZING TRIGGERS IN SQL SERVER



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Getting info from sys.triggers

```
SELECT * FROM sys.triggers;
```

name	parent_class_desc	create_date	is_disabled	is_instead_of_trigger
TrackRetiredProducts	OBJECT_OR_COLUMN	2019-04-19	0	0
PreventOrdersUpdate	OBJECT_OR_COLUMN	2019-04-22	0	1
TrackDatabaseTables	DATABASE	2019-04-23	0	0
KeepCanceledOrders	OBJECT_OR_COLUMN	2019-04-27	0	0
DiscountsPreventDelete	OBJECT_OR_COLUMN	2019-04-27	0	1
PreventNewDiscounts	OBJECT_OR_COLUMN	2019-04-27	0	1
PreventTableDeletion	DATABASE	2019-04-27	0	0

Getting info from `sys.triggers`

`name`

trigger name

`object_id`

unique identifier of the trigger

`parent_class`

trigger type as integer

`parent_class_desc`

trigger type as text

`parent_id`

unique identifier of the parent object

Getting info from sys.triggers

`create_date`

date of creation

`modify_date`

date of last modification

`is_disabled`

current state

`is_instead_of_trigger`

`INSTEAD OF` or `AFTER` trigger

Getting info from sys.server_triggers

```
SELECT * FROM sys.server_triggers;
```

name	parent_class_desc	create_date	is_disabled	...
-----	-----	-----	-----	---
DenyNewDatabases	SERVER	2019-01-22	0	...
DenyNewLinkedServers	SERVER	2019-01-22	1	...
DenyDatabaseDelete	SERVER	2019-01-22	1	...

Getting info from sys.trigger_events

```
SELECT * FROM sys.trigger_events;
```

object_id	type	type_desc	event_group_type	event_group_type_desc
1285579618	24	CREATE_INDEX	NULL	NULL
1301579675	52	ALTER_PROCEDURE	NULL	NULL
1301579675	53	DROP_PROCEDURE	NULL	NULL
1333579789	1	INSERT	NULL	NULL
1365579903	2	UPDATE	NULL	NULL
1381579960	3	DELETE	NULL	NULL
1557580587	21	CREATE_TABLE	10017	DDL_TABLE_VIEW_EVENTS
1557580587	22	ALTER_TABLE	10017	DDL_TABLE_VIEW_EVENTS
1557580587	23	DROP_TABLE	10017	DDL_TABLE_VIEW_EVENTS

Getting info from `sys.trigger_events`

`object_id`

unique identifier of the trigger

`type`

event type as integer

`type_desc`

event type as text

`event_group_type`

event group type as integer

`event_group_type_desc`

event group type as text

Getting info from sys.trigger_events

DDL_TABLE_VIEW_EVENTS

CREATE_TABLE

DROP_TABLE

ALTER_TABLE

CREATE_VIEW

DROP_VIEW

ALTER_VIEW

CREATE_INDEX

DROP_INDEX

ALTER_INDEX

CREATE_STATISTICS

DROP_STATISTICS

UPDATE_STATISTICS

CREATE_XML_INDEX

[...]

Getting info from sys.server_trigger_events

```
SELECT * FROM sys.server_trigger_events;
```

object_id	type	type_desc	event_group_type	event_group_type_desc
-----	-----	-----	-----	-----
1285579618	24	CREATE_LINKED_SERVER	NULL	NULL
1301579675	52	DROP_DATABASE	10004	DDL_DATABASE_EVENTS

Getting info from sys.trigger_event_types

```
SELECT * FROM sys.trigger_event_types;
```

type	type_name	parent_type
-----	-----	-----
21	CREATE_TABLE	10018
22	ALTER_TABLE	10018
23	DROP_TABLE	10018
24	CREATE_INDEX	10020
25	ALTER_INDEX	10020
26	DROP_INDEX	10020
10018	DDL_TABLE_EVENTS	10017

Trigger management in practice

```
SELECT t.name AS TriggerName,  
       t.parent_class_desc AS TriggerType,  
       te.type_desc AS EventName,  
       o.name AS AttachedTo,  
       o.type_desc AS ObjectType  
FROM sys.triggers AS t  
INNER JOIN sys.trigger_events AS te ON te.object_id = t.object_id  
LEFT OUTER JOIN sys.objects AS o ON o.object_id = t.parent_id;
```

Trigger management in practice

TriggerName	TriggerType	EventName	AttachedTo	ObjectType
-----	-----	-----	-----	-----
IndexSecurityTrigger	DATABASE	CREATE_INDEX	NULL	NULL
ProcedureSecurityTrigger	DATABASE	ALTER_PROCEDURE	NULL	NULL
ProcedureSecurityTrigger	DATABASE	DROP_PROCEDURE	NULL	NULL
CustomerDiscountHistory	OBJECT_OR_COLUMN	UPDATE	Discounts	USER_TABLE
TrackRetiredProducts	OBJECT_OR_COLUMN	DELETE	Products	USER_TABLE
PreventOrdersUpdate	OBJECT_OR_COLUMN	UPDATE	Orders	USER_TABLE
PreventDiscountsDelete	OBJECT_OR_COLUMN	DELETE	Discounts	USER_TABLE

Let's practice!

BUILDING AND OPTIMIZING TRIGGERS IN SQL SERVER

Troubleshooting triggers

BUILDING AND OPTIMIZING TRIGGERS IN SQL SERVER



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Tracking trigger executions (system view)

```
SELECT * FROM sys.dm_exec_trigger_stats;
```

database_id	object_id	last_execution_time	execution_count	...
4	1429580131	2019-05-26 18:30:12.660	1	...
4	1445580188	2019-05-26 18:30:26.450	2	...

Tracking trigger executions (custom solution)

```
CREATE TRIGGER PreventOrdersUpdate
ON Orders
INSTEAD OF UPDATE
AS
    RAISERROR ('Updates on "Orders" table are not permitted.
              Place a new order to add new products.', 16, 1);
```

Tracking trigger executions (custom solution)

```
ALTER TRIGGER PreventOrdersUpdate
ON Orders
INSTEAD OF UPDATE
AS
    INSERT INTO TriggerAudit (TriggerName, ExecutionDate)
    SELECT 'PreventOrdersUpdate',
           GETDATE();

RAISERROR ('Updates on "Orders" table are not permitted.
          Place a new order to add new products.', 16, 1);
```

Tracking trigger executions (custom solution)

```
UPDATE Orders  
SET Quantity = 300  
WHERE OrderID = 784;
```

(1 row affected)

Msg 50000, Level 16, State 1, Procedure PreventOrdersUpdate, Line 11
[Batch Start Line 27]

Updates on "Orders" table are not permitted.

Place a new order to add new products.

(0 rows affected)

Tracking trigger executions (custom solution)

```
SELECT * FROM TriggerAudit;
```

ID	TriggerName	ExecutionDate
----	-----	-----
1	PreventOrdersUpdate	2019-05-26 19:28:04.483

Identifying triggers attached to a table

```
SELECT name AS TableName,  
       object_id AS TableID  
FROM sys.objects  
WHERE name = 'Products';
```

TableName	TableID
-----	-----
Products	917578307

Identifying triggers attached to a table

```
SELECT o.name AS TableName,  
       o.object_id AS TableID,  
       t.name AS TriggerName,  
       t.object_id AS TriggerID,  
       t.is_disabled AS IsDisabled,  
       t.is_instead_of_trigger AS IsInsteadOf  
FROM sys.objects AS o  
INNER JOIN sys.triggers AS t ON t.parent_id = o.object_id  
WHERE o.name = 'Products';
```

Identifying triggers attached to a table

```
SELECT o.name AS TableName,
       o.object_id AS TableID,
       t.name AS TriggerName,
       t.object_id AS TriggerID,
       t.is_disabled AS IsDisabled,
       t.is_instead_of_trigger AS IsInsteadOf
FROM sys.objects AS o
INNER JOIN sys.triggers AS t ON t.parent_id = o.object_id
WHERE o.name = 'Products';
```

TableName	TableID	TriggerName	TriggerID	IsDisabled	IsInsteadOf
Products	917578307	TrackRetiredProducts	1349579846	0	0
Products	917578307	ProductsNewItem	1397580017	0	0
Products	917578307	PreventProductChanges	1541580530	0	1

Identifying events capable of firing a trigger

```
SELECT o.name AS TableName,  
       o.object_id AS TableID,  
       t.name AS TriggerName,  
       t.object_id AS TriggerID,  
       t.is_disabled AS IsDisabled,  
       t.is_instead_of_trigger AS IsInsteadOf,  
       te.type_desc AS FiringEvent  
FROM sys.objects AS o  
INNER JOIN sys.triggers AS t ON t.parent_id = o.object_id  
INNER JOIN sys.trigger_events AS te ON t.object_id = te.object_id  
WHERE o.name = 'Products';
```


Identifying events capable of firing a trigger

```
SELECT o.name AS TableName,
       o.object_id AS TableID,
       t.name AS TriggerName,
       t.object_id AS TriggerID,
       t.is_disabled AS IsDisabled,
       t.is_instead_of_trigger AS IsInsteadOf,
       te.type_desc AS FiringEvent
FROM sys.objects AS o
INNER JOIN sys.triggers AS t ON t.parent_id = o.object_id
INNER JOIN sys.trigger_events AS te ON t.object_id = te.object_id
WHERE o.name = 'Products';
```

TableName	TableID	TriggerName	TriggerID	IsDisabled	IsInsteadOf	FiringEvent	
Products	917578307	TrackRetiredProducts	1349579846	0	0	DELETE	
Products	917578307	ProductsNewItem	1397580017	0	0	INSERT	
Products	917578307	PreventProductChanges	1541580530	0	1	UPDATE	

Viewing the trigger definitions

```
SELECT o.name AS TableName,  
       o.object_id AS TableID,  
       t.name AS TriggerName,  
       t.object_id AS TriggerID,  
       t.is_disabled AS IsDisabled,  
       t.is_instead_of_trigger AS IsInsteadOf,  
       te.type_desc AS FiringEvent,  
       OBJECT_DEFINITION(t.object_id) AS TriggerDefinition  
FROM sys.objects AS o  
INNER JOIN sys.triggers AS t ON t.parent_id = o.object_id  
INNER JOIN sys.trigger_events AS te ON t.object_id = te.object_id  
WHERE o.name = 'Products';
```

Viewing the trigger definitions

```
SELECT o.name AS TableName,
       o.object_id AS TableID,
       t.name AS TriggerName,
       t.object_id AS TriggerID,
       t.is_disabled AS IsDisabled,
       t.is_instead_of_trigger AS IsInsteadOf,
       te.type_desc AS FiringEvent,
       OBJECT_DEFINITION(t.object_id) AS TriggerDefinition
FROM sys.objects AS o
INNER JOIN sys.triggers AS t ON t.parent_id = o.object_id
INNER JOIN sys.trigger_events AS te ON t.object_id = te.object_id
WHERE o.name = 'Products';
```

TableName	TableID	TriggerName	...	FiringEvent	TriggerDefinition
Products	917578307	TrackRetiredProducts	...	DELETE	CREATE TRIGGER TrackRetiredProducts ON Produc...
Products	917578307	ProductsNewItem	...	INSERT	CREATE TRIGGER ProductsNewItem ON Products A...
Products	917578307	PreventProductChanges	...	UPDATE	CREATE TRIGGER PreventProductChanges ON Produ...

Let's practice!

BUILDING AND OPTIMIZING TRIGGERS IN SQL SERVER

Wrapping up

BUILDING AND OPTIMIZING TRIGGERS IN SQL SERVER



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Summary

- Trigger definition
 - How triggers are used
 - Trigger alternatives
 - Trigger limitations
 - Real-life use cases
- `AFTER` triggers
 - `INSTEAD OF` triggers
 - DML, DDL, and logon triggers
 - Deleting and altering triggers
 - Troubleshooting and managing triggers

Thank you!

BUILDING AND OPTIMIZING TRIGGERS IN SQL SERVER