

# Introduction

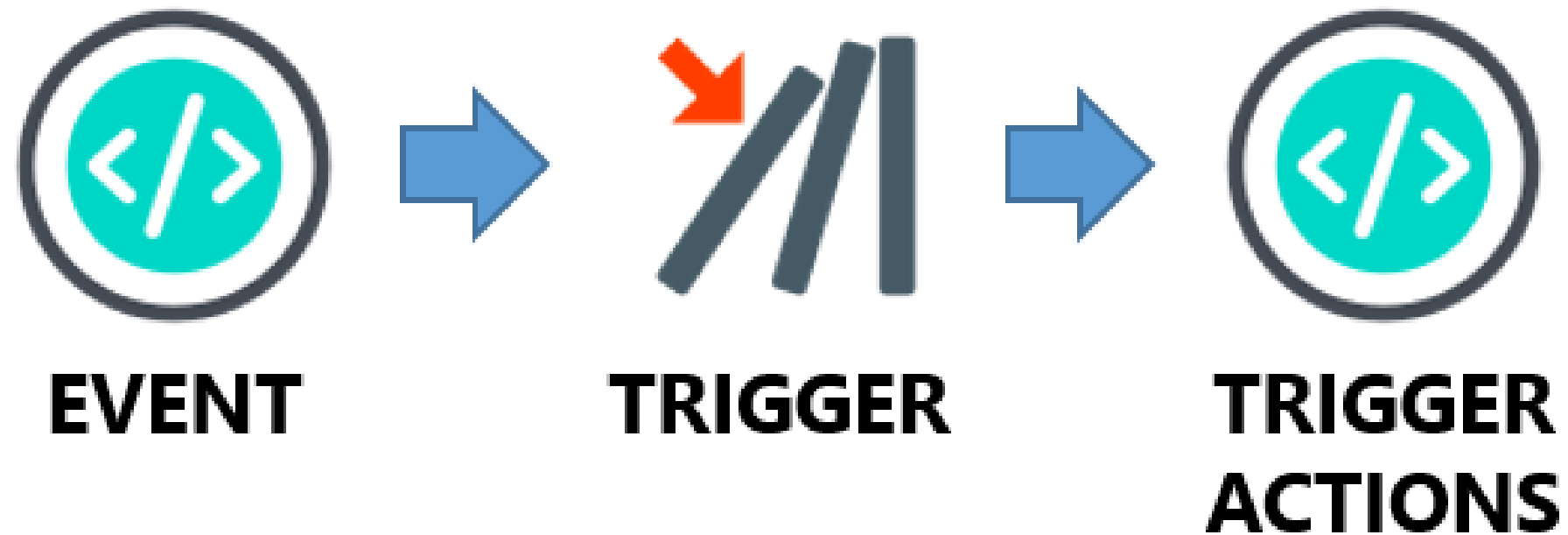
BUILDING AND OPTIMIZING TRIGGERS IN SQL SERVER



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Instructor

# What is a trigger?

- Special type of stored procedure
- Executed when an event occurs in the database server



# Types of trigger (based on T-SQL commands)

- Data Manipulation Language (DML) triggers
  - `INSERT` , `UPDATE` or `DELETE` statements
- Data Definition Language (DDL) triggers
  - `CREATE` , `ALTER` or `DROP` statements
- Logon triggers
  - `LOGON` events

# Types of trigger (based on behavior)

- **AFTER** trigger
  - The original statement executes
  - Additional statements are triggered
- Examples of use cases
  - Rebuild an index after a large insert
  - Notify the admin when data is updated

# Types of trigger (based on behavior)

- `INSTEAD OF` trigger
  - The original statement is prevented from execution
  - A replacement statement is executed instead
- Examples of use cases
  - Prevent insertions
  - Prevent updates
  - Prevent deletions
  - Prevent object modifications
  - Notify the admin

# Trigger definition (with AFTER)

```
-- Create the trigger by giving it a descriptive name
CREATE TRIGGER ProductsTrigger
-- The trigger needs to be attached to a table
ON Products
-- The trigger behavior type
AFTER INSERT
-- The beginning of the trigger workflow
AS
-- The action executed by the trigger
PRINT ('An insert of data was made in the Products table.');
```

# Trigger definition (with INSTEAD OF)

```
-- Create the trigger by giving it a descriptive name
CREATE TRIGGER PreventDeleteFromOrders
-- The trigger needs to be attached to a table
ON Orders
-- The trigger behavior type
INSTEAD OF DELETE
-- The beginning of the trigger workflow
AS
-- The action executed by the trigger
PRINT ('You are not allowed to delete rows from the Orders table.');
```

# AFTER vs. INSTEAD OF

```
CREATE TRIGGER MyFirstAfterTrigger
ON Table1
-- Triggered after
-- the firing event (UPDATE)
AFTER UPDATE
AS
{trigger_actions_section};
```

```
CREATE TRIGGER MyFirstInsteadOfTrigger
ON Table2
-- Triggered instead of
-- the firing event (UPDATE)
INSTEAD OF UPDATE
AS
{trigger_actions_section};
```



# Let's practice!

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# How DML triggers are used

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# Why should we use DML triggers?

- Initiating actions when manipulating data
- Preventing data manipulation
- Tracking data or database object changes
- User auditing and database security

# Deciding between AFTER and INSTEAD OF

```
CREATE TRIGGER MyFirstAfterTrigger
ON Table1
-- Triggered after
-- the firing event (UPDATE)
AFTER UPDATE
AS
{trigger_actions_section};
```

```
CREATE TRIGGER MyFirstInsteadOfTrigger
ON Table2
-- Triggered instead of
-- the firing event (UPDATE)
INSTEAD OF UPDATE
AS
{trigger_actions_section};
```

# Deciding between AFTER and INSTEAD OF

## AFTER trigger

Initial event fires the trigger

**Initial event executes**

The trigger actions execute



## INSTEAD OF trigger

Initial event fires the trigger

**Initial event is not executed anymore**

The trigger actions execute



# AFTER trigger usage example

- Data is inserted into a sales table
- Start a data cleansing procedure
- Generate a table report with the procedure results
- Notify the database administrator

```
CREATE TRIGGER SalesNewInfoTrigger
ON Sales
AFTER INSERT
AS
EXEC sp_cleansing @Table = 'Sales';
EXEC sp_generateSalesReport;
EXEC sp_sendnotification;
```

# INSTEAD OF trigger usage example

Brand	Model	Power	Stock
-----	-----	-----	-----
Ecco	Standard	30W	30
Miry	Buma	45W	0
Lume	Ultra	50W	0

```
CREATE TRIGGER BulbsStockTrigger
ON Bulbs
INSTEAD OF INSERT
AS
```

- The power changes for some models

# INSTEAD OF trigger usage example

Brand	Model	Power	Stock
Ecco	Standard	30W	30
Miry	Buma	50W	100
Lume	Ultra	52W	100

- The power changes for some models
- Update only the products with no stock

```
CREATE TRIGGER BulbsStockTrigger
ON Bulbs
INSTEAD OF INSERT
AS
IF EXISTS (SELECT * FROM Bulbs AS b
           INNER JOIN inserted AS i
               ON b.Brand = i.Brand
              AND b.Model = i.Model
          WHERE b.Stock = 0)
BEGIN
    UPDATE b
    SET b.Power = i.Power,
        b.Stock = i.Stock
    FROM Bulbs AS b
    INNER JOIN inserted AS i
        ON b.Brand = i.Brand
        AND b.Model = i.Model
    WHERE b.Stock = 0
END
```



# INSTEAD OF trigger usage example

Brand	Model	Power	Stock
Ecco	Standard	30W	30
Miry	Buma	50W	100
Lume	Ultra	52W	100
Ecco	Standard	35W	100

- The power changes for some models
- Update only the products with no stock
- Add new rows for the products with stock

```
-- First part was truncated for spacing reasons
IF EXISTS (SELECT * FROM Bulbs AS b
INNER JOIN inserted AS i
          ON b.Brand = i.Brand
          AND b.Model = i.Model
WHERE b.Stock = 0)
BEGIN
    UPDATE b
    SET b.Power = i.Power,
        b.Stock = i.Stock
    FROM Bulbs AS b
    INNER JOIN inserted AS i
          ON b.Brand = i.Brand
          AND b.Model = i.Model
    WHERE b.Stock = 0
END
ELSE
    INSERT INTO Bulbs
    SELECT * FROM inserted;
```

# Practice questions

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# Trigger alternatives

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# Triggers vs. stored procedures

## Triggers

- Fired automatically by an event

```
-- Will fire an INSERT trigger  
INSERT INTO Orders [...];
```

- Don't allow parameters or transactions
- Cannot return values as output

## Stored procedures

- Run only when called explicitly

```
-- Will run the stored procedure  
EXECUTE sp_DailyMaintenance;
```

- Accept input parameters and transactions
- Can return values as output

# Triggers vs. stored procedures

## Triggers

Used for:

- auditing
- integrity enforcement

## Stored procedures

Used for:

- general tasks
- user-specific needs

# Triggers vs. computed columns

## Triggers

- calculate column values
- use columns **from other tables** for calculations
- `INSERT` or `UPDATE` used to calculate

```
-- Used in the trigger body
[...]  
UPDATE  
SET TotalAmount = Price * Quantity  
[...]
```

## Computed columns

- calculate column values
- use columns **only from the same table** for calculations
- calculation defined when creating the table

```
-- Column definition  
[...]  
TotalAmount AS Price * Quantity  
[...]
```

# Example of a computed column

```
CREATE TABLE [SalesWithPrice]
(
    [OrderID] INT IDENTITY(1,1),
    [Customer] NVARCHAR(50),
    [Product] NVARCHAR(50),
    [Price] DECIMAL(10,2),
    [Currency] NVARCHAR(3),
    [Quantity] INT,
    [OrderDate] DATE DEFAULT (GETDATE()),
    [TotalAmount] AS [Quantity] * [Price]
);
```

# Using a trigger as a computed column

```
CREATE TRIGGER [SalesCalculateTotalAmount]
ON [SalesWithoutPrice]
AFTER INSERT
AS
    UPDATE [sp]
    SET [sp].[TotalAmount] = [sp].[Quantity] * [p].[Price]
    FROM [SalesWithoutPrice] AS [sp]
    INNER JOIN [Products] AS [p] ON [sp].Product = [p].[Product]
    WHERE [sp].[TotalAmount] IS NULL;
```



# Let's compare them in practice!

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