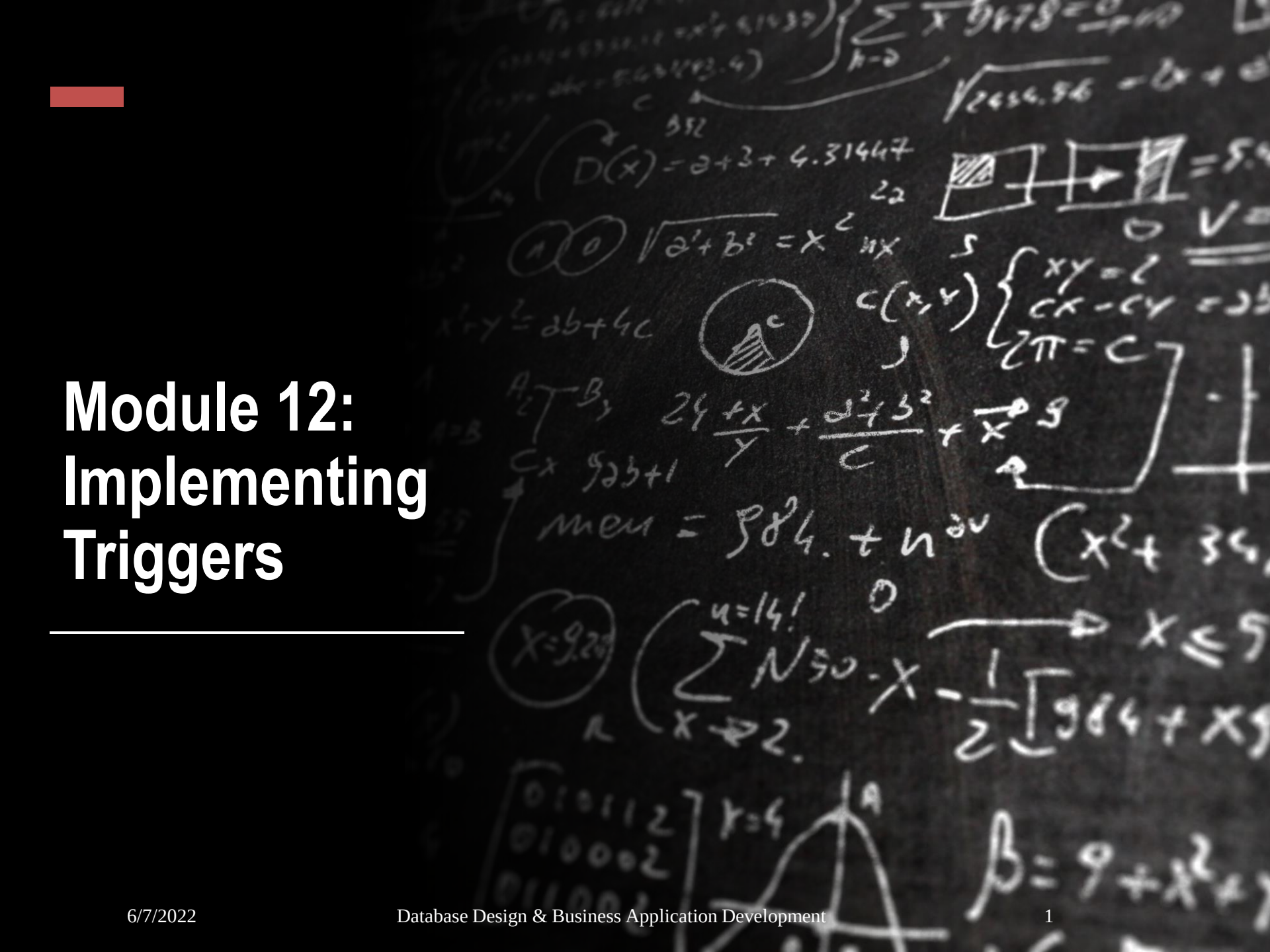
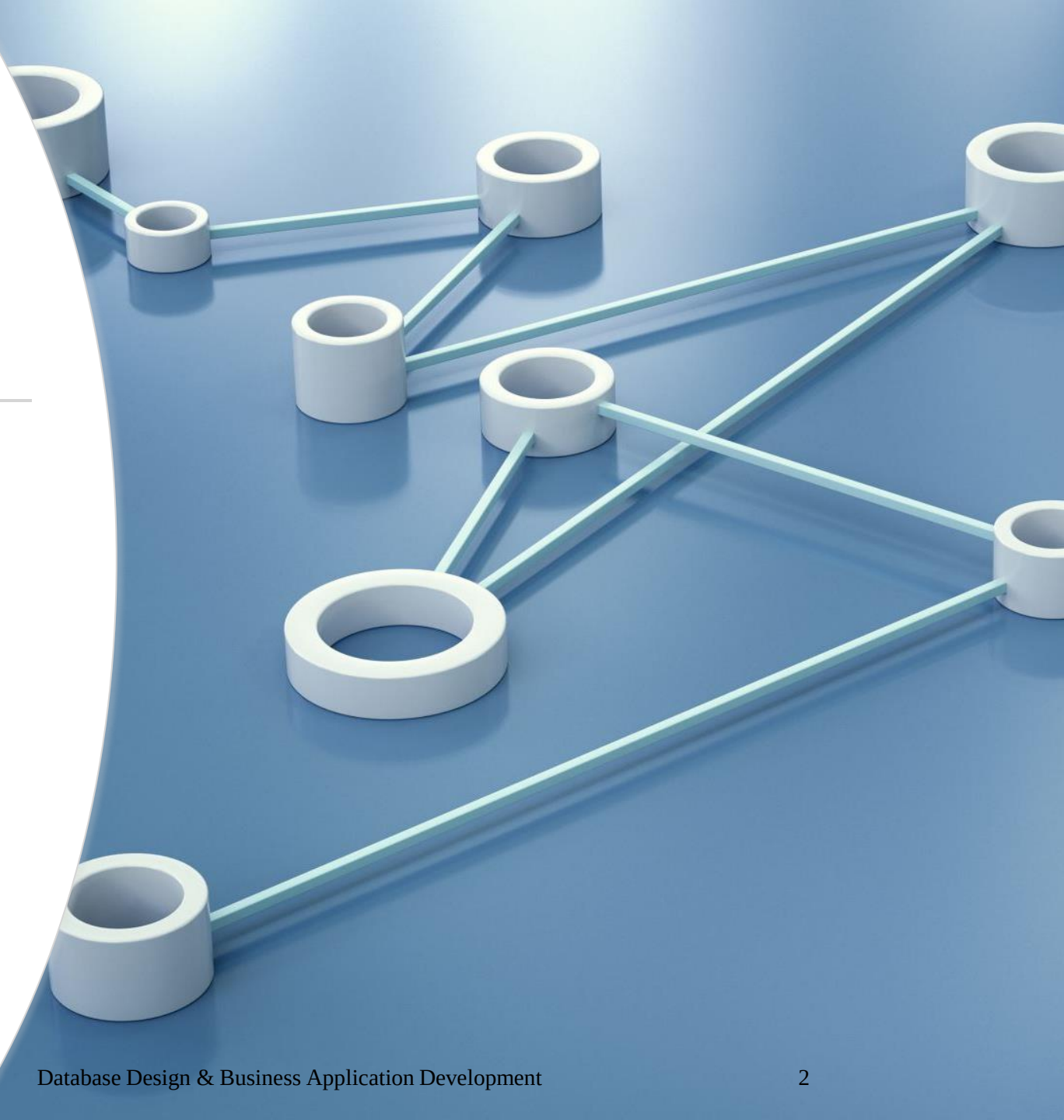
Module 12: Implementing Triggers



Overview

- Introduction to Triggers
- Defining Triggers
- How Triggers Work
- Examples of Triggers
- Performance Considerations



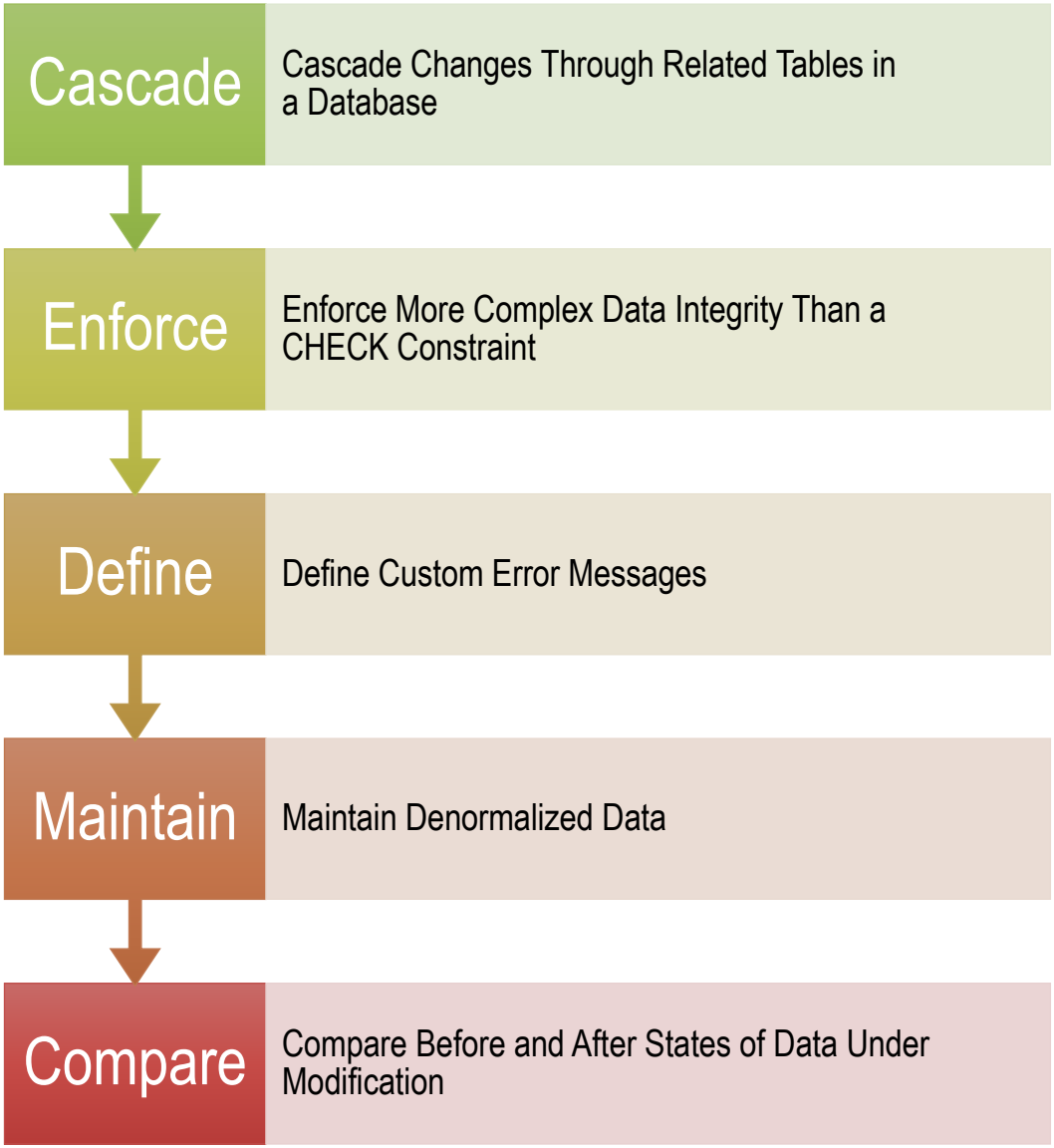
Introduction to Triggers

- What Is a Trigger?
- Uses of Triggers
- Considerations for Using Triggers

What Is a Trigger?

- Associated with a Table
- Invoked Automatically
- Cannot Be Called Directly
- Is Part of a Transaction

Uses of Triggers



Considerations for Using Triggers

- Triggers Are Reactive; Constraints Are Proactive
- Constraints Are Checked First
- Tables Can Have Multiple Triggers for Any Action
- Table Owners Can Designate the First and Last Trigger to Fire
- You Must Have Permission to Perform All Statements That Define Triggers
- Table Owners Cannot Create AFTER Triggers on Views or Temporary Tables

Defining Triggers

CREATING TRIGGERS

ALTERING AND DROPPING TRIGGERS

Creating Triggers

- **Requires Appropriate Permissions**
- **Cannot Contain Certain Statements**

```
Use Northwind
GO
CREATE TRIGGER Empl_Delete ON Employees
FOR DELETE
AS
IF (SELECT COUNT(*) FROM Deleted) > 1
BEGIN
   RAISERROR(
     'You cannot delete more than one employee at a time.', 16, 1)
   ROLLBACK TRANSACTION
END
```

Altering and Dropping Triggers

- **Altering a Trigger**
  - Changes the definition without dropping the trigger
  - Can disable or enable a trigger

```
USE Northwind
GO
ALTER TRIGGER Empl_Delete ON Employees
FOR DELETE
AS
IF (SELECT COUNT(*) FROM Deleted) > 6
BEGIN
   RAISERROR(
     'You cannot delete more than six employees at a time.', 16, 1)
   ROLLBACK TRANSACTION
END
```

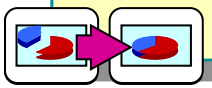
- **Dropping a Trigger**

How Triggers Work

- How an INSERT Trigger Works
- How a DELETE Trigger Works
- How an UPDATE Trigger Works
- How an INSTEAD OF Trigger Works
- How Nested Triggers Work
- Recursive Triggers

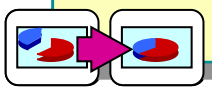
How an INSERT Trigger Works

1. INSERT Statement to a Table with an INSERT Trigger Defined
2. INSERT Statement Logged
3. Trigger Actions Executed



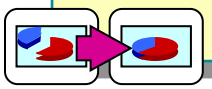
How a DELETE Trigger Works

1. DELETE Statement to a Table with a DELETE Statement Defined
2. DELETE Statement Logged
3. Trigger Actions Executed



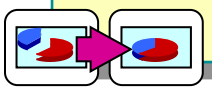
How an UPDATE Trigger Works

1. UPDATE Statement to a Table with an UPDATE Trigger Defined
2. UPDATE Statement Logged as INSERT and DELETE Statements
3. Trigger Actions Executed

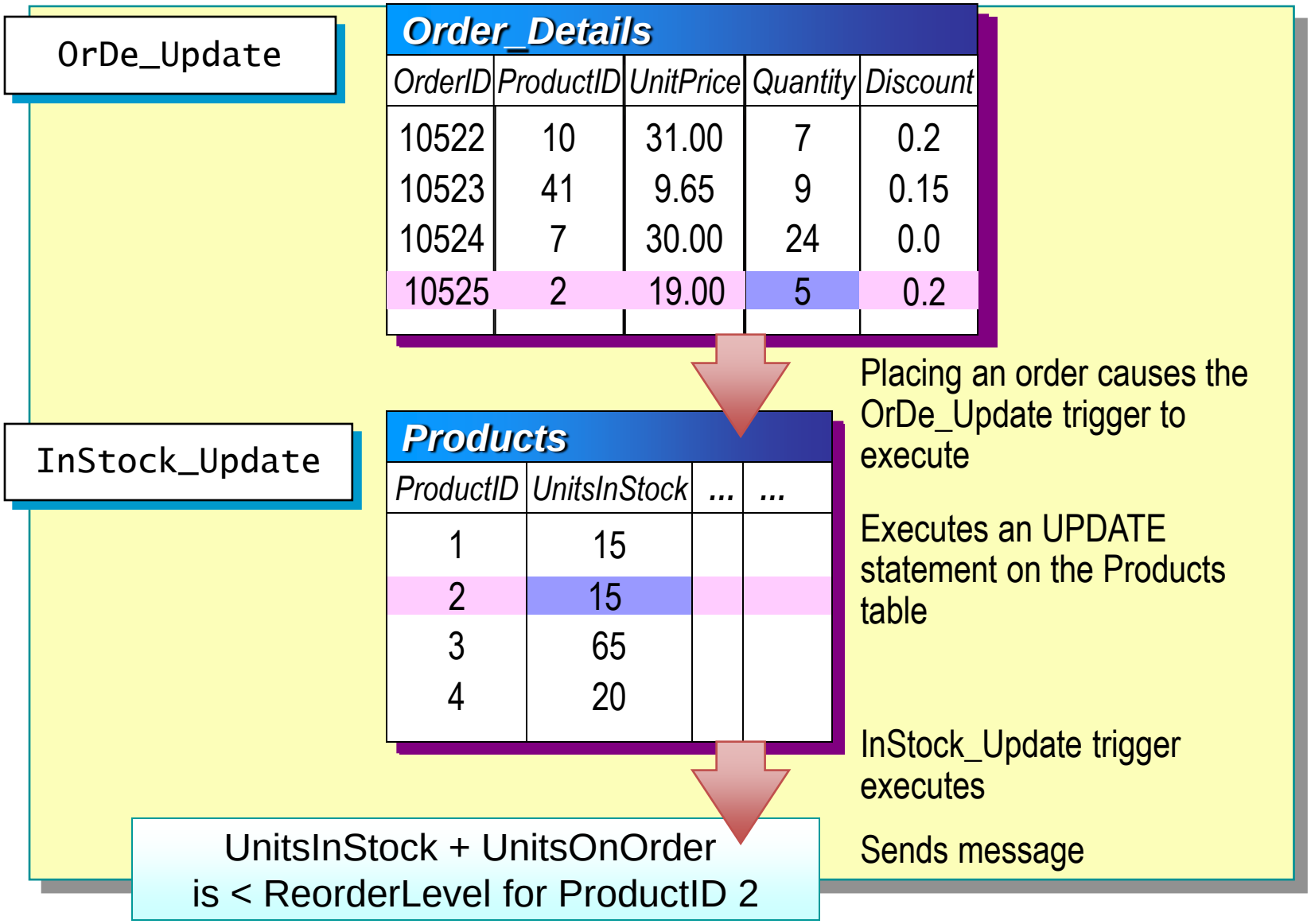


How an INSTEAD OF Trigger Works

1. INSTEAD OF Trigger Can Be on a Table or View
2. The Action That Initiates the Trigger Does NOT Occur
3. Allows Updates to Views Not Previously Updateable



How Nested Triggers Work



Recursive Triggers

Activating a Trigger Recursively

Types of Recursive Triggers

Direct recursion occurs when a trigger fires and performs an action that causes the same trigger to fire again

Indirect recursion occurs when a trigger fires and performs an action that causes a trigger on another table to fire

Determining Whether to Use Recursive Triggers

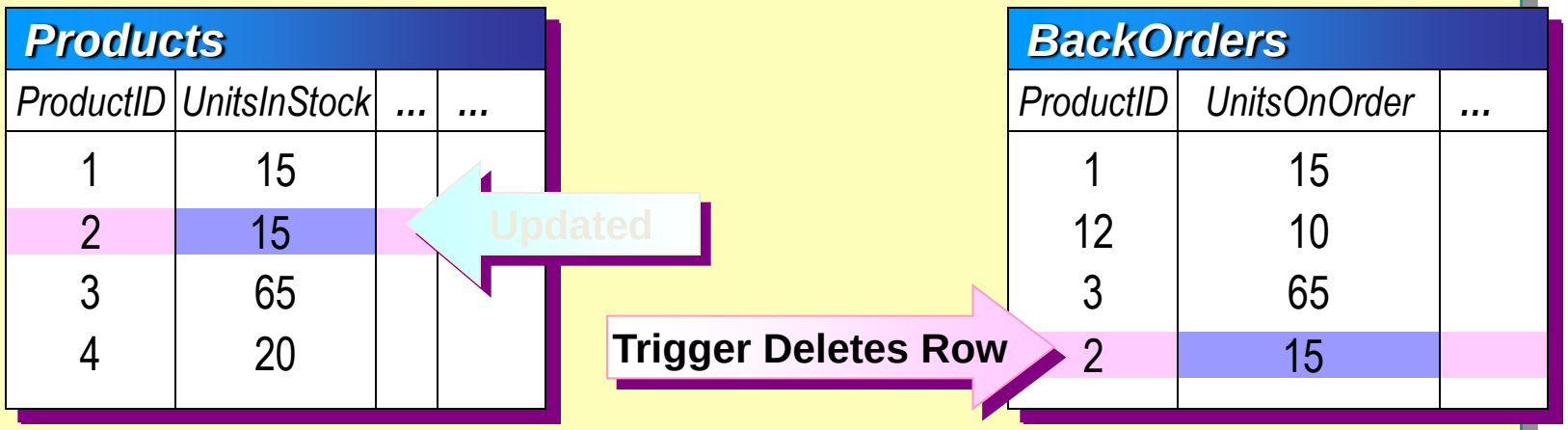
Examples of Triggers

ENFORCING DATA INTEGRITY

ENFORCING BUSINESS RULES

Enforcing Data Integrity

```
CREATE TRIGGER BackOrderList_Delete
    ON Products FOR UPDATE
AS
IF (SELECT BO.ProductID FROM BackOrders AS BO JOIN
    Inserted AS I ON BO.ProductID = I.Product_ID
    ) > 0
BEGIN
    DELETE BO FROM BackOrders AS BO
    INNER JOIN Inserted AS I
    ON BO.ProductID = I.ProductID
END
```



Enforcing Business Rules

Products with Outstanding Orders Cannot Be Deleted

```
IF (Select Count (*)
  FROM [Order Details] INNER JOIN deleted
  ON [Order Details].ProductID = deleted.ProductID
   ) > 0
ROLLBACK TRANSACTION
```

DELETE statement executed on Product table

Trigger code checks the Order Details table

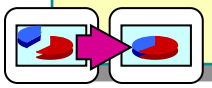
Transaction rolled back

Products

ProductID	UnitsInStock	...	...
1	15		
2	0		
3	65		
4	20		

Order Details

OrderID	ProductID	UnitPrice	Quantity	Discount
10522	10	31.00	7	0.2
10523	2	19.00	9	0.15
10524	41	9.65	24	0.0
10525	7	30.00		



```
'Transaction cannot be processed'
'This product has order history'
```

Performance Considerations

Triggers Work Quickly Because the Inserted and Deleted Tables Are in Cache

Execution Time Is Determined by:

- Number of tables that are referenced
- Number of rows that are affected

Actions Contained in Triggers Implicitly Are Part of a Transaction

Recommended Practices

Use Triggers Only When Necessary

Keep Trigger Definition Statements as Simple as Possible

Include Recursion Termination Check Statements in Recursive Trigger Definitions

Minimize Use of ROLLBACK Statements in Triggers

Lab: Creating Triggers

Review

- Introduction to Triggers
- Defining Triggers
- How Triggers Work
- Examples of Triggers
- Performance Considerations

Module References

- Create Trigger (Transact-SQL) - https://docs.microsoft.com/en-us/sql/t-sql/statements/create-trigger-transact-sql?f1url=%3FappId%3DDev15IDEF1%26l%3DEN-US%26k%3Dk(create_trigger_TSQL);k(sql13.swb.tsqlresults.f1);k(sql13.swb.tsqlquery.f1);k(MiscellaneousFilesProject);k(DevLang-TSQL)%26rd%3Dtrue&view=sql-server-ver15
- Create Trigger Oracle Database - https://docs.oracle.com/cd/B19306_01/server.102/b14200/statements_7004.htm
- Create Trigger MySQL Database - https://dev.mysql.com/doc/refman/5.7/en/create-trigger.html
- Microsoft Official Curriculum – Programming Microsoft SQL Server