

Triggers

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Exercise I

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The following tables form part of a database held in a relational DBMS:

Hotel (Hotel_No, Name, Address)

Room (Room_No, Hotel_No, Type, Price)

Booking (Hotel_No, Guest_No, Date_From, Date_To,
Room_No)

Guest (Guest_No, Name, Address)

List the price and type of all rooms at the Grosvenor Hotel.

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The following tables form part of a database held in a relational DBMS:

Hotel (Hotel_No, Name, Address)

Room (Room_No, Hotel_No, Type, Price)

Booking (Hotel_No, Guest_No, Date_From, Date_To,
Room_No)

Guest (Guest_No, Name, Address)

List the number of all unoccupied rooms at the Grosvenor Hotel? (TIP. Function CURDATE() returns the current date)

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The following tables form part of a database held in a relational DBMS:

Hotel (Hotel_No, Name, Address)

Room (Room_No, Hotel_No, Type, Price)

Booking (Hotel_No, Guest_No, Date_From, Date_To,
Room_No)

Guest (Guest_No, Name, Address)

What is the lost income from unoccupied rooms at the Grosvenor Hotel?

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The following tables form part of a database held in a relational DBMS:

Hotel (Hotel_No, Name, Address)

Room (Room_No, Hotel_No, Type, Price)

Booking (Hotel_No, Guest_No, Date_From, Date_To,
Room_No)

Guest (Guest_No, Name, Address)

What is the lost income from unoccupied rooms at each hotel today?

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The following tables form part of a database held in a relational DBMS:

Hotel (Hotel_No, Name, Address)

Room (Room_No, Hotel_No, Type, Price)

Booking (Hotel_No, Guest_No, Date_From, Date_To,
Room_No)

Guest (Guest_No, Name, Address)

What is the most commonly booked room type for each hotel in London?

Session Objectives

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In this session, you will learn:

- Triggers

Stored Programs

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Stored Programs

- Are computer programs that are stored and executed within the database server
- There are three major types of MySQL stored programs:
 - **Triggers:** Are programs that are activated in response to an activity in the database
 - **Stored Procedures:** Generic program executed on request that can accept multiple parameters
 - **Functions:** Their execution results in the return of a single value. They can be used within a standard SQL statement

Why Use Stored Programs?

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- More secure database (routines implemented by programmers with more database experience)
- Reduce network traffic (program executed on the server)
- Implement common routines available to multiple applications

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- Database *triggers* are stored programs that are executed in response to some kind of event that occurs in the database
- They can be used to:
 - Integrity check
 - Denormalization (maintaining derived data)
 - Logging

Trigger: Example

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Ensure that a product order is sent to a vendor when that product's inventory drops below its minimum allowable quantity on hand :

- 1** Business logic requires an update of the product quantity on hand each time there is a sale of that product.
- 2** If the product's quantity on hand falls below its minimum allowable inventory (quantity-on-hand) level, the product must be reordered.

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Trigger

A trigger is a program that is automatically invoked by the DBMS upon the occurrence of a given data manipulation event:

- A trigger is invoked before or after a data row is inserted, updated, or deleted.
- A trigger is associated with a database table.
- Each database table may have one or more triggers.

Create Trigger Syntax

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```
DELIMITER //  
CREATE TRIGGER trigger_name  
{BEFORE | AFTER}  
{UPDATE | INSERT | DELETE} ON table  
FOR EACH ROW  
BEGIN  
  variable_declaration  
  statement_list  
END//  
DELIMITER ;
```

- BEFORE or AFTER indicate that the trigger activates before or after each row to be modified

Variable Declaration Syntax

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```
DECLARE var_name [, var_name] ... type  
[DEFAULT value];
```

- This statement declares local variables within triggers. To provide a default value for a variable, include a DEFAULT clause. The value can be specified as an expression; it need not be a constant. If the DEFAULT clause is missing, the initial value is NULL
- The scope of a local variable is the BEGIN ... END block within which it is declared. The variable can be referred to in blocks nested within the declaring block, except those blocks that declare a variable with the same name.

Statements

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The statements in a trigger are procedural code that is executed when the trigger is activated

Assignments

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```
SET {column_name | variable_name} = expression  
    [, {column_name | variable_name} = expression]
```

The SET statement assigns values to columns or different types of variables

Operators

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- Mathematical operators:
 - +, -, *, /, DIV, %
- Comparison operators:
 - >, <, ..., BETWEEN, IN, LIKE, IS NULL
- Logical operators:
 - AND, OR, XOR

Functions

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Most of the SQL built-in functions can be used in triggers:

- String Functions
 - CONCAT,LENGTH,SUBSTRING,REPLACE
- Mathematical Functions
 - ABS, MOD, POWER, RAND, ROUND
- Date and Time Functions
 - NOW, CURDATE, DATE_SUB, DATE_ADD
- Information Functions
 - USER: Returns the current MySQL user name and host name as a string ('root@localhost')

Conditional Statements Syntax

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```
IF condition THEN statement_list
    [ELSEIF condition THEN statement_list]
    [ELSE statement_list]
END IF;

statement_list:= {statement; |
                  BEGIN statement_list END;}
```

IF implements a basic conditional construct

- If the condition evaluates to true, the corresponding commands are executed
- If condition does not match, the command list in the ELSE clause is executed
- Conditions can be written similarly to the WHERE of a SELECT

Column Values Within the Trigger

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Within a trigger you can refer to columns in the subject table (the table associated with the trigger) by using the aliases OLD and NEW:

- `OLD.col_name` refers to a column of an existing row before it is updated or deleted
- `NEW.col_name` refers to the column of a new row to be inserted or an existing row after it is updated

Modifying the NEW Column Values Within the Trigger

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- BEFORE triggers
 - activate before the row-change operation is executed.
Thus, **you can modify a NEW value with a SET statement** —thus changing the effect of the statement
- AFTER triggers
 - activate only after successful changes to the database.
Thus, **you cannot modify a NEW value**

Example I

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Branch (branchNo, street, city, postcode)
Staff (staffNo, fName, lName, position, sex, DOB, salary, branchNo)
PropertyForRent (propertyNo, street, city, postcode, type, rooms,
rent, tax, ownerNo, staffNo, branchNo)

```
DELIMITER //  
CREATE TRIGGER defineTax BEFORE INSERT ON PropertyForRent  
FOR EACH ROW  
BEGIN  
  IF NEW.rent<500 THEN  
    SET NEW.tax=0.05;  
  ELSEIF NEW.rent<1000 THEN  
    SET NEW.tax=0.1;  
  ELSE  
    SET NEW.tax=0.2;  
  END IF;  
END//  
DELIMITER ;
```

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Branch (branchNo, street, city, postcode)
Staff (staffNo, fName, lName, position, sex, DOB, salary, branchNo)
PropertyForRent (propertyNo, street, city, postcode, type, rooms,
rent, ownerNo, staffNo, branchNo)

```
DELIMITER //  
CREATE TRIGGER addedProperty AFTER INSERT ON PropertyForRent  
FOR EACH ROW  
BEGIN  
insert into logInfo (CONCAT('The user ',USER()),' has added a  
new property'));  
END//  
DELIMITER ;
```

What does this trigger?

Triggers Exercise (5 min)

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Give examples of when you might use a trigger BEFORE and AFTER:

- an insert operation
- an update operation
- a delete operation

Aborting Triggers: Example

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- In MySQL 5.5: SIGNAL is the way to “return” an error

```
SIGNAL SQLSTATE '45000'
```

```
SET MESSAGE_TEXT = 'An error occurred';
```

To signal a generic SQLSTATE value, use '45000', which means “unhandled user-defined exception”

Example

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Branch (branchNo, street, city, postcode)
Staff (staffNo, fName, lName, position, sex, DOB, salary, branchNo)
PropertyForRent (propertyNo, street, city, postcode, type, rooms,
rent, ownerNo, staffNo, branchNo)

```
DELIMITER //
CREATE TRIGGER checkPosition BEFORE INSERT ON Staff
FOR EACH ROW
BEGIN
  IF LOWER(NEW.position) NOT IN ('manager','director') then
    SIGNAL SQLSTATE '45000'
    SET MESSAGE_TEXT = 'The position must be manager or director';
  END IF;
END//
DELIMITER ;
```

What does this trigger do?

SQL In Stored Programs

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- Simple (non-SELECT) SQL statements that do not return a result set can be freely embedded within triggers
- A SELECT statement can be used to build conditions using EXISTS, IN, etc.
- A SELECT statement that returns only a single row can pass its result INTO local variables

Using Non-SELECT SQL

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- SQL statements that do not return a result (UPDATE,INSERT,DELETE) are executed in stored programs as in other contexts
- The SQL statements have full access to the programme variables

Using SELECT in Conditions

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- A SELECT statement can be used to build conditions using EXISTS, IN, etc.
- The SELECT statements have full access to the programme variables

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Branch (branchNo, street, city, postcode)
Staff (staffNo, fName, lName, position, sex, DOB, salary, branchNo)
PropertyForRent (propertyNo, street, city, postcode, type, rooms,
rent, ownerNo, staffNo, branchNo)

```
DELIMITER //
CREATE TRIGGER checkPosition BEFORE INSERT ON Staff
FOR EACH ROW
BEGIN
  IF LOWER(NEW.position) NOT IN (SELECT Position FROM Staff) then
    SIGNAL SQLSTATE '45000'
    SET MESSAGE_TEXT = 'The position must be manager or director';
  END IF;
END//
DELIMITER ;
```

What does this trigger do?

Using SELECT with an INTO Clause

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```
SELECT col_name[,...] INTO var_name[,...]  
FROM ...
```

- This SELECT syntax stores selected columns directly into variables. Therefore, **only a single row** may be retrieved
- Important: SQL variable names should not be the same as column names. If an SQL statement, such as a SELECT ... INTO statement, contains a reference to a column and a declared local variable with the same name, MySQL currently interprets the reference as the name of a variable.

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To delete or destroy a trigger, use:

```
DROP TRIGGER [IF EXISTS] trigger_name
```

If you drop a table, any triggers for the table are also dropped

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Branch (branchNo, street, city, postcode)
Staff (staffNo, fName, lName, position, sex, DOB, salary, branchNo)
PropertyForRent (propertyNo, street, city, postcode, type, rooms,
rent, ownerNo, staffNo, branchNo)

Suppose that the Letting Agency has a rule stating that an staff member's salary cannot be changed by more than 20% of the original salary. Create a trigger to enforce this constraint

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Branch (branchNo, street, city, postcode)
Staff (staffNo, fName, lName, position, sex, DOB, salary, branchNo)
PropertyForRent (propertyNo, street, city, postcode, type, rooms,
rent, ownerNo, staffNo, branchNo)

When a member of the staff leaves the company it no longer manages any property. Create a trigger to implement this constraint.

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In this session we have covered:

- Triggers

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**Suggested
Readings**

- Chapter 5 of Fundamentals of Database Systems. Elmasri & Navathe.