



Open Source Software Development

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Database Management System

MySQL

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Introduction to Database, SQL, DMS

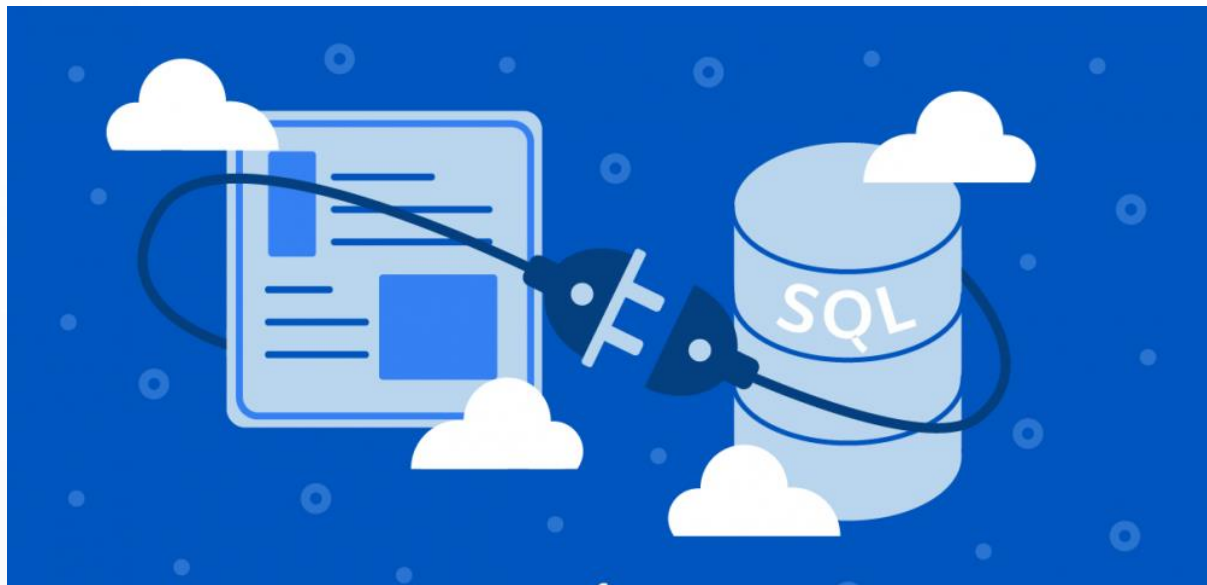
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Introduction to MySQL

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PhpMyAdmin





Database

Database

- A database is **an organized collection of structured information, or data**, typically stored in a computer system
- A database is usually **controlled by a database management system (DBMS)**

Database

- Data within the most common types of databases in operation today is typically **modeled in rows and columns in a series of tables** to make processing and data querying efficient
- The data can then be easily accessed, managed, modified, updated, controlled, and organized
- Most databases use **structured query language** (SQL) for writing and querying data

What is Structured Query Language?

SQL

- SQL is a **programming language** used by nearly all relational databases to query, manipulate, and define data, and to provide access control.
- SQL was first developed at IBM in the 1970s with Oracle as a major contributor.
- SQL has spurred many extensions from companies such as IBM, Oracle, and Microsoft



Types of Databases

There are many different types of databases:

- **Relational databases**

- Items are organized as a set of tables with columns and rows
- Provides the most efficient and flexible way to access structured information

- **Distributed databases**

The database may be stored on multiple computers, located in the same physical location, or scattered over different networks

Types of Databases

There are many different types of databases:

- **Data warehouses**

A central repository for data

- **NoSQL databases**

A NoSQL, or non-relational database, allows unstructured and semi-structured data to be stored and manipulated

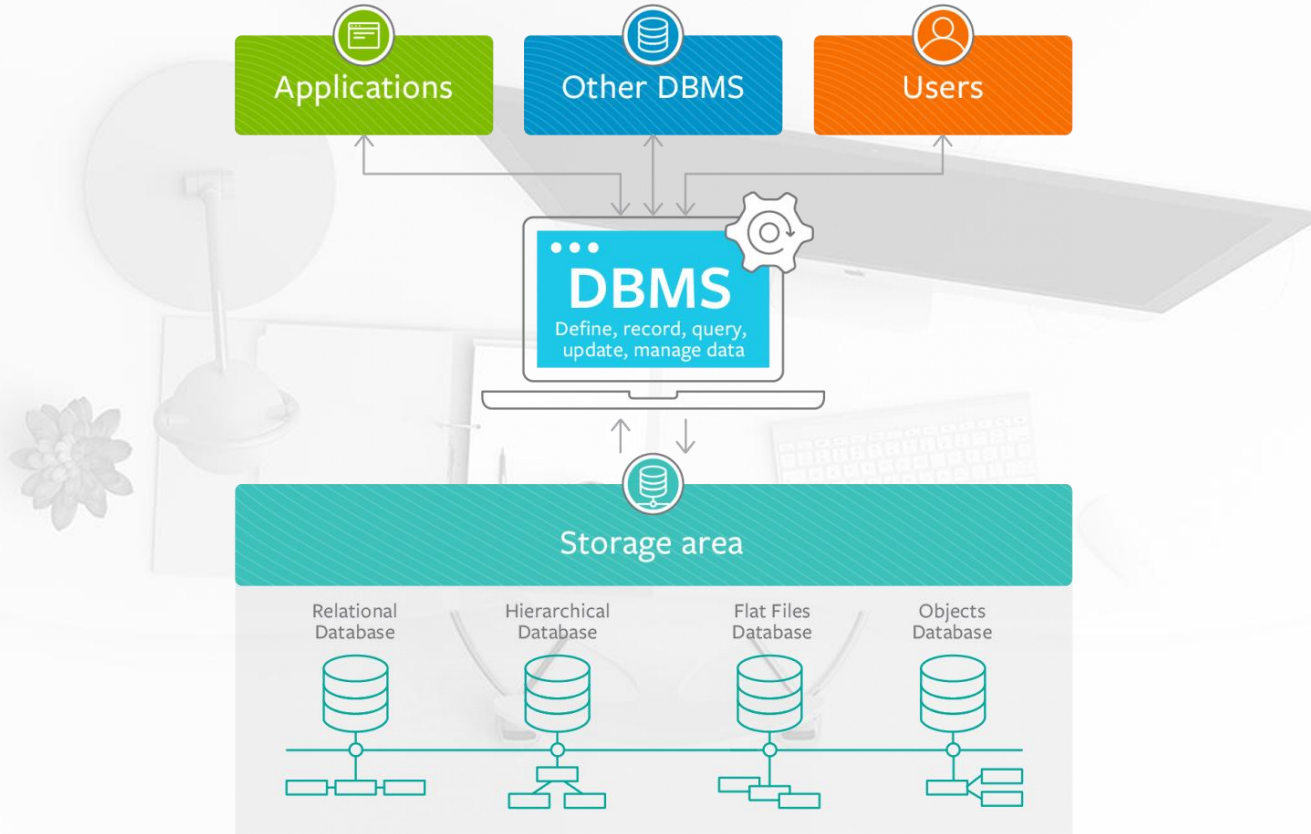
- **Open source databases**

An open source database system is one whose source code is open source

- **Cloud databases**

A collection of data, either structured or unstructured, that resides on a private, public, or hybrid cloud computing platform

What is a Database Management System?



What is a Database Management System?

- A database requires a comprehensive database software program known as DBMS
- A DBMS serves as **an interface between the database and its end users or programs**, allowing users to retrieve, update, and manage how the information is organized and optimized

What is a Database Management System?

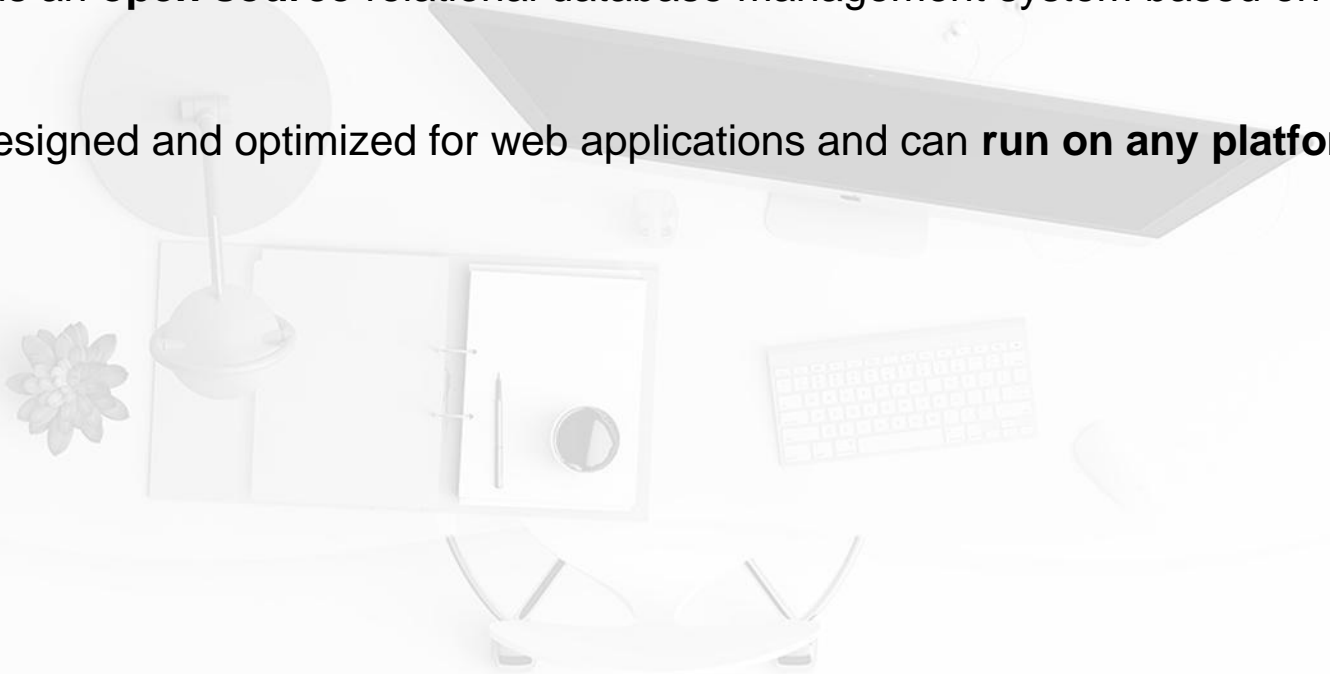
- A DBMS also facilitates oversight and control of databases, enabling a variety of administrative operations such as performance monitoring, tuning, and backup and recovery.
- E.g.: MySQL, Microsoft Access, Microsoft SQL Server, FileMaker Pro, Oracle Database, and dBASE



The world's most popular open source database

MySQL

- MySQL is an **open source** relational database management system based on SQL
- It was designed and optimized for web applications and can **run on any platform**



MySQL

- MySQL designed to process millions of queries and thousands of transactions
→ MySQL is a **popular choice for ecommerce businesses** that need to manage multiple money transfers
- MySQL is the DBMS **behind some of the top websites and web-based applications** in the world
Airbnb, Uber, LinkedIn, Facebook, Twitter, and YouTube

MySQL





MySQL Workbench

MySQL Workbench

- MySQL Workbench is a unified visual tool for database architects, developers, and database administrators
- MySQL Workbench provides data modeling, SQL development, and comprehensive administration tools for server configuration, user administration, backup, and much more
- MySQL Workbench is available on Windows, Linux and Mac OS X



Bringing MySQL to the web

phpMyAdmin

- A free software tool written in **PHP**, intended to **handle the administration of MySQL over the Web**
- phpMyAdmin supports a wide range of operations on MySQL and MariaDB
- Frequently used operations (managing databases, tables, columns, relations, indexes, users, permissions, etc.) can be **performed via the user interface**, while you still have **the ability to directly execute any SQL statement**

phpMyAdmin

- Has a wide range of documentation
- To ease usage to a wide range of people, phpMyAdmin is being **translated into 72 languages** and supports both LTR and RTL languages
- The phpMyAdmin project is a member of Software Freedom Conservancy
SFC is a not-for-profit organization that helps promote, improve, develop, and defend Free, Libre, and Open Source Software (FLOSS) projects



phpMyAdmin

Create DB

The screenshot shows the phpMyAdmin web interface. On the left sidebar, the 'New' button is highlighted with a red box. The main content area is titled 'Databases' and features a 'Create database' form, also highlighted with a red box. The form contains a 'Database name' input field with the text 'utf8mb4_unicode_ci' and a 'Create' button. Below the form is a table listing existing databases. The table has columns for 'Database', 'Collation', 'Master replication', and 'Action'. It lists four databases: 'information_schema', 'mysql', 'performance_schema', and 'sys', all with 'utf8mb4_0900_ai_ci' collation and 'Replicated' status. At the bottom, there is a 'Total: 4' row and a 'Check all' checkbox with a 'Drop' button.

Server: localhost:3306

Databases SQL Status User accounts Export Import Settings

Recent Favorites

New

- information_schema
- mysql
- performance_schema
- sys

Create database

Database name: utf8mb4_unicode_ci **Create**

Database	Collation	Master replication	Action
<input type="checkbox"/> information_schema	utf8_general_ci	✓ Replicated	Check privileges
<input type="checkbox"/> mysql	utf8mb4_0900_ai_ci	✓ Replicated	Check privileges
<input type="checkbox"/> performance_schema	utf8mb4_0900_ai_ci	✓ Replicated	Check privileges
<input type="checkbox"/> sys	utf8mb4_0900_ai_ci	✓ Replicated	Check privileges
Total: 4	utf8mb4_0900_ai_ci		

☐ Check all With selected: [Drop](#)

phpMyAdmin

Create user account and assign privileges

The screenshot shows the phpMyAdmin web interface. The top navigation bar includes tabs for 'Databases', 'SQL', 'Status', 'User accounts' (highlighted with a red box), 'Export', 'Import', and 'Settings'. Below the navigation bar, there are two sub-tabs: 'User accounts overview' and 'User groups'. The main content area displays the 'User accounts overview' table, which lists existing user accounts and their privileges. At the bottom, there is a 'New' button and a link to 'Add user account' (also highlighted with a red box).

Server: 127.0.0.1

Recent Favorites

New

- ielts
- information_schema
- mysql
- performance_schema
- phpmyadmin
- test
- tuhoctiengnhathat
- vitinhducthanh

User accounts overview

	User name	Host name	Password	Global privileges	User group	Grant	Action
<input type="checkbox"/>	Any	%	No	USAGE		No	Edit privileges Export
<input type="checkbox"/>	pma	localhost	No	USAGE		No	Edit privileges Export
<input type="checkbox"/>	root	127.0.0.1	No	ALL PRIVILEGES		Yes	Edit privileges Export
<input type="checkbox"/>	root	:::1	No	ALL PRIVILEGES		Yes	Edit privileges Export
<input type="checkbox"/>	root	localhost	No	ALL PRIVILEGES		Yes	Edit privileges Export

☐ Check all With selected: [Export](#)

New

[Add user account](#)

phpMyAdmin

Create user account and assign
privileges

phpMyAdmin 4.8.0.1

Server: 127.0.0.1

Databases SQL Status User accounts Export Import Settings Replication Variables Charsets Engines Plugins

Recent Favorites

New

- information_schema
- mysql
- performance_schema
- phpmyadmin
- test
- tuhoctienhhat
- vitinhducthanh

Add user account

Login Information

User name:

Host name: Any host %

Password: Strength:

Re-type:

Authentication Plugin: Native MySQL authentication

Generate password:

Database for user account

☐ Create database with same name and grant all privileges.

☐ Grant all privileges on wildcard name (username_%).

Global privileges

Note: MySQL privilege names are expressed in English.

Console

- ☐ Data
 - ☐ SELECT
 - ☐ INSERT
 - ☐ UPDATE
 - ☐ DELETE
 - ☐ FILE
- ☐ Structure
 - ☐ CREATE
 - ☐ ALTER
 - ☐ INDEX
 - ☐ DROP
 - ☐ CREATE TEMPORARY TABLES
 - ☐ SHOW VIEW
 - ☐ CREATE ROUTINE
 - ☐ ALTER ROUTINE
 - ☐ EXECUTE
 - ☐ CREATE VIEW
 - ☐ EVENT
 - ☐ TRIGGER

Administration

- ☐ GRANT
- ☐ SUPER
- ☐ PROCESS
- ☐ RELOAD
- ☐ SHUTDOWN
- ☐ SHOW DATABASES
- ☐ LOCK TABLES
- ☐ REFERENCES
- ☐ REPLICATION CLIENT
- ☐ REPLICATION SLAVE
- ☐ CREATE USER

Resource limits

Note: Setting these options to 0 (zero) removes the limit.

MAX QUERIES PER HOUR

MAX UPDATES PER HOUR

MAX CONNECTIONS PER HOUR

MAX USER_CONNECTIONS

SSL

☒ REQUIRE NONE

☐ REQUIRE SSL

☐ REQUIRE X509

☐ SPECIFIED

REQUIRE CIPHER

REQUIRE ISSUER

REQUIRE SUBJECT

phpMyAdmin

Create table

The screenshot displays the phpMyAdmin web interface. On the left sidebar, the 'test' database is selected and highlighted with a red box. The main panel shows the 'Structure' tab, also highlighted with a red box. A message states 'No tables found in database.' Below this, the 'Create table' form is visible, featuring a 'Name:' input field and a 'Number of columns:' dropdown menu set to '4'. A 'Go' button is located at the bottom right of the form. The interface includes a top navigation bar with tabs for Structure, SQL, Search, Query, Export, Import, and More. The server information at the top indicates 'Server: 127.0.0.1 » Database: test'.

phpMyAdmin

Recent Favorites

- New
- ielts
- information_schema
- mysql
- performance_schema
- phpmyadmin
- test**

Server: 127.0.0.1 » Database: test

Structure SQL Search Query Export Import More

⚠ No tables found in database.

Create table

Name: Number of columns: 4

phpMyAdmin

Create table

phpMyAdmin

Recent Favorites

- New
- ielts
- information_schema
- mysql
- performance_schema
- phpmyadmin
- test
- tuhoctienhhat
- vitinhducthanh

Server: 127.0.0.1 » Database: test » Table: users

Browse Structure SQL Search Insert Export Import Privileges Operations Tracking Triggers

Table name: users Add 1 column(s) Go

Name	Type	Length/Values	Default	Collation	Attributes	Null	Index	Comments
<input type="text"/>	INT	<input type="text"/>	None			<input type="checkbox"/>	---	<input type="checkbox"/>
Pick from Central Columns								
<input type="text"/>	INT	<input type="text"/>	None			<input type="checkbox"/>	---	<input type="checkbox"/>
Pick from Central Columns								
<input type="text"/>	INT	<input type="text"/>	None			<input type="checkbox"/>	---	<input type="checkbox"/>
Pick from Central Columns								
<input type="text"/>	INT	<input type="text"/>	None			<input type="checkbox"/>	---	<input type="checkbox"/>
Pick from Central Columns								

Structure

Table comments: Collation: Storage Engine: InnoDB

PARTITION definition:


Partition by: (Expression or column list)

Partitions:

Preview SQL Save

phpMyAdmin

Insert data



The image shows the phpMyAdmin web interface for inserting data into a table. The interface includes a sidebar with a database tree and a main area with a navigation bar and a form.

Navigation Bar: Server: 127.0.0.1 » Database: test » Table: users. Buttons: Browse, Structure, SQL, Search, Insert, Export, Import, More.

Form Fields:

Column	Type	Function	Null	Value
ID	int(11)	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>
StudentCode	varchar(20)	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>
StudentName	varchar(50)	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>
DoB	datetime	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>

Buttons: Recent, Favorites, New, Go.

phpMyAdmin

Export/Import data

The screenshot shows the phpMyAdmin web interface. At the top, the title 'phpMyAdmin' is displayed in a stylized font. Below it, there are navigation icons for Home, Back, Forward, Search, and Settings. On the left side, there are tabs for 'Recent' and 'Favorites'. A tree view on the left lists databases: 'New', 'ielts', 'information_schema', 'mysql', 'performance_schema', 'phpmyadmin', 'test', 'tuhoctiengnhat', 'vitinhducthanh', and 'wordpress'. The main area at the top shows the server connection: 'Server: 127.0.0.1 » Database: wordpress'. Below this, there is a navigation bar with buttons for 'Structure', 'SQL', 'Search', 'Query', 'Export', and 'Import'. The 'Export' and 'Import' buttons are highlighted with a red rectangular box. Below the navigation bar, there is a 'Filters' section with a text input field labeled 'Containing the word:'. At the bottom, there is a table listing the tables in the 'wordpress' database. The table has two columns: 'Table' and 'Action'. The tables listed are 'wp_commentmeta', 'wp_comments', 'wp_links', 'wp_options', 'wp_postmeta', and 'wp_posts'. Each table row has a checkbox, a star icon, and a set of action icons including 'Browse', 'Structure', 'Search', 'Insert', and 'Empty'.

phpMyAdmin

Recent Favorites

Server: 127.0.0.1 » Database: wordpress

Structure SQL Search Query **Export** **Import**

Filters

Containing the word:

	Table	Action
<input type="checkbox"/>	wp_commentmeta	★ Browse Structure Search Insert Empty
<input type="checkbox"/>	wp_comments	★ Browse Structure Search Insert Empty
<input type="checkbox"/>	wp_links	★ Browse Structure Search Insert Empty
<input type="checkbox"/>	wp_options	★ Browse Structure Search Insert Empty
<input type="checkbox"/>	wp_postmeta	★ Browse Structure Search Insert Empty
<input type="checkbox"/>	wp_posts	★ Browse Structure Search Insert Empty



MySQL statements

MySQL INSERT statement

- **Syntax for inserting one row** into table

INSERT INTO table (c1, c2,...) **VALUES** (v1, v2,...);

- **Syntax for inserting multiple rows** into table

INSERT INTO table (c1, c2,...)

VALUES

(v11, v12,...),

(v21, v22,...),

...

(vn1, vn2,...);

MySQL UPDATE statement

- To change the values in one or more columns of a single row or multiple rows

- **Syntax**

UPDATE table_name

SET

column_name1 = expr1,

column_name2 = expr2,

...

[WHERE condition];

MySQL DELETE statement

- To delete data from a table

- **Syntax**

```
DELETE FROM table_name  
[WHERE condition];
```

- **Note**

To delete all rows in a table without the need of knowing how many rows deleted, you should use the **TRUNCATE TABLE** statement to get better performance

MySQL SELECT statement

- To read data from one or more tables

- **Syntax**

SELECT select_list

FROM table_name

[WHERE search_condition]

[ORDER BY

column1 [ASC|DESC],

column2 [ASC|DESC],

...]

[LIMIT [offset,] row_count];

MySQL SELECT statement

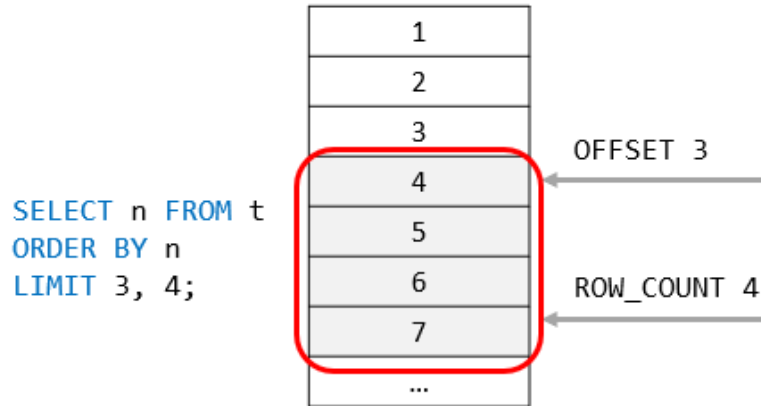
- **WHERE** clause to specify a search condition for the rows returned by a query

The **search_condition** is a combination of one or more predicates using the logical operator **AND**, **OR** and **NOT**

- **ORDER BY** clause to sort one or more columns
- **LIMIT** clause to constrain the number of rows to return
 - accepts one or two arguments (0 or positive integers)
 - **offset** specifies the offset of the first row to return
 - **row_count** specifies the maximum number of rows to return

MySQL SELECT statement

- The following picture illustrates the LIMIT clause



- The following picture illustrates the evaluation order of the LIMIT clause in the SELECT statement



MySQL statements for Beginners

Source:

https://www3.ntu.edu.sg/home/ehchua/programming/sql/MySQL_Beginner.html

```
-- Database-Level
DROP DATABASE databaseName           -- Delete the database (irrecoverable!)
DROP DATABASE IF EXISTS databaseName -- Delete if it exists
CREATE DATABASE databaseName         -- Create a new database
CREATE DATABASE IF NOT EXISTS databaseName -- Create only if it does not exists
SHOW DATABASES                         -- Show all the databases in this server
USE databaseName                     -- Set the default (current) database
SELECT DATABASE()                      -- Show the default database
SHOW CREATE DATABASE databaseName   -- Show the CREATE DATABASE statement

-- Table-Level
DROP TABLE [IF EXISTS] tableName, ...
CREATE TABLE [IF NOT EXISTS] tableName (
    columnName columnType columnAttribute, ...
    PRIMARY KEY(columnName),
    FOREIGN KEY (columnNmae) REFERENCES tableName (columnNmae)
)
SHOW TABLES                          -- Show all the tables in the default database
DESCRIBE|DESC tableName              -- Describe the details for a table
ALTER TABLE tableName ...           -- Modify a table, e.g., ADD COLUMN and DROP COLUMN
ALTER TABLE tableName ADD columnDefinition
ALTER TABLE tableName DROP columnName
ALTER TABLE tableName ADD FOREIGN KEY (columnNmae) REFERENCES tableName (columnNmae)
ALTER TABLE tableName DROP FOREIGN KEY constraintName
SHOW CREATE TABLE tableName        -- Show the CREATE TABLE statement for this tableName

-- Row-Level
INSERT INTO tableName
    VALUES (column1Value, column2Value,...)           -- Insert on all Columns
INSERT INTO tableName
    VALUES (column1Value, column2Value,...), ...       -- Insert multiple rows
INSERT INTO tableName (column1Name, ..., columnNName)
    VALUES (column1Value, ..., columnNValue)         -- Insert on selected Columns
DELETE FROM tableName WHERE criteria
UPDATE tableName SET columnName = expr, ... WHERE criteria
SELECT * | column1Name AS alias1, ..., columnNName AS aliasN
    FROM tableName
    WHERE criteria
    GROUP BY columnName
    ORDER BY columnName ASC|DESC, ...
    HAVING groupConstraints
    LIMIT count | offset count

-- Others
SHOW WARNINGS; -- Show the warnings of the previous statement
```



MySQL shell

MySQL shell

- Access the MySQL shell by typing the following command into terminal:

```
mysql -u root -p
```

- After entering the root MySQL password into the prompt, you will be able to start building your MySQL database
- Disconnect
Quit or Exit

MySQL shell

- Two points to keep in mind:
 - **All MySQL commands end with a semicolon;**
if the phrase does not end with a semicolon, the command will not execute
 - **MySQL command line is not case sensitive**
 - ✓ MySQL commands are usually written in uppercase
 - ✓ Databases, tables, usernames, or text are in lowercase

Basic MySQL commands

- Check what databases are available

SHOW DATABASES;

- Create a database

CREATE DATABASE database_name;

- Delete a database

DROP DATABASE database_name;

- Set a default (current) database for subsequent statements

USE db_name;

Basic MySQL commands

- Create a new MySQL User Account

CREATE USER 'newuser'@'localhost' **IDENTIFIED BY** 'user_password';

- To grant access from another host, change the hostname part with the remote machine IP

CREATE USER 'newuser'@'10.8.0.5' **IDENTIFIED BY** 'user_password';

- To create a user that can connect from any host, use the '%' wildcard as a host part

CREATE USER 'newuser'@'%' **IDENTIFIED BY** 'user_password';

Basic MySQL commands

- Change User Password

ALTER USER 'user'@'localhost' **IDENTIFIED BY** 'password';

or

ALTER USER 'root'@'localhost' **IDENTIFIED WITH** mysql_native_password **BY** 'password';

- Reload the grant tables and put new changes into effect

FLUSH PRIVILEGES;

Basic MySQL commands

- The most commonly used privileges are:
 - **ALL PRIVILEGES** – Grants all privileges to a user account
 - **CREATE** – The user account is allowed to create databases and tables
 - **DROP** – The user account is allowed to drop databases and tables
 - **DELETE** – The user account is allowed to delete rows from a specific table
 - **INSERT** – The user account is allowed to insert rows into a specific table
 - **SELECT** – The user account is allowed to read a database
 - **UPDATE** – The user account is allowed to update table rows

Basic MySQL commands

- Grant specific privileges to a user account, use the following syntax:

GRANT permission1, permission2 **ON** database_name.table_name **TO**
'database_user'@'localhost';

- Grant all privileges to a user account over a specific database

GRANT ALL PRIVILEGES ON database_name.* **TO** 'database_user'@'localhost';

Basic MySQL commands

- Grant all privileges to a user account on all databases:

GRANT ALL PRIVILEGES ON *.* TO 'database_user'@'localhost';

- Grant multiple privileges to a user account over a specific database:

GRANT SELECT, INSERT, DELETE ON database_name.* TO database_user@'localhost';

- Display User Account Privileges

SHOW GRANTS FOR 'database_user'@'localhost';

Basic MySQL commands

- Revoke all privileges from a user account over a specific database

REVOKE ALL PRIVILEGES **ON** database_name.* **FROM** 'database_user'@'localhost';

- Delete a MySQL user account

DROP USER 'user'@'localhost';



Q&A

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- **What Is a Database?**

<https://www.oracle.com/database/what-is-database/>

- **Connecting to and Disconnecting from the Server**

<https://dev.mysql.com/doc/refman/8.0/en/connecting-disconnecting.html>

- **SELECT Statement**

<https://dev.mysql.com/doc/refman/8.0/en/select.html>

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