Group A : Study of Databases

Assignment No:- 1

Aim:- Study of MySQL Open source software. Discuss the characteristics like efficiency, scalability, performance and transactional properties

What is Database?

A database is a separate application that stores a collection of data. Each database has one or more distinct APIs for creating, accessing, managing, searching and replicating the data it holds. So nowadays, we use relational database management systems (RDBMS) to store and manage huge Volume of data. This is called relational database because all the data is stored into different tables and Relations are established using primary keys or other keys known as foreign keys.

What is DBMS?

A software system that enables users to define, create, maintain, and control access to the database. The DBMS is the software that interacts with the users' application programs and the database.

Typically, a DBMS provides the following facilities:

- It allows users to define the database, usually through a Data Definition Language (DDL). The DDL allows users to specify the data types and structures and the constraints on the data to be stored in the database.
- It allows users to insert, update, delete, and retrieve data from the database, usually through a Data Manipulation Language(DML). The most common query language is the Structured Query Language (SQL, pronounced 'S-Q-L', or sometimes 'See-Quel'), which is now both the formal and de facto standard language for relational DBMSs.
- It provides controlled access to the database. For example, it may provide:
- A security system, which prevents unauthorized users accessing the database.
- An integrity system, which maintains the consistency of stored data
- A concurrency control system, which allows shared access of the database.
- A recovery control system, which restores the database to a previous consistent state following a hardware or software failure
- A user-accessible catalog, which contains descriptions of the data in the database.

What is RDBMS?

A relational database refers to a database that stores data in a structured format, using rows and columns. This makes it easy to locate and access specific values within the database. It is "relational" because the values within each table are related to each other. Tables may also be related to other tables. The relational structure makes it possible to run queries across multiple tables at once.

RDBMS Terminology:

Before we proceed to explain MySQL database system, let's revise few definitions related to database.

- Database: A database is a collection of tables, with related data.
- Table: A table is a matrix with data. A table in a database looks like a simple spread sheet.
- Column: One column(data element) contains data of one and the same kind, for example the Column post code.
- Row: A row (tuple, entry or record) is a group of related data, for example the data of one subscription.
- Redundancy: Storing data twice, redundantly to make the system faster.
- Primary Key: A primary key is unique. A key value cannot occur twice in one table. With a key, you can find at most one row.
- Foreign Key: A foreign key is the linking pin between two tables.
- Compound Key: A compound key(composite key) is a key that consists of multiple columns, Because one column is not sufficiently unique.

MySQL is a fast, easy-to-use RDBMS being used for many small and big businesses. MySQL is developed, marketed and supported by MySQL AB, which is a Swedish company. MySQL is becoming so popular because of many good reasons — > MySQL is released under an open-source license. So you have nothing to pay to use it. > MySQL is a very powerful program in its own right.

It handles a large subset of the functionality of the most expensive and powerful database packages. > MySQL uses a standard form of the well-known SQL data language. > MySQL works on many operating systems and with many languages including PIP, PERL, C, C++, JAVA, etc. > MySQL works very quickly and works well even with large data sets. > MySQL is very friendly to HIP, the most appreciated language for web development. > MySQL supports large databases, up to 50 million rows or more in a table.

The default file size limit for a table is 4GB, but you can increase this (if your operating system can handle it) to a theoretical limit of 8 million terabytes (TB). > MySQL is customizable. The open-source GPL license allows programmers to modify the MySQL software to fit their own specific environments.

MySQL Features

- **Relational Database Management System (RDBMS):** MySQL is a relational database management system.
- **Easy to use:** MySQL is easy to use. You have to get only the basic knowledge of SQL. You can build and interact with MySQL with only a few simple SQL statements.
- **It is secure:** MySQL consist of a solid data security layer that protects sensitive data from intruders. Passwords are encrypted in MySQL.
- **Client/ Server Architecture:** MySQL follows a client /server architecture. There is a database server (MySQL) and arbitrarily many clients (application programs), which communicate with the server; that is, they query data, save changes, etc.
- **Free to download:** MySQL is free to use and you can download it from MySQL official website.
- **It is scalable:** MySQL can handle almost any amount of data, up to as much as 50 million rows or more. The default file size limit is about 4 GB. However, you can increase this number to a theoretical limit of 8 TB of data.
- **Compatibale on many operating systems:** MySQL is compatible to run on many operating systems, like Novell NetWare, Windows* Linux*, many varieties of UNIX* (such as Sun* Solaris*, AIX, and DEC* UNIX), OS/2, FreeBSD*, and others. MySQL

  also provides a facility that the clients can run on the same computer as the server or on another computer (communication via a local network or the Internet).
- **Allows roll-back:** MySQL allows transactions to be rolled back, commit and crash recovery.
- **High Performance:** MySQL is faster, more reliable and cheaper because of its unique storage engine architecture.
- **High Flexibility:** MySQL supports a large number of embedded applications which makes MySQL very flexible.
- **High Productivity:** MySQL uses Triggers, Stored procedures and views which allows the developer to give a higher productivity.

Conclusion: In this way , study of MYSQL and its features is done.

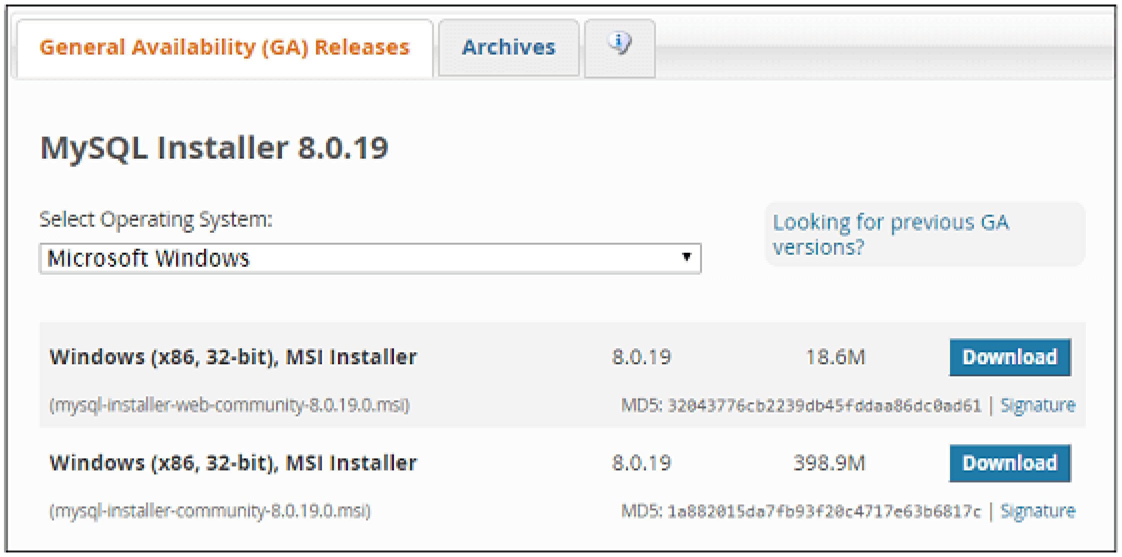
Assignment No :- 2

Aim :-Install and configure client and server of MySQL.(Show all commands and necessary steps for installation and configuration)

Download and Installation Steps :-

Step 1: Go to the official website of MySQL and download the community server edition software. Here, you will see the option to choose the Operating System, such as Windows.

Step 2: Next, there are two options available to download the setup. Choose the version number for the MySQL community server, which you want. If you have good internet connectivity, then choose the mysql-installer-web-community. Otherwise, choose the other one.


General Availability (GA) Releases
Archives
Looking for previous GA versions?
Download
Signature

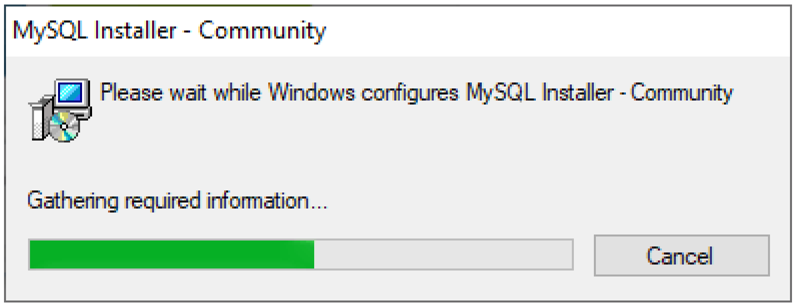
MySQL Installer 8.0.19

Select Operating System:
Microsoft Windows

Windows (x86, 32-bit), MSI Installer	8.0.19	18.6M	Download
(mysql-installer-web-community-8.0.19.0.msi)	MD5: 32043776cb2239db45fddaa86dc0ad61 | Signature		
Windows (x86, 32-bit), MSI Installer	8.0.19	398.9M	Download
(mysql-installer-community-8.0.19.0.msi)	MD5: 1a882015da7fb93f20c4717e63b6817c | Signature		

Installing MySQL on Windows

Step 1: After downloading the setup, unzip it anywhere and double click the MSI **installer .exe file.** It will give the following screen:

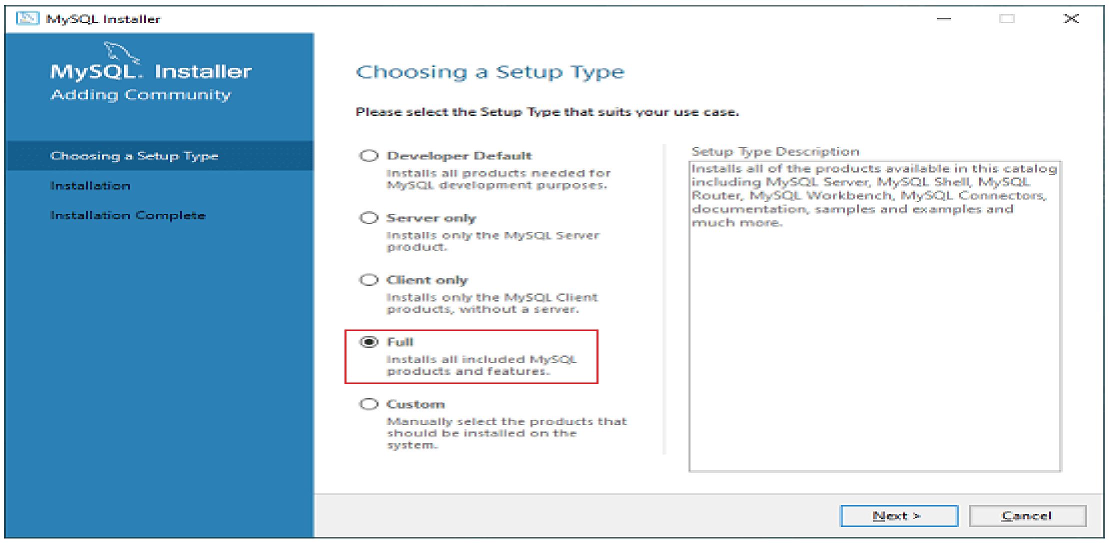


MySQL Installer - Community

Please wait while Windows configures MySQL Installer - Community

Gathering required information...

Step 2: In the next wizard, choose the **Setup Type**. There are several types available, and you need to choose the appropriate option to install MySQL product and features. Here, we are going to select the **Full** option and click on the Next button.



Choosing a Setup Type

Please select the Setup Type that suits your use case.

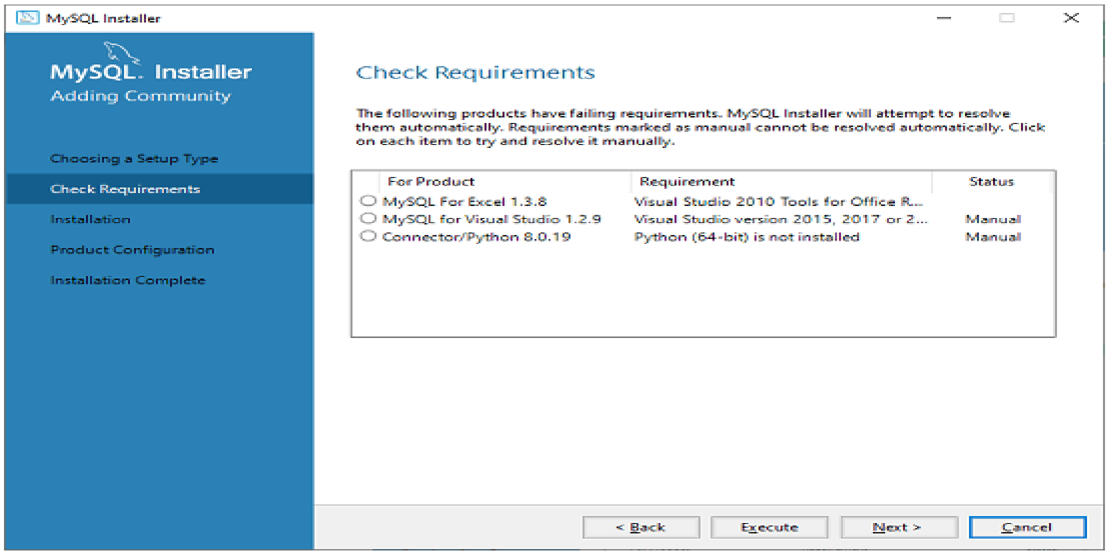
- Developer Default
  Installs all products needed for MySQL development purposes.
- Server only
  Installs only the MySQL Server product.
- Client only
  Installs only the MySQL Client products, without a server.
- [✓ Full]
  Installs all included MySQL products and features.
- Custom
  Manually select the products that should be installed on the system.

Setup Type Description

Installs all of the products available in this catalog including MySQL Server, MySQL Shell, MySQL Router, MySQL Workbench, MySQL Connectors, documentation, samples and examples and much more.

This option will install the following things: MySQL Server, MySQL Shell, MySQL Router, MySQL Workbench, MySQL Connectors, documentation, samples and examples, and many more.

Step 3: Once we click on the Next button, it may give information about some features that may fail to install on your system due to a lack of requirements. We can resolve them by clicking on the **Execute** button that will install all requirements automatically or can skip them. Now, click on the Next button.

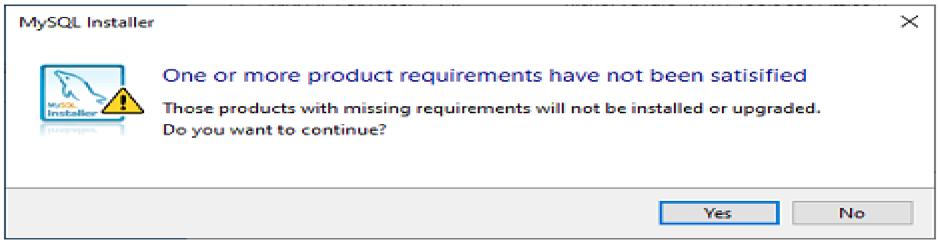


Check Requirements

The following products have failing requirements. MySQL Installer will attempt to resolve them automatically. Requirements marked as manual cannot be resolved automatically. Click on each item to try and resolve it manually.

For Product	Requirement	Status
MySQL For Excel 1.3.8	Visual Studio 2010 Tools for Office R...	
MySQL for Visual Studio 1.2.9	Visual Studio version 2015, 2017 or 2...	Manual
Connector/Python 8.0.19	Python (64-bit) is not installed	Manual

Step 4: In the next wizard, we will see a dialog box that asks for our confirmation of a few products not getting installed. Here, we have to click on the **Yes** button.

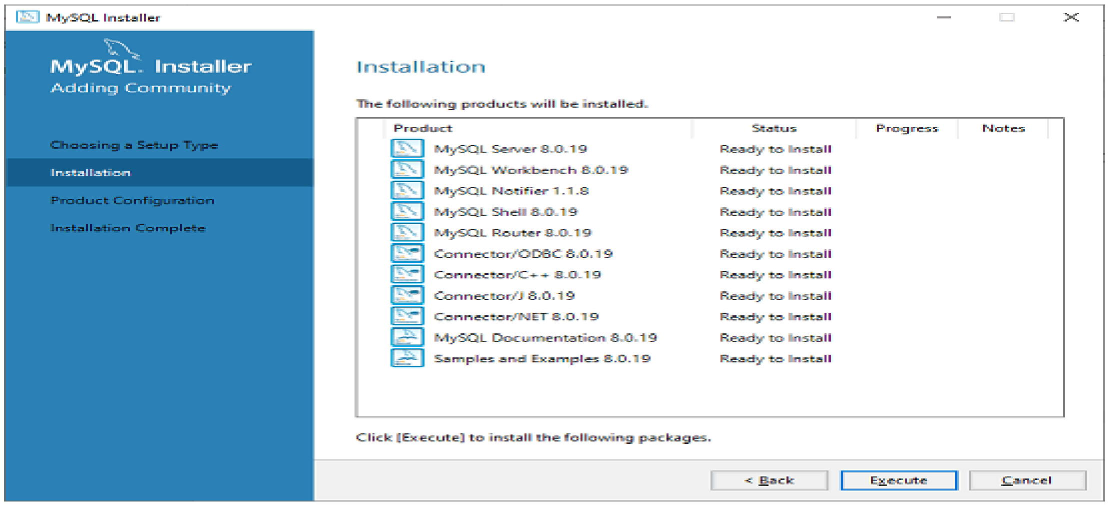


MySQL Installer

One or more product requirements have not been satisified

Those products with missing requirements will not be installed or upgraded.
Do you want to continue?

After clicking on the Yes button, we will see the list of the products which are going to be installed. So, if we need all products, click on the Execute button.



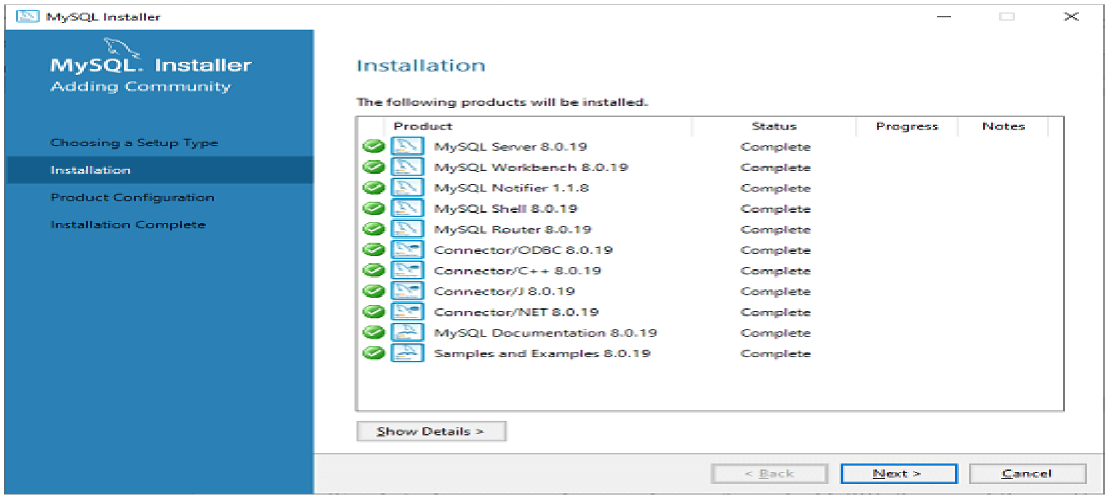
Installation

The following products will be installed.

Product	Status	Progress	Notes
MySQL Server 8.0.19	Ready to Install		
MySQL Workbench 8.0.19	Ready to Install		
MySQL Notifier 1.1.8	Ready to Install		
MySQL Shell 8.0.19	Ready to Install		
MySQL Router 8.0.19	Ready to Install		
Connector/ODBC 8.0.19	Ready to Install		
Connector/C++ 8.0.19	Ready to Install		
Connector/J 8.0.19	Ready to Install		
Connector/NET 8.0.19	Ready to Install		
MySQL Documentation 8.0.19	Ready to Install		
Samples and Examples 8.0.19	Ready to Install		

Click [Execute] to install the following packages.

Step 5: Once we click on the Execute button, it will download and install all the products. After completing the installation, click on the Next button.

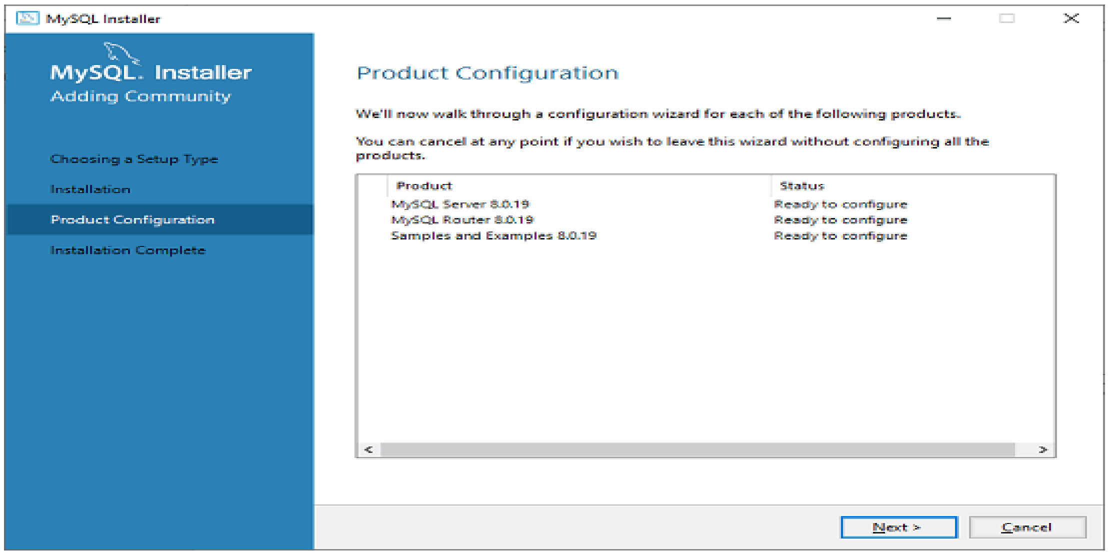


Installation

The following products will be installed.

Product	Status	Progress	Notes
✓ MySQL Server 8.0.19	Complete		
✓ MySQL Workbench 8.0.19	Complete		
✓ MySQL Notifier 1.1.8	Complete		
✓ MySQL Shell 8.0.19	Complete		
✓ MySQL Router 8.0.19	Complete		
✓ Connector/ODBC 8.0.19	Complete		
✓ Connector/C++ 8.0.19	Complete		
✓ Connector/J 8.0.19	Complete		
✓ Connector/NET 8.0.19	Complete		
✓ MySQL Documentation 8.0.19	Complete		
✓ Samples and Examples 8.0.19	Complete		

Step 6: In the next wizard, we need to configure the MySQL Server and Router. Here, I am not going to configure the Router because there is no need to use it with MySQL. We are going to show you how to configure the server only. Now, click on the Next button.



MySQL Installer

MySQL. Installer
Adding Community

- Choosing a Setup Type
- Installation
- Product Configuration
- Installation Complete

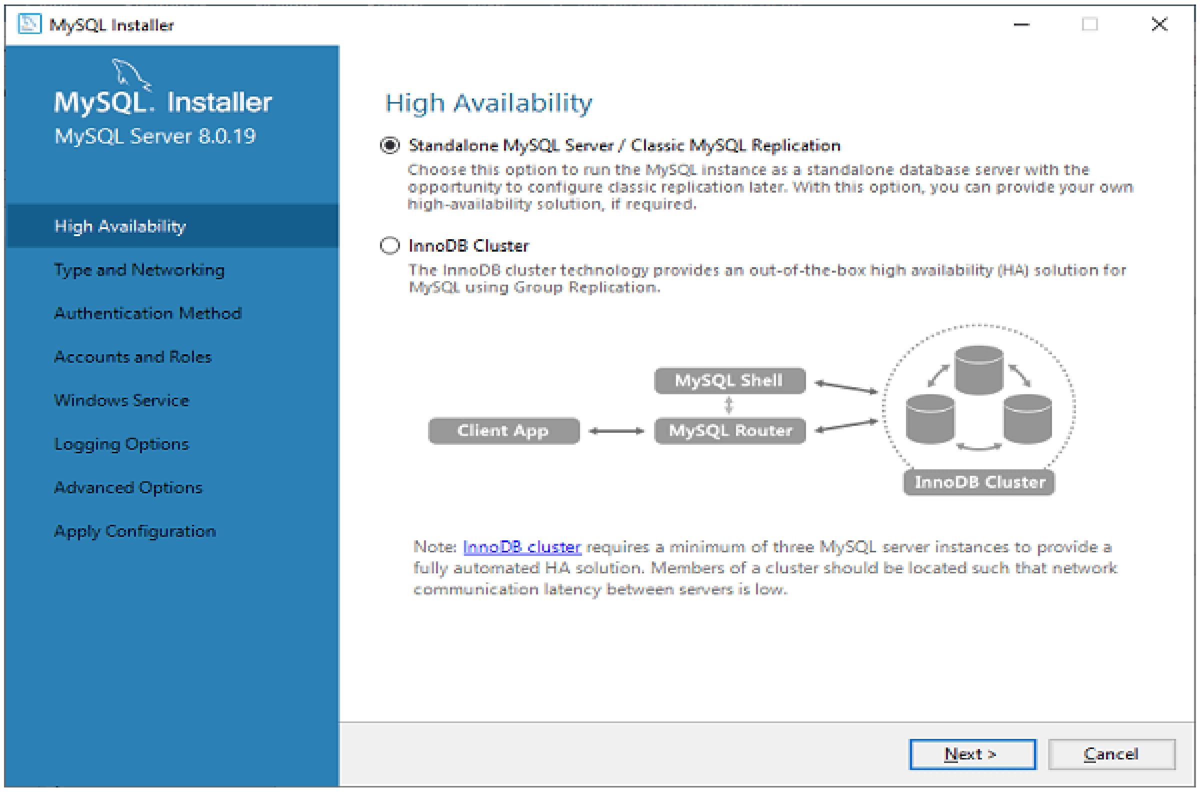
Product Configuration

We'll now walk through a configuration wizard for each of the following products.

You can cancel at any point if you wish to leave this wizard without configuring all the products.

Product	Status
MySQL Server 8.0.19	Ready to configure
MySQL Router 8.0.19	Ready to configure
Samples and Examples 8.0.19	Ready to configure

Step 7: As soon as you will click on the Next button, you can see the screen below. Here, we have to configure the MySQL Server. Now, choose the Standalone MySQL Server/Classic MySQL Replication option and click on Next. Here, you can also choose the InnoDB Cluster based on your needs.



MySQL Installer

MySQL. Installer
MySQL Server 8.0.19

- High Availability
- Type and Networking
- Authentication Method
- Accounts and Roles
- Windows Service
- Logging Options
- Advanced Options
- Apply Configuration

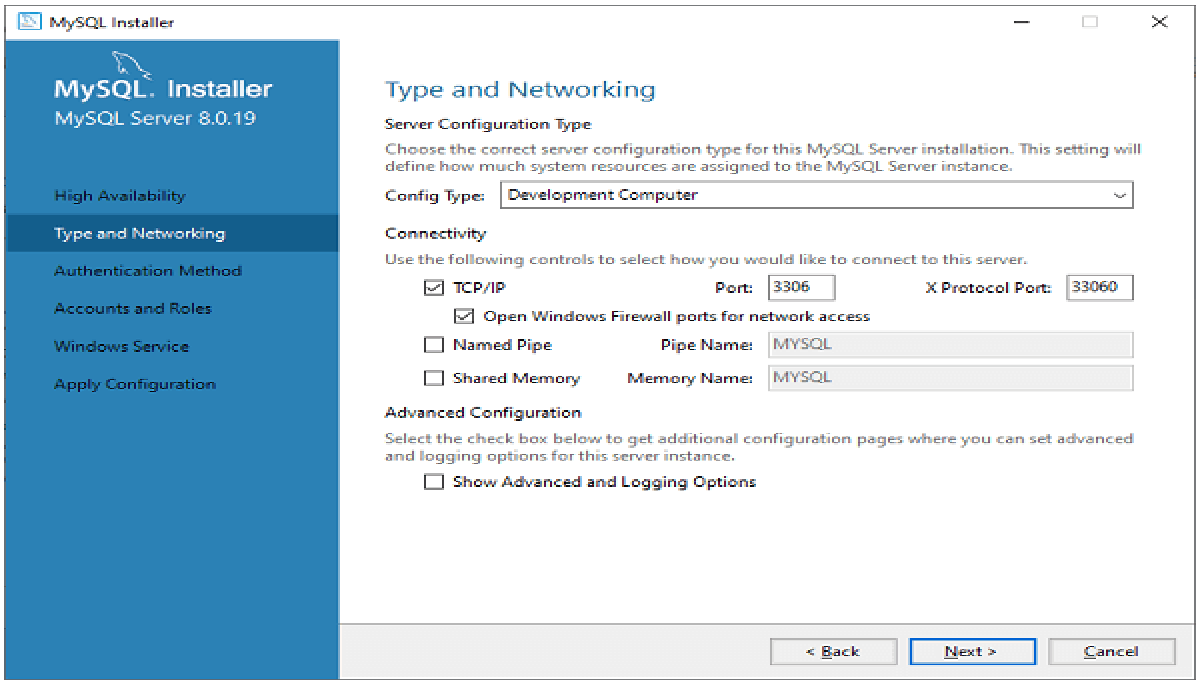
High Availability

(●) Standalone MySQL Server / Classic MySQL Replication
Choose this option to run the MySQL instance as a standalone database server with the opportunity to configure classic replication later. With this option, you can provide your own high-availability solution, if required.

( ) InnoDB Cluster
The InnoDB cluster technology provides an out-of-the-box high availability (HA) solution for MySQL using Group Replication.

Note: InnoDB cluster requires a minimum of three MySQL server instances to provide a fully automated HA solution. Members of a cluster should be located such that network communication latency between servers is low.

Step 8: In the next screen, the system will ask you to choose the Config Type and other connectivity options. Here, we are going to select the **Config Type** as 'Development Machine' and Connectivity as **TCP/IP,** and **Port Number** is 3306, then click on Next.



Type and Networking

Server Configuration Type

Choose the correct server configuration type for this MySQL Server installation. This setting will define how much system resources are assigned to the MySQL Server instance.

Config Type: Development Computer

Connectivity

Use the following controls to select how you would like to connect to this server.

[✓] TCP/IP Port: 3306 X Protocol Port: 33060

[✓] Open Windows Firewall ports for network access

[ ] Named Pipe Pipe Name: MYSQL

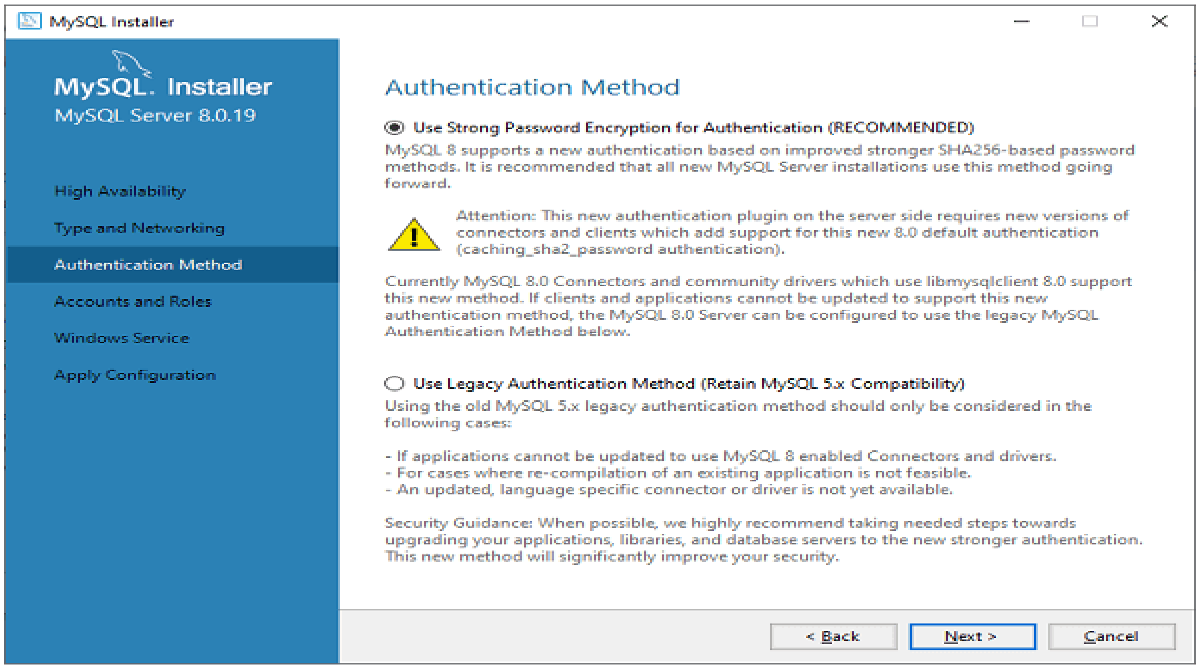
[ ] Shared Memory Memory Name: MYSQL

Advanced Configuration

Select the check box below to get additional configuration pages where you can set advanced and logging options for this server instance.

[ ] Show Advanced and Logging Options

Step 9: Now, select the Authentication Method and click on Next. Here, I am going to select the first option.



Authentication Method

[✓ Use Strong Password Encryption for Authentication (RECOMMENDED)]

MySQL 8 supports a new authentication based on improved stronger SHA256-based password methods. It is recommended that all new MySQL Server installations use this method going forward.

Attention: This new authentication plugin on the server side requires new versions of connectors and clients which add support for this new 8.0 default authentication (caching_sha2_password authentication).

Currently MySQL 8.0 Connectors and community drivers which use libmysqlclient 8.0 support this new method. If clients and applications cannot be updated to support this new authentication method, the MySQL 8.0 Server can be configured to use the legacy MySQL Authentication Method below.

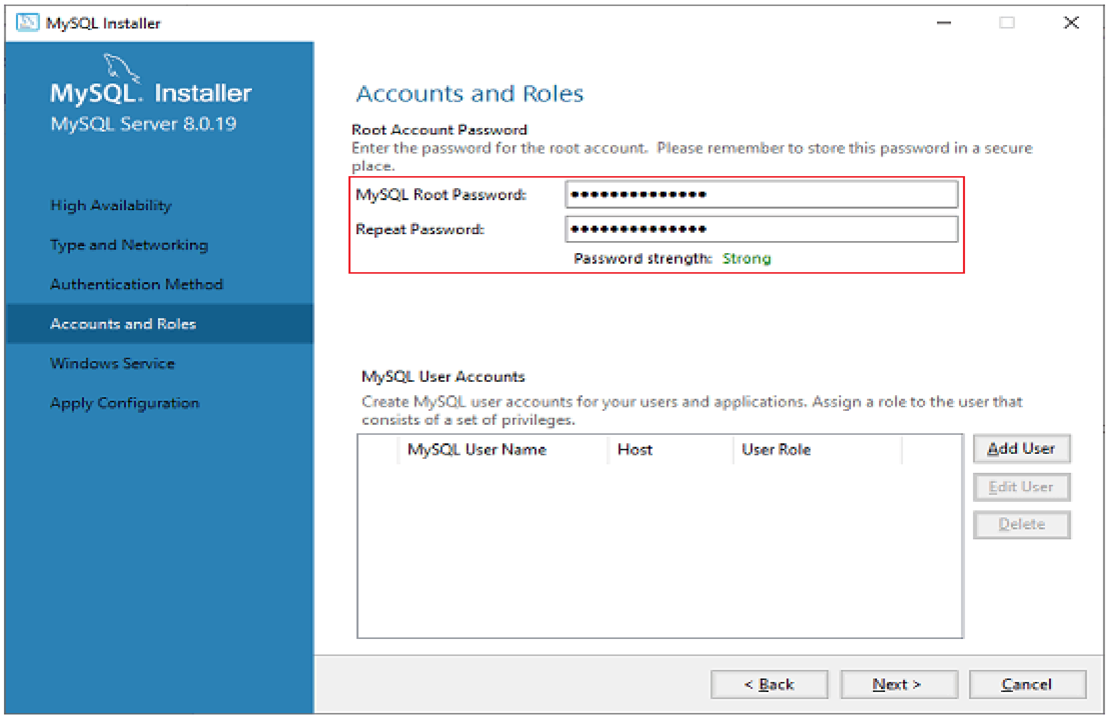
Use Legacy Authentication Method (Retain MySQL 5.x Compatibility)

Using the old MySQL 5.x legacy authentication method should only be considered in the following cases:

- If applications cannot be updated to use MySQL 8 enabled Connectors and drivers.
- For cases where re-compilation of an existing application is not feasible.
- An updated, language specific connector or driver is not yet available.

Security Guidance: When possible, we highly recommend taking needed steps towards upgrading your applications, libraries, and database servers to the new stronger authentication. This new method will significantly improve your security.

Step 10: The next screen will ask you to mention the MySQL Root Password. After filling the password details, click on the Next button.



Accounts and Roles

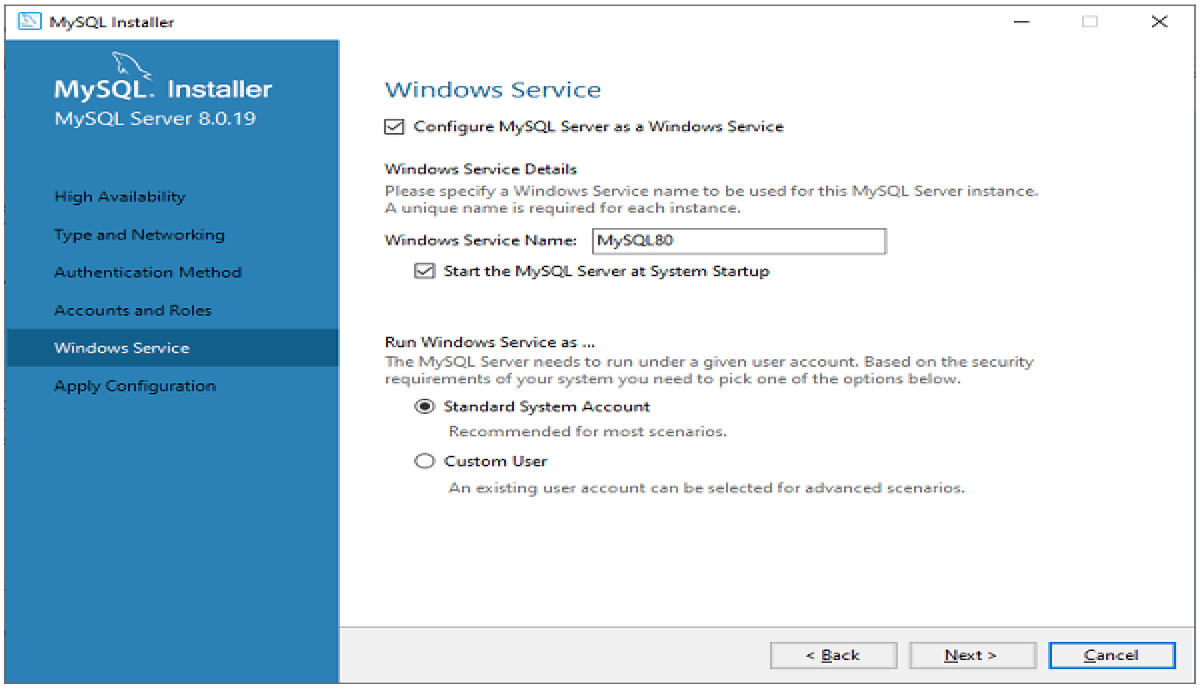
Root Account Password
Enter the password for the root account. Please remember to store this password in a secure place.

MySQL Root Password: •••••••••••••••
Repeat Password: •••••••••••••••
Password strength: Strong

MySQL User Accounts
Create MySQL user accounts for your users and applications. Assign a role to the user that consists of a set of privileges.

MySQL User Name	Host	User Role

Step 11: The next screen will ask you to configure the Windows Service to start the server. Keep the default setup and click on the Next button.



Windows Service

☑ Configure MySQL Server as a Windows Service

Windows Service Details
Please specify a Windows Service name to be used for this MySQL Server instance.
A unique name is required for each instance.

Windows Service Name: MySQL80

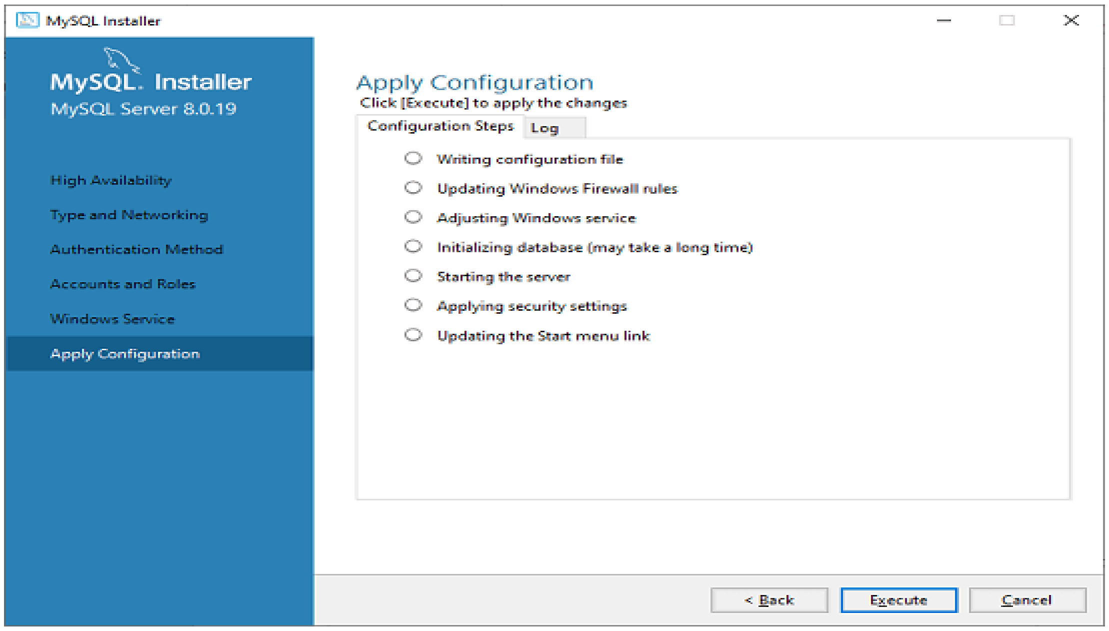
☑ Start the MySQL Server at System Startup

Run Windows Service as ...
The MySQL Server needs to run under a given user account. Based on the security requirements of your system you need to pick one of the options below.

● Standard System Account
Recommended for most scenarios.

○ Custom User
An existing user account can be selected for advanced scenarios.

Step 12: In the next wizard, the system will ask you to apply the Server Configuration. If you agree with this configuration, click on the Execute button.


MySQL Installer

MySQL. Installer
MySQL Server 8.0.19

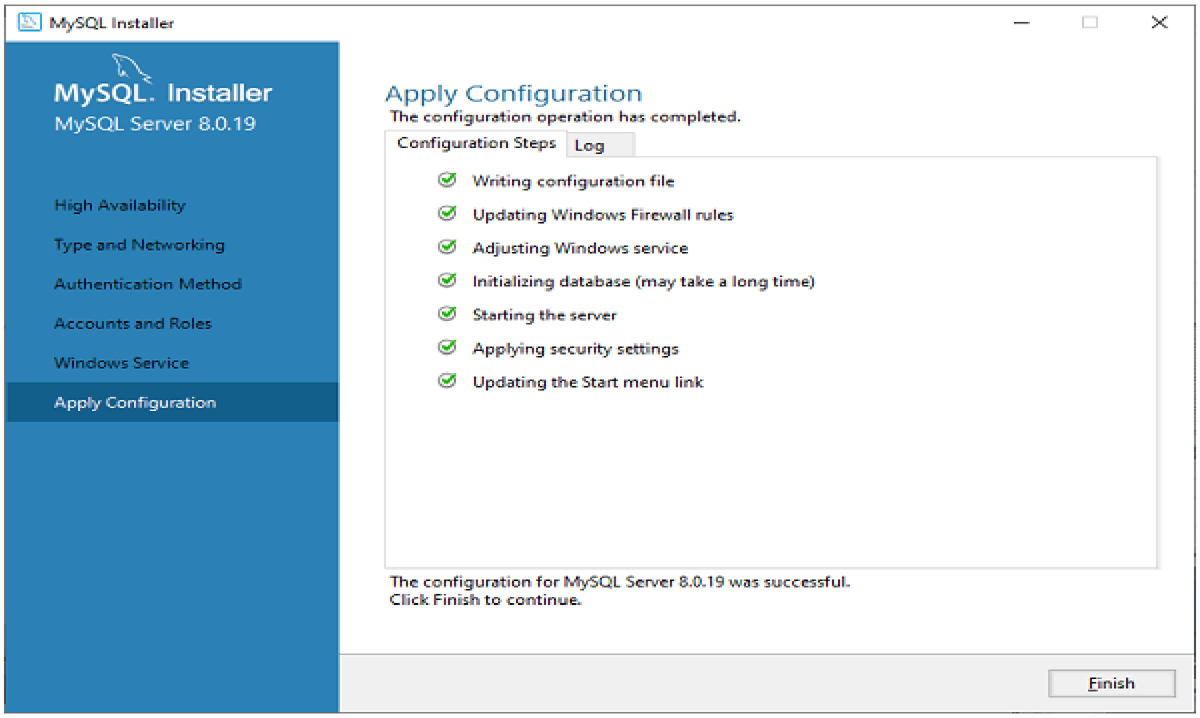
- High Availability
- Type and Networking
- Authentication Method
- Accounts and Roles
- Windows Service
- Apply Configuration

Apply Configuration
Click [Execute] to apply the changes

Configuration Steps | Log

- ○ Writing configuration file
- ○ Updating Windows Firewall rules
- ○ Adjusting Windows service
- ○ Initializing database (may take a long time)
- ○ Starting the server
- ○ Applying security settings
- ○ Updating the Start menu link

Step 13: Once the configuration has completed, you will get the screen below. Now, click on the **Finish** button to continue.


MySQL Installer

MySQL. Installer
MySQL Server 8.0.19

- High Availability
- Type and Networking
- Authentication Method
- Accounts and Roles
- Windows Service
- Apply Configuration

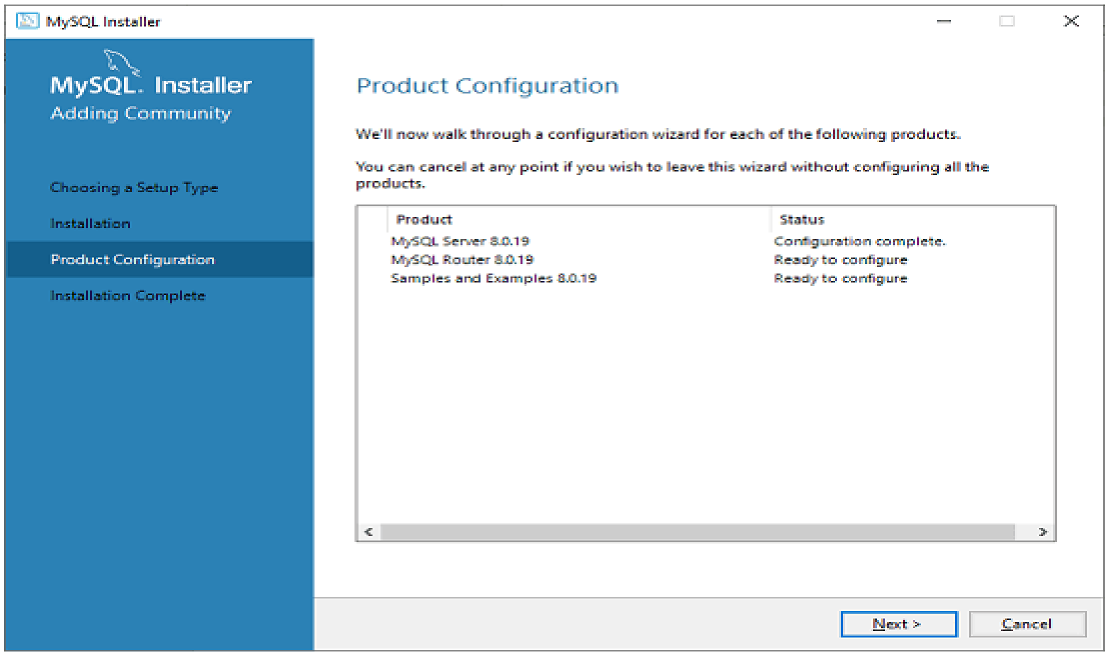
Apply Configuration
The configuration operation has completed.

Configuration Steps | Log

- ✓ Writing configuration file
- ✓ Updating Windows Firewall rules
- ✓ Adjusting Windows service
- ✓ Initializing database (may take a long time)
- ✓ Starting the server
- ✓ Applying security settings
- ✓ Updating the Start menu link

The configuration for MySQL Server 8.0.19 was successful.
Click Finish to continue.

Step 14: In the next screen, you can see that the Product Configuration is completed. Keep the default setting and click on the Next-> Finish button complete the MySQL package installation.to



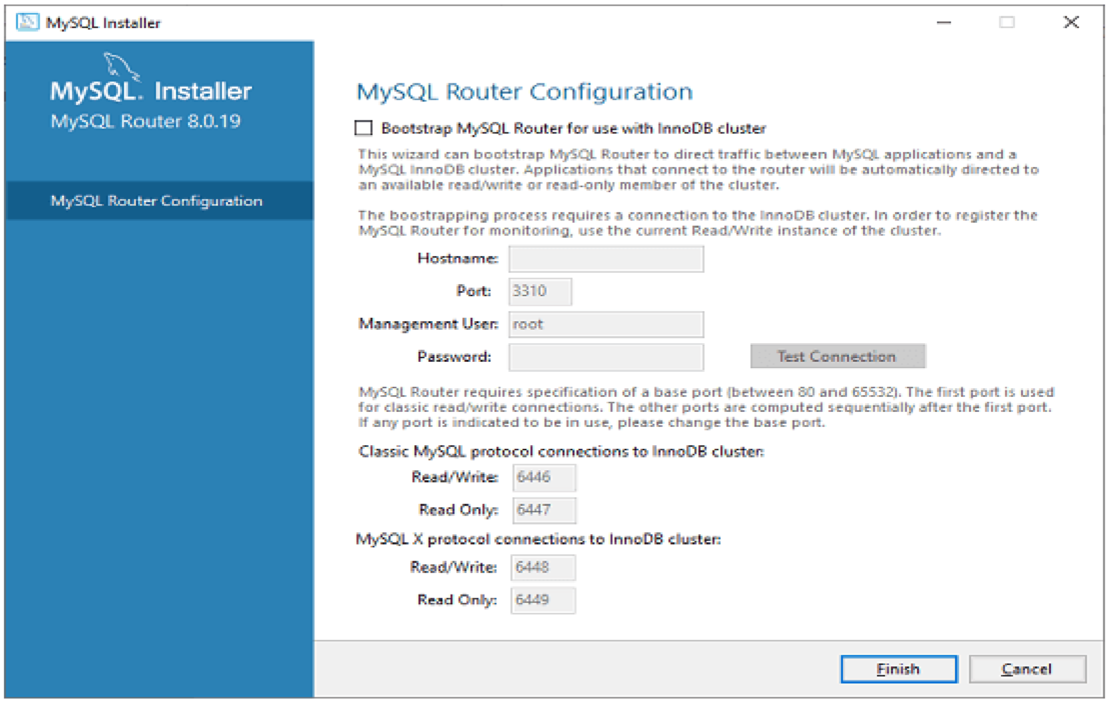
Product Configuration

We'll now walk through a configuration wizard for each of the following products.

You can cancel at any point if you wish to leave this wizard without configuring all the products.

Product	Status
MySQL Server 8.0.19	Configuration complete.
MySQL Router 8.0.19	Ready to configure
Samples and Examples 8.0.19	Ready to configure

Step 15: In the next wizard, we can choose to configure the Router. So click on Next->Finish and then click the Next button.



MySQL Router Configuration

☐ Bootstrap MySQL Router for use with InnoDB cluster

This wizard can bootstrap MySQL Router to direct traffic between MySQL applications and a MySQL InnoDB cluster. Applications that connect to the router will be automatically directed to an available read/write or read-only member of the cluster.

The boostrapping process requires a connection to the InnoDB cluster. In order to register the MySQL Router for monitoring, use the current Read/Write instance of the cluster.

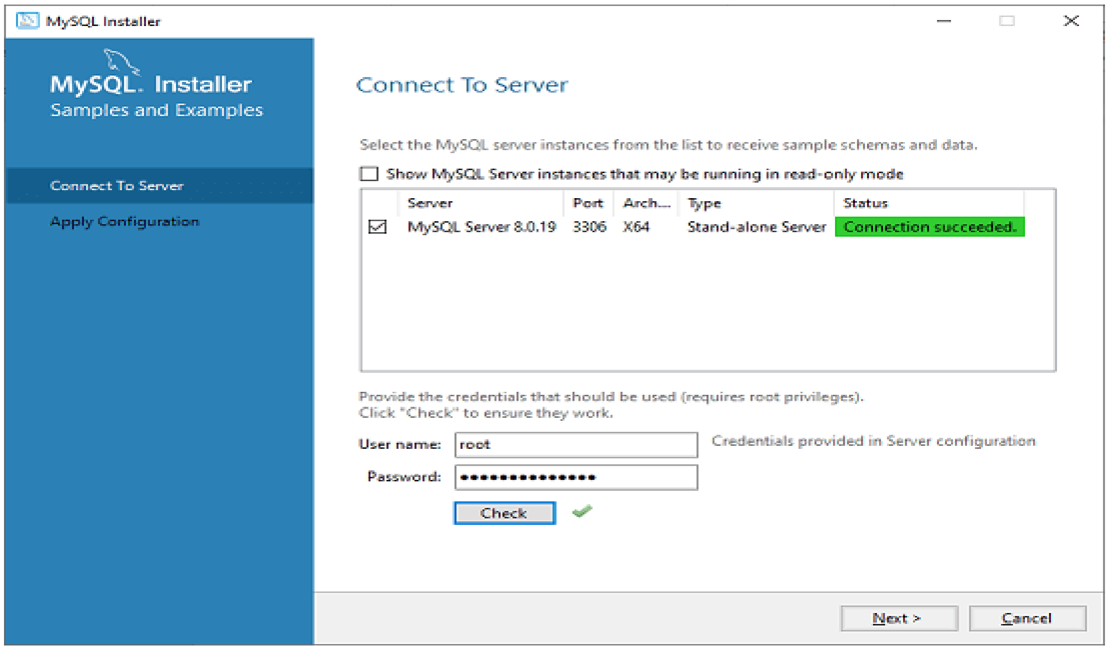
Hostname:
Port: 3310
Management User: root
Password:

MySQL Router requires specification of a base port (between 80 and 65532). The first port is used for classic read/write connections. The other ports are computed sequentially after the first port. If any port is indicated to be in use, please change the base port.

Classic MySQL protocol connections to InnoDB cluster:
Read/Write: 6446
Read Only: 6447

MySQL X protocol connections to InnoDB cluster:
Read/Write: 6448
Read Only: 6449

Step 16: In the next wizard, we will see the Connect to Server option. Here, we have to mention the root password, which we had set in the previous steps.



Connect To Server

Select the MySQL server instances from the list to receive sample schemas and data.

☐ Show MySQL Server instances that may be running in read-only mode

	Server	Port	Arch...	Type	Status
☑	MySQL Server 8.0.19	3306	X64	Stand-alone Server	Connection succeeded.

Provide the credentials that should be used (requires root privileges).
Click "Check" to ensure they work.

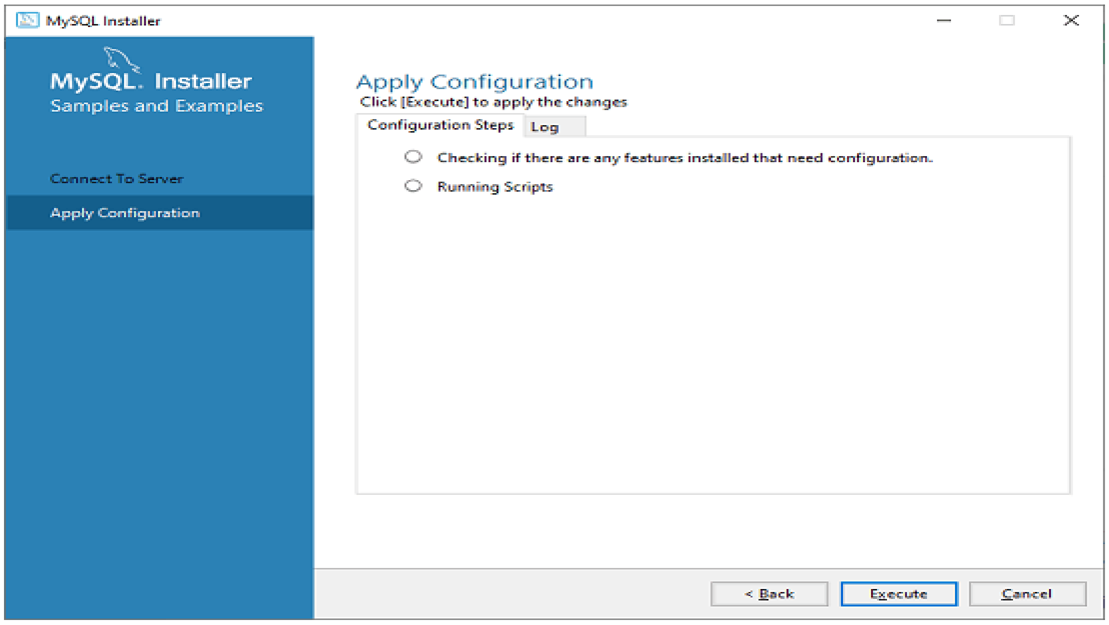
User name: root — Credentials provided in Server configuration

Password: •••••••••••••••

Check ✓

In this screen, it is also required to check about the connection is successful or not by clicking on the Check button. If the connection is successful, click on the Execute button. Now, the configuration is complete, click on Next.

Step 17: In the next wizard, select the applied configurations and click on the Execute button.



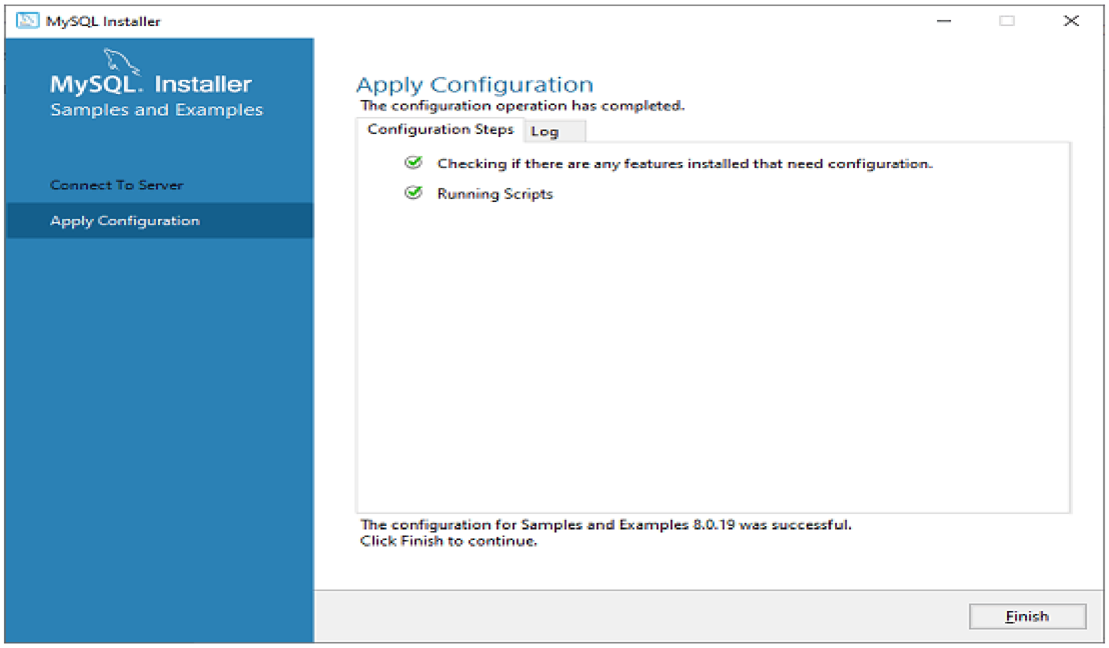
Apply Configuration

Click [Execute] to apply the changes

○ Checking if there are any features installed that need configuration.

○ Running Scripts

Step 18: After completing the above step, we will get the following screen. Here, click on the Finish button.



Apply Configuration

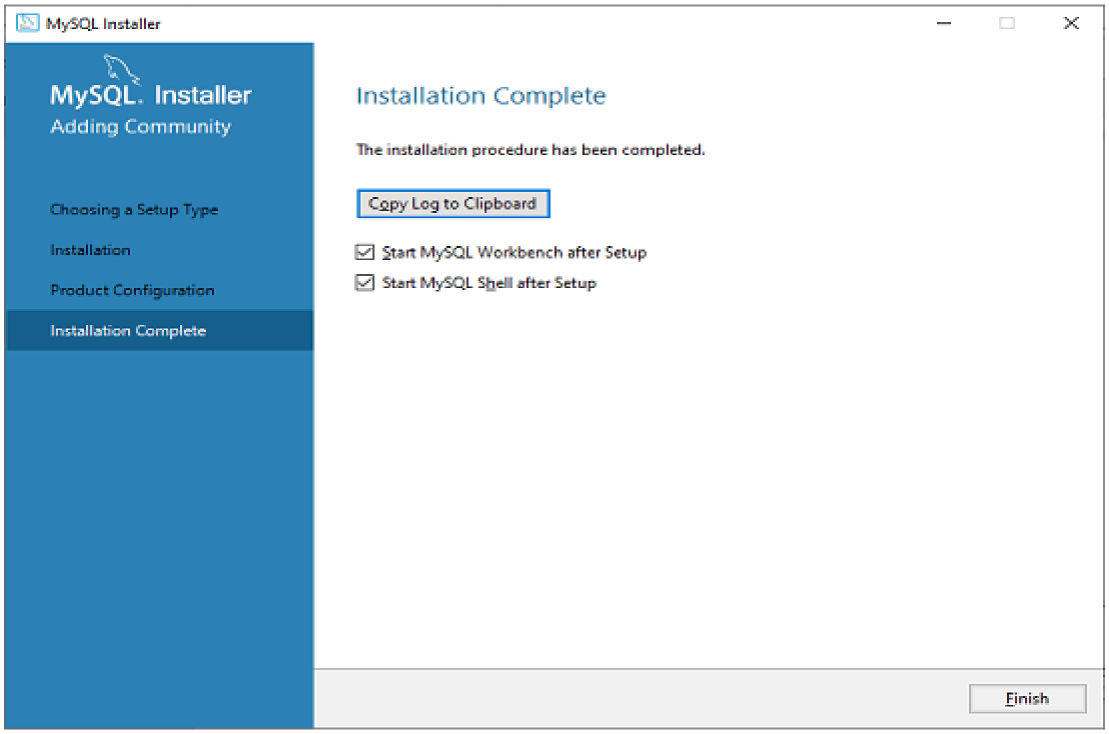
The configuration operation has completed.

✓ Checking if there are any features installed that need configuration.

✓ Running Scripts

The configuration for Samples and Examples 8.0.19 was successful.
Click Finish to continue.

Step 19: Now, the MySQL installation is complete. Click on the Finish button.



Installation Complete

The installation procedure has been completed.

[✓] Start MySQL Workbench after Setup

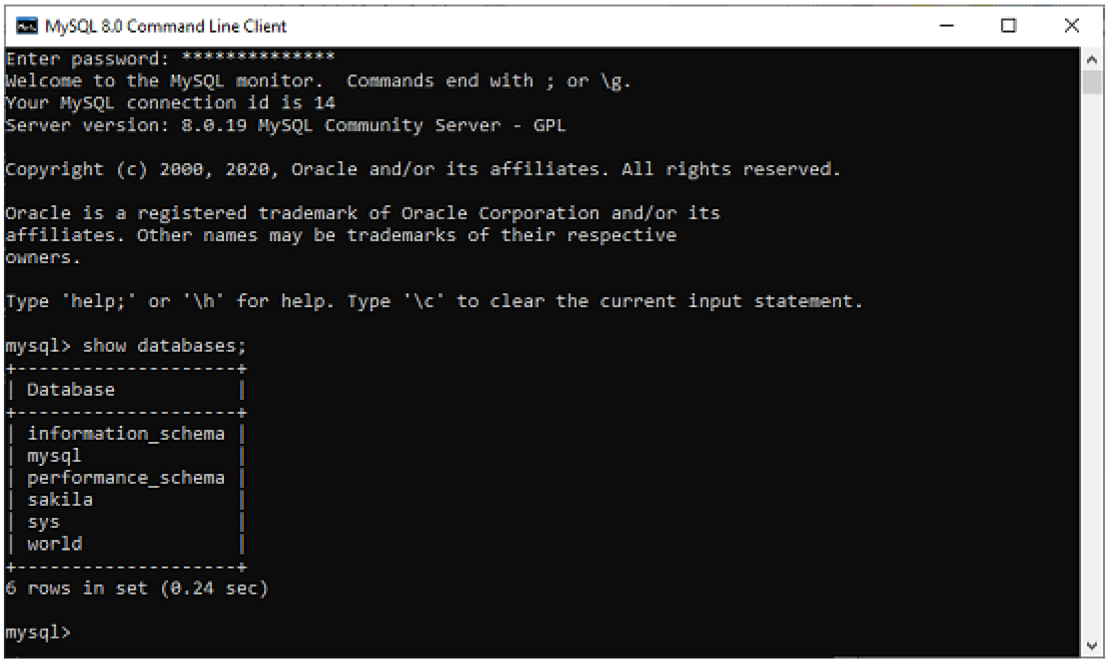
[✓] Start MySQL Shell after Setup

Verify MySQL installation

Once MySQL has been successfully installed, the base tables have been initialized, and the server has been started, you can verify its working via some simple tests.

Open your MySQL **Command Line Client**; it should have appeared with a **mysql> prompt**. If you have set any password, write your password here. Now, you are connected to the MySQL server, and you can execute all the SQL command at mysql> prompt as follows:

For example: Check the already created databases with show databases command:



```
Enter password: ***************
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 14
Server version: 8.0.19 MySQL Community Server - GPL

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owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| mysql              |
| performance_schema |
| sakila             |
| sys                |
| world              |
+--------------------+
6 rows in set (0.24 sec)

mysql>
```

Conclusion:-

We have studied the Installation and configuration of client and server for MySQL

Assignment No :- 3

Aim :-Study of SQLite: What is SQLite? Uses of Sqlite. Building and installing SQLite.

What is SQLite?

SQLite is an in-process library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine. It is a database, which is zero-configured, which means like other databases you do not need to configure it in your system.

SQLite engine is not a standalone process like other databases, you can link it statically or dynamically as per your requirement with your application. SQLite accesses its storage files directly.

SQLite Commands

The standard SQLite commands to interact with relational databases are similar to SQL. They are CREATE, SELECT, INSERT, UPDATE, DELETE and DROP. These commands can be classified into groups based on their operational nature −

DDL - Data Definition Language

Sr.No.	Command & Description
1	**CREATE** Creates a new table, a view of a table, or other object in database.
2	**ALTER** Modifies an existing database object, such as a table.
3	**DROP** Deletes an entire table, a view of a table or other object in the database.

DML - Data Manipulation Language

Command	Description
INSERT	Creates a record

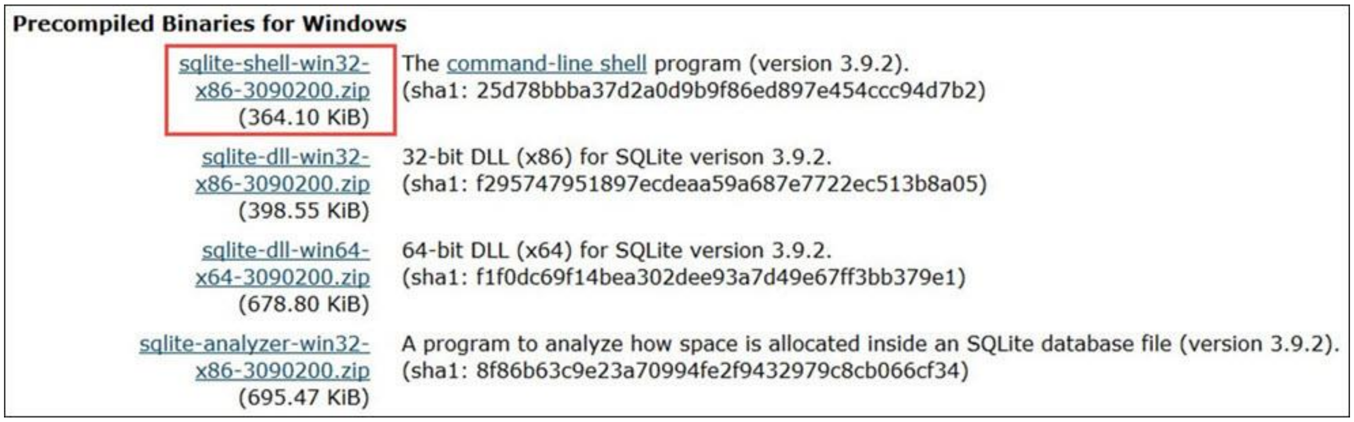
UPDATE	Modifies records
DELETE	Deletes records

DQL - Data Query Language

Sr.No.	Command & Description
1	**SELECT** Retrieves certain records from one or more tables

Download and Installation of SQLite

From the SQLite official website in the download section. The following screenshot allows you to download different SQLite's installation packages for Windows:



Precompiled Binaries for Windows

sqlite-shell-win32-x86-3090200.zip (364.10 KiB)	The command-line shell program (version 3.9.2). (sha1: 25d78bbba37d2a0d9b9f86ed897e454ccc94d7b2)
sqlite-dll-win32-x86-3090200.zip (398.55 KiB)	32-bit DLL (x86) for SQLite verison 3.9.2. (sha1: f295747951897ecdeaa59a687e7722ec513b8a05)
sqlite-dll-win64-x64-3090200.zip (678.80 KiB)	64-bit DLL (x64) for SQLite version 3.9.2. (sha1: f1f0dc69f14bea302dee93a7d49e67ff3bb379e1)
sqlite-analyzer-win32-x86-3090200.zip (695.47 KiB)	A program to analyze how space is allocated inside an SQLite database file (version 3.9.2). (sha1: 8f86b63c9e23a70994fe2f9432979c8cb066cf34)

The command line shell program:

The highlighted download package is called the **Command-Line Program (CLP)**. CLP is a command line application that let you access the SQLite database management system and all the features of the SQLite. Using CLP, you can create and manage the SQLite database. And it is the tool that we will use throughout the tutorial.

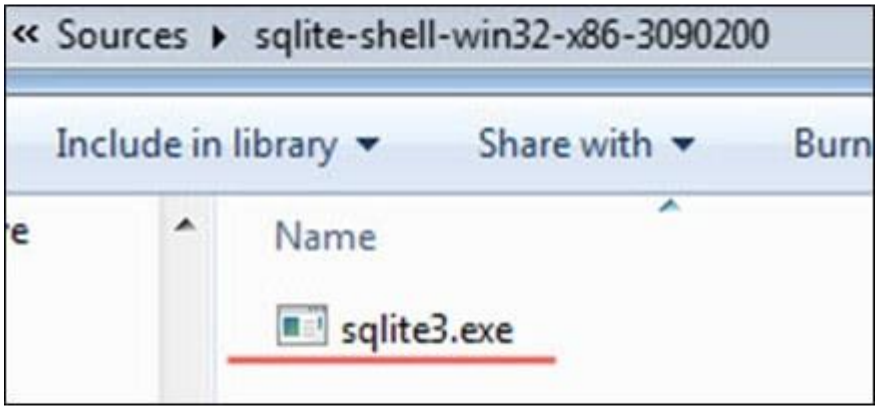
- 32-bit DLL(x86): The SQLite Database system core library for x86 platforms.
- 64-bit DLL (x64): The SQLite Database system core library for x64 platforms.

Installing the Command-Line Program (CLP) on your machine:

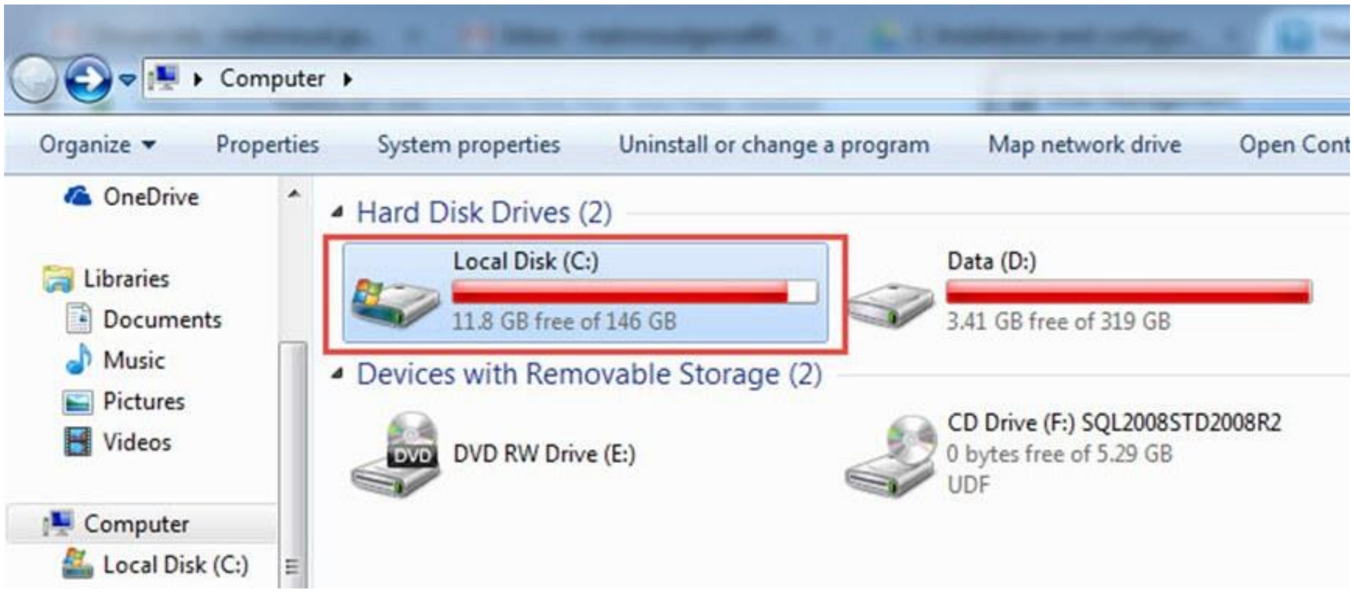
In the following steps, you will find the steps for how to install the Command-Line Program (CLP) on your machine:

Step 1) Download the highlighted download package from the previous image to your PC. It is a "**zip**" file.

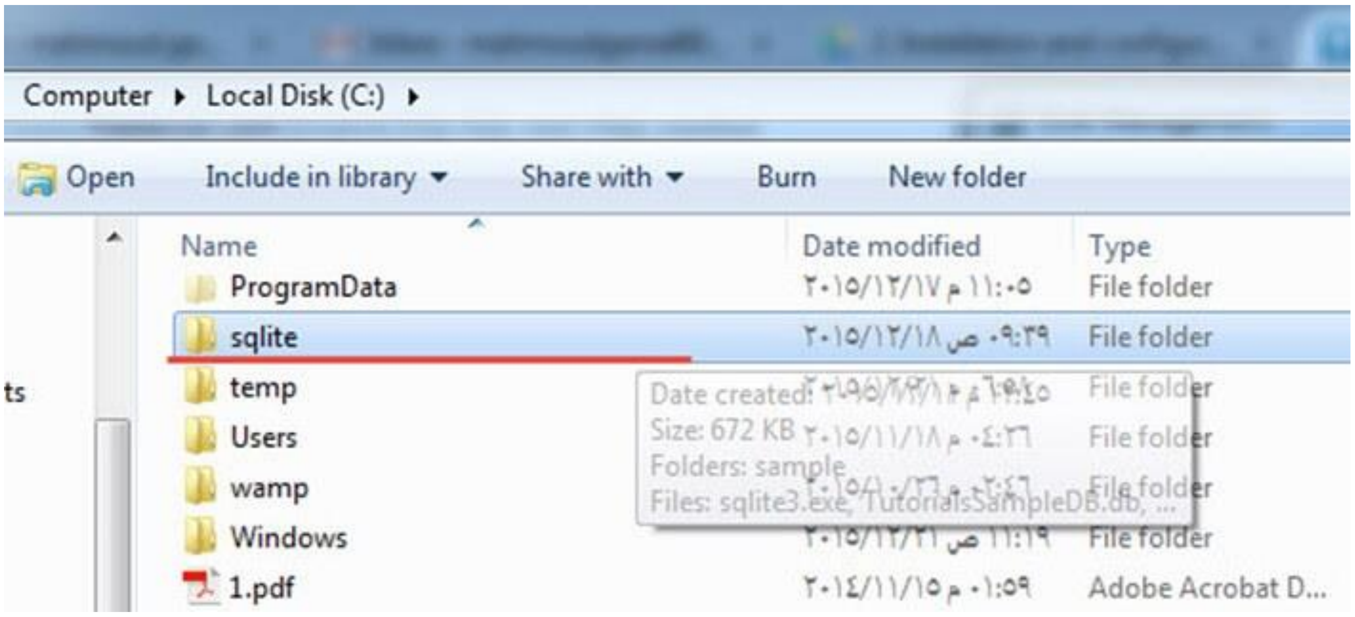
Step 2) Extract the zip file. You will find the "**sqlite3.exe**" in the extracted file as following:



Step 3) Open My Computer, and double-click the partition **"C"** to navigate to it:



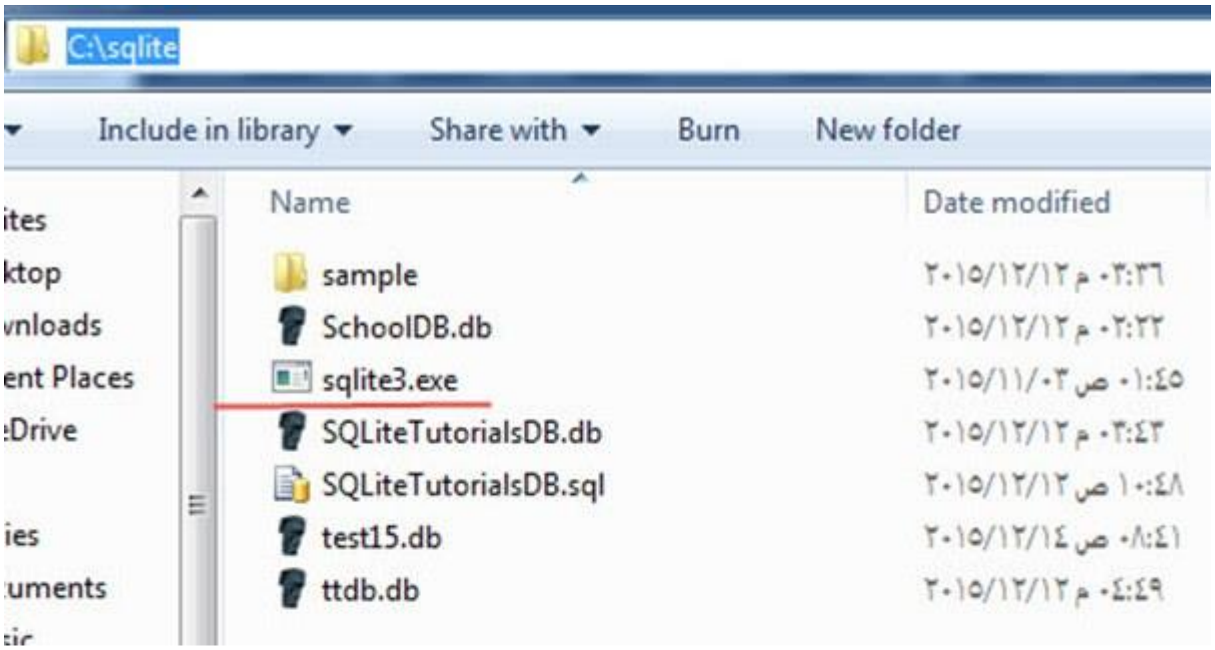
Step 4) Create a new directory "**sqlite**":



Name	Date modified	Type
ProgramData	٢٠١٥/١٢/١٧ م ١١:٠٥	File folder
sqlite	٢٠١٥/١٢/١٨ ص ٠٩:٣٩	File folder
temp	[illegible]	File folder
Users	٢٠١٥/١١/١٨ م ٠٤:٣٦	File folder
wamp	[illegible]	File folder
Windows	٢٠١٥/١٢/٢١ ص ١١:١٩	File folder
1.pdf	٢٠١٤/١١/١٥ م ٠١:٥٩	Adobe Acrobat D...

Date created: [illegible]
Size: 672 KB
Folders: sample
Files: sqlite3.exe, TutorialsSampleDB.db, ...

Step 5) Copy the file "**sqlite3.exe**" into it. This is what we will use through the tutorials to run SQLite queries:



Name	Date modified
sample	٢٠١٥/١٢/١٢ م ٠٣:٣٦
SchoolDB.db	٢٠١٥/١٢/١٢ م ٠٢:٢٢
sqlite3.exe	٢٠١٥/١١/٠٣ ص ٠١:٤٥
SQLiteTutorialsDB.db	٢٠١٥/١٢/١٢ م ٠٣:٤٣
SQLiteTutorialsDB.sql	٢٠١٥/١٢/١٢ ص ١٠:٤٨
test15.db	٢٠١٥/١٢/١٤ ص ٠٨:٤١
ttdb.db	٢٠١٥/١٢/١٢ م ٠٤:٤٩

//Execute some commands in sqlite such as create, insert….

Put here the screenshot of that command prompt

Conclusion:-

We have studied the SQLite database and its uses.

Group B MySQL

Assignment No:1

Aim: Design any database with at least 3 entities and relationships between them. Draw suitable ER/EER diagram for the system.

Entity Relationship Diagram:

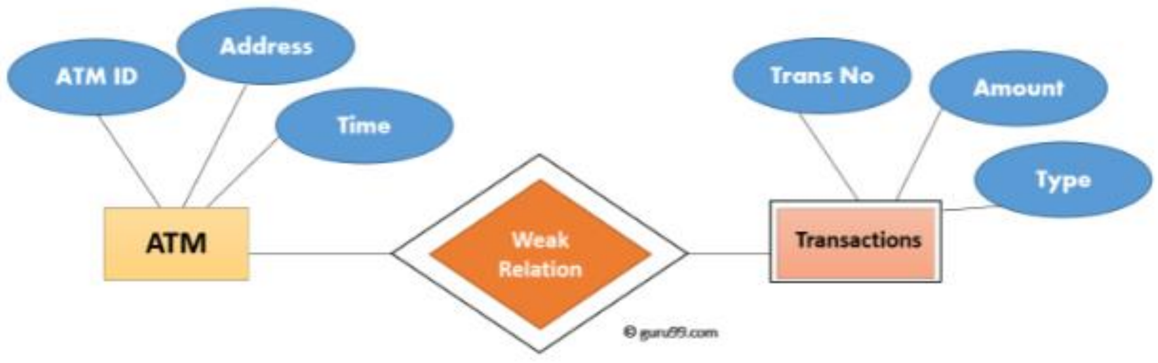
An **Entity–relationship model (ER model)** describes the structure of a database with the help of a diagram, which is known as **Entity Relationship Diagram (ER Diagram)**. An ER model is a design or blueprint of a database that can later be implemented as a database. The main components of E-R model are: entity set and relationship set.

What is an Entity Relationship Diagram (ER Diagram)?

An ER diagram shows the relationship among entity sets. An entity set is a group of similar entities and these entities can have attributes. In terms of DBMS, an entity is a table or attribute of a table in database, so by showing relationship among tables and their attributes, ER diagram shows the complete logical structure of a database. Lets have a look at a simple ER diagram to understand this concept.

A simple ER Diagram:

In the following diagram we have two entities ATM and Transactions and their relationship. The relationship between ATM and Transactions is weak relation. The attributes for ATM entities are ATM id, Address and Time. For transaction entities are Trans no, Amount and type.



ER Diagram

Geometric shapes and their meaning:

Rectangle: Represents Entity sets.
Ellipses: Attributes
Diamonds: Relationship Set
Lines: They link attributes to Entity Sets and Entity sets to Relationship Set
Double Ellipses: Multivalued Attributes
Dashed Ellipses: Derived Attributes
Double Rectangles: Weak Entity Sets
Double Lines: Total participation of an entity in a relationship set.

Components of a ER Diagram

An ER diagram has three main components:
1. Entity
2. Attribute
3. Relationship

Entity

An entity is an object or component of data. An entity is represented as rectangle in an ER diagram.

Weak Entity:

An entity that cannot be uniquely identified by its own attributes and relies on the relationship with other entity is called weak entity. The weak entity is represented by a double rectangle.

Attribute

An attribute describes the property of an entity. An attribute is represented as Oval in an ER diagram. There are four types of attributes:

1. Key attribute
2. Composite attribute
3. Multivalued attribute
4. Derived attribute

1. Key attribute:

A key attribute can uniquely identify an entity from an entity set. For example, student roll number can uniquely identify a student from a set of students

Key attribute is represented by oval same as other attributes however the **text of key attribute is underlined**.

2. Composite attribute:

An attribute that is a combination of other attributes is known as composite attribute. For example, In student entity, the student address is a composite attribute as an address is composed of other attributes such as pin code, state, country.

3. Multi valued attribute:

An attribute that can hold multiple values is known as multi valued attribute. It is represented with **double ovals** in an ER Diagram. For example – A person can have more than one phone numbers so the phone number attribute is multi valued.

4. Derived attribute:

A derived attribute is one whose value is dynamic and derived from another attribute. It is represented by **dashed oval** in an ER Diagram. For example – Person age is a derived attribute as it changes over time and can be derived from another

Relationship

A relationship is represented by diamond shape in ER diagram, it shows the relationship among entities. There are four types of relationships/cardinality ratio:
1. One to One
2. One to Many
3. Many to One
4. Many to Many

1. One to One Relationship

When a single instance of an entity is associated with a single instance of another entity then it is called one to one relationship. For example, a person has only one passport and a passport is given to one person.

2. One to Many Relationship

When a single instance of an entity is associated with more than one instances of another entity then it is called one to many relationship. For example – a customer can place many orders but a order cannot be placed by many customers.

3. Many to One Relationship

When more than one instances of an entity is associated with a single instance of another entity then it is called many to one relationship. For example – many students can study in a single college but a student cannot study in many colleges at the same time.

4. Many to Many Relationship

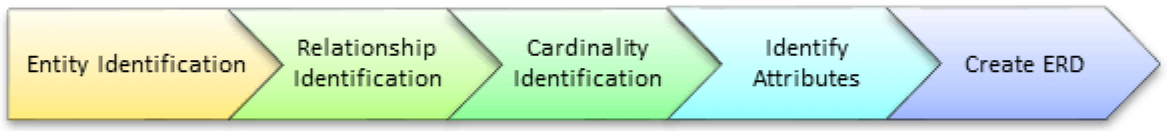
When more than one instances of an entity is associated with more than one instances of another entity then it is called many to many relationship. For example, a can be assigned to many projects and a project can be assigned to many students.

Participation Constraints

- **Total Participation** − Each entity is involved in the relationship. Total participation is represented by double lines.
- **Partial participation** − Not all entities are involved in the relationship. Partial participation is represented by single lines.

How to Create an Entity Relationship Diagram (ERD)

Following are the steps to create an ER Diagram:



Step 1) Entity Identification

Step 2) Relationship Identification

Step 3): Cardinality Identification:

Step 4) Identify Attributes

Conclusion: We have studied and created a database with at least 3 entities and relationships between them with creation of ER/EER diagram for the system

Assignment No: 2

Aim:- Design and implement a database (for assignment no 1) using DDL statements and apply normalization on them

RDBMS:

A relational database refers to a database that stores data in a structured format, using rows and columns. This makes it easy to locate and access specific values within the database. It is "relational" because the values within each table are related to each other. Tables may also be related to other tables. The relational structure makes it possible to run queries across multiple tables at once.

RDBMS Concepts:

Before we proceed to explain MySQL database system, let's revise few definitions related to database.

- Database: A database is a collection of tables, with related data.
- Table: A table is a matrix with data. A table in a database looks like a simple spread sheet.
- Column: One column (data element) contains data of one and the same kind, for example the Column post code.
- Row: A row (tuple, entry or record) is a group of related data, for example the data of one subscription.
- Redundancy: Storing data twice, redundantly to make the system faster.
- Primary Key: A primary key is unique. A key value cannot occur twice in one table. With a key, you can find at most one row.
- Foreign Key: A foreign key is the linking pin between two tables.
- Compound Key: A compound key(composite key) is a key that consists of multiple columns, Because one column is not sufficiently unique.

Structured Query Language(SQL):

- SQL is a database computer language designed for the retrieval and management of data in a relational database. SQL stands for Structured Query Language.
- SQL is Structured Query Language, which is a computer language for storing, manipulating and retrieving data stored in a relational database.
- SQL is the standard language for Relational Database System. All the Relational Database Management Systems (RDMS) like MySQL, MS Access, Oracle, Sybase, Informix, Postgres and SQL Server use SQL as their standard database language.
- SQL uses certain commands like Create, Drop, Insert, etc. to carry out the required tasks.

These SQL commands are mainly categorized into four categories as:

- DDL – Data Definition Language
- DQl – Data Query Language
- DML – Data Manipulation Language
- DCL – Data Control Language

Data Definition Language:

Data Definition Language helps you to define the database structure or schema. Let's learn about DDL commands with syntax.

Five types of DDL commands in SQL are:

- CREATE
- INSERT
- UPDATE
- ALTER
- DROP
- DELETE

CREATE:

Create statements is used to define the database structure schema:

Syntax:

```
CREATE TABLE TABLE_NAME (COLUMN_NAME DATATYPES [,....]);
```

Example:

```
CREATE TABLE EMPLOYEE (Name VARCHAR2(20), Email VARCHAR2(100), DOB DATE);
```

INSERT:

The INSERT statement is a SQL query. It is used to insert data into the row of a table.

Syntax:

```
INSERT INTO TABLE_NAME
(column1, column2, column3 ,.... columnN)
VALUES (value1, value2, value3 , .... valueN);
Or
INSERT INTO TABLE_NAME
VALUES (value1, value2, value3 , .... valueN);
```

Example:

```
INSERT INTO employee (Name, Salary) VALUES ("Meghana", 20000);
```

UPDATE:

This command is use d to update or modify the value of a column in the table.

Syntax:

```
UPDATE table_name SET [column_name1=value1,…,column_nameN=valueN]
[WHERE CONDITION]
```

Example:

```
UPDATE students
SET User_Name = 'Sonoo'
WHERE Student_Id = '3'
```

ALTER:

Syntax to add new column:

ALTER TABLE table_name ADD column_namedatatype;

Syntax to drop column:

ALTER TABLE table_name DROP COLUMN column_name;

Syntax to change datatype:

ALTER TABLE table_name MODIFY COLUMN column_namedatatype;

Example:

```
ALTER TABLE CUSTOMERS ADD Address Varchar(20);
ALTER TABLE CUSTOMERS DROP Address;
```

DROP

It is used to delete both the structure and record stored in the table.

Syntax:

```
DROP TABLE ;
```

Example:

```
DROP TABLE EMPLOYEE;
```

DELETE

This command is used to remove one or more rows from a table.

Syntax:

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

Example:

```
DELETE FROM EMPLOYEE
WHERE EMP_NAME = 'Kristen';
```

Normalization:

- Normalization is the process of organizing the data in the database.
- Normalization is used to minimize the redundancy from a relation or set of relations. It is also used to eliminate the undesirable characteristics like Insertion, Update and Deletion Anomalies.
- Normalization divides the larger table into the smaller table and links them using relationship.
- The normal form is used to reduce redundancy from the database table.

Types of Normalization:

First Normal Form(1NF):

A relation is in 1NF if it contains an atomic value.

An attribute (column) of a table cannot hold multiple values. It should hold only atomic values.

// Give your database example here for 1NF

Second Normal Form(2NF):

A table is said to be in 2NF if both the following conditions hold:

- Table is in 1NF (First normal form)
- No non-prime attribute is dependent on the proper subset of any candidate key of table.

An attribute that is not part of any candidate key is known as non-prime attribute.

// Give your database example here for 2NF

Third Normal Form(3NF):

A table design is said to be in 3NF if both the following conditions hold:

- Table must be in 2NF
- Transitive functional dependency of non-prime attribute on any super key should be removed.

An attribute that is not part of any candidate key is known as non-prime attribute.

// Give your database example here for 3NF

Boyce Codd normal form (BCNF)

- It is an advance version of 3NF that's why it is also referred as 3.5NF.
- BCNF is stricter than 3NF.
- A table complies with BCNF if it is in 3NF and for every functional dependency X->Y, X should be the super key of the table.

// Give your database example here for BCNF

// Output Screenshot of all DDL Queries in MySQL.

Conclusion: In this way we have implemented and created database using DDL Statements with the normalization technique to bring the database into normalized state.

Assignment No. 3

Aim: Create Table with primary key and foreign key constraints.

a. Alter table with add n modify b. Drop table

Primary key:

The PRIMARY KEY constraint uniquely identifies each record in a table.

Primary keys must contain UNIQUE values, and cannot contain NULL values.

A table can have only ONE primary key; and in the table, this primary key can consist of single or multiple columns (fields).

```
CREATE TABLE Persons (
   Person_IDint NOT NULL,
   LastName var char(255) NOT NULL,
   FirstName var char(255),
   Age int,
   PRIMARY KEY (ID)
);
```

To allow naming of a PRIMARY KEY constraint, and for defining a PRIMARY KEY constraint on multiple columns, use the following SQL syntax:

```
CREATE TABLE Persons (
   Person_IDint NOT NULL,
   LastName var char(255) NOT NULL,
   FirstName var char(255),
   Age int,
   CONSTRAINT PK_Person PRIMARY KEY (Person_ID,LastName)
);
```

To create a PRIMARY KEY constraint on the "ID" column when the table is already created, use the following SQL:

```
ALTER TABLE Persons
ADD PRIMARY KEY (ID);
```

To drop a PRIMARY KEY constraint, use the following SQL:

```
ALTER TABLE Persons
DROP PRIMARY KEY;
or
ALTER TABLE Persons
DROP CONSTRAINT PK_Person;
```

Foreign Key:

- The Foreign key constraint is used to prevent actions that would destroy links between tables.
- A FOREIGN KEY is a field (or collection of fields) in one table, that refers to the PRIMARY KEY in another table.
- The table with the foreign key is called the child table, and the table with the primary key is called the referenced or parent table.
- Notice that the "PersonID" column in the "Orders" table points to the "PersonID" column in the "Persons" table.
- The "PersonID" column in the "Persons" table is the PRIMARY KEY in the "Persons" table.
- The "Person ID" column in the "Orders" table is a FOREIGN KEY in the "Orders" table.

The FOREIGN KEY constraint prevents invalid data from being inserted into the foreign key column, because it has to be one of the values contained in the parent table.

```
CREATE TABLE Orders (
   Order IDint NOT NULL,
   Order Numberint NOT NULL,
   Person IDint,
   PRIMARY KEY (Order ID),
   FOREIGN KEY (Person ID) REFERENCES Persons(Person ID)
);
```

To allow naming of a FOREIGN KEY constraint, and for defining a FOREIGN KEY constraint on multiple columns, use the following SQL syntax:

```
CREATE TABLE Orders (
   OrderIDint NOT NULL,
   OrderNumberint NOT NULL,
   PersonIDint,
   PRIMARY KEY (OrderID),
   CONSTRAINT FK_PersonOrder FOREIGN KEY (PersonID)
   REFERENCES Persons(Person_ID)
);
```

To create a FOREIGN KEY constraint on the "PersonID" column when the "Orders" table is already created, use the following SQL:

```
ALTER TABLE Orders
ADD FOREIGN KEY (PersonID) REFERENCES Persons(PersonID);
```

To drop a FOREIGN KEY constraint, use the following SQL:

```
ALTER TABLE Orders
DROP FOREIGN KEY FK_PersonOrder;
```

// Screenshot of all your sql queries having primary and foreign key constraint by using all above syntax

Conclusion: In this assignment, we have successfully created table with primary key and foreign key constraints.

Assignment No: 4

Aim: Perform following SQL queries on the database created in assignment 1.

• Implementation of relational operators in SQL
• Boolean operators and pattern matching
• Arithmetic operations and built in functions
• Group functions
• Processing Date and Time functions
• Complex queries and set operators

Operator in SQL:

SQL stands for Structured Query Language. SQL lets you access and manipulate databases. An operator is a reserved word or a character used primarily in an SQL statement's WHERE clause to perform operation(s), such as comparisons and arithmetic operations. These Operators are used to specify conditions in an SQL statement and to serve as conjunctions for multiple conditions in a statement.

Relational Operator:

Relational operators are used for comparing numbers and strings. If a string is compared to a number, MySQL will try to convert the string to a number.
Relational operators in SQL are as follows:

Operator	**Called as**	**Example query**
=	Equals to	SELECT * FROM ProductsWHERE Price = 18;
>	Greater than	SELECT * FROM Products WHERE Price > 18;
<	Less than	SELECT * FROM Products WHERE Price < 18;
>=	Greater than or equal to	SELECT * FROM Products WHERE Price >= 18;
<=	Less than or equal to	SELECT * FROM Products WHERE Price <= 18;
<>	Not equal to	SELECT * FROM Products WHERE Price <> 18;

// give any 3 example query for arithematic operator related to assignment no 1(Screenshot of query with output)

Boolean Operator:
Following is the list of Boolean operator along with example query:

Operator	**Example query**
AND	SELECT c1,c2 FROM tbl1 WHERE c1= x AND c2=y
OR	SELECT c1,c2 FROM tbl1 WHERE c1= x OR c2=y
NOT	SELECT c1 FROM tbl1 WHERE NOT c1<100

ANY	SELECT column_name(s)
	FROM table_name
	WHERE column_name operator ANY
	(SELECT column_name
	FROM table_name
	WHERE condition);

ALL	SELECT column_name(s)
	FROM table_name
	WHERE column_name operator ALL
	(SELECT column_name
	FROM table_name
	WHERE condition);

EXISTS	SELECT column_name(s)
	FROM table_name
	WHERE EXISTS
	(SELECT column_name FROM table_name WHERE condition);

IN	SELECT column_name(s)
	FROM table_name
	WHERE column_name IN (value1, value2, ...);

BETWEEN	SELECT column_name(s)
	FROM table_name
	WHERE column_name BETWEEN value1 AND value2;

// give example of any 3 booleansql query for Boolean operator (Screenshot of query with output)

Pattern matching:
SQL pattern matching enables you to use _ to match any single character and % to match an arbitrary number of characters (including zero characters). In MySQL, SQL patterns are case-insensitive by default. Some examples are shown here. Do not use = or <> when you use SQL patterns.

Example Query- SELECT*FROM tbl1 WHEREnameLIKE'b%';

// give one example of pattern matching (Screenshot of query and output)

Arithmetic operations and built in functions

Operator	Called as	Example query
+	Add	SELECT 10 + 20;
-	Subtract	SELECT 10 - 20;
*	Multiply	SELECT 10 * 20;
/	Divide	SELECT 10 /20;
%	Modulo	SELECT 10 %20;

// give any 2 example query of arithematic operator

Built in Functions:

Numeric Functions:

Function	Input Argument	Value Returned
ABS (m)	m = value	Absolute value of m
MOD (m, n)	m = value, n = divisor	Remainder of m divided by n
POWER (m, n)	m = value, n = exponent	m raised to the nth power
ROUND (m [, n])	m = value, n = number of decimal places, default 0	m rounded to the nth decimal place
TRUNC (m [, n])	m = value, n = number of decimal places, default 0	m truncated to the nth decimal place
SQRT (n)	n = value	positive square root of n
EXP (n)	n = value	e raised to the power n
LN (n)	n > 0	natural logarithm of n
LOG (n2, n1)	base n2 any positive value other than 0 or 1, n1 any positive value	logarithm of n1, base n2
CEIL (n)	n = value	smallest integer greater than or equal to n
FLOOR (n)	n = value	greatest integer smaller than or equal to n
SIGN (n)	n = value	-1 if n < 0, 0 if n = 0, and 1 if n > 0

String Functions:

Function	**Input Argument**	**Value Returned**
INITCAP (s)	s = character string	First letter of each word is changed to uppercase and all other letters are in lower case.
LOWER (s)	s = character string	All letters are changed to lowercase.
UPPER (s)	s = character string	All letters are changed to uppercase.
CONCAT (s1, s2)	s1 and s2 are character strings	Concatenation of s1 and s2. Equivalent to *s1* || *s2*
LPAD (s1, n [, s2])	s1 and s2 are character strings and n is an integer value	Returns s1 right justified and padded left with n characters from s2; s2 defaults to space.
RPAD (s1, n [, s2])	s1 and s2 are character strings and n is an integer value	Returns s1 left justified and padded right with n characters from s2; s2 defaults to space.
LTRIM (s [, set])	s is a character string and *set* is a set of characters	Returns s with characters removed up to the first character not in set; defaults to space
RTRIM (s [, set])	s is a character string and *set* is a set of characters	Returns s with final characters removed after the last character not in set; defaults to space
REPLACE (s, search_s [, replace_s])	s = character string, search_s = target string, replace_s = replacement string	Returns s with every occurrence of search_s in s replaced by replace_s; default removes search_s
SUBSTR (s, m [, n])	s = character string, m = beginning position, n = number of characters	Returns a substring from s, beginning in position m and n characters long; default returns to end of s.
LENGTH (s)	s = character string	Returns the number of characters in s.
INSTR (s1, s2 [, m [, n]])	s1 and s2 are character strings, m = beginning position, n = occurrence of s2 in s1	Returns the position of the nth occurrence of s2 in s1, beginning at position m, both m and n default to 1.

// give any 3 example of built in functions.

Group functions

The `GROUP BY` statement groups rows that have the same values into summary rows, like "find the number of customers in each country".

The `GROUPBY` statement is often used with aggregate functions (`COUNT()`, `MAX()`, `MIN()`, `SUM()`, `AVG()`) to group the result-set by one or more columns.

```
SELECT column_name(s)
FROM table_name
WHERE condition
GROUP BY column_name(s)
ORDER BY column_name(s);
```

// give any 2 example of group fuctions

Processing Date and Time functions:

Date and time functions are scalar functions that perform an operation on a date and time input value and returns either a string, numeric, or date and time value.

Function	**Syntax**	**Description**
SYSDATETIME	SYSDATETIME()	Returns a datetime value that contains the date and time
CURRENT_TIMESTAMP	CURRENT_TIMESTAMP	Returns a datetime value that contains date and time.
DATEPART	DATEPART(datepart,date)	Returns an integer that represents the specified datepart of the specified date.
DAY/MONTH/YEAR	DAY(date)/MONTH(date)/ YEAR(date)	Returns an integer that represents the day/month/year part of the specified date.
DATEDIFF	DATEDIFF(datepart, startdate, enddate)	Returns the number of date and time datepart boundaries that are crossed between two specified date.
DATEADD	DATEADD(datepart, number, date)	Returns a new datetime value by adding an interval to the specified datepart of the specified date.

// execute any 3 date and time commands and put here that query example with output

Complex queries and set operators

Complex queries:

Queries such as find duplicate row, second highest salary, fetch first or last record form table, display first five rows are complex queries.

// Give two example of complex query here

Set Operator:

Set operators are used to join the results of two (or more) SELECT statements.The SET operators are UNION,UNION ALL,INTERSECT,andMINUS.

UNION Operation

The UNION operator is used to combine the result-set of two or more SELECT statements.

- Every SELECT statement within UNION must have the same number of columns
- The columns must also have similar data types
- The columns in every SELECT statement must also be in the same order

Syntax:

```
SELECT column_name(s) FROM table1
UNION
SELECT column_name(s) FROM table2;
```

INTERSECT

The SQL INTERSECT clause/operator is used to combine two SELECT statements, but returns rows only from the first SELECT statement that are identical to a row in the second SELECT statement. This means INTERSECT returns only common rows returned by the two SELECT statements.

Just as with the UNION operator, the same rules apply when using the INTERSECT operator. MySQL does not support the INTERSECT operator.

Syntax

The basic syntax of INTERSECT is as follows.

```
SELECT column1 [, column2 ]
FROM table1 [, table2 ]
[WHERE condition]

INTERSECT

SELECT column1 [, column2 ]
FROM table1 [, table2 ]
[WHERE condition]
```

MINUS

The Minus Operator in SQL is used with two SELECT statements. The MINUS operator is used to subtract the result set obtained by first SELECT query from the result set obtained by second SELECT query. In simple words, we can say that MINUS operator will return only those rows which are unique in only first SELECT query and not those rows which are common to both first and second SELECT queries.

Basic Syntax:

SELECT column1 , column2 , ... columnN

FROM table_name

WHERE condition

MINUS

SELECT column1 , column2 , ... columnN

FROM table_name

WHERE condition;

// Give 1 example of SET Operator

Conclusion: In this way, we have studied and implemented different SQL operator on sql query for our database.

Assignment No: 5

Aim: Execute DDL/DML statements which demonstrate the use of views. Update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.

VIEW:

In SQL, a view is a virtual table based on the result-set of an SQL statement.

A view contains rows and columns, just like a real table. The fields in a view are fields from one or more real tables in the database.

You can add SQL statements and functions to a view and present the data as if the data were coming from one single table.

A view is created with the CREATE VIEW statement.

```
CREATE VIEW view_nameAS
SELECT column1,column2, ...
FROM table_name
WHERE condition;
```

SQL REPLACE VIEW Syntax

```
REPLACE VIEW view_nameAS
SELECT column1,column2, ...
FROM table_name
WHERE condition;
```

A view is deleted with the DROP VIEW statement.

```
DROP VIEW view_name;
```

Updatable Views

Some views are updatable and references to them can be used to specify tables to be updated in data change statements. That is, you can use them in statements such as `UPDATE`, `DELETE`, or `INSERT` to update the contents of the underlying table.

A view is not updatable if it contains any of the following:

1. The SELECT statement which is used to create the view should not include GROUP BY clause or ORDER BY clause.
2. The SELECT statement should not have the DISTINCT keyword.
3. The View should have all NOT NULL values.
4. The view should not be created using nested queries or complex queries.
5. The view should be created from a single table. If the view is created using multiple tables then we will not be allowed to update the view.

- It is not possible to create an index on a view.
- Indexes can be used for views processed using the merge algorithm. However, a view that is processed with the temptable algorithm is unable to take advantage of indexes on its underlying tables (although indexes can be used during generation of the temporary tables).

View creation from multiple tables

To create a View from multiple tables we can simply include multiple tables in the SELECT statement.

```
CREATE VIEW v AS
SELECT tbl1.NAME, tbl1.ADDRESS, tbl2.MARKS
FROM tbl1, tbl2
WHERE tbl1.id = tbl2.id;
```

// Give Your Output Here

Conclusion: In this way we have demonstrated the use of views with view creation from multiple tables.

Group C: PL/SQL

Assignment No :- 1

Aim :- . Write and execute PL/SQL stored procedure and function to perform a suitable task on the database. Demonstrate its use.

Objective:

- To study and implement PL/SQL procedure.
- To study and implement PL/SQL function.

Theory : A subprogram is a program unit/module that performs a particular task. These subprograms are combined to form larger programs. This is basically called the 'Modular design'. A subprogram can be invoked by another subprogram or program which is called the calling program.

A subprogram can be created –

- At the schema level
- Inside a package
- Inside a PL/SQL block

At the schema level, subprogram is a standalone subprogram. It is created with the CREATE PROCEDURE or the CREATE FUNCTION statement. It is stored in the database and can be deleted with the DROP PROCEDURE or DROP FUNCTION statement.

PL/SQL subprograms are named PL/SQL blocks that can be invoked with a set of parameters. PL/SQL provides two kinds of subprograms –

- **Functions** –these subprograms return a single value; mainly used to compute and return a value.
- **Procedures** –these subprograms do not return a value directly; mainly used to perform an action.

Parts of a PL/SQL Subprogram- Each PL/SQL subprogram has a name, and may also have a parameter list. Like anonymous PL/SQL blocks, the named blocks will also have the following three parts –

1. **Declarative Part -** It is an optional part. However, the declarative part for a subprogram does not start with the DECLARE keyword. It contains declarations of types, cursors, constants, variables, exceptions, and nested subprograms. These items are local to the subprogram and cease to exist when the subprogram completes execution.

2. **Executable Part -** This is a mandatory part and contains statements that perform the designated action.

3. **Exception -** handling this is again an optional part. It contains the code that handles run-time errors

Creating a Procedure

A procedure is created with the CREATE OR REPLACE PROCEDURE statement. The simplified syntax for the CREATE OR REPLACE PROCEDURE statement is as follows –

```
CREATE [OR REPLACE] PROCEDURE procedure_name

 [(parameter_name [IN | OUT | IN OUT] type [, ...])]

{IS | AS}

BEGIN

<procedure_body>

END procedure_name;
```

Where, • procedure-name specifies the name of the procedure.

- [OR REPLACE] option allows the modification of an existing procedure.
- The optional parameter list contains name, mode and types of the parameters. IN represents the value that will be passed from outside and OUT represents the parameter that will be used to return a value outside of the procedure.
- procedure-body contains the executable part.
- The AS keyword is used instead of the IS keyword for creating a standalone procedure.

Example

The following example creates a simple procedure that displays the string 'Hello World!' on the screen when executed.

```
CREATE OR REPLACE PROCEDURE greetings AS BEGIN dbms_output.put_line('Hello World!');
END; /
```

Deleting a Standalone Procedure

A standalone procedure is deleted with the DROP PROCEDURE statement. Syntax for deleting a procedure is –

```
DROP PROCEDURE procedure-name;
```

You can drop the greetings procedure by using the following statement –

DROP PROCEDURE greetings;

Parameter Modes in PL/SQL Subprograms

The following table lists out the parameter modes in PL/SQL subprograms –

IN

An IN parameter lets you pass a value to the subprogram. It is a read-only parameter. Inside the subprogram, an IN parameter acts like a constant. It cannot be assigned a value. You can pass a constant, literal, initialized variable, or expression as an IN parameter. You can also initialize it to a default value; however, in that case, it is omitted from the subprogram call. It is the default mode of parameter passing. Parameters are passed by reference.

OUT

An OUT parameter returns a value to the calling program. Inside the subprogram, an OUT parameter acts like a variable. You can change its value and reference the value after assigning it. The actual parameter must be variable and it is passed by value.

IN OUT

An IN OUT parameter passes an initial value to a subprogram and returns an updated value to the caller. It can be assigned a value and the value can be read. The actual parameter corresponding to an IN OUT formal parameter must be a variable, not a constant or an expression. Formal parameter must be assigned a value. Actual parameter is passed by value.

// provide other example queries and outputs (screenshots) for procedure taken into lab session

Functions:

A function is same as a procedure except that it returns a value. Therefore, all the discussions of the previous chapter are true for functions too.

Creating a Function

A standalone function is created using the CREATE FUNCTION statement. The simplified syntax for the CREATE OR REPLACE PROCEDURE statement is as follows –

```
CREATE [OR REPLACE] FUNCTION function_name
 [(parameter_name [IN | OUT | IN OUT] type [, ...])]
RETURN return_datatype
 {IS | AS}
BEGIN
<function_body>
 END [function_name];
```

Where,

- function-name specifies the name of the function.
- [OR REPLACE] option allows the modification of an existing function.
- The optional parameter list contains name, mode and types of the parameters. IN represents the value that will be passed from outside and OUT represents the parameter that will be used to return a value outside of the procedure.
- The function must contain a return statement.
- The RETURN clause specifies the data type you are going to return from the function.
- function-body contains the executable part.
- The AS keyword is used instead of the IS keyword for creating a standalone function.

//provide other example queries and outputs(screenshots) taken into lab session

Conclusion:- We have studied and executed PL/SQL stored procedures and functions.

Assignment No :- 2

Aim :-Write and execute suitable database triggers .Consider row level and statement level triggers.

Objective:

- To study and implement PL/SQL triggers.

Theory :

Triggers are stored programs, which are automatically executed or fired when some events occur. Triggers are, in fact, written to be executed in response to any of the following events.

- A database manipulation (DML) statement (DELETE, INSERT, or UPDATE)
- A database definition (DDL) statement (CREATE, ALTER, or DROP).
- A database operation (SERVERERROR, LOGON, LOGOFF, STARTUP, or SHUTDOWN).

Triggers can be defined on the table, view, schema, or database with which the event is associated.

Benefits of Triggers

Triggers can be written for the following purposes –

- Generating some derived column values automatically
- Enforcing referential integrity
- Event logging and storing information on table access
- Auditing
- Synchronous replication of tables
- Imposing security authorizations
- Preventing invalid transactions **Creating Triggers**

The syntax for creating a trigger is –

```
CREATE [OR REPLACE ] TRIGGER trigger_name
 {BEFORE | AFTER | INSTEAD OF }

{INSERT [OR] | UPDATE [OR] | DELETE}

 [OF col_name]

 ON table_name
```

```
[REFERENCING OLD AS o NEW AS n]
[FOR EACH ROW]
WHEN (condition)
DECLARE Declaration-statements BEGIN Executable-statements
EXCEPTION Exception-handling-statements END;
```

Where,

- CREATE [OR REPLACE] TRIGGER trigger_name − Creates or replaces an existing trigger with the trigger_name.
- {BEFORE | AFTER | INSTEAD OF} − This specifies when the trigger will be executed. The INSTEAD OF clause is used for creating trigger on a view.
- {INSERT [OR] | UPDATE [OR] | DELETE} − This specifies the DML operation.
- [OF col_name] − This specifies the column name that will be updated.
- [ON table_name] − This specifies the name of the table associated with the trigger.
- [REFERENCING OLD AS o NEW AS n] − This allows you to refer new and old values for various DML statements, such as INSERT, UPDATE, and DELETE.
- [FOR EACH ROW] − This specifies a row-level trigger, i.e., the trigger will be executed for each row being affected. Otherwise the trigger will execute just once when the SQL statement is executed, which is called a table level trigger.
- WHEN (condition) − this provides a condition for rows for which the trigger would fire. This clause is valid only for row-level triggers.

//provide other example queries and outputs(screenshots) taken into lab session

Conclusion:- We have studied and executed different types of database triggers.

Assignment No :- 3

Aim :-Write a PL/SQL block to implement all types of cursor.

Objective:

• To study and implement PL/SQL cursors

Theory :

A cursor is a pointer to this context area. PL/SQL controls the context area through a cursor. A cursor holds the rows (one or more) returned by a SQL statement. The set of rows the cursor holds is referred to as the active set.

You can name a cursor so that it could be referred to in a program to fetch and process the rows returned by the SQL statement, one at a time. There are two types of cursors – Implicit cursors and Explicit cursors

Implicit Cursors

Implicit cursors are automatically created by Oracle whenever an SQL statement is executed, when there is no explicit cursor for the statement. Programmers cannot control the implicit cursors and the information in it.

Whenever a DML statement (INSERT, UPDATE and DELETE) is issued, an implicit cursor is associated with this statement. For INSERT operations, the cursor holds the data that needs to be inserted. For UPDATE and DELETE operations, the cursor identifies the rows that would be affected.

In PL/SQL, you can refer to the most recent implicit cursor as the SQL cursor, which always has attributes such as %FOUND, %ISOPEN, %NOTFOUND, and %ROWCOUNT. The SQL cursor has additional attributes, %BULK_ROWCOUNT and %BULK_EXCEPTIONS, designed for use with the FORALL statement. The following table provides the description of the most used attributes –

%FOUND

Returns TRUE if an INSERT, UPDATE, or DELETE statement affected one or more rows or a SELECT INTO statement returned one or more rows. Otherwise, it returns FALSE

%NOTFOUND
The logical opposite of %FOUND. It returns TRUE if an INSERT, UPDATE, or DELETE statement affected no rows, or a SELECT INTO statement returned no rows. Otherwise, it returns FALSE.

%ISOPEN

Always returns FALSE for implicit cursors, because Oracle closes the SQL cursor automatically after executing its associated SQL statement.

%ROWCOUNT

Returns the number of rows affected by an INSERT, UPDATE, or DELETE statement, or returned by a SELECT INTO statement.

Explicit Cursors

Explicit cursors are programmer-defined cursors for gaining more control over the context area. An explicit cursor should be defined in the declaration section of the

PL/SQL Block. It is created on a SELECT Statement which returns more than one row.

The syntax for creating an explicit cursor is –

```
CURSOR cursor_name IS select_statement;
```

Working with an explicit cursor includes the following steps –

- Declaring the cursor for initializing the memory
- Opening the cursor for allocating the memory
- Fetching the cursor for retrieving the data
- Closing the cursor to release the allocated memory

Declaring the Cursor

Declaring the cursor defines the cursor with a name and the associated SELECT statement. For example

```
CURSOR c_customers IS SELECT id, name, address FROM customers;
```

Opening the Cursor

Opening the cursor allocates the memory for the cursor and makes it ready for fetching the rows returned by the SQL statement into it. For example, we will open the above defined cursor as follows –

```
OPEN c_customers;
```

Fetching the Cursor

Fetching the cursor involves accessing one row at a time. For example, we will fetch rows from the above-opened cursor as follows –

```
FETCH c_customers INTO c_id, c_name, c_addr;
```

Closing the Cursor

Closing the cursor means releasing the allocated memory. For example, we will close the above-opened cursor as follows –

```
CLOSE c customers;
```

//provide other example queries and outputs(screenshots) taken into lab session

Conclusion:- We have studied and implemented cursors in PL/SQL.