

# Database Systems – I

## BIT Semester 2

# 1

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## Database System Environment

### 1. Database System Environment (5MCQs)

File base vs Database Approach-1, Database and DBMS-1, Architecture of DBMS-1, Three Level Architecture-1, Database Users and Practitioners-1, Database Languages-1, Database Types-1, Practical - Download, Install and Configure MySQL, Create and Use a Database.

### 2. Integrity Constraints and DDL (5MCQs)

### 3. Working with database using DML (8MCQs)

### 4. Relation Algebra (6MCQs)

### 5. Database Designing Process with ER Diagrams (8MCQs)

### 6. Normalization (10MCQs)

### 7. Views and Security with DCL (4MCQs)

### 8. Execute duties of a Database Administrator

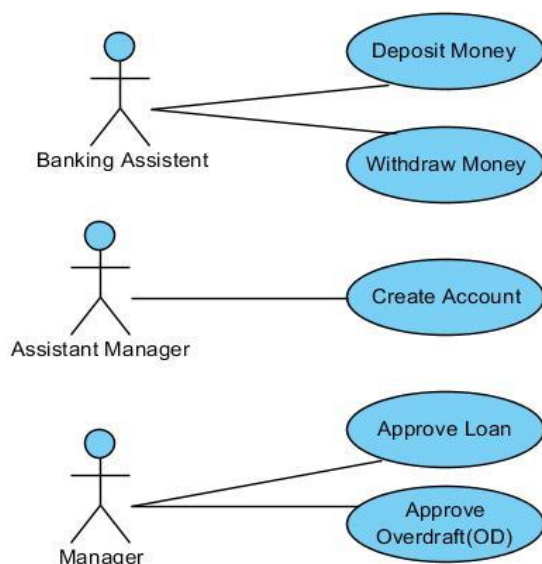
## Base Plan

- |   | Class | Date    |
|---|-------|---------|
| <b>1. <input type="checkbox"/> How Modules of BIT-Semester-2 help in System Development</b><br><input type="checkbox"/> Identify Few Users and Business Process of a bank and supermarket system<br><input type="checkbox"/> Professional target of the BIT Degree Holder<br><input type="checkbox"/> Define a CBIS as a collection of Programs + a Database<br><input type="checkbox"/> Ready-made vs Custom-made software in CBIS<br><input type="checkbox"/> Define algorithms of Withdrawal and Invoicing Process<br><input type="checkbox"/> Discuss how modules of BIT-Semester-2 help in developing CBIS   | [ 1 ] | 29/6/19 |
| <b>2. <input type="checkbox"/> Database Vs File-Based approaches in System Development</b><br><input type="checkbox"/> Difference between Database and File-Based Approaches<br><input type="checkbox"/> Program-Data Dependency in File-Based Approach<br><input type="checkbox"/> Problems in File-Based Approach due to Data-Dependency<br><input type="checkbox"/> Advantages of Database Approach <input type="checkbox"/> Disadvantages of Database Approach<br><input type="checkbox"/> 2014-03 <input type="checkbox"/> 2016-04 <input type="checkbox"/> 2015-01 <input type="checkbox"/> 2010-01 <input type="checkbox"/> 2006-02 <input type="checkbox"/> 2006-01 <input type="checkbox"/> 2011-01  | [ ]   |         |
| <b>3. <input type="checkbox"/> Database Approach to System Development, Database and DBMS</b><br><input type="checkbox"/> Database Definition <input type="checkbox"/> 2012-01 <input type="checkbox"/> Database Objects <input type="checkbox"/> 2017-02<br><input type="checkbox"/> Duty of the DBMS<br><input type="checkbox"/> 2014-02 <input type="checkbox"/> 2008-01 <input type="checkbox"/> 2008-02 <input type="checkbox"/> 2007-36<br><input type="checkbox"/> DBMS Type Classification<br><input type="checkbox"/> 2008-05 <input type="checkbox"/> 2009-44 <input type="checkbox"/> 2008-50 <input type="checkbox"/> 2006-42 <input type="checkbox"/> 2007-01  | [ ]   |         |
| <b>4. <input type="checkbox"/> Architecture of Database System, DBMS-Components</b><br><input type="checkbox"/> Major Compartments of a Database System <input type="checkbox"/> 2012-02<br><input type="checkbox"/> Meta Data and Data Dictionary<br><input type="checkbox"/> 2017-41 <input type="checkbox"/> 2007-02 <input type="checkbox"/> 2018-07 <input type="checkbox"/> 2012-04 <input type="checkbox"/> 2007-03 <input type="checkbox"/> 2015-03<br><input type="checkbox"/> DBMS Components and Their Duties<br><input type="checkbox"/> 2010-02 <input type="checkbox"/> 2018-04 <input type="checkbox"/> 2006-05 <input type="checkbox"/> 2017-17 <input type="checkbox"/> 2013-03  | [ ]   |         |
| <b>5. <input type="checkbox"/> ANSI-SPARC 3 Level Architecture</b><br><input type="checkbox"/> Why it is need to have a standard architecture for Database Systems<br><input type="checkbox"/> Levels of the 3-Level Architecture (Physical/Internal, Logical/Conceptual, External/User-Views)<br><input type="checkbox"/> 2014-08 <input type="checkbox"/> 2012-08 <input type="checkbox"/> 2009-02 <input type="checkbox"/> 2017-01 <input type="checkbox"/> 2016-02 <input type="checkbox"/> 2014-05<br><input type="checkbox"/> 2013-01 <input type="checkbox"/> 2011-07 <input type="checkbox"/> 2008-06 <input type="checkbox"/> 2006-03<br><input type="checkbox"/> Independencies (Physical Independency, Logical Independency) <input type="checkbox"/> Mapping between levels<br><input type="checkbox"/> 2009-03 <input type="checkbox"/> 2016-01 <input type="checkbox"/> 2013-02 <input type="checkbox"/> 2017-04 <input type="checkbox"/> 2009-04 <input type="checkbox"/> 2015-04<br><input type="checkbox"/> 2010-03 <input type="checkbox"/> 2007-04<br><input type="checkbox"/> Advantages of External View <input type="checkbox"/> 2006-40 <input type="checkbox"/> 2011-08 | [ ]   |         |
| <b>6. <input type="checkbox"/> Stakeholders of a Database System, Users and Practitioners</b><br><input type="checkbox"/> Direct and Indirect (Embedded SQL, ODBC) Users of Database System<br><input type="checkbox"/> Difference between Data-Administrator (DA) and Database Administrator (DBA)<br><input type="checkbox"/> Duties of DBA<br><input type="checkbox"/> 2011-06 <input type="checkbox"/> 2018-02 <input type="checkbox"/> 2006-06 <input type="checkbox"/> 2017-06 <input type="checkbox"/> 2009-01 <input type="checkbox"/> 2008-03  | [ ]   |         |
| <b>7. <input type="checkbox"/> Database Languages</b><br><input type="checkbox"/> Procedural (Relational Algebra) vs Non-Procedural (Declarative-SQL) Languages<br><input type="checkbox"/> SQL-DDL,DCL,DML<br><input type="checkbox"/> 2018-01 <input type="checkbox"/> 2017-03 <input type="checkbox"/> 2015-02 <input type="checkbox"/> 2012-30 <input type="checkbox"/> 2011-03 <input type="checkbox"/> 2010-05 <input type="checkbox"/> 2010-25<br><input type="checkbox"/> 2009-05 <input type="checkbox"/> 2009-44 <input type="checkbox"/> 2008-16 <input type="checkbox"/> <u>2008-44</u> <input type="checkbox"/> <u>2008-48</u> <input type="checkbox"/> <u>2007-38</u> <input type="checkbox"/> <u>2007-39</u><br><input type="checkbox"/> <u>2006-04</u> <input type="checkbox"/> <u>2012-19</u> <input type="checkbox"/> <u>2011-37</u><br><input type="checkbox"/> 2018-14 <input type="checkbox"/> 2017-08 <input type="checkbox"/> 2016-06 <input type="checkbox"/> 2014-16 <input type="checkbox"/> 2011-22 <input type="checkbox"/> 2008-10<br><input type="checkbox"/> 2006-39 <input type="checkbox"/> 2018-13 <input type="checkbox"/> 2017-15                           | [ ]   |         |

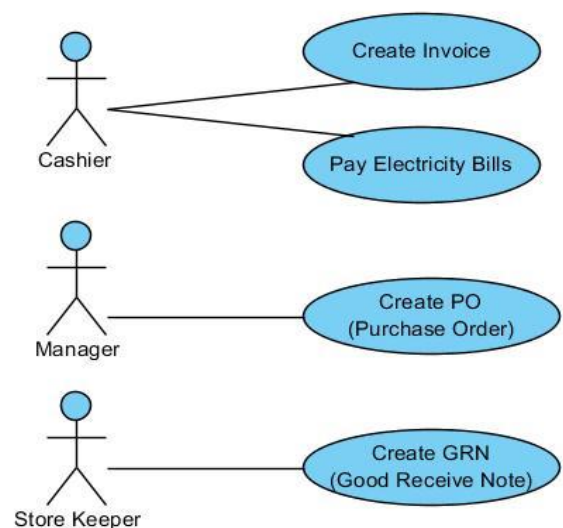
## How Modules of BIT-Semester-2 Help in System Development

1. Why are you here?  
To get the BIT degree
2. What is the Professional Goal of the BIT Degree?  
To get the ability to develop and maintain business information systems
3. Why it is important to use Computer Based Information System for Business?  
Details of the daily transactions are accurate, efficient and secure in CBIS than Paper-Based Manual Systems. Ease of Use. Increase Customer Loyalty.  
Compare Time taken to create an invoice using a barcode-reader at a supermarket POS-Point of Sale with a retail-shop counter.
4. Give 2 examples for business organizations that use CBIS to support their daily business process.  
Supermarket  
Bank
5. Identify 2 possible **users** and their **duties** related to the above Information-Systems.

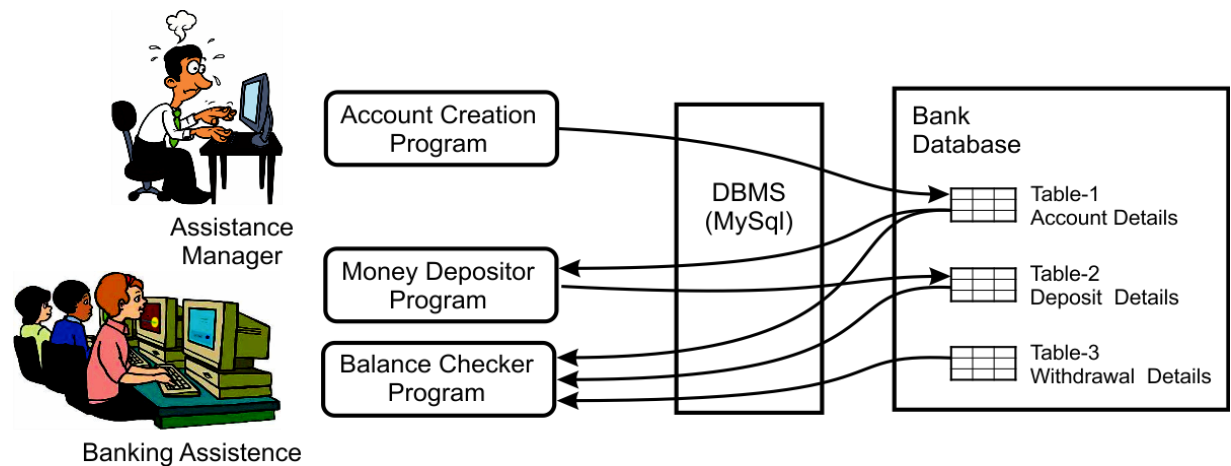
### Bank



### Supermarket



## 6. Draw a diagram to show the architecture of the CBIS using a banking system



## 7. What is the definition of the CBIS as defined by the above architectural diagram?

CBIS = Collection of Programs + A Database

## Database

Collection of tables that store details such as withdrawals, deposits along with account details of customers. The database may be centralized or distributed.

## Program

Accept input from the user, process them step by step, producing outputs to accomplish business duties of various users

Programs may be a Desktop-App, a Web-App or a Mobile-App.

## IT-Infrastructure

Programs and Databases are installed on a collection of computers connected by Networks. Computer consists of Hardware and Operating System.

## Example: Sampath-Bank CBIS

You can withdraw/deposit money at the bank-counter using a Desktop-App.  
 You can transfer money using the Web-App (Sampath Vishwa) using a web-browser.  
 You can transfer money using the Mobile-App using a smartphone.

All your account and transaction details are stored in the Sampath-Bank database.  
 All the above program get data from the same database.

## 8. Describe Computerization of Business Process "Creating Invoice" by "Invoice.exe" program?

Business - Supermarket

User - Cashier

Requirement - Creating Invoice

Program - invoice.exe

Database Tables - item (code, barcode, name, unitprice, quantity)  
 customer (id, telno, name, nic)  
 invoice (no, date, grandtotal, customerid)  
 invoiceitem ( invoiceno, itemcode, quantity, linetotal)

**Case Study:**

3 customers among 10 registered customers came to the supermarket and bought following list of items in given quantities. There are 100 items to be sold in the supermarket.

Customer-1 (White Sugar-1Kg, Highland 400g Milk Powder-2Packets, Red-Rice-5Kg)

Customer-2 (Red-Rice-3Kg, Sunlight Soap-4Pieces)

Customer-3 (Cashew-Nut-100g-3Packets)

**What are the number of rows saved in each of the above tables?**

item – ( ..... ) customer – ( ..... ) invoice – ( ..... ) invoiceitem – ( ..... )

## 9. Describe the algorithm (steps) of the invoice program

Get the barcode/item-code of the Item from the cashier

Get the quantity of the Item from the cashier

Connect with the database

Get the unit-price of the given Item code

Multiply the unit-price by the quantity to get the line-total

Add the line-total to the grand-total

Repeat the above steps until all the items are billed

Update the database

Insert an entry to the “invoice” table,

Insert set of entries into the “invoice-item” table repeatedly for each item.

Update the “quantity” of the relevant item in the “item” table repeatedly

Print the invoice

## 10. Describe Computerization of Business Process “Withdraw Money” by “withdrawer.exe” programs?

Business – Bank

User – Banking Assistant

Requirement – Withdrawing Money

Program – withdrawer.exe

Database Tables – account (number, name, nic, signature, balance)

employee (id, name)

withdraw (id, accountnumber, date, amount, employeeid)

## 11. Describe the algorithm (steps) of the withdraw program

Get the account-number

Get the required amount as the Input from the banking assistance,

Connect with the database using Database-Connector program

Get the name and signature of the given account-number from the database

Verify the Customer by matching the name, nic and signature.

Get the available balance of the account.

Then checks the amount requested with the available balance.

If the balance > amount

Insert a withdraw entry(row) with withdraw details into the withdraw-table

Print the Receipt with transaction details using the Printer-Driver program

Else

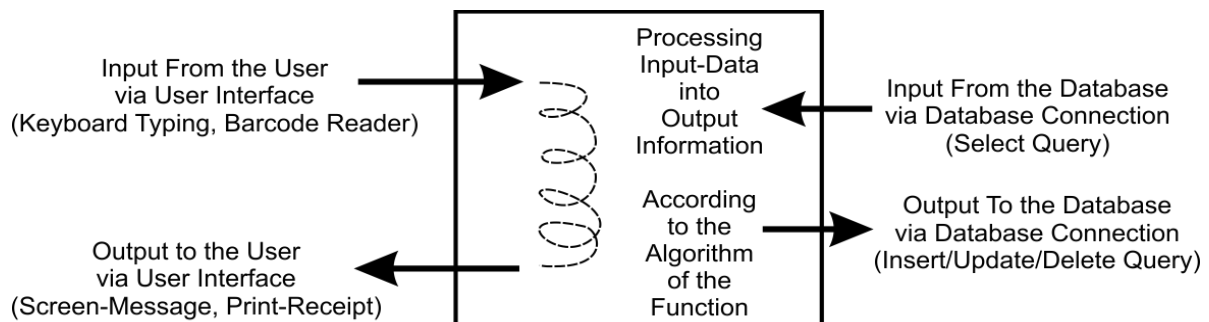
Inform the banking assistant that “No Enough Money”

12. What is the difference between ready-made and custom-made software related to CBIS development?

Will you give “Windows-Media-Player” to support Banking-Assistance to check the balance?  
Will you create “Balance-Checker-Program” (a custom-made software) to get the balance?

Will you give “Adobe-Photoshop” to support Cashier to accomplish “Creating Invoice”?  
Will you create “Invoice-Program” (a custom-made) to create invoice for a customer?

13. Draw a diagram to show the “General View of a Program” in a Business Information System



14. Why are you here?

To learn how to develop quality information system for businesses.

So, you could make you happy as,

You will contribute to empower the human society using these systems and

You will be paid by the business owners of these systems.

15. Why BIT-Semester-2 is very important for you?

Because Information System is a “Collection of Programs + a Database”.

#### Database Systems-1 (DBMS)

This Module teach us

How to Design a Database (ER) for a particular business,

Install and Configure a DBMS (MySQL),

Create the Database (DDL), Use the Database (DML) and Control the Database (DCL)

#### Programming-1 (Java)

This Module give us the ability to

Create Application Programs using Java-Language to supports user needs of the System.

Java Program could get Inputs from the User and the Database, Process them and

produce Outputs.

#### System Analysis and Designing (SAD)

This Module describe techniques and tools used to

Study (Analysis) the Existing Business-System to identify users and their needs.

Plan (Designing) the New CBIS as a collection of Programs + a Database to be developed.

#### Mathematics-1

This module teaches us how to

Process Data Collections as Sets,

Handle Relations between data items

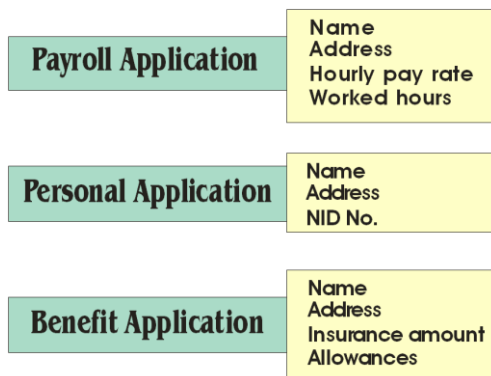
Use Logics in Algorithmic Data Processing and Conditional Decision Points

Please Revise and Update the relevant topics of the base plan.

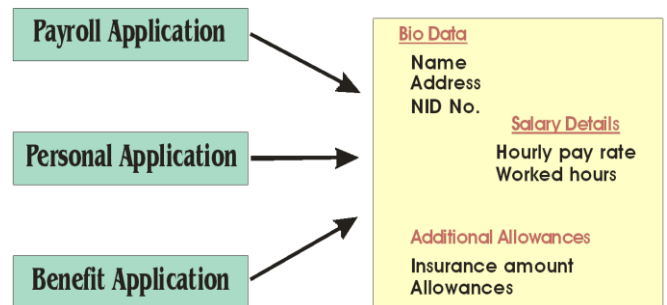
## Database Vs File Base Approaches In System Development

### 1. Using a Block diagram describe the difference between “Traditional File Base Approach and Modern Database Approach in Information System?”

Traditional File Base Approach –  
Use Separate Data File  
for each Application Program



Modern Data Base Approach –  
Use a Common Pool of Data  
for all Application Programs



### 2. What are the problems with File-Base/Traditional Approach?

1. **Data Dependency**
2. Separation and Isolation of Data
3. Lack of Integration
4. Data Redundancy
5. Increase Update Effort and Partial Update
6. Data Inconsistency
7. Limited Proliferation

### 3. Describe above problems briefly

#### Data Dependency

Each Program store and manages its own set of data.

The format and the structure of data are defined by each program.

The way each program store data is differ from one language to another (pre-defined data), one program to another (user-defined data).

They cannot be understood by other programs.

So, one program cannot access another's data.

The data in a file can be utilized only by the program that it was defined for.

So, data utilization is depending on the Program.

This is also called **Data Dependence** (or the **Data-Data Dependence / Program-Data Dependence.**)

All other problems in "File-Based-Approach" are consequence of the "Data-Dependency"

#### **Separation and Isolation of Data**

Each program contains its own set of data.

Each program unaware of data in other programs as they are stored in different formats.

Some Application Program may have more valuable data, but others do not know about them.

#### **Lack of Integration of Data**

Combining data from different files are very difficult as they are stored in different formats.

#### **Data Redundancy**

Same data items are stored by different programs in different data-files.

Duplicate data among data-files.

Name and Address are stored in "Payroll", "Personal" and "Benefit" files.

Waste storage spaces by storing duplicate data – Wasting resources.

#### **Increase Update Effort and Partial Update**

##### **Data Inconsistency**

Need to update several-files whenever Name or Address Changed.

Increase Update Effort may lead to partial-updates making the name in one file may not consistent with another file

*Payroll Application*      ← *Name-Karunathilaka, Address-Gampaha*

*Personal Application*    ← *Name-Karunathilaka, Address-Mahara*

Suppose Mr. Karunathilaka changed the residence from Gampaha to Mahara.

The Address of the Payroll Application has changed to Gampaha but it was not changed in the Personal Application. Gamapaha ? Or Mahara ? Or Anyware else ? --- No consistency.

#### **Limited Proliferation**

Programs are written to perform a specific task.

If we need to perform a new task, we should write another program.

The new program can't use existing data-file as they are in different format by other programs.

Whenever we need to add a new program into the system, we have to collect all the data even they are already stored in other-files.



**4. What are the disadvantages of Database/Modern Approach?**

1. Complexity
2. Size of the Database
3. Cost of the DBMS
4. Additional Hardware Cost for Database Servers
5. Conversion Cost (Format Conversion, ODBC(Common)→JDBC(Java))
6. Reduced Performance
7. Higher Impact to Failure

**5. What are the Advantages of the Database Approach?**

1. Improved data maintenance through program-data independence  
(Format of data could be change without changing application programs)
2. Minimal data redundancy
3. Improved data consistency
4. Improved data sharing
5. Increased productivity
6. Enforcement of standards
7. Improved data integrity
8. Improved data accessibility and responsiveness
9. Improved security
10. Increased concurrency
11. Improved Backup and Recovery
12. Report Generation for various users
13. Build-In Function Definitions such as “Sum(), Avg(), Max(), Min(), Count()”.

**File base vs Database Approach****Drawbacks of File base System**

**2014-03**      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

**Advantages of Database Approach**

**2016-04**      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

**2015-01**      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

**2010-01**      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

**2006-02**      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

**2006-01**      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

**Comparison between File based and Database Approaches**

**2011-01**      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

## Database Approach in System Development

### Database and DBMS

#### What is the Definition of a Database?

##### Describe the important terms in the Definition.

Database is a collection of related, controlled and shared data.

##### Related

Data in a column of a particular table may be related with another column in another table.

Foreign key relationship.

Coordinator number of the course table should be one of the teacher numbers in the teacher table.

##### Shared

Data in the database is used by various Application Programs.

Data in the database is used by various levels of Administration of the Company. Data in the database is used for various tasks.

##### Controlled

Database is located centrally and controlled by the Database Administrator Using the DBMS Software.

DBA control access to the database using DCL commands of SQL.

Grant and Revoke privileges such as Select, Insert, Update and Delete on various tables are defined by the DBA. It is important to control the database as it is a shared resource and an asset of the business.



#### Database Definition

**2012-01**

Class—☐ Home—☐ Group—☐ Mock Exam—☐ Exam—☐

#### Database Objects

Tables ← Base Tables, Actually Stored.

Views ← Derived Tables, Virtual Tables.

Files ← Physically Stored,

Sequential (Unordered), Index-Sequential (Primary Indexing, Ordered), Hashed/Direct

Indexes (Secondary Indexing) ← Additional data structure used to speed up data access.

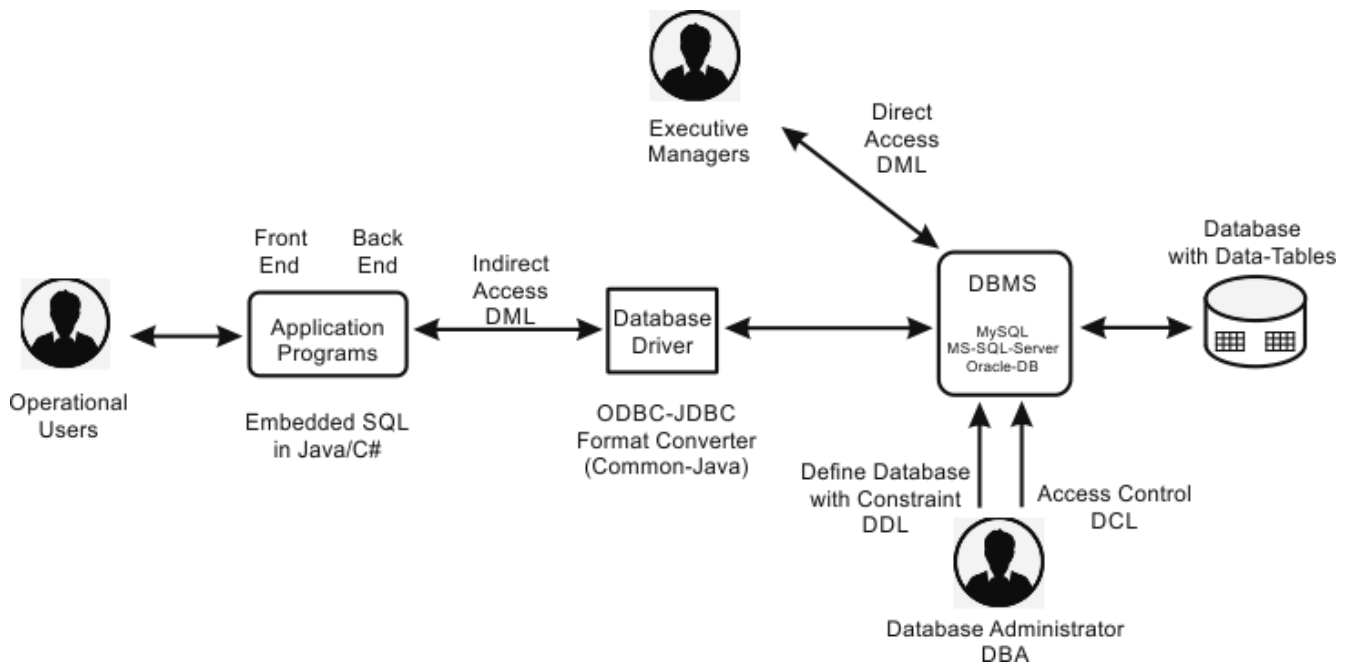


#### Database Objects

**2017-02**

Class—☐ Home—☐ Group—☐ Mock Exam—☐ Exam—☐

## DBMS – Database Management Software



### Examples of DBMS

MySQL, MS-SQL-Server, Oracle-DB, Postgre-SQL, IBM-DB2, Maria-DB, Mongo-DB

### PP Database Definition

<b>2014-02</b>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
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<b>2008-02</b>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
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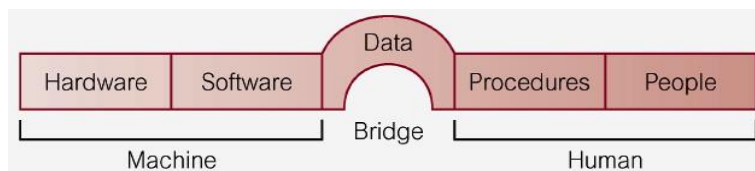
### Database System Classification

- Based on size  
[Personal databases, Workgroup databases, Departmental databases, Enterprise databases],  
Data Warehouse is an example for an enterprise database that is used for data mining.  
**2008-5, 2009-45, 2008-49, 2007-40, 2005-43**
- Based on Architecture  
[Distributed, Centralized]  
**2009-44, 2008-50, 2006-42**
- Based on data model  
[Natural Model (Hierarchy/Tree), Relational Model, Object Oriented Model, Object Relational Model, Matrix / Network Model]  
**2007-1**
- Based on the Purpose  
General-Purpose (MySQL, MS-SQL-Server, Oracle)  
Special-Purpose (YouTube-Video-DBMS, Google-Map-DBMS)

## Architecture of a Database System

### DBMS Components

#### 1. Major Compartments of a Database System.



#### **PP** Major Compartments of a Database System.

**2012-02**

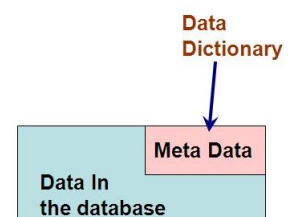
Class—☐ Home—☐ Group—☐ Mock Exam—☐ Exam—☐

#### 2. Data Dictionary/System Catalog/Information Schema

It is a part of the database that stores metadata.

All DDL-Definitions including name of tables, columns and their data types and other constraints are stored in the Catalog.

If anyone needs to use the data in the database, they could use the System Catalog to know about the properties of data that they are going to manipulate.



#### 3. Meta Data

Data that describe the characteristics of data stored in the database.

Description/Properties of data stored in the database.

#### 4. Example Characteristics Specified by Meta Data

- Name of the data item
- Size of the data item
- Data type of the data item
- Length of the data item
- Minimum and maximum allowable values.
- Rules on the data
- Constraints on the data
- Brief description of the data item.

##### Data Item

RegistrationMonth = 08

##### Meta Data

Name – RegistrationMonth  
 Type – Number  
 Length – 2 digits  
 Maximum – 12  
 Minimum – 01  
 Constraints – Single Digit (8) not allowed.

## 5. Importance of Meta Data

Database is a shared resource.

It is important to describe the data stored within the database to be useful for other users.

Otherwise Direct Users and Application Programs could not handle these data as they do not know anything about them.

### PP Data Dictionary

2017-41      Class-☐ Home-☐ Group-☐ Mock Exam-☐ Exam-☐

2007-02      Class-☐ Home-☐ Group-☐ Mock Exam-☐ Exam-☐

### PP Meta Data

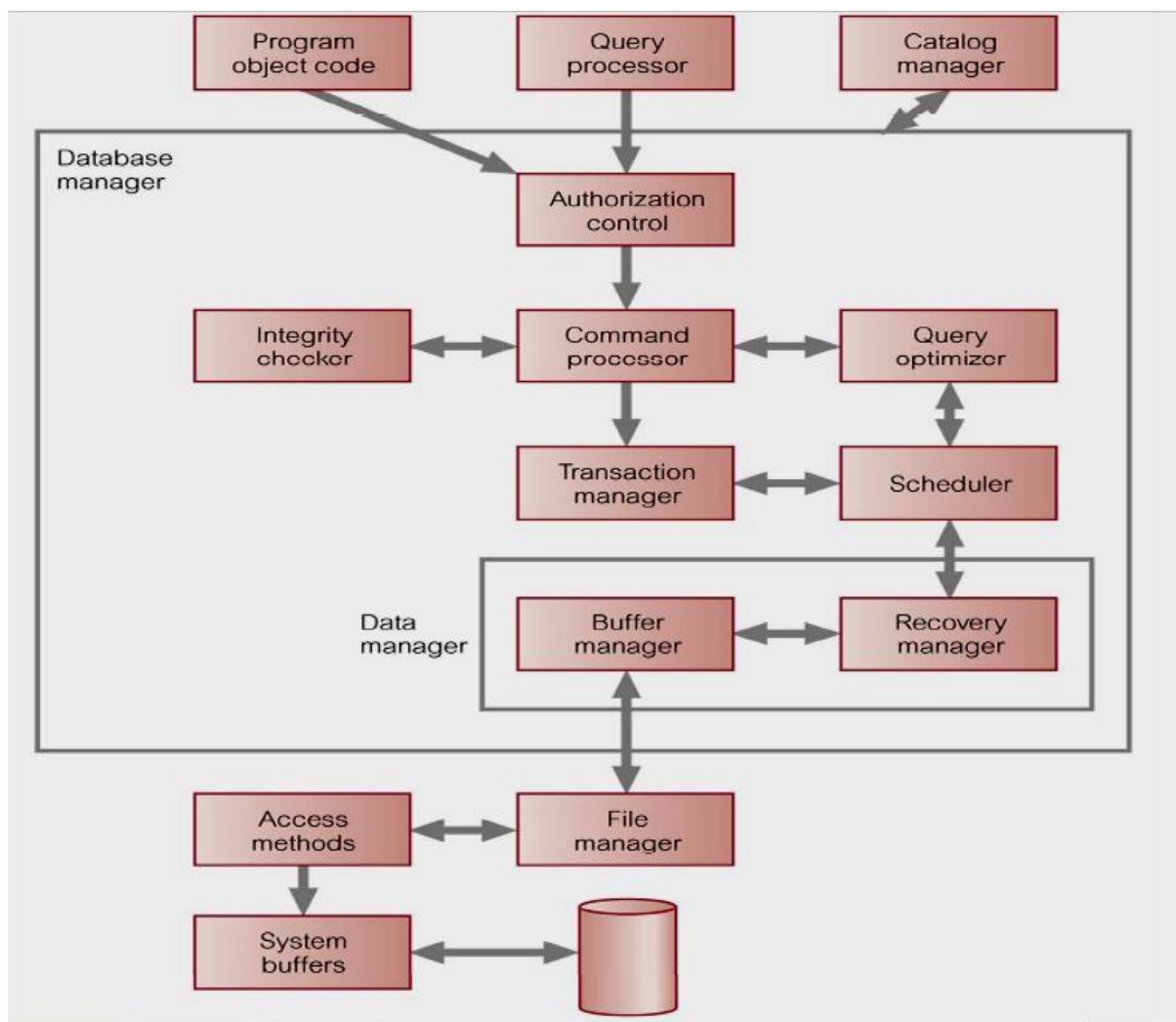
2018-07      Class-☐ Home-☐ Group-☐ Mock Exam-☐ Exam-☐

2012-04      Class-☐ Home-☐ Group-☐ Mock Exam-☐ Exam-☐

2007-03      Class-☐ Home-☐ Group-☐ Mock Exam-☐ Exam-☐

2015-03      Class-☐ Home-☐ Group-☐ Mock Exam-☐ Exam-☐

## 6. DBMS Components and Their Duties



**Catalog Manager**

Store and retrieve the meta-data in the system catalog/data dictionary.

Help other modules to use meta-data whenever they need.

Ex: Authorization Controller needs to have the list of users and their privilege levels.

Integrity Checker needs to know all the Constraint before it inserts Data into tables.

**Authorization Controller**

Authenticate and Authorize users to use the database.

Authenticate mean identify legitimate user by username and password.

Authorization mean allowing user to do various operations (insert, update ...etc.) on various tables

**Integrity Checker**

Integrity checker checks that the requested operation satisfies all necessary integrity constraints.

Ex : Inserting or changing the Month field to 13 will not be allowed by the Integrity checker as it is constrained to 0-12.

**Scheduler****Transaction Manager**

Scheduler is responsible to maintain concurrent operations without conflicting with one another.

It controls the relative order in which the transaction operations should be executed.

**Recovery Manager**

Recovery Manager is responsible to maintain database consistency in the presence of failures.

It will restore the database to last consistent state whenever error occur.

**Query Processor**

Query Processor process the SQL query to obtain a result set with the help of other components.

Execute Insert, Update, Delete and Select Operations.

**Query Optimizer**

Select the most efficient query plan from among a set of possible plans to retrieve data in less processing time.

**DBMS Components and Their Duty****2010-02**Class ☐ Home ☐ Group ☐ Mock Exam ☐ Exam ☐**2018-04**Class ☐ Home ☐ Group ☐ Mock Exam ☐ Exam ☐**2006-05**Class ☐ Home ☐ Group ☐ Mock Exam ☐ Exam ☐**2017-17**Class ☐ Home ☐ Group ☐ Mock Exam ☐ Exam ☐**2013-03**Class ☐ Home ☐ Group ☐ Mock Exam ☐ Exam ☐

## 3 Level Architecture ANSI-SPARC

### 1. What is the “ANSI/SPARC Three Level Architecture”?

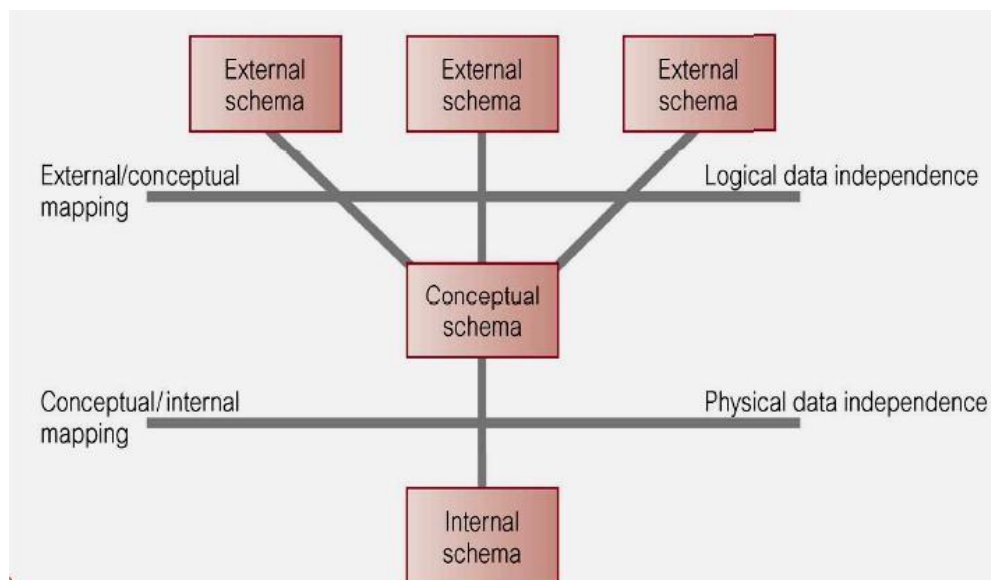
It is a standard architecture to build a database.

It was introduced by the SPARC committee under ANSI. (American National Standardization Institute)

### 2. Why it is needed to have a Standard Architecture for the Database System?

Database is a shared resource.

So, it is important to follow a standard architecture to minimize conflicts between users of the database system.

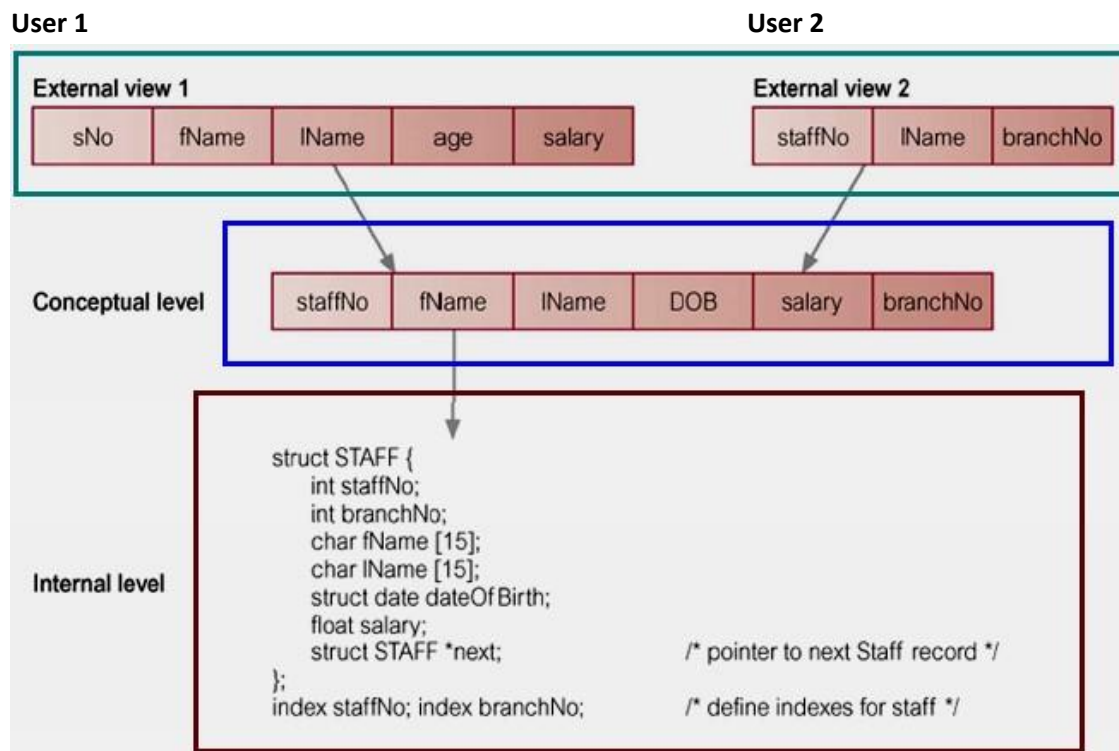


## Levels

### 3. What are the three layers defined in the “ANSI/SPARC Three Level Architecture”?

- |       |                      |                   |
|-------|----------------------|-------------------|
| (i)   | Conceptual / Logical | Layer/Schema/View |
| (ii)  | Physical / Internal  | Layer/Schema/View |
| (iii) | User / External      | Layer/Schema/View |

#### 4. Describe the above three layers using Block Diagrams as far as possible?



#### Conceptual Level / Logical Schema

The conceptual schema describes the entire database as a set of tables. It provides a complete view of the data requirements of the organization. This is independent of any storage considerations.

Simply, conceptual schema will describe about

- What are the tables (Entities) in the Database?
  - What are the Data fields (attributes) in the tables
  - What are the relationships (foreign keys) between each table.
- The constraints on the data
- Security and integrity information

You and your friend might propose 2 different conceptual schemas for a company.

Your schema may have 12 tables with various columns.

Your Friend's schema may have 8 tables with another set of columns.

But **one of them** will be selected to be implemented.

Defined by the DDL.

#### Internal Level / Physical Schema

Physical Schema describes the way how the actual data is stored in the storage devices such as hard disks.

Tables in the Conceptual schema will be stored in various places (HD, DVD, DB Servers) in various ways.

Data storage mechanisms may vary from one storage device to another. (B tree, B+ Tree, Hash-Files ..etc)

That means, you can store data of the conceptual schema in different ways in different places.

But only **one method** will be applied at a time.



Defining the physical schema is a duty of DBA, DBMS and the Operating System.

Actually, Internal Schema and Physical Schema are slightly different.

Internal Schema – The Format is defined by the DBMS (Depend on its language)

Physical Schema – The ultimate storage format is defined by

Operation System + Driver Software + Hardware Device

Database Tuning – Internal Schema should be defined to optimize the space utilization and run time performance. It is very important to establish a rapid responsive and efficient database.

Defined by the Storage Definition Language or the DDL.

Physical Structure of the Database should describe,

- Data structures which is used to store data in the storage.
- File organizations within the storage device.
- Storage space allocation for data.
- Details of indexes. (Indexes are used to access the stored data in the storage devices)
- Data Partition in Distributed Databases among different Database Servers. (Locations)

### External Schema / User View

When you developed the conceptual schema, you may not consider individual needs of each user separately. Instead you consider the data need of the whole company.

But each user needs to access specific set of data.

Different users need to use different set of data.

So, you need to rearrange the data for each user.

Though you have only one conceptual schema and one physical schema for the same database, there must be set of **different view for each user**. [View is a virtual table derived from one or more actual tables.]

Defined by Sub-Schema Definition Language or DDL.

### PP Levels

<b><u>2014-08</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>
<b><u>2012-08</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>
<b><u>2009-02</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>
<b><u>2017-01</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>
<b><u>2016-02</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>
<b><u>2014-05</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>
<b><u>2013-01</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>
<b><u>2011-07</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>
<b><u>2008-06</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>
<b><u>2006-03</u></b>	Class- <input type="checkbox"/>	Home- <input type="checkbox"/>	Group- <input type="checkbox"/>	Mock Exam- <input type="checkbox"/>	Exam- <input type="checkbox"/>

### Interdependencies

#### 5. What are the three types of Interdependencies seen in database systems?

- (i) Program Data Independence
- (ii) Physical Data Independence
- (iii) Logical Data Independence

## 6. Describe each of the above Independence briefly.

### Program Data Independence (Not relevant to the 3-level architecture)

This is an advantage of database approach against in file-base approach.

Data in the Database does not depend on the Application Programs.

They are independence from the Application Programs.

So, you can modify database structures without changing the application programs.

### Physical Data Independence

Physical schema could be change by replacing a new storage device or new storage structure without worrying about the Logical Schema.

So, the Physical schema is independent. (Physical Data Independence)

It proves that there is no effect on Logical Schema.

So, this will add Immunity/safety to the Logical Schema when the Physical schema is changing.

### Logical Data Independence

Logical Schema could be change without affecting the external views.

So, the Logical Schema is independent. (Logical Data Independence)

It proves that there is no effect on external schemas.

So, this will add Immunity to the external schemas when the logical schema is changing.

## PP Interdependencies

2009-03      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

2016-01      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

2013-02      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

2017-04      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

2009-04      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

2015-04      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

2010-03      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

2007-04      Class—☐    Home—☐    Group—☐    Mock Exam—☐    Exam—☐

## Advantage of External View

## 7. What is the importance of defining User Views?

### Hide unauthorized data

Ex:      Some of the examination details does not include in student-view.

### Provide user view

Ex:      Cashier has a user view that includes payment details.

Customized/natural view – Provide only what the data they need among lot of data.

This will increase working efficiency as they do not contain irrelevant data.

### Derive new attributes

Ex:      Age is derived from the date of birth in the database.

**Change unit of measurement**

Ex: Show price in US-Dollars for USA users, Euro for German users.  
But the price is actually stored in rupees in the DB.

**Define different security levels for data**

Ex: DBA can restrict the access to the same base tables by defining different views and access controlling for each user.

**8. What is the Mapping?**

The DBA will create the conceptual schema of the company database at the end of the database designing process.

Then the DBA will describe the conceptual schema to the DBMS using DDL of the SQL.

Then the DBMS will create the physical schema for the defined conceptual schema with the help of operating system as the DBA specified.

Then Users will insert data into the database.

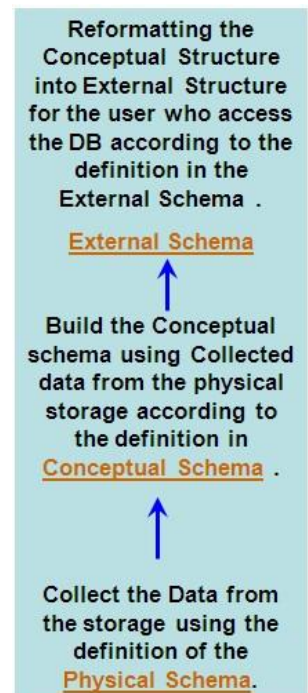
These data actually stored in stored media according to the physical schema.

Whenever user need data, the user will access the relevant user-view.

To build the user-view according to the view definitions, the DBMS should have to build the base-tables of the conceptual schema first.

So, it is needed to convert the Data in the Physical Schema into Logical Schema.

Ones the Conceptual Schema has been built, then it should be converted into the view tables.

**The above two conversions are called “Mapping between Levels” ?**

Converting the Physical Structure into Logical – Physical to Logical Mapping

Converting the Logical Structure into External – Logical to External Mapping

**Advantages of External View****2006-40**Class-☐ Home-☐ Group-☐ Mock Exam-☐ Exam-☐**2011-08**Class-☐ Home-☐ Group-☐ Mock Exam-☐ Exam-☐

## Database Users and Practitioners

### DBA-Database Administrator

#### 1. Stakeholders of Database System

Two different types of people (end-users and practitioners) are people who interact with the database.

##### End-Users

Clients of the database, who need information from the database to carry out their duties.

They may be Direct Users or Indirect Users.

Ex: Executives, managers, staff, clerical personnel

##### Practitioners

People responsible for creating and maintaining the database system and its associated application software.

Ex: Data and Database administrators, Database designers, Application developers.

#### 2. What is the difference between Direct Access and Indirect Access?

Direct	User will directly instruct the DBMS usually using static DML queries.
Indirect	User will interact with the DBMS via Application Programs. DML queries are embedded among the program codes (Java/C#) in the program. Query variables are able to be changed depends on the user inputs. So, Dynamic SQL. (Programmatic SQL)

##### Embedded/Programmatic/Dynamic SQL

2011-03, 2012-33, 2009-44, 2008-44, 2007-38, 2006-37

##### ODBC-Open Database Connectivity

2008-48, 2007-39

##### Triggers

2008-45, 2008-46, 2006-43

##### Stored Procedures

2008-47, 2007-35, 2006-44, 2006-45

### 3. Difference between Data Administrator (DA) and Database Administrator (DBA)?

#### Data Administrator (DA)

The person who create policies for whole data of the company to achieve the company vision.

Ex: Policies for Access restriction for users, Security of Data, Privacy of Data.

He does not need to have Technical Knowledge about the Database.

He does not control the User Access to the DB.

(DA just create access policies. These policies will be implemented by the DBA.)

#### Database Administration (DBA)

A person who take care of the database at all.

He should have, Managerial Knowledge (Company Policies) Technical Knowledge (About the DBMS)

There may be a staff to assists the DBA.

DBA can replace DA.

### 4. What are the responsibilities of DBA?

1. Authorize the users to access the Database according to the company policies.
2. Monitor and Co-ordinate the Use of the Database.
3. Acquire needed Software and Hardware to maintain and to upgrade the Database as needed.
4. Response time of the Database for Application users.
5. Security and Integrity of the Data in the Database.
6. Communicating with Database Users.
7. Designing, Planning and Implementing the Database.
8. Establishing Standards and Policies for the Use of the Database.
9. Database recovery.



#### Duties of Database Administrator

<u>2011-06</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2018-02</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2006-06</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2007-06</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2009-01</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2008-03</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>

## Database Languages

### DDL, DCL and DML

#### 1. What are Database Languages?

Give Some Examples or Database languages used in Relational Databases.

Languages used to talk with the DBMS.

Languages used to create, use and control database.

- ☐ SQL – Structured Query Language
- ☐ Relational Algebra
- ☐ Relational Calculus
- ☐ QBE – Query By Example

#### 2. What is the difference between Procedural vs Non-Procedural?

Procedural DML/Non-Declarative : Relational Algebra

Procedural DML instruct DBMS both what data to be retrieved and how to be retrieved.

They specify the retrieval procedure, so called Procedural.

Non-Procedural DML/Declarative : SQL-DML/Relational Calculus/QBE-Query-By-Example

Non-Procedural DML instruct DBMS what data to be retrieved.

They do not specify how to be retrieved.

#### 3. What are the major categories of DML? Describe their usage briefly.

(i) DDL–Data Definition Language:

Use to define/create tables, views, indexes of the database by DBA.

**[Create]**-Define Table Structure, **[Alter]**-Modify Table Structure, **[Drop]**-Remove a Table]

(ii) DML–Data Manipulating Languages:

Use by database users to insert data into the tables. **[Insert, Select, Update, Delete]**

(iii) DCL–Data Control Languages: Use to control the user access by the DBA.

**[Grant]**-Give Privileges to do DML-Operations on Tables, **[Revoke]**-Remove Privileges]



## Database Languages

<u>2018-01</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2017-03</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2015-02</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2012-30</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2011-03</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2010-05</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2010-25</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2009-05</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2009-44</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>

2008-16—☐, 2008-44—☐, 2008-48—☐, 2007-38—☐, 2007-39—☐,  
2006-04—☐, 2012-19—☐, 2011-37—☐

<u>2018-14</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2017-08</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2016-06</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2014-16</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2011-22</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2008-10</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2006-39</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2018-13</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>
<u>2017-15</u>	Class— <input type="checkbox"/>	Home— <input type="checkbox"/>	Group— <input type="checkbox"/>	Mock Exam— <input type="checkbox"/>	Exam— <input type="checkbox"/>

### Relational Algebra

Procedural query language.

Select, Project, Union, set different, Cartesian product, Intersection, Join and Division are the basic operation. They accept relations/tables as their input and produces relations as their output.

Query-Processor will break a Declarative SQL-Query into set of RA-Procedure.

### Relational Calculus

Non-Procedural.

It uses mathematical predicate calculus instead of algebra.

Based on Universal and Existential Quantifier.

It is consisted for Domain Relation Calculus and Tuple Relational Calculus.

Expressing Power of both Relational Algebra and Relational Calculus are same, that mean anything that you could do with Relational Algebra is also possible with Relational Calculus.

### QBE –Query by Example (Visual Database Language)

Non-Procedural.

Originally limited to select data, but QBE was later extended to allow other operations, such as inserts, deletes and updates, as well as creation of temporary tables.

## Database Administration Practical Guideline

### 1. Installing the DBMS (MySQL Server 8.0.16)

Database Administrator's primary duty is to install a suitable DBMS for the company. Following screen shots show the default Installation and Configuration Process. Each step is very important to be considered. You will later learn what are the importance of each configuration step. For the moment just follow the default Installation Process and default Configuration Process.

#### Step 1 : Download the Setup File from the web

Search 'download mysql' at the Google search engine

Select the MySQL official web page that allows you to download the DBMS. (<https://dev.mysql.com/downloads/>)

Click on "MySQL Community Server".

Click on "MySQL Installer for Windows" banner.

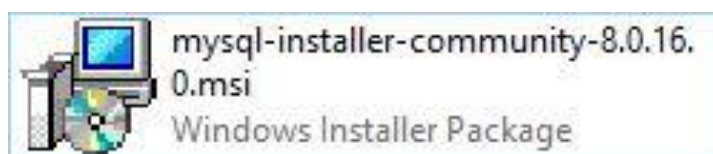
Select the platform (Microsoft Windows)

Click on Download the MySQL Community Server (Offline version is much preferable)

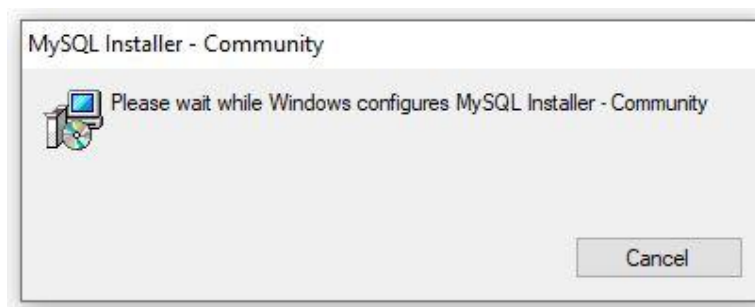
Click on "No thanks, just start my download".

Save the Downloaded file .

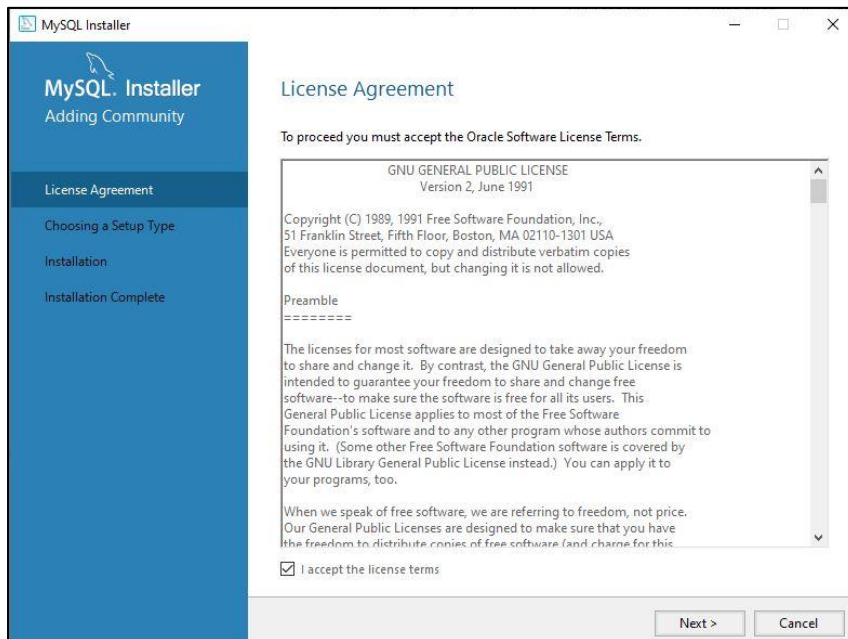
#### The Setup File



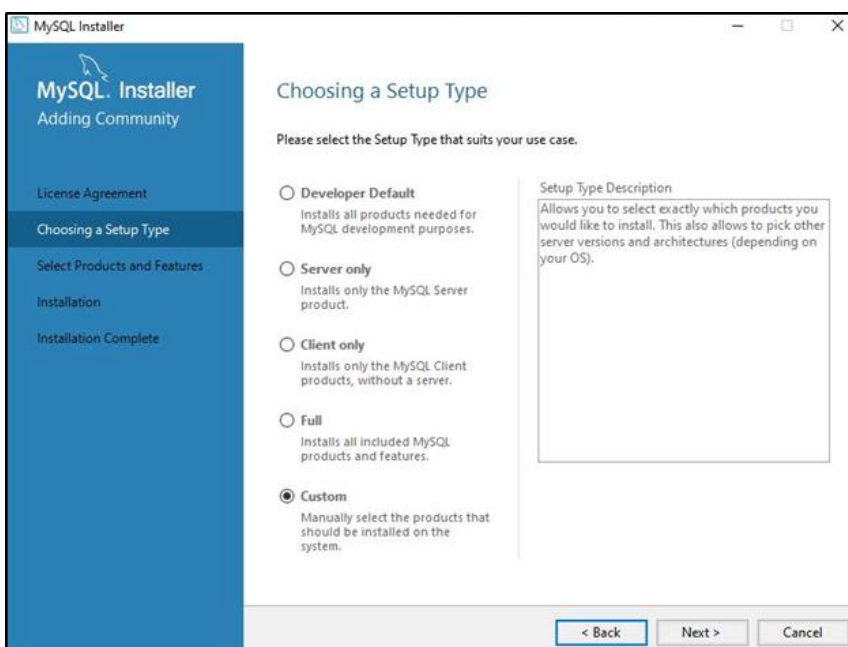
**Step 2 : Install the MySQL by double clicking the Setup File and giving Administrative Permission to install. Then, Wait until installation wizard appear on the screen.**



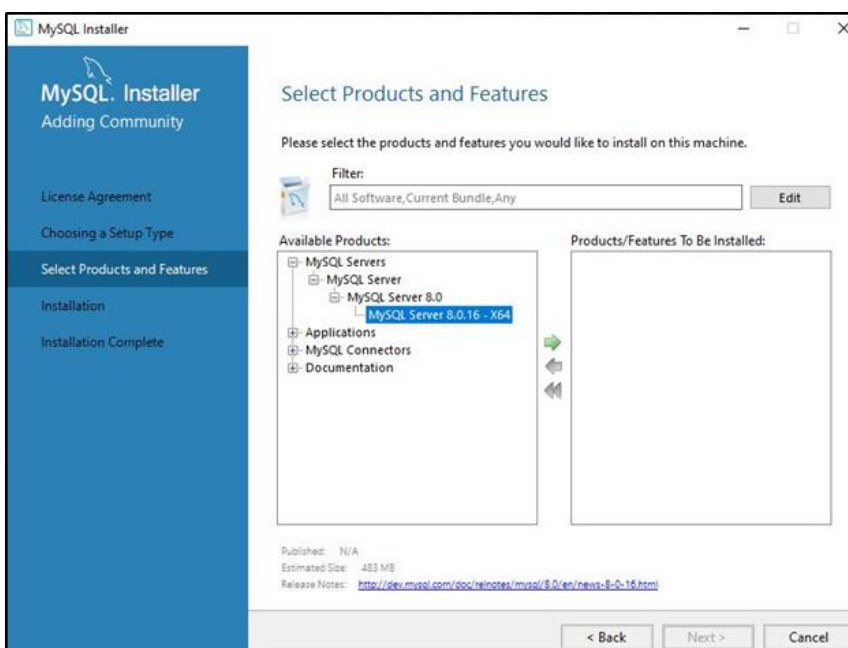




Accept the license terms,  
Then click, Next.



Choose "Custom",  
Then click Next.

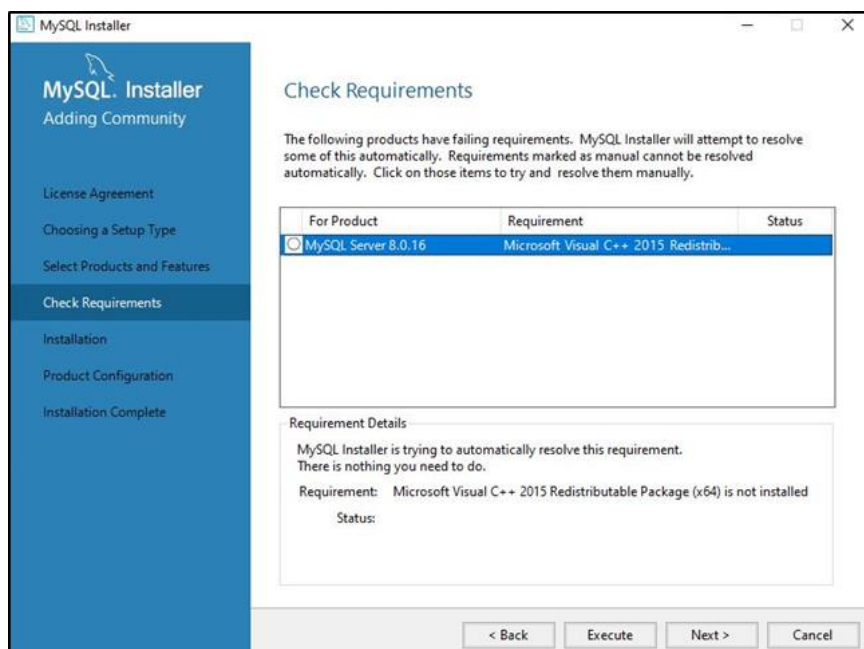


Expand (MySQL Servers -> MySQL Server -> MySQL Server 8.0 )

Select "MySQL Server 8.0.16 -x64" .

Click on right arrow key.

Then, click Next.

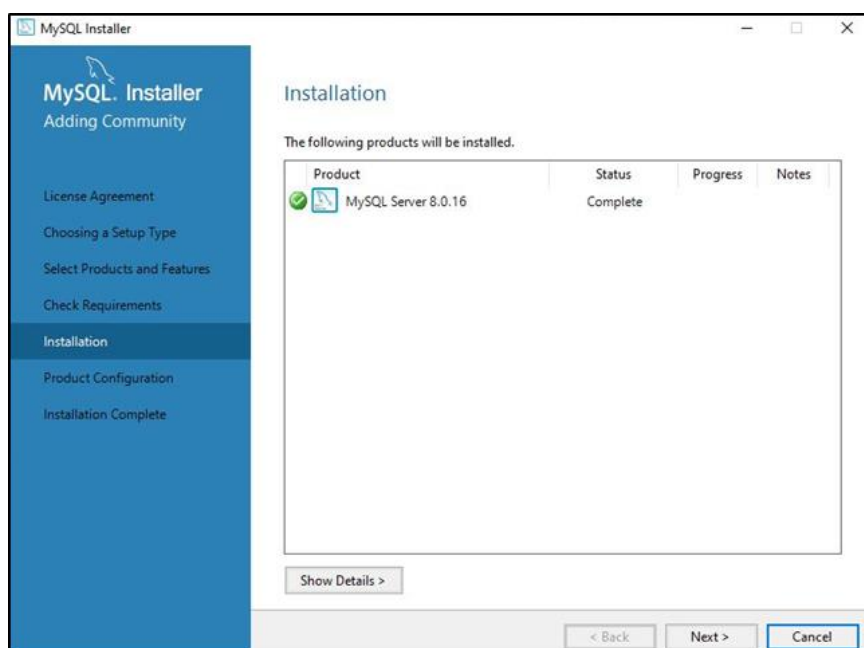
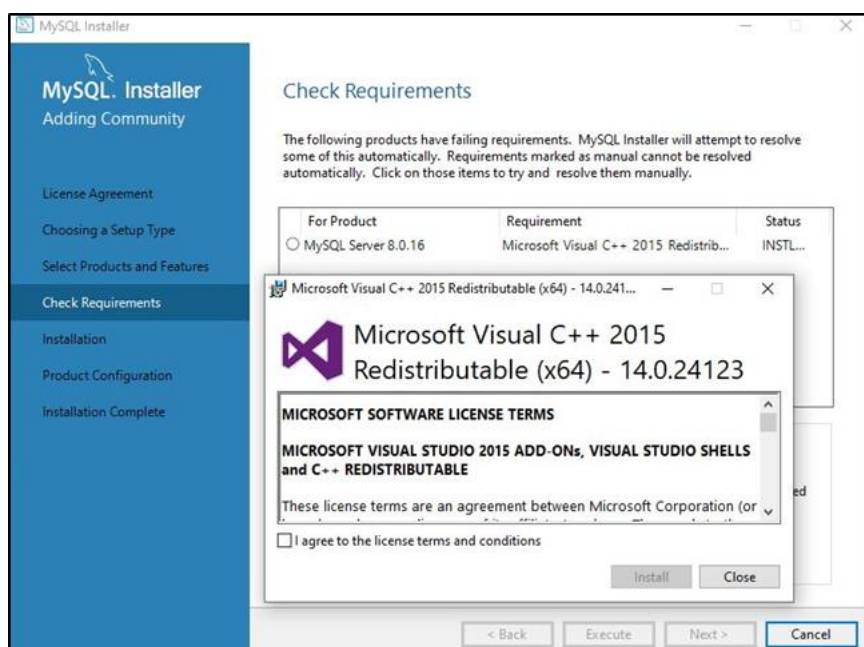


*If this page appears it means that you'll need to install supportive software to run MySQL Server.*

*If you have an active internet connection click on Next. (The wizard will automatically download necessary files)*

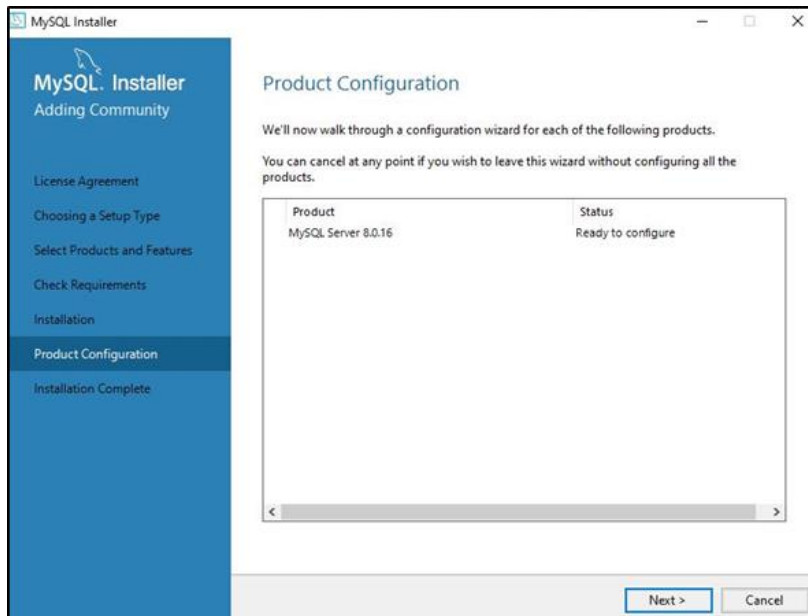
*If you don't have an internet connection, you'll need to manually download required files and install.*

*Click on next after successful installation*

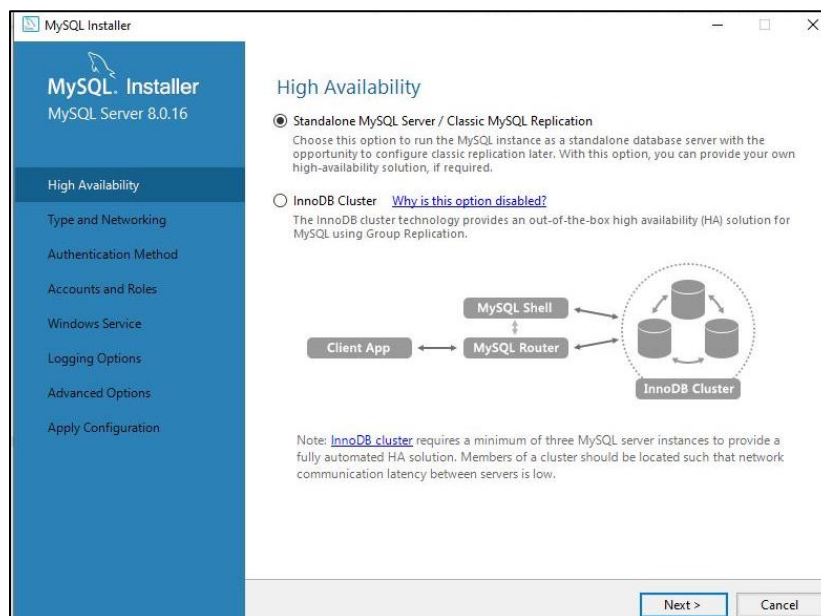


*After installing the DBMS, it is needed to Configure (Modify) the DBMS as needed for the Application Environment.*

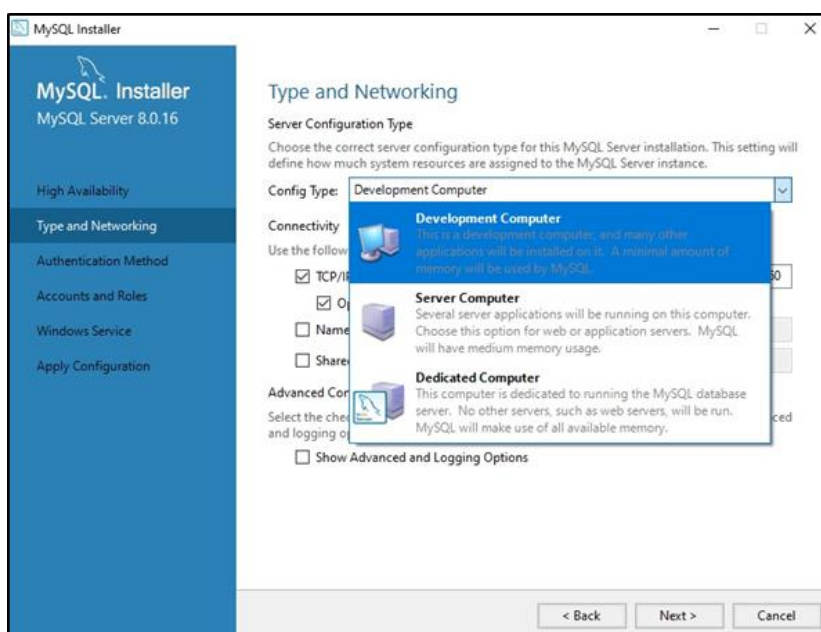
*Click next to continue with the Configuration Wizard.*



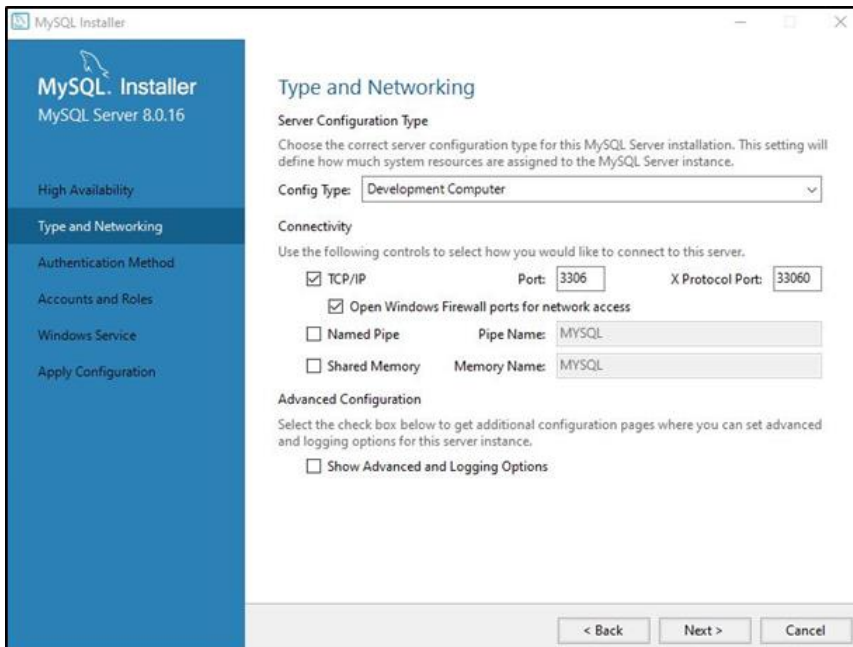
**Step 3 : Configure the My SQL as needed by the Application Environment.**



*Click Next.*



*Select config type as "Development Computer".*



**MySQL Installer**  
MySQL Server 8.0.16

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

### 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:

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

☒ TCP/IP Port:  X Protocol Port:

☒ Open Windows Firewall ports for network access

☐ Named Pipe Pipe Name:

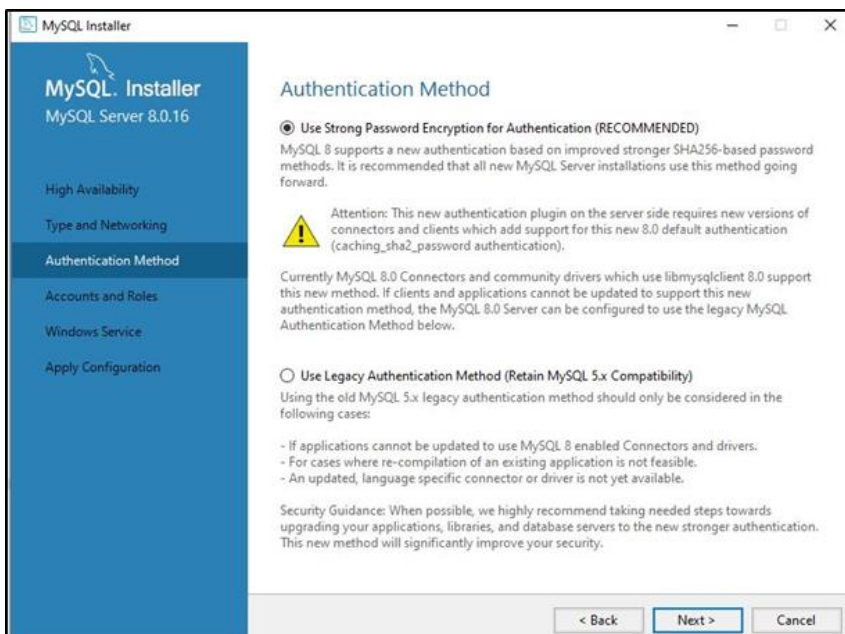
☐ Shared Memory Memory Name:

**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

< Back Next > Cancel

Click Next.



**MySQL Installer**  
MySQL Server 8.0.16

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

### 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.

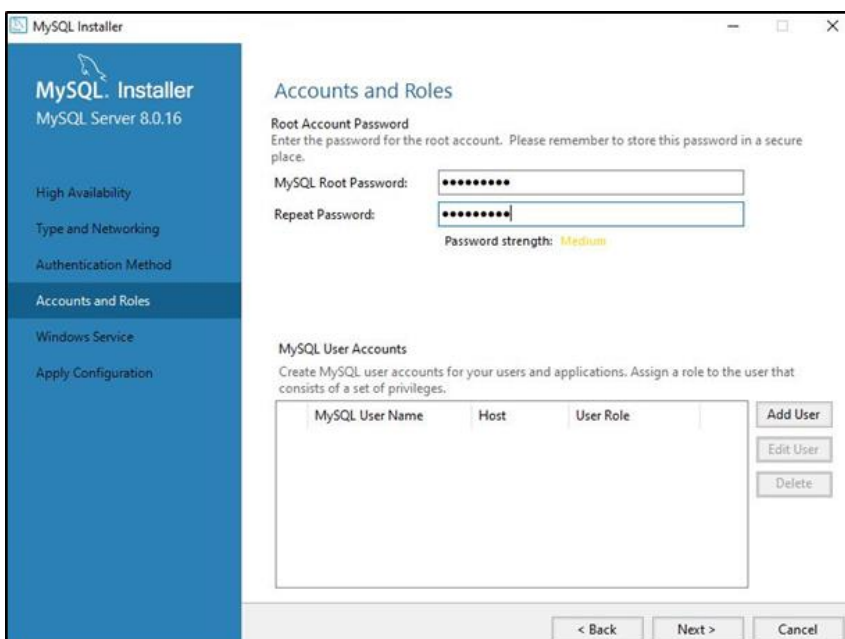
☐ **Use Legacy Authentication Method (Retain MySQL 5.x Compatibility)**  
Using the old MySQL 5.x legacy authentication method should only be considered in the following cases:

- 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.

< Back Next > Cancel

Click Next.



**MySQL Installer**  
MySQL Server 8.0.16

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

### 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: **Medium**

**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.

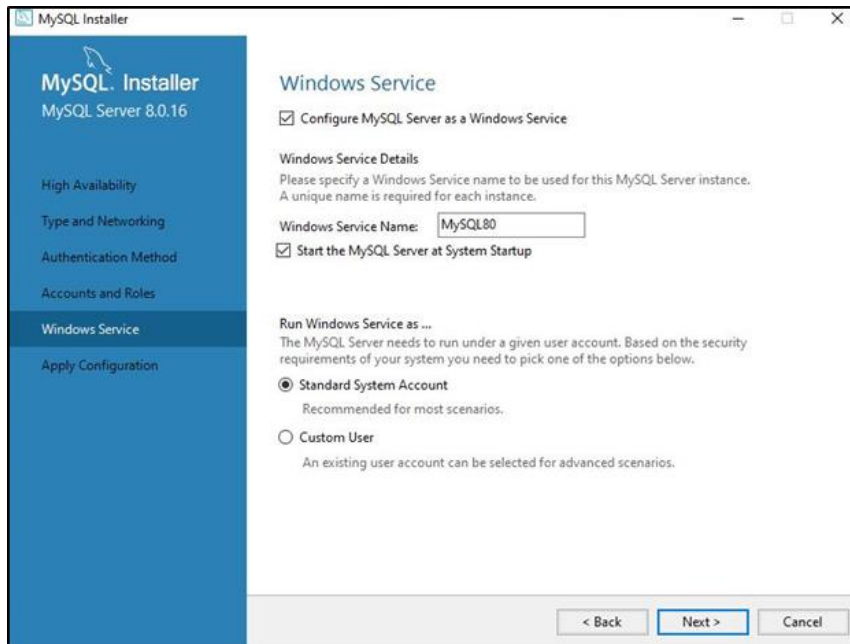
MySQL User Name	Host	User Role

Add User Edit User Delete

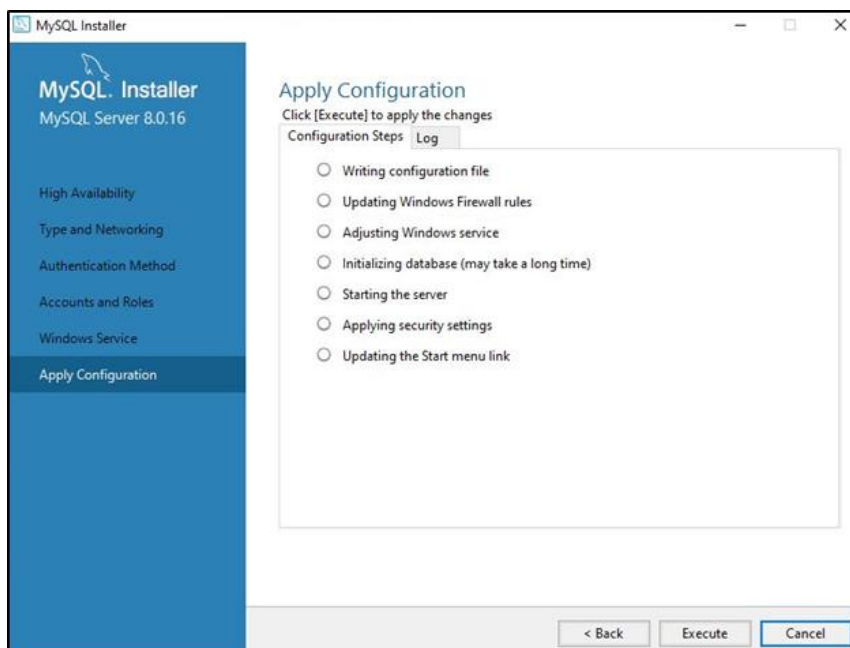
< Back Next > Cancel

Type a password for MySQL root user.

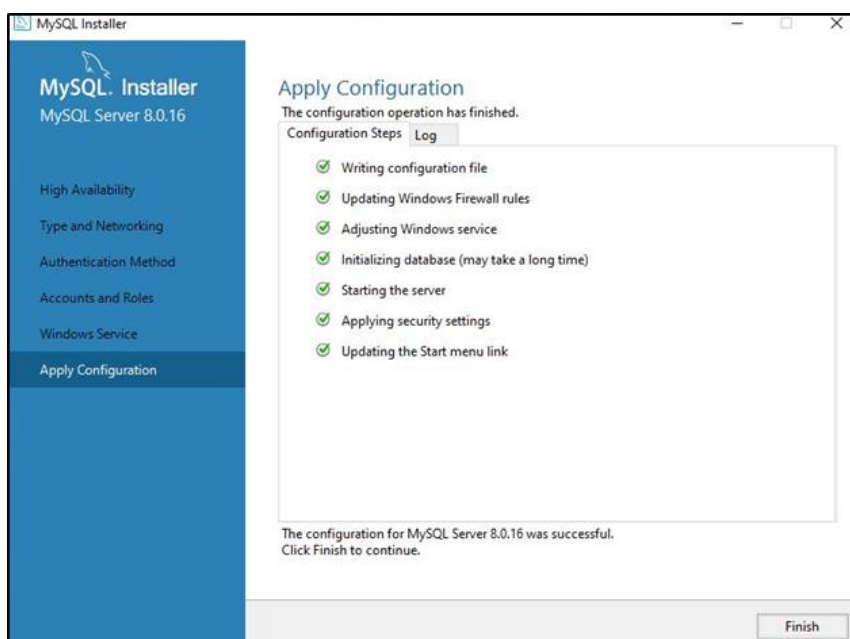
Ex. Earth-001



Click Next.



Click Execute.



Wait a moment for wizard to complete the configuration.

After done Click on Finish.  
In the installer click on next then finish.



**SQL Commands Needed**

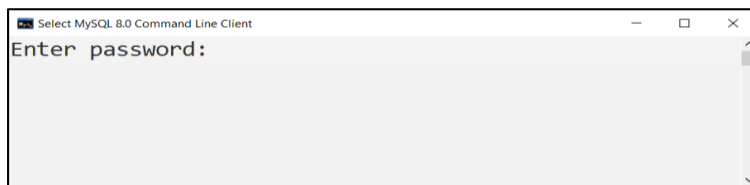
- DDL (Data Definition Language) – Create, Alter, Drop
- DML (Data Manipulation Language) – Insert, Select, Update, Delete
- DCL (Data Controlling Language) – Grant , Revoke

**Practical – 1 : DDL for Defining Tables and DML for Manipulating Tables**

1. Download MySQL Setup.
2. Install MySQL.
3. Configure MySQL.
4. Invoke MySQL Command Line Client.
5. Logging giving the password for Root Account.
6. Create a database. (earth)
7. Select the database. (use earth)
8. Create a table. (student)
9. Insert/Select/Update/Delete data to and from the table.
10. Alter the table
11. Drop table and database
12. Show databases.
13. Show tables.
14. Show columns from tables

**Step 4 : Invoke the My SQL Command Line Client**

Start Menu → MySQL → MySQL 8.0 Command Line Client

**Step 5 : Logging to the DBMS (Enter root account password)**

```
Enter password: ****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 9
Server version: 8.0.16 MySQL Community Server - GPL

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owners.

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

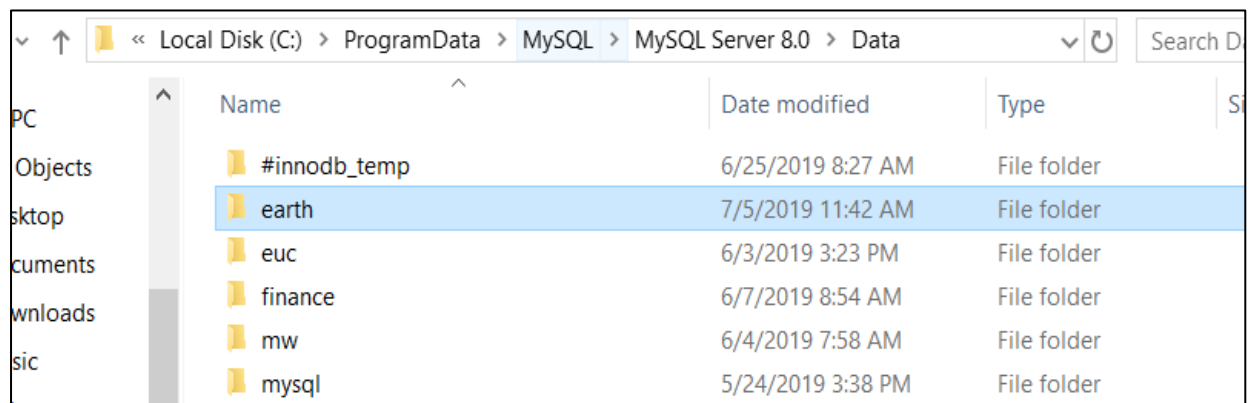
mysql>
```

**Step 6 : Creating a Database**

```
mysql> create database earth;
Query OK, 1 row affected (0.47 sec)
```

**Observe the newly Created Database in the MySQL data folder.**

("C:\ProgramData\MySQL\MySQL Server 8.0\Data" – Location might differ on OS)



### Step 7 : Selecting the Database

```
mysql> use earth;
Database changed
```

### Step 8 : Creating a Table in the selected database (Here it is "earth")

### Appearance of the proposed Table

***student (earth.student)***

<i><u>name</u></i>	<i>age</i>	<i>gender</i>

### Design Specification of the Table

- |                          |         |                   |
|--------------------------|---------|-------------------|
| (1) Name of the Database | earth   |                   |
| (2) Name of the Table    | student | ( earth.student ) |
| (3) Column Definitions   |         |                   |

Column Name	Data Type	Maximum Length	Constraint	Other Constraint
name	Text	30	Primary Key	Not Null, Unique
age	Numeric	2	-	-
gender	Text	6	-	-

## DDL(SQL) Description of a Table

Table Name (Column Definition1, Column Definition2, ..., Constrain Definitions-If needed ) ;

Column Definition –	ColumnName	Domain/DataType (Length)	Constraints-If needed
---------------------	------------	--------------------------	-----------------------

```
student    (      name      varchar(30)  primary key ,
              age          int(2) ,
              gender       varchar(6)
            ) ;
```

---

```
create table student (name varchar(30) primary key , age int(2) , gender varchar(6));
```

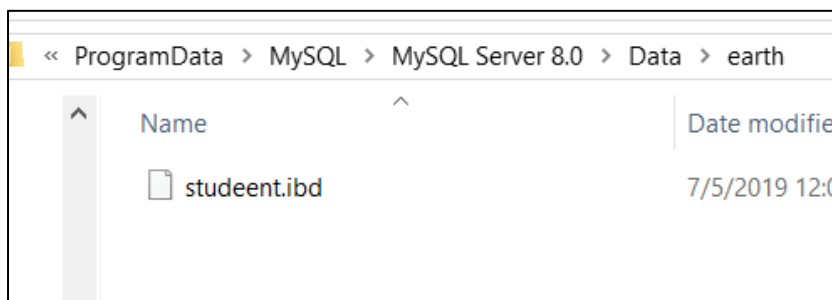
---

```
mysql> create table student (name varchar(30) primary key, age int(2),
gender varchar(6));
Query OK, 0 rows affected (0.96 sec)
```

\*You can also separate column definition by pressing enter.

```
mysql> create table student(
-> name varchar(30) primary key,
-> age int(2),
-> gender varchar(6)
-> );
```

**Observe the newly Created Table in the relevant Database Folder of the MySQL data folder.**



### **Step 9(a) : Insert data into the student table**

#### **Appearance of the proposed Table**

student (earth.student)

<u>name</u>	<u>age</u>	<u>gender</u>
Nalinda	21	Male

**(1) User should give values for all the columns.**

```
insert into tableName values (firstColumnName, secondColumnName ....);
```

**(2) User can give any number of columns.**

But should obey the constraints of the table.

If a column is not null(PK), user must give a value to that column necessarily

```
insert into tableName (firstColumnName, ....) values (firstColumnName, ...);
```

```
insert into student values ("Nalinda", 21, "Male") ;
```

```
mysql> insert into student values("Nalinda",21,"Male") ;
Query OK, 1 row affected (0.15 sec)
```



```
insert into student(name, gender) values("Tharindu", "Male") ;
mysql> insert into student(name, gender) values ("Tharindu", "Male");
Query OK, 1 row affected (0.14 sec)
```

```
insert into student(age, gender) values(24, "Male") ;
mysql> insert into student(age, gender) values (24, "Male");
ERROR 1364 (HY000): Field 'name' doesn't have a default value
```

Primary Key should not be Null. "name" is the PK of the "student" table. So it is a Compulsory.

```
insert into student values("Nalinda", 26, "Male") ;
mysql> insert into student values ("Nalinda", 26, "Male");
ERROR 1062 (23000): Duplicate entry 'Nalinda' for key 'PRIMARY'
```

Primary Key should not be repeated.

It should be unique. One and Only 'Nalinda' could be inserted into the table.

```
insert into student values ('Pathum', 21, 'Male') ;
mysql> insert into student values("Pathum", 21, "Male");
Query OK, 1 row affected (0.17 sec)
```

Both "age" and "gender" columns are not unique columns. They are no need to be "Not Null" as well.

### Step 9(b) : Selecting/Viewing data from the student table

#### Appearance of the Expected Table

*student*

<u>name</u>	age	gender
Nalinda	21	Male
Tharindu	Null	Male
Pathum	21	Male

select \* from student ;      " \* " means "All" ( Select all from student )

```
mysql> select * from student;
+-----+-----+-----+
| name   | age  | gender |
+-----+-----+-----+
| Nalinda | 21   | Male   |
| Pathum  | 21   | Male   |
| Tharindu | NULL | Male   |
+-----+-----+-----+
3 rows in set (0.10 sec)
```

select name, age from student;      (Select All tuples/rows of the Specified Columns)

```
mysql> select name,age from student;
+-----+-----+
| name   | age  |
+-----+-----+
| Nalinda | 21   |
| Pathum  | 21   |
| Tharindu | NULL |
+-----+-----+
3 rows in set (0.00 sec)
```

`select * from student where name="Pathum";` (Select All columns of the Specified row(s))

```
mysql> select * from student where name = "Pathum";
+-----+-----+-----+
| name  | age  | gender |
+-----+-----+-----+
| Pathum | 21  | Male   |
+-----+-----+-----+
1 row in set (0.00 sec)
```

`select age, gender from student where name='Pathum' ;`  
(Select Specified Columns for the Specified Rows)

```
mysql> select age, gender from student where name = "Pathum";
+-----+-----+
| age  | gender |
+-----+-----+
| 21   | Male   |
+-----+-----+
1 row in set (0.00 sec)
```

`select gender from student where age > 20;`

According to the rules of “Relational Database Model”, the output should contain any value only at ones. But, according to the SQL, it is possible to setup duplicates, if need.

```
mysql> select gender from student where age > 20;
+-----+
| gender |
+-----+
| Male   |
| Male   |
+-----+
2 rows in set (0.00 sec)
```

It is possible to define a table without a PK. (But it is opposite to the Relational Model)

`select name from student where age is null;`

```
mysql> select name from student where age is null;
+-----+
| name  |
+-----+
| Tharindu |
+-----+
1 row in set (0.00 sec)
```

`select name from student where age is not null;`

```
mysql> select name from student where age is not null;
+-----+
| name  |
+-----+
| Nalinda |
| Pathum  |
+-----+
2 rows in set (0.00 sec)
```

**Step 9(c) : Updating/Modifying data in the student table**

*Update TableName Set ColumnName = NewValue Where .....Selection Criteria....*

update student set age=21 where name='Tharindu' ;

```
mysql> update student set age = 21 where name = "Tharindu";
Query OK, 1 row affected (0.13 sec)
Rows matched: 1  Changed: 1  Warnings: 0

mysql> select * from student;
+-----+-----+-----+
| name   | age  | gender |
+-----+-----+-----+
| Nalinda | 21  | Male   |
| Pathum  | 21  | Male   |
| Tharindu | 21  | Male   |
+-----+-----+-----+
3 rows in set (0.00 sec)
```

Update student set name='Nalinda' where name='Tharindu' ;

```
mysql> update student set name = "Nalinda" where name = "Tharindu";
ERROR 1062 (23000): Duplicate entry 'Nalinda' for key 'PRIMARY'
```

It is the Primary Key. Primary Key could not include duplicate names.

Update student set gender='male' where gender='Male';

```
mysql> update student set gender = "gender" where gender = "Male";
Query OK, 3 rows affected (0.17 sec)
Rows matched: 3  Changed: 3  Warnings: 0

mysql> select * from student;
+-----+-----+-----+
| name   | age  | gender |
+-----+-----+-----+
| Nalinda | 21  | gender |
| Pathum  | 21  | gender |
| Tharindu | 21  | gender |
+-----+-----+-----+
3 rows in set (0.00 sec)
```

SQL Key Words are not case sensitive. ( SELECT = Select = select = SeLEct )

But Data Items are case sensitive. ( 'Male' and 'male' will show as they appeared )

But the MySQL DBMS will operate them as case in-sensitive.

For MySQL, both 'Pathum' and 'pathum' is equal.

```
mysql> SeLEct * from student where name = "pathum";
+-----+-----+-----+
| name   | age  | gender |
+-----+-----+-----+
| Pathum | 21  | gender |
+-----+-----+-----+
1 row in set (0.00 sec)
```

```
mysql> insert into student values ("pathum", 21, "Male");
ERROR 1062 (23000): Duplicate entry 'pathum' for key 'PRIMARY'
```

**Step 9(d) : Deleting/Removing data from the student table****(a) Selected Deletion – Delete only specified set of tuples(records/rows/instances).**

*Delete From TableName .....Selection Criteria ...*

delete from student where name = 'Nalanda';

```
mysql> delete from student where name = "Nalinda";
Query OK, 1 row affected (0.34 sec)

mysql> select * from student;
+-----+-----+-----+
| name   | age  | gender |
+-----+-----+-----+
| Pathum | 21   | gender |
| Tharindu | 21  | gender |
+-----+-----+-----+
2 rows in set (0.00 sec)
```

**(b) Delete all tuples from the table. But it does not delete the Table from the database.**

delete from student

```
mysql> delete from student;
Query OK, 2 rows affected (0.18 sec)

mysql> select * from student;
Empty set (0.00 sec)
```

**Step 10 : Altering/Modifying the structure of the student table****Appearance of the existing Table**

*student (earth.student)*

<u>name</u>	age	gender

**Appearance of the proposed Table**

*student (earth.student)*

<u>name</u>	age	gender	nic

**(i) Add a Column to an Existing Table**

*Alter Table tableName Add ( Column Definition1, .... );*

(You could add more columns)

alter table student add( nic char (10) );

(Fix length Attributes – char )

(Varying length – varchar )

```
insert into student values('Thilan', 23, 'male', '871891834V') ;
select * from student ;
```

```
mysql> alter table student add (nic char(10) );
Query OK, 0 rows affected (0.68 sec)
Records: 0 Duplicates: 0 Warnings: 0

mysql> insert into student values ("Thilan",23,"male","871891834V");
Query OK, 1 row affected (0.07 sec)

mysql> select * from student;
+-----+-----+-----+-----+
| name   | age  | gender | nic       |
+-----+-----+-----+-----+
| Thilan | 23   | male   | 871891834V |
+-----+-----+-----+-----+
1 row in set (0.00 sec)
```

Here you could insert any record without providing the 'nic' value as it is not a "Not Null" column.  
 insert into student(name, age, gender) values('Dilanka' , 21 , 'male');

## (ii) Remove a column from a table.

*Alter Table tableName Drop columnName;*

```
alter table student drop nic;
```

```
mysql> alter table student drop nic;
Query OK, 0 rows affected (1.36 sec)
Records: 0 Duplicates: 0 Warnings: 0

mysql> select * from student;
+-----+-----+-----+
| name   | age  | gender |
+-----+-----+-----+
| Dilanka | 21   | male   |
| Thilan  | 23   | male   |
+-----+-----+-----+
2 rows in set (0.00 sec)
```

## Step 11(a) : Removing the student table from the database

*Drop Table tableName;* (Act same as the Restricted mode, Will not remove the table if there are data in the table )  
*Drop Table tableName Restrict;*

*Drop Table tableName Cascade;* (Remove the whole table including all the data within it)

**\*\*But, in the MySQL DBMS, all statement will remove the table even though there are data in the table.**

```
drop table student restrict;
```

```
mysql> drop table student restrict;
Query OK, 0 rows affected (0.45 sec)

mysql> select * from student;
ERROR 1146 (42S02): Table 'earth.student' doesn't exist
```

**Step 11(b) : Removing the database from the DBMS**

*Drop Database dbName ;*

**\*\*Some SQL DBMS versions may have 'Restricted' and 'Cascade' options.**

(Restricted – If there are tables in the database, the DBMS will not drop the database.)

(Cascade – Even though there are non-dropped tables in the database, they will be dropped with the database as well.)

*Drop Database dbName Restrict;*

*Drop Database dbName Cascade;*

`drop database earth ;`

```
mysql> drop database earth;
Query OK, 0 rows affected (0.47 sec)

mysql> use earth;
ERROR 1049 (42000): Unknown database 'earth'
```

Schema Vs Database – Some DBMS vendors use 'schema' instead of 'database' ;

```
mysql> create database academic;
Query OK, 1 row affected (0.08 sec)
```

```
mysql> create schema earth;
Query OK, 1 row affected (0.25 sec)
```

Name	Date modified
#innodb_temp	6/25/2019 8:27 AM
academic	7/5/2019 3:05 PM
earth	7/5/2019 3:04 PM
euc	6/3/2019 3:23 PM
finance	6/7/2019 8:54 AM

**Step-12 : Listing the tables of a Database.**

Here you have to select the database first.

If the database does not have any table, it will return 'empty' set.

```
mysql> show tables;
ERROR 1046 (3D000): No database selected
```

```
mysql> use earth;
Database changed
```

```
mysql> show tables;
Empty set (0.15 sec)
```

```
mysql> create table student (
  -> name varchar(30) primary key,
  -> age int(2)
  -> );
Query OK, 0 rows affected (0.62 sec)
```

```
mysql> show tables;
+-----+
| Tables_in_earth |
+-----+
| student          |
+-----+
1 row in set (0.02 sec)
```

```
mysql> create table department (
  -> depno int(2),
  -> depname varchar(30)
  -> );
Query OK, 0 rows affected (0.46 sec)
```

### **Step-13 : show tables from earth**

```
mysql> show tables;
+-----+
| Tables_in_earth |
+-----+
| department      |
| student         |
+-----+
2 rows in set (0.02 sec)
```

« ProgramData » MySQL » MySQL Server 8.0 » Data » earth		
	Name	Date modified
	department.ibd	7/5/2019 3:19 PM
	student.ibd	7/5/2019 3:10 PM

### **Step-14 : show columns of a table**

```
mysql> describe student;
+-----+-----+-----+-----+-----+-----+
| Field | Type          | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| name  | varchar(30)   | NO   | PRI | NULL    |       |
| age   | int(2)        | YES  |     | NULL    |       |
+-----+-----+-----+-----+-----+-----+
2 rows in set (0.11 sec)
```

## **Practical – 2 : DCL for Controlling Access to Tables**

Data Control Language (DCL) is used for control access of data (authorization).

DCL Commands include,

- GRANT – To allow specified **user** to do specified tasks.
- REVOKE – Remove user accessibility to database object.

The privileges that are granted or revoked from a specified user can be applied to both Data Control Language (DCL) and Data Manipulation Language (DML), and may include create, alter, drop, insert, update, delete, select.

### **MYSQL Database users**

By default, a “root” account is created when configuring a MySQL database. The root account has the highest privileges. Giving out root authentication details for employees who access the database may be problematic.

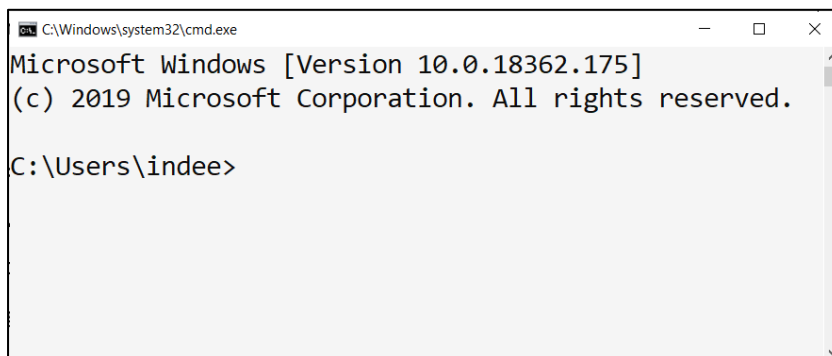
Solution is to create user accounts for each employee. By doing so database administrator can audit activities occur in the system.

### **Practical 2.1:**

Important: You learnt to log into MySQL database using built in MySQL command line client program. This program logs into root account by default.

As we are working with user accounts other than root, use windows command prompt.

Open Command prompt program.



```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 10.0.18362.175]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\indee>
```

Type in command prompt,

```
cd <bin folder location in MySQL installation directory >
```

```
cd c:\Program Files\MySQL\MySQL Server 5.7\bin
```

```
C:\Users\indee>cd C:\Program Files\MySQL\MySQL Server 8.0\bin
C:\Program Files\MySQL\MySQL Server 8.0\bin>■
```

Now let's login with the **root account**.

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

```
C:\Program Files\MySQL\MySQL Server 8.0\bin>mysql -u root -p
Enter password: ■
```



```

C:\Program Files\MySQL\MySQL Server 8.0\bin>mysql -u root -p
Enter password: ****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 11
Server version: 8.0.16 MySQL Community Server - GPL

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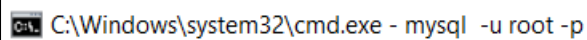
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql>

```

Enter your root password.

Look at the title bar of the cmd.



You'll see the logged user's name

Create a database named "euc"

```
create database euc;
```

```

mysql> create database euc;
Query OK, 1 row affected (0.11 sec)

```

Select database euc

```
use euc;
```

```

mysql> use euc;
Database changed

```

Create a table called student (id, name, mobile) \*Don't forget to enter "use euc" command.

```

mysql> create table student (
-> id int primary key,
-> name varchar (20),
-> mobile char (10)
-> );
Query OK, 0 rows affected (0.53 sec)

```

Insert a record (1, Kamal, 0771234567)

```

mysql> insert into student values (1, "Kamal", "0771234567");
Query OK, 1 row affected (0.06 sec)

```

As you witnessed you were able to perform all these SQL commands (Which includes DDL & DCL commands). Because root account can perform any action on the database.

## Practical –2.2

Sunil is an employee (Receptionist) of an organization. Bellow table shows that which privileges he has.

Username	Privilege
Sunil	Insert, Select

Creating a user named "sunil".

create user sunil identified by "12345"; ← quotation mark is must be within password

```
mysql> create user sunil identified by "12345";
Query OK, 0 rows affected (0.45 sec)
```

Granting privileges to "sunil",

Grant Syntax:

grant <Privilege list> on <Database/Relation Name> to <user>;

Privilege list: Which operation a user can do (create, alter, drop, select, insert .....)

E.g. create -> user can only execute create command

update(mobile) -> Specified user can only update mobile field.

Database/Relation Name: Which database or table that specified user has privileges.

E.g. euc.\* -> all tables in euc database

euc.student -> student table in euc database

\*.\* -> All the databases and its tables.

User : User name of the user.

Granting Insert and Select privileges to user sunil.

Grant insert, select on euc.\* to sunil;

```
mysql> grant insert, select on euc.* to sunil;
Query OK, 0 rows affected (0.16 sec)
```

*\*Grant insert and select privilege on euc database and its all tables to sunil.*

Question :

1. What happen if sunil tries view records on student table ?
2. What happen if sunil tries to update kamal's name to Karuna?

In order to answer these questions first you must log in as Sunil.

Frist type in "\q" to logout from MySQL root user.

```
mysql> \q
Bye
```

```
C:\Program Files\MySQL\MySQL Server 8.0\bin>_
```

mysql -u sunil -p (Login as Sunil)

```
C:\Program Files\MySQL\MySQL Server 8.0\bin>mysql -u sunil -p
Enter password:
```

Enter password (12345) and press enter.

```

C:\Windows\system32\cmd.exe - mysql -u sunil -p

C:\Program Files\MySQL\MySQL Server 8.0\bin>mysql -u sunil -p
Enter password: ****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 12
Server version: 8.0.16 MySQL Community Server - GPL

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affiliates. Other names may be trademarks of their respective
owners.

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

mysql>

```

### Answer

- 1) SQL will execute successfully. Because sunil has privilege to view all records of a table that exists on the euc database.

```

mysql> select * from student;
+----+-----+-----+
| id | name   | mobile |
+----+-----+-----+
|  1 | Kamal  | 0771234567 |
|  2 | Sirimal | 0765345673 |
+----+-----+-----+
2 rows in set (0.00 sec)

```

- 2) An error will be prompted. Sunil hasn't access to update any data.

```

mysql> update student set name = "Kamal" where id = 1;
ERROR 1142 (42000): UPDATE command denied to user 'sunil'@'localhost'
for table 'student'

```

Sunil misused his privileges. He obtained personal details of students and gave them to his friends. Then DBA wants to revoke his privileges to view student details.

Sunil's new privileges as follows.

Username	Privilege
Sunil	Insert, <del>Select</del>

### Revoking privileges from sunil,

Revoke Syntax:

```
revoke <Privilege list> on <database/table Name> from <user>;
```

Privilege list: Which operation to revoke from a user (create, alter, drop, select, insert .....)

Database/Relation Name: Which database and table that specified user is revoked from privileges.

**\*\*First login as root user.**

```

mysql> \q
Bye

C:\Program Files\MySQL\MySQL Server 8.0\bin>mysql -u root -p
Enter password: ****

```

```
revoke select on euc.* from sunil;
```

```
mysql> revoke select on euc.* from sunil;  
Query OK, 0 rows affected (0.12 sec)
```

Now login as “sunil” and check whether he can view data on student table.

```
mysql> \q  
Bye
```

```
C:\Program Files\MySQL\MySQL Server 8.0\bin>mysql -u sunil -p  
Enter password: *****
```

```
mysql> use euc;  
Database changed  
mysql> select *from student;  
ERROR 1142 (42000): SELECT command denied to user 'sunil'@'localhost'  
for table 'student'
```

\*\*\*\*\*