

## Overview of DBMS

Database is collection of interrelated data where data can be easily accessed, managed and updated.

## DBMS

A DBMS is software that allows creation, definition and manipulation of database. Ex: MySQL, Oracle, Microsoft Access etc.

## Components of DBMS

The database system can be divided into four components:

- **Users:** Users may be of various type such as DB administrator, System developer and End users.
- **Database Application:** Database application may be Personal, Departmental, Enterprise and Internal.
- **DBMS:** Software that allow users to define, create and manages database access, Ex: MySQL, Oracle etc.
- **Database:** Collection of logical data as a single unit.

## Functions of DBMS

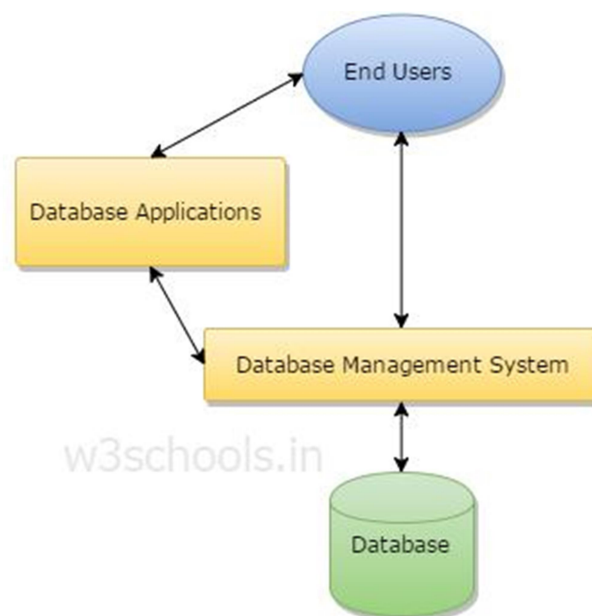
1. Data Storage Management
2. Data Manipulation Management
3. Backup and Recovery Management
4. Transaction Management
5. Security Management

## Advantages of DBMS

1. Controlling Redundancy
2. Data Sharing
3. Data Consistency
4. Data Integration
5. Data Security
6. Data Atomicity
7. Concurrency Control

## Disadvantages of DBMS

1. Costly
2. Complexity
3. Database Failure
4. Large in Size
5. Performance



Components of a Database Management System

## Characteristics of a DBMS

- **Real-world entity:** Should be able to store all kinds of data that exists in this real world.
- **Relation-based tables:** DBMS allows entities and relations among them to form tables.
- **Isolation of data and application:** Data and application should be isolated.
- **Less redundancy:** There should not be any duplication of data in the database.
- **Consistency:** Consistency is a state where every relation in a database remains consistent.
- **Query Language:** DBMS has a strong query language.
- **ACID Properties:** DBMS follows the concepts of Atomicity, Consistency, Isolation, and Durability (normally shortened as ACID).
- **Multiuser and Concurrent Access:** Multiple users should be able to access the same database, without affecting the other user.
- **Multiple views:** It supports multiple views to the user, depending on his role.
- **Security:** Database should also provide security.

## Basic terminology

- **Database (DB):** A database is a collection of information that is organized so that it can be easily accessed, managed and updated.
- **Command:** A command is a string that you send to the server.
- **Query:** A query is a type of command that retrieves data from the server.
- **Table (relation, file, class):** A table is a collection of data elements organised in terms of rows and columns.
- **Column (field, attribute):** A single unit of named data that has a particular data type
- **Row (record, tuple):** A row is a collection of column values.
- **View:** A view is an alternative way to present a table (or tables).
- **Client:** A client is an application that makes requests of the PostgreSQL server.
- **Server:** The PostgreSQL server is a program that services commands coming from client applications.
- **Postmaster:** Postmaster creates a new server process in the host operating system.
- **Transaction:** A transaction is a collection of database operations that are treated as a unit.
- **Commit:** A commit marks the successful end of a transaction.
- **Rollback:** A rollback marks the unsuccessful end of a transaction.
- **Index:** An index is a data structure that a database uses to reduce the amount of time it takes to perform certain operations.
- **Result set:** When you issue a query to a database, you get back a result set.

## Database System VS File System

Sr. No.	Difference Factor	File System	DBMS
1.	Definition	A File Management System is an abstraction to store, retrieve, management and update of set files.	DBMS is a collection of inter-related data and a set of programs to access to those data.
2.	Data Sharing	File System does not allow data sharing or data sharing is very complex.	In DBMS, data can be shared very easily due to centralized system.
3.	Data Consistency	When data is redundant, it is difficult to update.	In DBMS, as there is no or less data redundancy, data remains constant.
4.	Difficult to search/access data	Difficult to search data items because for every operation we have to make different programs.	Easy to search data items because searching and querying operations are already available.
5.	Data Isolation	There is no standard format or data is scattered in various formats or files.	Due to centralized system, the format of similar type of data remains same.
6.	Security Problems	In File System, there is no or very less security. General Security provided by file system are locks, guards, etc.	DBMS have high level security like encryption, passwords, biometric security (fingerprint matching, face and voice detection, etc.)etc.

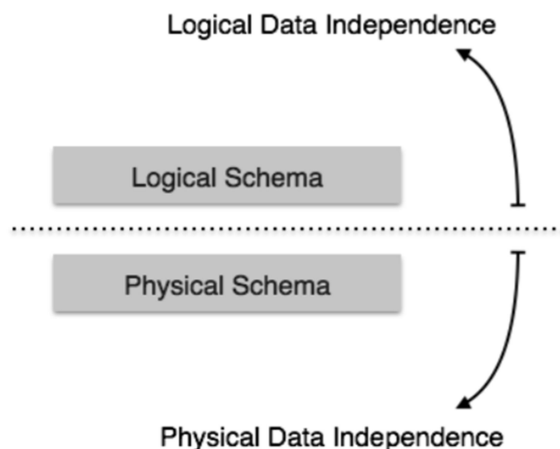
## Data Independence

Data independence is ability to modify a schema definition in one level without affecting a schema definition in the next higher level.

There are two levels of data independence:

**1. Physical Data Independence:** Physical Data Independence is the ability to modify the physical schema without requiring any change in application programs.

**2. Logical Data Independence:** Logical data independence is ability to modify the conceptual schema without requiring any change in application programs.



## Architecture of DBMS

DBMS architecture is depending on its design and can be of the following types:

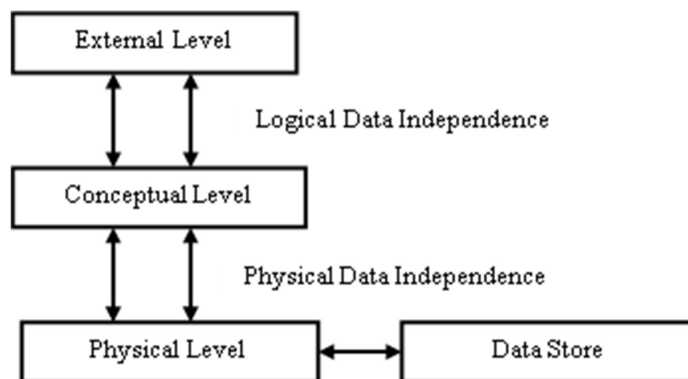
- Centralized
- Decentralized
- Hierarchical

DBMS architecture can be seen as either single tier or multi-tier.

**In 1-tier architecture**, the DBMS is the only entity where the user directly sits on the DBMS and uses it.

**In 2-tier architecture**, it must have an application through which the DBMS can be accessed.

**DBMS 3-tier Architecture:** DBMS 3-tier architecture divides the complete system into three inter-related but independent modules as shown in Figure:



### 1. Physical Level

- Physical level describes the physical storage structure of data in database.
- It is also known as Internal Level.
- This level is very close to physical storage of data.

### 2. Conceptual Level

- Conceptual level describes the structure of the whole database for a group of users.
- It is also called as the data model.
- Conceptual schema is a representation of the entire content of the database.

### 3. External Level

- External level is related to the data which is viewed by individual end users.
- This level includes a no. of user views or external schemas.
- This level is closest to the user.

## Database Schema

A database schema is the skeleton structure that represents the logical view of the entire database. It can be categorized into three parts. These are:

1. **Physical Schema:** Physical schema can be defined as the design of a database at its physical level. In this level, it is expressed how data is stored in blocks of storage.
2. **Logical Schema:** Logical schema can be defined as the design of database at logical level. In this level, the programmers as well as the database administrator (DBA) work.
3. **View Schema:** View schema can be defined as the design of database at view level which generally describes end-user interaction with database systems.

**Instances:** A database is generally used by many users where insertion and deletion of data occurs frequently. Overall information stored in a database at a particular moment is called the instance of the database.

## DBMS languages

Database languages are used for read, update and store data in a database.

### Types of DBMS languages

**Data Definition Language (DDL):** DDL is used to define the database structure or schema.

**Examples:**

- CREATE - to create objects in the database
- ALTER - alters the structure of the database
- RENAME - rename an object

**Data Manipulation Language (DML):** DML is used for accessing and manipulating data in a database. **Examples:**

- SELECT - Retrieve data from the a database
- INSERT - Insert data into a table
- UPDATE - Updates existing data within a table
- DELETE - deletes all records from a table, the space for the records remain

**Data Control Language (DCL):** DCL is used to control the user access to the database. **Examples:**

- GRANT – To grant access to user
- REVOKE – To revoke access from user

**Transaction Control Language (TCL):** TCL is used to manage the changes made by DML statements.

- COMMIT - save work done
- SAVEPOINT - identify a point in a transaction to which you can later roll back
- ROLLBACK - restore database to original since the last COMMIT

## Database Administrator (DBA)

A Database Administrator, Database Analyst or Database Developer is the person responsible for managing the information within an organization.

### Functions and responsibilities of DBAs

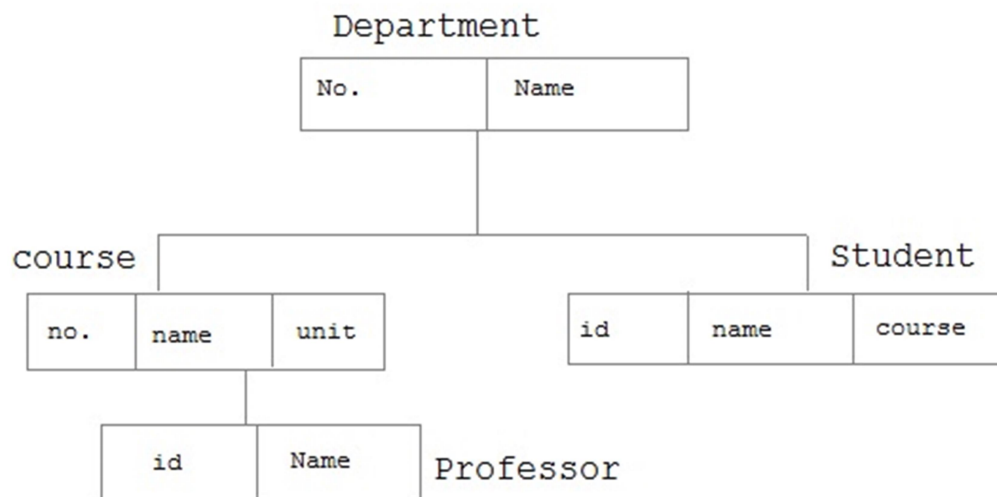
1. Installing and Upgrading an SQL Server
2. Monitoring performance
3. Using Storage Properly
4. Working with Developers
5. Transferring Data, etc.

### Data models in DBMS

A Data Model is a logical structure of Database. The model describes the relationships between different parts of the data. Historically, in database design, three models are commonly used. They are,

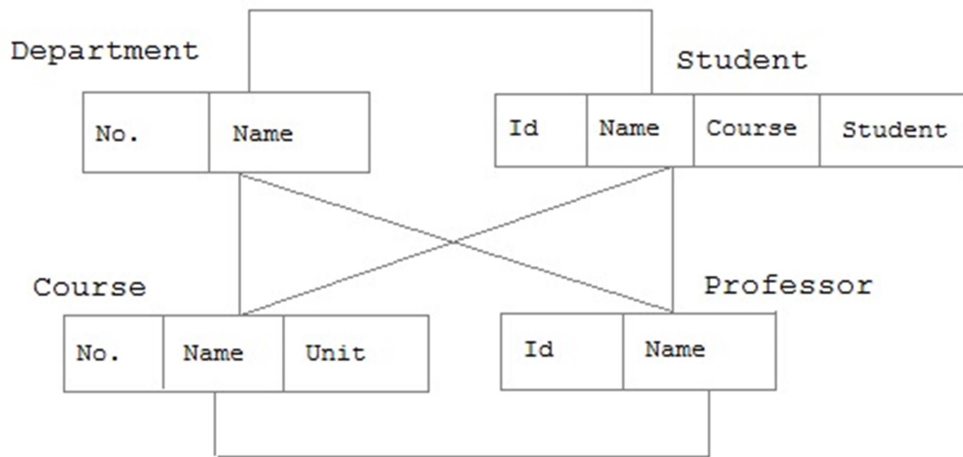
#### Hierarchical Model

In this model each entity has only one parent but can have several children.



## Network Model

In the network model, entities are organized in a graph, in which some entities can be accessed through several paths.



## Relational Model

In this model, data is organized in two-dimensional tables called relations. The tables or relation are related to each other.

