

DATABASE MANAGEMENT SYSTEMS

Couse code:CSC403

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Syllabus

1. Introduction Database Concepts
2. Entity–Relationship Data Model
3. Relational Model and relational Algebra
4. Structured Query Language (SQL)
5. Relational-Database Design
6. Transactions Management and Concurrency and Recovery

Books:

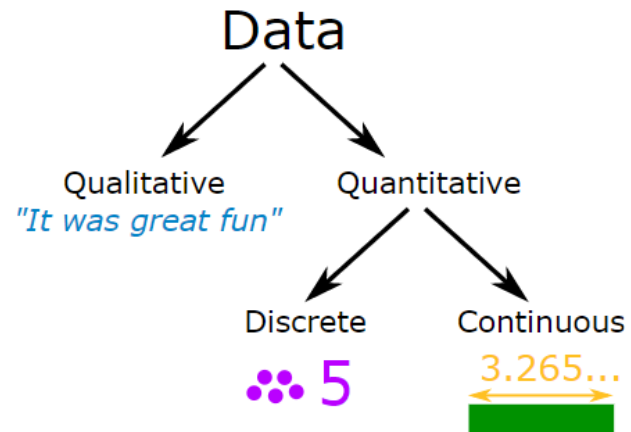
- 1 Korth, Silberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill
- 2 Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education

Introduction Database Concepts

- Introduction
- Characteristics of databases
- File system v/s Database system
- Data abstraction and data Independence
- DBMS system architecture
- Database Administrator

DATA?

- Data is a collection of facts, such as numbers, words, measurements, observations or just descriptions of things.



Database

- Organized collection of data
- Easily accessed, managed and updated
- Example:
 - Collage database stores information about students, teachers, classes, subjects, etc...

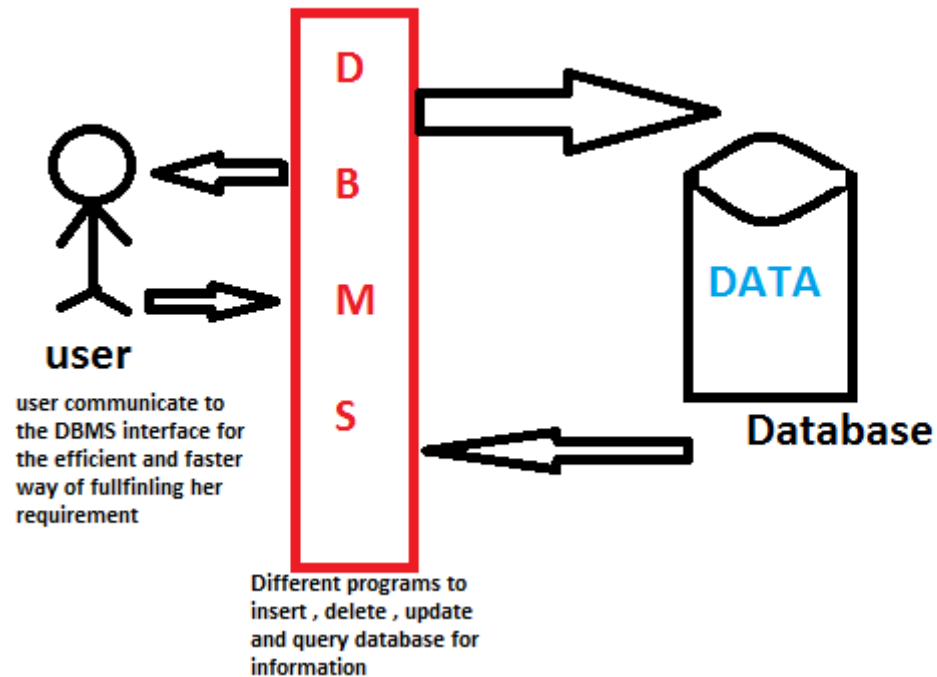


First Name	Last Name	Address	City	Age
Mickey	Mouse	123 Fantasy Way	Anaheim	73
Bat	Man	321 Cavern Ave	Gotham	54
Wonder	Woman	987 Truth Way	Paradise	39
Donald	Duck	555 Quack Street	Mallard	65
Bugs	Bunny	567 Carrot Street	Rascal	58
Wiley	Coyote	999 Acme Way	Canyon	61
Cat	Woman	234 Purrfect Street	Hairball	32
Tweety	Bird	543	Itotitaw	28

Records

DATABASE MANAGEMENT SYSTEM

A database management system is a software used to perform different operations, like addition, access, updating, and deletion of the data



Need of DBMS

- When dealing with huge amount of data, there are two things that require optimization:
 - **Storage of data**
eg: saving & salary account in same bank
 - **Retrieval of data.**
- Managing the data – eg: university
 - Add
 - Delete
 - Update
 - Retrieve

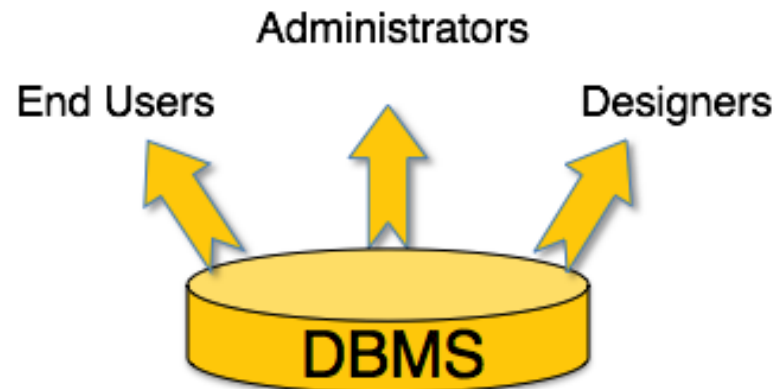
Why do we use DBMS?

- Data independence and efficient access.
- Reduced application development time.
- Data integrity and security. Different users may access different data subsets.
- Uniform data administration.
- Concurrent access, recovery from crashes.



Users of DBMS

Component Name	Task
Application Programmers	The Application programmers write programs in various programming languages to interact with databases.
Database Administrators	Database Admin is responsible for managing the entire DBMS system. He/She is called Database admin or DBA.
End-Users	The end users are the people who interact with the database management system. They conduct various operations on database like retrieving, updating, deleting, etc.

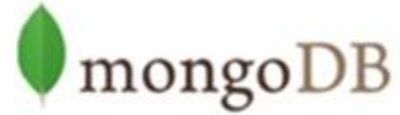


Application of DBMS

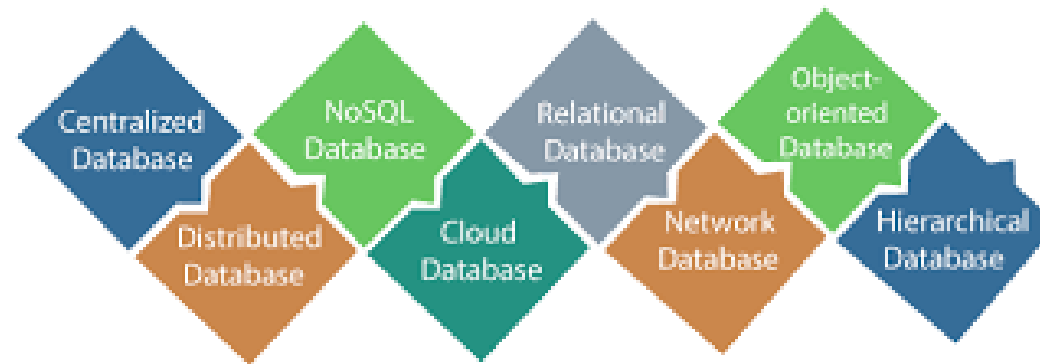
Sector	Use of DBMS
Banking	For customer information, account activities, payments, deposits, loans, etc.
Airlines	For reservations and schedule information.
Universities	For student information, course registrations, colleges and grades.
Telecommunication	It helps to keep call records, monthly bills, maintaining balances, etc.
Finance	For storing information about stock, sales, and purchases of financial instruments like stocks and bonds.
Sales	Use for storing customer, product & sales information.
Manufacturing	It is used for the management of supply chain and for tracking production of items. Inventories status in warehouses.
HR Management	For information about employees, salaries, payroll, deduction, generation of paychecks, etc.

DBMS - Most Popular Database Management Systems

ORACLE®
DATABASE



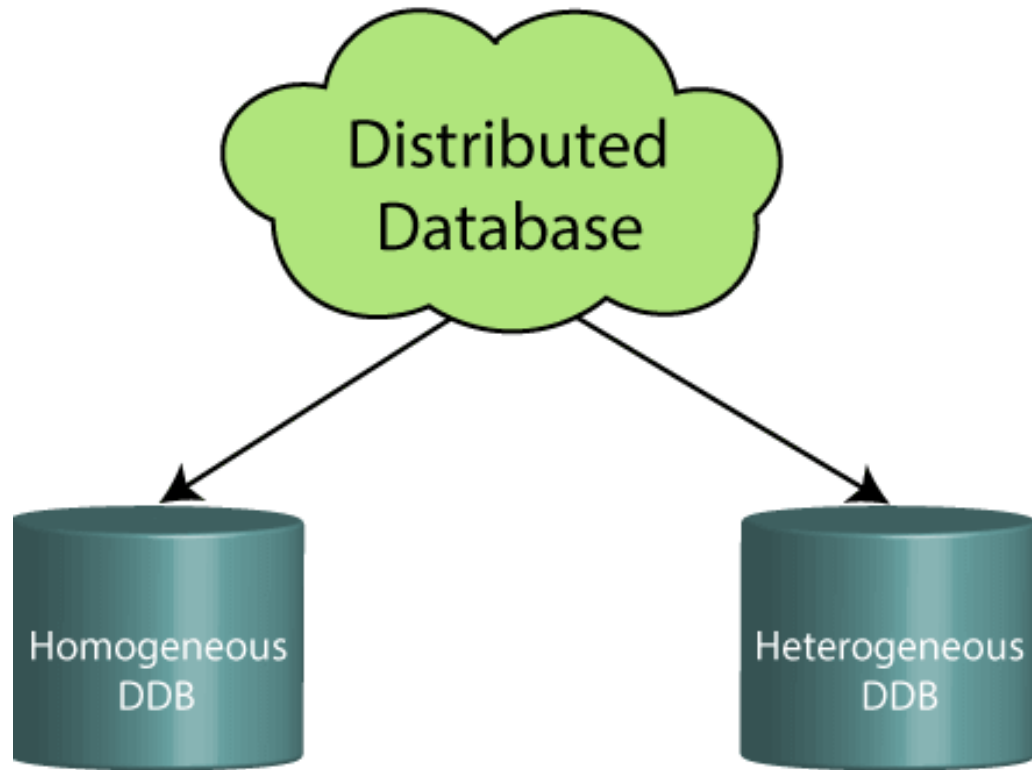
Types of Database



Centralized database

- Users can access the stored data from different locations through several applications.
- These applications contain the authentication process to let users access data securely.
- Advantages:
 - Data consistency is maintained as it manages data in a central repository.
 - It provides better data quality, which enables organizations to establish data standards.
- Disadvantages:
 - The size of the centralized database is large, which increases the response time for fetching the data.
 - It is not easy to update such an extensive database system.
 - If any server failure occurs, entire data will be lost, which could be a huge loss.

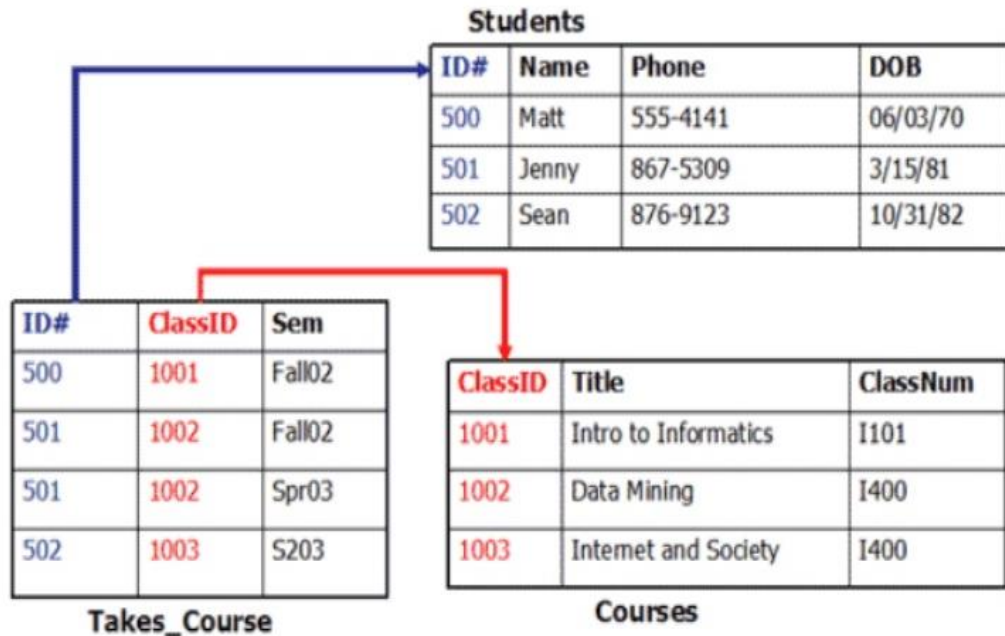
Distributed database



- Data is distributed among different database systems of an organization. These database systems are connected via communication links.
- One server failure will not affect the entire data set.
- **Homogeneous DDB:** database systems which execute on the same OS & use the same application process and carry the same hardware devices.
- **Heterogeneous DDB:** database systems which execute on different OS under different application procedures, and carries different hardware devices.

Relational database

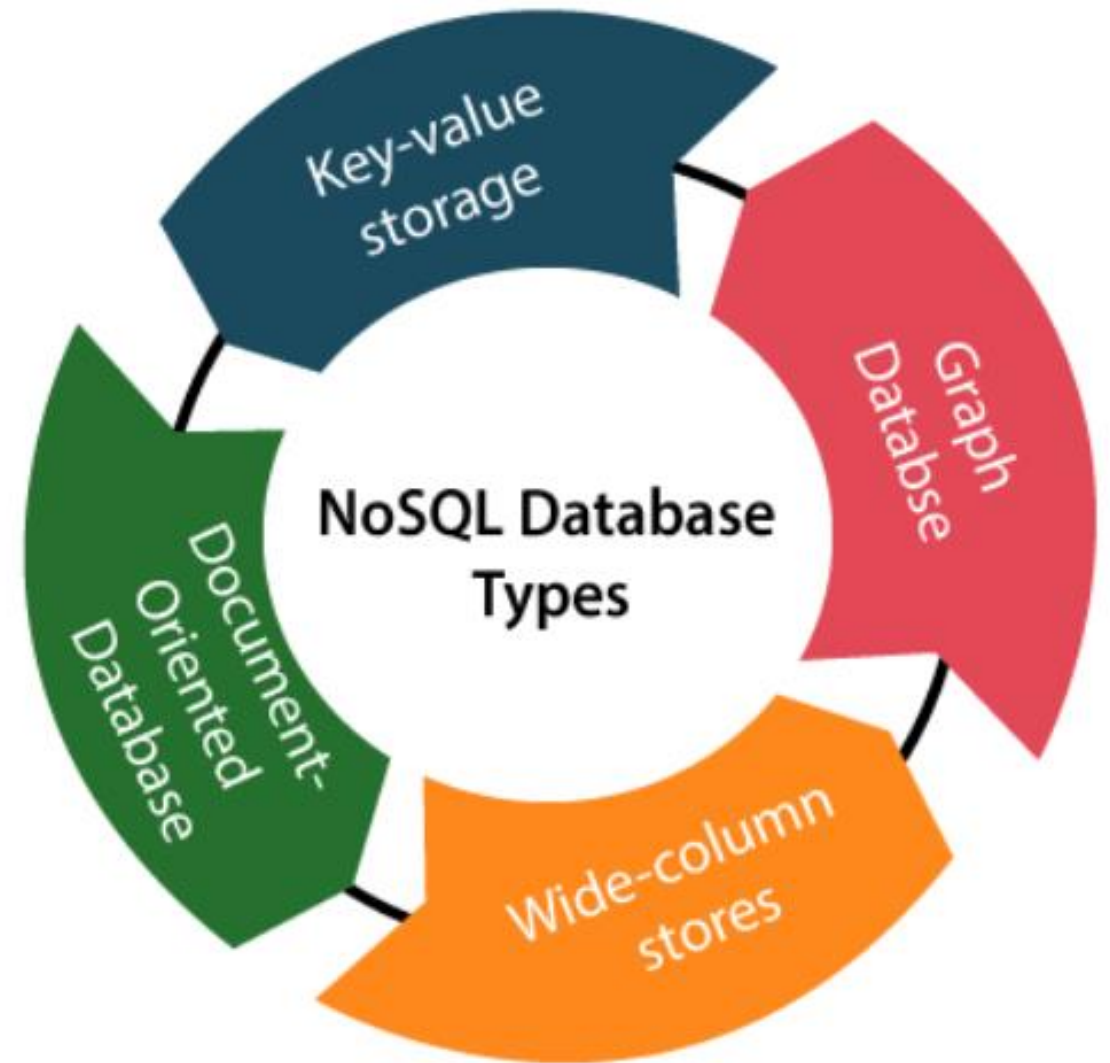
Relational DBMS



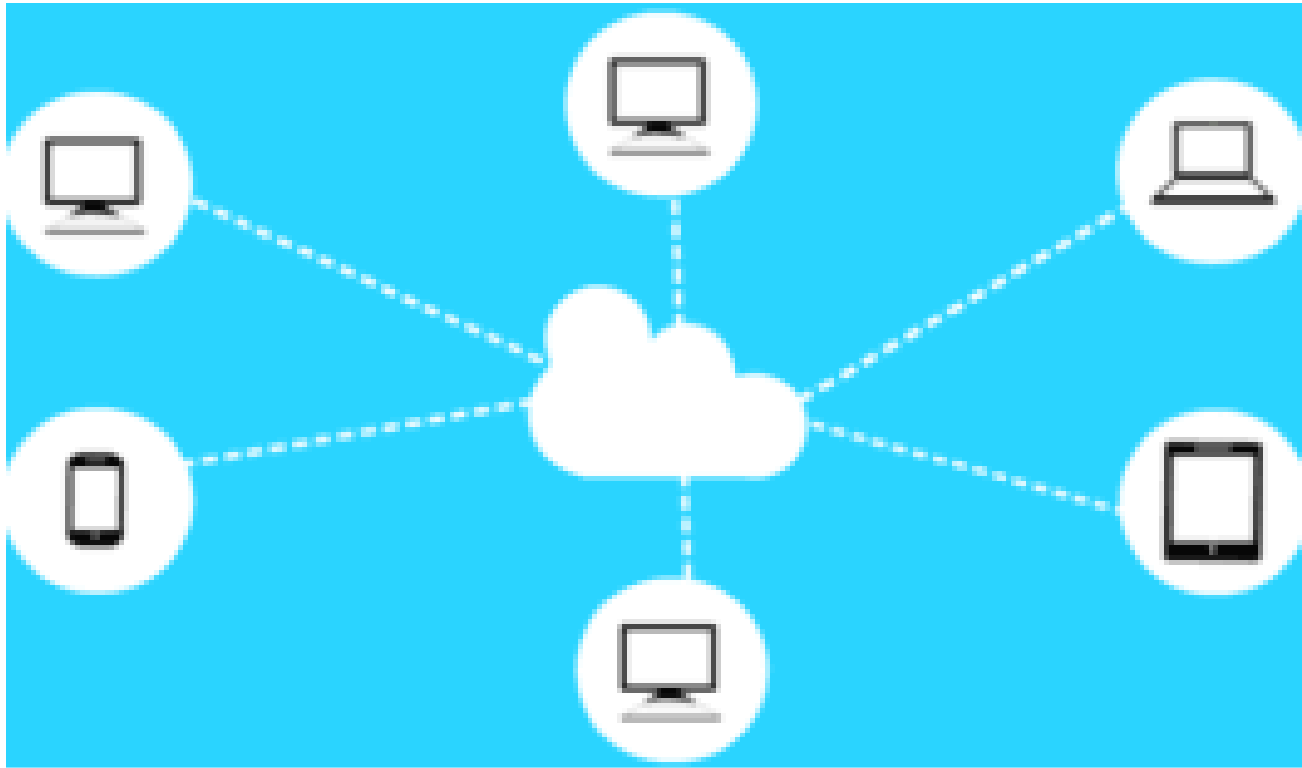
- Stores data in the form of rows(tuple) and columns(attributes), and together forms a table(relation).
- It uses SQL for storing, manipulating, as well as maintaining the data.

NoSQL database

- Used for storing a wide range of data sets.
- It came into existence when the demand for building modern applications increased.
- It presented a wide variety of database technologies in response to the demands.
- NoSQL database is further divided into four types



Cloud database



- Data is stored in a virtual environment and executes over the cloud computing platform.
- It provides users with various cloud computing services (SaaS, PaaS, IaaS, etc.) for accessing the database.

Object-oriented database

- It uses the object-based data model approach for storing data in the database system.
- The data is represented and stored as objects which are similar to the objects used in the object-oriented programming language.

Object-Oriented Model

Object 1: Maintenance Report

Date	
Activity Code	
Route No.	
Daily Production	
Equipment Hours	
Labor Hours	

Object 1 Instance

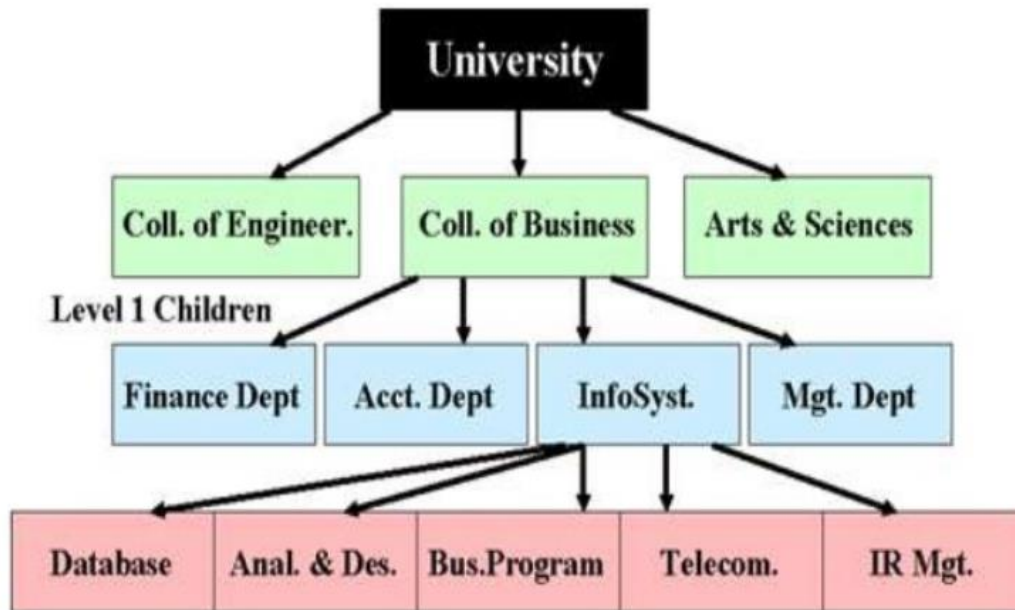
01-12-01
24
I-95
2.5
6.0
6.0

Object 2: Maintenance Activity

Activity Code	
Activity Name	
Production Unit	
Average Daily Production Rate	

Hierarchical database

Hierarchical DBMS

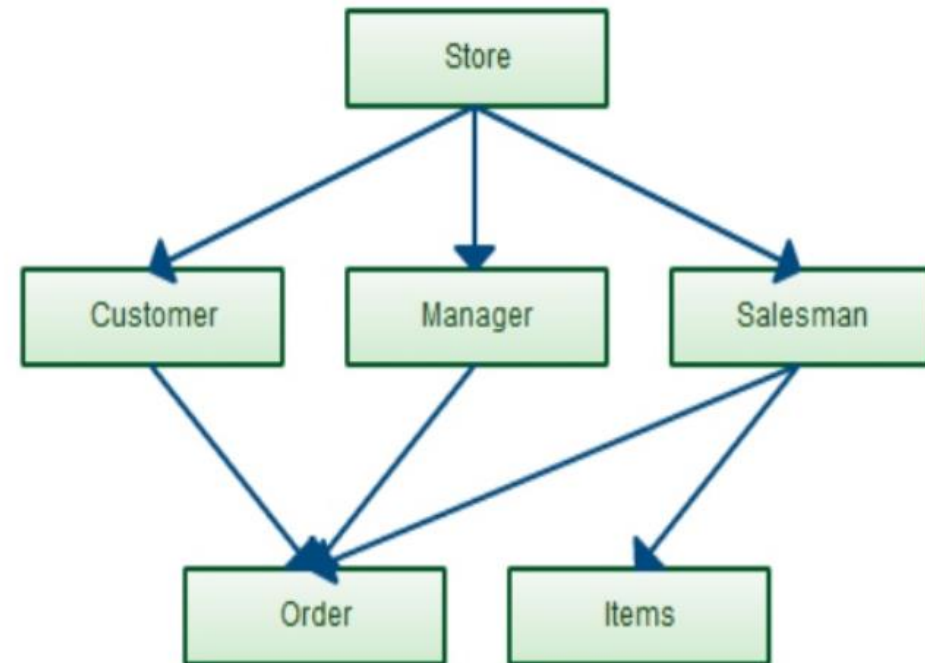


- It represents the data in a tree-like structure in which there is a single parent for each record.
- Data get stored in the form of records that are connected via links.
- This model structure allows the one-to-one and a one-to-many relationship between two/ various types of data.
- This structure is very helpful in describing many relationships in the real world; table of contents, any nested and sorted information.

Network database

- Representation of data is in the form of nodes connected via links between them.
- Unlike the hierarchical database, it allows each record to have multiple children and parent nodes to form a generalized graph structure.

Network DBMS



Characteristics of databases

- **Self-describing nature of a database system:** A DBMS stores the description (structure, type, storage format of each entities) of the database. The description is called meta-data). This allows the DBMS software to work with different databases.
- **Insulation between programs and data:** Called program-data independence. Allows changing data storage structures and operations without having to change the DBMS access programs.
- **Data Abstraction:** A data model is used to hide storage details and present the users with a conceptual view of the database; does not include how data is stored and how the operations are implemented.

Characteristics of databases

- **Support of multiple views of the data:** Each user may see a different view of the database, which describes *only* the data of interest to that user.
- **Multi-user environment:** DBMS supports multi-user environment that allows users to access and manipulate data in parallel.
- **Provides security and removes redundancy.**

Difference between filesystem vs. DBMS

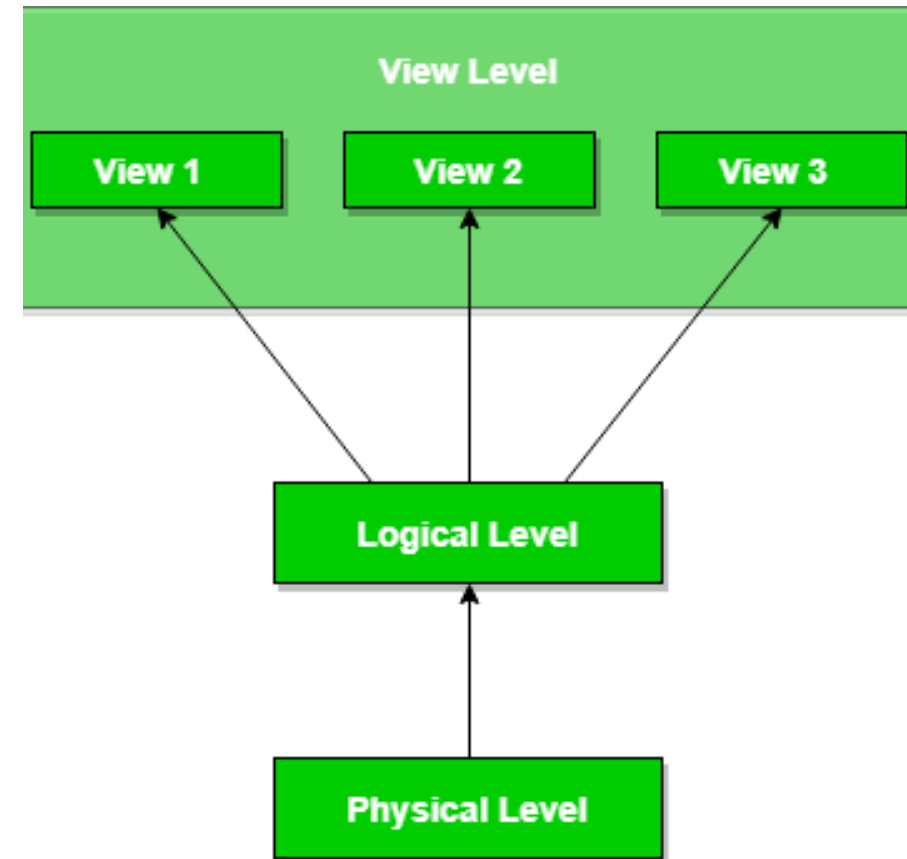


File System	DBMS
A file system is a software that manages and organizes the files in a storage medium. It controls how data is stored and retrieved.	DBMS or Database Management System is a software application. It is used for accessing, creating, and managing databases.
The file system provides the details of data representation and storage of data.	DBMS gives an abstract view of data that hides the details
Storing and retrieving of data can't be done efficiently in a file system.	DBMS is efficient to use as there are a wide variety of methods to store and retrieve data.
It does not offer data recovery processes.	There is a backup recovery for data in DBMS.
The file system doesn't have a crash recovery mechanism.	DBMS provides a crash recovery mechanism
Protecting a file system is very difficult.	DBMS offers good protection mechanism.
In a file management system, the redundancy of data is greater.	The redundancy of data is low in the DBMS system.
Data inconsistency is higher in the file system.	Data inconsistency is low in a database management system.

The file system offers lesser security.	Database Management System offers high security.
File System allows you to stores the data as isolated data files and entities.	Database Management System stores data as well as defined constraints and interrelation.
Not provide support for complicated transactions.	Easy to implement complicated transactions.
The centralization process is hard in File Management System.	Centralization is easy to achieve in the DBMS system.
It doesn't offer backup and recovery of data if it is lost.	DBMS system provides backup and recovery of data even if it is lost.
There is no efficient query processing in the file system.	You can easily query data in a database using the SQL language.
These system doesn't offer concurrency.	DBMS system provides a concurrency facility.

Data abstraction

- Database systems are made-up of complex data structures.
- To ease the user interaction with database, the developers hide internal irrelevant details from users.
- This process of hiding irrelevant details from user is called data abstraction.
- There are three levels of abstraction:
 1. Physical – describes how a record is stored
 2. Logical – describes data stored in a database & the relationships among the data
 3. View – describes the user interaction with database





Example

Let's say we are storing customer information in a customer table.

1. Physical - these records can be described as blocks of storage (bytes, gigabytes, terabytes etc.) in memory. These details are often hidden from the programmers.
2. Logical - these records can be described as fields and attributes along with their data types, their relationship among each other can be logically implemented. The programmers generally work at this level because they are aware of such things about database systems.
3. View - user just interact with system with the help of GUI and enter the details at the screen, they are not aware of how the data is stored and what data is stored; such details are hidden from them.

Data independence

- The main purpose of data abstraction is achieving data independence in order to save time and cost required when the database is modified or altered.
- There are two levels of data independence:
 1. Physical level data independence
 2. Logical level data independence

Physical level data independence

- Characteristic of being able to modify the physical schema without any alterations to the conceptual or logical schema.
- Conceptual structure of the database would not be affected by any change in storage size of the database system server.
- These alterations or modifications to the physical structure may include:
 - Utilising new storage devices.
 - Modifying data structures used for storage.
 - Altering indexes or using alternative file organisation techniques etc.

Logical level data independence

- Characteristic of being able to modify the logical schema without affecting the external schema or application program.
- The user view of the data would not be affected by any changes to the conceptual view of the data.
- These changes may include:
 - insertion or deletion of attributes
 - altering table structures entities or relationships to the logical schema etc.

Working of three level architecture

Presentation tier

The top-most level of the application is the user interface. The main function of the interface is to translate tasks and results to something the user can understand.



Logic tier

This layer coordinates the application, processes commands, makes logical decisions and evaluations, and performs calculations. It also moves and processes data between the two surrounding layers.



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TOGETHER



Data tier

Here information is stored and retrieved from a database or file system. The information is then passed back to the logic tier for processing, and then eventually back to the user.



Database



Storage



Database administrator

- Individual or person responsible for controlling, maintenance, coordinating, and operation of database management system.
- They are responsible and in charge for authorizing access to database, coordinating, capacity, planning, installation, and monitoring uses and for acquiring and gathering software and hardware resources as and when needed.
- Database administration is major and key function in any firm or organization that is relying on one or more databases. They are overall commander of Database system.

Role & duties of DBA

- Decides hardware
- Manages data integrity and security
- Database design
- Database implementation
- Query processing performance
- Tuning Database Performance