

Database fundamentals:

Introduction

Database management system or dbms in short refers to the technology of sorting and retrieving users data with utmost efficiency along with appropriate security measures. The database is a collection of inter-related data which is used to retrieve, insert, delete the data efficiently. It is also used to organize the data in the form of table, schema, views, and reports etc.

For example: The college Database organizes the data about the admin, staff, students, and faculty etc. Using the database, you can easily retrieve, insert, and delete the information.

Database management system is a software which is used to manage the database. For example, my sql, oracle etc. are very popular commercial databases which are used in different applications.

DBMS provides an interface to perform various operations like database creation, storing data in it, updating data, creating a table in the database, and a lot more.

It provides protection and security to the database. In the case of multiple users, it also maintains data consistency.

DBMS allows users the following tasks:

1. data definition: it is used for creation, modification, and removal of definition that defines the organization of data in the database.
2. Data updation: it is used for the insertion, modification, and deletion of the actual data in the database.
3. data retrieval: it is used to retrieve the data from the database which can be used by applications for various purposes.
4. User Administration: It is used for registering and monitoring users, maintaining data integrity, enforcing data security, dealing with concurrency control, monitoring performance, and recovering information corrupted by unexpected failure.

Characteristics of dbms:

It uses a digital repository established on a server to store and manage the information.

It can provide a clear and logical view of the process that manipulates data.

Dbms contains automatic backup and recovery procedures.

It contains ACID properties which maintain data in a healthy state in case of failure.

It can reduce the complex relationship between data.

It is used to provide security of data.

It is used to support manipulation and processing of data.

It can view the database from different viewpoints according to the requirements of the user.

ADVANTAGES OF DBMS:-

Controls database redundancy: It can control data redundancy because it stores all the data in one single database file and that recorded data is placed in the database.

Data sharing: In DBMS, the authorized users of an organization can share the data among multiple users.

Easily Maintenance: It can be easily maintainable due to the centralized nature of the database system.

Reduce time: It reduces development time and maintenance need.

Backup: It provides backup and recovery subsystems which create automatic backup of data from hardware and software failures and restores the data if required.

multiple user interface: It provides different types of user interfaces like graphical user interfaces, application program interfaces

Disadvantages of DBMS

Cost of hardware and software: It requires a high speed of data processor and large memory size to run DBMS software.

Size: It occupies a large space of disks and large memory to run them efficiently

Complexity: Database system creates additional complexity and requirements

Higher Impact of failure: Failure is a highly impacted the database because in most of the organisation, all the data stored in a single database and if the database is damaged due to electric failure or db corruption then the data may be lost forever.

TO store and manage data efficiently in the database let use understand some key terms

Database schema : it is a design of the database or we can say that it is a skeleton of the database that is used to represent the structure types of data will be stored in the rows and coloums constraints relationships between the tables

Data constraints: In a database, sometimes we put some restrictions on the table that what type of data can be stored in one or more columns of the table, it can be done by using constraints. Constraints are defined while we are creating a table.

Data Dictionary or Metadata: Metatdata is known as the data about the data. Or we can say that the database schema along with different types of constraints on the data is stored by DBMS in the dictionary is known as metadata.

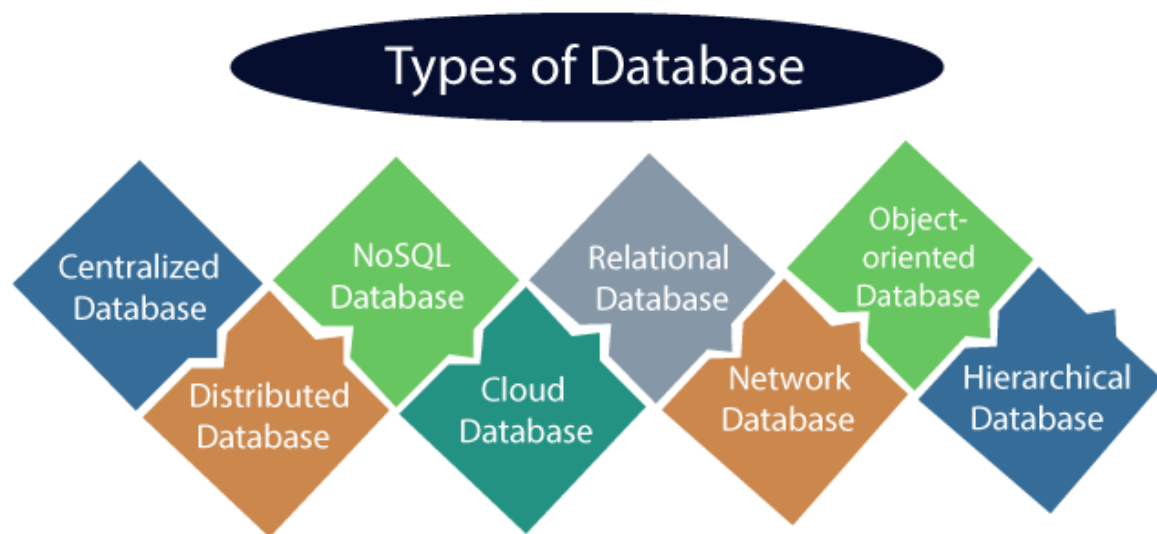
Database instance: In a database, a database instance is used to define the complete database environment and its components. Or we can say that it is a set of memory structures and background processes that are used to access the database files.

Query: In a database, a query is used to access data from the database. So, users have to write queries to retrieve or manipulate data from the database.

Data manipulation : in a database we can easily manipulate data using the three main operations that is insertion deletion and updation

Data engine: it is an underlying component that is used to create and manage various database queries

Types of database:



Centralized db

No sql db

Relational db

Object oriented db

Distributed db

Cloud db

Network db

Hierarchial db

Centralized database

It is the type of db that stores data at centralized db system it comforts the user to access the stored data from different locations through several applications contains the authentication process to let users access data securely an example of a centralized db can be central library that carries a central db of each library in college/uni

Advantages of central db:-

- It has decreased the risk of data management manipulation of the data will not affect the core data

- data consistency is maintained as it manages data in central repo

It provides better data quality which enables org to establish data standards

It is less costly bcoz fewer vendors are required to handle the data sets.

Disadvantages of centralized db:

- The size of the centralized db is large which increases the response time for fetching data

- it is not easy to update such an extensive db system

- if any server failure occurs entire data will be lost which could be a huge loss

Distributed db:-

- unlike a centralized db system in distributed systems data is distributed data is distributed among different db system of an organization

- these db system are connected via communications links such links help the end users access the data easily

Example:- of the distributed db are apache Cassandra,hbase,ignite

3) .RELATIONAL DB:-

This database is based on the relational data model which stores data in the form of rows and columns and together forms a table relation

- A relation db uses sql for storing manipulating as well as storing manipulating as well as maintaining data e.f codd invented the db in 1970

- each table in the db carries a key that makes data unique from others

Eg:- rdb are mysql, Microsoft sql server ,oracle,etc.

-there are following four commonly known properties of a relational model known as acid properties

A means atomicity C means consistency

I means isolation D means Durability

No sql db:

-Non sql is a type of db that is used to storing a wide range of data sets

-it is not a relational db as it stores data not only in tabular form but in several different ways

-it came into existence when the demand for building modern applications increased

-thus nosql presented a wide variety of db technologies technologies responds to the demands

-we can further divide a nosql db into the following four types

-key value storage

-document oriented db

-graph db

-wide coloumn stores

5.) CLOUD DATABASE

A type of db where data is stored in a virtual environment and executes over the cloud computing platform it provides user with various cloud computing service (saas,paas,laas) for accessing db. There are numerous cloud platform but the best options are

-Amazon web services

-microsoft azure

-kamatera

-phoenixNAP

-ScienceSoft

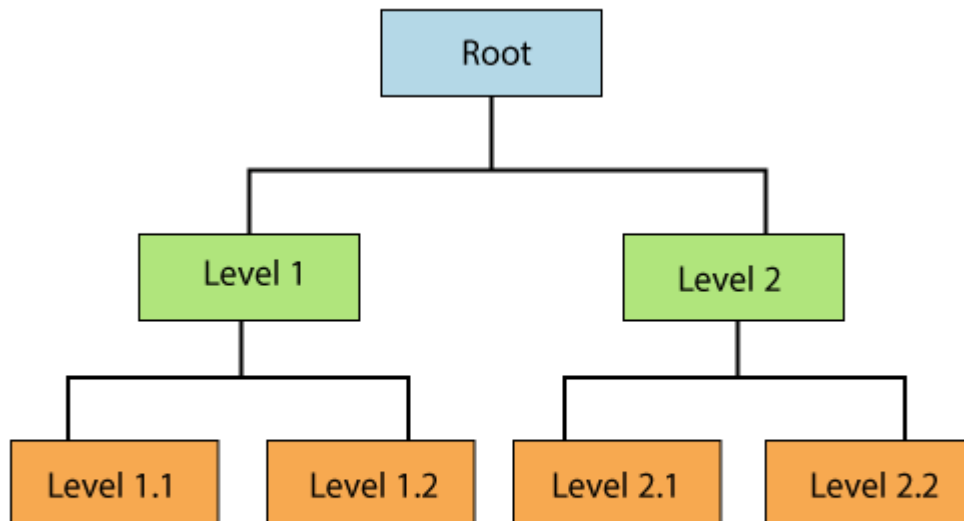
-Google cloud Sql

6) OBJECT ORIENTED DB

The type of db. that uses 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 object-oriented programming language

7.) Hierarchial DB

It is the type of db that stores data in the form of parent children relationship nodes here it organizes data in a tree like structure data get stored in the form of records that are connected via links. each child record in the tree will contain only one parent on the other hand each parent record can have multiple child records.



Hierarchical Database

8.) Network DB:

It is the db that typically follows the network data model. here the 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 path

9.) Personal db:

collecting and storing data on the user's system defines a personal db. this db is basically designed for single user

10.) operational db:-

The type of db which creates and updates the db in real-time it is basically designed for executing and handling the daily data operations in several business for example an organization uses operational db for managing per day transaction

11.) Enterprise db :-

Large org or enterprises use this database for managing a massive amount of data it helps organization to increase and improve their efficiency such a db allows simultaneous access to users.

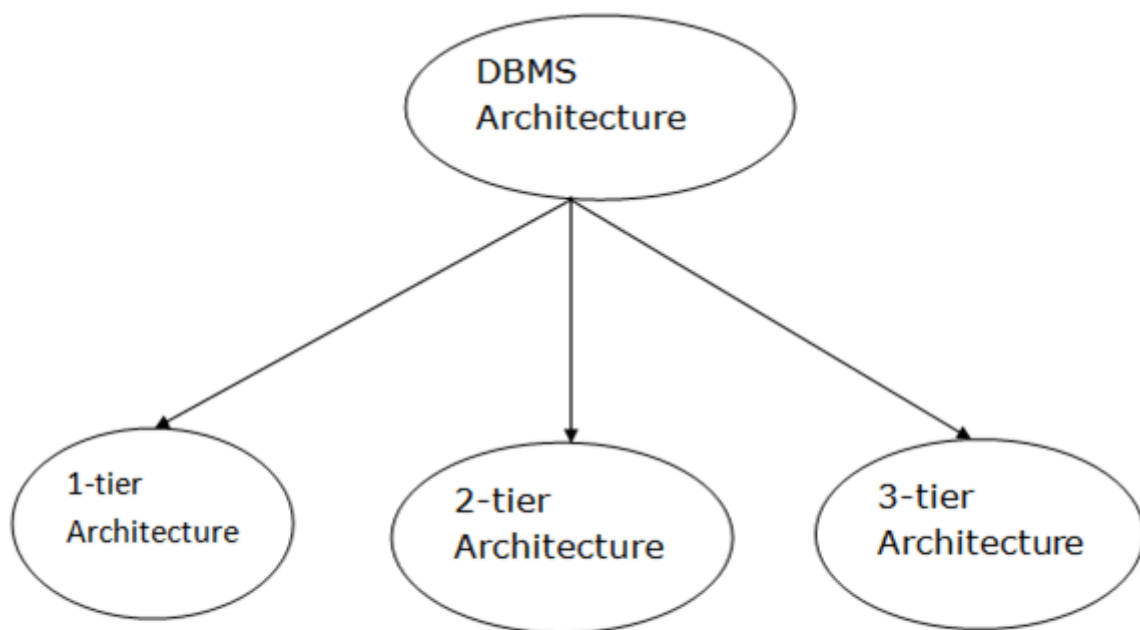
DBMS:-

- 1 Dbms applications store data as file
2. In dbms data is generally stored in either a hierarchial form or a navigational form
- 3.Normalization is not present in dbms
- 4.dbms does not apply any security with regards to data manipulation
- 5.Dbms uses file system to store data so there will be no relation between the tables
- 6.dbms has to provide some uniform method to access the stored information
- 7.dbms does not support distributed db
- 8.dbms is meant to be for small org and deal with small data it supports single users
9. example of dbms are file system,xml

RDBMS:-

- 1.RDBMS application stores data in tabular form
- 2.In rdbms the table have an identifier called primary key and the data value are stored in the form of tables
- 3.Normalization is present in rdbms
- 4.Rdbms defines the integrity constraint for the purposes of ACID
5. in rdbms data value are stored in the form of tables so a relationship between these data values will be stored in the form of table as well
6. rdbms system supports a tabular structure of the data and a relationship between them to access the stored information
- 7.rdbms supports distributed db
- 8.rdbms is designed to handle large amount of data it supports multipls users
- 9.example of dbms are mysql,postgre sql,sql,server,oracle

Types of dbms architecture



1-tier architecture:-

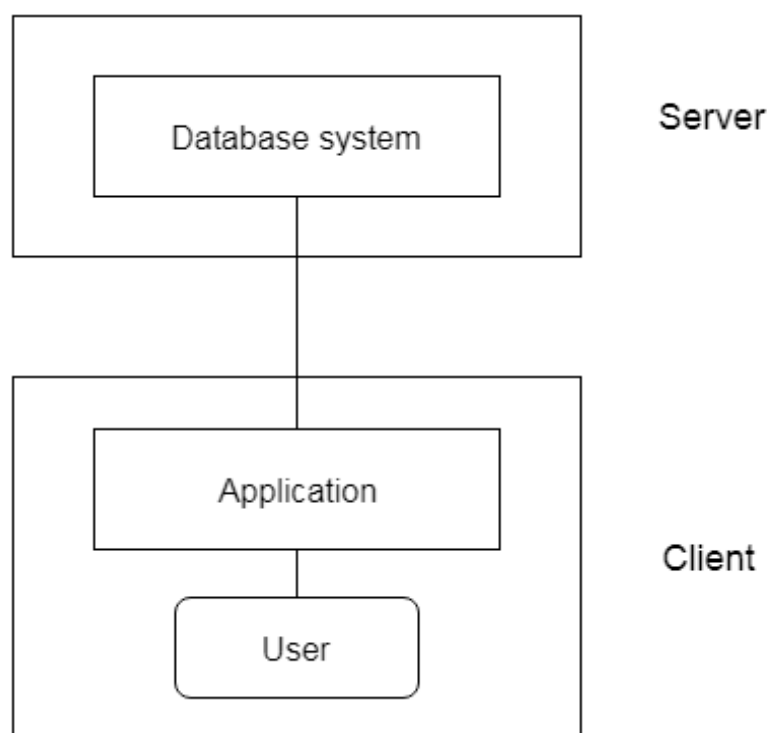
-in this architecture the db is directly available to the user it means the user can directly sit on the dbms and uses it

-any changes done here will directly be on the db itself it doesn't provide a handy tool for end users

-The tier-1 arc is used for development of the local application where programmers can directly communicate with the db for quick response.

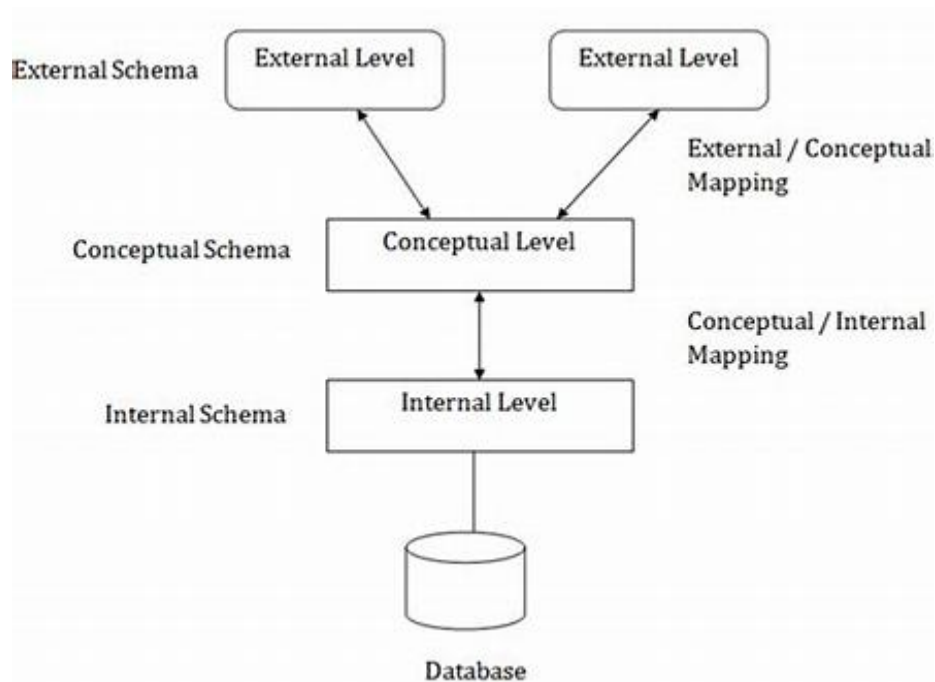
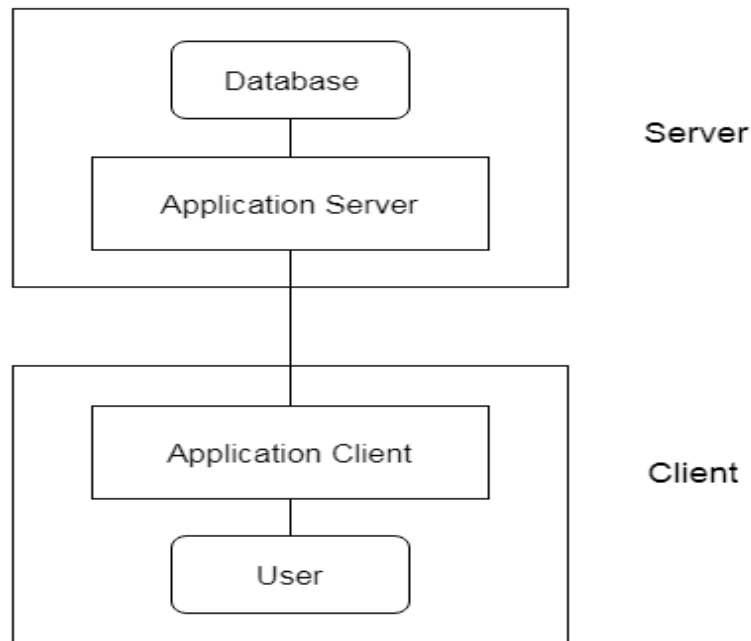
2-Tier architecture

- The 2-tier architecture is same as basic client server in the two tier architecture applications on the client end can directly communicate with the db at the server side for this interaction Api's like odbc,jdbc are used
- the user interface and application programs are run on the client side
- the sever side is responsible to provide the functionalities like query processing and transaction management
- to communicate with the dbms client side application establishes a connection with the server side



3-Tier architecture

- The 3-Tier architecture contains another layer between the client and server in this architecture client cant directly communicate with the server
- The application on the client end interacts with an application server which further communicates with db system.
- End users has no idea about the existence of the db beyond the application server.the db also has no idea about any other user beyond the application
- the 3 tier architecture is used in the case of large application .



NORMALIZATION

This is the process of organizing a db to minimize redundancy and dependency by breaking down complex tables into smaller and more manageable ones its important to understand normalization because it helps you create efficient and scalable db reduces data inconsistency and duplication and makes it easier to update and maintain the db over time. This information is often skipped over in inductor material because it can be technical and complex but it is critical for understanding how to properly design and maintain a db.

OBJECTIVES OF THREE SCHEMA ARCHITECTURE:-

The main objective of three level architecture is to enable multiple users to access the same data with a personalised view while storing the underlying data only once thus it separates the users view from the physical structure of the database this separation is desirable for the following reasons

- different user need different view of the same data
- The approach in which a particular user need to see the data may change over time
- the user of the db should not worry about the physical implementation and internal workings of the db such as data compression and encryption techniques ,hashing,optimization of the internal structure
- all users should be able to access the same data according to their requirement
- dba should be able to change the conceptual structure of the db without affecting the users
- internal structure of the db should be unaffected by change to physical aspect of the storage