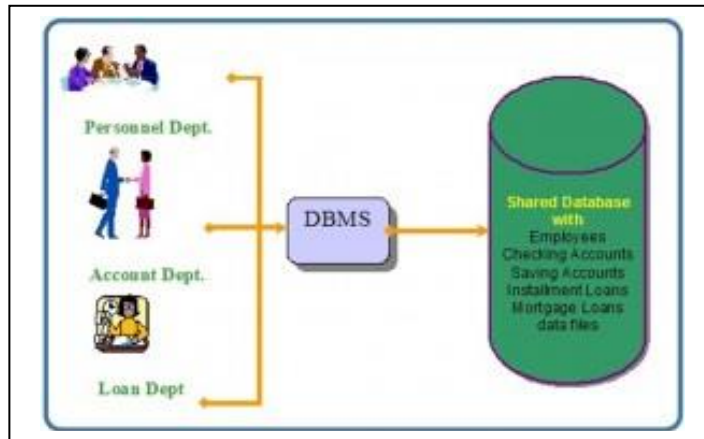


BIM

Semester: I

FOUNDATION OF INFORMATION TECHNOLOGY

Database and Database Management System



REFERENCE NOTE

Unit-8: Database and Database Management System

Data:

Data is defined as the raw facts and figures. It could be any numbers, pictures, sound, alphabets or any combination of it. Which do not provide clear meaning. Examples, 101, Hari, Bharatpur etc.

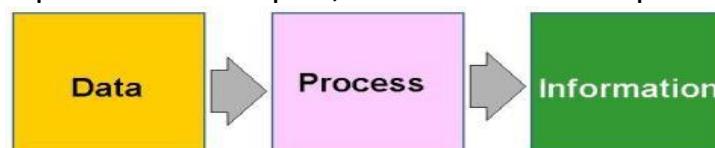
- 1. Primary Data:** Facts and figures newly collected. Examples, observation data, questionnaire data, surveys data etc.
- 2. Secondary data:** Facts and figures already collected. Examples, Financial statements, customer list, sales report, census report etc.

Data Processing:

Data processing is the mechanism of converting unprocessed data into meaningful result or information.

Information:

When data are processed using a database program or software, they are converted to the meaningful result, called information. Information provides answers to "who", "what", "where", and "when" questions. Examples, Hari lives in Bharatpur-11, Chitwan.



Data Processing

Difference between Data and Information

S.N.	Data	S.N.	Information
1	It is raw or known facts.	1	It is processed or refined data.
2	It stores the facts.	2	It presents the facts.
3	It is inactive in nature (they exist)	3	It is active in nature (It enables doing)
4	It is technology-based	4	It is business based
5	Data is gathered from various sources.	5	Information is transformed from data
6	Data do not have fixed format.	6	Information normally in the form of table, graph, curve line etc.

Flat File/ File based system:

- It is traditional way to keeping records of any organization in a manual filing system. It means to used to keep records in file based or flat file system non computerized.
- A flat file system is a system of files in which every file in the system must have a different name.

Limitation of file based/ Flat file system

- Duplication of data (Data Redundancy)
- Inconsistent data.
- Program Data dependence.
- Poor data control.
- Limited data sharing.
- Security problems.
- Incompatible file formats.
- Fixed queries

Database System:

A database system consists of a collection of interrelated data and a set of application programs to access, update and manage the data.

Database:

It is organized form of record about some person, organization or something store under certain media.

It is a collection of related information about a subject organized in a useful manner that provides a base or foundation for procedure, such as retrieving information, drawing conclusion and make decision.

Advantage of database over flat file or file based system

1. Reduction of data redundancies
2. Shared data
3. Data independent
4. Improved integrity
5. Efficient data access
6. Multiple user interface
7. Improved security
8. Improved backup and recovery
9. Supports for concurrent transactions
10. Unforeseen queries can be answered

File based system Vs Electronic Database System

S.N.	File Based System	S.N.	Electronic Database System
1	It provide detail of the data representation and storage of data	1	Database System gives abstract view of data that hides details.
2	It doesn't have a crash recovery mechanism.	2	It provides crash recovery mechanism using backup and other security measures.
3	It is difficult to reduce data redundancy.	3	Data redundancy can be done easily.
4	Searching of data requires a lot of time and effort.	4	Data can be easily searched.
5	Difficult to maintain the database.	5	Easy to maintain the database.

Field/ Attribute:

A field is a piece of information about an element. A field is represented by a column. Every field has got a title called the field title.

Record (Tuple):

A record is information about an element such as a person, student, an employee, client, etc. A record can have much information in different heading or titles.

Table:

A table is the arrangements of rows and columns. Each table must have unique name and must be simple. It is the place where data and information are stored.

Table: Student Information		
Roll No.	Name	Address
1	Gita	Narayangarh
2	Sita	Gaindakot
3	Arjun	Bharatpur

Objects:

Database Objects are the essential tools of relational database. These database objects helps to store, view, edit and manipulate the data and information stored in database.

It can be used to hold and manipulate the data. Some of the examples of database objects are view, sequence, indexes, form, query report etc.

- ❖ **Table:** Basic unit of storage; composed rows and columns
- ❖ **View:** Logically represents subsets of data from one or more tables
- ❖ **Sequence:** Generates primary key values
- ❖ **Index:** Improves the performance of some queries
- ❖ **Synonym:** Alternative name for an object

Some Basic Terms used in Database

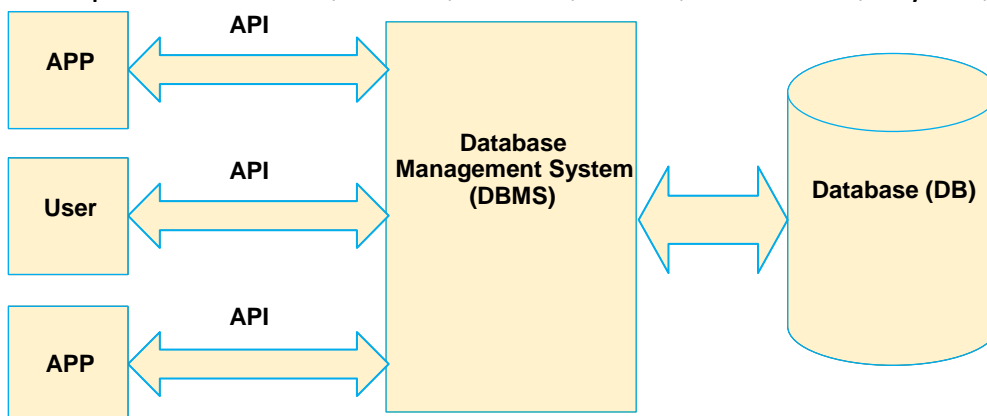
- ❖ **Schema:** A schema is the structure of database which defines name of tables, data fields with data types, relationships and constraints.
- ❖ **Instance:** It defines data values in a record.
- ❖ **Entity:** An entity is a thing or object in the real world that is different from other objects.
- ❖ **Attribute:** Attribute is properties possessed by an entity or relationship.
- ❖ **Index:** It is used to create indexes in database. It helps searching and sorting operation faster and improves the performances of queries.
- ❖ **Query:** It is the object of DBMS which is mainly used to extract and upgrade the necessary records that are present in the database.
- ❖ **Form:** It is object of database which is mainly used for data entry. It is easy to add, modify and delete the records in form.
- ❖ **Report:** Report are the printed output that is created from table or query. We can't add, modify and delete the records in report.

DBMS:

Database Management System is software that manages the data stored in a database. This is a collection of software which is used to store data, records, process them and obtain desired information. Since, data are very important to the end users, we must have a good way of managing data.

A DBMS is a collection of programs that manages the database structure and controls access to the data stored in the database. The DBMS make it possible to share the data in the database among multiple applications or users. The DBMS stands between the database and the user.

Examples: MS-Access, Oracle, FoxPro, dBase, SQL server, MySQL, Delphi, Sybase, etc.



Why to Use DBMS?

1. To develop software application in less time.
2. Data independence and efficient use of data.
3. For uniform data administration.
4. For data integrity and security.
5. For concurrent access to data, and data recovery from crashes.
6. To use user friendly declarative query language.

Some major database System activities are (Functions of DBMS)

1. Adding new file to the database
2. Inserting data into the database
3. Retrieving/viewing data from the database
4. Updating data in existing database file
5. Deleting data from the database file
6. Removing files from the database

Advantages of DBMS (Features /Objectives of DBMS)

1. Sharing data
2. Reduced data redundancy
3. Data backup and recovery
4. Inconsistency avoided
5. Data integrity
6. Data security
7. Data independence
8. Multiple user interfaces
9. Process complex query

Disadvantages of DBMS

1. Expensive
2. Changing Technology
3. Needs Technical Training
4. Backup is needed

Keys of DBMS:

Key is a field that uniquely identifies the records, tables or data. Key in a table allows us to establish the relation between multiple tables. Keys are also useful for finding the unique records or combination of records from a large database tables.

❖ **Primary Key:** A primary key is one or more columns in a table used to uniquely identify each row in the table. Primary key cannot contain Null value.

A primary key is a special relational database table column (or combination of columns) designated to uniquely identify each table record. A table cannot have more than one primary key.

A primary key's main features are:

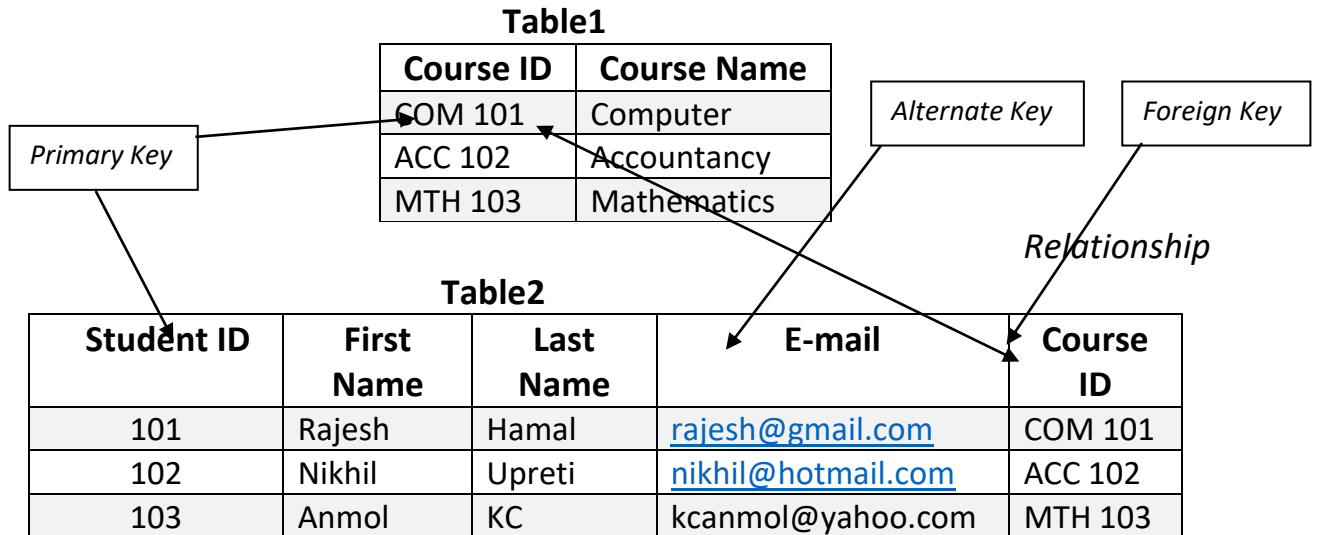
- It must contain a unique value under the field.
- It cannot contain null values.
- Every row must have a primary key value.

❖ **Foreign Key:** Foreign keys represent relationships between tables. A foreign key is a column whose values are derived from the primary key of some other table.

❖ **Candidate Key:** If a relational schema has more than one key, that is called a candidate key. All the keys which satisfy the condition of primary key can be candidate key. There can be any number of candidate keys that can be used in place of the primary key if required.

❖ **Alternate Key/ Secondary Key:** Alternative keys are those candidate keys which are not the primary key. There can be only one primary key for a table. Therefore all the remaining candidate keys are known as alternative.

- ❖ **Compound Key:** It has two or more attributes that allow you to uniquely recognize specific record. It is possible that each column may not be unique by itself within the database.

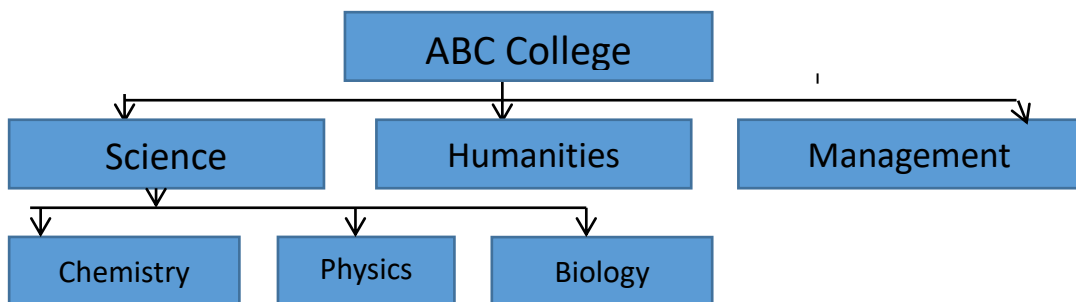


Database Model:

A Database model defines the logical design and structure of a database and are used to show how data will be stored, accessed and updated in a Database Management System. It refers to the layout of a database and helps in designing a database. The various types of database models are

Different database models

1. **Hierarchical database model:** this is one of the oldest types of database models. In this model data is represented in the form of records. Each record has multiple fields. All records are arranged in database as tree like structure. The relationship between the records is called parent child relationship in which any child record relates to only a single parent type record.



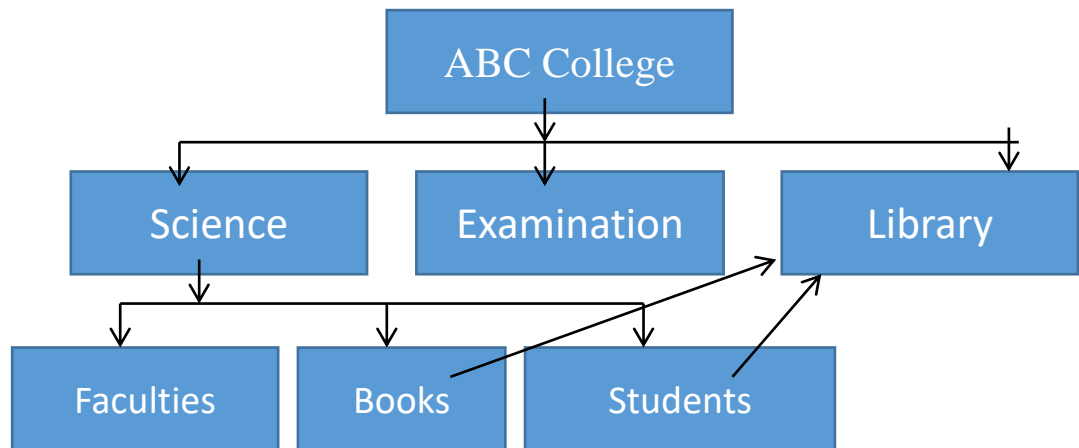
Advantages

- It is the easiest model.
- Searching is fast and easy if parent is known.
- It is very efficient in handling one to one and one to many relationships.

Disadvantages

- It is old and outdated database model.
- It does not support many to many relationships.
- It increases redundancy because same data is to be repeated in different places.

2. **Network database model:** It replaced hierarchical network database model due to some limitations on the model. Suppose, if an employee relates to two departments, then the hierarchical database model cannot be able to arrange records in proper place. So network, database model was emerged to arranged non-hierarchical database. *The structure of database is more like graph rather than tree structure. A network database model is a database model that allows multiple records to be linked the same owner file. The network model allows each child to have multiple parents.*



Advantages

- It accepts many to many relationships, so it is more flexible.
- The searching is faster because of multidirectional pointer.
- The network model is simple and easy to design.
- It reduces the redundancy.

Disadvantages

- It is difficult to handle the relationship in complex programs.
- There is less security because of sharing data.
- It increases the processing overhead due to the complex relationship.

3. **Relational database model:** in this model, the data is organized into tables which contain multiple rows and columns. These tables are called relations. A row in a table represents a relationship among a set of values. Since a table is a collection of such relationships, it is generally referred to the mathematical term relation, from which the relational database model derives its name.

We notice from below table, here each student has a unique roll number and has marks of subject. Here Roll makes relation between these two tables.

Table: Student		Table: Subject			
Roll	Name	Roll	Math	English	Computer
1	Hari	1	80	90	95
2	Sita	2	90	80	85
3	Ram	3	95	95	95

For example, if we make relation between student and subject, we get following:

Table: Subject				
Roll	Name	Math	English	Computer
1	Hari	80	90	95
2	Sita	90	80	85
3	Ram	95	95	95

Advantages

- The breaking of complex database table into simple database table becomes possible.
- Database processing is faster than other model.
- There is very less redundancy.
- The integrity rules can easily be implemented.

Disadvantages

- It is more complex than other models.
- There are too many rules because of complex relationships.
- It needs more powerful computers and data storage devices.

4. **Object oriented database model:** In the object-oriented model, both data and their relationships are contained in a single structure known as an object. An Object-Oriented Model reflects a very different way to define and use entities. An object includes information about relationships between the facts within the object, as well as information about its relationships with other objects. An objects include data, various types of relationships, and operational procedures, the object becomes self-contained, thus making the object-at least potentially-a basic building block for autonomous structures.

Advantages

- Semantic content is added.
- Visual representation includes semantic content.
- Inheritance promotes data integrity.

Disadvantages

- Slow development of standards caused vendors to supply their own enhancements, thus eliminating a widely accepted standard.
- It is a complex navigational system.
- There is a steep learning curve.
- High system overhead slows transactions.

5. Entity Relationship Diagram:

The diagrammatic representation of entities attributes and relationship is called E-R diagram. The E-R diagram is an overall logical structure of a database that can be expressed graphically. It was developed to facilitate database design. It is graphical representation of database.

Components of E-R Diagram

Entity	Attribute	Link	Relationship
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- **Entity:** An entity is defined as anything about which data to be collected and stored.
- **Relationships:** Relationships describes associations among data. Most relationships describes associations between two entities.
- **Attribute:** Attribute describes particular characteristics of the entity.

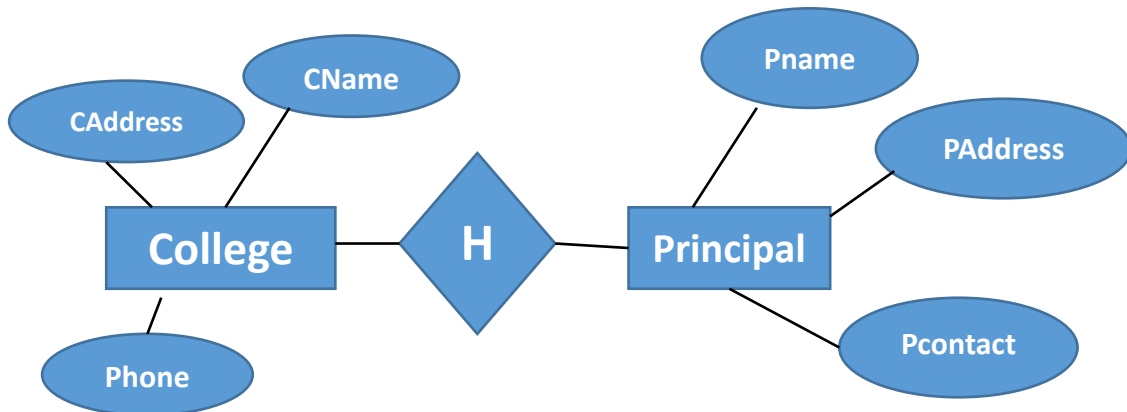


Fig. E-R diagram for relation between college and principal

Relationship and its types:

A relationship is an association among several entities and represents meaningful dependencies between them. It is represented by diamond. There are 3 types of relationship:

- i. One to one
- ii. One to many
- iii. Many to many

1. One to one: if one record of an entity is related with only one record of another entity then such type of relationship is called one to one relationship.

- College-----Principal
- Bank -----Manager
- Driver-----Car

2. One to many: If one instance of one entity is related with many instances of other entity then it is called the one to many relationship.

- College-----students
- Bank ----- Employers

3. Many to many: If many instances of the one entity are related with many instances of another entity then it is called many to many relationship.

- Teachers -----students
- Books -----Readers
- Employers -----Customers

Centralized database system Vs. Distributed database system:

Centralized database system:

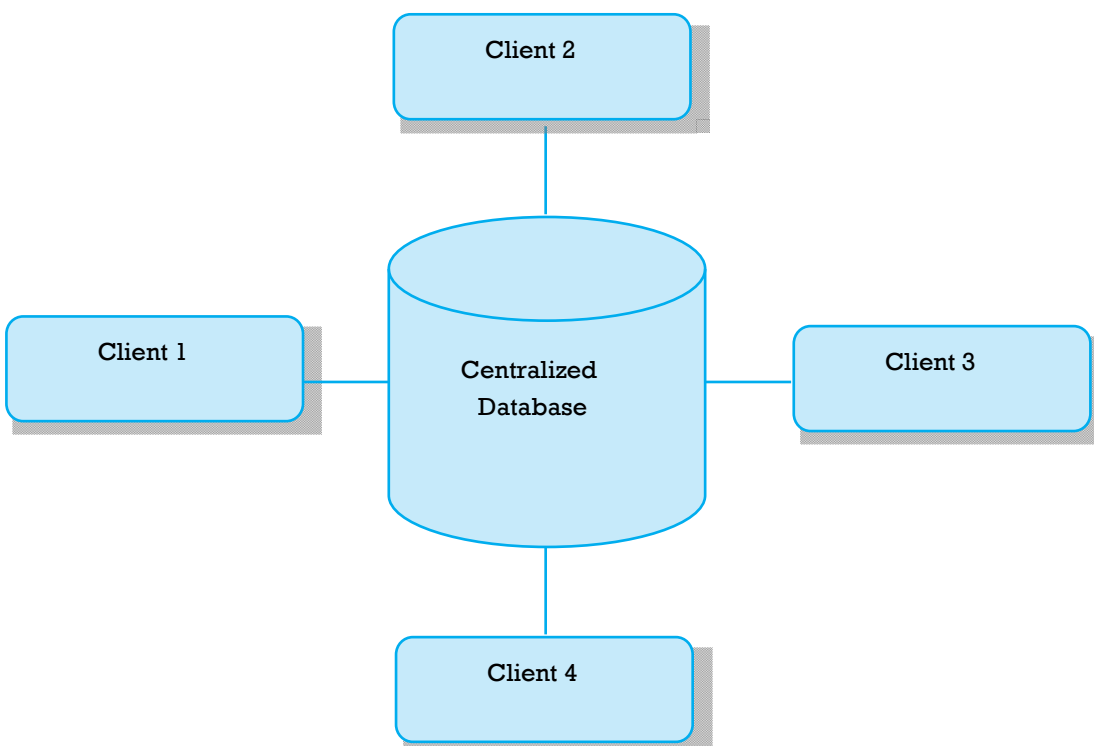
- The database system where data and information are stored in the centralized server or centralized database system.
- The data stored in database are accessed from different locations through several applications. The information (data) is stored at a centralized location and the users from different locations can access this data.
- This type of database contains application procedures that help the users to access the data even from a remote location.

Advantages:

- It decreases risk of data manipulation. i.e. manipulation of data will not affect the core data.
- Data consistency is maintained as it manages data in a central repository.
- It provides better data quality, which enables organizations to establish data standards.
- It is less costly as fewer vendors are required to handle the data sets.

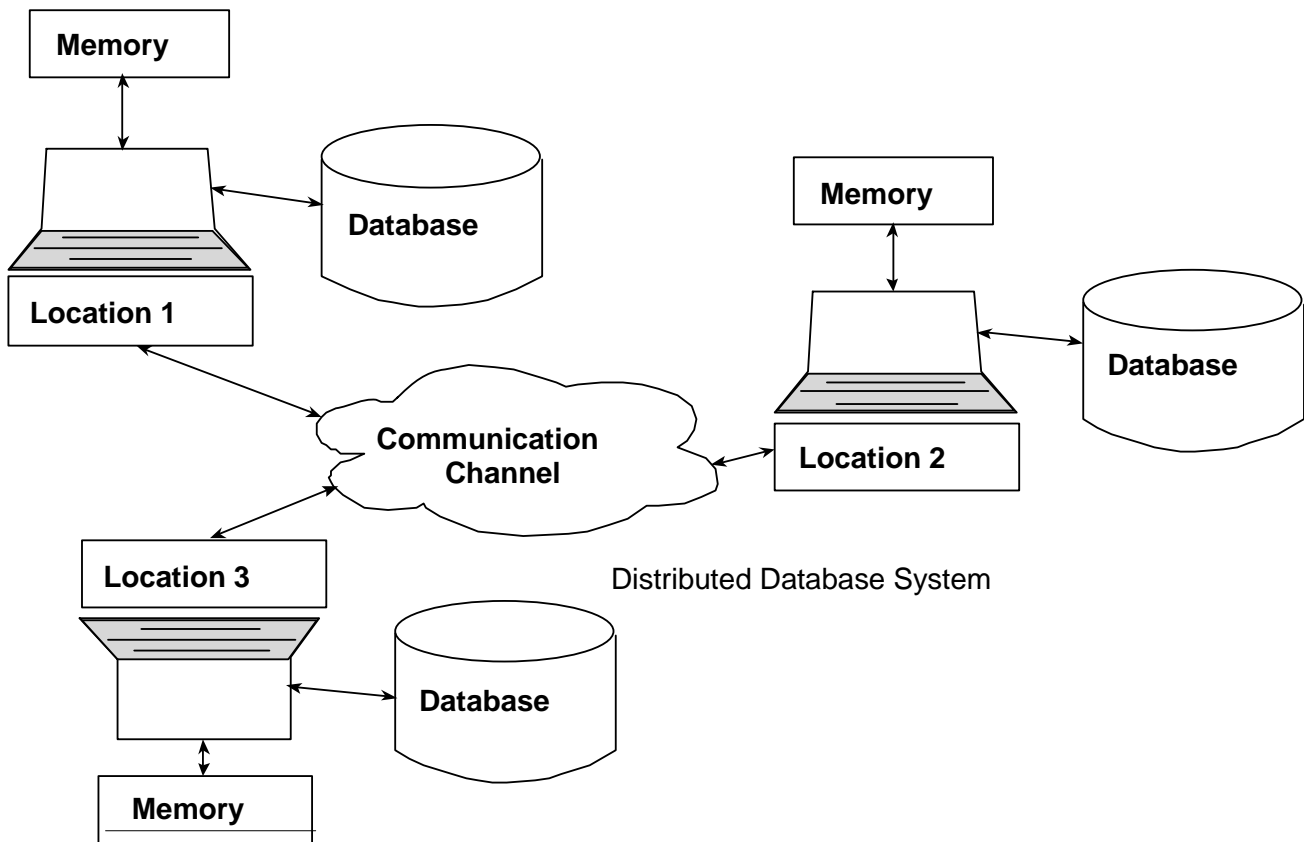
Disadvantages:

- The size of centralized database is large which increases the response time of fetching data.
- It is difficult to update the centralized database.
- If server gets damaged entire data will be lost.



Distributed database system:

- Distributed database doesn't store all data and information in the single but store on various sites or places, which are connected by the help of communication, links which helps them to access the distributed data easily.
- In distributed database various portions of a database are stored in multiple different locations along with the application procedures which are replicated and distributed among various points in a network.



Advantages:

- The system can be expanded by including new computers and connecting them to the distributed system.
- Distributed database is more reliable than centralized database.
- The performance and service are better.
- Large numbers of users are supported.
- One server failure will not affect the entire data set.

Disadvantages:

- It is difficult to administrate and manage the database
- It is expensive to set up.
- This database has high risk of hacking and data theft.

Different between centralize and distributed database system

Centralized database system	Distributed database system
1. Simple type	1. Complex type
2. Located on particular location	2. Located in many geographical locations.
3. Consists of only one server	3. Contains servers in several locations
4. Suitable for small organizations	4. Suitable for large organizations
5. Less chance of data lost	5. More chances of data hacking, lost
6. Maintenance is easy and security is high	6. Maintenance is not easy and security is low
7. Failure of system makes whole system down	7. Failure of one server does not make the whole system down
8. There is no feature of load balancing	8. There is feature of load balancing
9. Data traffic rate is high	9. Data traffic rate is low
10. Cost of centralized database system is low	10. Cost of distributed database system is high

DBA (Database Administrator)

DBA is the most responsible person in an organization with sound knowledge of DBMS. He/she is the overall administrator of the program. He/she has the maximum amount of privileges for accessing database and defining the role of the employee which use the system. The main goal of DBA is to keep the database server up to date, secure and provide information to the user on demand.

Qualities of good DBA

1. He/she should have sound and complete knowledge about DBMS and its operation.
2. He/she should be familiar with several DBMS packages such as MS Access, MY SQL, Oracle etc
3. He/she should have depth knowledge about the OS in which database server is running.
4. He/she should have good understanding of network architecture.
5. He/she should have good database designing skill.

Responsibilities

1. DBA has responsibility to install, monitor, and upgrade database server.
2. He/she should has responsibility to maintain database security by creating backup for recovery.
3. He/she has responsibility to conduct training on the uses of database.
4. DBA defines user privilege, relationships and manages form, reports in database.

Database Applications

Databases ranges from those designed for a single user with a desktop computer to those mainframe computers with thousands of users. The database applications can be for different purposes like:

1. **Personal database:** that supports one user with a stand along personal computer.
2. **Workgroup database:** for a small team of people (less than 25) who work in Collaboration on a project.
3. **Departmental database:** designed to support the various functions and activities of a Department.
4. **Enterprise database:** that supports organization-wide operations and decision making.

Some of the examples of database applications are:

1. **Banking system:** It use database for storing customer info, tracking day to day credit and debit transactions, generating bank statements, etc.
2. **Airlines:** To travel though airlines, we make early reservations. This reservation information along with flight schedule is stored in database.
3. **Telecom:** It use database to keep track of the information regarding calls made, network usage, customer details, etc.
4. **Industry:** An industry usually contains a manufacturing unit and warehouse or distribution Centre. Each of these requires a database to keep the records of ins and outs.
5. **Sales:** To store customer information, production information and invoice details.
6. **Education sector:** Database systems are frequently used in schools and colleges to store and retrieve the data regarding student details, staff details, course details, exam details, payroll data, attendance details, fees details, etc.
7. **Online shopping:** These sites store the product information, customer's addresses and preferences, credit details and provide the relevant list of products based on users query. All this involves a Database management system.
8. **Railway reservation system:** In the railway reservation system, the database is required to store the record or data of ticket bookings, status about train's arrival, and departure. Also if trains get late, people get to know it through database update.
9. **Library management system:** Database management system (DBMS) is used to maintain all the information related to the name of the book, issue date, availability of the book, and its author.
10. **Credit card transactions:** Database Management system is used for purchasing on credit cards and generation of monthly statements.
11. **Social media sites:** Daily, millions of peoples sign up for these social media accounts like Facebook, Twitter, and Instagram. By the use of the database management system, all the information of users and user's activities are stored in the database.

- 12. Finance:** The database management system is used for storing information about sales. holding and purchases of financial instruments such as stocks and bonds in a database.
- 13. Human resource management:** Big firms or companies have many workers or employees working under them. They store information about employee's salary, tax, and work with the help of database management system (DBMS)
- 14. Military:** The military keeps records of millions of soldiers and it has millions of files that should be kept secured and safe. As DBMS provides a big security assurance to the military information so it is widely used in militaries. One can easily search for all the information about anyone within seconds with the help of DBMS

Cloud Database

A cloud database is a database that is built, deployed, and accessed in a cloud environment. Such as a private, public, or hybrid cloud.

There are two primary cloud database deployment models

1. Traditional database:

Is very similar to an onsite, in-house managed database-except for infrastructure provisioning. In this case, an organization purchases virtual machine space from a cloud services provider, and the database is deployed to the cloud. The organization's developers use a DevOps model or traditional IT staff to control the database. The organization is responsible for oversight and database management.

2. Database as a service (DBaaS): In which an organization contracts with a cloud services provider through a fee-based subscription service. The service provider offers a variety of real-time operational maintenance, administrative, and database management tasks to the end user. The database runs on the service provider's infrastructure. This usage model typically includes automation in the areas of provisioning backup scaling, high availability, security, patching, and health monitoring. The DBaaS model provides organizations with the greatest value, allowing them to use outsourced database management optimized by software automation rather than hire and manage in-house database experts.

Features of Cloud Database

The key features of cloud database are:

- A database service is built and accessed through a cloud platform.
- It enables enterprise users to host databases without buying dedicated hardware.
- It can be managed by the user or offered as a service and managed by a provider.
- It supports relational databases (including MySQL and PostgreSQL) and NoSQL databases (including MongoDB and Apache CouchDB).
- It can be accessed through a web interface or vendor-provided API.

Benefits of a Cloud Database

Cloud databases offer many of the same benefits as other cloud services, including

1. Fast Implementation:

Cloud databases can be set up and withdrawn very quickly- making testing, validating, and operationalizing new business ideas easy and fast. If the organization decides not to operationalize a project, it can simply the project (and its database) and move on to the next innovation,

2. Faster time to market:

When using a cloud database, there's no need to order hardware or spend time waiting for shipments, installation, and network setup when a new product is in the development queue. Database access can be available within minutes.

3. Reduced risks:

Cloud databases offer numerous opportunities to reduce risk across the business, particularly for DBaaS models. Cloud services providers can use automation to enforce security best practices and features and to lower the probability of human error- the primary cause of software downtime.

4. Cheaper cost:

This is much less costly than maintaining these capabilities in-house, where organizations must purchase physical servers that can handle peak demand even though they may only need peak capabilities a couple of days per quarter.