Introduction

- DBMS stands for Database Management System.

- DBMS is a software system for creating, organizing and managing the database.

- It provides an environment to the user to perform operations on the database for creation, insertion, deletion, updating and retrieval of data.

What is Data ?

- A collection of raw facts and figures.
- Raw material that can be processed by any computing machine.
- A collection of facts from which conclusions may be drawn.
- Data can be represented in the form of and words which can be

stored in computer‟s language.

i.e. Paan Singh, Anshul 007

What is Information?

- Systematic and meaningful form of data.
- Knowledge acquired through study or experience.
- Information helps human beings in their decision making.

Database

- A repository of logically related and similar data.

- An organized collection of related information so that it can easily be accessed, managed and updated.

E.g.:

Dictionary Airline Database Studer
Library

Railways Timetable YouTube (All so

Data Models, Schema and Instances

- **Data Models:**

-Describes structure of the database.

-Aim is to support the development of information systems by providing the definition and format of data.

-If the same data structures are used to store and access data then different applications can share data.

-Classification:

1. High-Level Model
2. Representation Model
3. Low-Level Model

1. High-Level Model

- Ensures data requirement of the users.
- Not concerned with representation, but it‟s a conceptual form.
- Three Imp terms:

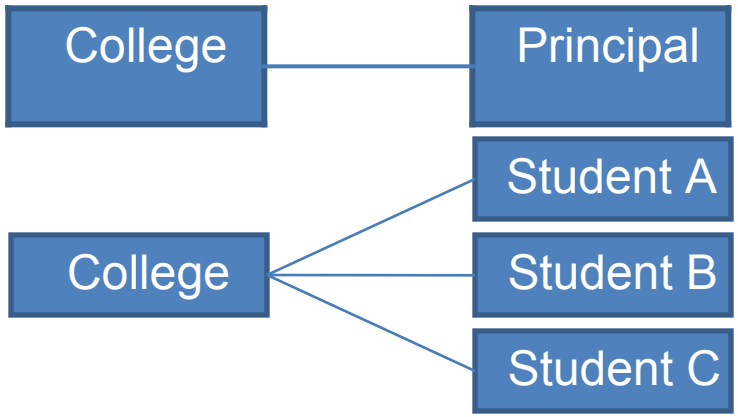
a)Entity: - Any object, exists physically or conceptually.

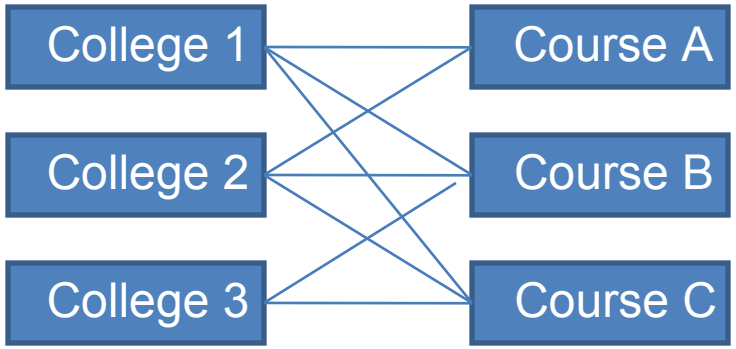
b)Attribute:- Property or characteristic of entity.

c)Relationship:- Association or link b/w two entities.

- These 3 terms make Entity-Relationship Model.

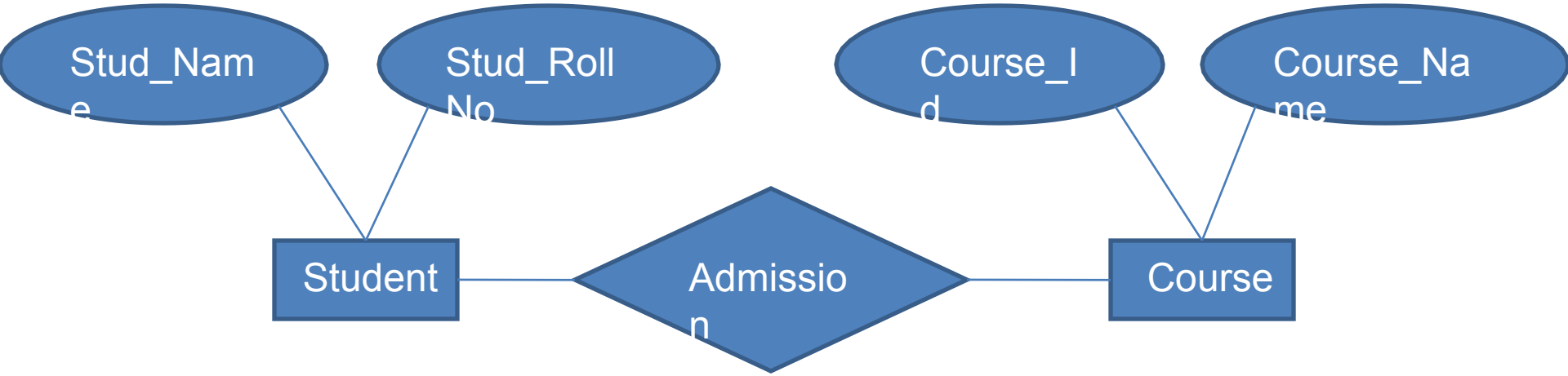
Entity-Relationship (E-R) Model





Relationships

E-R diagram



2. Representation Model

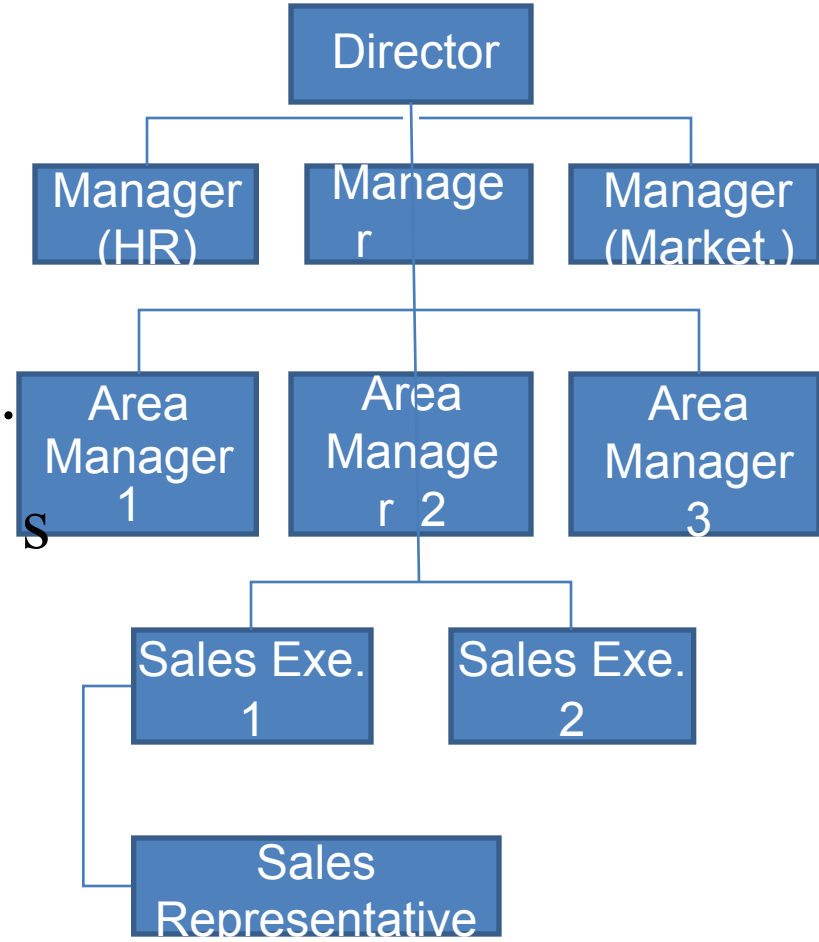
- Representation of data stored inside a database.
- Describes the physical structure of the database.
- It uses the concepts which are close to the end-users.

- Classification:

  a. Hierarchical
  b. Relational
  c. Network

a. Hierarchical Database Model

- Developed by IBM, is the Oldest database model.
- Represented using a tree-diagram. (Parent-child relationship)
- The box is called a "Node"
- Each node represents a record type.
- A line connecting nodes represent the link.



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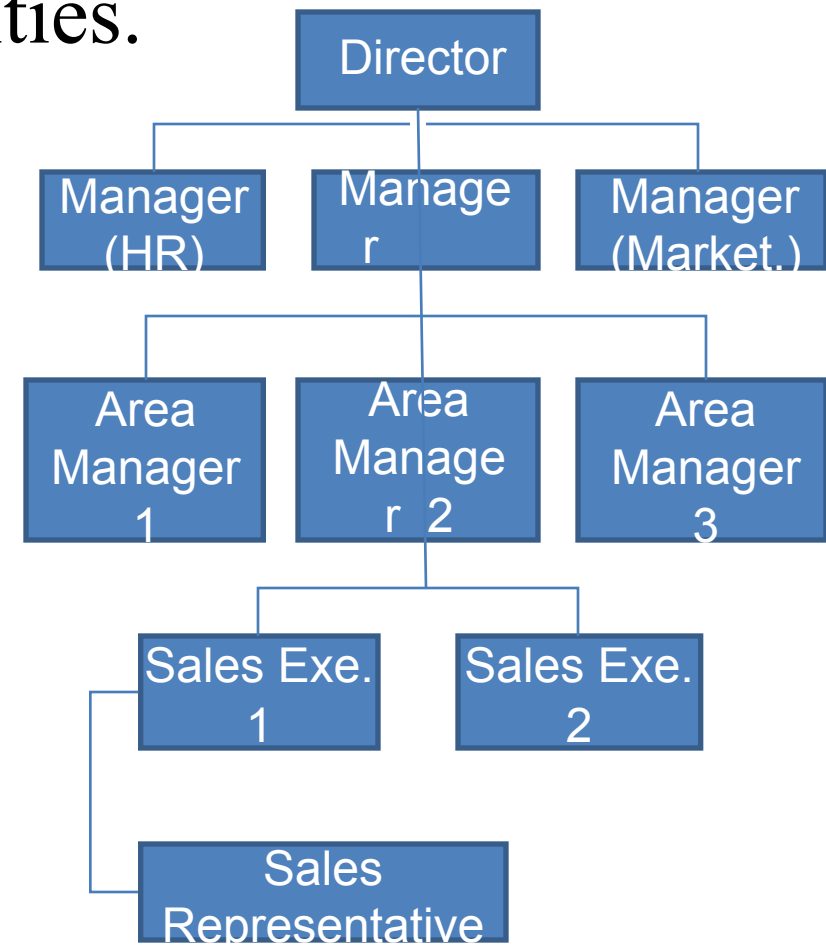
- Parent-child type is suited for One-to-many relationship between two entities.
- But difficult to implement many-to-many relationship.

e.g.:

IMS system from IBM.



b. Relational Database Model

- Simplest and the most common model.
- Developed in 1970 by E.F. Codd, it became commercial in the 80s.
- Data elements are stored in different tables made up of rows and columns.

Roll No	Name	Surname	Section
1001	Rajkumar	Tomar	D
1002	Rajkumar	Singh	D

Cont…

- Terminologies:

-Data Values: alphanumeric raw data (Rajkumar)

-Columns: fields (item or object that holds the data)

-Rows: record (a group of data for related field)

-Table: collection (all records & fields)

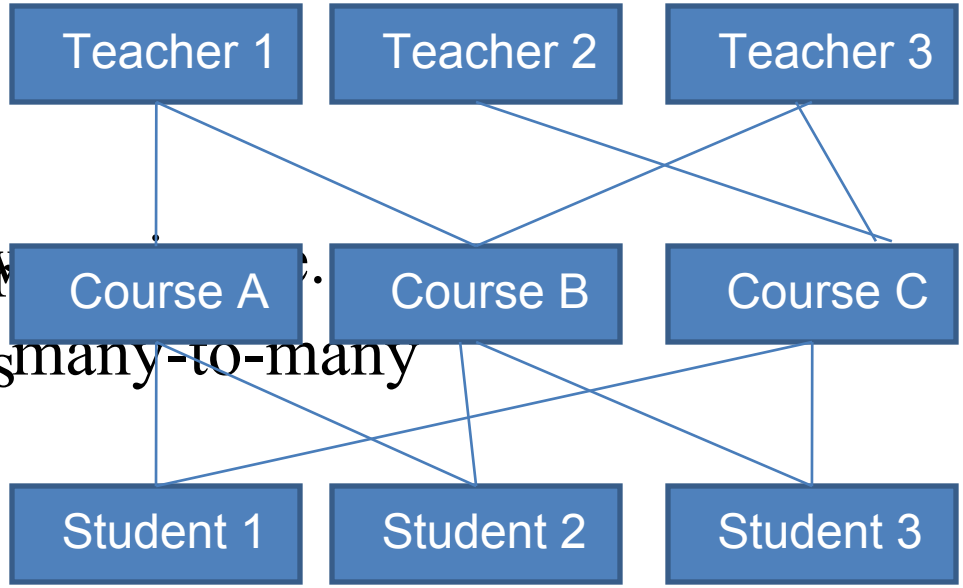
-Key: identifier (uniquely identifies a row in the table. It can be value of a single or multiple column. e.g.:

DB2, ORACLE, SQL Server.

Roll No	Name	Surname	Section
1001	Rajkumar	Tomar	D
1002	Rajkumar	Singh	D

c. Network Database Model

- Represented using a Data-Structure Diagram.
- Boxes represents the records & lines the links.
- Based on „owner-member relationship.“
- Members of an owner may be many but for many membe o .
- Can represent one-to-one and many-to-many as well.



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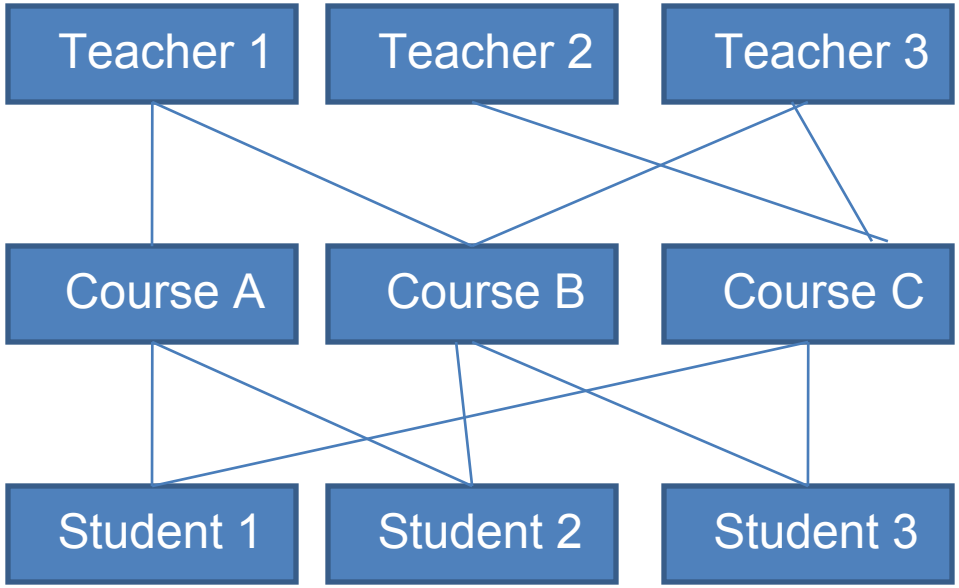
- One-to-many relationship is converted into a set of one-to-one.
- Also, many-to-many is converted into 2 or more one-to-many relationship.



e.g.:

IDMS, IMAGE.

Cont…

- **Schema:**

- Logical structure of the database.
  - Doesn‟t show the data in database.
  - Classification:
    1. Physical
    2. Conceptual
    3. External

Cont…

1. **Physical Schema:**

-Describes the physical storage of database.

-Not in terms of blocks or devices, but describes organization of files, access path etc.

2. **Conceptual Schema:**

-Describes structure of whole database.

-Describes entities their relationships and constr

3. **External Schema:**

-Provides a user‟s view of data.

-Shows relevant info particular to user, hide

-one or more levels.

- **Instances:** Actual data contained in point of time.

Components of Database System

- **Users**- People who interact with the database:

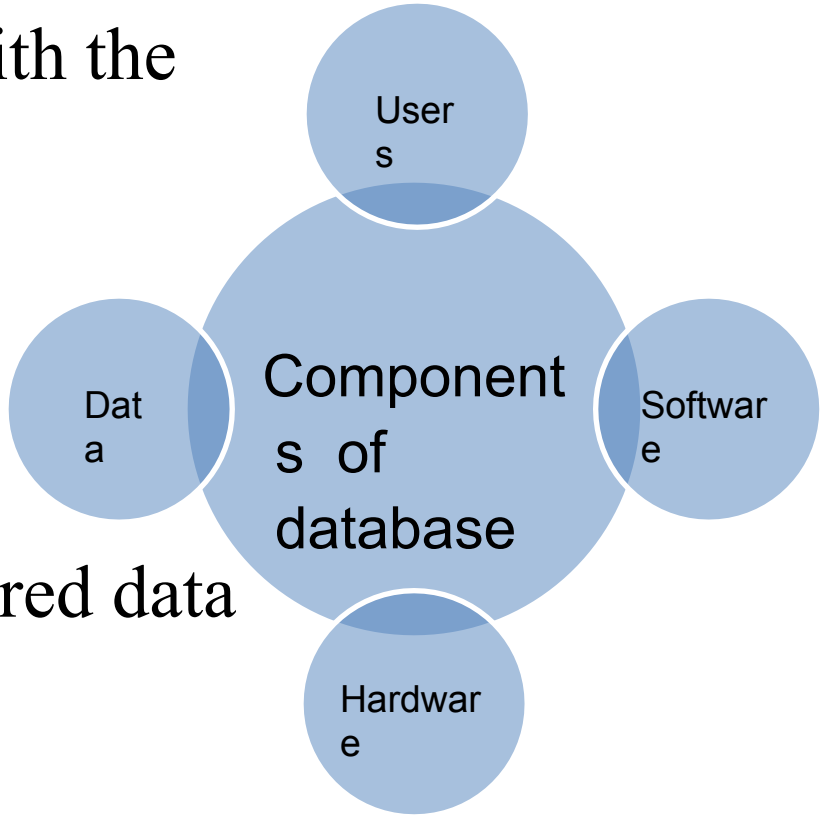
-Application Programmers.

-End Users.

- Data Administrators.

- **Software**- Lies between the stored data and the users:

  - DBMS.
  - Application Software.
  - User Interface.



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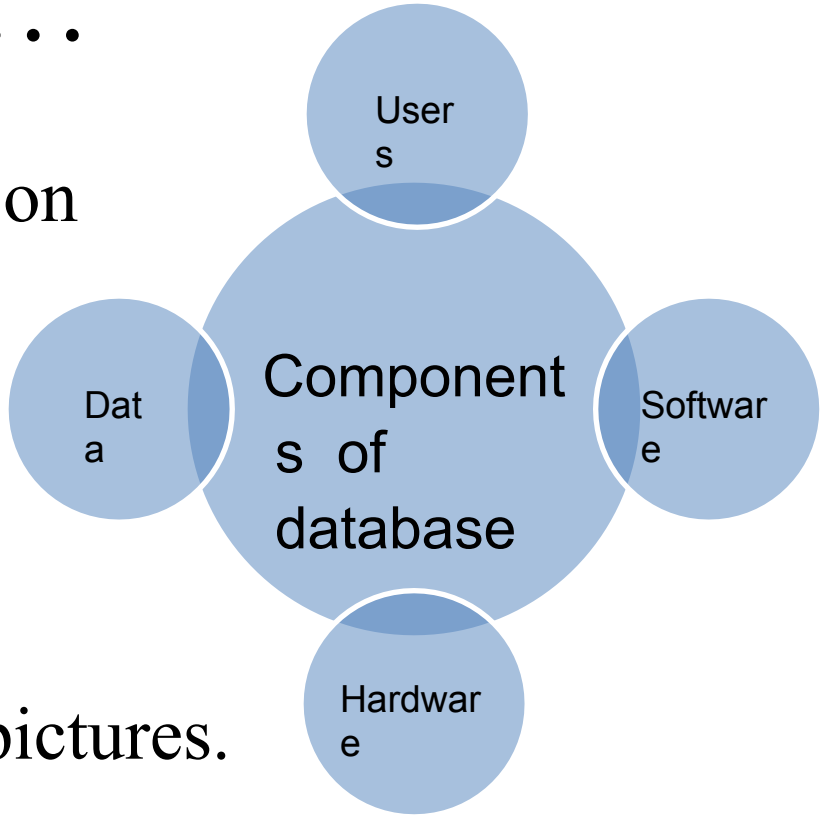


- **Hardware**- Physical device on which database resides.

  e.g.:
  Computers, Disk Drives,

  Printers, Cables etc.
- **Data**- numbers, characters, pictures.

  e.g.:

Shri Shri Nilesh, 1008, India.

Database Administrator (DBA)

- Individual or a group, having centralized control of the database.
- Has a good understanding of database and coordinates all activities of the database.
- Functions:

-Defines schema.

-Defines storage structure and access method.

-Modification of both.

-Granting user authority to access the database.

-Monitoring performance and responding to changes.

Database Languages

- Once data is filled, manipulation is required (insertion, deletion, modification of data)
- For these, a set of languages is provided by DBMS:

1. Data Definition Language.
2. Data Manipulation Language.

Cont…

1. **Data Definition Language (DDL):**

-Used by DB designers to define schema.

-DDL compiler converts DDL statements and generate a set of tables which are stored in. e.g.: SQL

2. **Data Manipulation Language (DML):**

-For accessing and manipulating the data. e.g.: SQL

3. **Data Control Language (DCL):**

-Similar to a computer programming language used to control access to data stored in a database.

-operations like:

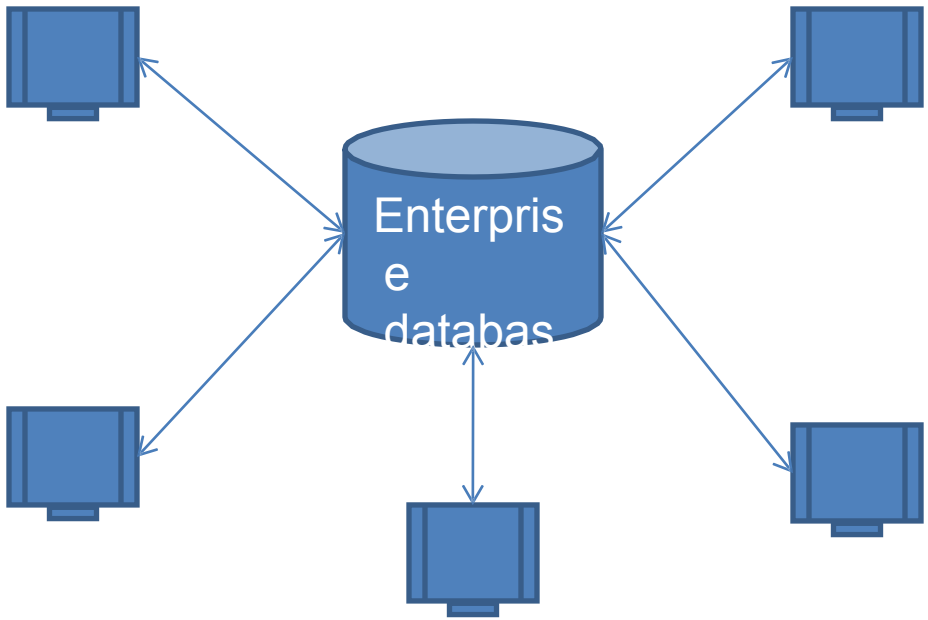
CONNECT, SELECT, INSERT, UPDATE, DELETE, EXECUTE, and USAGE. e.g.: SQL

Database System Architectures

- The journey from big mainframe to pc has also evolved the database and its architecture.
- Classification:
    1. Centralized DBMS Architecture
    2. Client-Server Architecture
    3. Distributed Databases

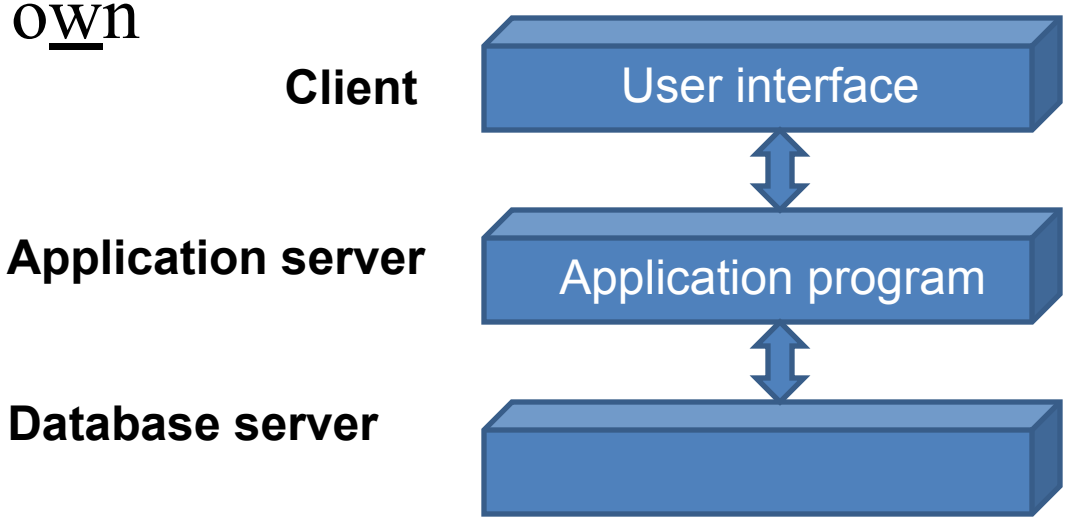
1. Centralized DBMS Architecture

- Traditional form, all data, functionality, apps are located on one machine.
- Access via communication links.



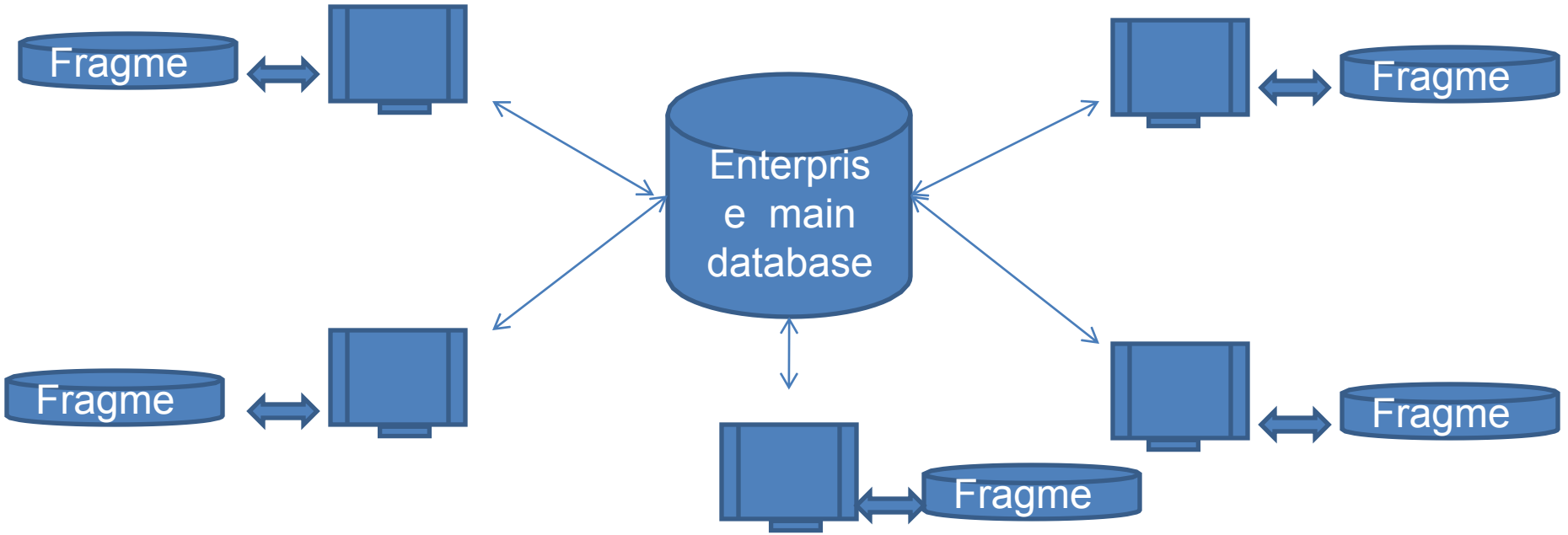
2. Client-Server Architecture

- Involves a client and a server.
- Clients are PCs or workstations.
- Servers are powerful computers, can manage files, printers, e-mails.
- Client interacts server when additional functionality doesn‟t exits in its own machine.



3. Distributed Database Architecture

- Decentralized functionality, distributed among many computers.
- Storage computers are at diff. geographical locations.



Database Management System (DBMS)

Typical DBMS Functionality

- Define a database : in terms of data types, structures and constraints
- Construct or Load the Database on a secondary storage medium
- Manipulating the database : querying, generating reports, insertions, deletions and modifications to its content
- Concurrent Processing and Sharing by a set of users and programs – yet, keeping all data valid and consistent

Components of DBMS Environment

- **Hardware**
  - **PC, workstation, mainframe, a network of computers.**
- **Software**
  - **DBMS, operating system, network software (if necessary) and also the application programs.**
- **Data**
  - **Used by the organization and a description of this data called the schema.**
- **Procedures**
  - **Instructions and rules that should be applied to the design and use of the database and DBMS.**
- **People**

Roles in the Database Environment

- **Data Administrator (DA)**
- **Database Administrator (DBA)**
- **Database Designers (Logical and Physical)**
- **Application Programmers**
- **End Users (naive and sophisticated)**

Example of a Database (with a Conceptual Data Model)

- **Mini-world for the example**: Part of a UNIVERSITY environment.
- **Some mini-world *entities***:
  - –STUDENTs
  - –COURSEs
  - –SECTIONs (of COURSEs)
  - –(academic) DEPARTMENTs
  - –INSTRUCTORs

Note: The above could be expressed in the ENTITY-RELATIONSHIP data model.

Example of a Database (with a Conceptual Data Model)

- **Some mini-world *relationships***:
  - –SECTIONs *are of* specific COURSEs
  - –STUDENTs *take* SECTIONs
  - –COURSEs *have* prerequisite COURSEs
  - –INSTRUCTORs *teach* SECTIONs
  - –COURSEs *are offered by* DEPARTMENTs
  - –STUDENTs *major in* DEPARTMENTs

Note: The above could be expressed in the *ENTITY-RELATIONSHIP* data model.

Characteristics of Database

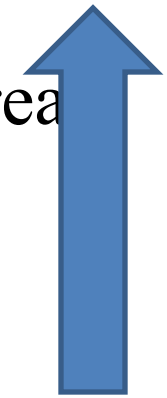
- Self-describing nature of a database system: A DBMS **catalog** stores the *description* of the database. The description is called **meta-data**). This allows the DBMS software to work with different databases.
- Insulation between programs and data: Called **program-data independence**. Allows changing 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.
- 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.

- Sharing of data and multiuser transaction processing : allowing a set of concurrent users to retrieve and to update the database. Concurrency control within the DBMS guarantees that each **transaction** is correctly executed or completely aborted. OLTP (Online Transaction Processing) is a major part of database applications.

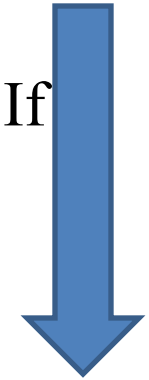
Advantages of DBMS

- **Controlling Data Redundancy:** Data is recorded in only one place in the database and it is not duplicated.
- **Data Consistency:** Data item appears only once, and the updated value is immediately available to all users.
- **Control Over Concurrency :** In a computer file-based system in updating, one may overwrite the values recorded by the other.
- **Backup and Recovery Procedures:** automatically crea the backup of data and restore data if required.
- **Data Independence:** Separation of data structure of database from application program that uses the data is called data independence.



Disadvantages of DBMS

- **Cost of Hardware and Software:** Processor with high speed of data processing and memory of large size is required.
- **Cost of Data Conversion:** Very difficult and costly method to convert data of data file into database.
- **Cost of Staff Training:** A lot of amount for the training of staff to run the DBMS.
- **Appointing Technical Staff:** Trained technical persons such as database administrator, application programmers, data entry operators etc. are required to handle the DBMS.
- **Database Damage:** All data is integrated into a single database. If database is damaged due to electric failure or database is corrupted on the storage media, then your valuable data may be lost forever.



Examples of DBMS

- Some of the common used DBMSs are:

-Oracle, IBM‟s DB2, Microsoft‟s SQL Server,

MS-Access and Informix.

- Some of the desktop based DBMSs are:

-Microsoft FoxPro, Borland dBase and

Microsoft Access.

Applications of DBMS

- **Airlines and Railways:** Online databases for reservation, and displaying the schedule information.
- **Banking:** Customer inquiry, accounts, loans, and other transactions.
- **Education:** Course registration, result, and other information.
- **Telecommunications:** Communication network, telephone numbers, record of calls, for generating monthly bills, etc.
- **E-commerce:** Business activity such as online shopping, booking of holiday package, consulting a doctor, etc.
- **Human resources:** Organizations use databases for storing information about their employees, salaries, benefits, taxes, and for generating salary checks.

- **Object-oriented applications:** OODBMSs were introduced in late 1980's and early 1990's to cater to the need of complex data processing in CAD and other applications. Their use has not taken off much.
- **Data on the Web and E-commerce Applications:** Web contains data in HTML (Hypertext markup language) with links among pages. This has given rise to a new set of applications and E-commerce is using new standards like XML (eXtended Markup Language).

Extending Database Capabilities

- **New functionality is being added to DBMSs in the following areas:**
  - –Scientific Applications
  - –Image Storage and Management
  - –Audio and Video data management
  - –Data Mining
  - –Spatial data management
  - –Time Series and Historical Data Management

The above gives rise to new research and development in incorporating new data types, complex data structures, new operations and storage and indexing schemes in database systems.

When not to use a DBMS

- **Main inhibitors (costs) of using a DBMS**:
  - –High initial investment and possible need for additional hardware.
  - –Overhead for providing generality, security, concurrency control, recovery, and integrity functions.
- **When a DBMS may be unnecessary:**
  - –If the database and applications are simple, well defined, and not expected to change.
  - –If there are stringent real-time requirements that may not be met because of DBMS overhead.
  - –If access to data by multiple users is not required.

- **When no DBMS may suffice:**
  - If the database system is not able to handle the complexity of data because of modeling limitations
  - If the database users need special operations not supported by the DBMS.