Unit 1
Database system architecture:

1. What is DBMS
2. Application Of DBMS
3. Advantages of DBMS
4. Architecture of DBMS
5. Data Abstraction
6. Data Independence
7. Database Users
8. Role of DBA
9. DDL
10. DML

What is Database Management System (DBMS)?

- Data - **Fact** that can be recorded or stored
  - e.g. Person Name, Age, Gender and Weight etc.
- Database - Collection of **logically related data**
  - e.g. Books Database in Library, Student Database in University etc.
- Management - Manipulation, Searching and Security of data
  - e.g. Viewing result in GTU website, Searching exam papers in GTU website etc.
- System - **Programs** or **tools** used to manage database
  - e.g. SQL Server Studio Express, Oracle etc.
- DBMS - A Database Management System is a software for creating and managing databases.
- Database Management System (DBMS) is a **software designed to define, manipulate, retrieve and manage data in a database**.
  - e.g. MS SQL Server, Oracle, My SQL, SQLite, MongoDB etc.

Applications of DBMS

- DBMS is a computerized record-keeping system.
- DBMS is required where ever data need to be stored.
  - E-Commerce (**Flikart, Amazon, Shopclues, eBay** etc...)
  - Online Television Streaming (**Hotstar, Amazon Prime** etc...)
  - Social Media (**WhatsApp, Facebook, Twitter, LinkedIn** etc...)
  - Banking & Insurance
  - Airline & Railway
  - Universities and Colleges/Schools
  - Library Management System
  - Human Resource Department
  - Hospitals and Medical Stores
  - Government Organizations

Advantages of DBMS

Reduce data redundancy (duplication)

Computer

Emp_Name	Addres	Mobile	Subje
Prof. Ajay Shah	Rajkot	1234	PPS

Database management system can remove such data redundancy by storing data centrally.

Civil

Emp_Name	Addres	Mobile	Subje
Prof. Ajay Shah	Rajkot	1234	PPS

Same data is stored at four different places.

Emp_Name	Addres	Mobile	Subje
Prof. Ajay Shah	Rajkot	1234	PPS

Electrical

Emp_Name	Addres	Mobile	Subje
Prof. Ajay Shah	Rajkot	1234	PPS

Mechanical

Remove data inconsistency

Computer

Emp_Name	Addres	Mobile	Subje
Prof. Ajay Shah	Rajkot	6789	PPS

Database management system can keep data in consistent state.

Civil

Emp_Name	Addres	Mobile	Subje
Prof. Ajay Shah	Rajkot	1234	PPS

Same data having different state (values)

Mobile no is changed

Electrical

Emp_Name	Addres	Mobile	Subje
Prof. Ajay Shah	Rajkot	6789	PPS

Mechanical

Emp_Name	Addres	Mobile	Subje
Prof. Ajay Shah	Rajkot	1234	PPS

Data isolation

- Data are **scattered** in various files.
- Files may be in **different formats**.
- **Difficult to retrieve** the appropriate data.

DBMS allow us to access (retrieve) appropriate data easily.

Data isolation is a property that determines when and how changes made by one operation become visible to other concurrent users and systems. This issue occurs in a concurrency situation.

File - 1

Emp Name	Addres	Mobile	Subje
Prof. Ajay Shah	Rajkot	1234	PPS

File - 2

lame	Post	Salary	Load
Prof. Ajay Shah	Lectur er	50,00 0	15

File - 3

Emp Name	Teachin	Knowled	Ratin
Prof. Ajay Shah	Good	Excellent	9

Guaranteed atomicity

- Atomicity: Either transaction **execute 0% or 100%**.

Sum of both account before transfer is 3000

Person A Account A Bal : 2000

Transfer 500

Person B Account B Bal : 1000

Step 1 : Debit 500 from Account A

Step 2 : Credit 500 into Account B

Transaction is failed

Sum of both account after transfer is 3000

Sum of both account is 2500 so inconsistent

Basic Terms

- Data
- Information
- Metadata
- Data dictionary
- Data warehouse
- Field
- records

Basic terms

- Data
  - Data is **raw, unorganized facts** that need to be processed.
  - Example: Marks of students
  - Student_1 = 50/100, Student_2 = 25/100.
- Information
  - When data is **processed, organized, structured** or presented in a given context so as to make it useful, it is called information.
  - Example: Result of students (Pass or Fail)
  - Student 1 = Pass, Student 2 = Fail.
- Metadata
  - Metadata is **data about data**.
  - Data such as table name, column name, data type, authorized user and user access privileges for any table is called metadata for that table.

Faculty

Emp_Name	Address	Mobile_No	Subject
Prof. Ajay Shah	Rajkot	9876543210	PPS

  - Metadata of above table is:
    - Table name such as Faculty
    - Column name such as Emp_Name, Address, Mobile_No, Subject
    - Datatype such as Varchar, Decimal
    - Access privileges such as Read, Write (Update)

- Data dictionary
  - A data dictionary is an information repository which **contains metadata**.
    - Table Name – Faculty
    - Column Name – EmpName, Address, Mob, Subject, Salary
    - Datatype – Varchar, Decimal
    - Access Privileges – Read, Write (Update)
- Data warehouse
  - A data warehouse is an information repository which **stores data**.
- Field
  - A field is a **character or group of characters** that have a specific meaning.
  - E.g, the value of Emp_Name, Address, Mobile_No etc are all fields of Faculty table.

Faculty

Emp_Name	Address	Mobile_No	Subject
Prof. Ajay Shah	Rajkot	9876543210	PPS
Prof. Ajay Patel	Surat	0123456789	DBMS

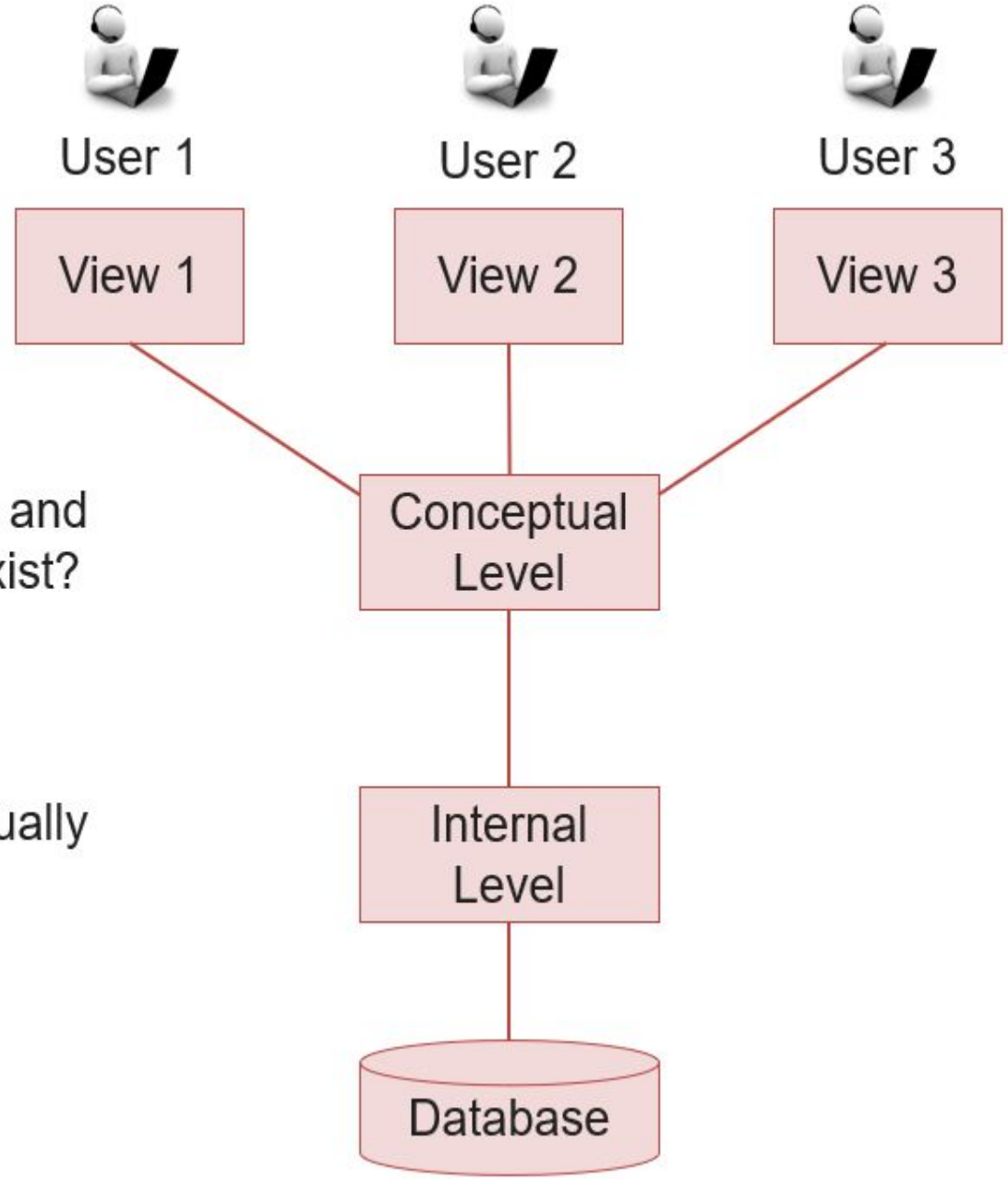
- Rec
  - A record is a **collection of logically related fields**.
  - E.g, the collection of fields (Emp_Name, Address, Mobile_No, Subject) forms a record for the Faculty.

DBMS Architecture

How data are viewed by each users?

What data are stored and **What** relationships exist?

How the data are actually stored on storage devices?



View Level

Logical Level

Physic al Level

Data Abstraction in DBMS

- 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.

Data Independence

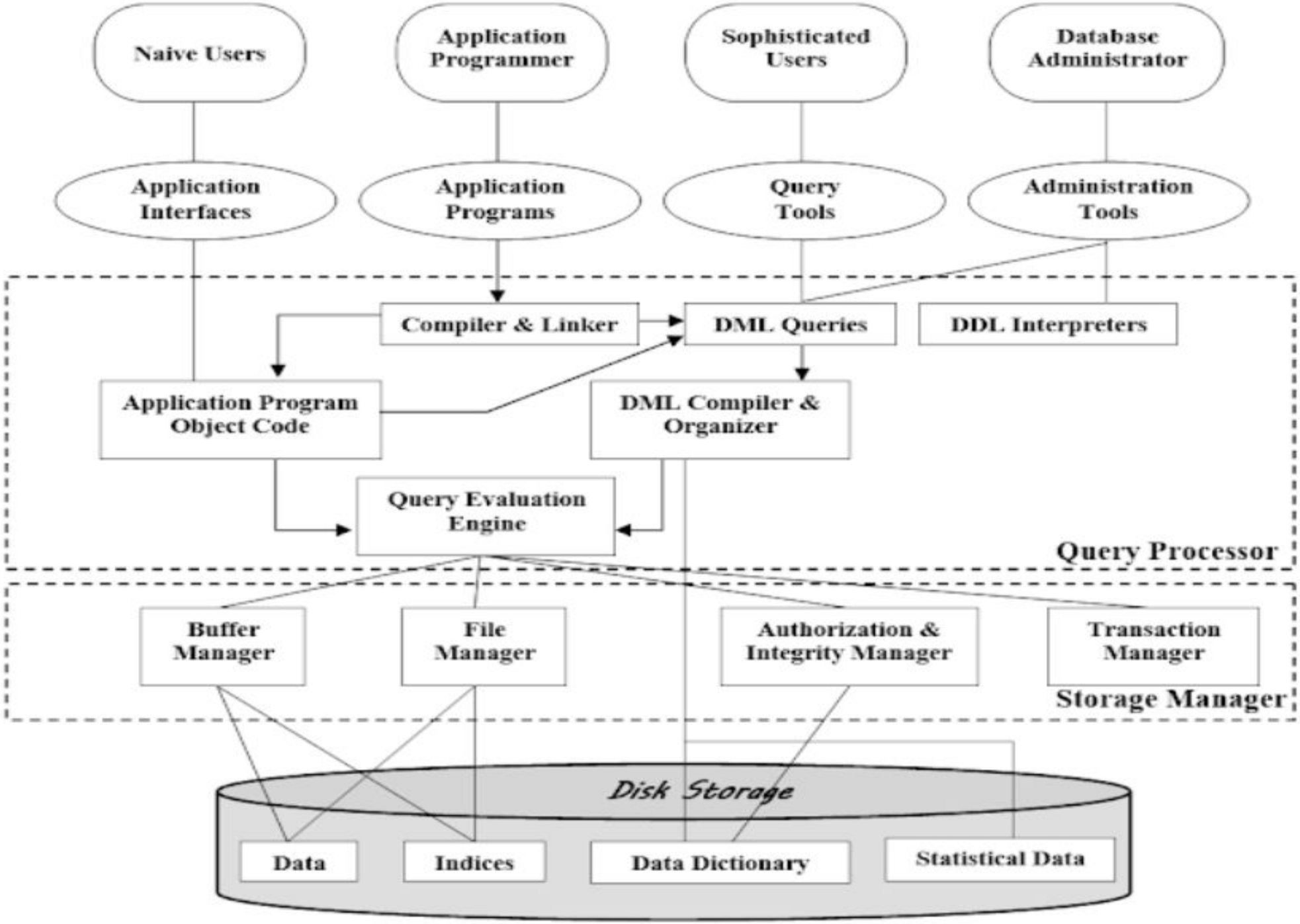
- Physical Data Independence
  - Physical Data Independence is the ability to modify the physical schema without requiring any change in logical (conceptual) schema and application programs.
  - Modifications at the internal levels are occasionally necessary to improve performance.
  - Possible modifications at internal levels are changes in file structures, compression techniques, hashing algorithms, storage devices, etc.
- Logical Data Independence
  - Logical data independence is the ability to modify the conceptual schema without requiring any change in application programs.
  - Modification at the logical levels is necessary whenever the logical structure of the database is changed.
  - Application programs are heavily dependent on logical structures of the data they access. So any change in logical structure also requires programs to change.

Type of Database Users

- Naive Users (End Users)
  - **Unsophisticated users** who have zero knowledge of database system
  - End user interacts to database via sophisticated software or tools
  - e.g. Clerk in bank
- Application Programmers
  - **Programmers** who write software using tools such as Java, .Net, PHP etc..
  - e.g. Software developers
- Sophisticated Users
  - **Interact with database system** without using an application program
  - Use query tools like SQL
  - e.g. Analyst
- Specialized Users (DBA)
  - User **write specialized** database applications program
  - Use administration tools
  - e.g. Database Administrator

Role of DBA
(Database Administrator)

- Schema Definition
  - DBA **defines the logical schema** of the database.
- Storage Structure and Access Method Definition
  - DBA **decides how the data is to be represented** in the database & how to access it.
- Defining Security and Integrity Constraints
  - DBA **decides on various security and integrity constraints**.
- Granting of Authorization for Data Access
  - DBA **determines which user needs access to which part** of the database.
- Liaison with Users
  - DBA **provide necessary data** to the user.
- Assisting Application Programmer
  - DBA **provides assistance to application programmers** to develop application programs.
- Monitoring Performance
  - DBA **ensures that better performance is maintained** by making a change in the physical or logical schema if required.
- Backup and Recovery
  - DBA **backing up the database** on some storage devices such as DVD, CD or magnetic tape or remote servers and **recover the system in case of failures**, such as flood or virus attack from this backup.


Naive Users
Application Programmer
Sophisticated Users
Database Administrator
Application Interfaces
Application Programs
Query Tools
Administration Tools
Compiler & Linker
DML Queries
DDL Interpreters
Application Program Object Code
DML Compiler & Organizer
Query Evaluation Engine
Query Processor
Buffer Manager
File Manager
Authorization & Integrity Manager
Transaction Manager
Storage Manager
Disk Storage
Data
Indices
Data Dictionary
Statistical Data

DDL	DML
It is Data Definition Language	It is Data Manipulation Language
These are used to define data structure	It is used to manipulate the existing databases.
It is used to define database structure or schema	It is used for managing data within schema objects
Commands are: CREATE, ALTER, DROP, TRUNCATE, RENAME	Commands are: SELECT, INSERT, DELETE, UPDATE, MERGE, CALL
It works on whole table	It works on one or more rows
It do not have a where clause to filter	It have where clause to filter records
Changes done by DDL commands cannot be rolled back	Changes can be rolled back
It is not further classified.	It is further classified as procedural and non procedural DML's
Example:- drop table tablename;	Select * from employee