

# Unit 1-Introduction to Database Management System

**Subject Code: 303105203**

---

**Prof. S.W.Thakare**  
Assistant Professor,  
Computer science & Engineering



## CHAPTER-1

# Database Management System



## Introduction

1. **Data - Fact** that can be recorded or stored  
e.g. Person Name, Age, Gender and Weight etc.
2. **Information**  
When data is **processed**, organized, structured or presented in a given context so as to make it useful, it is called information.
3. **knowledge**  
It is the appropriate collection of information

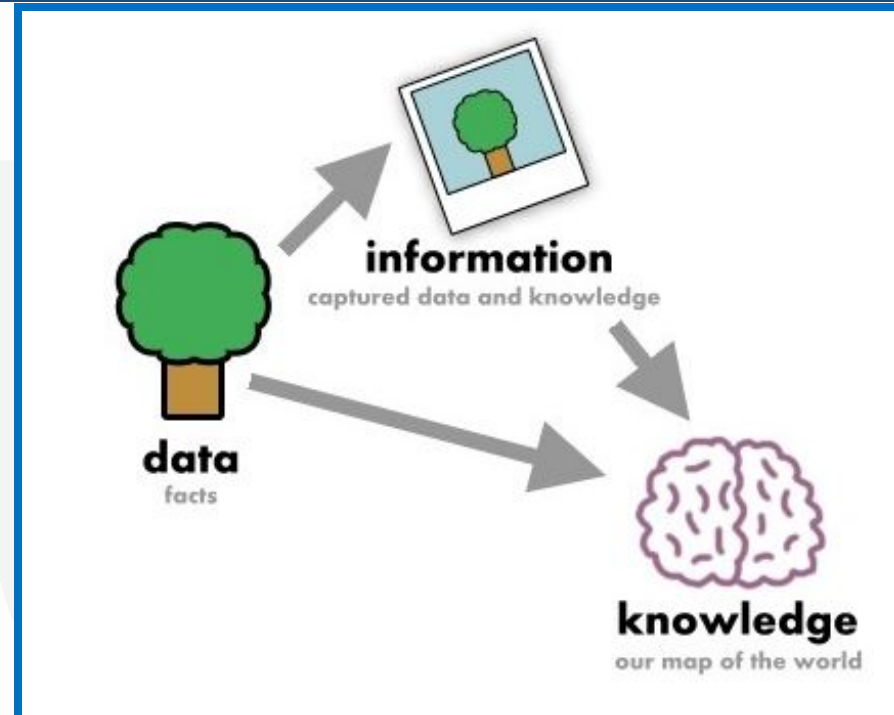


Figure: 1.1 An example of Data, information and knowledge

(Image Source : <https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)



## What is DBMS?

□ **DBMS (Database Management System)** = Database + Set of programs

- **Database**:- A 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** - 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.





## Examples of DBMS

- Online Telephone Directory
- Electricity Service provider
- Facebook
- Whatsapp
- etc



Figure: 1.2 Online Telephone Directory

(Image Source : <https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)



Figure:1.5 Whatsapp

(Image Source  
<https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)



Figure: 1.4 Facebook

(Image Source :  
<https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)

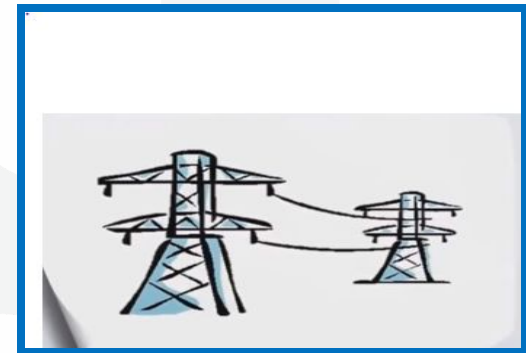


Figure: 1.3 Electricity Service provider

(Image Source : <https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)



## Database System Applications

- 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



## File Processing System (FPS) or File System

- In Computer Science, File Processing System (FPS) is a way of storing, retrieving and manipulating data which is present in various files.

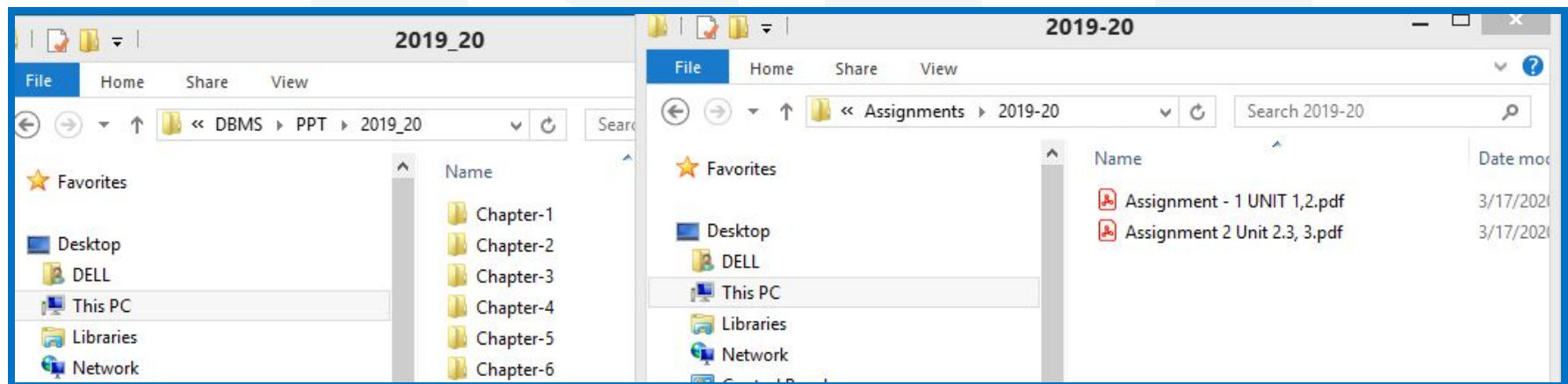


Figure: 1.6 An example of File Processing System



## Advantages of File Processing System

- **Cost friendly –**  
There is a very minimal to no set up and usage fee for File Processing System.  
(In most cases, free tools are inbuilt in computers.)
- **Easy to use –**  
File systems require very basic learning and understanding, hence, can be easily used.
- **High scalability –**  
One can very easily switch from smaller to larger files as per his needs.





## Disadvantages of File Processing System

- **Data redundancy and inconsistency**
  - Multiple file formats, duplication of information in different files
- **Difficulty in accessing data**
  - Need to write a new program to carry out each new task
- **Data isolation-** data are scattered in various files, and files may be in different formats, writing new application programs to retrieve the appropriate data is difficult.
- **Integrity problems-** when new constraints are added, it is difficult to change the programs to enforce them.



## Disadvantages of File Processing System

- **Atomicity problems**
  - Failures may leave database in an inconsistent state with partial updates carried out
  - Example: Transfer of funds from one account to another should either complete or not happen at all
- **Concurrent-access by multiple users**
  - Example: Two people reading a balance (say 100) and updating it by withdrawing money (say 50 each) at the same time
- **Security problems**
- **Poor data control**
- **Limited data sharing**
- **Excessive programming effort**



## Application of DBMS

- Providing Application Flexibility with Relational Databases.
- Object oriented Applications and the need for more complex Databases.
- Early DB Applications
- Extending DB capabilities for new applications



## Advantages of DBMS over file management system.

- Minimal data redundancy
- Program data independence
- Efficient data access
- Improved data sharing
- Improved security
- Economy of scale
- Reduced program maintenance
- Improved Backup
- Improved data quality



## Purpose of DBMS

- Compactness- no need of paper work
- Speed
- Accuracy
- Protection

PU





## Benefits of DB Approach

- Data can be Shared
- Redundancy can be reduced
- Inconsistency can be avoided
- Security can be enforced
- Conflicting requirements can be balanced
- Integrity can be maintain

## Reduce data redundancy (duplication)

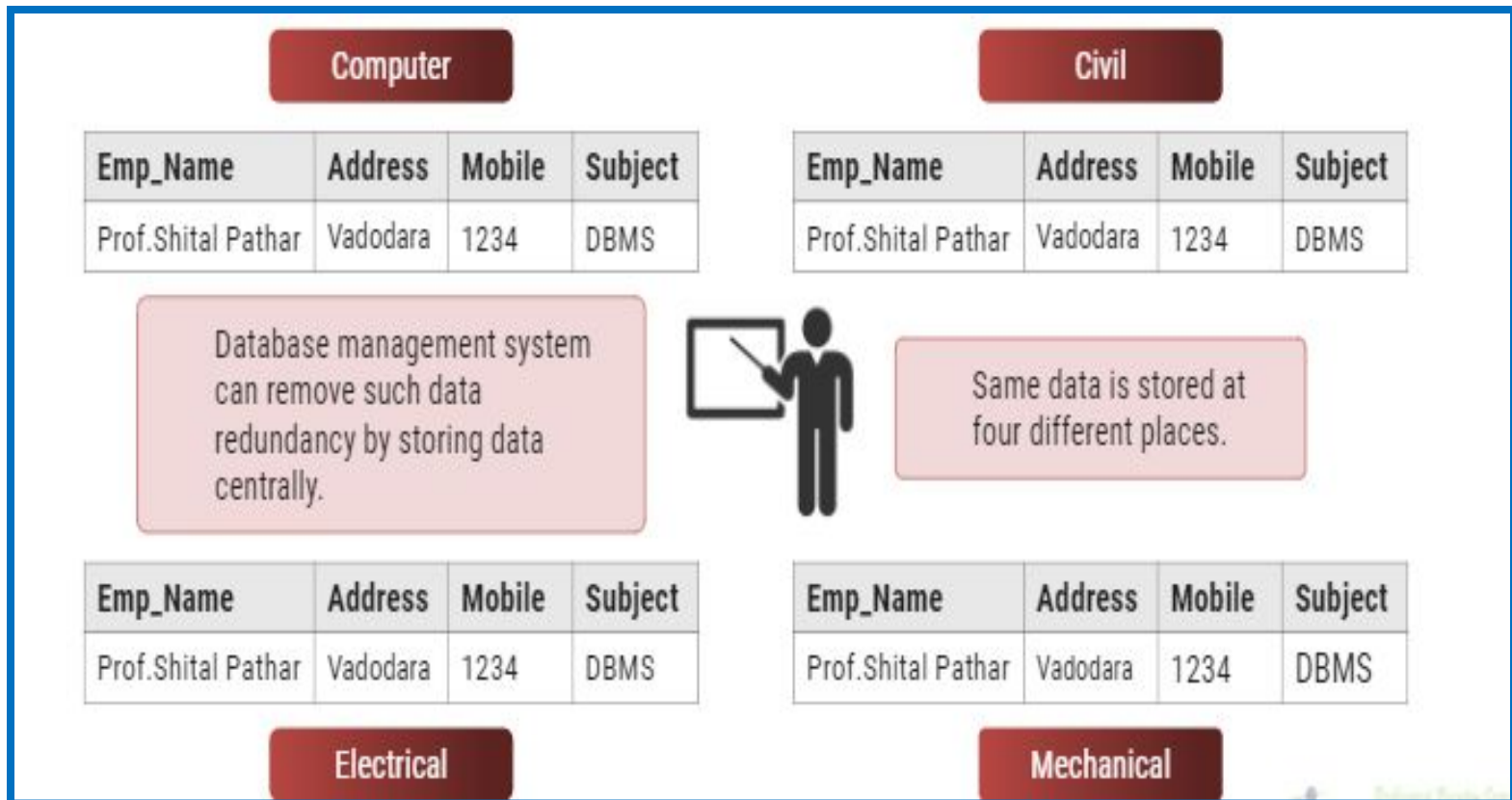


Figure: 1.7 An example of data redundancy

(Image Source :

[https://www.researchgate.net/figure/An-example-of-redundancy-of-data-and-functionality\\_fig1\\_266550024](https://www.researchgate.net/figure/An-example-of-redundancy-of-data-and-functionality_fig1_266550024))

## Remove data inconsistency

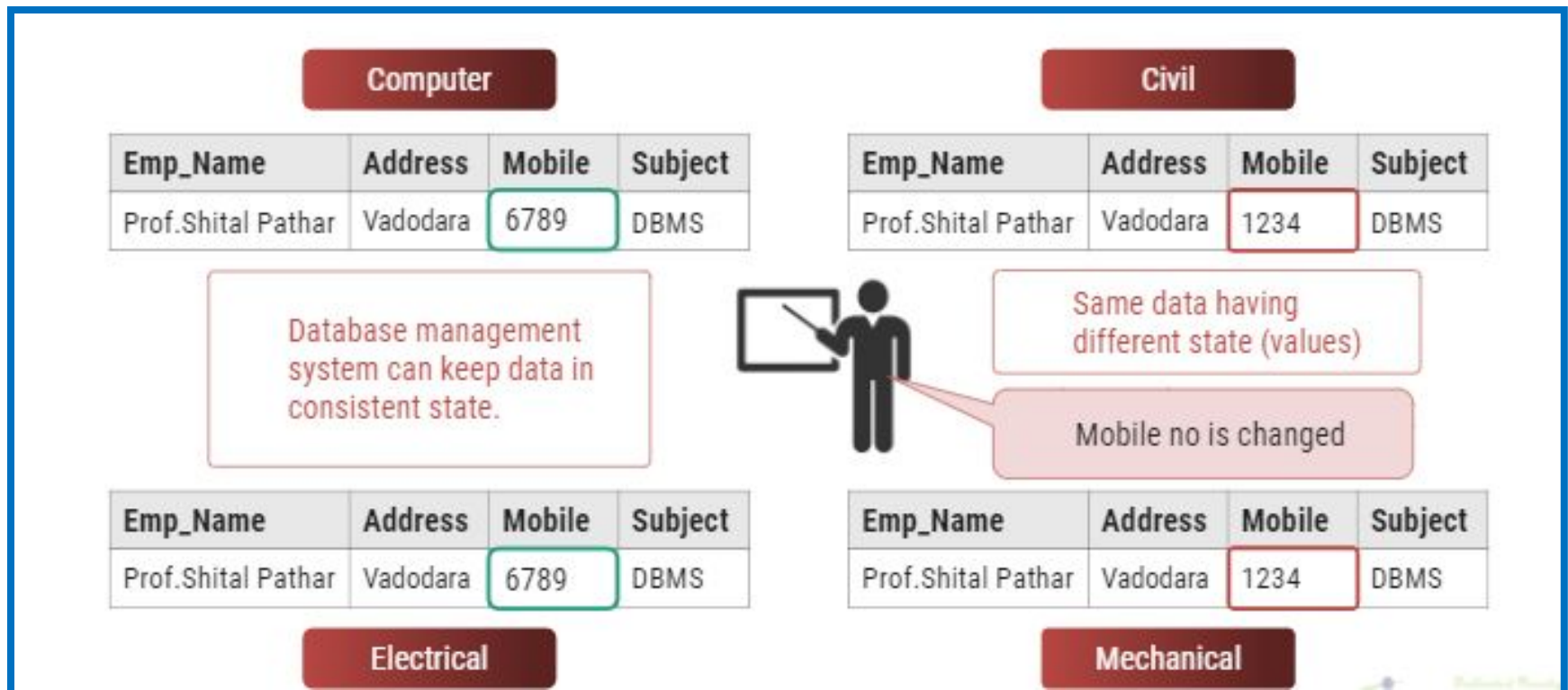


Figure: 1.8 An example of data inconsistency  
(Image Source : <https://www.quora.com/What-is-data-inconsistency-1>)



## 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	Address	Mobile	Subject
Prof.Shital Pathar	Vadodara	1234	DBMS

File - 2

Emp_Name	Post	Salary	Load
Prof.Shital Pathar	Vadodara	50,000	18

File - 3

Emp_Name	Teaching	Knowledge	Rating
Prof.Shital Patha	Good	Excellent	9

Figure: 1.9 An example Data isolation

(Image Source :

[https://www.researchgate.net/figure/Example-of-data-isolation-problem\\_fig1\\_278658528](https://www.researchgate.net/figure/Example-of-data-isolation-problem_fig1_278658528))

## Guaranteed atomicity

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

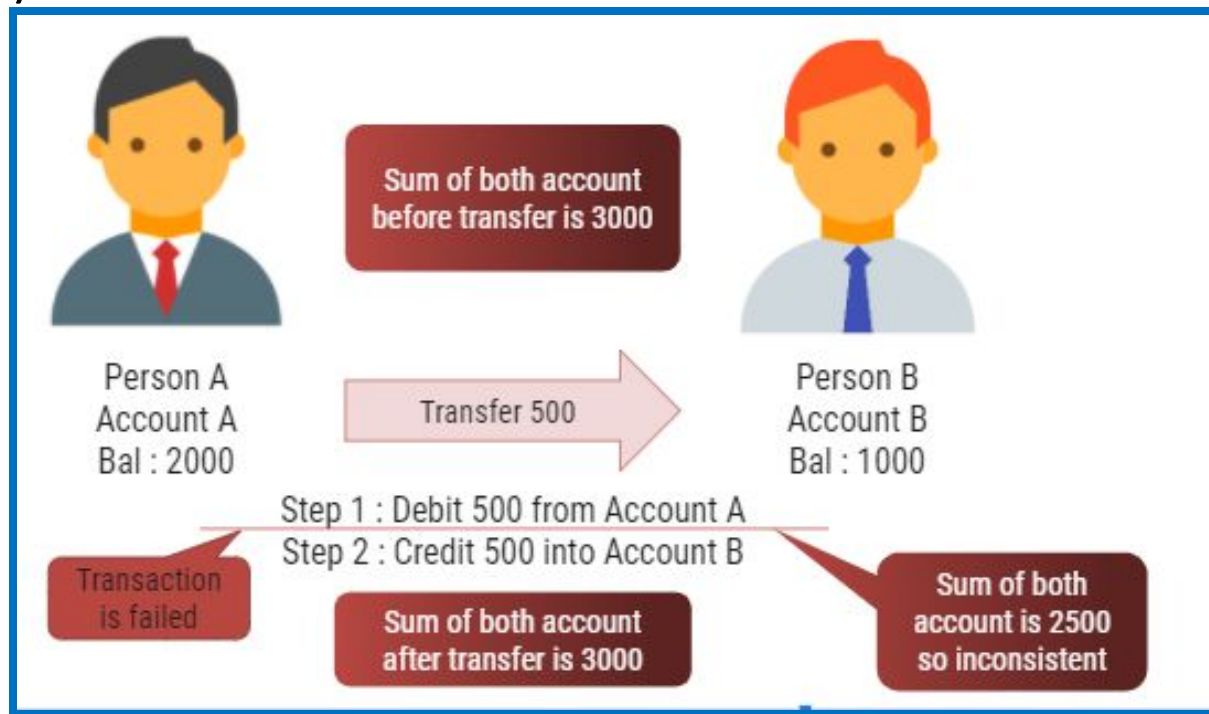


Figure: 1.10 An example of atomicity

(Image Source :

<https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcSVFDVbwXtsq94f6HGuntRnVsOaz27Xnw-Lew&usqp=CAU>)





## Allow to implement integrity constraints

Emp_Name	Address	Mobile_No	Subject
Prof.Shital Pathar	Vadodara	9876543210	PPS

Should contain exact 10 digits

Student_Name	Branch	Backlog	SPI
Krishna Patel	CSE	0	8.5

Should be between 0 to 10

**DBMS allows us to implement such business rules in our database.**

Figure: 1.11 An example integrity constraints

## Sharing of data among multiple users

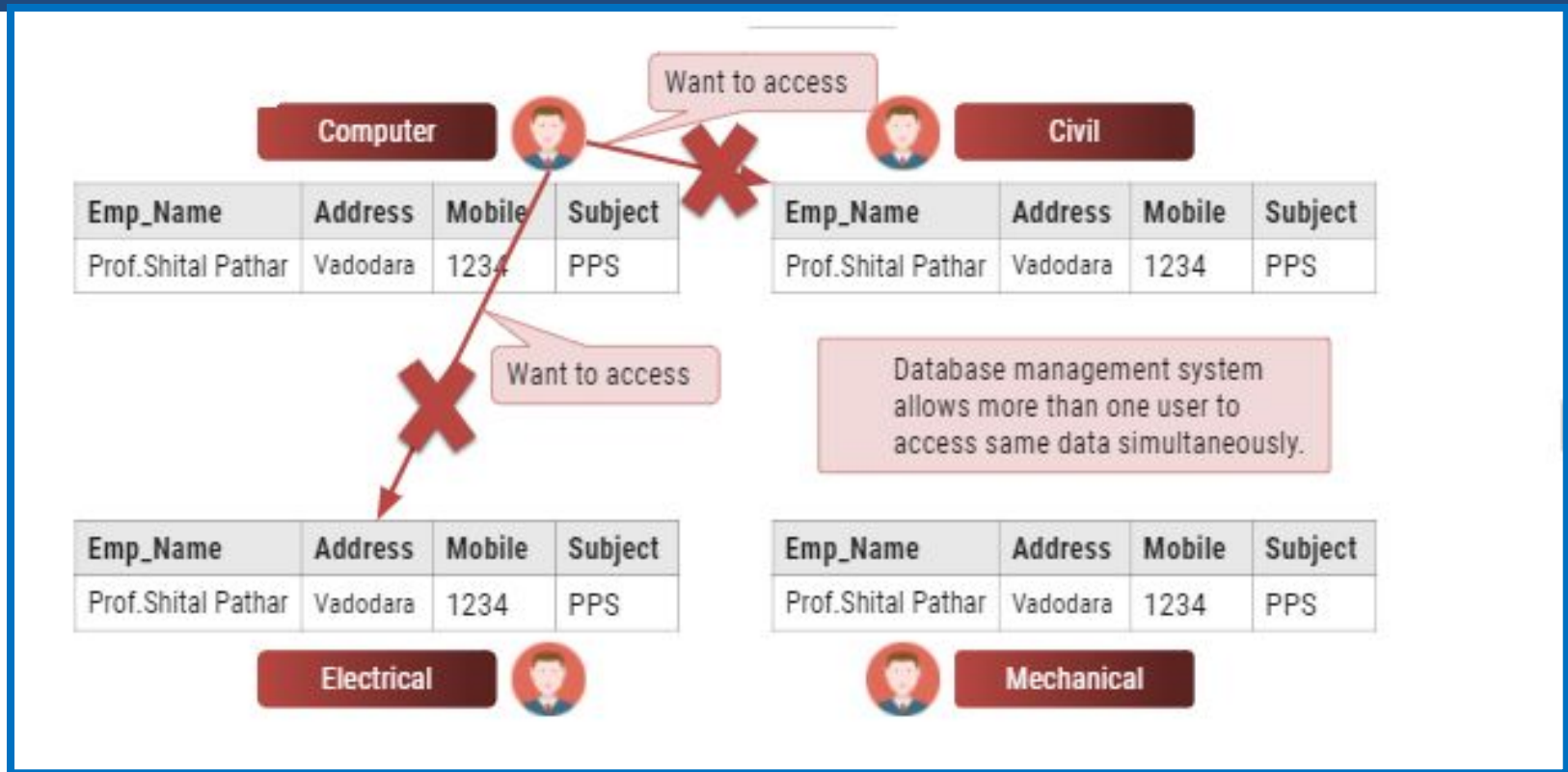


Figure: 1.12 An example of **Sharing**  
(Image Source : <http://www.allfordrugs.com/data-integrity/>)

## Restricting unauthorized access to data

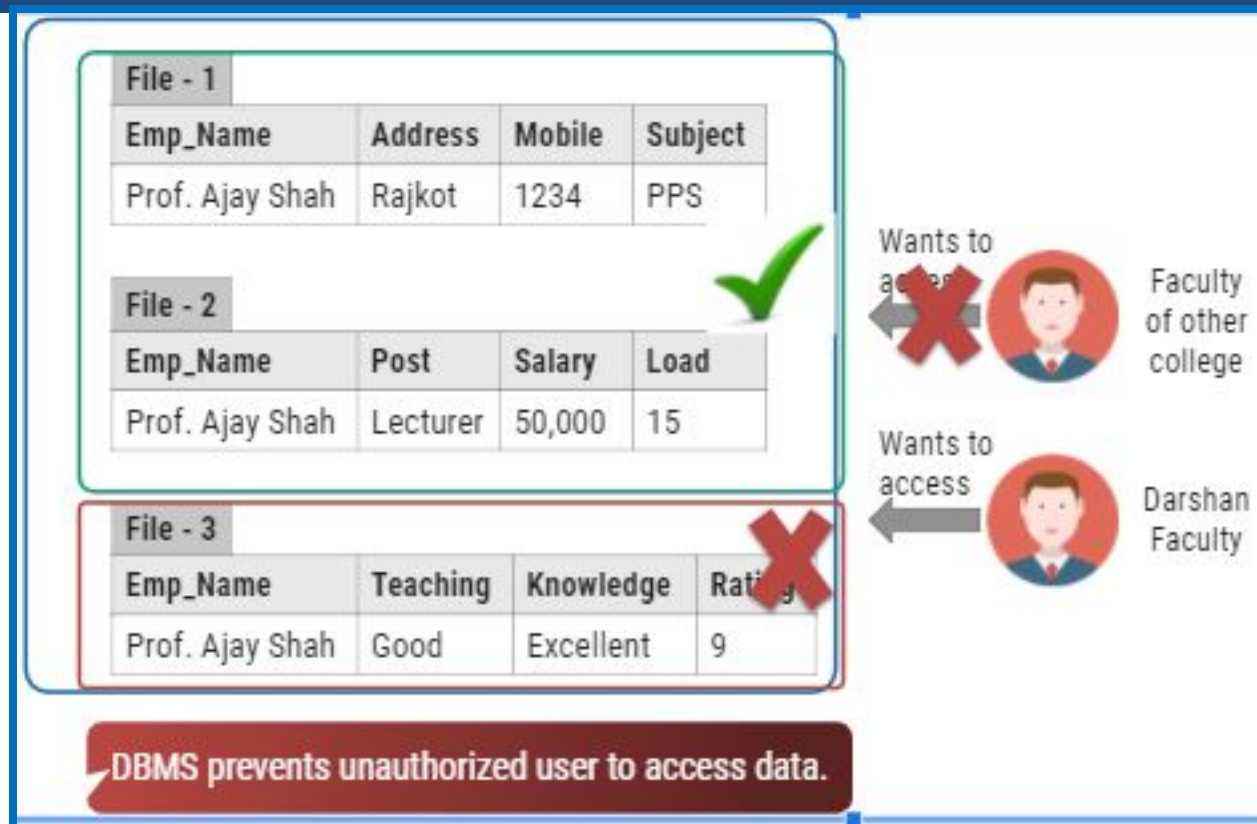


Figure: 1.13 An example of unauthorized access to data

(Image Source :

<https://www.mageplaza.com/kb/your-web-server-set-up-incorrectly-allows-unauthorized-access-sensitive-files-magento-2.html>)

## Providing backup and recovery services

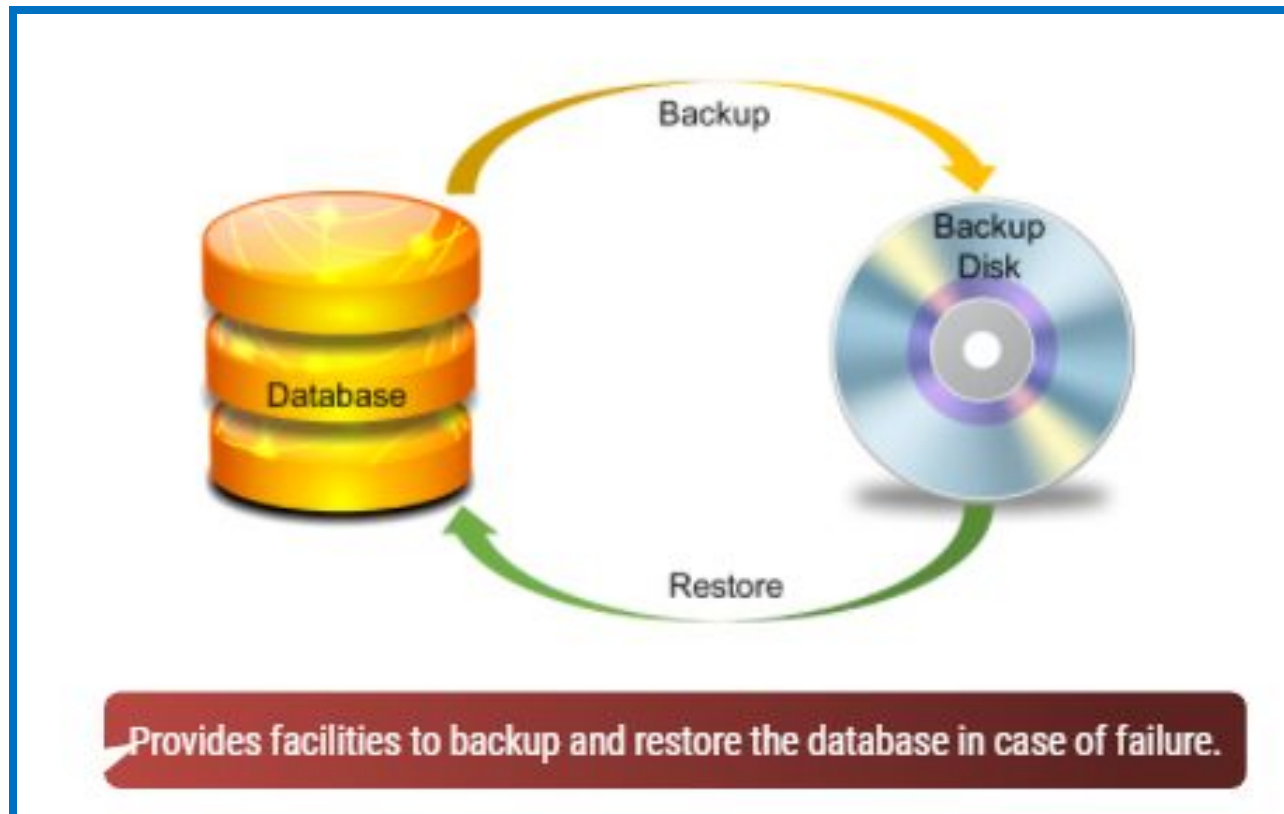


Figure: 1.14 An example of backup and recovery services

(Image Source :

<https://www.enterprisestorageforum.com/backup-recovery/enterprise-backup-and-recovery-software.html>)



## Advantages of DBMS (Summary)

- Reduce data redundancy (duplication)
  - **Avoids unnecessary duplication** of data by storing data centrally.
- Remove data inconsistency
  - By **eliminating redundancy**, data inconsistency can be removed.
- Data isolation
  - A user can **easily retrieve proper data** as per his/her requirement.
- Guaranteed atomicity
  - Either transaction **executes 0% or 100%**.





## Advantages of DBMS (Summary)

- Allow implementing integrity constraints
  - **Business rules can be implemented** such as do not allow to store amount less than Rs. 0 in balance.
- Sharing of data among multiple users
  - **More than one users can access** same data at the same time.
- Restricting unauthorized access to data
  - A user can **only access data which is authorized** to him/her.
- Providing backup and recovery services
  - Can **take a regular auto or manual backup** and **use it to restore** the database if it corrupts.



## Basic Terms of DBMS

- **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.

## Basic Terms of DBMS

- **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

Figure: 1.15 An example of Metadata

Metadata of above table is (Image Source : <https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)

- 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)

## Basic Terms of DBMS

- **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)

Figure: 1.16 An example of data dictionary

(Image Source : <https://dataedo.com/kb/data-glossary/what-is-data-dictionary>)

## Basic Terms of DBMS

- **Data warehouse**
  - A data warehouse is an information repository which **stores data**.

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

Figure: 1.17 An example of warehouse

(Image Source : <https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)



## Basic Terms of DBMS

- **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

Fields

Prof. Ajay Shah

Rajkot

9876543210

Figure: 1.18 An example of field

(Image Source : <https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)



## Basic Terms of DBMS

- Record / Tuple
  - 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.

Prof. Ajay Shah	Rajkot	9876543210	PPS
Prof. Ajay Patel	Surat	0123456789	DBMS

Record / Tuple

Figure: 1.19 An example of Record  
(Image Source : <https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)



## 3 Levels ANSI SPARC Database System

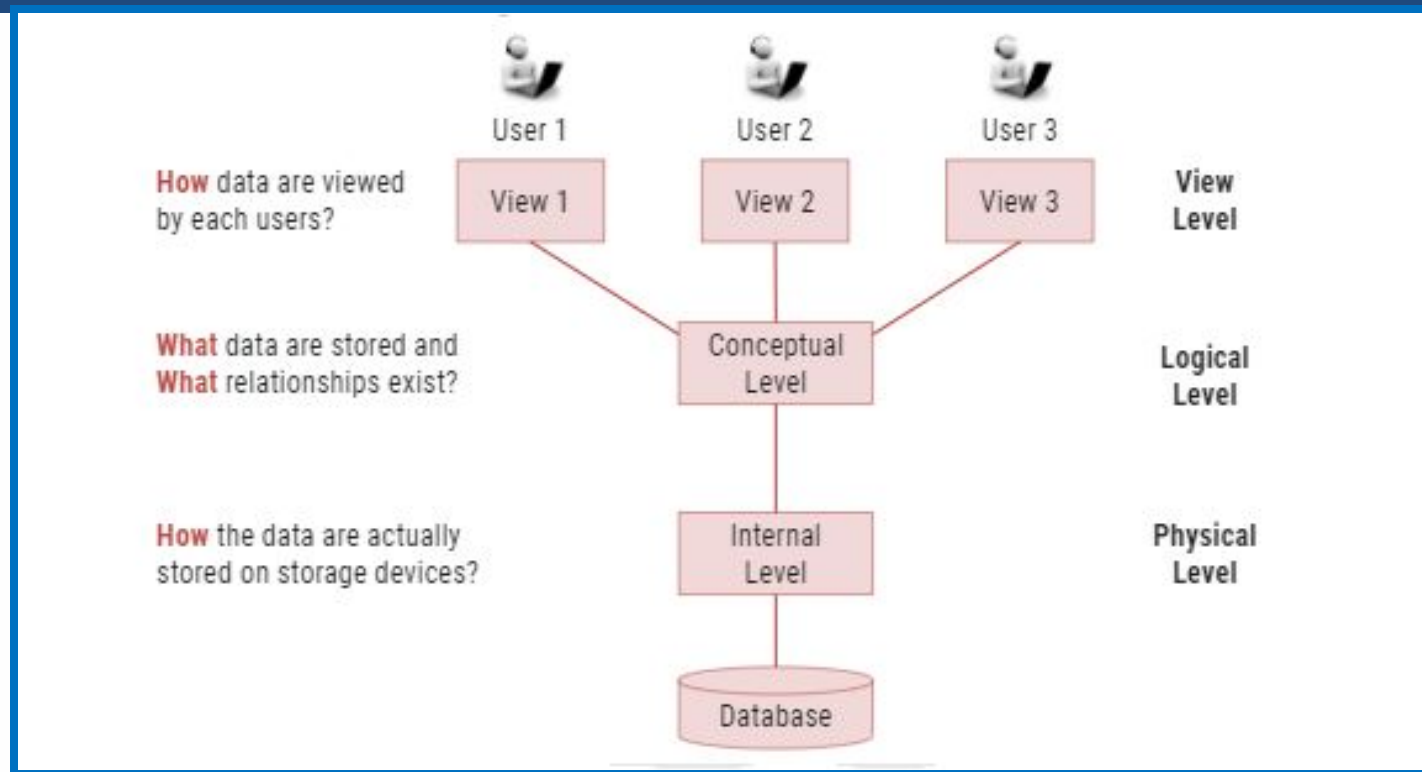


Figure: 1.20 ANSI SPARC Database System

(Image Source :  
<https://pt.slideshare.net/NurHidayahKhazali/chapter-2-database-environment/13>)



## Internal Level

- The internal level has an internal schema which describes the physical storage structure of the database.
- The internal schema is also known as a physical schema.
- It uses the physical data model. It is used to define that how the data will be stored in a block.
- The physical level is used to describe complex low-level data structures in detail.



## Conceptual Level

- The conceptual schema describes the design of a database at the conceptual level. Conceptual level is also known as logical level.
- The conceptual schema describes the structure of the whole database.
- The conceptual level describes what data are to be stored in the database and also describes what relationship exists among those data.
- In the conceptual level, internal details such as an implementation of the data structure are hidden.
- Programmers and database administrators work at this level.



## External Level

- At the external level, a database contains several schemas that sometimes called as subschema. The subschema is used to describe the different view of the database.
- An external schema is also known as view schema.
- Each view schema describes the database part that a particular user group is interested and hides the remaining database from that user group.
- The view schema describes the end user interaction with database systems.



## 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.

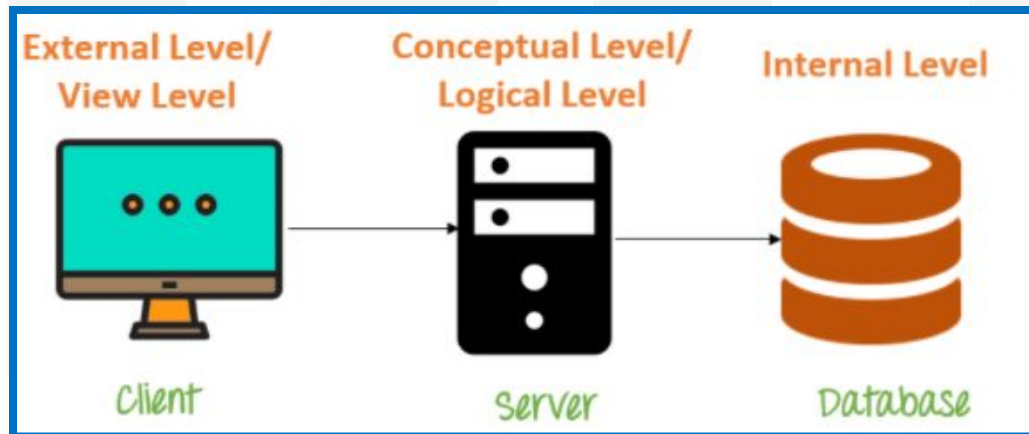


Figure: 1.21 An example of Data Abstraction

(Image Source : <https://prepinsta.com/dbms/data-abstraction-and-data-independence/>)

## Mapping and Data Independence

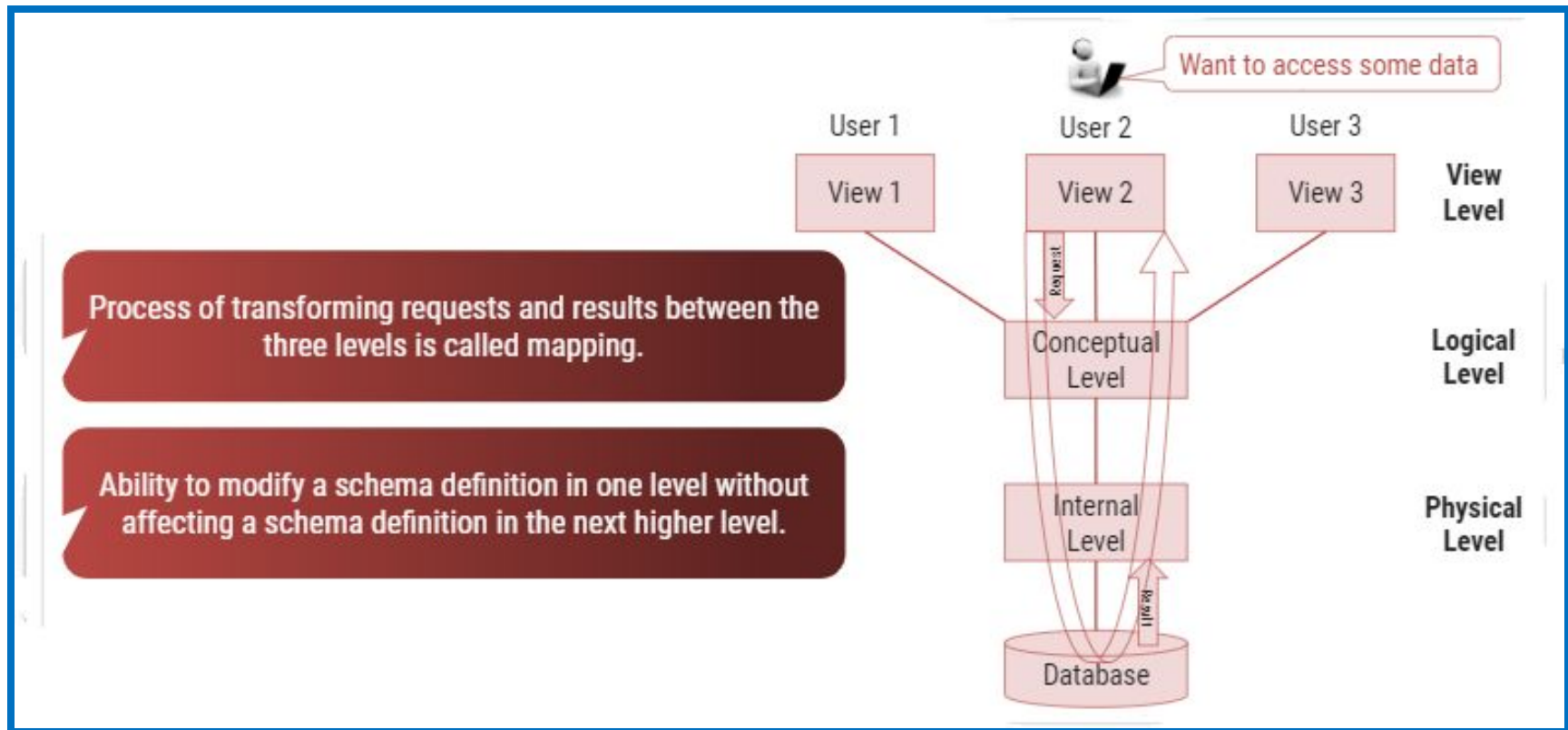


Figure1.22: Mapping and Data Independence

(Image Source : <https://images.app.goo.gl/cbtcdV1EMn3SoWzi7>)



## Types of 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.



## Types of Data Independence

- **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.



## Types 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



## Types of Database Users

- 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.



## Role of DBA

- 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.

## Database System Architecture

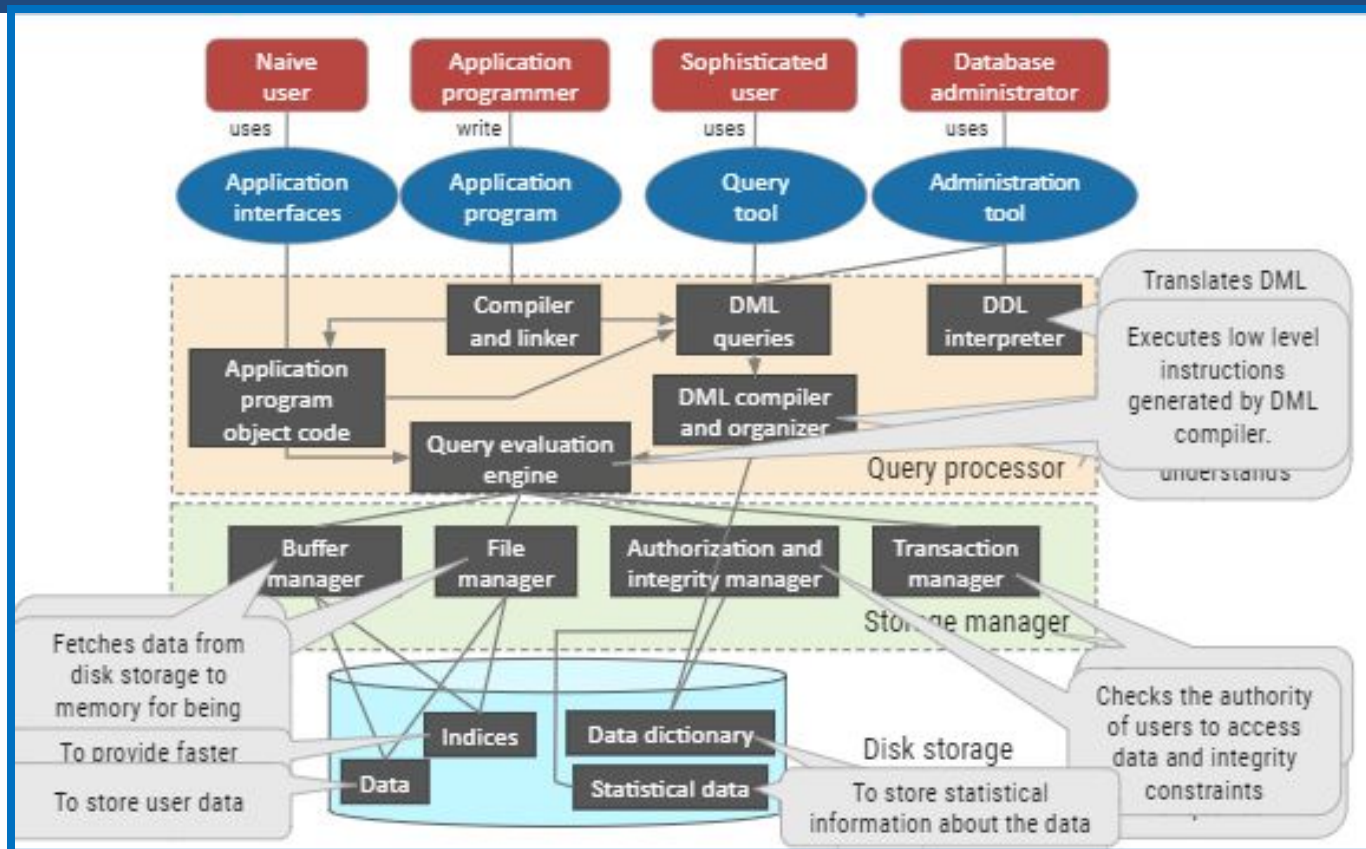


Figure: 1.23 Database System Architecture

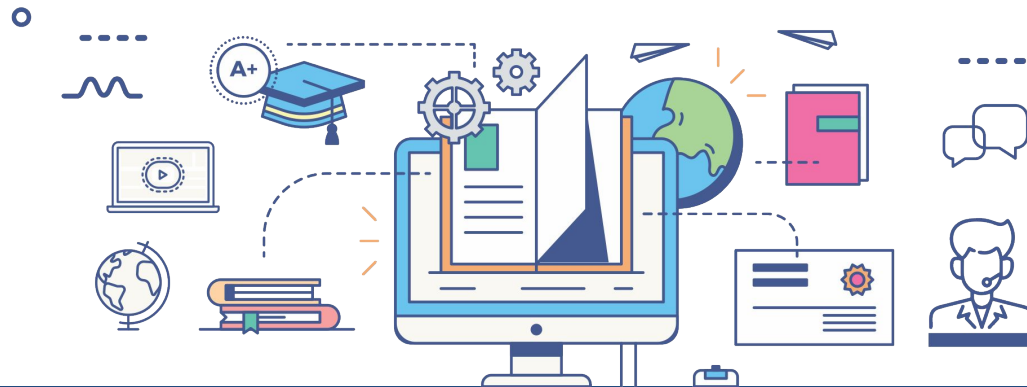
(Image Source :



## References

- [1] Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw-Hill Education (Asia), Seventh Edition, 2019.
- [2] C. J. Date, A. Kannan and S. Swamynathan, An Introduction to Database Systems, Pearson Education, Eighth Edition, 2009.
- [3] Database Management Systems, CSE, DIET,  
<https://www.darshan.ac.in/DIET/CE/GTU-Computer-Engineering-Study-Material>
- [4] Database management systems by Raghu Ramakrishnan and Johannes Gehrke  
<http://pages.cs.wisc.edu/~dbbook/openAccess/thirdEdition/slides/slides3ed.html>
- [5] Database management system tutorial,  
<https://www.tutorialspoint.com/dbms/index.htm>

## x DIGITAL LEARNING CONTENT



**Parul<sup>®</sup>** University



[www.paruluniversity.ac.in](http://www.paruluniversity.ac.in)