



Database Management System

Introduction

Mohammad Imam Hossain, Lecturer, Dept. of CSE, UIU

Data vs Information

Computer Data

- ▶ Data is a collection of values. Those values can be characters, numbers, or any other data type.
- ▶ Computer data is a bunch of 1's and 0's, known as binary data.
- ▶ Computer data is processed by the computer's CPU and is stored digitally in files and folders on the computer's hard disk.

Example of Data:

UIU, Email; Mr. X, x@cse.uiu.ac.bd,
Dept. of CSE, Lecturer

Information

- ▶ When data are processed, interpreted, organized, structured or presented in a given context so as to make them meaningful or useful, they are called information.
- ▶ Data is raw material (i.e. bits of information) and Information is the product.

Example of Information :

Mr. X
Lecturer
Dept. of CSE
UIU
Email: x@cse.uiu.ac.bd

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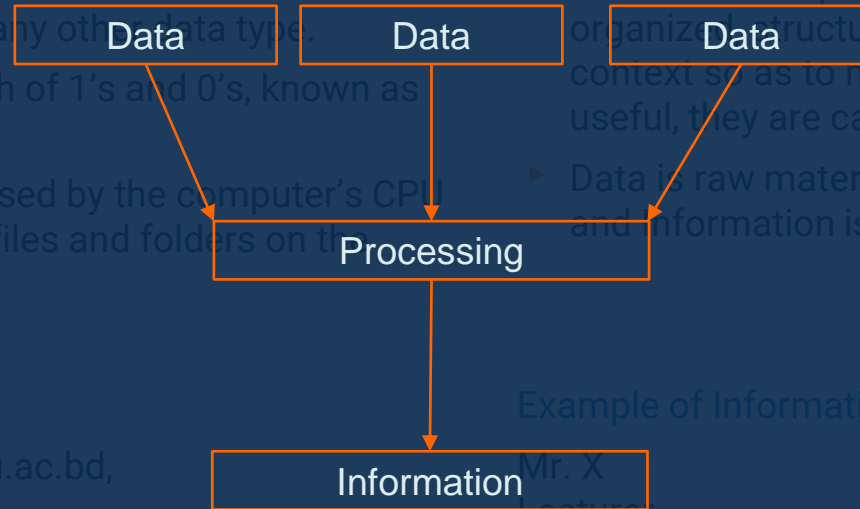
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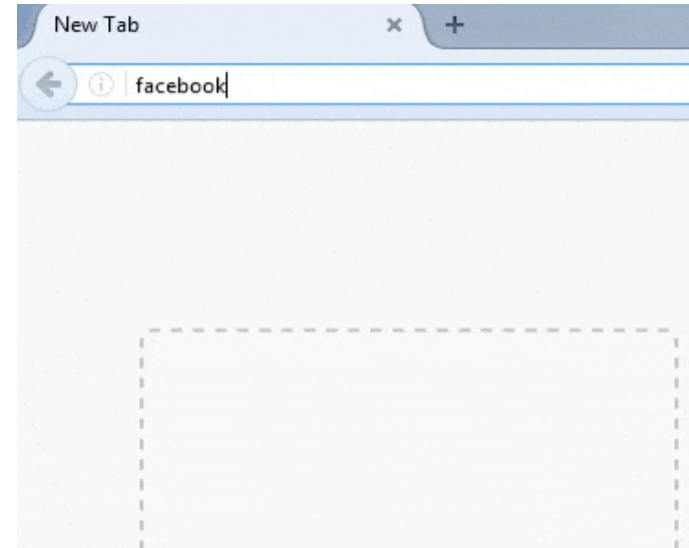
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Web-based Information System

Web-based Information System

An information system that uses *Internet web technologies* to deliver information and services, to users or other information systems/applications.

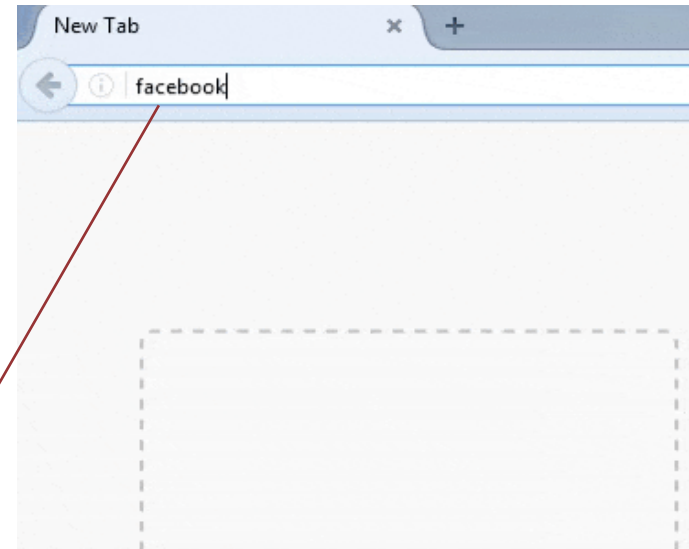


Web-based Information System

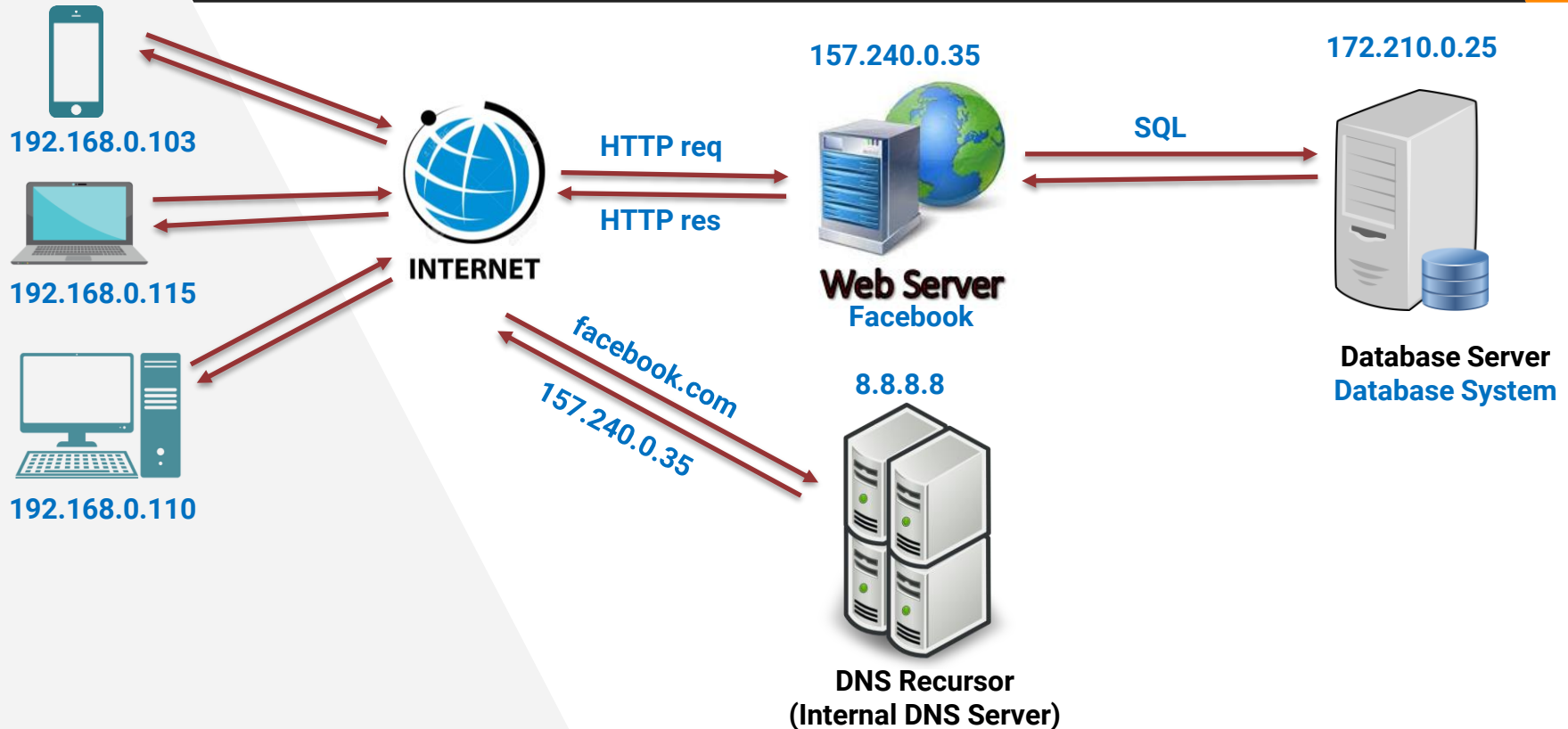
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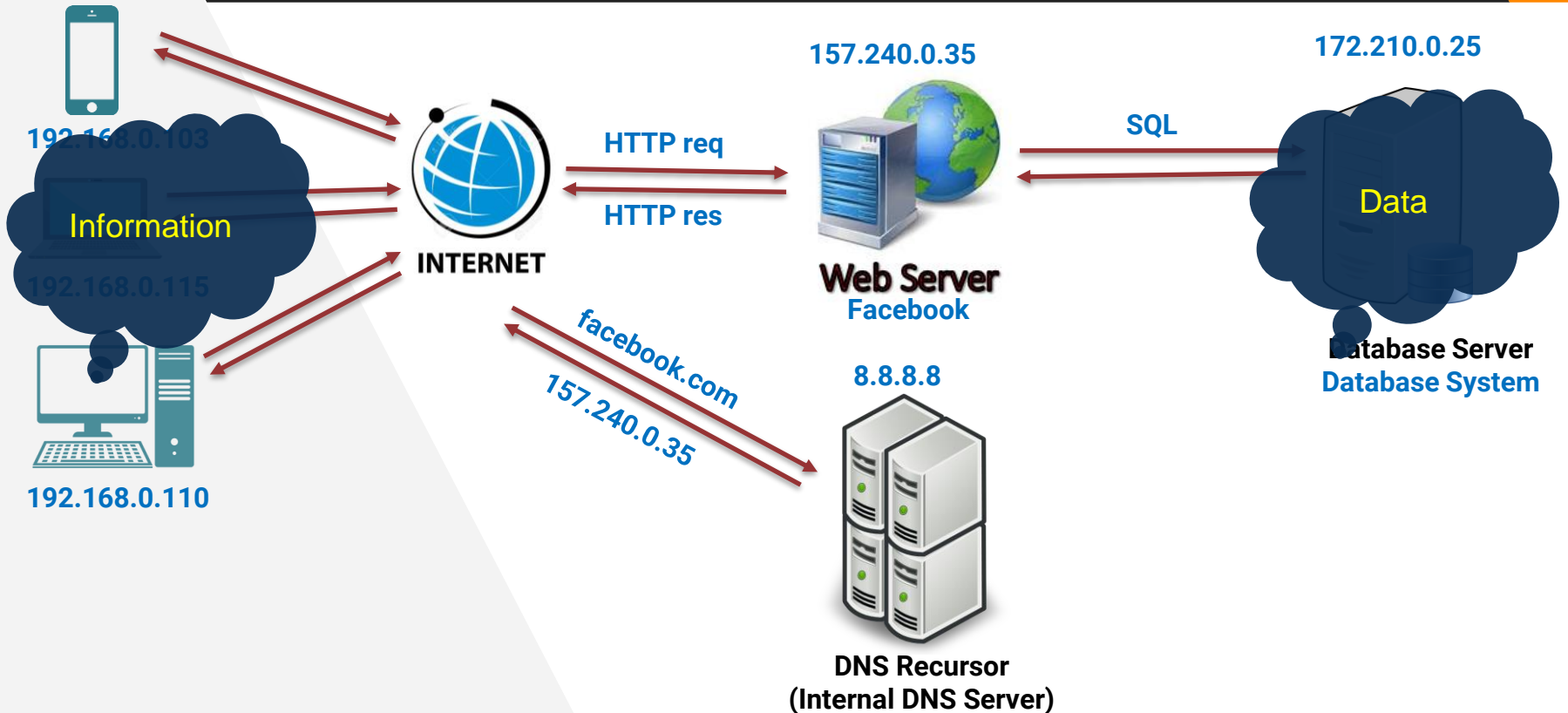
What is happening in the background !!!!



Web-based System >> Background Process



Web-based System >> Background Process



Web-based System >> Two-tier vs Three-tier Architecture

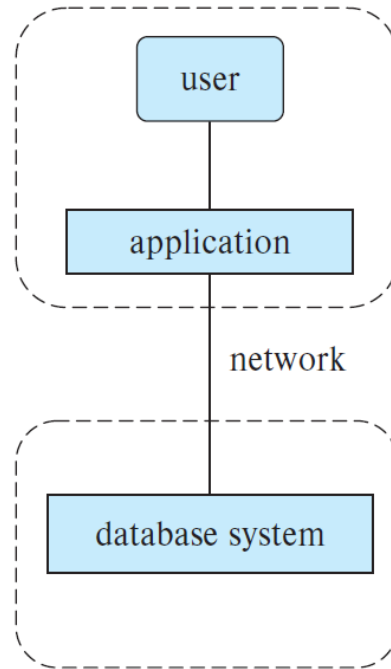
Two-tier Architecture

The application resides at the client machine, and invokes database system functionality at the server machine through query language statements.

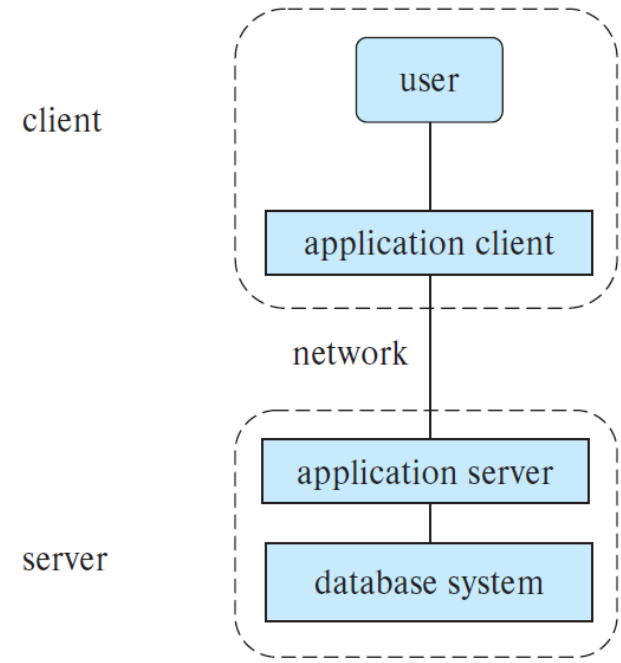
Three-tier Architecture

The client machine acts as a front end that communicates with an application server. The application server, in turn, communicates with a database system to access data.

The business logic of the application, which says what actions to carry out under what conditions, is embedded in the application server, instead of being distributed across multiple clients.



(a) Two-tier architecture



(b) Three-tier architecture

Database vs Database Management System

Database

A database is an organized collection of interrelated data, generally stored and accessed electronically from a computer system.

Database Management System

A DBMS is software that interacts with end users, applications, and the database itself to control the storage, organization, and retrieval of data.



192.168.0.110



HTTP req

HTTP res

facebook.com

157.240.0.35

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Web Server
Facebook

8.8.8.8



DNS Recursor
(Internal DNS Server)

SQL

172.210.0.25



Database Server
Database System = DBMS + Database

Web-based System >> DBMS

A DBMS understands the commands and the queries which define what data is required by the app or website and thus use the meaningful method of accessing the database to retrieve the information.

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and
192.168.0.115



192.168.0.110



INTERNET

HTTP req

HTTP res

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SQL

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Database Server

Database System = DBMS + Database

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DNS Recursor
(Internal DNS Server)

DBMS >> Key Features

- Minimizes data redundancy.
- Provides data consistency.
- Easy to write, update, search, delete data.
- Provides atomicity of updates.
- Concurrency control for multiple users.
- Provides data isolation.
- Provides high level of security.
- Easy to add/update different integrity constraints.

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Web Server
Facebook

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Database Server
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DNS Recursor
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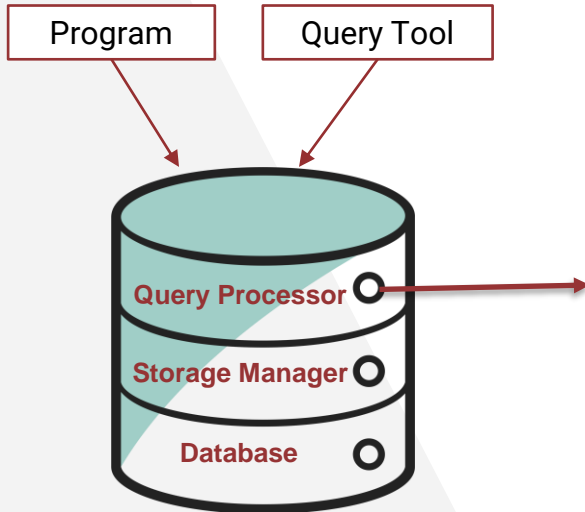
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Database System Structure >> Query Processor

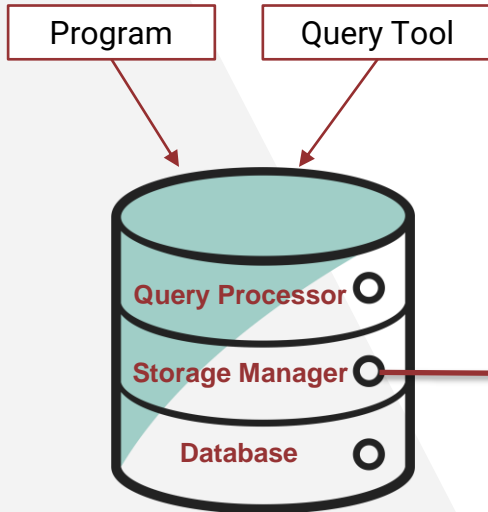


Query Processor

- **DDL interpreter:** interprets DDL statements and records the definitions in the data dictionary.
- **DML compiler:** translates DML query statements into low-level instructions that the query evaluation engine understands.

Also performs query optimization i.e. it picks lowest cost evaluation plan from a number of alternative evaluation plans.
- **Query evaluation engine:** executes low-level instructions generated by the DML compiler.

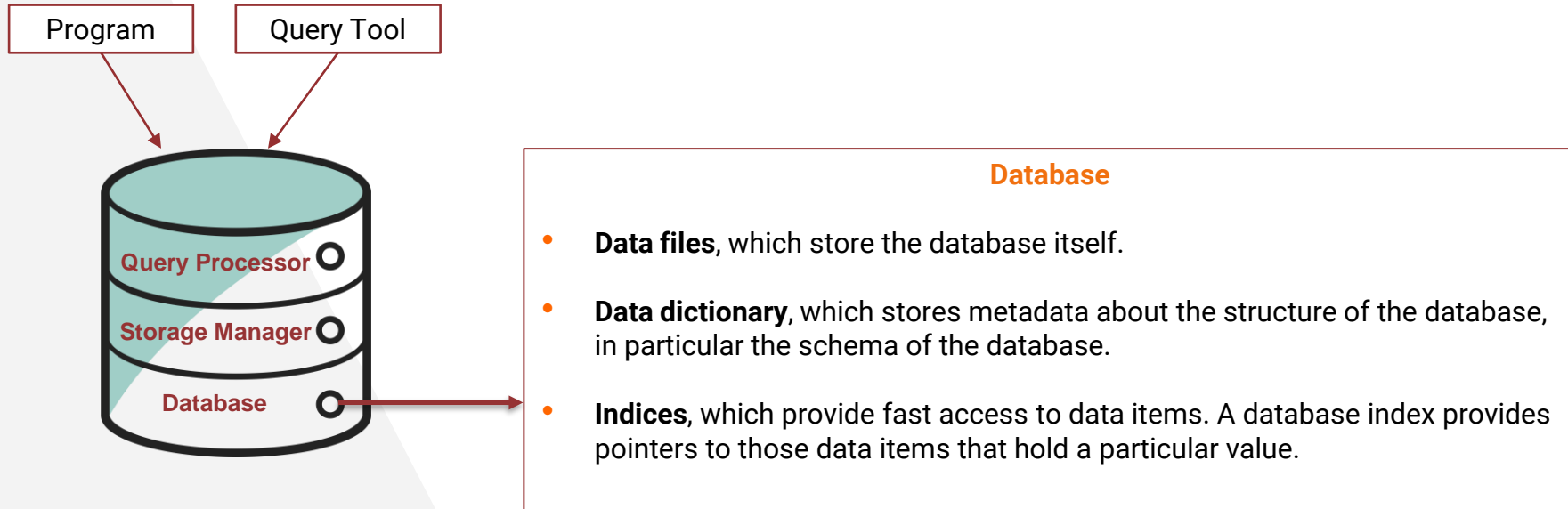
Database System Structure >> Storage Manager



Storage Manager

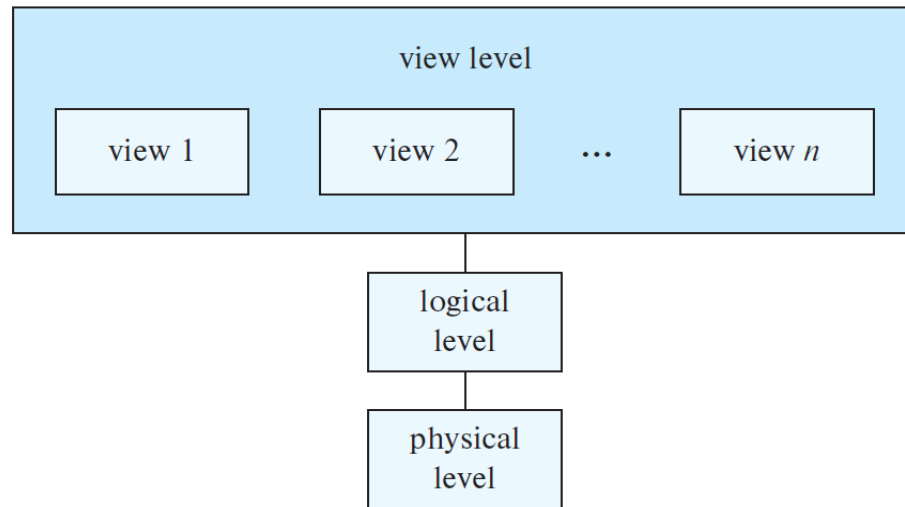
- **Authorization and integrity manager** tests for the satisfaction of integrity constraints and checks the authority of users to access data.
- **Transaction manager** ensures that the database remains in a consistent (correct) state despite system failures, and that concurrent transaction executions proceed without conflicting.
- **File manager** manages the allocation of space on disk storage and the data structures used to represent information stored on disk.
- **Buffer manager** is responsible for fetching data from disk storage into main memory, and deciding what data to cache in main memory.

Database System Structure >> Database



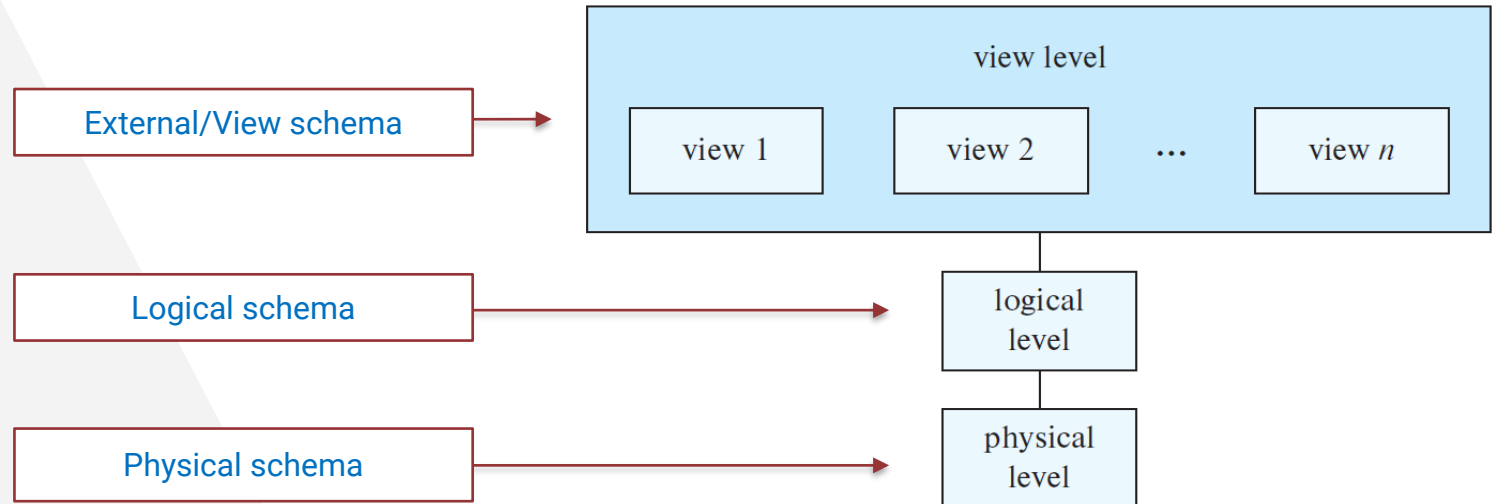
Data Abstraction

- A database system is a collection of interrelated data(DB) and a set of programs (DBMS) that allow users to access and modify these data.
- A major purpose of a database system is to provide users with an abstract view of the data. That is, the system hides certain details of how the data are stored and maintained.
- To simplify users' interactions with the system, developers hide the complexity from users through several levels of data abstraction.



Database Schema

- ▶ Schema describes the overall design of the database at different levels.
- ▶ Each schema (logical) corresponds to a data model that is a collection of conceptual tools and languages for describing data, data relationships, data semantics, and consistency constraints.



Types of Data Models

- ▶ High-level conceptual data model
 - E-R Model
 - Object oriented Model

- ▶ Record based logical data models
 - These models specify logical structure of database with records, fields and attributes.

 - Relational Model – collections of tables
 - Hierarchical Model – collections of trees
 - Network Model – collections of records and links (graphs)

- ▶ Physical data models (physical level)

SQL vs NoSQL Database

SQL

Relational Database

SQL databases use structured query language and have a predefined schema.

SQL databases are vertically scalable.

SQL databases are table based.

- SQLite
- PostgreSQL
- Oracle
- MySQL
- Microsoft SQL server

NoSQL

Non-relational Database

NoSQL databases have dynamic schemas for unstructured data.

NoSQL databases are horizontally scalable.

NoSQL databases are document, key-value, graph or wide-column stores.

- MongoDB
- Cassandra

Relational DBMS >> MySQL

Student		
student_id	name	age
1	ABC	25
2	DEF	20
3	GHI	22
4	JKL	27

Course		
course_id	name	faculty
1	Java	X
2	Python	Y
3	CPP	W
4	JS	M

Student_Course		
student_id	course_id	marks
1	4	85
1	3	90
2	3	70
4	2	67

Non-relational DBMS >> MongoDB

```
{
  name: "al",
  age: 18,
  status: "D",
  groups: [ "politics", "news" ]
}
```

Collection 1

```
Doc N
Doc 2
Doc 1
{
  _id: (ObjectID: "5bf675kj8887dbc0")
  studentName: "Viraj",
  regNo: "7007",
  course: "BTECH",
  address: "Delhi"
}
```

Collection 2

THANKS!

Any questions?

Email : imam@cse.uiu.ac.bd

Reference:

Database System Concepts by S. Sudarshan, Henry F. Korth, Abraham Silberschatz