



# Lecture 2 Database Management System

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# Lesson 1: Introduction to DBMS (5hrs)

1. **Overview of Database and DBMS**
2. **Characteristics and Applications**
3. Data Abstraction and Independence
4. Database Users and Administrator
5. Application Architecture
6. Basics of Database Language (DDL, DML, DCL)

# Overview of Database

- ◆ Data are the collection of facts and figures that are raw and can be found after some experiment, observation or experience.
- ◆ Data itself do not provide any meaning but after processing it becomes information.
- ◆ The collection of related data organized in some specific manner is known as database.
- ◆ Management of data involves defining structure for storage of information and providing mechanisms for manipulation of information.

# Data Management and Database

- ◆ Importance of Data Management:
  - Efficient storage and retrieval of data.
  - Data consistency and accuracy.
- ◆ A database is a structured collection of data that is organized in a way that a computer program can quickly select and retrieve specific pieces of data.
- ◆ A database is a collection of interrelated data which helps in the efficient retrieval, insertion, and deletion of data from the database and organizes the data in the form of tables, views, schemas, reports, etc.
- ◆ A database system involves four major components: **data, hardware, software, and users.**

# DBMS

1. A Database Management System (DBMS) is software that enables users to interact with databases, providing an interface for data input, retrieval, and management.
2. It provides a structured environment for data, enabling users to interact with the database through a user-friendly interface.
3. Essentially, DBMS serves as a crucial tool for systematically handling data in various applications and industries.
4. With a DBMS, the online bookstore can efficiently manage customer information, book details, and orders. Data retrieval is faster, updates are more reliable, and the overall system operates with increased integrity and security.

# Features of DBMS

1. **Data Definition:** It helps in the creation, modification, and removal of definitions that define the organization of data in the database.
2. **Data Updation:** It helps in the insertion, modification, and deletion of the actual data in the database.
3. **Data Retrieval:** It helps in the retrieval of data from the database which can be used by applications for various purposes.
4. **User Administration:** It helps in registering and monitoring users, enforcing data security, monitoring performance, maintaining data integrity, dealing with concurrency control, and recovering information corrupted by unexpected failure.

# Why DBMS

- ◆ Let us consider the example of file-based University Management System.
- ◆ Data of students is available to their respective Departments, Academics Section, Result Section, Accounts Section, Hostel Office, etc.
- ◆ Some of the data is common for all sections like Roll No, Name, Father Name, Address, and Phone number of students but some data is available to a particular section only like Hostel allotment number which is a part of the hostel office.
- ◆ Let us discuss the issues with this system:



# Why DBMS

- ◆ **Redundancy of data:** If a student wants to change their Phone number, he or she has to get it updated in various sections. Similarly, old records must be deleted from all sections representing that student.
- ◆ **Inconsistency of Data:** If the Phone number is different in Accounts Section and Academics Section, it will be inconsistent. Inconsistency may be because of typing errors or not updating all copies of the same data.
- ◆ **Difficult Data Access:** A user should know the exact location of the file to access data, so the process is very cumbersome and tedious. If the user wants to search the student hostel allotment number of a student from 10000 unsorted students' records, how difficult it can be.



# Why DBMS

- ◆ **Unauthorized Access:** File Systems may lead to unauthorized access to data. If a student gets access to a file having his marks, he can change it in an unauthorized way.
- ◆ **No Concurrent Access:** The access of the same data by multiple users at the same time is known as concurrency. The file system does not allow concurrency as data can be accessed by only one user at a time.
- ◆ **No Backup and Recovery:** The file system does not incorporate any backup and recovery of data if a file is lost or corrupted.

# Advantages of DBMS

- ◆ **Data Organization** : structured storage of data
- ◆ **Data Integrity** : accuracy and consistency of data
- ◆ **Concurrent Access** : multiple access to data
- ◆ **Data Security** : controlling access and encrypting data
- ◆ **Backup and recovery** : backup for system failures
- ◆ **Data Sharing** : sharing for collaborative environment

# Disadvantages of DBMS

- ◆ **Complexity**: required specialized knowledge
- ◆ **Performance Overhead**: increases overhead for normal application
- ◆ **Scalability** : limits the scalability since required locking and synchronize mechanism
- ◆ **Cost** : cost of purchasing, maintaining and upgrading can be high
- ◆ **Limited Use Case** : not suitable for all cases

# Characteristics of DBMS

## 1. Data Integrity:

- ◆ Ensures the accuracy and consistency of data by enforcing integrity constraints, (e.g., primary key constraints, foreign key relationships).

## 2. Data Security:

- ◆ Implements access controls and authentication mechanisms to protect data from unauthorized access or manipulation.

## 3. Data Independence:

- ◆ Provides logical and physical data independence, allowing changes to the data structure without affecting the application programs.

## 4. Concurrency Control:

- ◆ Manages simultaneous access to the database by multiple users or applications, ensuring data consistency and preventing conflicts.

# Characteristics of DBMS

## 5. Data Recovery:

- ◆ Supports mechanisms for data recovery after system failures, such as crash recovery and rollback operations.

## 6. Data Abstraction:

- ◆ Presents a simplified and abstracted view of the data to users, shielding them from the complexities of the underlying database structure.

## 7. Query Language Support:

- ◆ Offers a query language (e.g., SQL - Structured Query Language) that allows users to interact with the database by writing queries to retrieve, insert, update, and delete data.

## 8. Transaction Management:

- ◆ Enforces the ACID properties (Atomicity, Consistency, Isolation, Durability) to ensure the reliability of

# Characteristics of DBMS

## 9. Scalability:

- ◆ Scales to handle increasing amounts of data and user requests without sacrificing performance or responsiveness.

## 10. Data Dictionary Management:

- ◆ Maintains a centralized repository known as a data dictionary or data catalog, containing metadata about the database's structure, relationships, and constraints.

## 11. Performance Optimization:

- ◆ Utilizes indexing, caching, and query optimization techniques to enhance database performance.

## 12. Backup and Recovery:

- ◆ Provides mechanisms for regular backups and restoration of data to prevent data loss in case of system failures or disasters.

# Applications of DBMS

- ◆ Banking: customer and their account info
- ◆ Airlines: reservations and schedules info
- ◆ Universities: student info, grades etc.
- ◆ Telecommunications: record of calls made, generating bills, balances
- ◆ Finance: for storing information about holding, sales and purchases etc.
- ◆ Sales: for customer, product and purchase information.
- ◆ Manufacturing: for management of supply chain.
- ◆ Human resources: for information about employee, salary, payroll, tax



# END OF LECTURE 2

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# PREVIEW FOR LECTURE 3

DATA ABSTRACTION

DATA INDEPENDENCE

DATABASE USERS AND ADMINISTRATORS

APPLICATION ARCHITECTURE