Introduction to Database Systems

Module Name: **Relational Database Management System**

Module Code: **CS 1211**

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Data

Data is a collection of a distinct small unit of information.

- It can be used in a variety of forms like text, numbers, media, bytes, etc.
- It can be stored in pieces of paper or electronic memory, etc.
- In computing, Data is information that can be translated into a form for efficient movement and processing.

Database

A database is an organized collection of structured information, or data, typically stored electronically in a computer system.

Or

A **database** is an organized collection of data, so that it can be easily accessed and managed.

Examples are

- Tracking customer orders
- Maintaining Employees Records.
- Maintaining Students Information

Purpose of Database

The **main purpose** of the database is to operate a large amount of information by storing, retrieving, and managing data efficiently.

Key purposes:

- Data storage – Keeps large amounts of data organized
- Data retrieval – Allows quick access to needed information
- Data consistency – Ensures accurate and uniform data
- Data security – Protects data from unauthorized access
- Data sharing – Multiple users can access data simultaneously



A cylindrical structure is used to display the image of a database.

Database Components/ Environment

Hardware: The hardware consists of physical, electronic devices like computers, I/O devices, storage devices, etc. This offers the interface between computers and real-world systems.

Software: This is a set of programs used to manage and control the overall database. This includes the database software itself, the Operating System, the network software used to share the data among users, and the application programs for accessing data in the database.

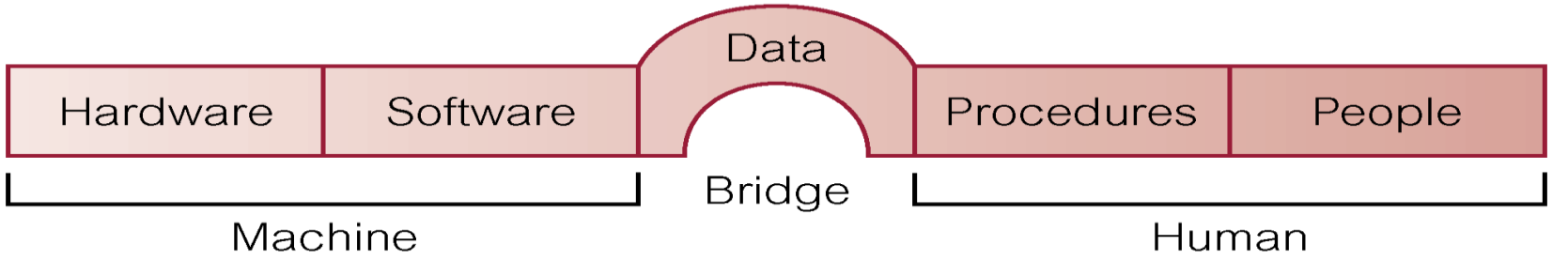
Data: Data is a raw and unorganized fact that is required to be processed to make it meaningful. Data can be simple at the same time unorganized unless it is organized. Generally, data comprises facts, observations, perceptions, numbers, characters, symbols, images, etc.

Procedure: Procedure are a set of instructions and rules that help you to use the DBMS. It is designing and running the database using documented methods, which allows you to guide the users who operate and manage it.

Database Access Language: Database Access language is used to access the data to and from the database, enter new data, update already existing data, or retrieve required data from DBMS. The user writes some specific commands in a database access language and submits these to the database.

DBMS Environment: Example

- **Hardware:** Client-server architecture
- **Software:** dbms, os, network, application
- **Data:** Schema, subschema, table, attribute
- **People:**
  - Data administrator & database administrator
  - Database designer: logical & physical
  - Application programmer
  - End-user: naive & sophisticated
- **Procedure:** Start, stop, log on, log off, back up, recovery



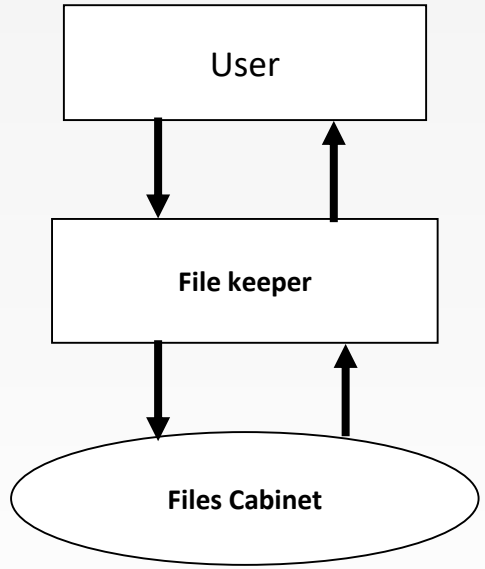
History of Database

Manual systems

Before the advent of the ideas behind the modern database systems, it was common for different firm to store information using manual system.

Structure of manual system

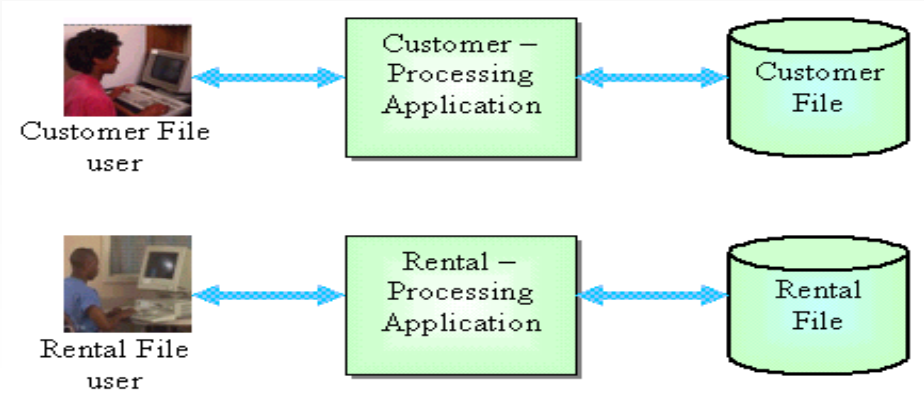
- Information concern all division in the firm, can be stored in dedicated room or each division such as sales, accounts, production can store their own information in separate offices.
- Room or office will be furnished with shelves; different shelves will hold Records for different subjects.
- Records will be stored in hard flat files, each file will carry one record
- Each file will have a specific number to identify it.
- A person will use the file number to retrieve the specific file (record).



History of Database cont…

File Processing Systems (FPS)

- Information stored as groups of records in separate files
- File processing systems consisted of a few data files and many application programs
- Each file called a soft flat file
- Flat file contained the processed information for one specific function
- Use of programming languages to write applications
- Little flexibility
- High maintenance
- Many limitations



History of Database cont…

Limitations of File Processing Systems:

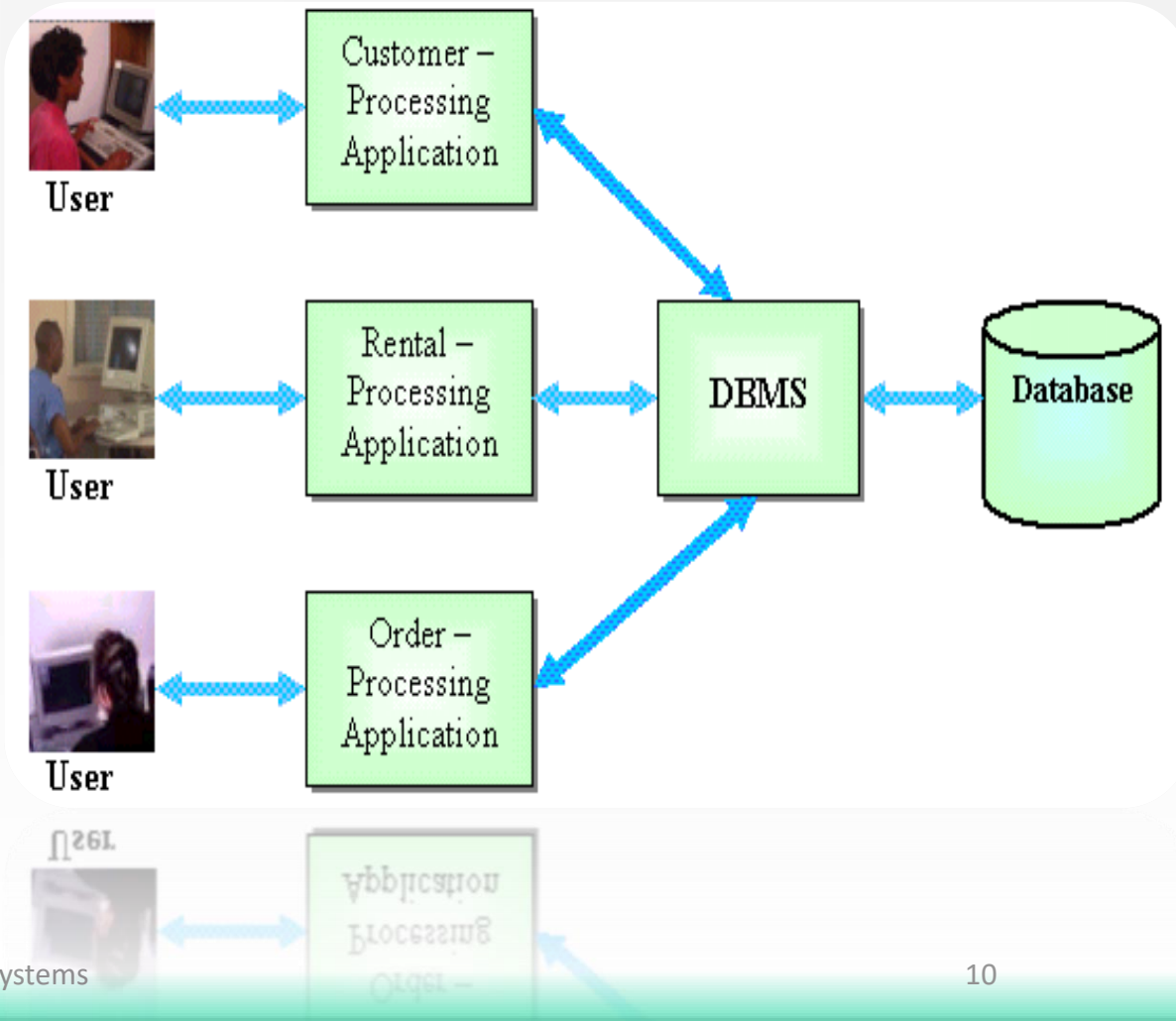
- Separate and isolated data
- Program - data interdependence for file formats and access techniques; In file processing systems, files and records were described by specific physical formats that were coded into the application program by programmers.
- Data redundancy; Often the same information was stored in more than one file.
- Difficulty in representing data from the user's view; To create useful applications for the user, often data from various files must be combined. In file processing, it was difficult to determine relationship between isolated data in order to meet the user requirement.
- Data inflexibility; Program-data interdependency and data isolation limited the flexibility of file processing systems in providing users with ad hoc information request.

Due to these limitations, file-processing systems were difficult to maintain as systems became more complex. It is against these drawbacks that the concept of Database Management System (DBMS) arises.

History of Database cont…

Database Management systems (DBMS):

- A program that allows users to define, create, manipulate, store, maintain, retrieve, and process the data in a database in order to produce meaningful information.
- Focus on information representation
- Data stored as records in various database files that can be combined to produce meaningful information for users
- DBMS controls all functions of capturing, processing, storing, retrieving data and generates various forms of data output
- Manages access by multiple users and multiple programs to a common store of data



History of Database cont…

RDBMS (Relational Database Management System):

- The word RDBMS is termed as 'Relational Database Management System.' It is represented as a table that contains rows and column. RDBMS is based on the Relational model; it was introduced by E. F. Codd.

A relational database contains the following components:

- Table
- Record/ Tuple
- Field/Column name /Attribute
- Instance
- Schema
- Keys
- An RDBMS is a tabular DBMS that maintains the security, integrity, accuracy, and consistency of the data.

Types of Database

1. Flat Databases
2. Hierarchical Databases
3. Network Databases
4. Relational Databases
5. Centralized databases
6. Distributed Database
7. NoSQL Database
8. Cloud Database
9. Object-oriented Databases

Types of Database: Relational Database

- This database is based on the relational data model, which stores data in the form of rows(tuple) and columns(attributes), and together forms a table(relation). A relational database uses SQL for storing, manipulating, as well as maintaining the data.
- Each table in the database carries a key that makes the data unique from others. **Examples** of Relational databases are MySQL, Microsoft SQL Server, Oracle, etc.

Types of Database: Relational DB cont…

Properties of Relational Database

There are following four commonly known properties of a relational model known as ACID properties, where:

- ***A means Atomicity*:** This ensures the data operation will complete either with success or with failure. It follows the 'all or nothing' strategy. For example, a transaction will either be committed or will abort.
- ***C means Consistency:*** If we perform any operation over the data, its value before and after the operation should be preserved. For example, the account balance before and after the transaction should be correct, i.e., it should remain conserved.
- ***I means Isolation:*** There can be concurrent users for accessing data at the same time from the database. Thus, isolation between the data should remain isolated. For example, when multiple transactions occur at the same time, one transaction effects should not be visible to the other transactions in the database.
- **D means Durability:** It ensures that once it completes the operation and commits the data, data changes should remain permanent.

DBMS Vs. Flat-file

DBMS	Flat File Management System
• Multi-user access	• It does not support multi-user access
• Design to fulfill the need of small and large businesses	• It is only limited to smaller DBMS systems.
• Remove redundancy and Integrity.	• Redundancy and Integrity issues
• Expensive. But in the long term Total Cost of Ownership is cheap	• It's cheaper
• Easy to implement complicated transactions	• No support for complicated transactions

Tools for developing database

- **MySQL:** MySQL is used by top companies like Google, LinkedIn, YouTube, PayPal and Twitter, just to name a few. This open-source relational database is easy to use
- **SQL Server Management Studio:** It combines a powerful set of user-friendly graphical tools and variety of script editors to provide access and management for SQL Server.
- **Oracle RDBMS:** The Oracle database is the most widely used object-relational database management software. The latest version of the tool incorporates cloud computing and it supports multiple Windows, Linux and UNIX versions.
- **PhpMyAdmin:** phpMyAdmin can work well for small organizations. For large ones, enterprise solutions could be better.

Database Platforms

- MySQL
- MariaDB
- MongoDB
- Microsoft SQL Server
- PostgreSQL
- Microsoft Access
- IBMdB and etc

Database Administrator

A **database administrator (DBA)** controls and manages the database.

Function of a DBA

- Make decisions concerning the content of the database
- Plan storage structures and access strategies.
- Provides support to users
- Defines security and integrity checks
- Interprets backup and recovery strategies.

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Thank you!!