University of Central Florida
CGS 2545
Database Concepts

DEPARTMENT OF ELECTRICAL ENGINEERING & COMPUTER SCIENCE
COMPUTER SCIENCE DIVISION

Overview

Database Management System

- **Data**
  - represents recordable facts
  - aids in producing information, which is based on facts
  - For example, if we have data about marks obtained by all students, we can then conclude about toppers and average marks.

Database Management System

- **Database**
  - collection of interrelated data
  - is a collection of facts and figures that can be processed to produce information
  - contains information relevant to an enterprise
  - used to retrieve, insert and delete the data efficiently
  - used to organize the data in the form of
    - table
    - schema
    - view
    - report

Database Management System

- **Database-management system (DBMS)**
  - software which is used to manage the database
  - a set of programs to access those data
  - stores data in such a way that it becomes easier to retrieve, manipulate, and produce information
  - provides an interface to perform various operations like database creation, storing data, updating data, creating a table in the database
  - provides protection and security to the database
  - in the case of multiple users, it maintains data consistency

Database Management System

- **DBMS allows users the following tasks**
  - **Data Definition:** used for creation, modification, and removal of definition that defines the organization of data in the database
  - **Data Updation:** used for the insertion, modification, and deletion of the actual data in the database
  - **Data Retrieval:** used to retrieve the data from the database which can be used by applications for various purposes

Database Management System

- **DBMS allows users the following tasks**
  - **User Administration:** used for registering and monitoring users, maintain data integrity, enforcing data security, dealing with concurrency control, monitoring performance and recovering information corrupted by unexpected failure.
- **Primary goal of a DBMS is to provide**
  - a way to store and retrieve database information
  - convenient
  - efficient

Database Management System

- **Characteristics**
  - traditionally, data was organized in file formats
  - DBMS as a new concept then focused on research to overcome the deficiencies file format data management
  - uses a digital repository established on a server to store and manage data and metadata
  - can provide a clear and logical view of the process that manipulates data
  - contains automatic backup and recovery procedures

Database Management System

- **Characteristics**
  - contains ACID properties which maintain data in a healthy state in case of failure
  - can reduce the complex relationship between data
  - used to support manipulation and processing of data
  - used to provide security of data.
  - can view the database from different viewpoints according to the requirements of the user

Database Management System

- Characteristics
  - A modern DBMS has the following characteristics
    - **Real-world entity**
    - **Relation-based tables**
    - **Isolation of data and application**
    - **Less redundancy**
    - **Consistency**
    - **Query Language**
    - **ACID Properties**
    - **Multiuser and Concurrent Access**
    - **Multiple views**
    - **Security**

Database Management System

- Characteristics
  - **Real-world entity**
    - A modern DBMS is more realistic and uses real-world entities to design its architecture.
    - It uses the behavior and attributes too.
    - For example, a school database may use students as an entity and their age as an attribute.
  - **Relation-based tables**
    - DBMS allows entities and relations among them to form tables.
    - A user can understand the architecture of a database just by looking at the table names.

Database Management System

- Characteristics
  - **Isolation of data and application**
    - A database system is entirely different than its data.
    - A database is an active entity, whereas data is said to be passive, on which the database works and organizes.
    - DBMS also stores metadata, which is data about data, to ease its own process.
  - **Less redundancy**
    - DBMS follows the rules of normalization, which splits a relation when any of its attributes is having redundancy in values.
    - Normalization is a mathematically rich and scientific process that reduces data redundancy.

Database Management System

- Characteristics
  - **Consistency**
    - Consistency is a state where every relation in a database remains consistent.
    - There exist methods and techniques, which can detect attempt of leaving database in inconsistent state.
    - A DBMS can provide greater consistency as compared to earlier forms of data storing applications like file-processing systems.
  - **Query Language**
    - DBMS is equipped with query language, which makes it more efficient to retrieve and manipulate data.
    - A user can apply as many and as different filtering options as required to retrieve a set of data.
    - Traditionally it was not possible where file-processing system was used.

Database Management System

- Characteristics
  - **ACID Properties**
    - DBMS follows the concepts of **A**tomicity, **C**onsistency, **I**solation, and **D**urability (normally shortened as ACID).
    - These concepts are applied on transactions, which manipulate data in a database.
    - ACID properties help the database stay healthy in multi-transactional environments and in case of failure.
  - **Multiuser and Concurrent Access**
    - DBMS supports multi-user environment and allows them to access and manipulate data in parallel.
    - Though there are restrictions on transactions when users attempt to handle the same data item, but users are always unaware of them.

Database Management System

- Characteristics
  - **Multiple views**
    - DBMS offers multiple views for different users.
    - A user who is in the Sales department will have a different view of database than a person working in the Production department.
    - This feature enables the users to have a concentrate view of the database according to their requirements.

Database Management System

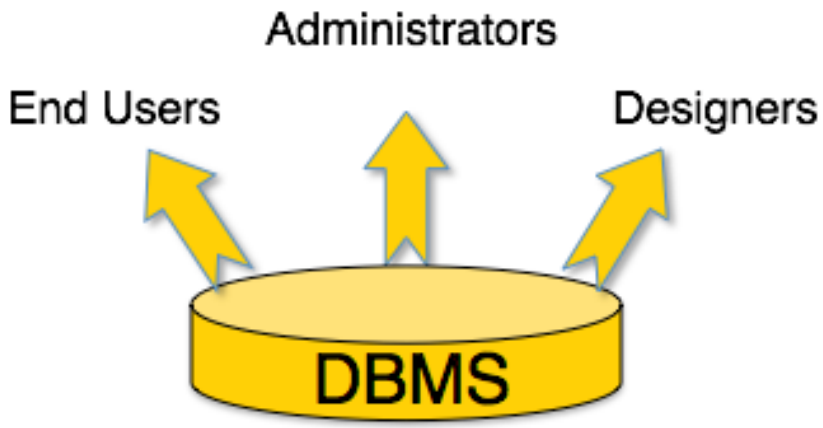
- Characteristics
  - **Security**
    - Features like multiple views offer security to some extent where users are unable to access data of other users and departments.
    - DBMS offers methods to impose constraints while entering data into the database and retrieving the same at a later stage.
    - DBMS offers many different levels of security features, which enables multiple users to have different views with different features.

Database Management System

- Characteristics
  - **Security**
    - For example, a user in the Sales department cannot see the data that belongs to the Purchase department.
    - Additionally, it can also be managed how much data of the Sales department should be displayed to the user.
    - Since a DBMS is not saved on the disk as traditional file systems, it is very hard for miscreants to break the code.

Database Management System

- Users
  - A typical DBMS has users with different rights and permissions who use it for different purposes.
  - Some users retrieve data and some back it up.
  - The users of a DBMS can be broadly categorized as
    - **Administrators**
    - **Designers**
    - **End Users**



Database Management System

- Users
  - **Administrators**
    - Administrators maintain the DBMS and are responsible for administrating the database.
    - They are responsible to look after its usage and by whom it should be used.
    - They create access profiles for users and apply limitations to maintain isolation and force security.
    - Administrators also look after DBMS resources like system license, required tools, and other software and hardware related maintenance.

Database Management System

- Users
  - **Designers**
    - Designers are the group of people who actually work on the designing part of the database.
    - They keep a close watch on what data should be kept and in what format.
    - They identify and design the whole set of entities, relations, constraints, and views.

Database Management System

- Users
  - **End Users**
    - End users are those who actually reap the benefits of having a DBMS.
    - End users can range from
      - simple viewers who pay attention to the logs or market rates
      - sophisticated users such as business analysts

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Database Management System

- **Advantages**
  - **Controls database redundancy:** can control data redundancy because it stores all the data in one single database file and that recorded data is placed in the database
  - **Data sharing:** authorized users of an organization can share the data among multiple user
  - **Easily Maintained:** can be easily maintainable due to the centralized nature of the database system

Database Management System

- **Advantages**
  - **Reduce time:** reduces development time and maintenance needed
  - **Backup:** provides backup and recovery subsystems which create automatic backup of data from hardware and software failures and restores the data if required
  - **Multiple user interface:** provides different types of user interfaces like graphical user interfaces, application program interfaces

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Database Management System

- **Disadvantages**
  - **Cost of Hardware and Software:** requires a high speed data processor and large memory size to run DBMS software
  - **Size:** occupies a large space of disks and large memory to run them efficiently
  - **Complexity:** creates additional complexity and requirements

Database Management System

- **Disadvantages**
  - **Higher impact of failure:**
    - failure is highly impacted using a database because in most organizations all the data is stored in a single database
    - if the database is damaged due to electric failure or database corruption then the data may be lost forever