Database Management Systems

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Session Objective

- DBMS Introduction
- DBMS - An example
- Characteristics of Database Approach
- Database Users

Session Outcome

At the end of this session, participants will be able to:

- Understand the basis of DBMS
- Understand the Characteristics of database
- Understand simplified database environment
- Database Users

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Introduction

Database and Database technology had a major impact on the growing use of computers.

- **Data:** Known facts that can be recorded and have an implicit meaning
- **Database:** A very large, integrated collection of interrelated data.
- Eg: Contact list in Mobile phones

Properties of database

A database has following implicit properties:

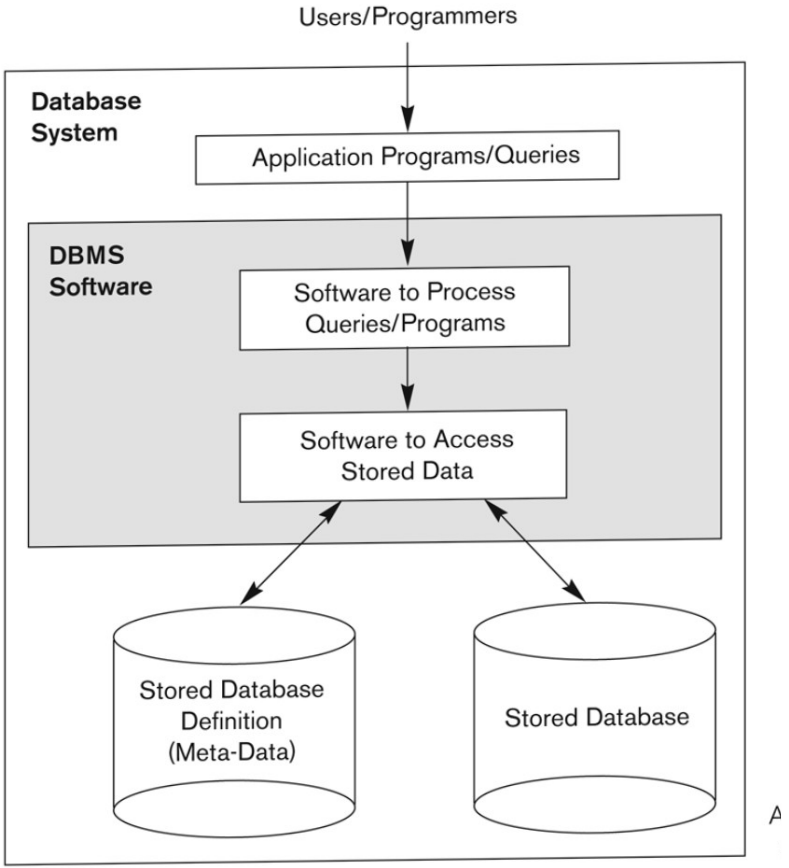
- A database(db) represents some aspects of the real world called mini world and changes in the mini world are reflected in the db.
- It is a **logically coherent collection of data** with some inherent meaning but not a random collection.
- It is **designed, built, and populated** with data for a specific purpose.
- It has an intended group of users and some preconceived applications in which users are interested.

Example - Database

Database is of any size and complexity

- List of names and addresses
- Computerized catlog of large library
- Facebook
- Amazon

Simplified Database Enivornment



Database Management System

- **Data Base System** is a collection of programs that enables users to create and maintain the database.
- A general-purpose software system that facilitates the processes of defining, constructing, manipulating and sharing databases for various applications.
  - **Defining a database** - Involves specifying the data types, structures and constraints for the data to be stored in the database. The database definition is also stored by the DBMS in the form of a database catalog or dictionary; it is called **meta-data**.
  - **Constructing a database** - Process of storing the data itself on storage medium that is controlled by DBMS.
  - **Manipulating a database** - Includes functions such as querying the DB for retrieval, updating the database to reflect changes in the miniworld and generating the reports, etc.,
  - **Sharing**- Allows multiple users and programs to acess the database simultaneously

DBMS -Functions

- **Protection:** includes system protection against hardware or software malfunction (or crashes) and security protection against unauthorized or malicious access.
- **Maintain:**A typical large database may have a long life cycle, the DBMS must be able to maintain the database system by allowing the system to evolve as requirements change over time.

The database and DBMS software together a database system.

Steps in Database Construction

The db design is implemented, populated with actual data and maintained to reflect the state of the mini world

- Specification and Analysis phase
- Coceptual Design - Database Design using Data Model
- Logical Design - Designing the releations using DBMS software
- Physical Design -How the logical structure is physically stored in the target dbms

Database - Example

STUDENT

Name	Student_number	Class	Major
Smith	17	1	CS
Brown	8	2	CS

COURSE

Course_name	Course_number	Credit_hours	Department
Intro to Computer Science	CS1310	4	CS
Data Structures	CS3320	4	CS
Discrete Mathematics	MATH2410	3	MATH
Database	CS3380	3	CS

SECTION

Section_identifier	Course_number	Semester	Year	Instructor
85	MATH2410	Fall	07	King
92	CS1310	Fall	07	Anderson
102	CS3320	Spring	08	Knuth
112	MATH2410	Fall	08	Chang
119	CS1310	Fall	08	Anderson
135	CS3380	Fall	08	Stone

GRADE_REPORT

Student_number	Section_identifier	Grade
17	112	B
17	119	C
8	85	A
8	92	A
8	102	B
8	135	A

PREREQUISITE

Course_number	Prerequisite_number
CS3380	CS3320
CS3380	MATH2410

Figure 1.2
A database that stores

Characteristics of database Approach

Main Characteristics of database approach versus the file-processing approach

- Self-describing nature of a database system
- Insulation between programs and data and data abstraction
- Support of multiple views of the data
- Sharing of data and multi-user transaction processing

Characteristics of database Approach

Self-describing nature of a database system:

- Database system contains not only the database but definition or description of db structure and constraints.
- Definition - structure of each file, the type and storage format of data item and various constraints on the data - stored in catalog -**meta-data**.
- Information used by both users and DBMS software
- A geneal purpose dbms software is not written for specific database application- works with any no of applications by refering the catalog
- Traditional file processing constrained to work with only one specific database - data definition part of application programs

Database Catlog- Example

RELATIONS

Relation_name	No_of_columns
STUDENT	4
COURSE	4
SECTION	5
GRADE_REPORT	3
PREREQUISITE	2

COLUMNS

Column_name	Data_type	Belongs_to_relation
Name	Character (30)	STUDENT
Student_number	Character (4)	STUDENT
Class	Integer (1)	STUDENT
Major	Major_type	STUDENT
Course_name	Character (10)	COURSE
Course_number	XXXXNNNN	COURSE
....	....	.....
....	....	.....
....	....	.....
Prerequisite_number	XXXXNNNN	PREREQUISITE

Characteristics of database Approach

Insulation between programs and data and data abstraction:

- **Program data independence**: Changing the structure of the catlog file if needed without changing the access programs.
- **Program - operation Independence**: Application programs can operate on data by invoking the operations (methods or functions) regardless of how operations are implemented.
- **Data Abstraction:** A characteristic that allow Program data independence and Program - operation Independence .

DBMS provides users with conceptual representation of data(details of how data stored or how operations are implemented) with help of datamodels leads to data abstraction

Characteristics of database Approach

Support of multiple views of the data:

- Each user may have a different prespective or view of the database, based on the data of interest to that user.
- Views are virtual data dervied from one or more relation.
- Many users may not aware whether they refer is stored or derived.
- A multiuser DBMS whose users have variety of distinct applications must provide facilities for defining multiple views.

Database views- Example

(a)

TRANSCRIPT

Student_name	Student_transcript				
	Course_number	Grade	Semester	Year	Section_id
Smith	CS1310	C	Fall	08	119
	MATH2410	B	Fall	08	112
Brown	MATH2410	A	Fall	07	85
	CS1310	A	Fall	07	92
	CS3320	B	Spring	08	102
	CS3380	A	Fall	08	135

(b)

COURSE_PREREQUISITES

Course_name	Course_number	Prerequisites
Database	CS3380	CS3320
		MATH2410
Data Structures	CS3320	CS1310

Characteristics of database Approach

Sharing of data and multi-user transaction processing:

- Allow multiple users to acess the database at the same time correctly and efficiently.
- Concurrency control within the DBMS guarantees that each transaction is correctly executed or aborted
- Transaction - is an executing program or process such as reading and updating of database records
- Each transaction is supposed to execute logically correct database acess without interference from other transactions.
- Transaction becomes central to many db applications and should enforce ACID properties

Actors on the scene

The people who design,use and administer a database

- Data base Administrators:
  1. Administering (oversee and manage) the primary and secondary resources
  2. Responsible for:
     - Authorizing access to the database
     - Coordinating and monitoring its use
     - Acquiring software and hardware resources
     - Accountable for problems such as security breaches and poor system response time.
- Database Designers:
  1. Communicate with potential users to understand requirements
  2. Create design to meet the requirements.
  3. Identifying and choosing appropriate structures to represent and store this data.
  4. Develop views of the database that meet the data and processing requirments of groups.

Actors on the Scene: End Users

Access the database for querying, updating, and generating reports
There are several categories of end users:

- **Casual End Users**:
  1. Occasionally access the database, need different information each time.
  2. Use a sophisticated database query interface to specify their requests.
  3. They are middle or high-level managers or occasional browsers.

Actors on the Scene: End Users

- **Navie or Parametric End Users**:
  1. Constantly querying and updating the database
  2. Uses standard types of queries and updates called **canned transactions**
  3. Learn very little about the facilities of DBMS
  4. Wider knowledge of user interfaces.
- **Sophisticated end users**
  1. Include engineers, scientists, business analysts, and others
  2. They are familiarized with the facilities of the DBMS.
  3. They are able to implement their own applications to meet their complex requirements.
- **Standalone users**:
  1. Maintain personal databases by using ready-made program packages interfaces.
  2. Proficient in using specific software package
  3. Eg: Financial software package that stores a variety of personal financial data.

System Analysts and Application Programmers

- **System analysts:**
  1. Determine the requirements of end users
  2. Develop specifications for standard canned transactions
- **Application programmers:**
  1. Implement the specifications as programs
  2. Test, debug, document, and maintain these canned transactions.

Workers behind the scene

People associated with the design, development, and operation of the DBMS software and system environment.

- **DBMS system designers and implementers:** Design and implement the DBMS modules and interfaces as a software package.
- **Tool developers design and implement tools:**—the software packages that facilitate database modeling and design, database system design, and improved performance.
- **Operators and maintenance personnel** (system administration personnel) responsible for the actual running and maintenance of the hardware and software environment for the database system.

Summary

- Introduction to DBMS
- Simplified example of Database
- Characteristics of database approach
- Database users

Reference

 Fundamentals of Database systems 7^{th} Edition by Ramez Elmasri.