

5th Edition

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Lecture eight

Introduction: Databases and Database Users

Types of Databases and Database Applications

- ▶ Traditional Applications:
 - ▶ Numeric and Textual Databases
- ▶ More Recent Applications:
 - ▶ Multimedia Databases
 - ▶ Geographic Information Systems (GIS)
 - ▶ Many other applications
- ▶ First part of book focuses on traditional applications

Basic Definitions

- ▶ **Database:**
 - ▶ A collection of related data.
- ▶ **Data:**
 - ▶ Known facts that can be recorded and have an implicit meaning.
- ▶ **Mini-world:**
 - ▶ Some part of the real world about which data is stored in a database.
- ▶ **Database Management System (DBMS):**
 - ▶ A software package/ system to facilitate the creation and maintenance of a computerized database.
- ▶ **Database System:**
 - ▶ The DBMS software together with the data itself.

Simplified database system environment

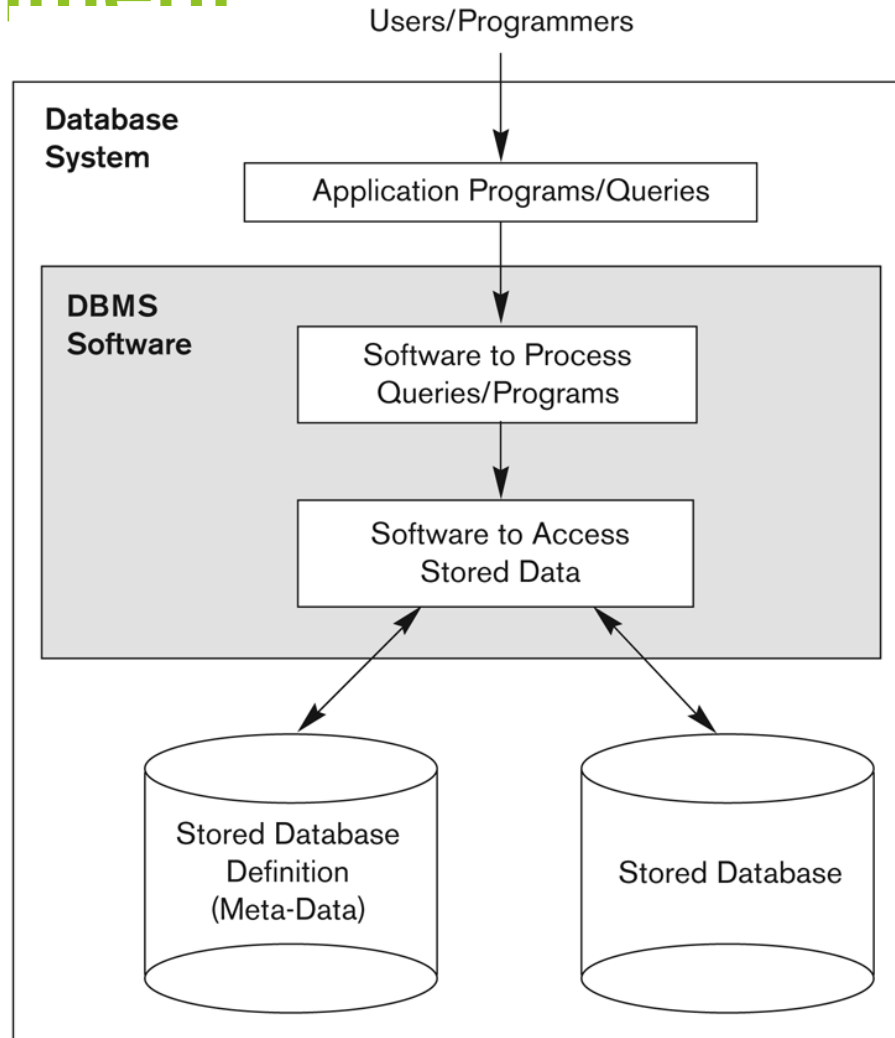


Figure 1.1
A simplified database system environment.

Typical DBMS Functionality

- ▶ *Define* a particular database in terms of its data types, structures, and constraints (**Create**)
- ▶ *Construct* or Load the initial database contents on a secondary storage medium (**Input**)
- ▶ *Manipulating* the database: (**process**)
 - ▶ Retrieval: Querying, generating reports (**Output**)
 - ▶ Modification: Insertions, deletions and updates to its content
 - ▶ Accessing the database through Web applications
- ▶ *Processing* and *Sharing* by a set of concurrent users and application programs - yet, keeping all data valid and consistent

Example of a Database (with a Conceptual Data Model)

- ▶ **Mini-world for the example:**
 - ▶ Part of a UNIVERSITY environment.
- ▶ **Some mini-world *entities*:**
 - ▶ STUDENTs
 - ▶ COURSEs
 - ▶ SECTIONs (of COURSEs)
 - ▶ (academic) DEPARTMENTs
 - ▶ INSTRUCTORs

Example of a Database (with a Conceptual Data Model)

- ▶ Some mini-world *relationships*:
 - ▶ SECTIONs *contain specific* COURSEs
 - ▶ STUDENTs *belong to* SECTIONs
 - ▶ COURSEs *have prerequisite* COURSEs
 - ▶ INSTRUCTORs *teach* SECTIONs
 - ▶ COURSEs *are offered by* DEPARTMENTs
 - ▶ STUDENTs *recorded in* DEPARTMENTs

Example of a simple database

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	04	King
92	CS1310	Fall	04	Anderson
102	CS3320	Spring	05	Knuth
112	MATH2410	Fall	05	Chang
119	CS1310	Fall	05	Anderson
135	CS3380	Fall	05	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
CS3320	CS1310

Figure 1.2

A database that stores student and course information.

Main Characteristics of the Database Approach

- ▶ **Self-describing nature of a database system:**
 - ▶ A DBMS **catalog** stores the description of a particular database (e.g. data structures, types, and constraints)
 - ▶ The description is called **meta-data**.
 - ▶ This allows the DBMS software to work with different database applications.
- ▶ **Insulation between programs and data:**
 - ▶ Called **program-data independence**.
 - ▶ Allows changing data structures and storage organization without having to change the DBMS access programs.

Example of a simplified database catalog

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

Figure 1.3

An example of a database catalog for the database in Figure 1.2.

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Note: Major_type is defined as an enumerated type with all known majors. XXXXNNNN is used to define a type with four alpha characters followed by four digits

Main Characteristics of the DBase

- ▶ **Data Abstraction:** is used to hide storage details from the user
- ▶ **Support of multiple views of the data:**
 - ▶ Each user may see a different view of the database, which describes **only** the data of interest to that user.
- ▶ **Sharing of data and multi-user transaction processing:**
 - ▶ Allowing a set of **concurrent users** to retrieve from and to update the database. **OLTP** (Online Transaction Processing) This allows hundreds of concurrent transactions to execute per second.
 - ▶ *Concurrency control* within the DBMS guarantees that each **transaction** is correctly executed or aborted
 - ▶ *Recovery* subsystem ensures each completed transaction has its effect permanently recorded in the database

Database Users

Database administrators (DBA):

- ▶ Responsible for authorizing access to the database, for coordinating and monitoring its use, buying software and hardware resources, controlling its use and monitoring efficiency of operations.
- ▶ **Database Designers:**
 - ▶ Responsible to define the content, the structure, the constraints, and functions or transactions against the database. They must communicate with the end-users and understand their needs.
- ▶ **End-users:** They use the data for queries, reports and some of them update the database content.

Advantages of Using the Database Approach

- ▶ Controlling redundancy in data storage (save the same information in many locations)
- ▶ Restricting unauthorized access to data (security)
- ▶ Providing backup and recovery services.
- ▶ Providing multiple interfaces to different classes of users (different views).
- ▶ Representing complex relationships among data.
- ▶ Enforcing integrity constraints on the database

Questions

- ▶ Define the following terms
 - ▶ Data, DBMS, User, data base system, GIS, OLTP, Constrain, Backup, veiw, redundancy, indexes, DBA, designer, Data abstraction, concurrency, program-data independence. Manipulating the database, Retrieval, Modification, cataloged
 - ▶ What is advantages of the data base ?
 - ▶ What are the DB users types.
 - ▶ What are the DB Main Characteristics
 - ▶ What are the Typical DBMS Functionality