

ENSF 608:

What are databases and how are they used?

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Textbook: Fundamentals of Database Systems, 7th Ed., Elmasri & Navathe

Lesson Content

1.1 Types of Databases and Database Applications

1.2 Basic Definitions

1.3 Typical DBMS Functionality

1.4 Example of a Database (University)

1.5 Main Characteristics of the Database Approach

1.6 Types of Database Users

1.7 Advantages of Using the Database Approach

1.8 Historical Development of Database Technology

1.9 Extending Database Capabilities

1.10 When Not to Use Databases

Types of Databases and Database Applications

- Traditional Applications:
 - Numeric and textual databases
- More recent applications:
 - Multimedia databases
 - Geographic Information Systems (GIS)
 - Biological and genome databases
 - Data warehouses
 - Mobile databases
 - Real-time and active databases
- First part of textbook focuses on traditional applications
- Several recent applications are described in later textbook chapters

Everyday Databases

- Social networks capture a lot of information about people and their interactions among people- posts, tweets, photos, videos in systems such as:
 - Facebook
 - Twitter
 - LinkedIn
- All of the above constitutes data
- Search engines (Google, Bing, Yahoo) collect their own repository of web pages for searching purposes

Impact of Databases and Database Technology

- **Businesses:** Banking, insurance, retail, transportation, healthcare, manufacturing
- **Service Industries:** Financial, real-estate, legal, e-commerce, small businesses
- **Education:** Resources for content and delivery
- **More recently:** Social networks, environmental and scientific applications, medicine and genetics
- **Personalized applications:** Based on smart mobile devices

Basic Definitions

- **Data:**
 - Known facts that can be recorded and have an implicit meaning.
- **Database:**
 - A collection of related data.
- **Mini-world:**
 - Some part of the real world about which data is stored in a database. For example, student grades and transcripts at a university.

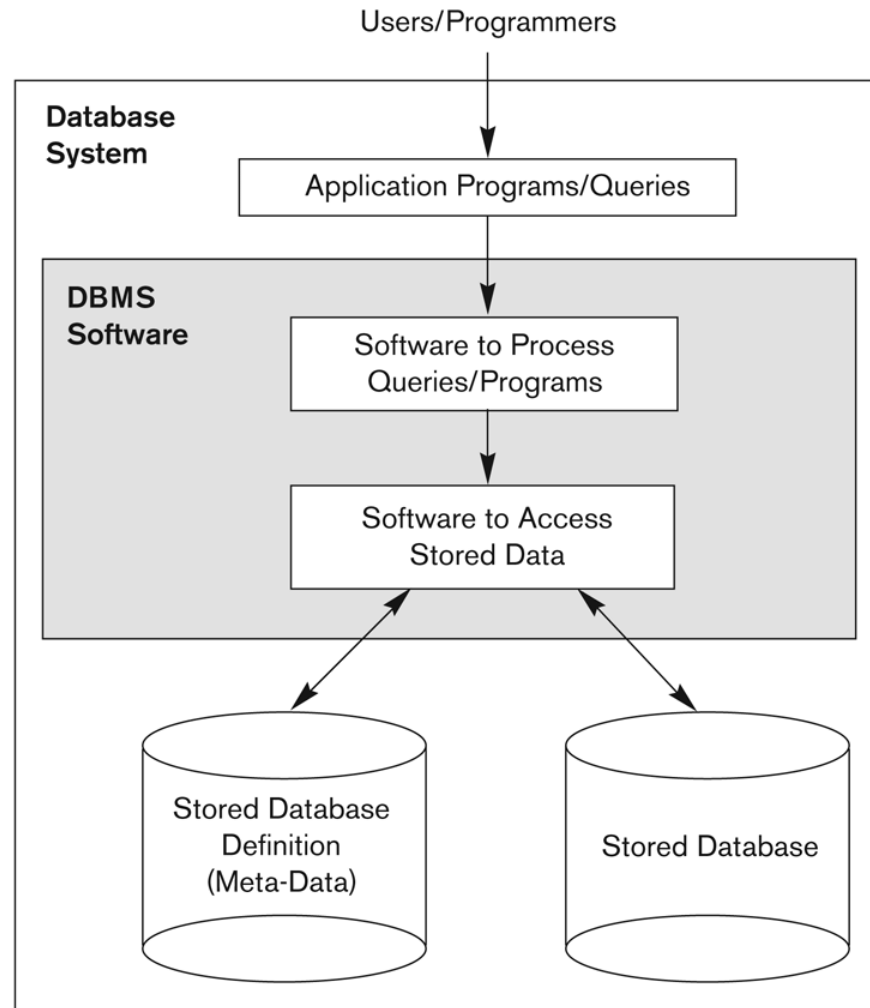
Basic Definitions

- **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. Sometimes, the applications are also included.

Typical DBMS Functionality

- **Define** a particular database in terms of its data types, structures, and constraints
- **Construct** or load the initial database contents on a secondary storage medium
- **Manipulating** the database:
 - Retrieval: Querying, generating reports
 - 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

Figure 1.1 Simplified database system environment



Application Activities Against a Database

- Applications interact with a database by generating
 - **Queries:** that access different parts of data and formulate the result of a request
 - **Transactions:** that may read some data and “update” certain values or generate new data and store that in the database
- Applications must not allow unauthorized users to access data
- Applications must keep up with changing user requirements against the database

Additional DBMS Functionality

- **DBMS may additionally provide:**
 - Protection or security measures to prevent unauthorized access
 - “Active” processing to take internal actions on data
 - Presentation and visualization of data
 - Maintenance of the database and associated programs over the lifetime of the database application
 - Called database, software, and system maintenance

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 are of specific COURSEs**
 - **STUDENTs take SECTIONs**
 - **COURSEs have prerequisite COURSEs**
 - **INSTRUCTORs teach SECTIONs**
 - **COURSEs are offered by DEPARTMENTs**
 - **STUDENTs major in DEPARTMENTs**
- **Note:** The above entities and relationships are typically expressed in a conceptual data model, such as the ENTITY-RELATIONSHIP data model (see Chapters 3, 4)

Figure 1.2 Example of a simple database (1 of 4)

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

Figure 1.2 Example of a simple database (2 of 4)

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

Figure 1.2 Example of a simple database (3 of 4)

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

Figure 1.2 Example of a simple database (4 of 4)

PREREQUISITE

Course_number	Prerequisite_number
CS3380	CS3320
CS3380	MATH2410
CS3320	CS1310

Example DBMS Functionality

- **Define** the STUDENT record name and ID number
- **Construct** or load the STUDENT record information
- **Manipulating** the database:
 - Retrieve all grades associated with ID number 809
 - List all students missing the prerequisite course
 - Add an A+ for ENSF 608 grade
- **Processing** and **Sharing** by Registrar, departments, advisors, etc.

Name	Student_number
C. Smith	809
L. Brown	542

Design Phases

- Requirements specification and analysis phase
- Conceptual design phase
- Logical design phase
- Physical design phase