



## CS 3002D Database Management Systems

### Lecture 3 Basic Concepts (2)



## Example of a Database

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

*Note:* The above could be expressed in the ENTITY-RELATIONSHIP data model.

## Example of a Database

### 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 could be expressed in the **ENTITY-RELATIONSHIP** data model.

A database that stores student and course information.

Schema of Database. ( Attributes or Columns or fields )

Database name

STUDENT	Name	StudentNumber	Class	Major
Smith	17	1	CS	
Brown	8	2	CS	

COURSE	CourseName	CourseNumber	CreditHours	Department
Intro to Computer Science	CS1310	4	CS	
Data Structures	CS3320	4	CS	
Discrete Mathematics	MATH2410	3	MATH	
Database	CS3380	3	CS	

} entries or tuples or records .

A database that stores student and course information.

SECTION	SectionIdentifier	CourseNumber	Semester	Year	Instructor
	85	MATH2410	Fall	98	King
	92	CS1310	Fall	98	Anderson
	102	CS3320	Spring	99	Knuth
	112	MATH2410	Fall	99	Chang
	119	CS1310	Fall	99	Anderson
	135	CS3380	Fall	99	Stone

A database that stores student and course information.

GRADE_REPORT	StudentNumber	SectionIdentifier	Grade
	17	112	B
	17	119	C
	8	85	A
	8	92	A
	8	102	B
	8	135	A

PREREQUISITE	CourseNumber	PrerequisiteNumber
	CS3380	CS3320
	CS3380	MATH2410
	CS3320	CS1310

- DBMS catalog facilitates DBMS to work with different databases.

## Main Characteristics of the Database Approach

- Self-describing nature of a database system: A DBMS **catalog** stores the *description* of the database. (The description is called **meta-data**). This allows the DBMS software to work with different databases.

DBMS Catalog

(also called Data dictionary)

is used to store description of database  
(Called MetaData)

## Main Characteristics of the Database Approach

Example of a DBMS Catalog:

### RELATIONS

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

→ involved in that relation.

## Program Data Independence

- Capability of DBMS to separate data from the programs that access data

Program Data independence enables us to change data storage structures without actually having to change the programs that access data.

## Main Characteristics of the Database Approach

- Insulation between programs and data: Called **program-data independence**. Allows changing data storage structures and operations without having to change the DBMS access programs.

## Data Abstraction

- Helps in Program-data Independence
- A data model is used to hide storage details from user & present User with just a conceptual view of the database

Database Management System supports multiple views i.e. Each user sees a diff. view i.e. the data that he wants.

## Main Characteristics of the Database Approach

- Data Abstraction: A **data model** is used to hide storage details and present the users with a *conceptual view* of the database.
- 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.

Two views derived from the previous database

- (a) The STUDENT TRANSCRIPT view.
- (b) The COURSE PREREQUISITES view.

(a)

TRANSCRIPT	StudentName	Student Transcript				
		CourseNumber	Grade	Semester	Year	SectionId
Smith	CS1310	C	Fall	99	119	
	MATH2410	B	Fall	99	112	
Brown	MATH2410	A	Fall	98	85	
	CS1310	A	Fall	98	92	
Database	CS3320	B	Spring	99	102	
	CS3380	A	Fall	99	135	

(b)

PREREQUISITES	CourseName	CourseNumber	Prerequisites
Database	CS3380		CS3320 MATH2410
Data Structures	CS3320		CS1310

## Main Characteristics of the Database Approach

- Sharing of data and multiuser transaction processing : allowing a set of concurrent users to retrieve and to update the database. Concurrency control within the DBMS guarantees that each **transaction** is correctly executed or completely aborted. OLTP (Online Transaction Processing) is a major part of database applications.

is completely executed or completely aborted. **Atomicity**

- OLTP(Online Transaction Processing) is major application of this.

## Database Users

Users may be divided into

- Those who actually use and control the content (called "Actors on the Scene") and
- Those who enable the database to be developed and the DBMS software to be designed and implemented (called "Actors Behind the Scene").

① 2 types of users

(Actors on scene)  
(i) users who

operate on DB.

(ii) users who  
create &  
define  
Database

(Actors Behind the Scene)

## Database Users

Actors on the scene

- **Database administrators:** responsible for authorizing access to the database, for coordinating and monitoring its use, acquiring 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 actually update the database content.

Actors on  
Scene

ii End users  
Those who  
operate on  
data for  
querying

(i) Database  
designers

who define database.

(ii) Database  
Administrators  
who controls the  
access to  
database

## Database Users

### Actors behind the scene

- **System Designers and Implementors:** Design and implement DBMS packages in the form of modules and interfaces and test and debug them. The DBMS must interface with applications, language compilers, operating system components, etc.
- **Tool Developers:** Design and implement software systems called tools for modeling and designing databases, performance monitoring, prototyping, test data generation, user interface creation, simulation etc. that facilitate building of applications and allow using database effectively.
- **Operators and Maintenance Personnel:** They manage the actual running and maintenance of the database system hardware and software environment.

## Advantages of Using the Database Approach

- Controlling redundancy in data storage and in development and maintenance efforts.
- Sharing of data among multiple users.
- Restricting unauthorized access to data.
- Providing Storage Structures for efficient Query Processing

## Advantages of Using the Database Approach

- Providing backup and recovery services.
- Providing multiple interfaces to different classes of users.
- Representing complex relationships among data.
- Enforcing integrity constraints on the database.

## Additional Implications of Using the Database Approach

- Potential for enforcing standards: this is very crucial for the success of database applications in large organizations.  
Standards refer to data item names, display formats, screens, report structures, meta-data (description of data) etc.
- Reduced application development time: incremental time to add each new application is reduced.

## Additional Implications of Using the Database Approach

- Flexibility to change data structures: database structure may evolve as new requirements are defined.
- Availability of up-to-date information – very important for on-line transaction systems such as airline, hotel, car reservations.
- Economies of scale: by consolidating data and applications across departments wasteful overlap of resources and personnel can be avoided.

## When not to use a DBMS

- **Main inhibitors (costs) of using a DBMS:**
  - High initial investment and possible need for additional hardware.
  - Overhead for providing generality, security, concurrency control, recovery, and integrity functions.
- **When a DBMS may be unnecessary:**
  - If the database and applications are simple, well defined, and not expected to change.
  - If access to data by multiple users is not required.
  - A DBMS may be infeasible in embedded systems where a general purpose D B M S may not fit in available storage



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