INT104 – Database Management Systems

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CSE / SOC

Readings

- **TEXTBOOK**

  1. Henry F.Korth, Abraham Silberschatz, Sudarshan. Database System Concepts, McGraw Hill, 6th Edition, 2010.

  2. R.Elmasri, S.B.Navathe. Fundamentals of Database Systems, Addison Wesley, 7th Edition, 2016.

Outline

- Database Definition
- Types of Databases and Database Applications
- Basic Definitions
- Typical DBMS Functionality
- Example of a Database (UNIVERSITY)

Introduction

- **What is a database?**
  - Collection of related data.

- **What is data?**
  - Known facts that can be recorded and have an implicit meaning.

Database Definition

- "A database has some source from which data are derived, some degree of interaction with events in the real world, and an audience that is actively interested in the contents of the database"

- Implicit Properties of a Database:
    - Represents some aspect of the real world (Mini-world).
    - A logically coherent collection of words with some inherent meaning.
    - Designed, built & populated with data for a specific purpose.

Database Systems: Then

Databases Everywhere
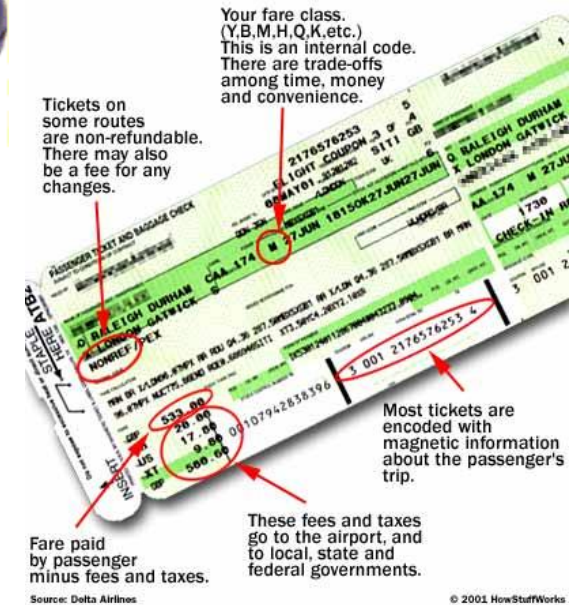
Databases and database systems

- Databases and database systems are an essential component of life in modern society

- Most of us encounter several activities every day that involve some interaction with a database.

Data in Context

Class Roster

Course: MGT 500   Semester: Spring 200X
            Business Policy

Section: 2

Name	ID	Major	GPA
Baker, Kenneth D.	324917628	MGT	2.9
Doyle, Joan E.	476193248	MKT	3.4
Finkle, Clive R.	548429344	PRM	2.8
Lewis, John C.	551742186	MGT	3.7
McFerran, Debra R.	409723145	IS	2.9
Sisneros, Michael	392416582	ACCT	3.3

Context helps users understand data

Figure 1-1b Converting data to information - Summarized data

MKT (15%)

FIN (10%)

MGT (20%)

OTHER (15%)

ACCT (25%)

IS (15%)

Percent Enrollment by Major (200X)

= actual
= estimated

Number of Students

300

200

100

1998 1999 2000 2001 2002 2003

Year
Enrollment Projections
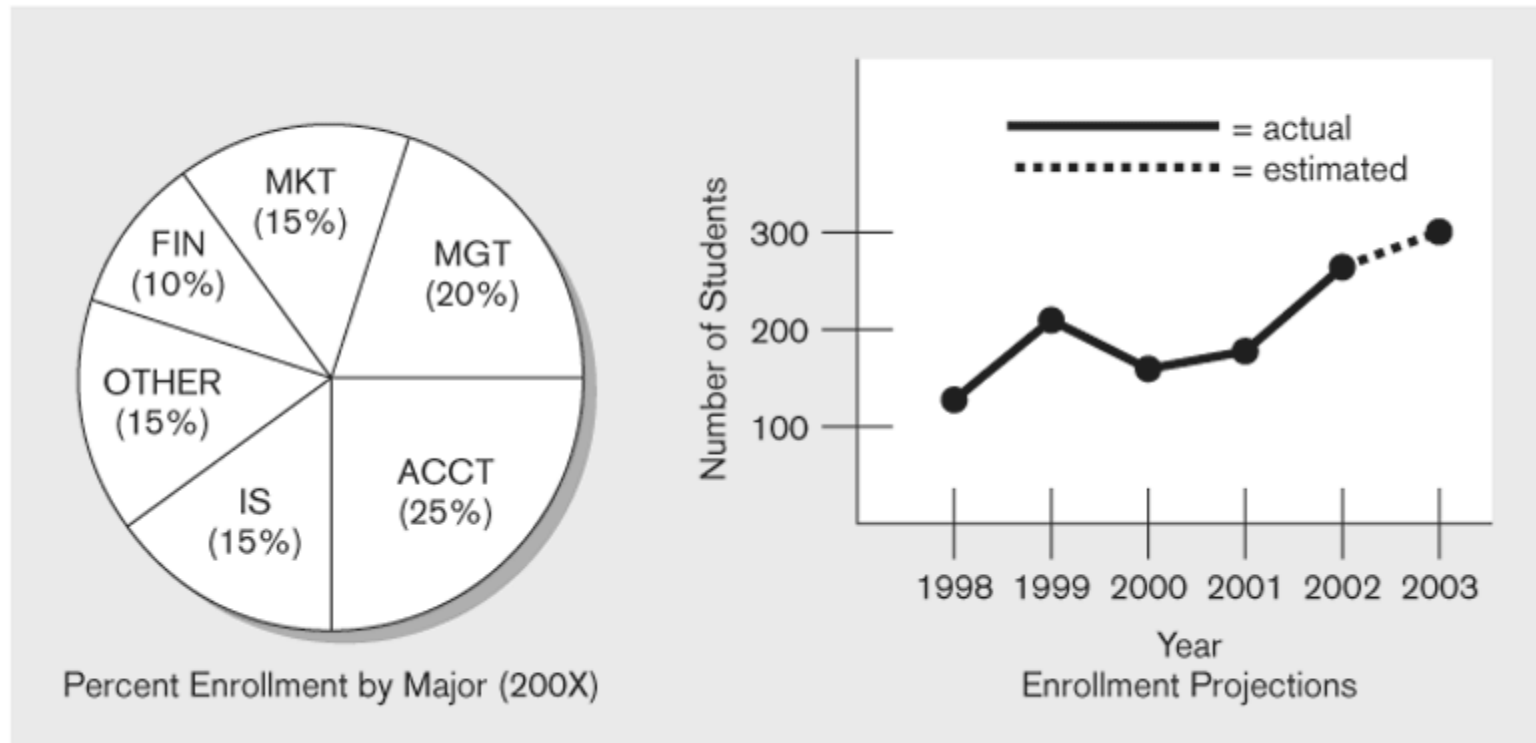
Graphical displays turn data into useful information that managers can use for decision making and interpretation

Types of Databases and Database Applications

- Traditional Applications:
  - Numeric and Textual Databases
- More Recent Applications:
  - Multimedia Databases
  - Geographic Information Systems (GIS)
  - Data Warehouses
  - Real-time and Active Databases
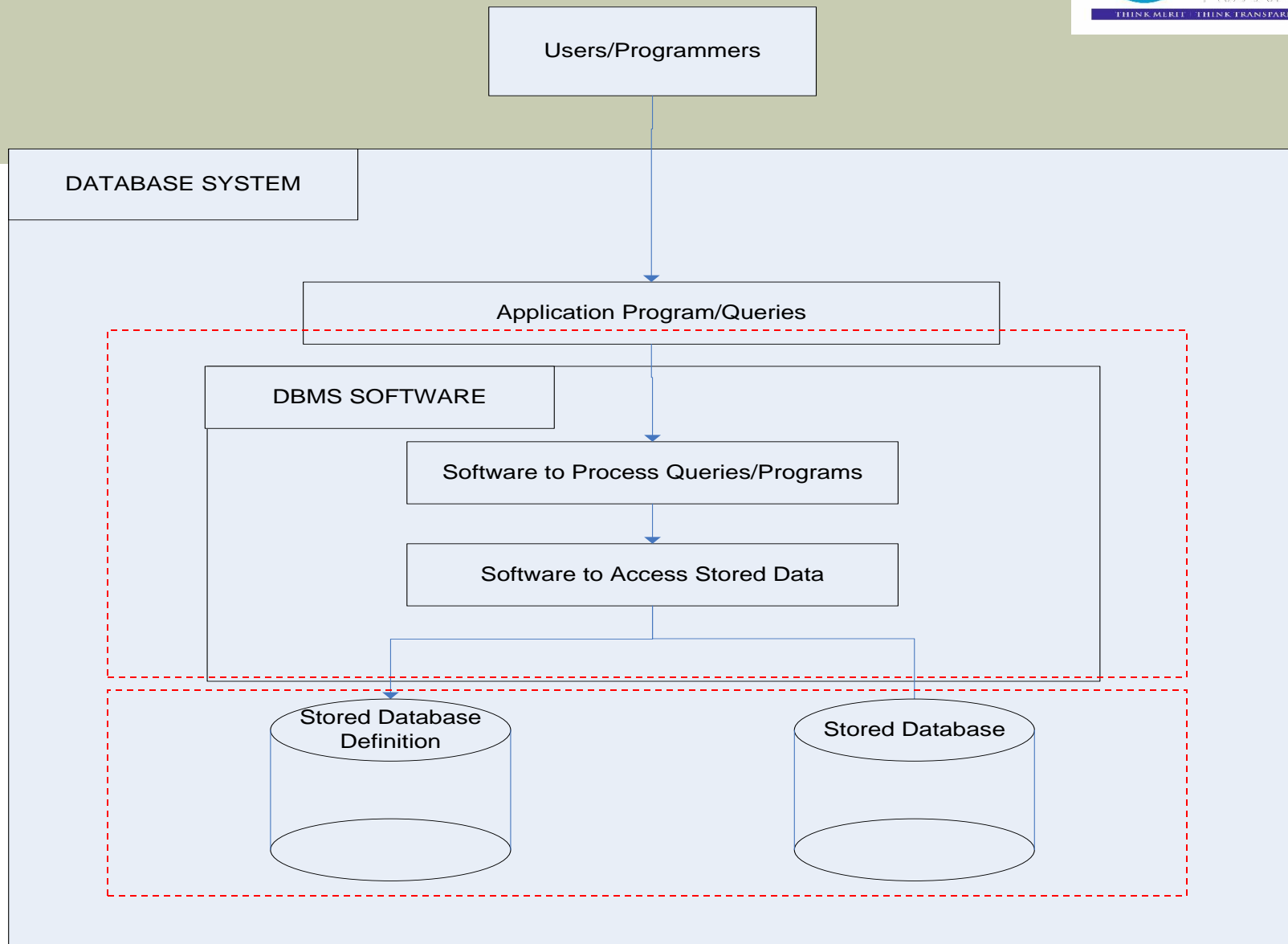 - Many other applications

Database Implementation

- **Defining** a database
  - Data types
  - Structures
  - Constraints
- **Constructing** a database
  - Storing the data itself on a storage medium
- **Manipulating** a database
  - Querying
  - Updating
  - Generating reports

Database Management System (DBMS)

- ***General-purpose*** software system that facilitates the processes of defining, constructing and manipulating databases.

- Can also write your own set of programs to create and maintain the database, i.e. your own ***Special-purpose*** DBMS software.

Database + Software == Database System

3. Users

2. Software

1. Data

4. Hardware

Users/Programmers

DATABASE SYSTEM

Application Program/Queries

DBMS SOFTWARE

Software to Process Queries/Programs

Software to Access Stored Data

Stored Database Definition
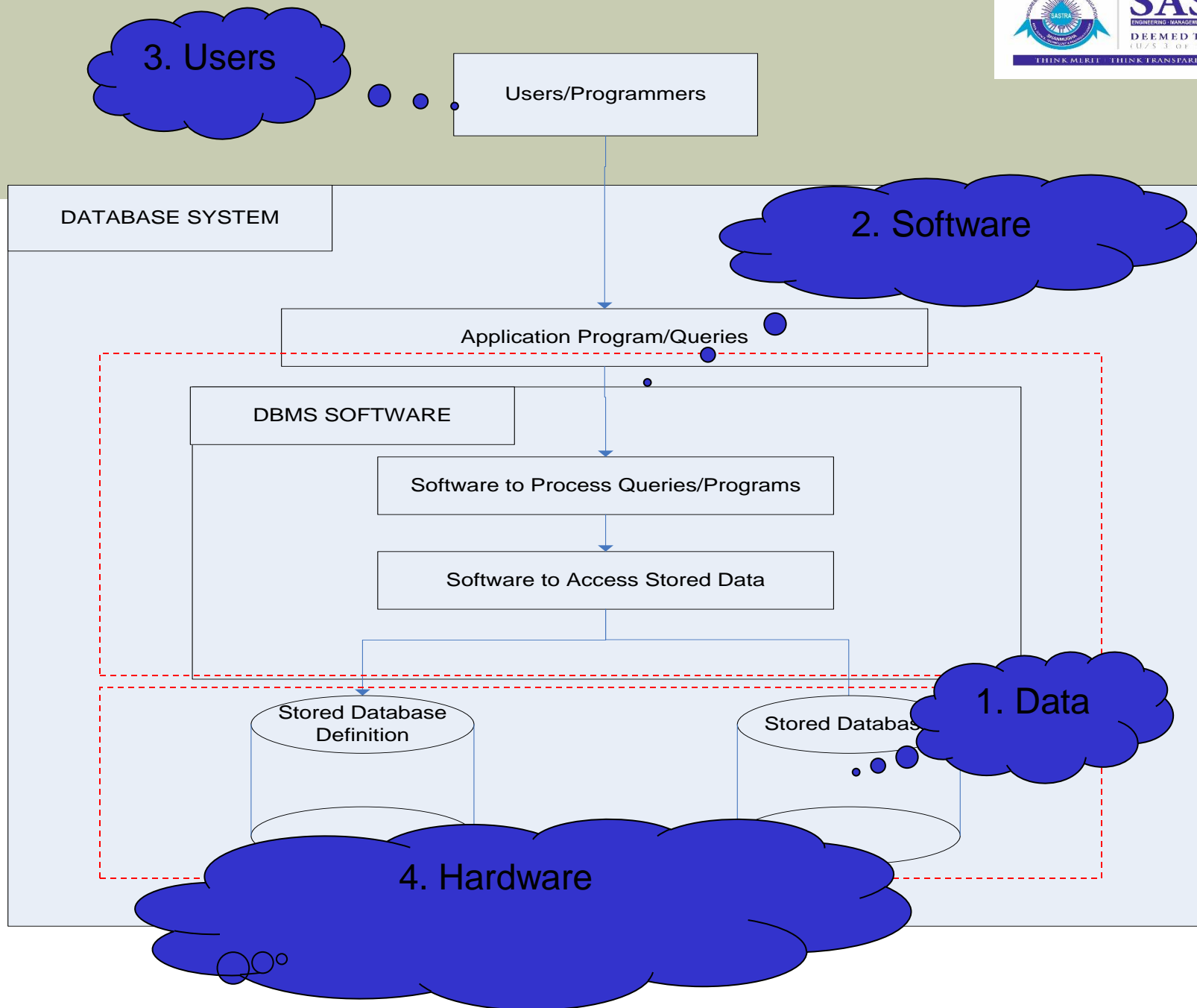
Stored Database

Summary of 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. For example, student grades and transcripts at a university.
- **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

Typical DBMS Functionality

- Other features:
  - Protection or Security measures to prevent unauthorized access
  - "Active" processing to take internal actions on data
  - Presentation and Visualization of data
  - Maintaining the database and associated programs over the lifetime of the database application
    - Called database, software, and system maintenance

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

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 entities and relationships are typically expressed in a conceptual data model, such as the ENTITY-RELATIONSHIP data model (see Chapters 3, 4)

Example of a simple database

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	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.

The Database Approach Vs File Processing Approach

- In traditional file processing, each user defines and implements the files needed for a specific application.
  - redundancy in defining and storing data.
  - wastes storage space and effort used to maintain the common data up-to-date.

- In the database approach, a single repository of data is maintained that is defined once and then is accessed by various users.
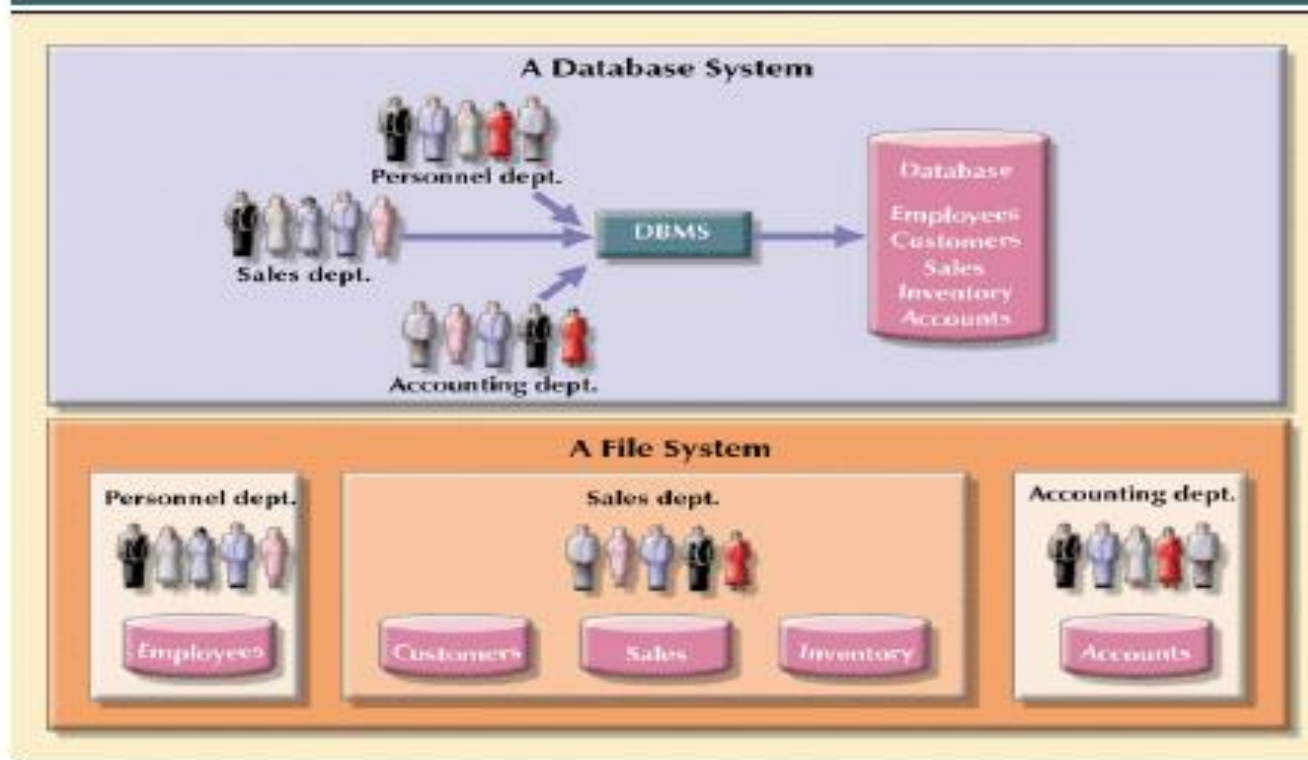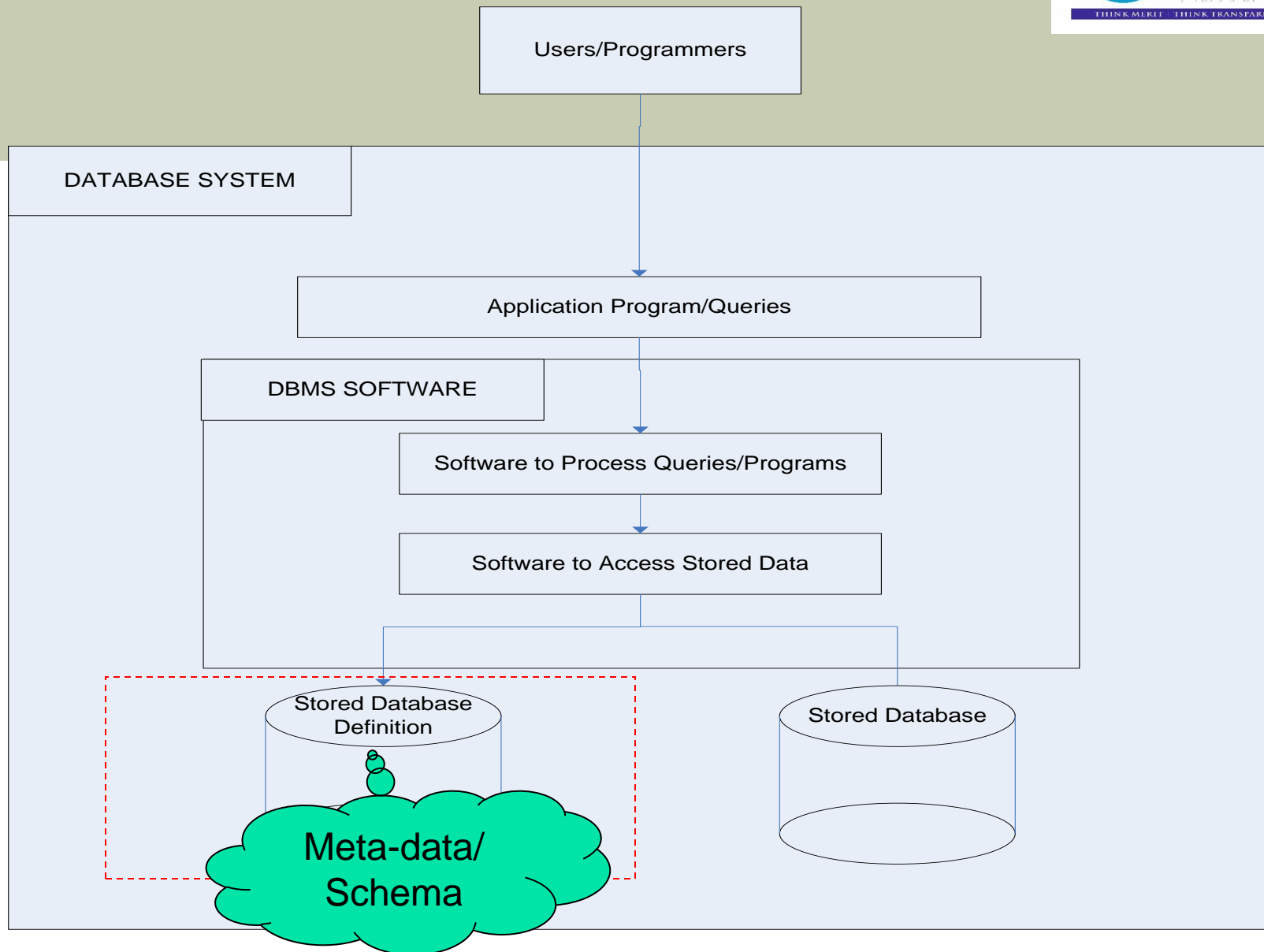
Example of a simplified database catalog

RELATIONS

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

Figure 1.3
An example of a database catalog for the database in Figure 1.2.

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

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

Thank U