Lesson 1: Introduction to Databases

CSC430/530 – DATABASE MANAGEMENT SYSTEMS

DR. ANDREY TIMOFEYEV

OUTLINE

- Introduction.
- Database concept overview.
- Database management system (DBMS).
- Overview of database design process.
- Characteristics of database approach.

INTRODUCTION (1)

- Why study databases?
  - **Academic**.
    - Databases involve many aspects of computer science.
    - Active area of research.
  - **Developer**.
    - A wide array of applications involve using or accessing databases.
  - **Business**.
    - Every organization needs databases.
  - **Student**.
    - Easier to get hired.

INTRODUCTION (2)

- Databases are **everywhere**:
  - Bank withdrawal or deposit.
  - Hotel or airline reservation.
  - Groceries shopping.
  - Online shopping.
  - More examples?
- Generally, databases can be divided into two **classes**:
  - **Traditional** databases**.**
    - Store **numeric** and **textual information**.
  - **Non-traditional** databases.
    - Store **information** generated on the **web** (posts, tweets, images, videos, webpages).
    - **Big data storage systems** and **NOSQL** (Not Only SQL) databases.

DATABASE CONCEPT OVERVIEW

- Definition 0: **Database** is a collection of **related data**.
  - **Data** - known facts that can be recorded and that have implicit meaning.
- **Database properties**:
  - Represents some aspect of the real world (**mini-world**).
  - Logically coherent **collection** of data with inherent **meaning**.
  - Designed, built, and populated with data for a specific **purpose**.
- **Database has**:
  - **Source** from which data is derived.
  - I**nteraction** with events in the real world.
  - **Audience** that is actively interested in its contents.

DATABASE MANAGEMENT SYSTEM (1)

- **Database management system** (**DBMS**) - general-purpose software system that allows users to **create** and **maintain** a database.

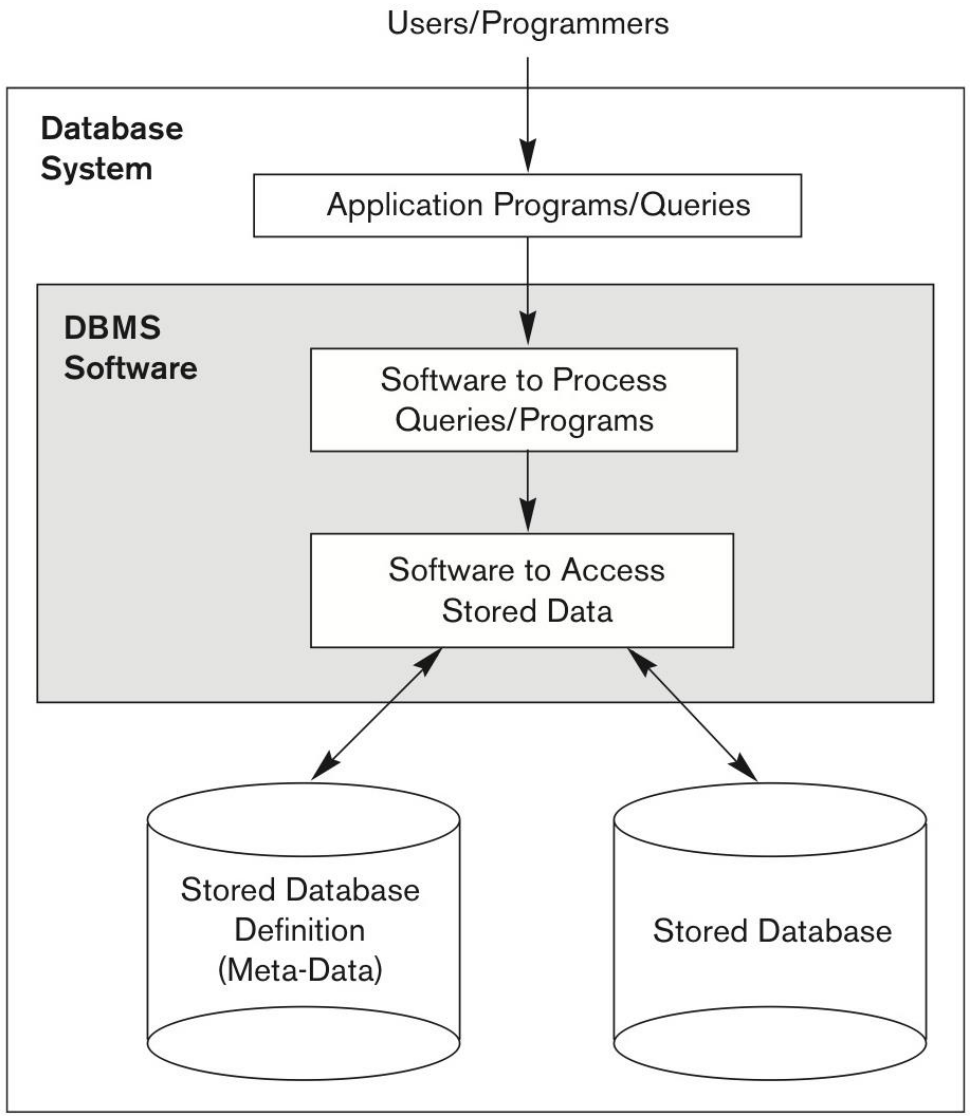
- Typical DMBS **functionality**:
  - **Define** database.
  - **Construct** database.
  - **Manipulate** database.
  - **Share** database. - allow multiple users to query the DB.
  - **Protect** database. - give different users different permissions; also protection from hardware/software problems
  - **Maintain** database.
    - ↳ DBs may evolve over time

DBMS can be thought of as an IDE

our focus in this class

DATABASE MANAGEMENT SYSTEM (2)

- **Database system** = DBMS software + database itself.



Simplified Database System Environment

DATABASE EXAMPLE

- Five **files/tables** (each store data records of the same type):
  - **Student**, **Course**, **Section**, **Prerequisite**, and **Grade report**.

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

PREREQUISITE

Course_number	Prerequisite_number
CS3380	CS3320
CS3380	MATH2410
CS3320	CS1310

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

OVERVIEW OF DATABASE DESIGN PROCESS

- **Database design** stages:
  - **Requirements specification** and **analysis**.
  - **Conceptual design**.
    - Entity-relationship and enhanced entity-relationship models.
  - **Logical design**.
    - Relational DBMS.
  - **Physical design**.
- The **database** is
  - **implemented**,
  - **populated** with an actual data, and
  - continuously **maintained** to reflect the state of the mini-world.

gather requirements; speak to clients and see what is needed for the database

EER

ER

Entity is the object (i.e. student, section, course, pre-req, grade report.)

Relational model is essentially the table name w/ the headers.

CHARACTERISTICS OF DATABASE APPROACH (1)

- **Characteristics** of **database approach**:
  - **Self-describing nature.**
    - Definition of data is stored in the DBMS catalog (meta-data).
  - **Insulation between programs and data.**
    - Program-data independence.
  - **Data abstraction.**
    - Data model is used to hide storage details and present the users with a conceptual view of the database.

changes in the program interface don't affect the data

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 (2)

- **Characteristics** of **database approach** (cont.):
  - **Support of multiple views of the data.**
    - User may see a different view of the database, which describes 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.

DBMS takes care of the conflicts

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

COURSE_PREREQUISITES

Course_name	Course_number	Prerequisites
Database	CS3380	CS3320
		MATH2410
Data Structures	CS3320	CS1310

Two Views Derived From University Database

SUMMARY

- Database definition and properties.
- DBMS definition and functionality.
- Concept of database system.
- Database design stages.
- Characteristics of database approach.