Department of Computer Science

Database Systems
COMP333

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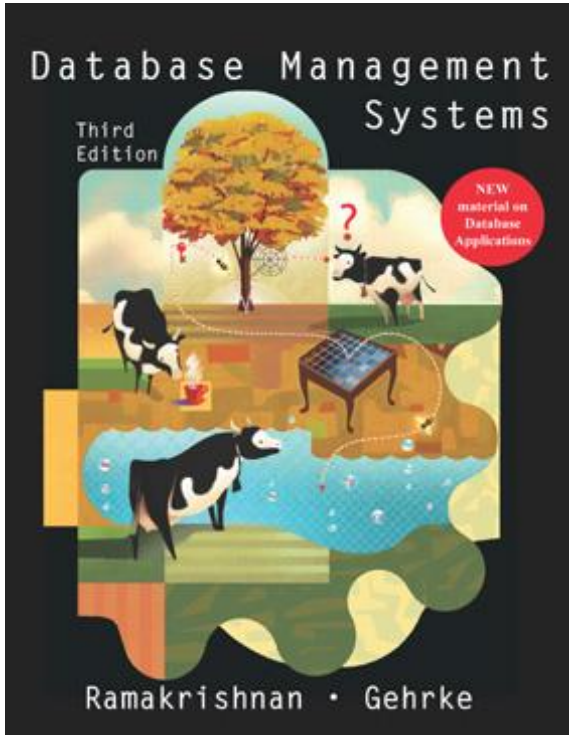
Textbook

Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", McGraw-Hill, Third Edition. 2003.



Objectives

By the end of the course, the students should develop skills in:

- The design methodology for databases and verifying their design correctness.
- Implementing databases and applications software primarily in the relational model.
- Using querying languages such relational algebra and SQL with the supporting database software.
- Applying the theory behind various database models and query languages
- Working in-group settings to design and implement larger programming projects.

Outline

Topic	Material	# of Lectures (75 min)
1. Overview of database system	Ch.1(1.1-1.4+1.8-1.10)	2
2. Introduction to database design	Ch.2 (except 2.4.5, 2.5.4, 2.8)	3
3. Relational model	Ch.3 (except 3.5.7, 3.6,3.7, 3.8)	3
4. Relational algebra	Ch.4 (4.1- 4.2 except 4.2.5)	2
5. SQL: queries, constraints	Ch.5 (except 5.6.4, 5.7, 5.9)	5
6. lab	Lab (creating database + SQL)	2
	Midterm Exam	
7. Connecting java with database	Lecture notes	1
8. Normalization	Ch. 19.1- 19.7 and lecture notes	3
9. Transactions	Ch.16.1-16.4	2
10. Overview of storage and indexing.	Ch.8 (8.1-8.3)	3
11. Query evaluation and optimization	Ch.12(12.1 – 12.4) Ch. 14(14.1 – 14.3,14.4.1)	2
12. project presentation		2
Total		**30**

Grading

- Midterm 30%
- Project 20%
- Assignments & Quizzes 10%
- Final Exam 40%

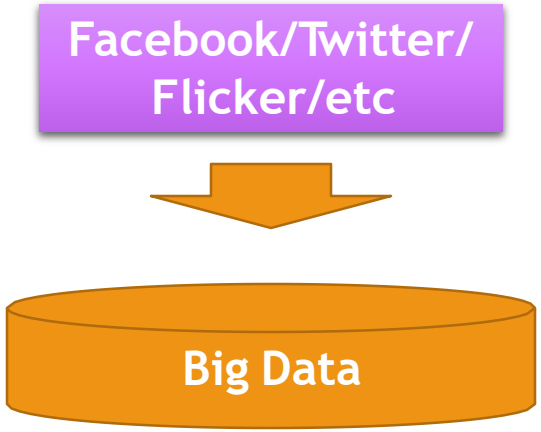
Why Study Databases??

Big Data Revolution:

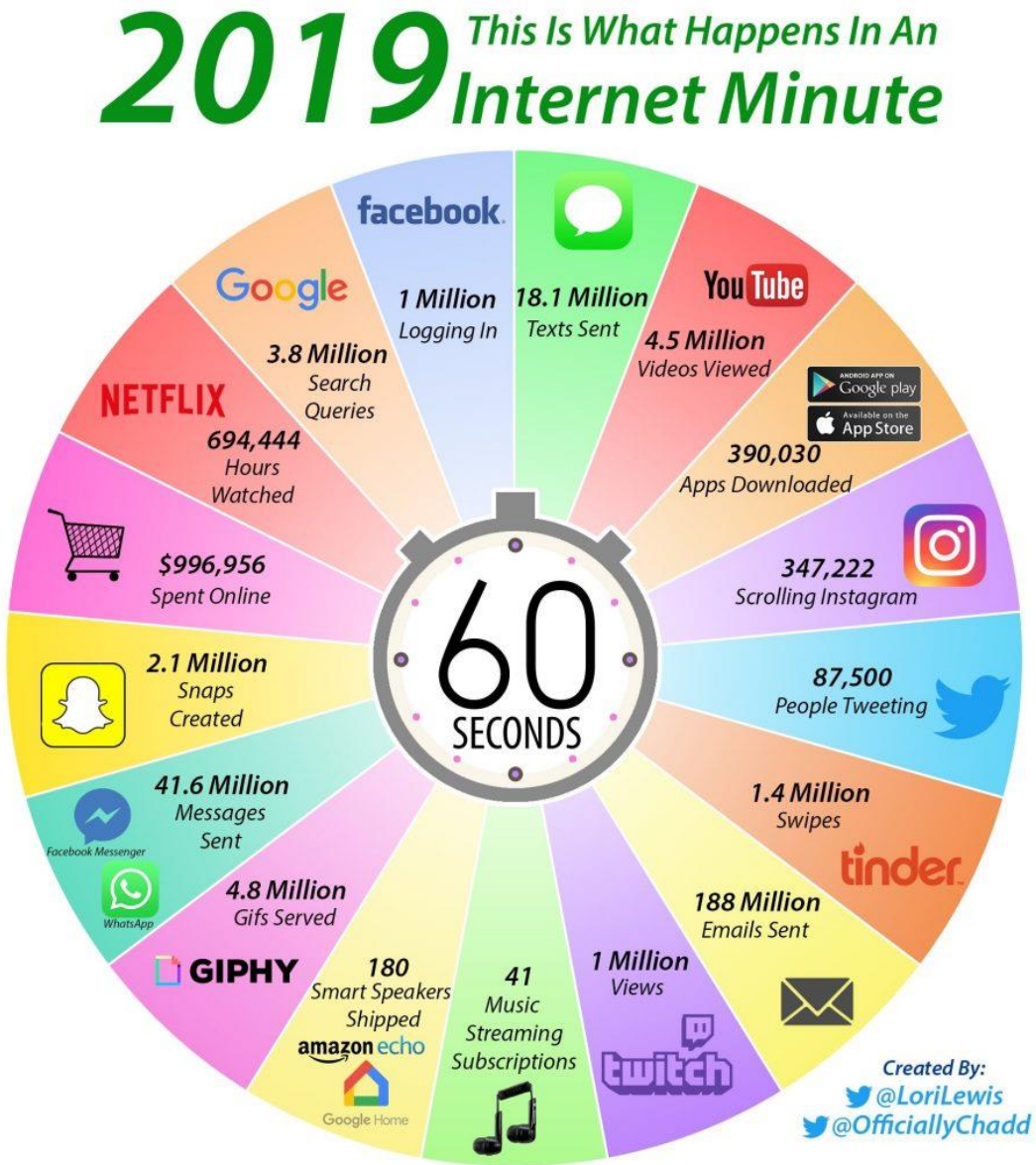
"Between the dawn of civilization and 2003, we only created five exabytes of information; now we're creating that amount every two days." **Eric Schmidt, Google**

The Need for Databases

- **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:
- **Multimedia Databases: video, images, and sound data.**
- **Geographical Databases: Maps, weather, and satellite data.**
- **Adding post/comment to facebook.**
- **Making a tweet on Twitter!**
- **Buying from supermarket.**
- **Reserving a hotel room.**
- **Bank deposit/withdraw**
- **You name it!**



“Big Data” Buzz



The Need for Databases

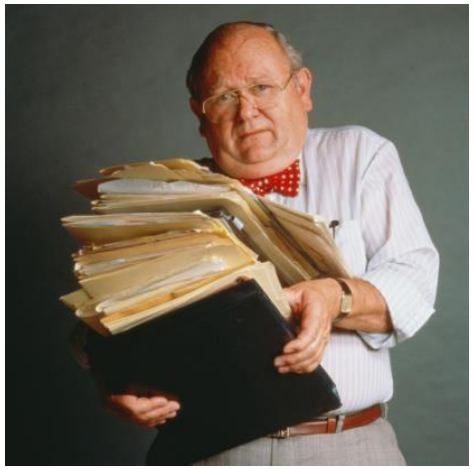
- Storing and retrieving of information has been a necessity in all ages of business and organizations.
- For a business to be successful, a fast access to information is vital.
- Important decisions are based on the information being available at any time, and any place

The Need for Databases

Traditionally, the data was stored in voluminous repositories such as:

- Files
- Books
- Ledgers.

- However, storing data and retrieving information from these repositories was a time- consuming task.



Problems of Manual Systems

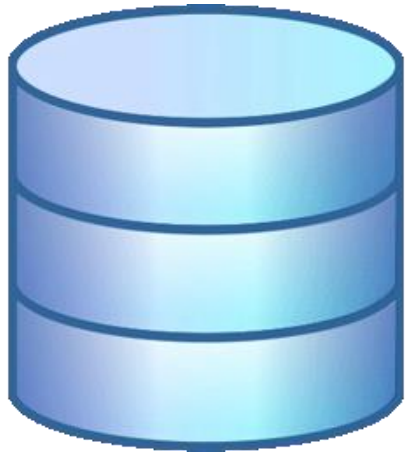
- Time consuming
- Storage and Space
- Retrieval and Search
- Reports for Managers
- Security
- Availability
- Use your imagination

Rise of Databases

- With the development of computers, the problem of information storage and retrieval was resolved.
- Computers replaced tons of paper, file folders, and ledgers as the principal media for storing important information.
- Information can be accessed any time, anywhere

What is a Database?

- ✓ A **database** can be defined as a collection of related data from which users can efficiently store and retrieve the desired information.
- ✓ It could be as simple as phone book, or as complex as media and videos database to a GPS system.



Database Example

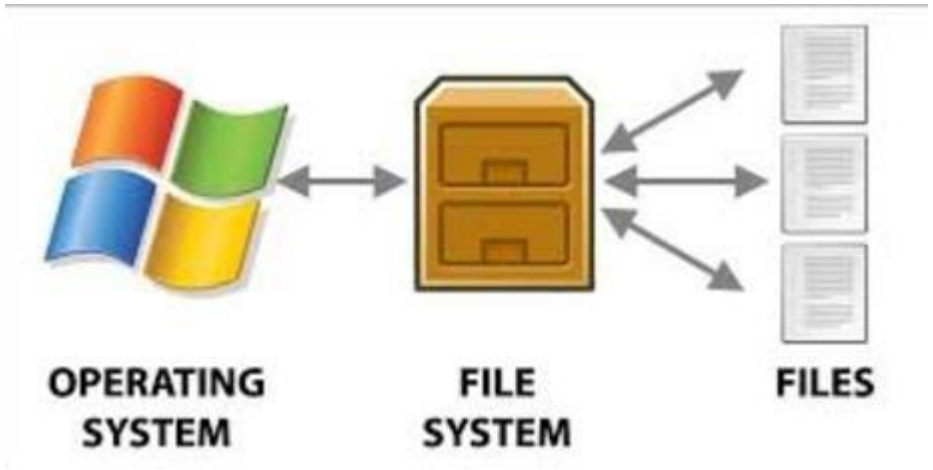
- **Imagine a database for a university, it** could have data about:
  - ❑ Entities such as
    - Students
    - Teachers
    - Courses
    - Sections
    - Departments
  - ❑ Relationships between entities:
    - Students enroll in courses and sections
    - Teachers teach courses
    - Students and Teachers belong to departments

Database Models

- Database model describes the relation between different parts of data.
- There are three database models:
    1. Hierarchical Model, early 60's
    2. Network Model, late 60's
    3. **Relational Model**, nowadays

So what is the problem of using files?

- Main Memory, i.e. 500 GB
- special programs to answer each question a user may want to ask about the data. [complex]
- Consistency
- Security
- Multi-user
- ….



DBMS

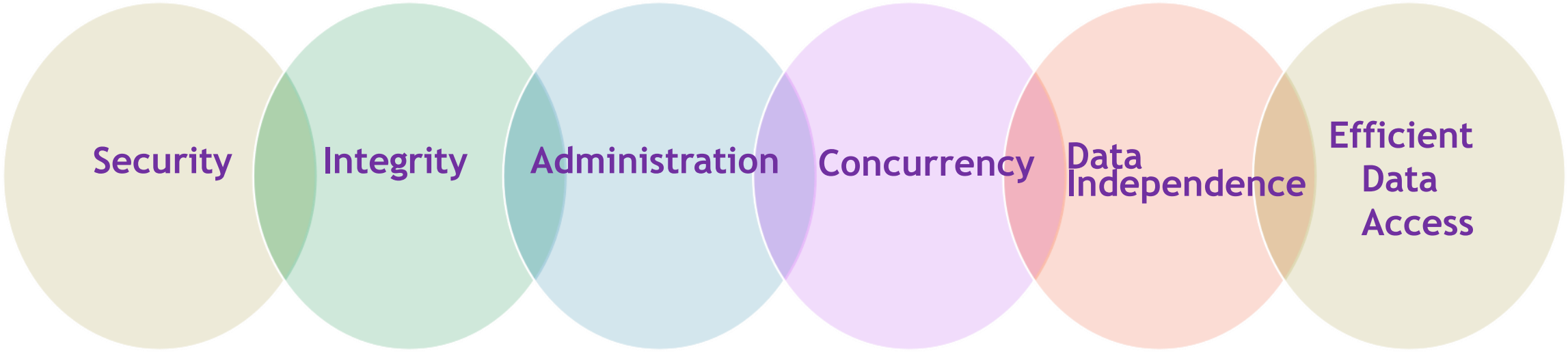
A **Database Management System** (DBMS) is an integrated set of programs used to create and maintain a database.

- They are very complex systems
- Examples:
  - Oracle
  - DB2
  - MySql
  - SQL SERVER
  - Sybase

DB System Landscape

https://db-engines.com/en/ranking

Advantages of DBMS



When not to use DBMS?

- Tight real-time constrain, specialized performance.
- If the required data manipulation is not supported by DBMS, e.g. text data processing
- **If the added benefits of a DBMS are not required.**

DBMS users

- Designers and developers
- Administrators
- End-users

Users

- External Schema: describe how users see the data.
- Conceptual schema describes all relations that are stored in DB.
- Physical schema describes the files and indexes used.