# Database Systems

# Lecture 1: Introduction

**Momtazi**
**momtazi@aut.ac.ir**

based on the slides of the course book

# Outline

- **Administrative Information**
- Introduction to the Course
- Overview of the Semester

# Course

- Credit point: 3
- Lecture
  - Saturdays 9:15 - 10:45
  - Mondays 9:15 - 10:45
- Location:
  - 204
- First lecture
  - 10.11.1394
- Last lecture
  - 17.03.1395

# Course Home Page

- Administrative information
- Slides
- Exercises

# Mailing List

- We will set a mailing list
- All students, tutors and lecturer will be on it
- Purpose:
  - Raise questions to everybody
  - Discuss questions
  - Announcements
  - ...

# Assessment

- Regular attendance in the class

- Doing exercises, project (30%)
- Midterm exam (30%)
- Final exam (40%)

# Teaching

- Both theoretical and practical concepts in main sessions
- Two or three practical sessions with teacher assistant
- More practical sessions by teacher assistant
  - Teacher assistant: Mr. Edalat and Mr. Alvani
  - Goals:
    - Solving exercises
    - Teaching MySQL and MangoDB
  - Timeslot: ?

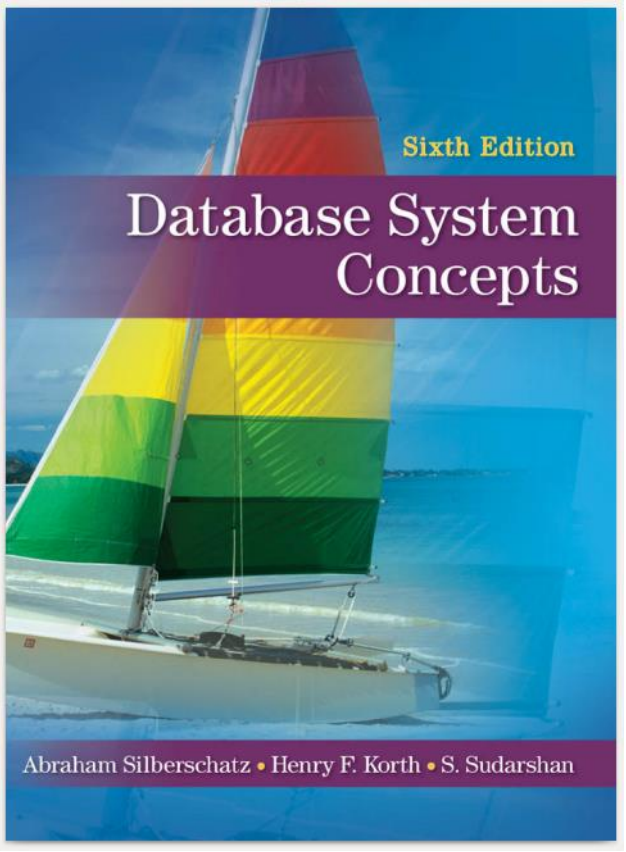
# Contact

- Email: momtazi@aut.ac.ir

- Consultations: Sundays 10:45 – 12:00
- Office
- Phone

# Text Book

## Database System Concepts




by Abraham Silberschatz

Henry F. Korth

S. Sudarshan

SIXTH EDITION

Publisher: McGraw-Hill

# Rules of the Game

- In case you don’t understand something:
  - Ask!!!
  - Ask!!!
  - Ask!!!

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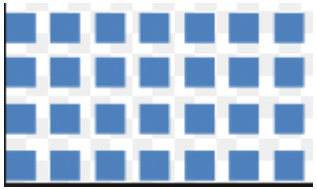
# Data

- Storage


- Retrieval

# Data

- Structured



| ID | name | dept_name | salary |
|---|---|---|---|
| 22222 | Einstein | Physics | 95000 |
| 12121 | Wu | Finance | 90000 |
| 32343 | El Said | History | 60000 |
| 45565 | Katz | Comp. Sci. | 75000 |
| 98345 | Kim | Elec. Eng. | 80000 |
| 76766 | Crick | Biology | 72000 |
| 10101 | Srinivasan | Comp. Sci. | 65000 |
| 58583 | Califieri | History | 62000 |
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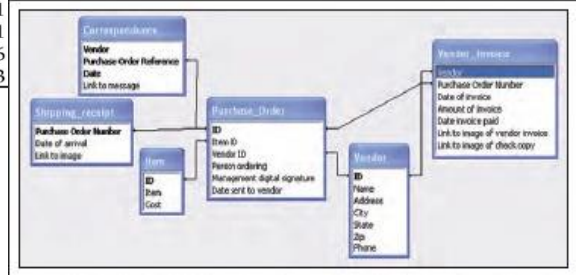
| 15151 | | | |
| 33456 | | | |
| 76543 | | | |




- Unstructured

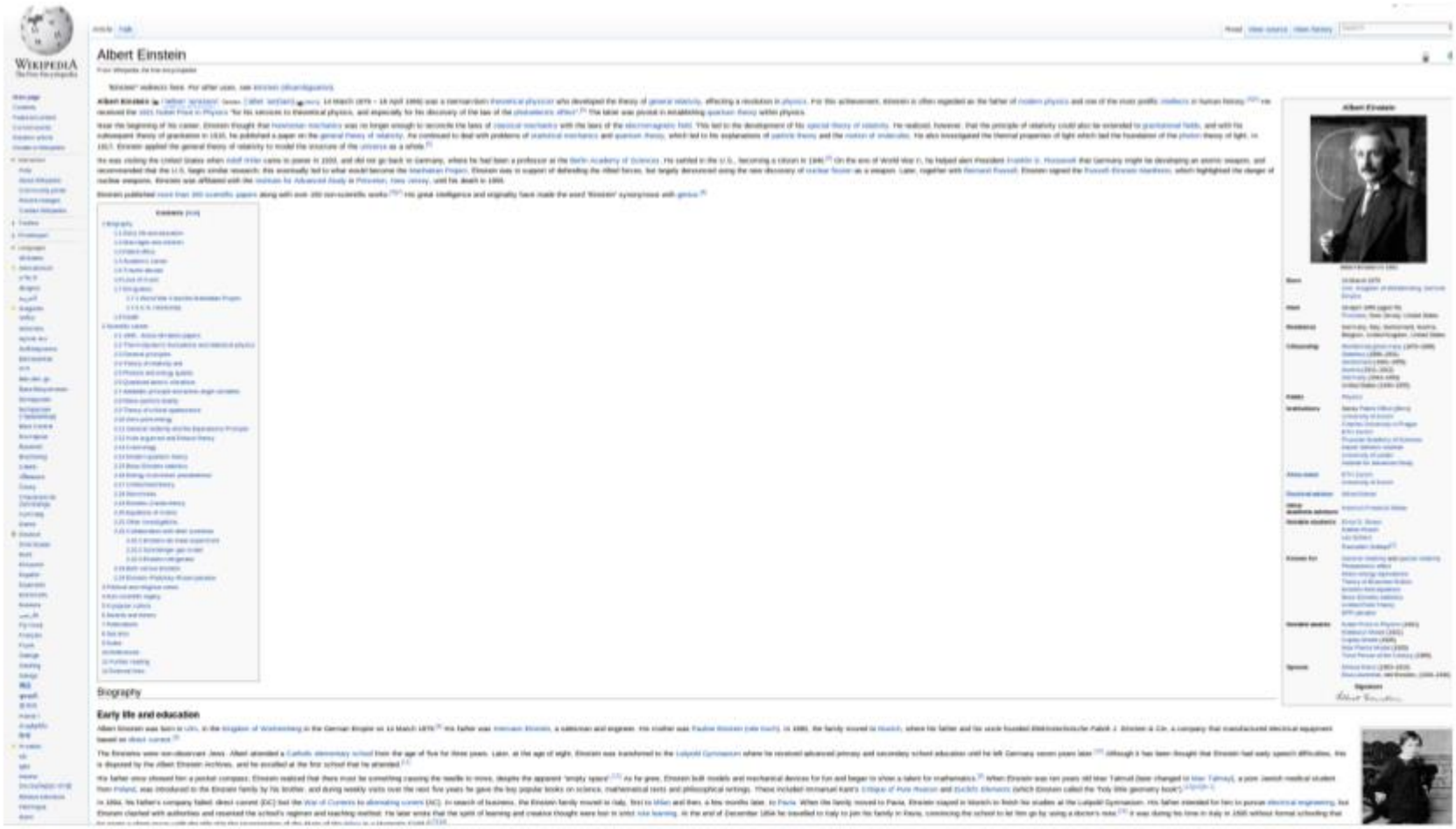
Techniques such as data mining, Natural Language Processing(NLP), and text analytics provide different me
interpret, this information. Common techniques for structuring text usually involve manual tagging with me
further text mining-based structuring. Unstructured Information Management Architecture (UIMA) provides
information to extract meaning and create structured data about the information.[5]

Software that creates machine-processable structure exploits the linguistic, auditory, and visual structure in
communication.[6] Algorithms can infer this inherent structure from text, for instance, by examining word m
small- and large-scale patterns. Unstructured information can then be enriched and tagged to address amb
then used to facilitate search and discovery. Examples of "unstructured data" may include books, journals, d
audio, video, analog data, images, files, and unstructured text such as the body of an e-mail message, Web
the main content being conveyed does not have a defined structure, it generally comes packaged in objects
themselves have structure and are thus a mix of structured and unstructured data, but collectively this is sti
example, an HTML web page is tagged, but HTML mark-up typically serves solely for rendering. It does not c
elements in ways that support automated processing of the information content of the page. XHTML tagging
elements, although it typically does not capture or convey the semantic meaning of tagged terms.

Since unstructured data commonly occurs in electronic documents, the use of a content or document mana
entire documents is often preferred over data transfer and manipulation from within the documents. Docun
means to convey structure onto document collections.

Search engines have become popular tools for indexing and searching through such data, especially text.

# Structured vs. Unstructured Data



# The Need for Databases

- The Internet revolution of the late 1990s sharply increased direct user access to databases.
- Converting many of phone interfaces into Web interfaces
- Making a variety of services and information available online.
  - Accessing an online bookstore and browse a book or music collection
  - Entering an order online
  - Accessing a bank Web site and retrieving bank balance and transaction information
  - Accessing a Web site and browsing its advertisement

# The Need for Databases

- Database system vendors are among the largest software companies in the world

# Database Management System (DBMS)

- DBMS contains information about a particular enterprise
  - Collection of interrelated data
  - Set of programs to access the data
  - An environment that is both *convenient* and *efficient* to use
- Databases can be very large.
- Databases touch all aspects of our lives

# Database Applications

- Banking: transactions
- Airlines: reservations, schedules
- Universities:  registration, grades
- Sales: customers, products, purchases
- Online retailers: order tracking, customized recommendations
- Manufacturing: production, inventory, orders, supply chain
- Human resources:  employee records, salaries, tax deductions

# University Database Example

- Application program examples
  - Add new students, instructors, and courses
  - Register students for courses, and generate class rosters
  - Assign grades to students, compute grade point averages (GPA) and generate transcripts
- In the early days, database applications were built directly on top of file systems

# Drawbacks of using file systems to store data

- Data redundancy and inconsistency
  - Multiple file formats, duplication of information in different files
- Difficulty in accessing data
  - Need to write a new program to carry out each new task
- Data isolation
  - Multiple files and formats
- Integrity problems
  - Integrity constraints (e.g., account balance > 0) become "buried" in program code rather than being stated explicitly
  - Hard to add new constraints or change existing ones

# Drawbacks of using file systems to store data

- Atomicity of updates
  - Failures may leave database in an inconsistent state with partial updates carried out
  - Example: Transfer of funds from one account to another should either complete or not happen at all
- Concurrent access by multiple users
  - Concurrent access needed for performance
  - Uncontrolled concurrent accesses can lead to inconsistencies
  - Example: Two people reading a balance (say 100) and updating it by withdrawing money (say 50 each) at the same time
- Security problems
  - Hard to provide user access to some, but not all, data

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# View of Data

- A database system is a collection of interrelated data and a set of programs
- Allow users to access and modify these data

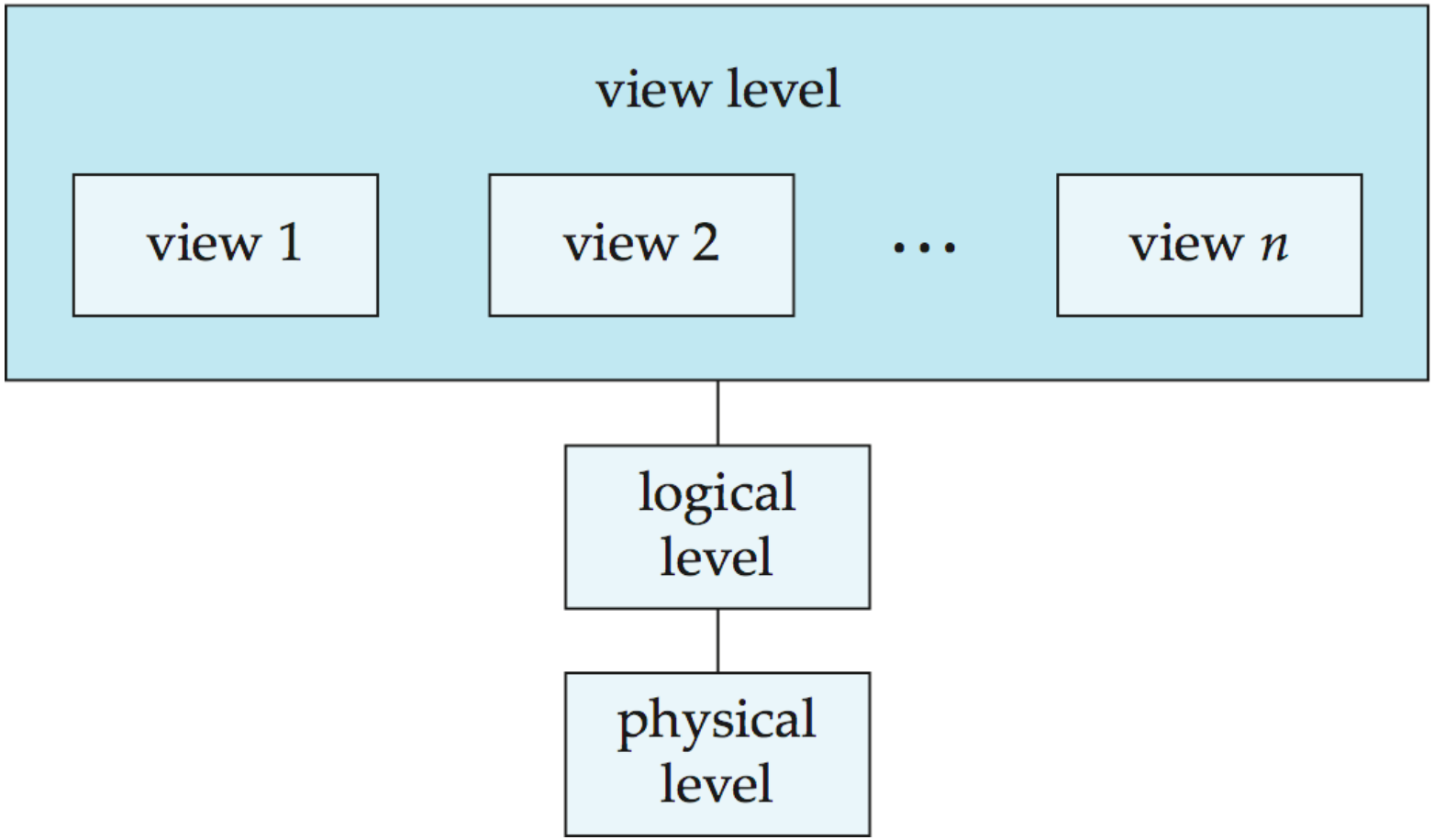
- Major purposes:
  - Providing users with an abstract view of the data
  - Hiding certain details of how the data are stored and maintained.

# Levels of Abstraction

- **Physical level:** describes how a record (e.g., instructor) is stored.
- **Logical level:** describes data stored in database, and the relationships among the data.
- **View level:** application programs hide details of data types. Views can also hide information (such as an employee's salary) for security purposes.

# View of Data

An architecture for a database system



# Example

**type** *instructor* = **record**

*ID* : string;
*name* : string;
*dept_name* : string;
*salary* : integer;

**end**;

- A university organization may have several such record types:
  - Department (dept name, building, and budget)
  - Course (course id, title, dept name, and credits)
  - Student (ID , name, dept name, and tot_cred)

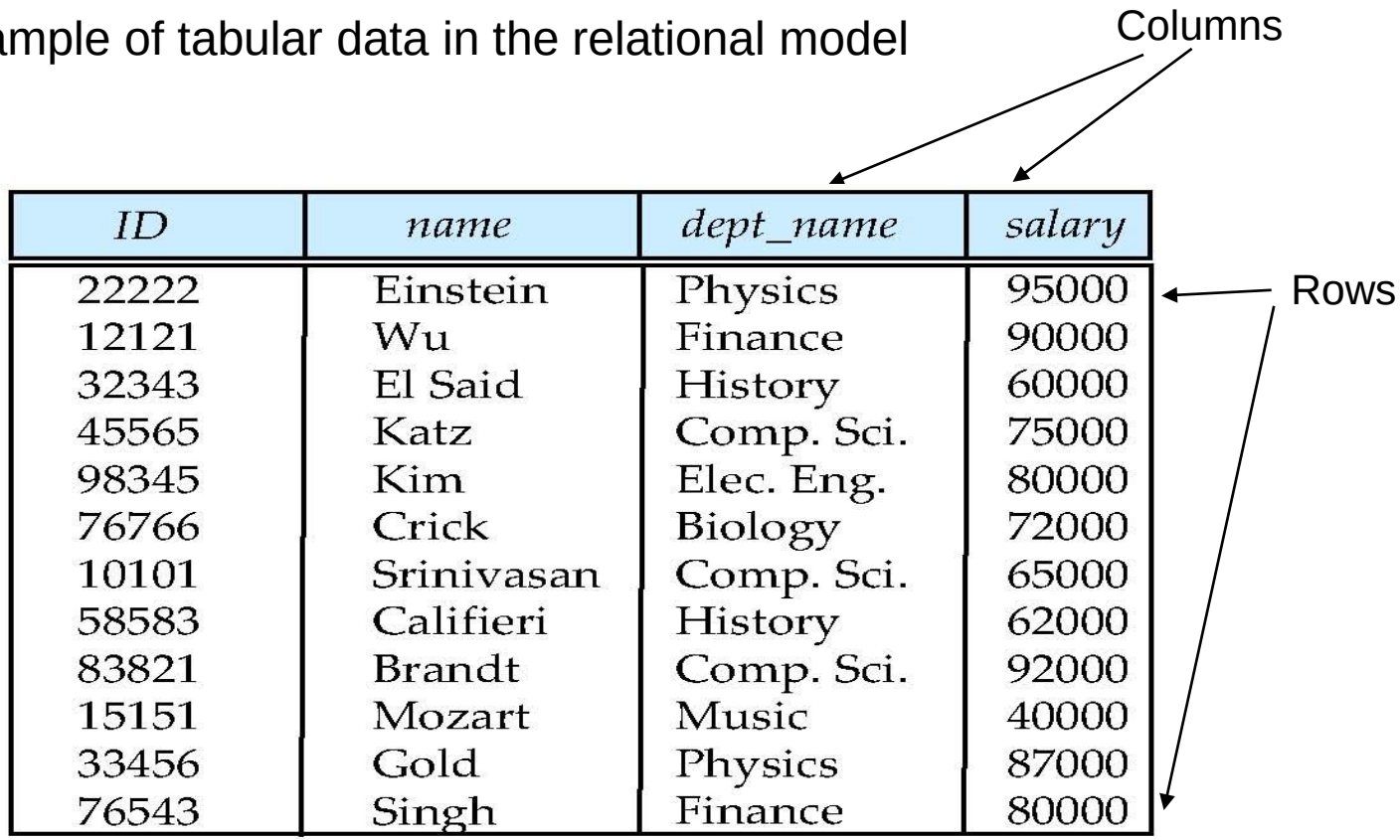
# Data Models

- A collection of tools for describing
  - Data
  - Data relationships
  - Data semantics
  - Data constraints

- Data Models:
  - Relational model
  - Entity-Relationship data model (mainly for database design)
  - Object-based data models (Object-oriented and Object-relational)
  - Semistructured data model  (XML)

# Relational Model

- All the data is stored in various tables.
- Example of tabular data in the relational model

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| 83821 | Brandt | Comp. Sci. | 92000 |
| 15151 | Mozart | Music | 40000 |
| 33456 | Gold | Physics | 87000 |
| 76543 | Singh | Finance | 80000 |

(a) The *instructor* table

# Example of Relational Database

| *ID* | *name* | *dept_name* | *salary* |
|---|---|---|---|
| 22222 | Einstein | Physics | 95000 |
| 12121 | Wu | Finance | 90000 |
| 32343 | El Said | History | 60000 |
| 45565 | Katz | Comp. Sci. | 75000 |
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| 15151 | Mozart | Music | 40000 |
| 33456 | Gold | Physics | 87000 |
| 76543 | Singh | Finance | 80000 |

(a) The *instructor* table

| *dept_name* | *building* | *budget* |
|---|---|---|
| Comp. Sci. | Taylor | 100000 |
| Biology | Watson | 90000 |
| Elec. Eng. | Taylor | 85000 |
| Music | Packard | 80000 |
| Finance | Painter | 120000 |
| History | Painter | 50000 |
| Physics | Watson | 70000 |

(b) The *department* table

# Topics

- Data Definition Language (DDL)
- Data Manipulation Language (DML)
- Structured Query Language (SQL)
- Database Design Approaches

# Question?