Database Systems

Lecture 1:
Course Overview

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based on the slides of the course book

Outline

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

Course Home Page

- Administrative information
- Slides
- Exercises

Assessment

- Regular attendance in the class
  - More than 3/16 absences will be reported
- Final exam (50%)
- Midterm exam (20%)
- Exercises (20%)
- Final project (10%)

Teaching

- Both theoretical and practical concepts in main sessions
- More practical sessions by teacher assistant
  - Goals:
    - Solving exercises
    - Teaching MySQL

Contact

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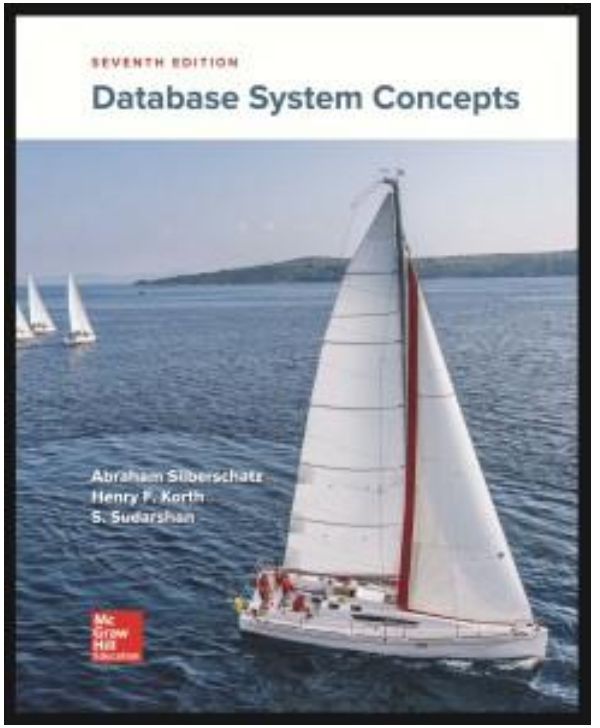
Text Book

Database System Concepts

by Abraham Silberschatz

Henry F. Korth

S. Sudarshan



7th EDITION

Publisher: McGraw-Hill

2019

Rules of the Game

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

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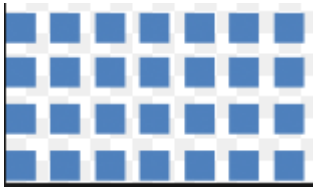
Data

- 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
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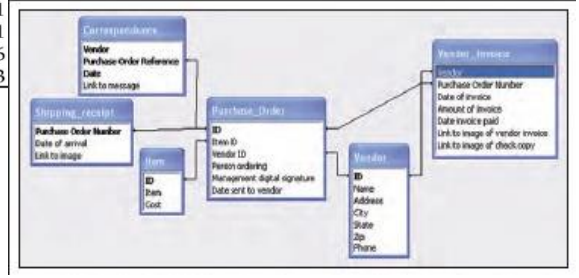
83821			
15151			
33456			
76543			



- Unstructured

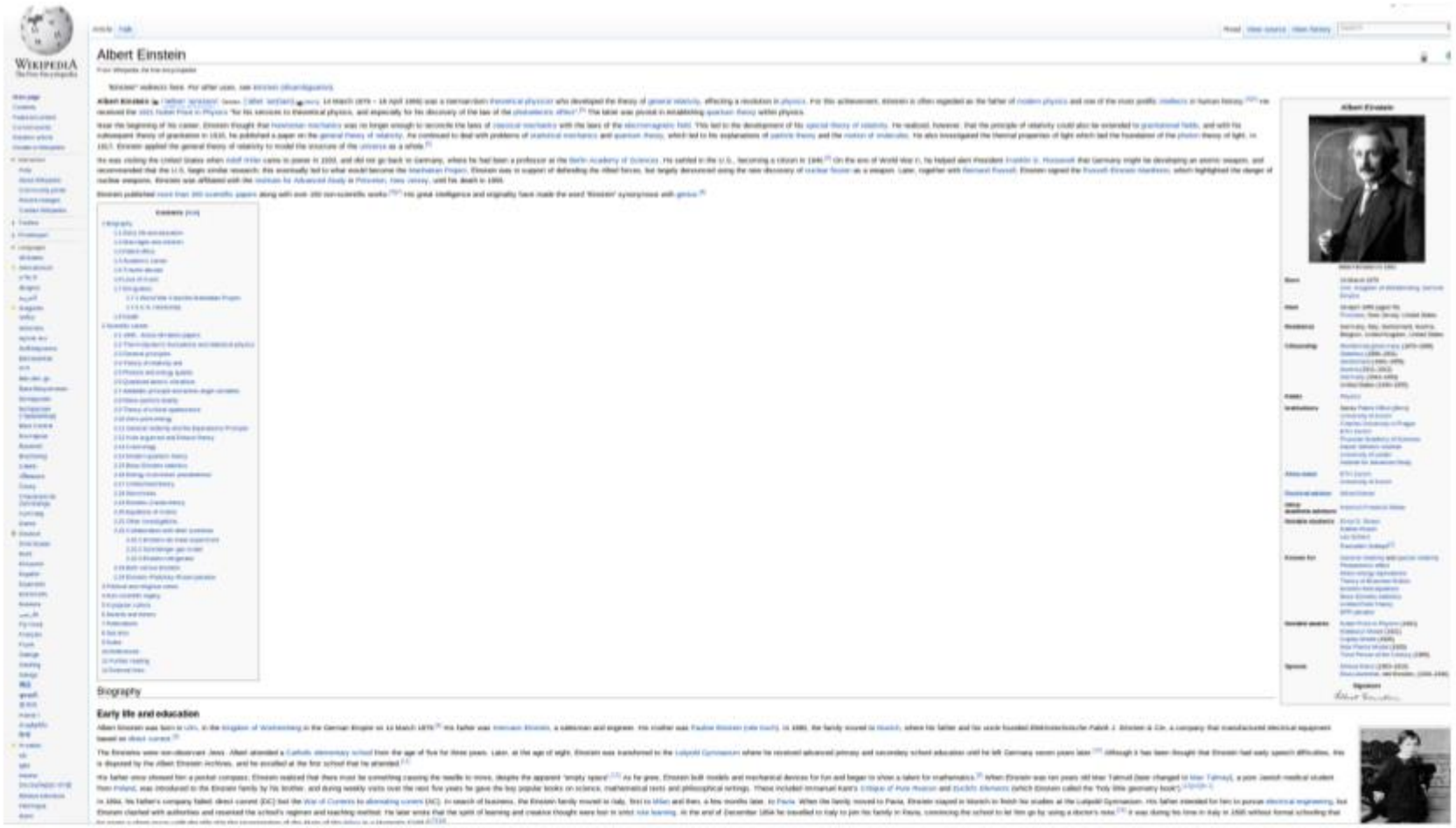
Techniques such as data mining, Natural Language Processing(NLP), and text analytics provide different me interpret, this information. Common techniques for structuring text usually involve manual tagging with me further text mining-based structuring. Unstructured Information Management Architecture (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, 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 object 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 elements in ways that support automated processing of the information content of the page. XHTML taggin 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



Data

- Storage

- Retrieval

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

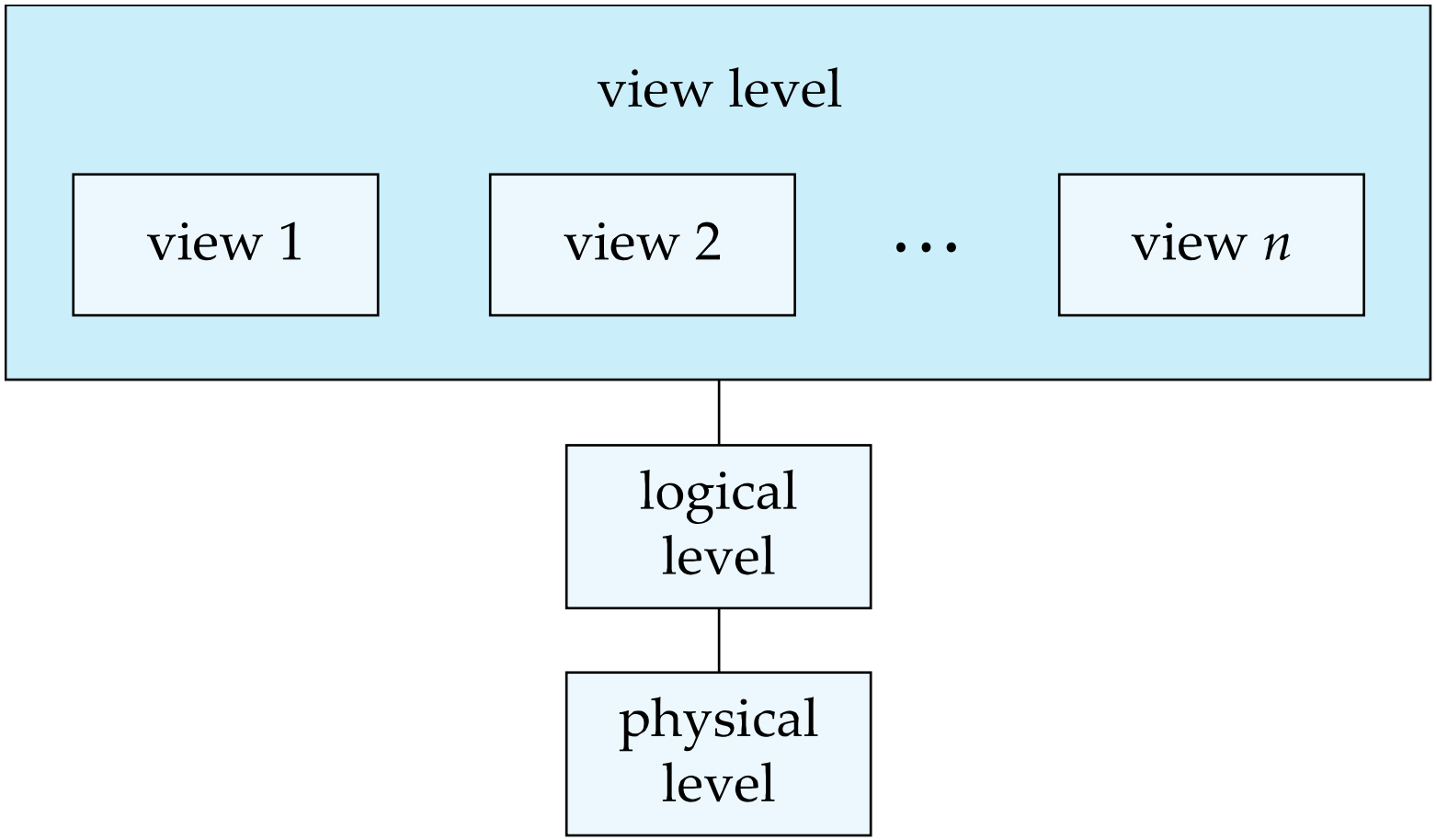
- Major purposes:
  - Providing users with an abstract view of the data
  - Hiding certain details of how the data are stored and maintained.

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)

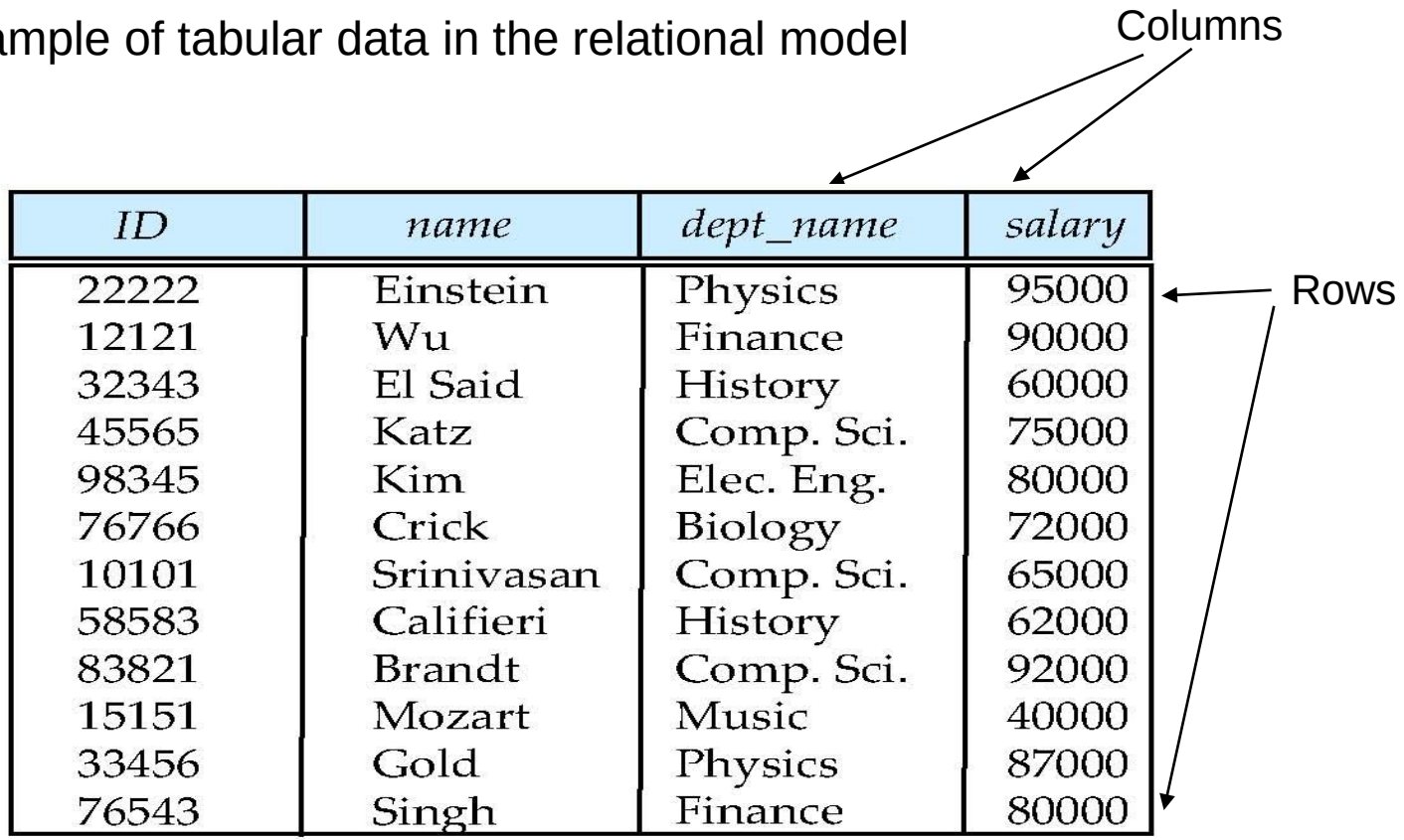
Data Models

- 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)
  - Complex Types
    - Object-based data models (Object-oriented and Object-relational)
    - Semi-structured data model

Relational Model

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



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58583	Califieri	History	62000
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

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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
  - Entity Relationship (ER) Model
  - Normalization
- Advanced Topics (Complex Data Types):
  - JSON
  - XML
  - RDF
  - Object-based data models

Question?