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Chapter 1: Introduction

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Database System Concepts, 6th Ed.

Database Management System (DBMS)

Introduction:

- In computerized information system data is the basic resource of the organization. So, proper organization and management for data is required for organization to run smoothly.
- Database management system deals the knowledge of how data stored and managed on a computerized information system. In any organization, it requires accurate and reliable data for better decision making, ensuring privacy of data and controlling data efficiently.
- The examples include deposit and/or withdrawal from a bank, hotel, airline or railway reservation, purchase items from supermarkets in all cases, a database is accessed.

Database Management System (DBMS)

- **Data?**
- Data is the known facts or figures that have implicit meaning. It can also be defined as it is the representation of facts ,concepts or instruction in a formal manner, which is suitable for understanding and processing.
  - : 26, “prachi”, “abc@gmail.com” etc.

- **Information?**
- Information is the processed data on which decisions and actions are based. Information can be defined as the organized and classified data to provide meaningful values.

  Eg: “The age of Prachi is 26”

- **File?**
- File is a collection of related data stored in secondary memory.

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

Database Management System (DBMS)

- **File Oriented approach:**

- The traditional file oriented approach to information processing has for each application a separate master file and its own set of personal file. In file oriented approach the program dependent on the files and files become dependent upon the programs.
- Eg. Thinking of offline files of audit

Database Management System (DBMS)

- **Disadvantages of file oriented approach:**

- **Data redundancy and inconsistency:**
  - The same information may be written in several files. This redundancy leads to higher storage and access cost. It may lead data inconsistency that is the various copies of the same data may longer agree. for example a changed customer address may be reflected in single file but not else where in the system.
- **Difficulty in accessing data :**
  - The conventional file processing system do not allow data to retrieved in a convenient and efficient manner according to user choice.
- **Data isolation :**
  - Because data are scattered in various file and files may be in different formats with new application programs to retrieve the appropriate data is difficult.

Database Management System (DBMS)

- **Integrity Problems:**
  - Developers enforce data validation in the system by adding appropriate code in the various application program. How ever when new constraints are added, it is difficult to change the programs to enforce them.
- **Atomicity:**
  - It is difficult to ensure atomicity in a file processing system when transaction failure occurs due to power failure, networking problems etc.
  - (atomicity: either all operations of the transaction are reflected properly in the database or non are)
- **Concurrent access:**
  - Example: Two people reading a balance (say 100) and updating it by withdrawing money (say 50 each) at the same time
- **Security problems:**
  - There is no security provided in file processing system to secure the data from unauthorized user access.

Database Management System (DBMS)

Database systems offer solutions to all the above problems

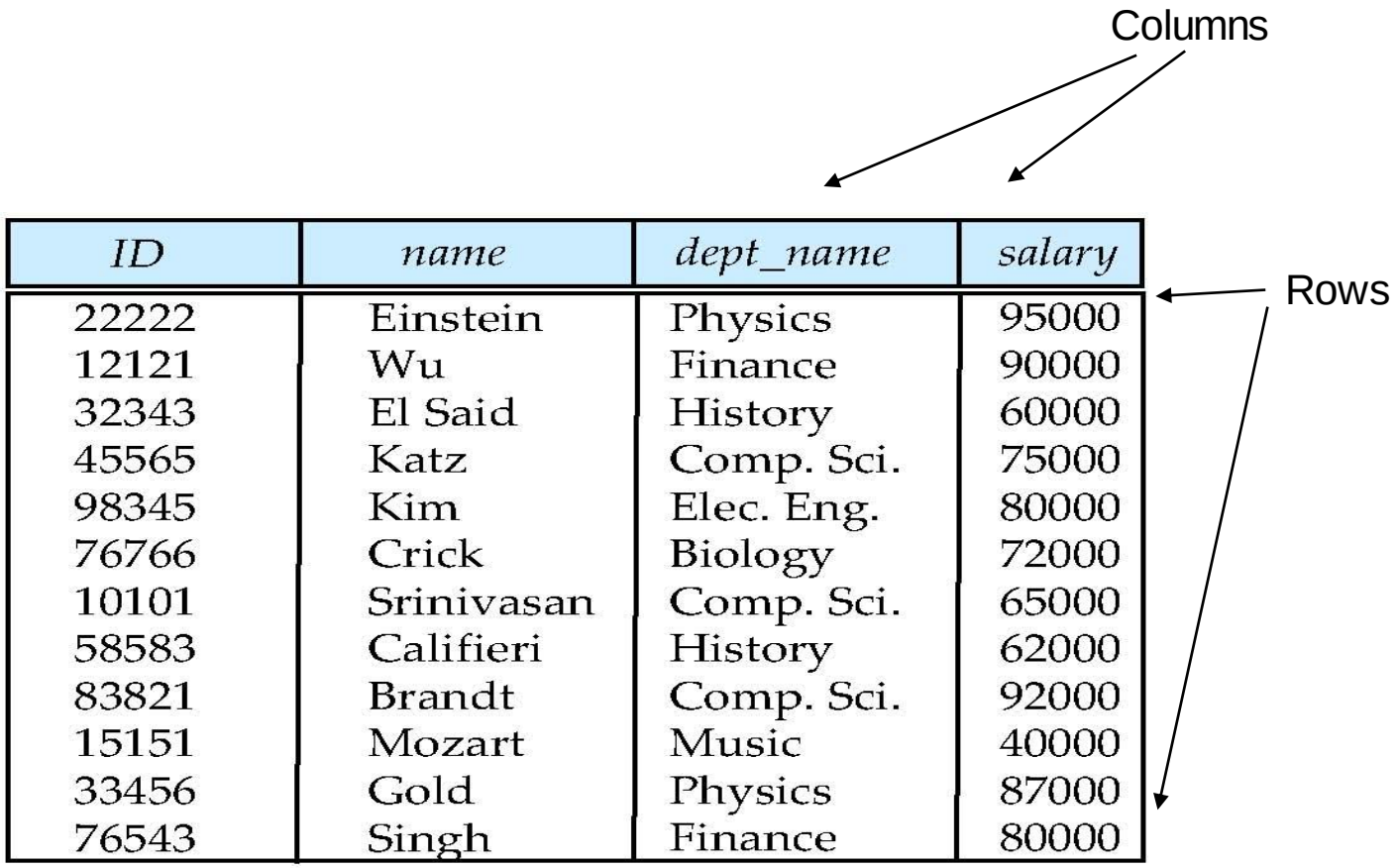
- DBMS contains information about a particular enterprise
  - Collection of interrelated data
  - Set of programs to access the data
  - An environment that is both *convenient* and *efficient* to use
- Database Applications:
  - Banking: transactions
  - Airlines: reservations, schedules
  - Universities: 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
- Databases can be very large.
- Databases touch all aspects of our lives

Data Models

- A Database model defines the **logical design** and structure of a database and defines how data will be stored, accessed and updated in a database management system.
- A collection of tools for describing
  - Data
  - Data relationships
  - Data semantics
  - Data constraints
- Relational model
- Entity-Relationship data model (mainly for database design)
- Hierarchical model
- Semi structured data model (XML)

Relational Model

- The basic structure of data in the relational model is tables. All the information related to a particular type is stored in rows of that table.
- Hence, tables are also known as **relations** in relational model.



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

(a) The *instructor* table

A Sample Relational Database

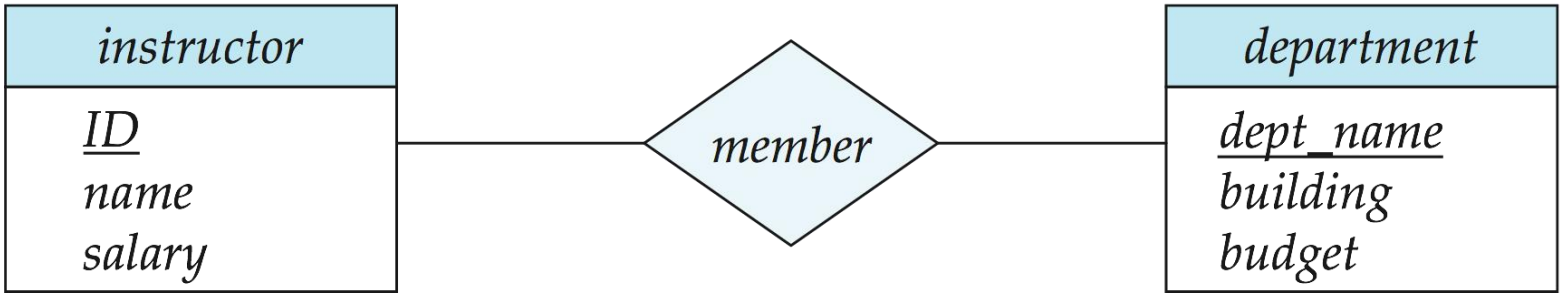
student_Id	name	age
1	Akon	17
2	Bkon	18
3	Ckon	17
4	Dkon	18

subject_Id	name	teacher
1	Java	Mr. J
2	C++	Miss C
3	C#	Mr. C Hash
4	Php	Mr. P H P

student_Id	subject_Id	marks
1	1	98
1	2	78
2	1	76
3	2	88

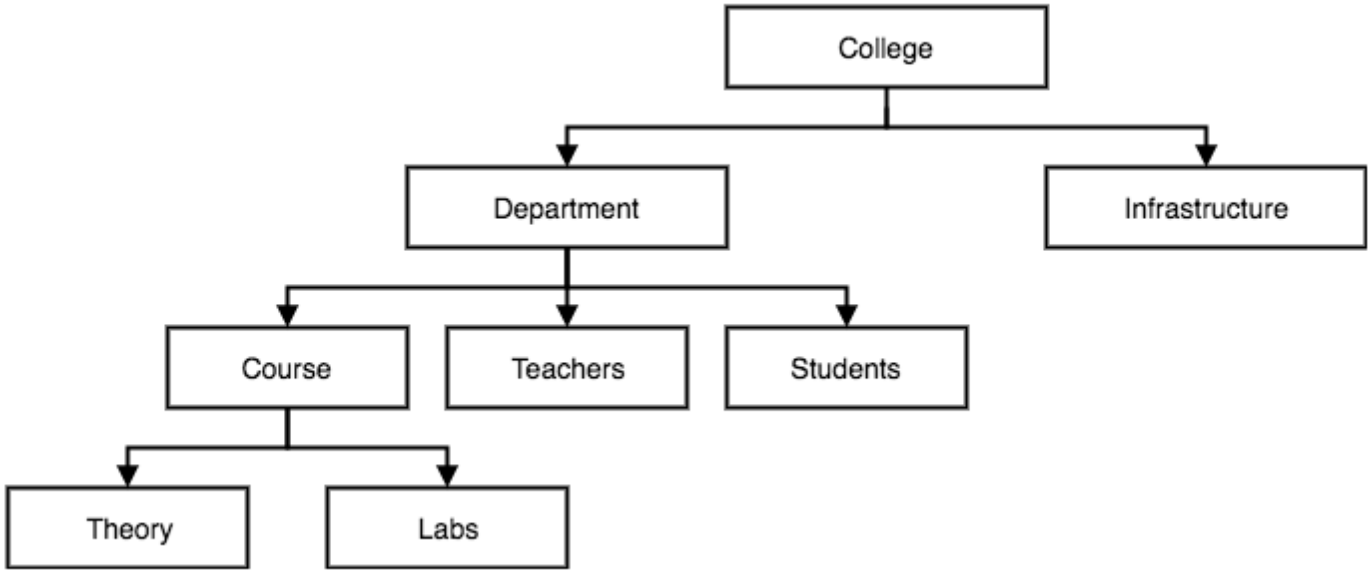
The Entity-Relationship Model

- In this database model, relationships are created by dividing object of interest into entity and its characteristics into attributes.
- Models an enterprise as a collection of *entities* and *relationships*
  - Entity: a “thing” or “object” in the enterprise that is distinguishable from other objects
    - Described by a set of *attributes*
  - Relationship: an association among several entities
- Represented diagrammatically by an *entity-relationship diagram:*

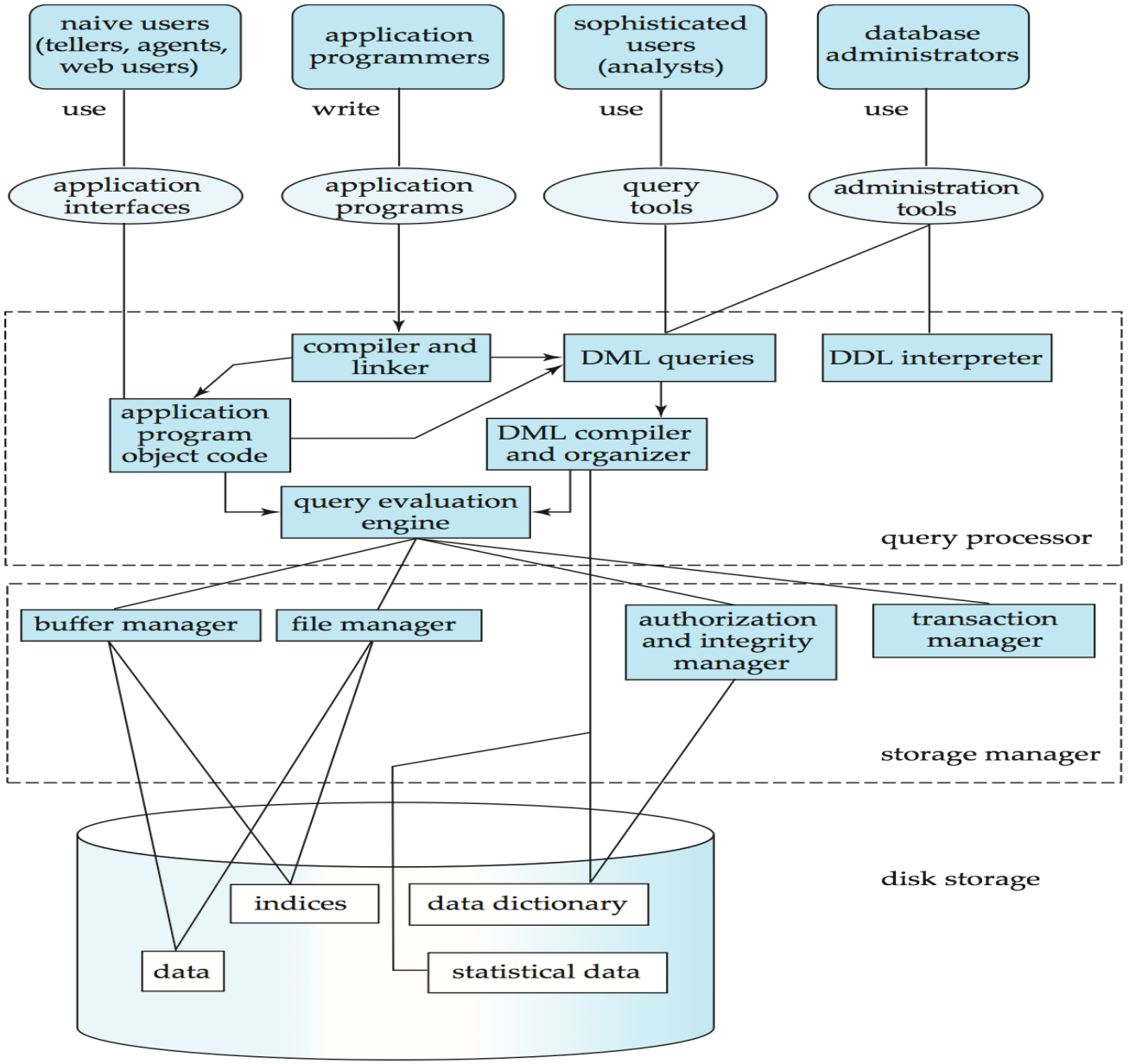


The Hierarchical Model

- This database model organizes data into a tree-like-structure, with a single root, to which all the other data is linked. The hierarchy starts from the **Root** data, and expands like a tree, adding child nodes to the parent nodes.
- This model efficiently describes many real-world relationships like index of a book, recipes etc.



Database System Structure



Database Architecture

- **Query Processor** translates statements in a query language into low-level instructions the database manager understands. (May also attempt to find an equivalent but more efficient form.) The Query Processor simplifies and facilitates access to data.
- **The DDL interpreter** interprets DDL statements and records the definition in the data dictionary.
- **The DML compiler** translates DML statements in a query language into an evaluation plan consisting of low-level instructions that the query evaluation engine understands.
- The DML compiler also performs **query optimization**, which is it picks the lowest cost evaluation plan from among the alternatives.
- **Query evaluation engine** executes low level instructions generated by the DML compiler.

Database Architecture

- In addition, several data structures are required for physical system implementation:
- **Data Files**: store the database itself.
- **Data Dictionary**: stores information about the structure of the database. It is used heavily. Great emphasis should be placed on developing a good design and efficient implementation of the dictionary.
- **Indices**: provide fast access to data items holding particular values.

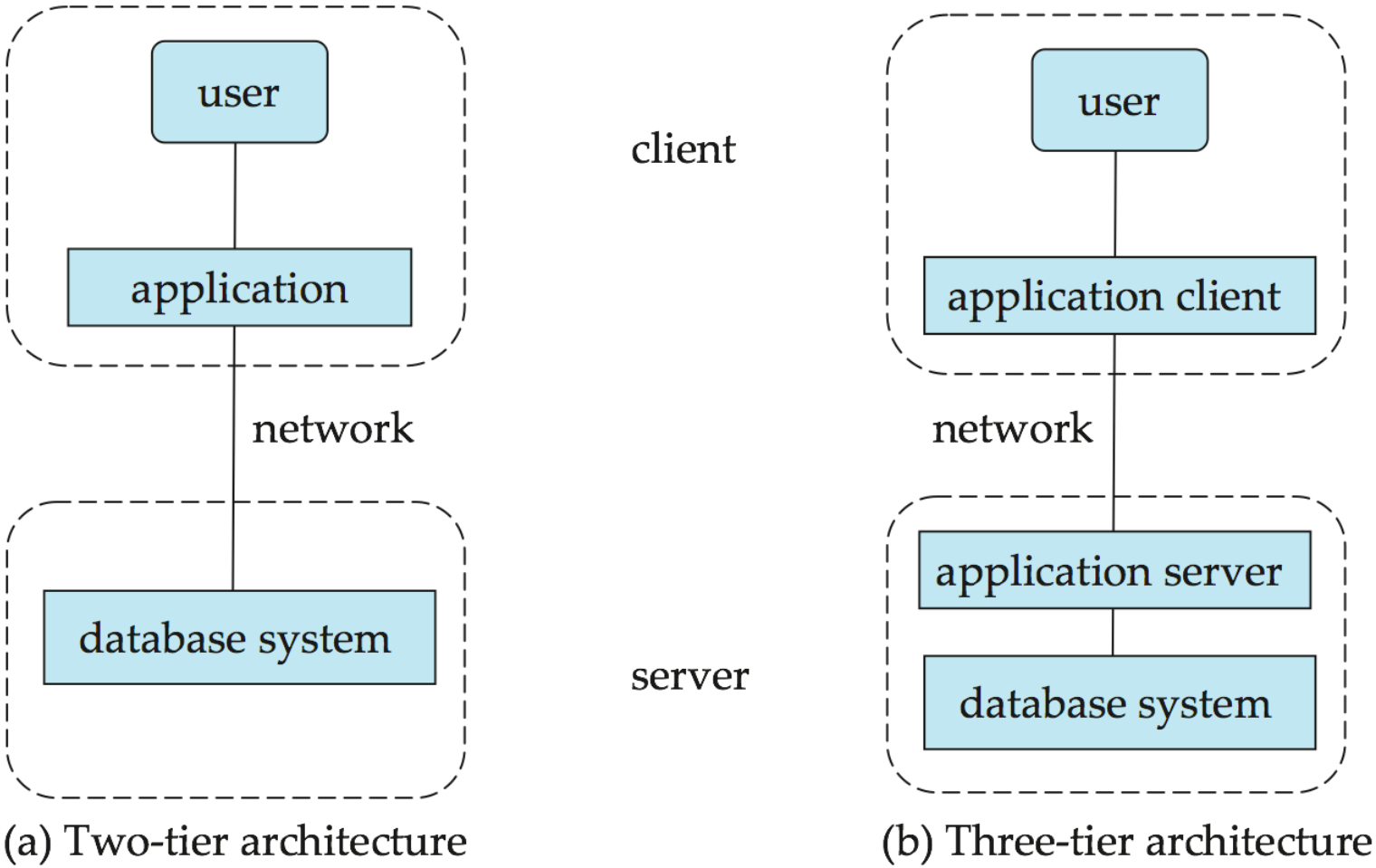
- **Storage Manager**
- The storage manager is important because database typically require a large amount of storage space. So it is very important efficient use of storage, and to minimize the movement of data to and from disk .

Database Architecture

The architecture of a database systems is greatly influenced by the underlying computer system on which the database is running:

- Client-server (1-tier, 2-tier, 3-tier)

Figure 1.06



(a) Two-tier architecture

(b) Three-tier architecture

End of Chapter 1