



Lecture 2:

Ch2. Database System **Concepts** and **Architecture** part1

Dr. Alaa eldin Abdallah Yassin

Outline*

- **Database Users**
- Data Models, Schemas, and Instances.
- Three-Schema Architecture and Data Independence
- Database Languages and Interfaces
- Introduction to SQL

Database Users



Database Users

Users may be divided into

1. Those who actually **use and control the database** content, and those who design, develop and maintain database applications (called “**Actors on the Scene**”).
2. Those who **work to maintain the database** system environment but who are not actively interested in the database itself (called “**Workers Behind the Scene**”).

Database Users ...

Administrator

Actors on the scene 😊

➡ Database administrators: DBA

❖ Responsible for :

- ❖ authorizing access to the database,
- ❖ for coordinating and monitoring its use,
- ❖ acquiring software and hardware resources as needed.
- ❖ security and poor response time and monitoring efficiency of operations.

Database Users ...

Designer

Actors on the scene 😊

➡ Database Designers:

❖ Responsible for:

- ❖ identifying data to be stored in database,
- ❖ the structure, the constraints, and functions or transactions against the database.
- ❖ They must communicate with the end-users and understand their needs.
- ❖ Develop different views.

Database Users ...

End users

Actors on the scene (continued) 😊

- ➡ **End-user's** people whose jobs require access to the database to for querying, updating and generating reports; the database is primarily existing for their use.
- ➡ There are several categories for end users.

Database Users ...

➡ System Analysts & App Programmers (software engineers):

- ❖ S.A determine the requirements of end users develop spec for canned transaction to meet these requirements.
- ❖ A.P implement these spec as program.
 - They test, debug, document and maintain these canned transaction.
- ❖ S.A and A.P commonly referred to as software developer or software engineers.

Database Users ...

Workers Behind the Scene

➡ DBMS system designer & implementers (ORACLE, SQL):

- ❖ Implementing the catalog, processing query language, processing the interface, buffering data, controlling concurrency, data recovery & security.

➡ Tool developer:

- ❖ Develop package for database modeling & design, database system design, improve performance.
- ❖ Tools are optional to purchase.

➡ Operator & maintenance personnel:

- ❖ Responsible for the actual running & maintenance of the h/w & s/w environment for the database.

Data Models

➡ Data Model:

➡ Data abstraction : remember (lec. 1)

❖ Data Model: “A **set of concepts** to **describe** the **structure*** of a database, and certain **constraints** that the database should obey “.

➡ Data Model basic Operations:

❖ Operations for specifying database **retrievals** and **updates** by referring to the concepts of the data model.

❖ Operations on the data model may include basic operations and **user-defined** operations.

Categories of data models*

► Conceptual (High-level, Semantic) data models*:

- ❖ Provide concepts that are close to the way many users perceive data. (Also called *entity-based* or *object-based* data models.)

► Physical (Low-level, internal) data models:

- ❖ Provide concepts that **describe details** of how data is stored in the computer (this category meant for computer specialists, not for end users).

► Implementation (representational) data models:

- ❖ Provide concepts that **fall between the above two**, balancing user views with some computer storage details.
- ❖ This category include the Widely used **relational data model**.

Schemas, Instances, and Database State

- **Database Schema:** The “*description*” of a database. Includes descriptions of the database structure and the constraints that should hold on the database.
 - ❖ **Schema Diagram:** A diagrammatic display of (some aspects of) a database schema.
 - ❖ **Schema Construct:** A component of the schema or an **object within the schema**, e.g., STUDENT, COURSE.
- **Database Instance:** The *actual data stored* in a database at a particular moment in time. Also called **database state** (or occurrence).

Schema Diagram*

STUDENT

Name	Student_number	Class	Major
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COURSE

Course_name	Course_number	Credit_hours	Department
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PREREQUISITE

Course_number	Prerequisite_number
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SECTION

Section_identifier	Course_number	Semester	Year	Instructor
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GRADE_REPORT

Student_number	Section_identifier	Grade
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Database State 😊

- ➡ **Database State**: Refers to the **content** of a database **at a moment in time**.
- ➡ **Initial Database State**: Refers to the database when it is loaded.
- ➡ **Valid State**: A state that satisfies the structure and constraints of the database.
- ➡ **Distinction**
 - ❖ The database **schema** *changes very infrequently* (rarely).
 - ❖ The database **state** *changes every time the database is updated*.
 - ❖ **Schema** is also called **intension***, whereas **state** is called **extension**

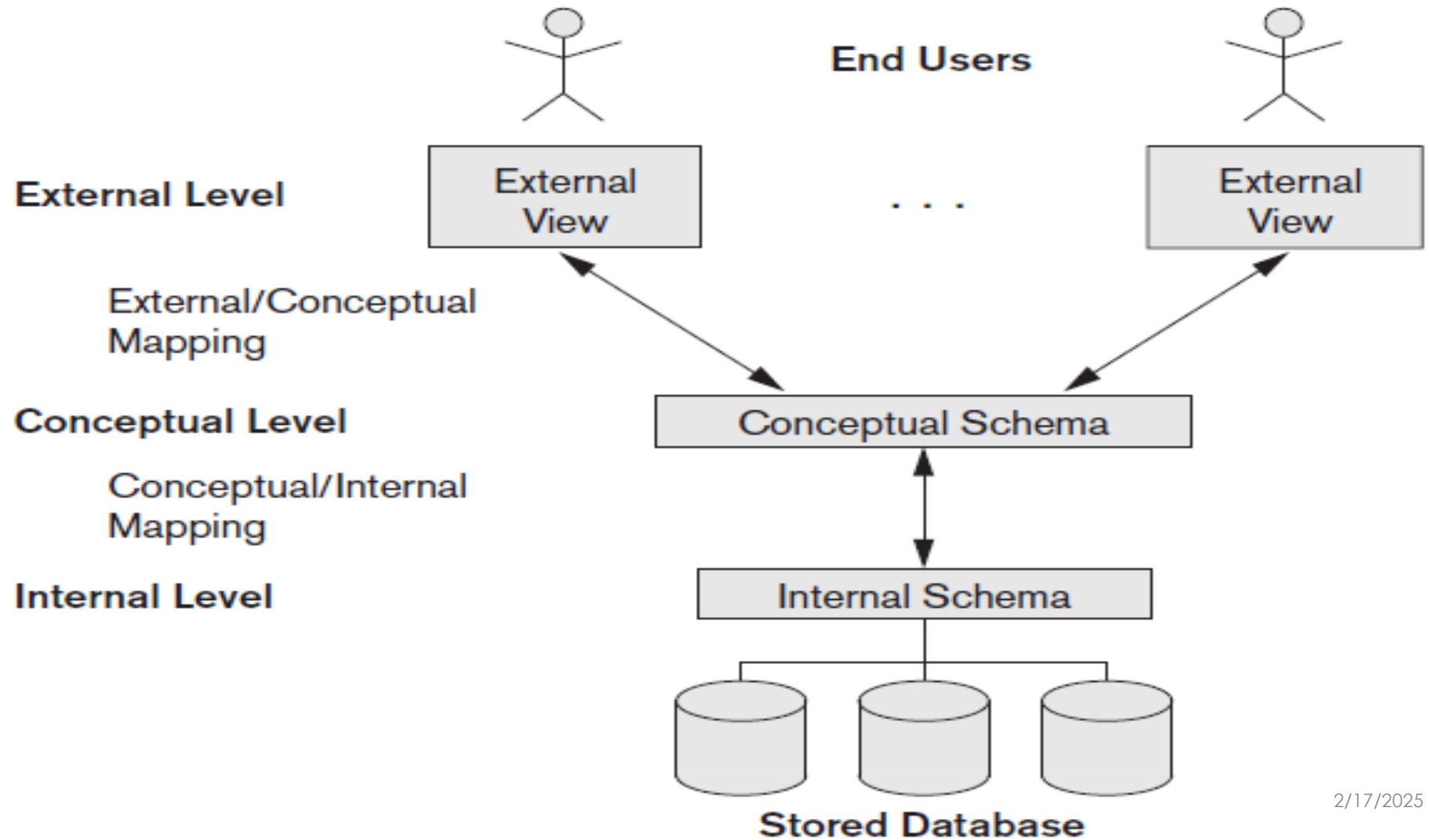
Three-Schema Architecture

- The **goal** of the three-schema architecture, is “to separate the user applications from the physical database”*.
- So, its Proposed to **support DBMS** characteristics of:
 - ❖ Program-data **independence**.
 - ❖ Support of **multiple views** of the data.

DBMS schemas at three levels ☺

- **Internal schema:** at the internal level
 - ❖ to describe **physical storage** structures and **access paths**.
 - ❖ Typically uses a physical data model.
- **Conceptual schema** at the conceptual level:
 - ❖ to describe the **structure and constraints for the whole database** for a community of users.
 - ❖ Its hide details of physical storage.
 - ❖ Uses a conceptual or representational data model.
- **External schemas** at the external level (view level):
 - ❖ to describe the **various user views**.

Three-Schema Architecture ☺



Data Independence

- The three-schema architecture can be used to further explain the concept of **data independence**, which can be defined as “*the capacity to change the schema at one level of a database system without having to change the schema at the next higher level*”.

We can define two types of data independence:

- ❖ **Logical Data Independence**: The capacity to **change the conceptual schema** without having to change the external schemas and their application programs*.
- ❖ **Physical Data Independence**: The capacity to **change the internal schema** without having to change the conceptual schema.

DBMS Languages ☺

➡ Data Definition Language (**DDL**):

- ❖ Used by the DBA and database designers to specify the conceptual schema of a database.
- ❖ In many DBMSs, the DDL is also used to define internal and external schemas (views).

➡ Storage definition language (**SDL**):

- ❖ used to define internal schemas

➡ View definition language (**VDL**):

- ❖ used to define external schemas(user view)/ and mappings to conceptual schema.

➡ Data Manipulation Language (**DML**):

- ❖ Used to specify database retrievals and updates (insertion, deletion , modification)

DBMS Interfaces

User-friendly interfaces provided by a DBMS may include the following:

- **Menu-based**, popular for browsing on the web
- **Forms-based**, designed for naïve users
- **Graphics-based** (Point and Click, Drag and Drop etc.)
- **Natural language**: requests in written English or some other lang.
- **Combinations** of the above.
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SQL

What is SQL?

- SQL stands for Structured Query Language.
- SQL lets you **access** and **manipulate** databases.
- SQL became a **standard** of the American National Standards Institute (**ANSI**) in 1986, and of the International Organization for Standardization (**ISO**) in 1987.

What Can SQL do?

- SQL can **execute** queries against a database.
- SQL can **retrieve** data from a database.
- SQL can **insert** records in a database.
- SQL can **update** records in a database.
- SQL can **delete** records from a database.
- SQL can **create** new **databases**.
- SQL can **create** new **tables** in a database.
- SQL can **create** stored **procedures** in a database.
- SQL can **create** **views** in a database.
- SQL can set **permissions** on tables, procedures, and views.

Is SQL Standard ?

- SQL is a Standard - BUT....
- Although SQL is an ANSI/ISO standard, there are different versions of the SQL language.
- However, to be compliant with the ANSI standard, they all support at least the major commands (such as SELECT, UPDATE, DELETE, INSERT, WHERE) in a similar manner.

Using SQL in Your Web Site

- To build a web site that shows data from a database, you will need:
- An RDBMS database program (i.e., MS Access, SQL Server, MySQL):
 - To use a server-side scripting language, like PHP or ASP.
 - To use SQL to get the data you want.
 - To use HTML / CSS to style the page.
- What is RDBMS?
 - RDBMS stands for Relational Database Management System.
 - RDBMS is the basis for SQL, and for all modern database systems such as MS SQL Server, IBM DB2, Oracle, MySQL, and Microsoft Access.
 - The data in RDBMS is stored in database objects called tables.
 - A table is a collection of related data entries, and it consists of columns and rows.

Database Tables

- A database most often contains one or more tables.
- Each table is identified by a name (e.g., "Customers" or "Orders").
- Tables contain records (rows) with data.

CustomerID	CustomerName	ContactName	Address	City	PostalCode	Country
1	Alfreds Futterkiste	Maria Anders	Obere Str. 57	Berlin	12209	Germany
2	Ana Trujillo Emparedados y helados	Ana Trujillo	Avda. de la Constitución 2222	México D.F.	05021	Mexico
3	Antonio Moreno Taquería	Antonio Moreno	Mataderos 2312	México D.F.	05023	Mexico
4	Around the Horn	Thomas Hardy	120 Hanover Sq.	London	WA1 1DP	UK
5	Berglunds snabbköp	Christina Berglund	Berguvsvägen 8	Luleå	S-958 22	Sweden

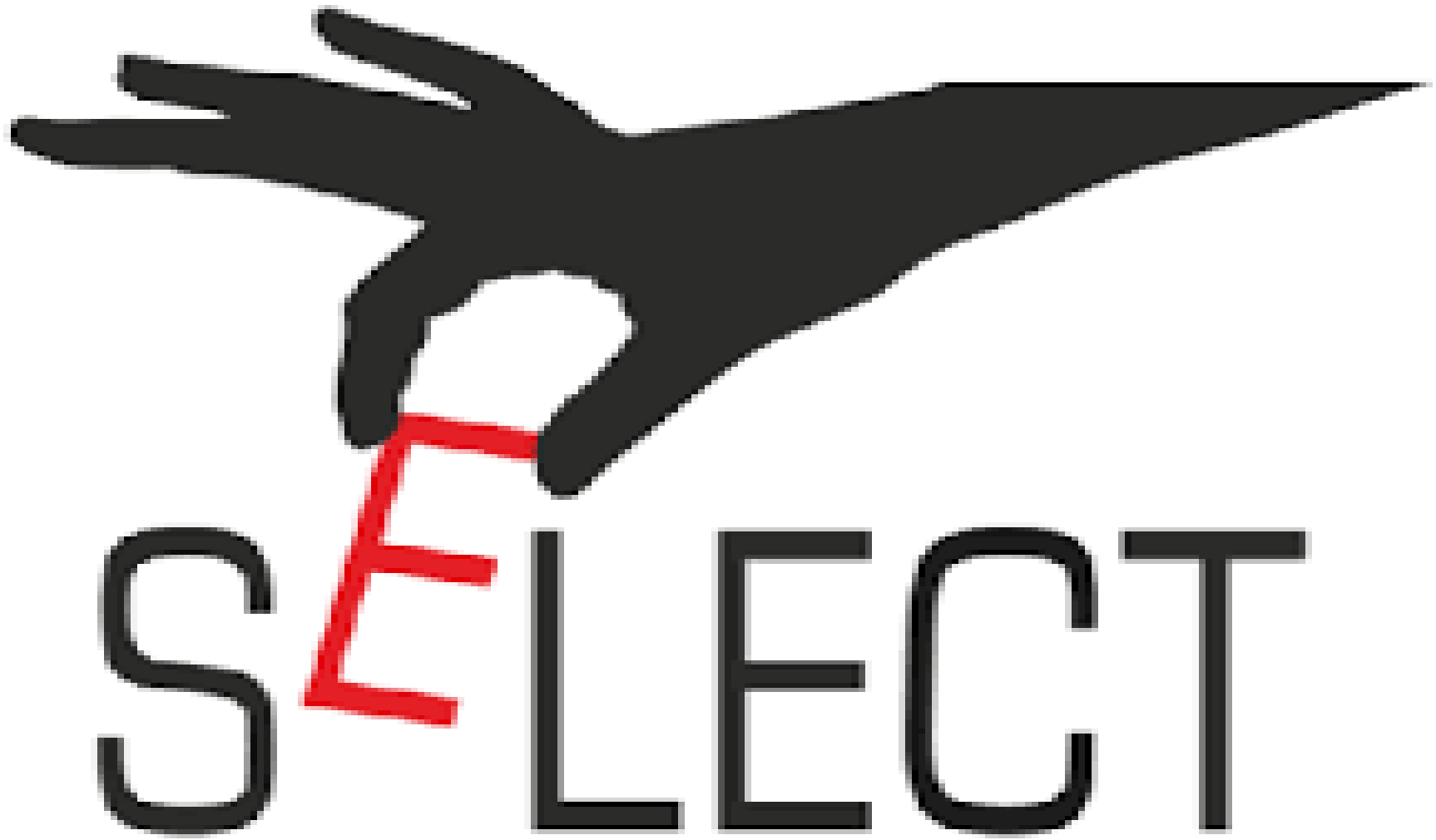
- The table above contains **five records** (one for each customer) and **seven columns** (CustomerID, CustomerName, ContactName, Address, City, PostalCode, and Country).

SQL Statements

- Most of the actions you need to perform on a database are done with SQL statements.
- The following SQL statement selects all the records in the "Customers" table:
- `SELECT * FROM Customers;`
- Now, we will teach you all about the different **SQL statements**.
- Keep in Mind That...
 - SQL keywords are **NOT** case sensitive: select is the same as SELECT
- Semicolon after SQL Statements?
 - **Some** database systems require a semicolon **at the end** of each SQL statement.
 - Semicolon is the standard way to separate each SQL statement in database systems that **allow more than one SQL statement to be executed in the same call to the server.**

The Most Important SQL Commands

- **SELECT** - extracts data from a database
- **UPDATE** - updates data in a database
- **DELETE** - deletes data from a database
- **INSERT INTO** - inserts new data into a database
- **CREATE DATABASE** - creates a new database
- **ALTER DATABASE** - modifies a database
- **CREATE TABLE** - creates a new table
- **ALTER TABLE** - modifies a table
- **DROP TABLE** - deletes a table
- **CREATE INDEX** - creates an index (search key)
- **DROP INDEX** - deletes an index



SQL **SELECT** Statement

- The **SELECT** statement is used to select data from a database.
- The data returned is stored in a result table, called the result-set.
- **SELECT Syntax :**
 - **SELECT** column1, column2, ...
 - **FROM** table_name;
 - Here, column1, column2, ... are the **field names** of the table you want to select data from.
 - If you want to select all the fields available in the table, use the following syntax:
 - **SELECT * FROM** table_name;

SQL **SELECT** Statement...

example:

- **Ex1:** write the select statement which select the **Customer Name** and its **City** from the "Customers" table

➤ **SELECT** CustomerName, City **FROM** Customers;

CustomerID	CustomerName	ContactName	Address	City	PostalCode	Country
1	Alfreds Futterkiste	Maria Anders	Obere Str. 57	Berlin	12209	Germany
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- **Ex2:** write the select statement which select **all data about Customer** stored in "Customers" table

➤ **SELECT** * **FROM** Customers;

