Ministry of Higher Education
Karwan University
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Database I

Lecture 2: Database Architecture

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Lectures & other related materials are available here: https://github.com/mujtabaSultani01/Database-I

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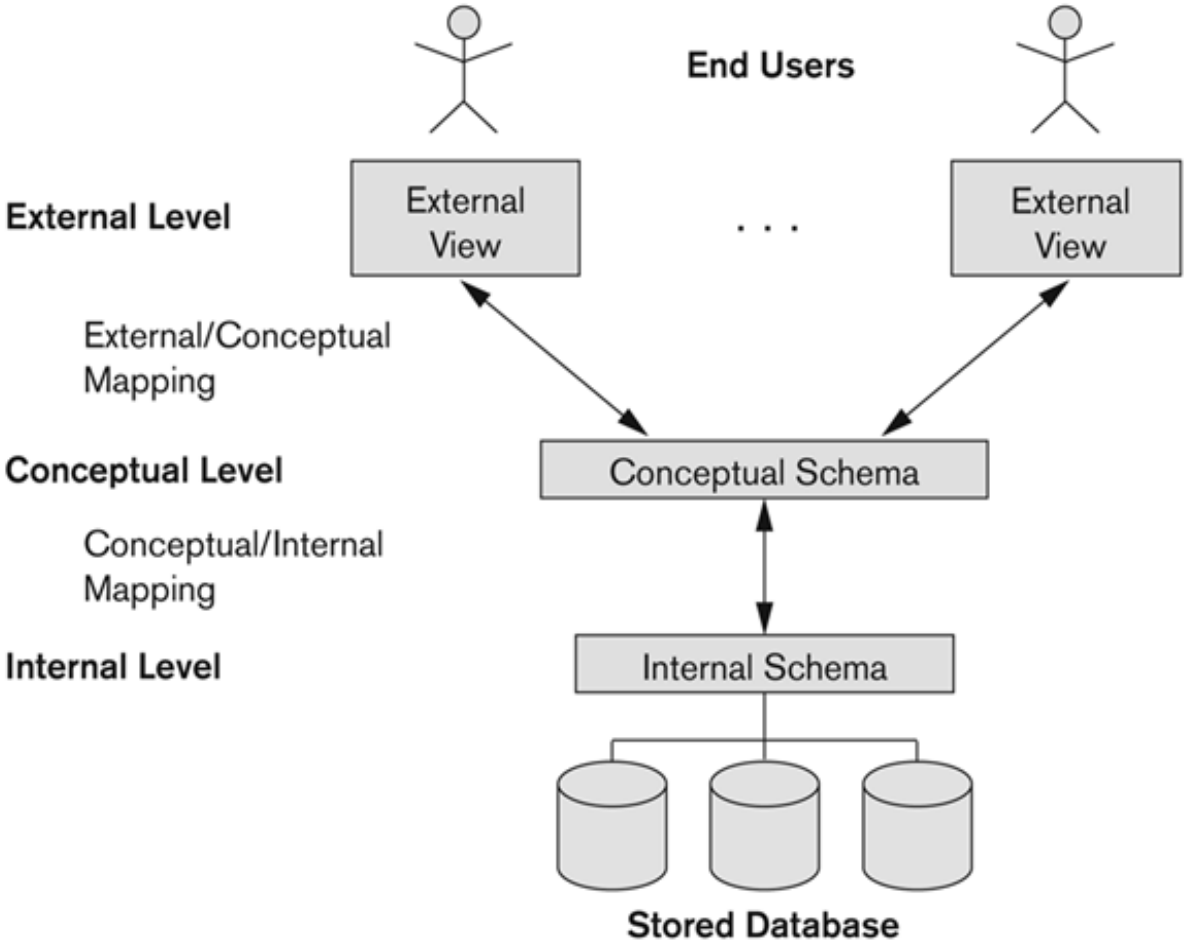
Three-Level/The ANSI-SPARC Architecture

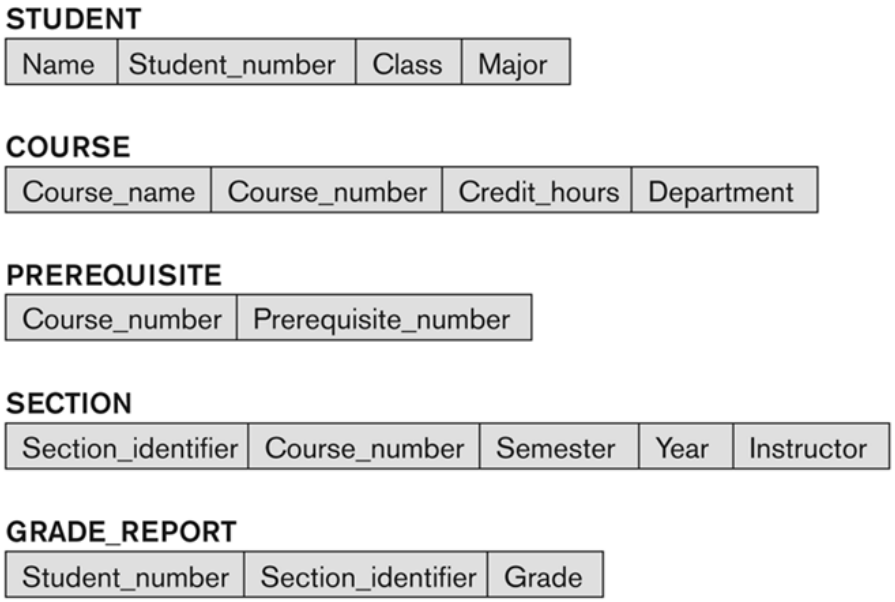
- **External level (Schema, Model)**
  - The users' view of the database.
  - That part of the database that is relevant to each user.
- **Conceptual Level (Schema, Model)**
  - The community view of the database.
  - Describes the logical structure and constraints for the whole database.
- **Internal Level (Schema, Model)**
  - The physical representation of the database on the computer.
  - How the data is stored in the database?

Three-Level Architecture



Database Schema

- The description of the database (Structure, Data Types, Constraints).
- The permanent structure of the database.
- **Schema Diagram:** Descriptive display of database.



Mapping

- **Conceptual/internal mapping**:
  - The DBMS finds the actual records in physical storage by using the logical record in the conceptual schema
  - Using constraints for that logical record.

- **External/conceptual mapping**:
  - The DBMS is mapping names in the user's view on to the relevant part of the conceptual schema.

Data Independence

- **Logical Data Independence:**
  - To change the conceptual schema without having to change the external schemas and their associated application programs.

- **Physical Data Independence:**
  - To change the internal schema without having to change the conceptual schema.

Data Model

- Collection of concepts for describing the structure of a database and the operations for manipulating these structures.
  - **Structure:** Elements & Relationships
  - **Manipulation:** the operations such as retrievals and updates
  - **Constraints:** Restrictions/control on the data.

Data Model

- **Types of Data Models:**

  Object Based: The concepts of Entities, Attributes and relationships. (OODB)

  Record Based: Describes the external and conceptual levels of database.

  - Hierarchical Model
  - Network Model
  - Relational Model

  Physical: The details how data is stored in the computer.

Database Languages

- **Data Definition Language (DDL)**
  - Used by the DBA and database designers to specify conceptual schema of a database.
- **Data Manipulation Language (DML)**
  - Used to specify database retrievals and updates
  - Performs a set of operations on the data.
  - DML commands can be embedded in a general-purpose programming language such as C, C++, Java or C#.
  - The data retrieval commands are also called Query Language.

DML Types

- **Procedural DML**
  - To specify what data is needed and how to retrieve it.
  - The user creates the constructs and procedures by using different algorithms and data structures.
  - Embedded in a high level language/third generation languages.
  - Network & Hierarchical DMLs are procedural.
- **Non-Procedural DML**
  - Also called high-level or declarative language.
  - The user only specifies what data is needed instead of how to retrieve.
  - Using SQL relational language or 4th generation language.

Database Users

- **Data Designers**
  - Define the content, the structure, the constraints and functions or transactions of the database.
  - Communicate with the end-users and understand their needs.
- **Database Administrator (DBA)**
  - Responsible for the:
    - Physical database design and implementation,
    - Authorizing access to the database,
    - Coordinating and monitoring its use,
    - Security and integrity control,
    - Maintenance of the system …

Database Users

- **End users**
  - The end users access the database for querying, updating and generating reports.
- **Categories of end users**
  - **Naïve or Parametric users:**
    - They have no technical knowledge of DBMS. They access the database through specially written application programs that attempt to make the operations as simple as possible.
  - **Sophisticated users**:
    - These type of end users are familiar with the structure of the database.
    - They can use a query language to perform the required operations.

Database Users

- **System Analyst**
  - Determines the requirements of end users and develop specifications for the standard system.
- **Application Developers/Programmers**
  - Implementing the specifications by system analyst as programs, then they test, debug, document and maintain the system.
- **Note:**
  - The analysts and programmers referred to as Software Developers or Software Engineers who can both analyze the system and develop the programs.

DBMS Interfaces

- **High-level Query Language Interface**
  - Sophisticated users use this interface.
- **Programmer Interface**
  - Embedding DML in programming languages such as C, C++ or Java.
- **User-Friendly Interface**
  - **Menu-Based Interfaces:** For Web Browsing
  - **Forms-Based Interfaces:** Filling the forms to insert or to retrieve data.
  - **Graphical User Interfaces:** Both Menu & Form based interfaces
  - **Natural Language Interfaces:** Accept and realize the natural language commands for retrieving data.
  - **Interface for DBA:** For management purposes.

References

- Modern Database Management 10th Edition.

Questions…?