

# Introduction to Databases

CE3101 - Databases



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- This presentation was prepared with the guide material used by the professor during classes. It has been modified to be used as a summary for students. It is not a final version, so it may still require some adjustments. For evaluation aspects, this presentation is only a guide, so the student should delve with the assigned reading material and what has been discussed in class.
- Esta presentación fue elaborada con el material de guía usado por el profesor durante las clases. El mismo ha sido modificado para ser utilizado como resumen para los estudiantes. No es una versión final, por lo que la misma podría requerir todavía hacer algunos ajustes. Para aspectos de evaluación esta presentación es solo una guía, por lo que el estudiante debe profundizar con el material de lectura asignado y lo discutido en clases para aspectos de evaluación.

## Pregunta inicial

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¿Saben cómo se hace el café más caro del mundo?

# Concepts

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→ Database refers to a set of related data and the way it is organized.



**Random ordering?**

# Concepts

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**Random ordering?**

**Random  
structure?**

# Concepts

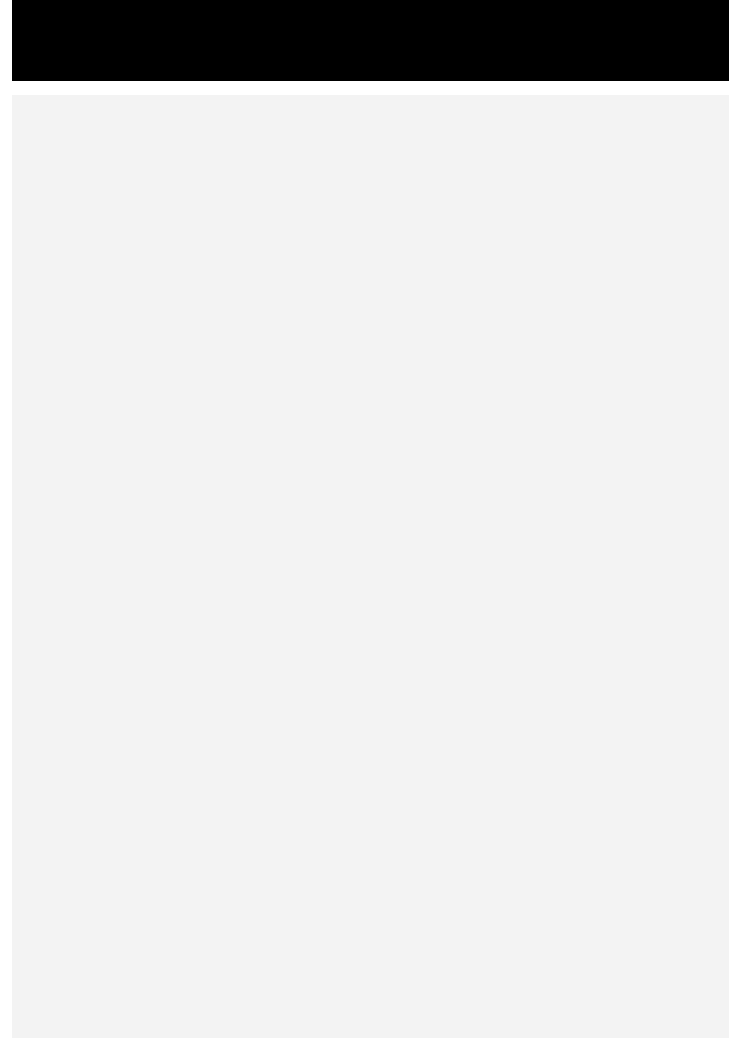
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- Database refers to a set of related data and the way it is organized.
- Access to these data is usually provided by a "database management system" (DBMS) consisting of an integrated set of computer software that allows users to interact with one or more databases and provides access to all of the data contained in the database. **Examples?**

# Concepts

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→ The database systems are an essential component of life in modern society: most of us encounter several activities every day that involve some interaction with a database.



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## EXAMPLES



Bank to deposit or withdraw funds.



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Purchase something online.

# Concepts

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- The database systems are an essential component of life in modern society: most of us encounter several activities every day that involve some interaction with a database.
- All these activities involve someone or some computer program accessing database.

## EXAMPLES



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# Concepts

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- A database represents some aspect of the real world, sometimes called the **miniworld** or the **universe of discourse (UoD)**. Changes to the miniworld are reflected in the database.
- A database is a logically coherent collection of data with some inherent meaning. A random assortment of data cannot correctly be referred to as a database.
- A database is designed, built, and populated with data for a specific purpose. It has an intended group of users and some preconceived applications in which these users are interested.

# Concepts

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- DBMS (Database Management System) refers to a set of computer software that allows user to interact with databases and provide access to all of the data contained in the database. **Examples?**
- Miniworld or Universe of Discourse (UoD) refers to aspects of real world that are represented by a database.

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**SABD in spanish**

# Concepts

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**BEFORE**



**AFTER**





# Concepts

## Complex & Size

BEFORE



AFTER

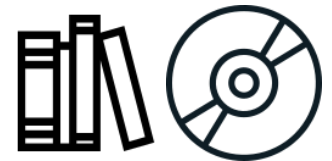


# Concepts

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## → Amazon

- ◆ It contains data for over 20 million books, CDs, videos, DVDs, games, electronics, apparel and other items.



- ◆ The database occupies over 2 terabytes (a terabyte is  $10^{12}$  bytes worth of storage) and is stored on 200 different computers (called servers).



- ◆ About 15 million visitors access Amazon.com each day and use the database to make purchases.



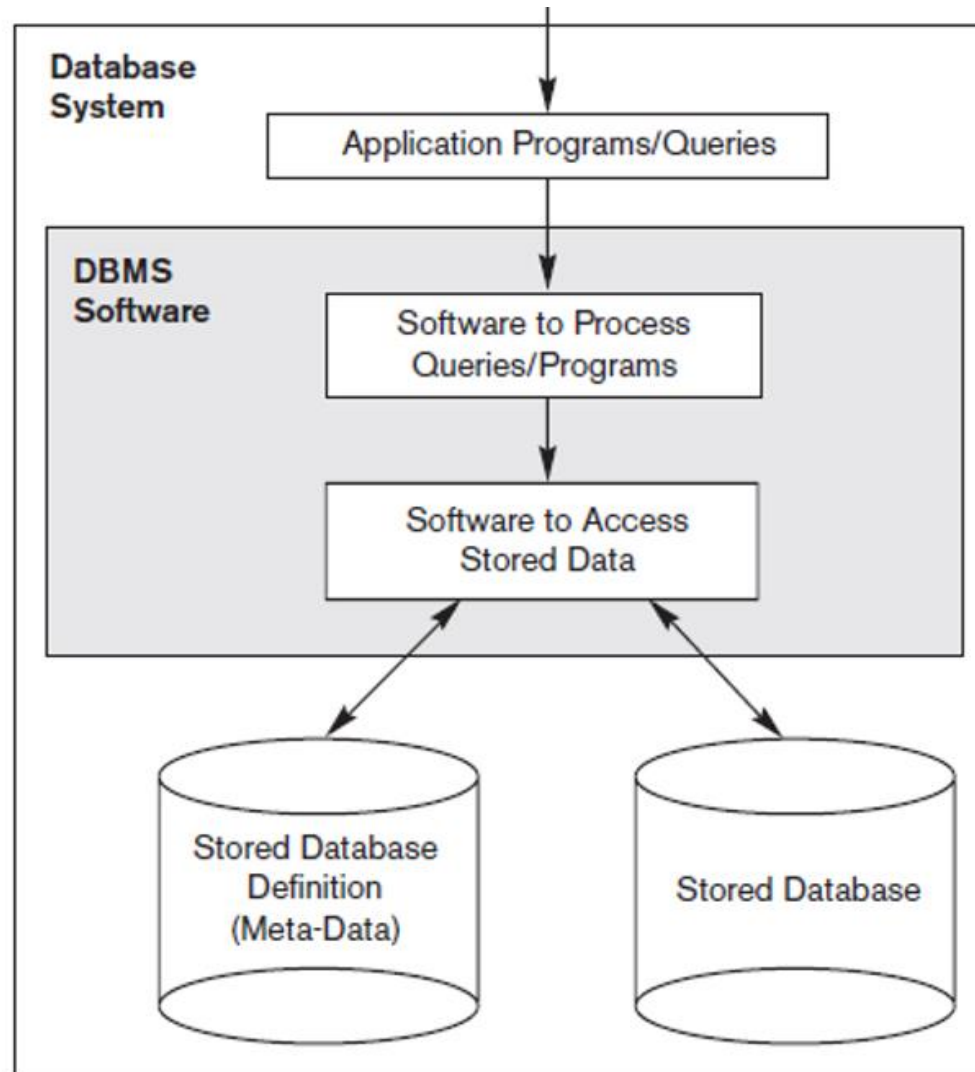
# Concepts

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- A database management system (DBMS – SABD)
  - ◆ Is a collection of programs that enables users to create and maintain a database.
  - ◆ The DBMS is a general-purpose software system that facilitates the processes of **defining, constructing, manipulating**, and **sharing databases** among various users and applications.

# Concepts

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# Concepts

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## General Concepts

K	H	C	R	P	I	K	Q	W	F	Z
M	G	W	M	J	M	E	V	N	W	W
Q	I	E	S	V	W	I	U	G	P	E
T	R	G	A	J	G	E	P	S	N	Y
G	K	Q	B	O	Z	P	P	T	D	P
M	Y	V	D	A	S	U	Q	U	B	J
M	I	N	I	W	O	R	L	D	M	A
G	H	K	I	T	G	M	O	W	S	K
U	D	D	A	T	A	B	A	S	E	C
U	J	R	S	S	N	U	U	P	N	J
J	P	P	O	V	L	J	G	G	V	Q

# Concepts

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## General Concepts

K	H	C	R	P	I	K	Q	W	F	Z
M	G	W	M	J	M	E	V	N	W	W
Q	I	E	<u>S</u>	V	W	I	U	G	P	E
T	R	G	<u>A</u>	J	G	E	P	S	N	Y
G	K	Q	<u>B</u>	O	Z	P	P	T	<u>D</u>	P
M	Y	V	<u>D</u>	A	S	U	Q	U	<u>B</u>	J
<u>M</u>	<u>I</u>	<u>N</u>	<u>I</u>	<u>W</u>	<u>O</u>	<u>R</u>	<u>L</u>	<u>D</u>	<u>M</u>	A
G	H	K	I	T	G	M	O	W	<u>S</u>	K
U	D	<u>D</u>	<u>A</u>	<u>T</u>	<u>A</u>	<u>B</u>	<u>A</u>	<u>S</u>	<u>E</u>	C
U	J	R	S	S	N	U	U	P	N	J
J	P	P	O	V	L	J	G	G	V	Q

# Characteristics of the Database Approach

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- Self-Describing Nature of a Database System (Meta-Data)
  - ◆ The database system contains not only the database itself but also a complete definition or description of the database structure and constraints.
- Insulation between Programs and Data, and Data Abstraction
- Support of Multiple Views of the Data
- Sharing of Data and Multiuser Transaction Processing

# Actors

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## **DATABASE ADMINISTRATOR (DBA)**

- Primary resource: the database itself.
- Secondary resource is the DBMS and related software.
- Administering these resources is the responsibility of the database administrator (DBA).
- Responsible for authorizing access to the database, coordinating and monitoring its use, and acquiring software and hardware resources as needed



# Actors

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**In large organizations, the DBA is assisted by a staff that carries out these functions.**

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## DATABASE DESIGNERS

- Are responsible for identifying the data to be stored in the database and for choosing appropriate structures to represent and store this data.

# Actors

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## END USERS

- End users are the people whose jobs require access to the database for querying, updating and generating reports.
- The database primarily exists for this use.

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## CASUAL END USERS

- Occasionally access the database, but they may need different information each time.

## PARAMETRIC END USERS

- Their main job function revolves around constantly querying and updating the database, using standard types of queries and updates that have been carefully programmed and tested.

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## SOPHISTICATED END USERS

- Include engineers, scientists, business analysts.
- Familiarize themselves with the facilities of the DBMS in order to implement their own applications to meet their complex requirements.

# Respuesta a la pregunta inicial

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El café más caro del mundo, el kopi luwak o **café de civeta**, no tiene un origen agradable. Explicado con claridad, se obtiene de granos que, tras ser ingeridos por una civeta, pasan por su tracto intestinal y son expulsados entre sus heces. 10 nov. 2015

# Actors

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## STANDALONE USERS

- Maintain personal databases by using ready-made program packages that provide easy-to-use menu-based or graphics-based interfaces. An example is the user of a tax package that stores a variety of personal financial data for tax purposes.



# Advantages of using the DBMS Approach

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- Controlling redundancy.
- Restricting unauthorized access.
- Providing storage structures and search technique for efficient query processing.
- Providing backup and recovery.

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- Providing storage structures and search technique for efficient query processing.
- Providing backup and recovery.

- Enforcing integrity constraints.
- Providing multiple user interfaces.
- Providing persistent storage for program objects.

# Data Models, Schemas and Instances

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## Data Abstraction

- Refers to the suppression of details of data organization and storage, and the highlighting of the essential features for an improved understanding of data.

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## Data Model

- Collection of concepts that can be used to describe the structure of a database.
- Provides the necessary means to achieve this abstraction.

# Data Models, Schemas and Instances

## (Categories of Data Models)

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- **High-level (Conceptual)**. Provide concepts that are close to the way many users perceive data.
- **Low-level (Physical)**. Provide concepts that describe the details of how data is stored on the computer storage media.
- **Representational**. Which provide concepts that may be easily understood by end users but that are not too far removed from the way data is organized in computer storage.

# Data Models, Schemas and Instances

## High-level Data Models

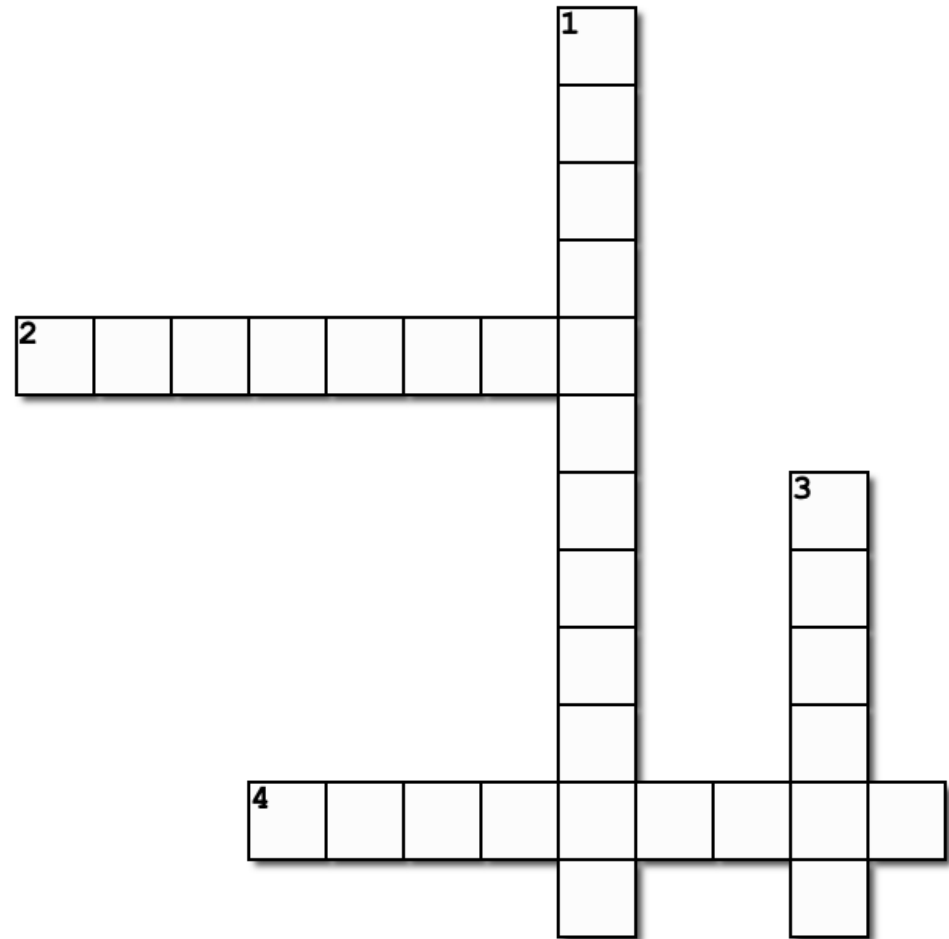
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### Vertical

1. Represents an association among the entities.
3. Represents a real-world object or concept.

### Horizontal

2. The data in the database at a particular moment.
4. Represents some property of interest that further describes an entity.



# Data Models, Schemas and Instances

## High-level Data Models

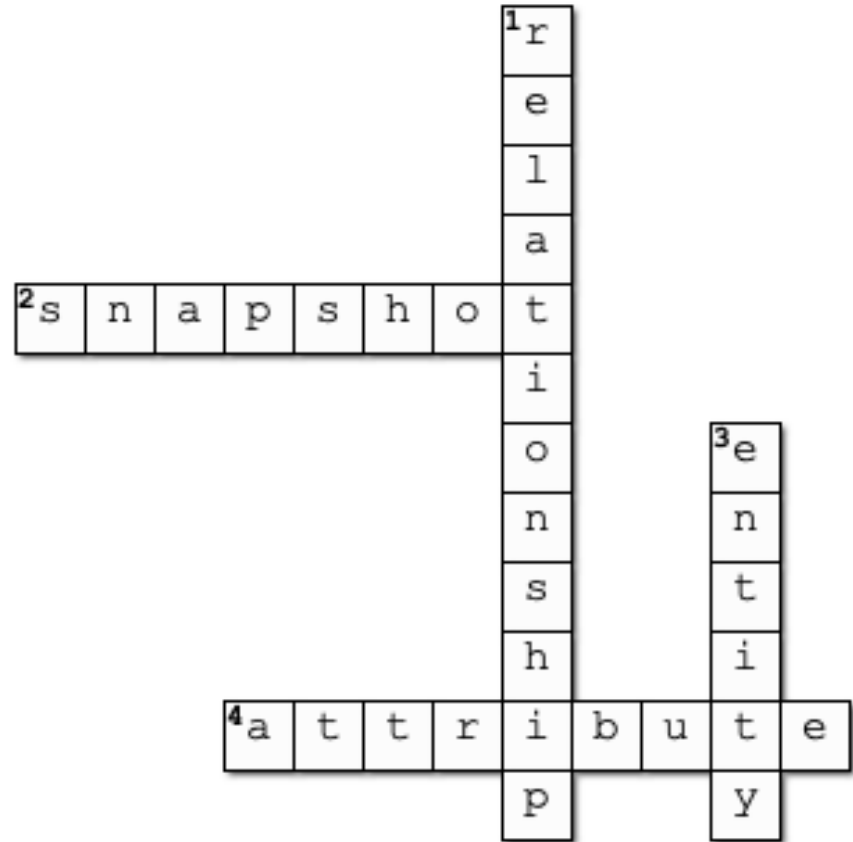
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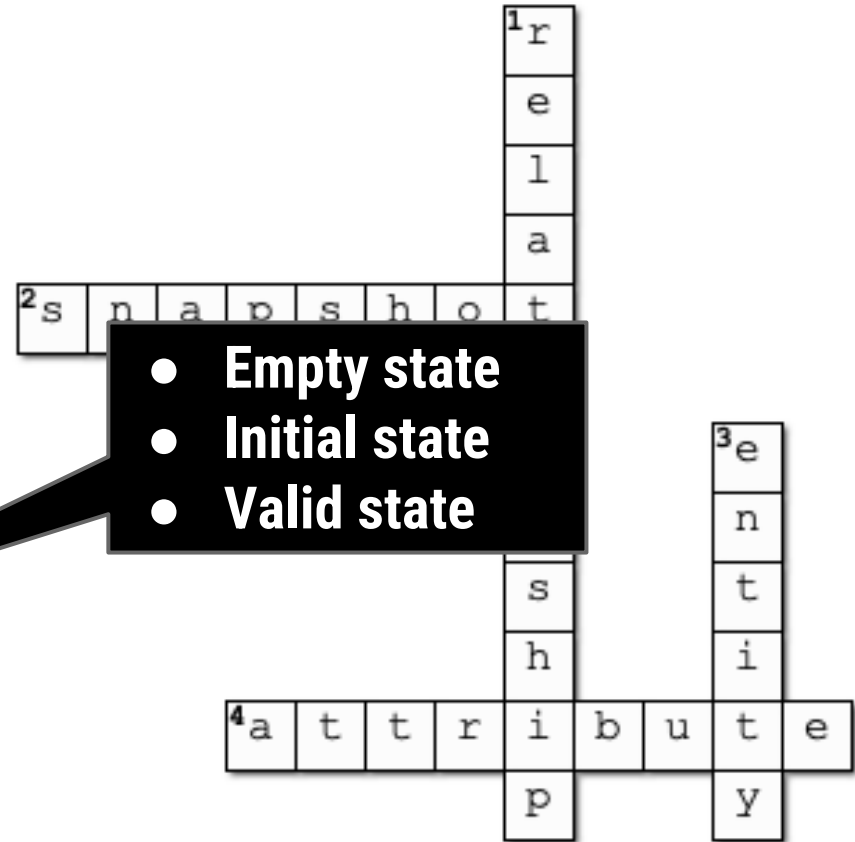
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# Data Models, Schemas and Instances

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- **Database Schema.** Is the description of the database. Which is specified during database design and is not expected to change frequently.
- **Schema Diagram.** A displayed schema. Displays only some aspects of a schema, such as the name of record type and data items, and some types of constraints.



# Data Models, Schemas and Instances

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## → 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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# Schemas, Instances and Database State

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## → Database state or snapshot

- ◆ The data in the database at a particular moment.
  - **Empty state:** its database schema only.
  - **Initial state:** when the database is first populated or loaded with the initial data.
  - **Valid state:** is a state that satisfies the structure and constraints specified in the schema.

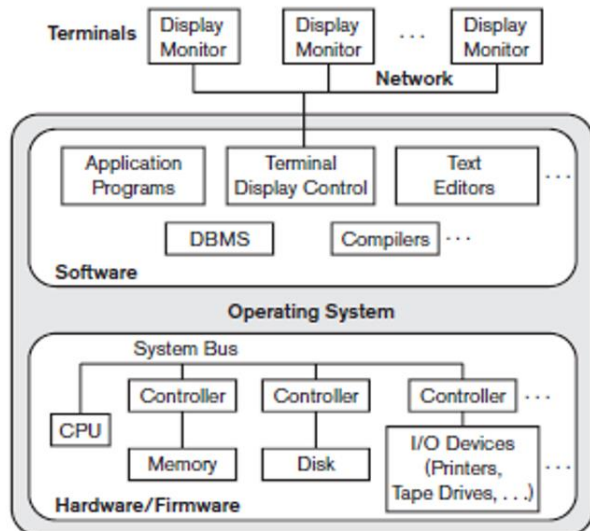
# Data Models, Schemas and Instances

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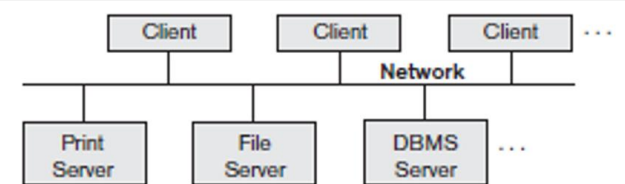
- **DDL (Data Definition Language)**. Used by DBA and designers to define both schemas.
- **SDL (Storage Definition Language)**. Used to specify the internal schema.
- **VDL (View Definition Language)**. Used to specify user views and their mappings to the conceptual schema.
- **DML (Data Manipulation Language (DML))**. Used to manipulate the database. Typical manipulations include: retrieval, insertion, deletion and modification of the data.

# Centralized and Client/Server Architectures for DBMSs

## Centralized DBMs Architecture

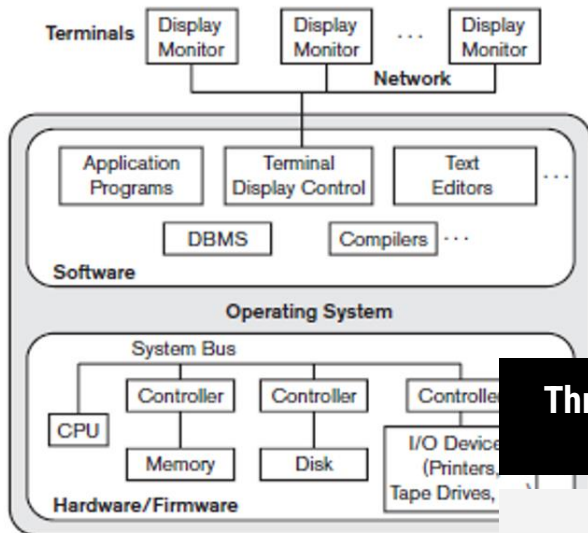


## Basic Client/Server Architectures

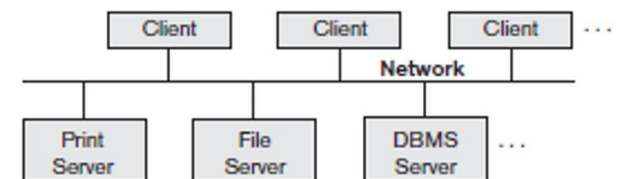


# Centralized and Client/Server Architectures for DBMSs

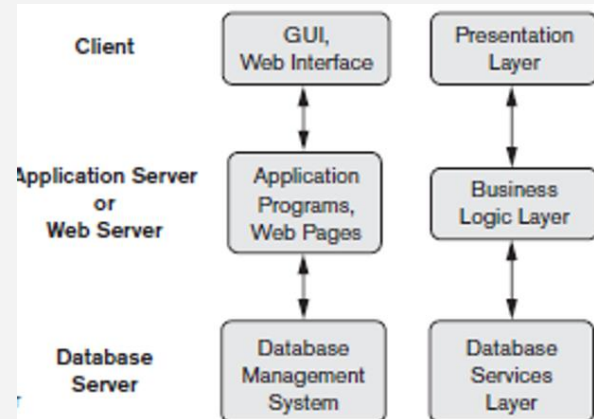
## Centralized DBMs Architecture



## Basic Client/Server Architectures



## Three-Tier and n-Tier Architecture for Web Applications



# Classification of Database Management Systems

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## DATA MODEL

- Relational
- Object
- Hierarchical
- Network

## NUMBER OF USERS

- Single-user Systems
- Multiuser Systems

## NUMBER OF SITES

- Centralized
- Distributed

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