Databases Course
[02] Databases Management Systems Concepts

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GUIA Grupo de Univalle en Inteligencia Artificial

Universidad del Valle

Outline

1. Information management
    - Data, information and knowledge
2. Databases
3. Data model
4. Design of a database
5. Data independence
6. Data access
7. Advantages and disadvantages of a DBMS

8. Components

Information management

Information is recorded and exchanged in different forms.

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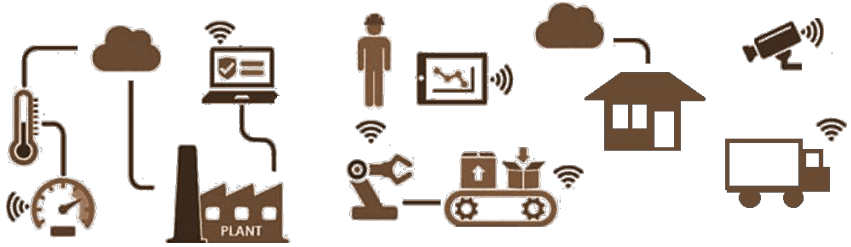
Over time, different methods and formats to organize and codify information have been introduced



Information management

Information is recorded and exchanged in different forms.

Over time, different methods and formats to organize and codify information have been introduced

In computer systems information is represented by means of data.

- The data are raw symbols which have to be interpreted and correlated to provide information

Data, information and knowledge

The concept of data as it is used in the syllabus is commonly referred to as 'raw' data – a collection of text, numbers and symbols with no meaning.

Data therefore has to be processed, or provided with a context, before it can have meaning.

Data, information and knowledge

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Data therefore has to be processed, or provided with a context, before it can have meaning.

Data, information and knowledge

Is the result of processing data, usually by computer. This results in facts, which enables the processed data to be used in context and have meaning. Information is data that has meaning.

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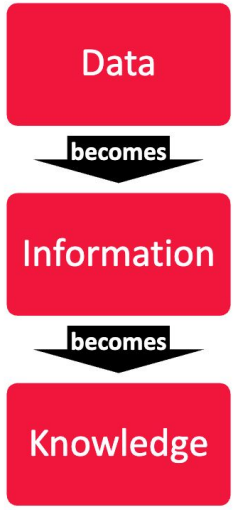
Data, information and knowledge

Is the result of understanding information that has been given to us, and using that information to gain knowledge of how to solve problems.

Knowledge can therefore be:

- acquiring and remembering a set of facts, or
- the use of information to solve problems.



Introduction to databases

Information management

A local veterinary clinic is looking to implement a system to manage information related to its services and pet care. The system should allow the registration of pets, their owners, veterinary appointments, and treatments performed. Additionally, the different types of services offered by the clinic, such as consultations, vaccinations, and surgeries, must be managed.

1. **Pets:** Each pet must be registered in the system with its name, species (dog, cat, etc.), breed, age, and weight. Each pet has a single owner.
2. **Owners:** Owners should be registered with their name, address, phone number, and email. An owner can have multiple pets.
3. **Appointments:** Appointments should include the date and time, the assigned veterinarian, and the pet that will attend the appointment.
4. **Veterinarians:** Each veterinarian must be registered with their name, specialization, and license number. A veterinarian can attend multiple appointments.
5. **Services:** The clinic offers different services that should be registered, such as type of service (consultation, vaccination, surgery), duration, and cost.
6. **Treatments:** Each treatment performed during an appointment must be recorded, indicating the type of treatment, the medications used (if applicable), and the responsible veterinarian.

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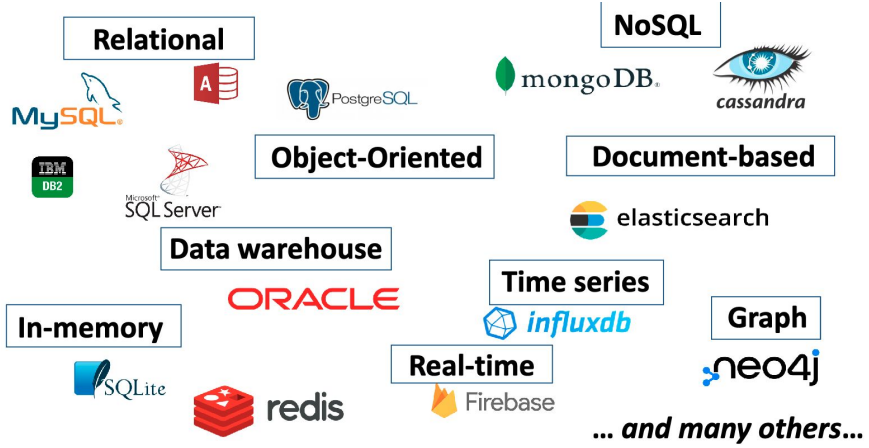
Database

Is a collection of data that represents information of interest for a computer system

“Technical” definition:

A database is a collection of data managed by a DBMS (Database Management System)



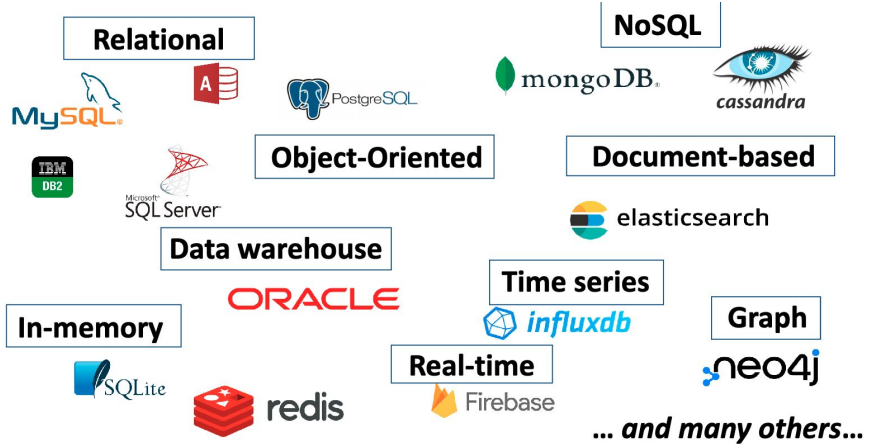
Database

Is a collection of data that represents information of interest for a computer system

“Technical” definition:

*A database management system (DBMS) is a collection of interrelated data and a set of programs for accessing that data. The primary purpose of a DBMS is to provide a convenient and efficient way to store and retrieve database information. ***

*** A. Silberschatz*



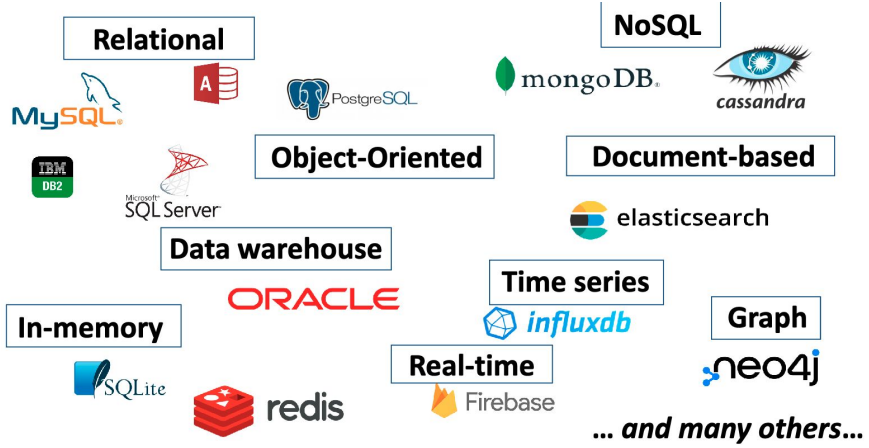
Database

Is a collection of data that represents information of interest for a computer system

"Technical" definition:

*A database management system (DBMS) is a software tool capable of managing large collections of data that are shared and persistent, ensuring their reliability and privacy. A database is a collection of data managed by a DBMS.****

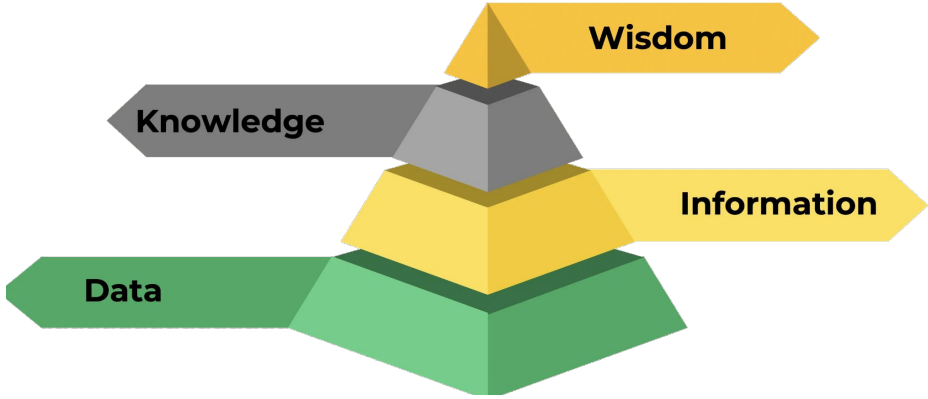
*** P. Atzeni*



Database

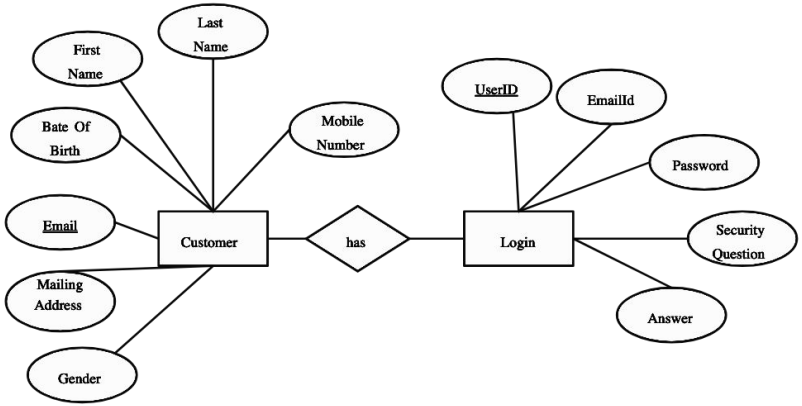
The presentation of the relationships among data, information, knowledge, and sometimes wisdom in a hierarchical arrangement has been part of the language of information science for many years.

DIKW pyramid, also known variously as the DIKW hierarchy, wisdom hierarchy, knowledge hierarchy, information hierarchy, information pyramid, and the data pyramid,



Introduction to databases

Database

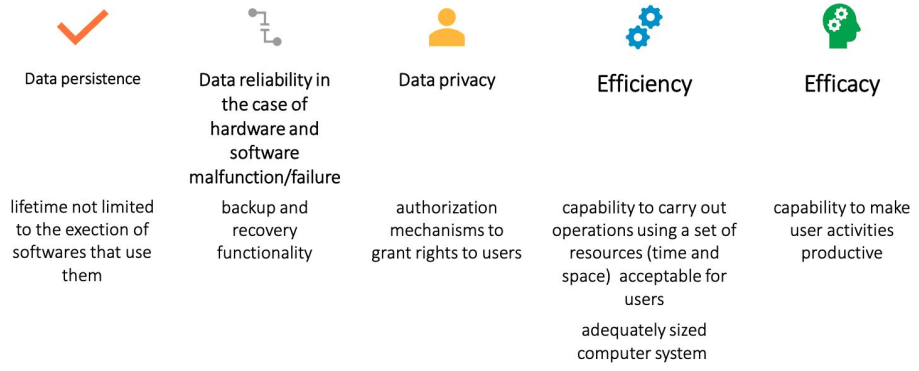


DataBase Management System - DBMS

A DBMS (DataBase Management System) is a software system able to manage collections of data that are

- Large
- Shared
- Persistent

ensuring their reliability and privacy



DBMS Components

A database engine (or storage engine) is the underlying software component that a database management system (DBMS) uses to create, read, update and delete (CRUD) data from a database.

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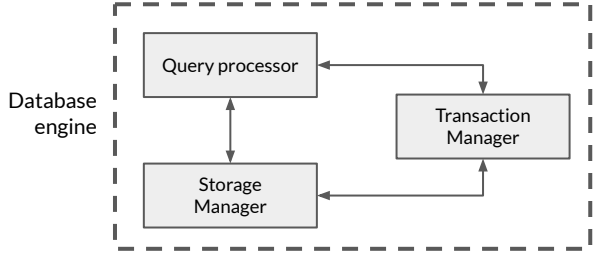

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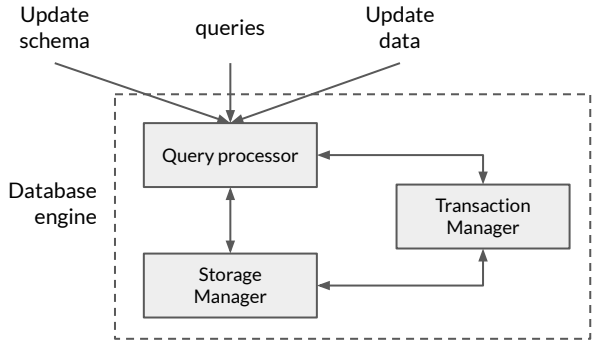

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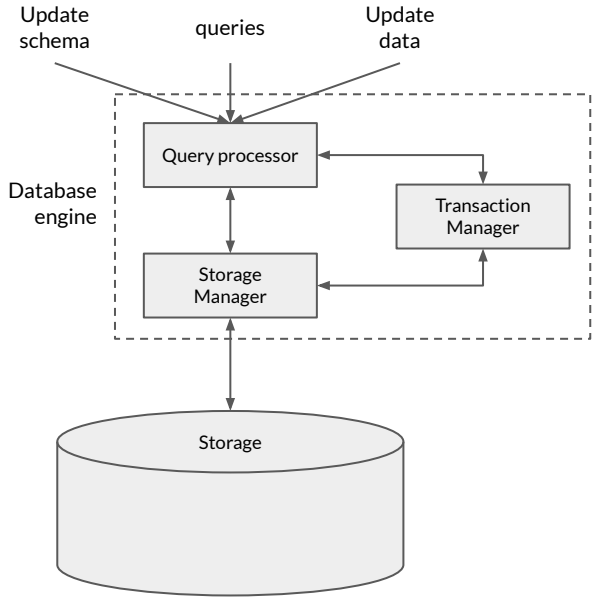

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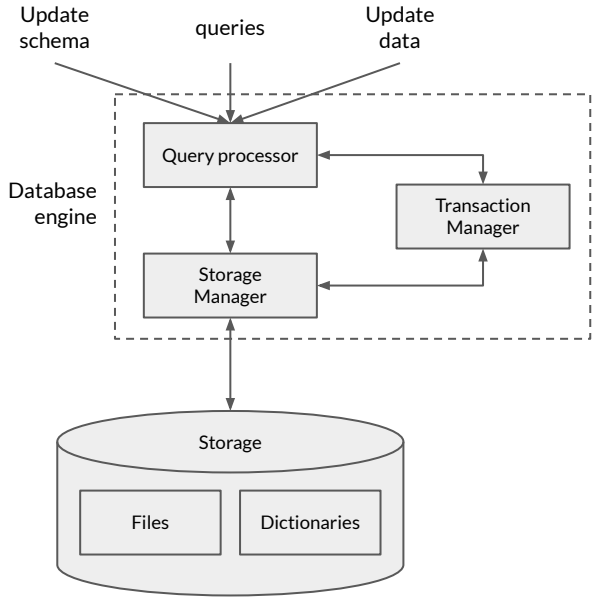

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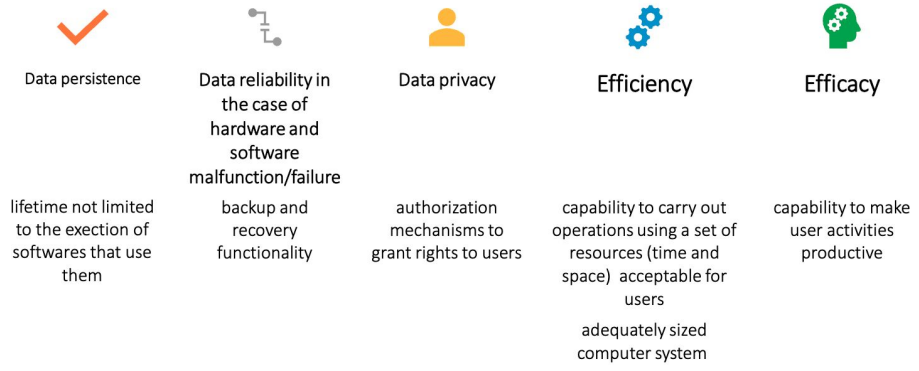


Introduction to databases

DataBase Management System - DBMS

The Anto's store wants to create a simple system to manage its products, customers, and orders. The store sells a widely variety of video games, comics, characters, toys and so forth. Customers can place orders to purchase these products.

- Products: Each product must be registered in the system with its name, price, and stock quantity.
- Customers: Customers need to be registered with their name, email, and delivery address.
- Orders: Each order should include the order date, the customer who placed the order, and the list of products ordered. A customer can place multiple orders, but each order is placed by only one customer.

Outline

1. Information management
2. Databases
3. Data models
    - Entity-Relationship
    - Relational
    - . . .
4. Design of a database
5. Data independence
6. Data access
7. Advantages and disadvantages of a DBMS

Data models

- Entity-relationship model (ER, MER)
- Relational (REL)

Conceptual model

- It is possible to represent data indipendently from the logical model
  - describes real world concepts
  - used in the designing phase
- Example: entity-relationship model

Logical model

- Describes the data structure in the DBMS
  - used by the programmers accessing the data
  - Indipendent from the physical structure
- Example: relational model

Data models

Relational model

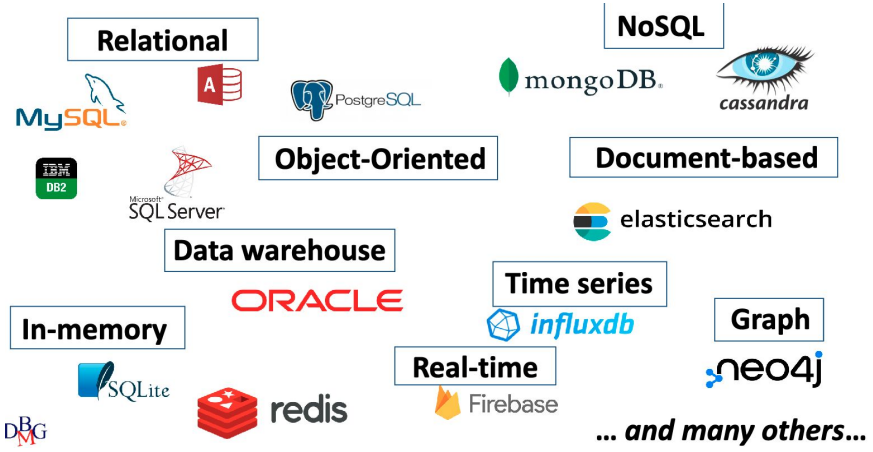
- Most widespread data model
- Data are organized into sets of homogeneous (fixed structure) records and represented as tables

Before the relational model, other models closer to the physical structures of storing were used

- Hierarchical model, network model

Since the relational model

- Object model, XML, database NOSQL



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Introduction to databases

Data models

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    - Pipeline
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Design of a database

Represent the informal requirements of an application in terms of a conceptual schema that refers to a conceptual data model

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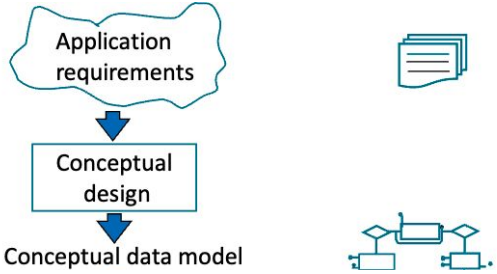
Translation of the conceptual schema previously defined into the database logical schema that refers to a logical data model

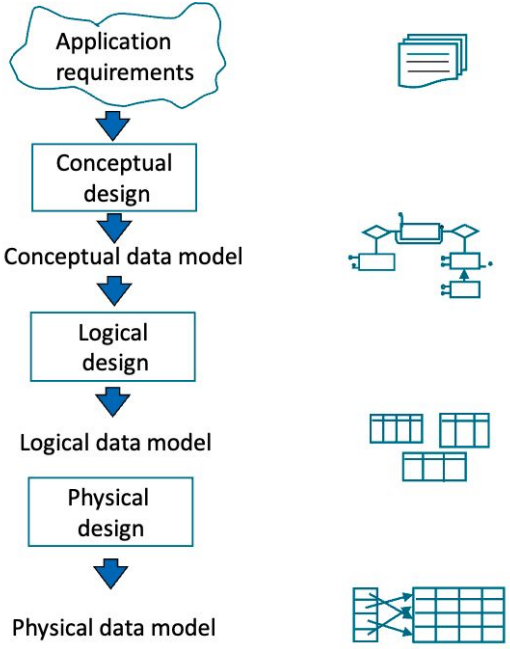


Design of a database

Represent the informal requirements of an application in terms of a conceptual schema that refers to a conceptual data model

Translation of the conceptual schema previously defined into the database logical schema that refers to a logical data model

The logical schema is completed by the details of the physical implementation (file organization and indices) on a given DBMS. The product is called physical schema and refers to a physical data model



Outline

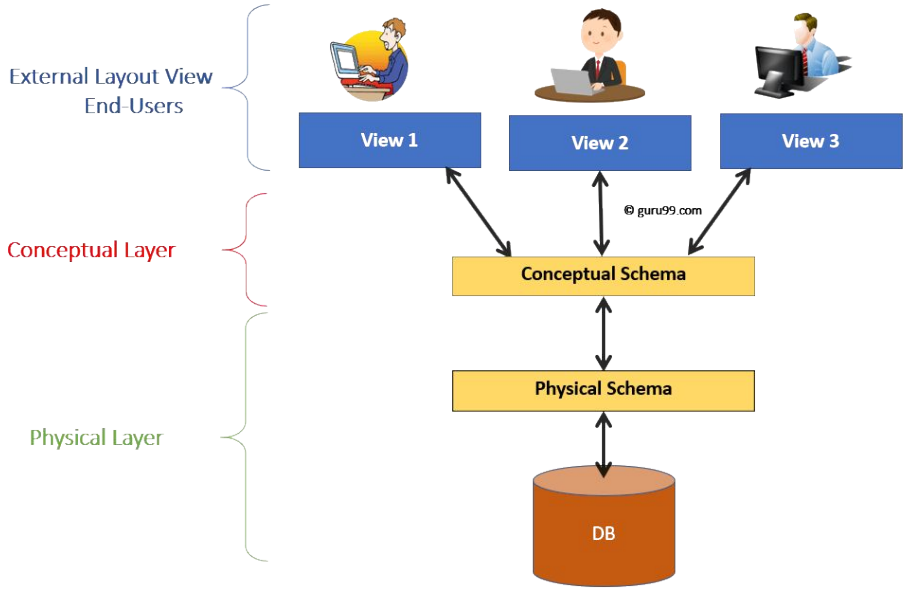
1. Information management
2. Databases
3. Data model
4. Design of a database
5. Data independence
    - Physical
    - Logical
6. Data access
7. Advantages and disadvantages of a DBMS

Data independence

Data independence guarantees that users and application software which utilize a database can ignore the designing details used in the construction of the database.

It is a consequence of dividing the design process at different abstraction levels

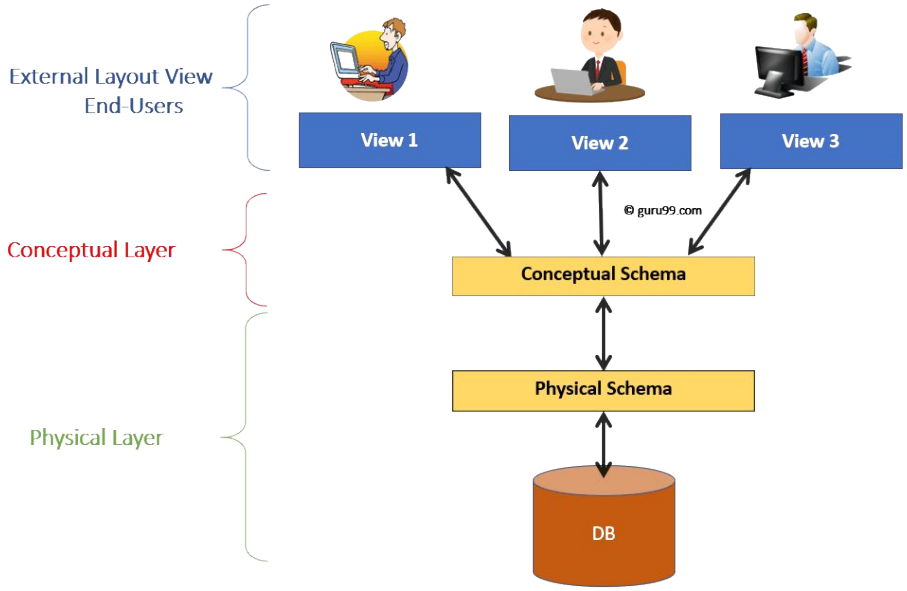
Levels of data independence:
- Physical independence
- Logical independence



Data independence: Physical independence

Physical independence

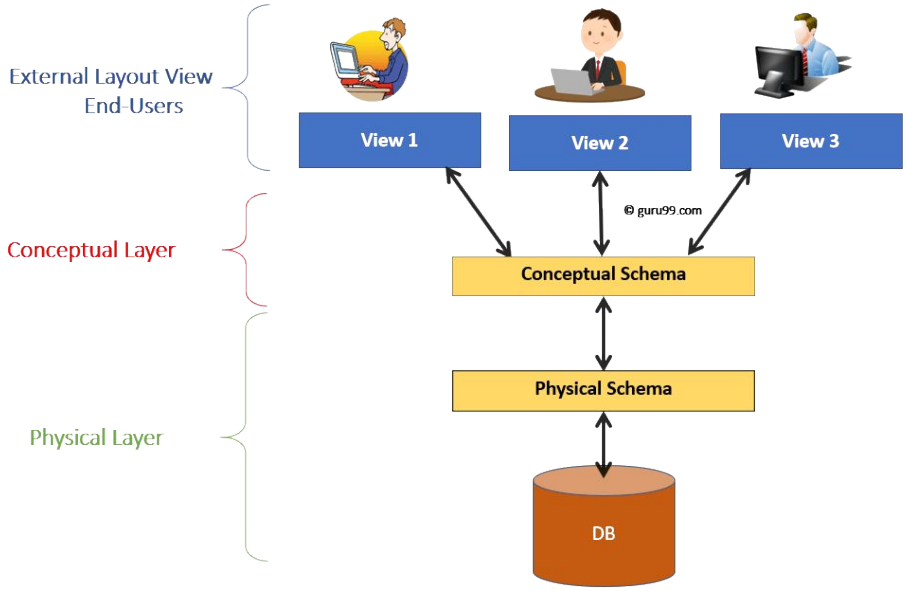
- Enables interaction with the DBMS independently from the physical structure of the data
- Access to a (logical or external level) relationship always takes place in the same way, independently of how data is actually stored
- It is possible to change the way the data is physically stored without affecting or changing the software applications using them



Data independence: Logical independence

Logical independence

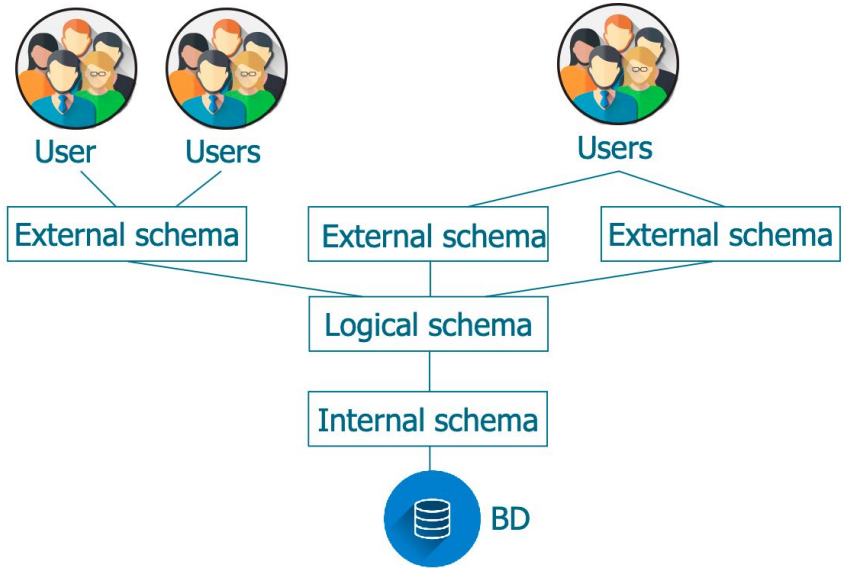
- Enables interaction with the external level independently of the logical level
- It is possible to change the logical level maintaining the external structures unaltered (*as long as the correspondences are unaltered*)
- It is possible to add new views or alter existing views without changing the logical schema



Standard three-level architecture for DBMS

External schema

- Description of parts of the database, called "views", which reflect the point of view of particular users
- Defined on the logical model



Standard three-level architecture for DBMS

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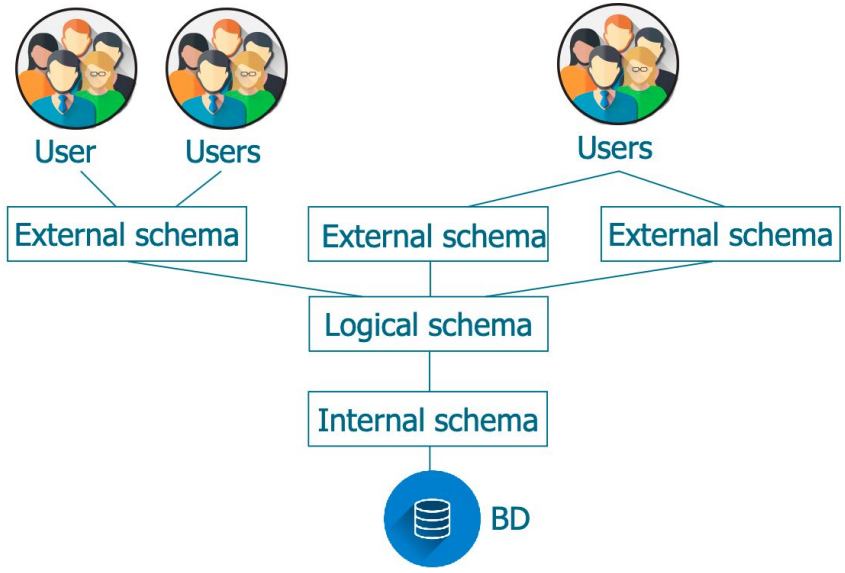
Logical schema

- Description of the database using the logical model of the DBMS



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External schema

- Description of parts of the database, called "views", which reflect the point of view of particular users
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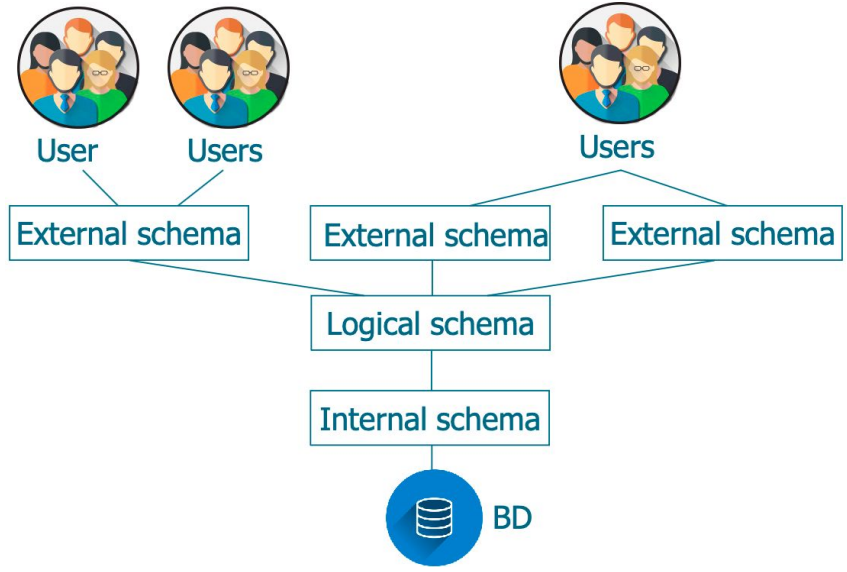
- Description of the database using the logical model of the DBMS

Internal schema

- Representation of the logical schema on the physical storage structure



Introduction to databases

Data independence

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1. Information management
2. Databases
3. Data model
4. Design of a database
5. Data independence
6. Data access
    - Users
    - Languages
7. Advantages and disadvantages of a DBMS

DB Users

Administrator: in charge of (centralized) control and management of the database:

- guarantees sufficient performance
- ensures system reliability
- manages authorizations and access to data

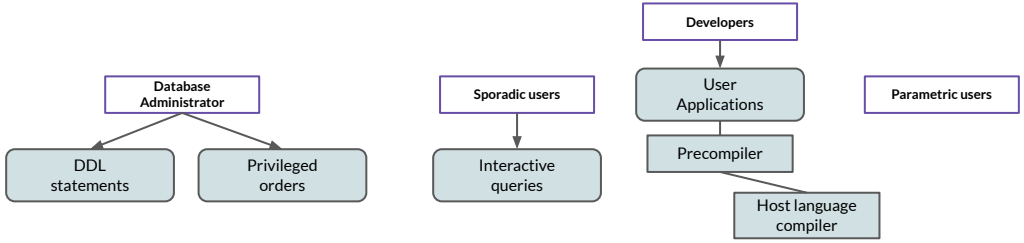
Designers and programmers: they define and realize

- the structure of the database
- the programmes accessing the database

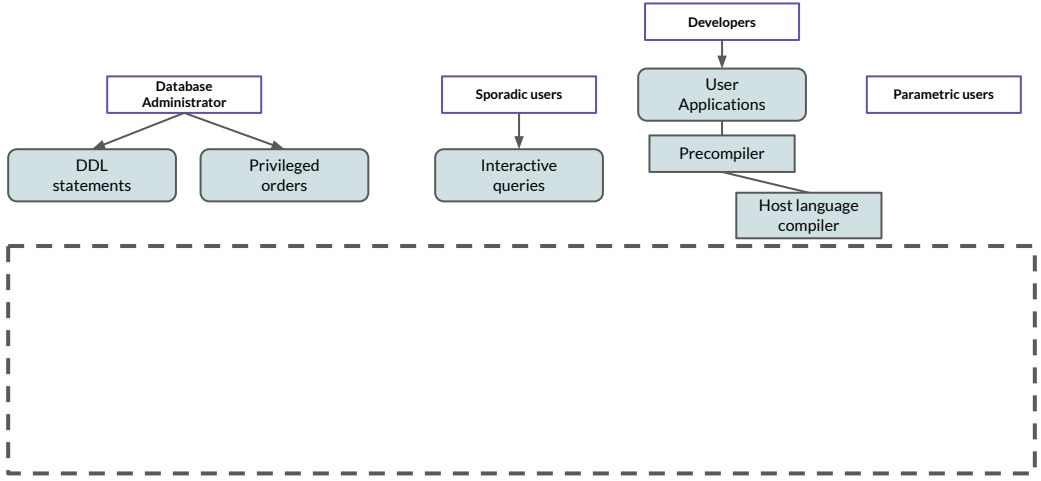
DB Users

Users: they use the database for their activities

- end users: they use transactions, i.e. programmes that carry out predefined activities
- casual users: they formulate queries (or updates) which are not predefined by the interactive access languages of the database



DB Users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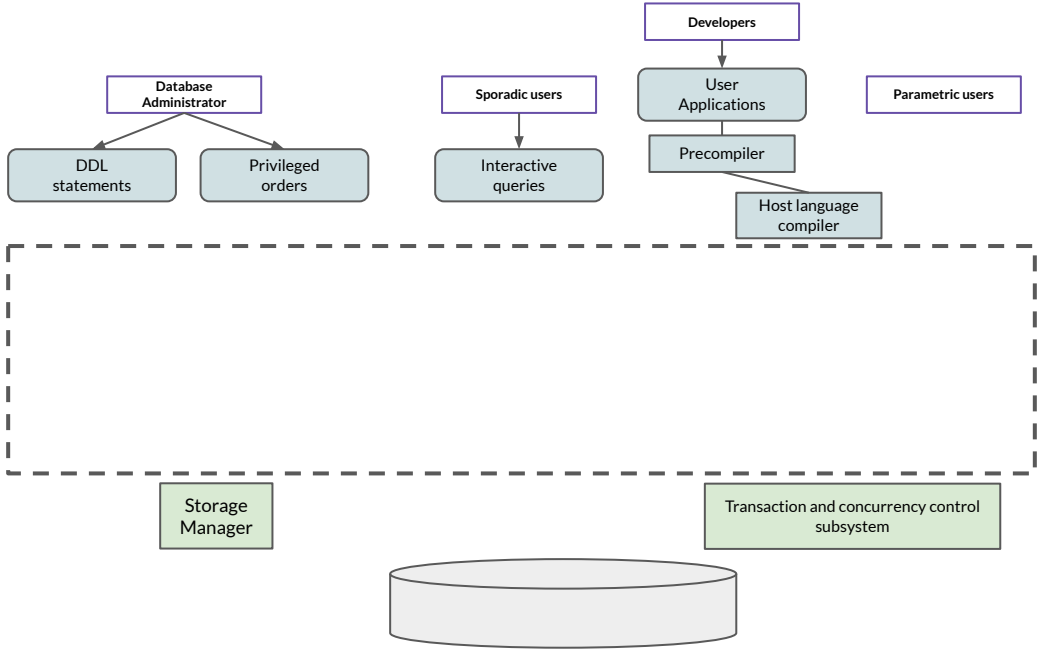
Database Administrator
Sporadic users
User Applications
Parametric users
DDL statements
Privileged orders
Interactive queries
Precompiler
Host language compiler

DB Users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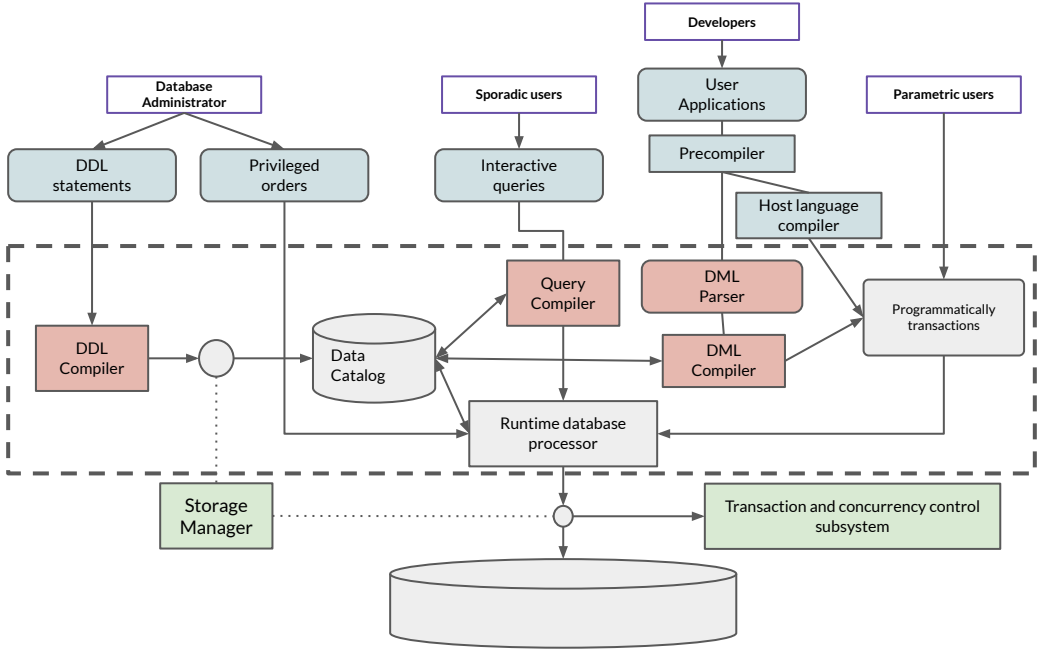
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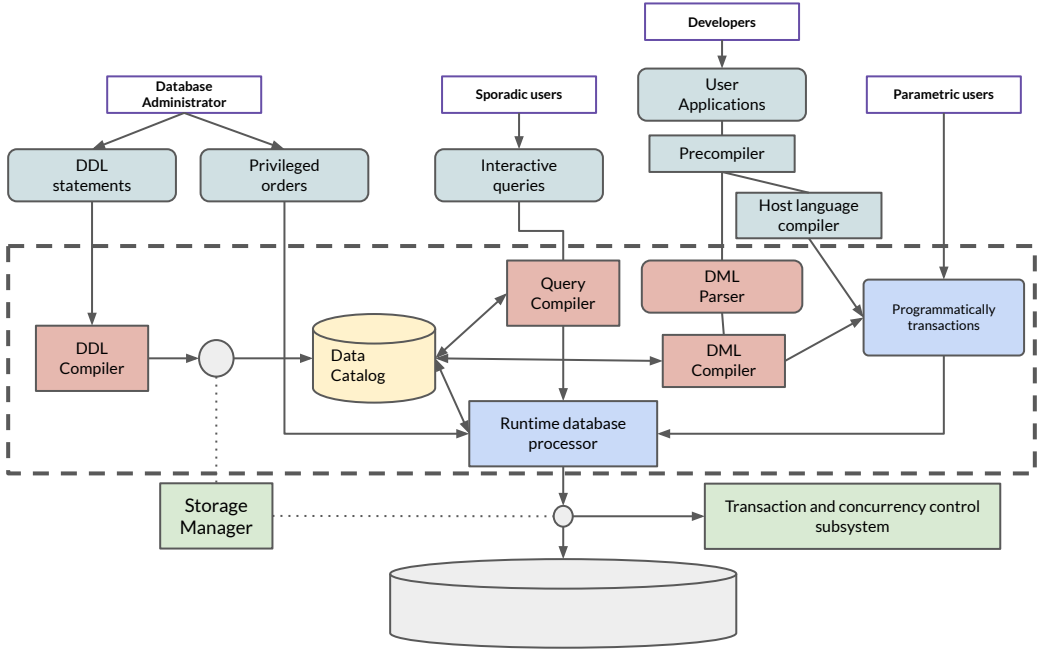
DB Users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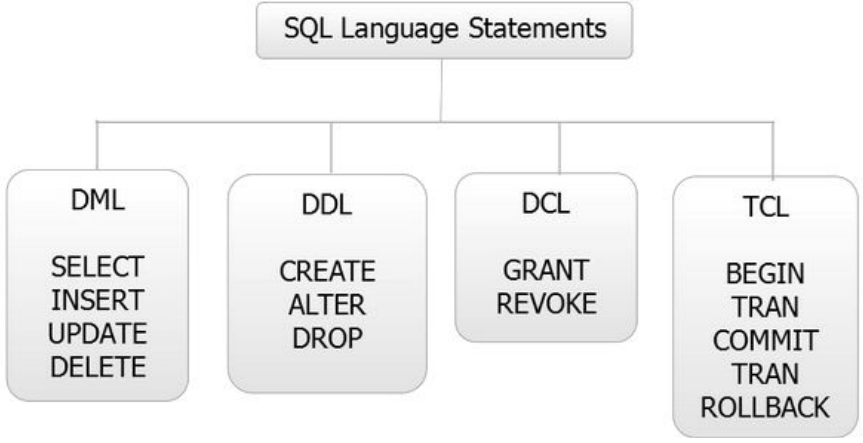
Data access languages

SQL is the standard query language used in the industry. SQL is a declarative language and their statements consist of clauses identified through keywords (e.g., SELECT, FROM, or WHERE)

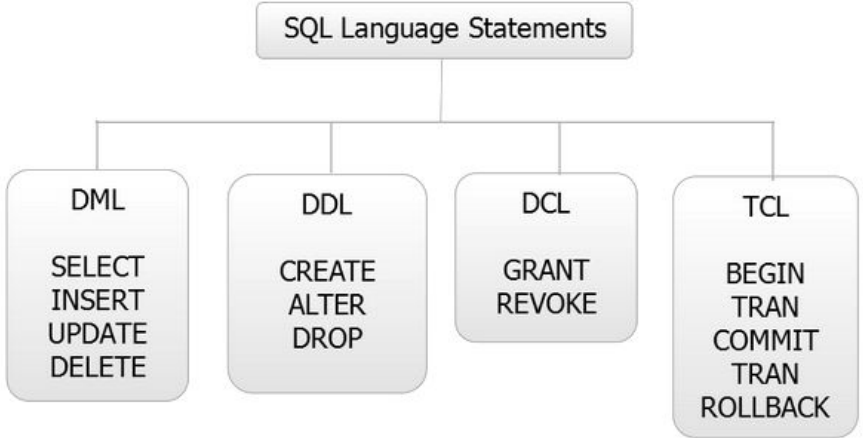
SQL is either used interactively or embedded into programs written in other languages (e.g., through a library provided by the database system)



Data access languages

SQL is a DML, DDL, DCL and TCL

- Data Definition Languages (DDL) used to define the logical, external and physical schemas, and access authorizations
- Data Manipulation Languages (DML) used for querying and updating database instances



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7. Advantages and disadvantages of a DBMS
    - Files vs DBMS

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