


**Databases**

**Unit 1**  
**Introduction**

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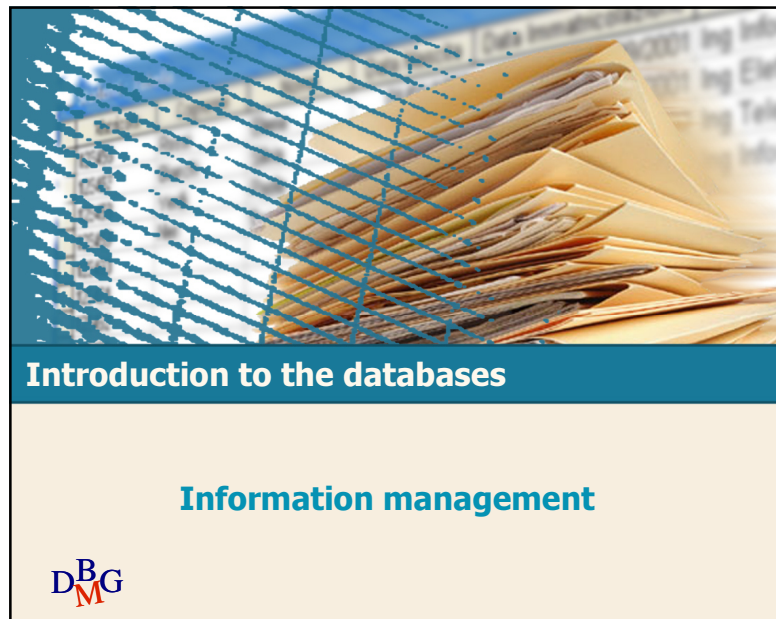


**Introduction to the databases**

- Information management
- Databases
- Data model
- Data independence
- Data access
- Advantages and disadvantages of DBMS

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**Information management**

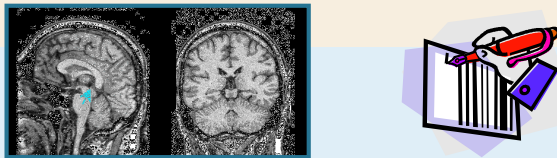
Information is recorded and exchanged in different forms

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## Information management

➤ Information is recorded and exchanged in different forms



➤ Forms of information organization and codification have been introduced over time


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## Computer systems

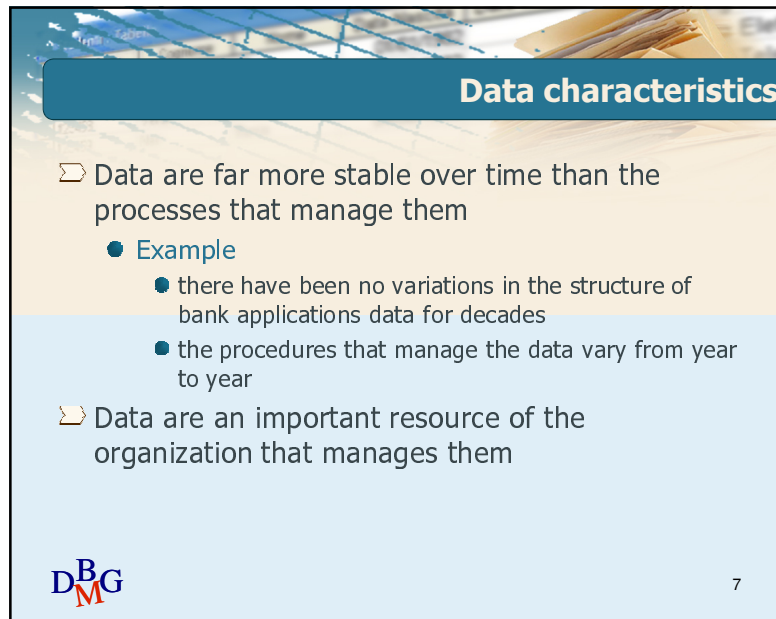
➤ In computer systems information is represented by means of data

- the data are rough symbols which have to be interpreted and correlated to provide information
- example
  - data: "Mario Rossi" and 424242
  - information: result of looking up a telephone number in your personal telephone directory (e.g., list of contacts)



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### Data characteristics

- Data are far more stable over time than the processes that manage them
  - **Example**
    - there have been no variations in the structure of bank applications data for decades
    - the procedures that manage the data vary from year to year
- Data are an important resource of the organization that manages them

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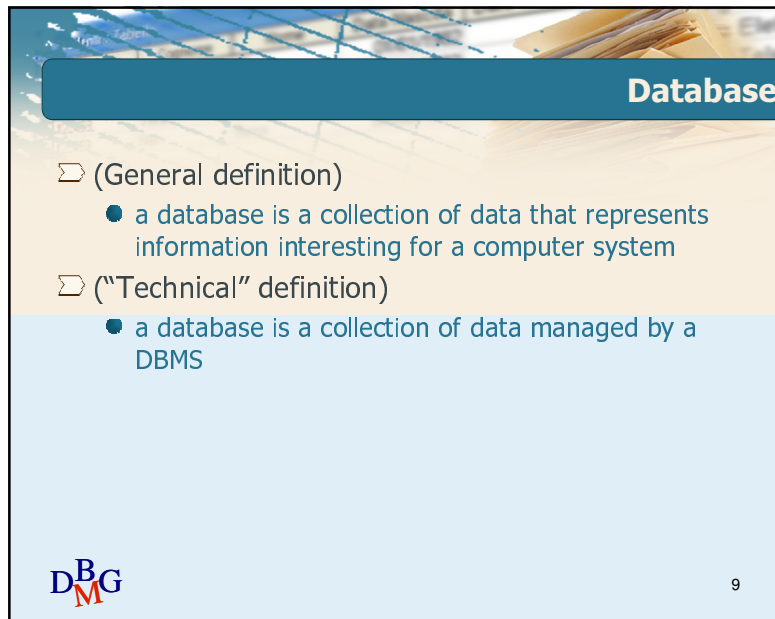
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### Introduction to the databases

## Databases

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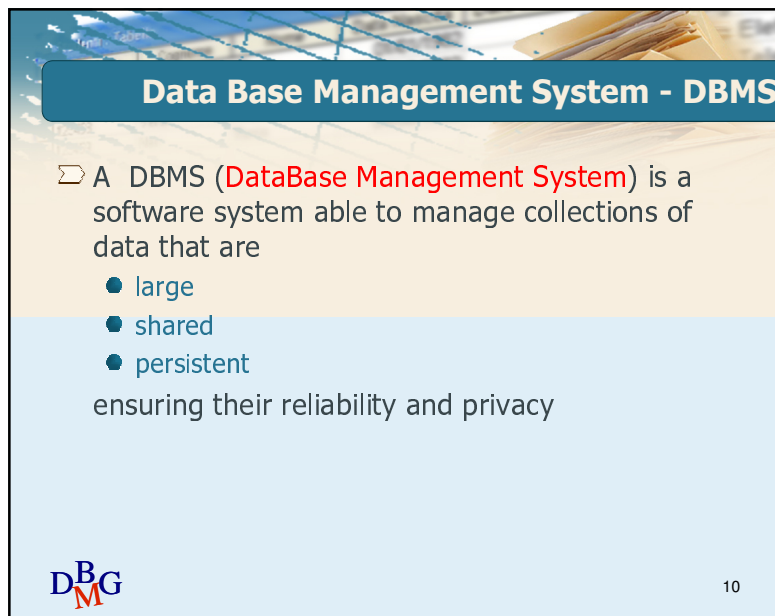


## Database

- ▷ (General definition)
  - a database is a collection of data that represents information interesting for a computer system
- ▷ ("Technical" definition)
  - a database is a collection of data managed by a DBMS

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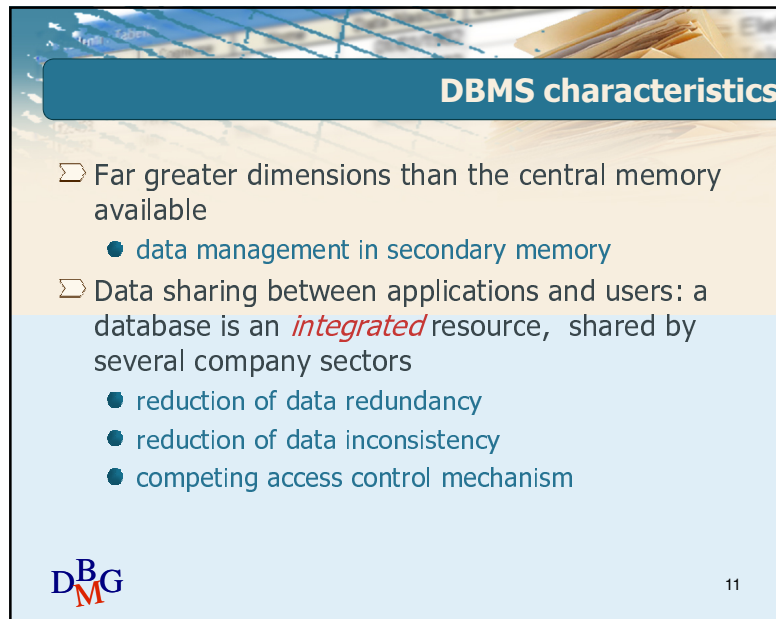


## Data Base Management System - DBMS

- ▷ A DBMS (**DataBase Management System**) is a software system able to manage collections of data that are
  - large
  - shared
  - persistentensuring their reliability and privacy

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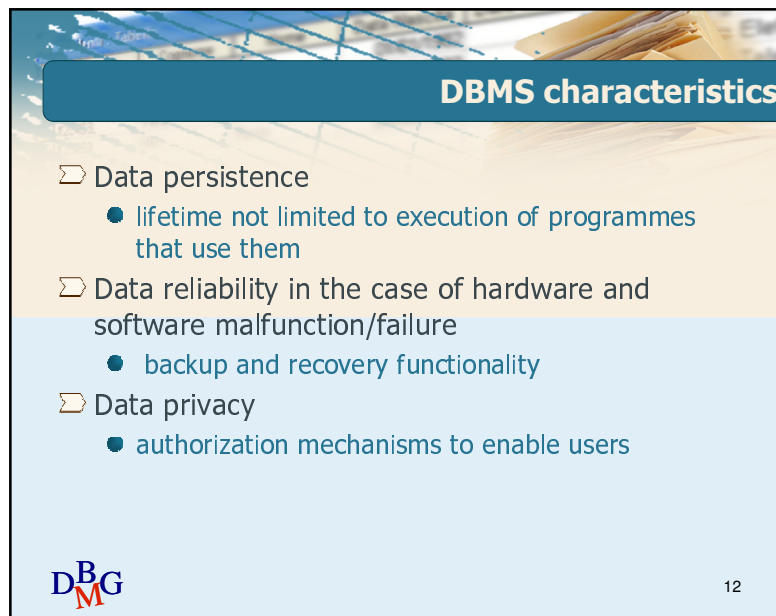


### DBMS characteristics

- Far greater dimensions than the central memory available
  - data management in secondary memory
- Data sharing between applications and users: a database is an *integrated* resource, shared by several company sectors
  - reduction of data redundancy
  - reduction of data inconsistency
  - competing access control mechanism

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### DBMS characteristics

- Data persistence
  - lifetime not limited to execution of programmes that use them
- Data reliability in the case of hardware and software malfunction/failure
  - backup and recovery functionality
- Data privacy
  - authorization mechanisms to enable users

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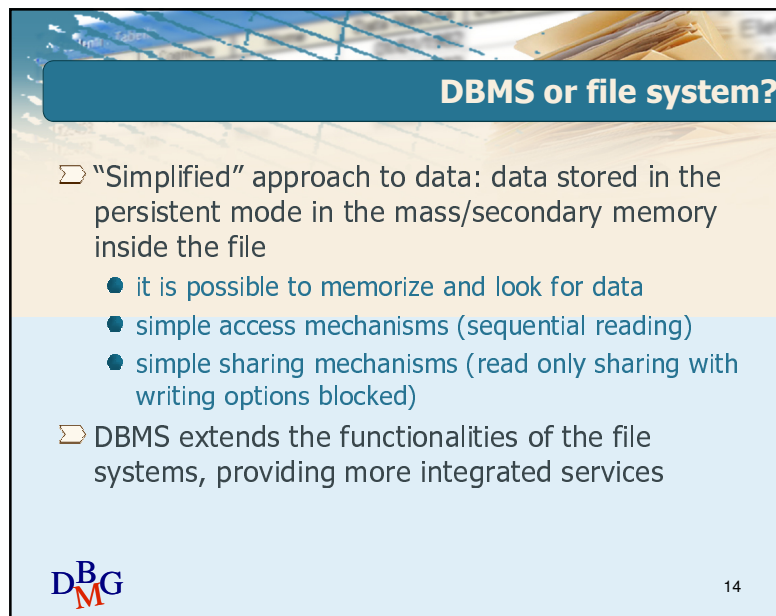


### DBMS characteristics

- Efficiency
  - capacity to carry out operations using a set of resources (time and space) acceptable for users
  - Adequately sized computer system
- Efficacy
  - capacity to render user activities productive

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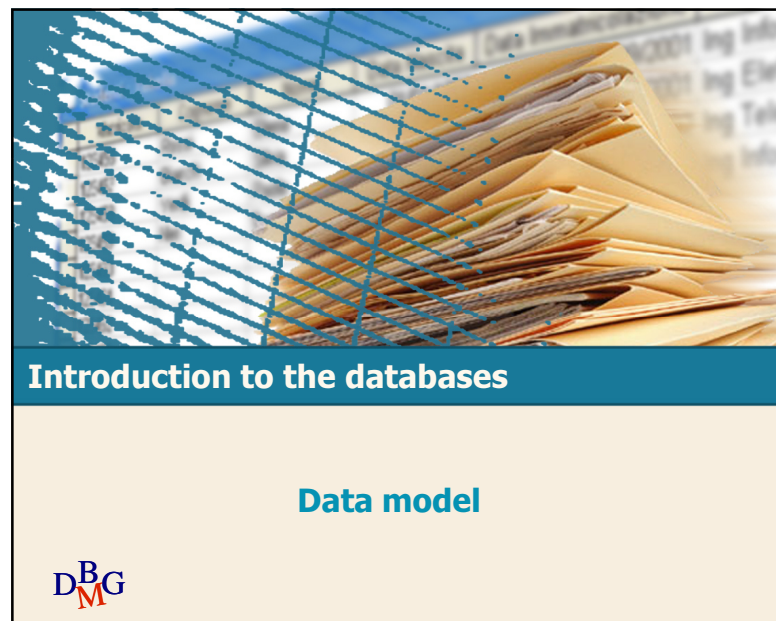
### DBMS or file system?

- “Simplified” approach to data: data stored in the persistent mode in the mass/secondary memory inside the file
  - it is possible to memorize and look for data
  - simple access mechanisms (sequential reading)
  - simple sharing mechanisms (read only sharing with writing options blocked)
- DBMS extends the functionalities of the file systems, providing more integrated services

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The slide has a background image of a stack of yellow folders with a blue grid overlay. The title 'Data model' is in a dark blue bar at the top. The main content is in a light blue bar, and the DBG logo is in the bottom left corner.

**Data model**

▷ A data model is a set of concepts utilized for organizing data of interest and describing its structure in a way that is understood by a computer

- elementary data types (integer, character...)
- structuring mechanism for defining more complex structures (record builder, array,...)



## Relational model

- Most widespread data model
- Defines the relationships builder, which organizes the data into sets of homogeneous (fixed structure) records
  - The relationships are represented as tables



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## Relational model

Courses

Code	Name	TeacherID
M2170	Information systems	D101
M4880	Computer Networks	D102
F0410	Databases	D321

Teacher

ID	Name	Department	Phone#
D101	Green	Computer Engineering	123456
D102	White	Telecommunications	636363
D321	Black	Computer Engineering	414243



### Other data models

- Before the relational model, other models closer to the physical (not very abstract) structures of storing were used
  - hierarchical model
  - network model
- Since the relational model
  - Object model
  - XML

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### Schema and instances

- Defined in the database are
  - the *schema*, which describes the structure of the data. The schema
    - is practically unvarying over time
    - is represented by the heading of each table (table name and column names)
- Example
  - schema of the database

Courses	Code	Name	TeacherID	
Teacher	ID	Name	Department	Phone#

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## Schema and instances

Defined in a database are

- the *instance*, composed of the content of each table, i.e. of the data effective values which are
  - variable over time, also very rapidly
  - represented by the rows in the tables

Example

- instance of the Teacher table

D101	Green	Computer Engineering	123456
D102	White	Telecommunications	636363
D321	Black	Computer Engineering	414243

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## Model types

*Conceptual model*

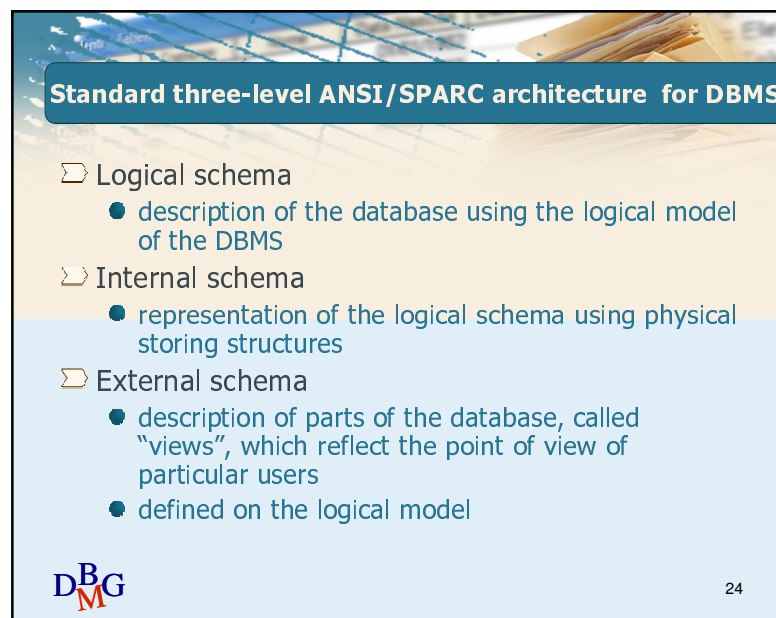
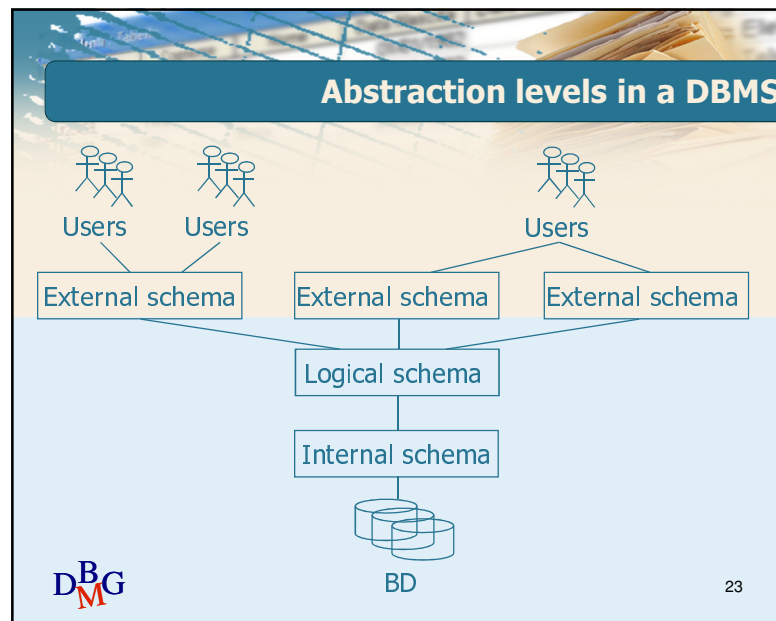
- It is possible to represent data independently from the logical
  - describes real world concepts
  - used in the designing phase
- example: entity-relationship model

*Logical model*

- Describes the data structure in the DBMS
  - used by the programmes accessing the data
  - independent from the physical structures
- Example: relational model

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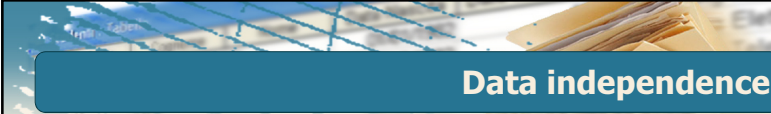




## Introduction to the databases

### Data independence

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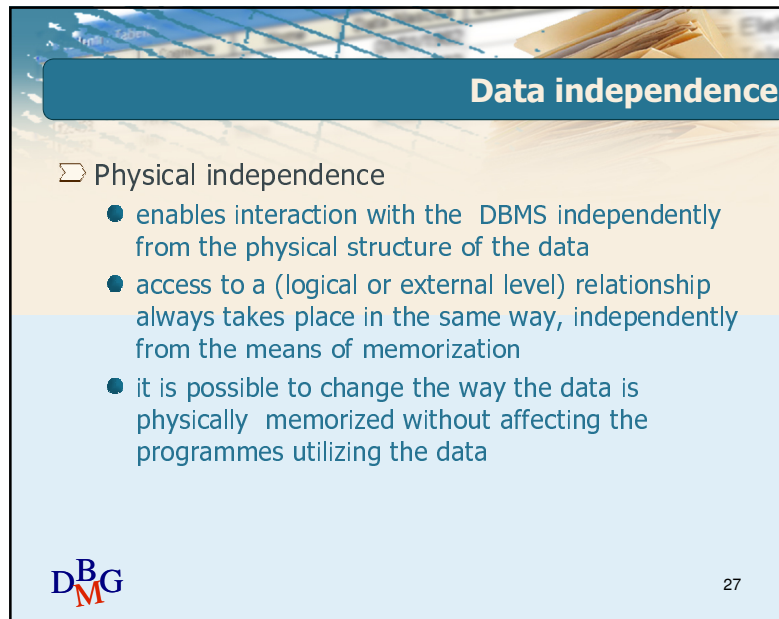


## Data independence

- Data independence guarantees that users and application programmes which utilize a database can ignore the designing details used in the construction of the database
- It is a consequence of the subdivision into levels of abstraction

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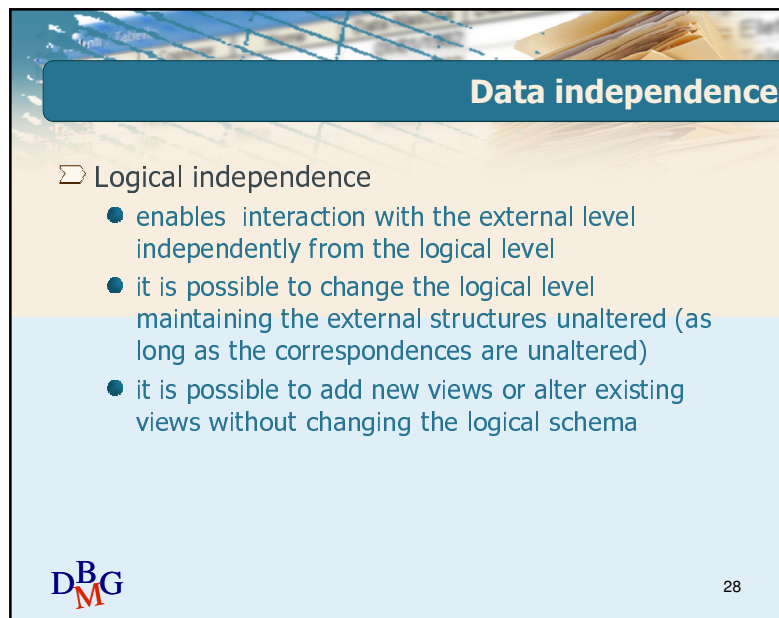
## Data independence

➤ 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 from the means of memorization
- it is possible to change the way the data is physically memorized without affecting the programmes utilizing the data

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## Data independence

➤ Logical independence

- enables interaction with the external level independently from 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


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## Introduction to the databases

### Data access



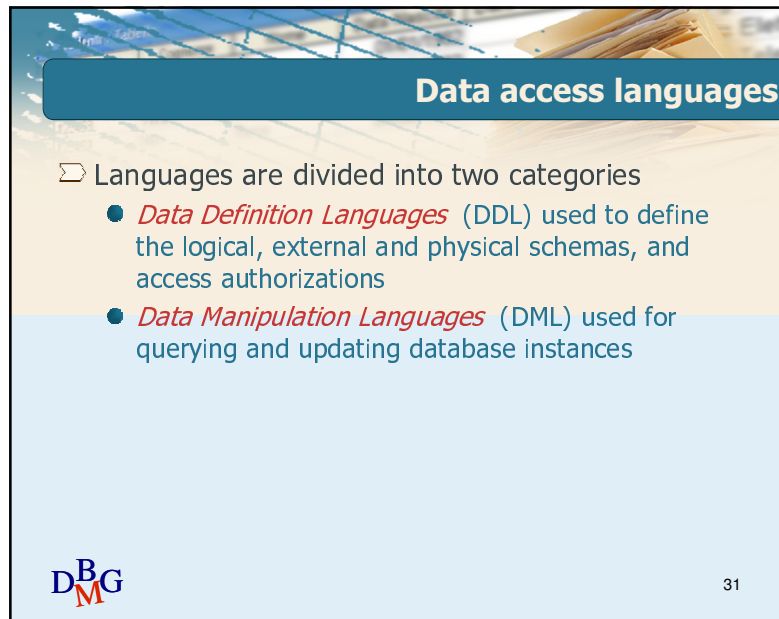
## Data access languages

- User-friendly interfaces that enable specific queries without using a textual language
- Interactive languages (SQL)
- Commands similar to interactive commands introduced into traditional programming languages (C, C++, COBOL, Java, ...), so-called host languages
- Commands similar to interactive commands introduced into ad hoc development languages, often with specific functionalities (generation of graphics, complex prints, screens)



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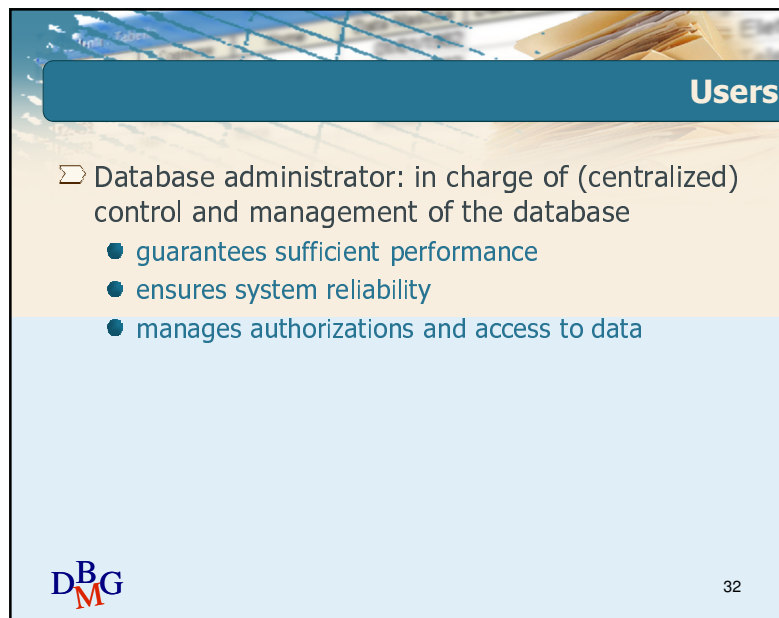
### Data access languages

▷ Languages are divided into two categories

- *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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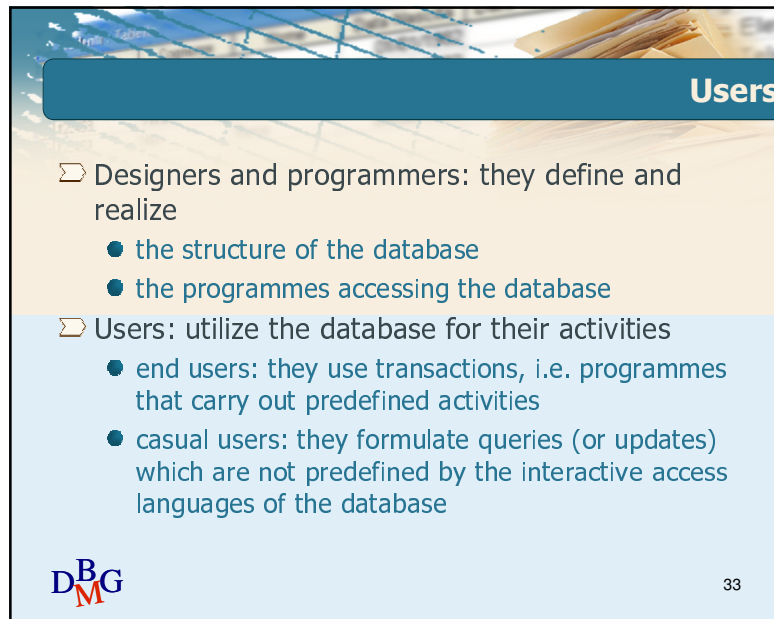
### Users

▷ Database administrator: in charge of (centralized) control and management of the database

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

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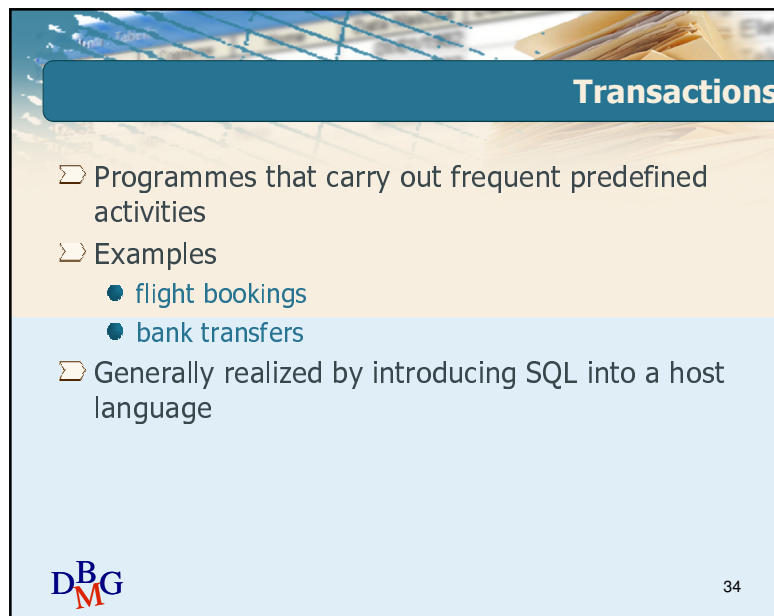


## Users

- Designers and programmers: they define and realize
  - the structure of the database
  - the programmes accessing the database
- Users: utilize 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

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## Transactions

- Programmes that carry out frequent predefined activities
- Examples
  - flight bookings
  - bank transfers
- Generally realized by introducing SQL into a host language

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## Introduction to the databases

### Advantages and disadvantages of DBMS

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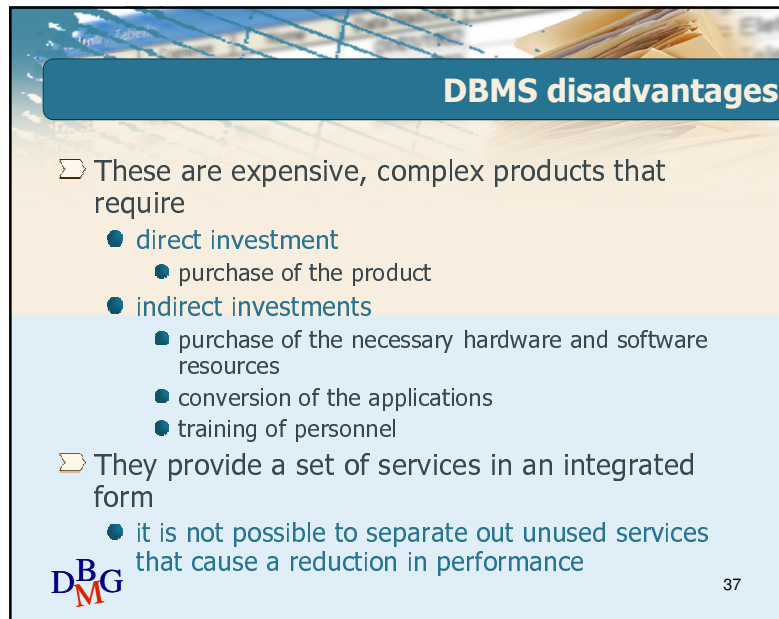


## DBMS advantages

- Data as a common resource of the whole organization
  - reduction of redundancies and inconsistencies
- Unified and precise data model of facts of interest to the organization
- Possible centralized control of data
  - standardization, economies of scale
- Data independence

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### DBMS disadvantages

- These are expensive, complex products that require
  - **direct investment**
    - purchase of the product
  - **indirect investments**
    - purchase of the necessary hardware and software resources
    - conversion of the applications
    - training of personnel
- They provide a set of services in an integrated form
  - it is not possible to separate out unused services that cause a reduction in performance

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