Ministry of Higher Education and Scientific Research
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Chapter I Fundamental Concepts

2nd Year LMD Relational Databases

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Introduction

- The information system is a working tool for decision-makers.
- Any decision (technical, political, financial, etc.) cannot be made without information that will be represented by data. **Information -> Data**
- 2 approaches for storing information and processing it:
  - File approach
  - Database approach.
- In the first approach, the information is stored in a data structure called a file with a system that manages it called a SGF (File Management System).
- Disadvantages of the file approach: redundancy of information (*unnecessary duplication of data*) and therefore inconsistency. In addition, the data depends on the processing and vice versa, as well as anomalies due to concurrent access..

Définitions

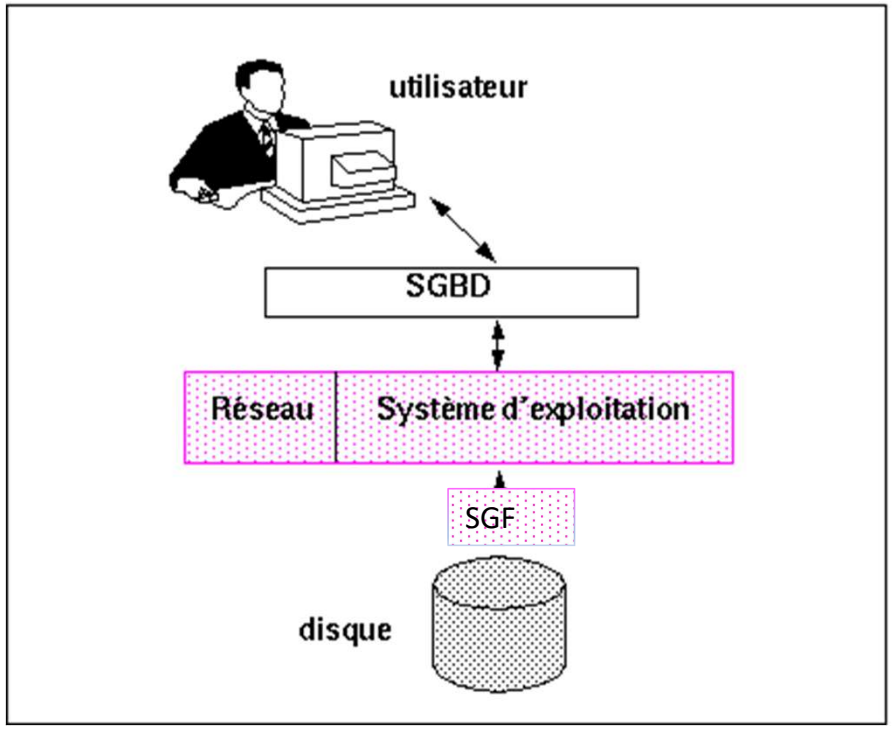
- The limitations of the File approach are at the origin of the database concept which constitutes the heart of the IS.
- A database (DB) represents the set (coherent, integrated, shared) of information necessary for the operation of a company.
- Integrated means the data is stored centrally and organized according to a structured model
- This set is structured, i.e. the data is grouped and linked together with a *minimum of redundancy*.
- Example: relational database:

  Course (CourseName, section, prerequisites, TeacherName *),
  Teacher (TeacherName, grade, recruitment date),
  Student (StudentName, section, group…)
  Studentgrade (StudentName*, CourseName*, grade)

- The information relating to the course, teacher, student is recorded only once, so there is no redundancy (unnecessary duplication)

Définition (2)

- The Data Base is stored on a computer medium (hard disk) and managed by a database management system (DBMS) placed above the SGF.



Data Base Management System (DBMS)

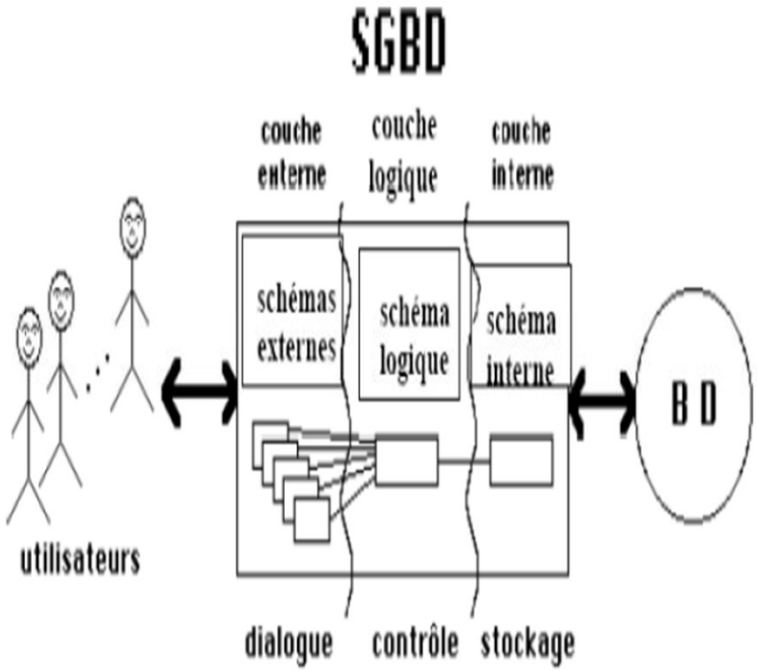
- A DBMS (Data Base Management System) is a set of programs (software) that perform the following functions:
- Define the DB: allows you to describe the data in the DB using a data definition language (DDL)
- Manipulate the DB: Query and update the data using the DML, e.g. list the orders for the customer Amir.
- Ensure integrity: allows you to define rules called integrity constraints in order to avoid the risk of having erroneous data, e.g. quantity ordered > 0. (LDD, Triggers: Triggers)
- Ensure confidentiality: through authentication mechanisms and **user access rights**.
- Concurrency: Management of access conflicts (several users access the same data simultaneously).
- Security: recovery after failure, logging

DBMS examples

- Most DBMSs operate in a client/server mode.
- The server (the machine that stores the DB) receives requests from several clients and this in a concurrent manner.
- The server analyzes the request, processes it and returns the result to the client (client application).
- There are many database management systems, for example:
- ACCESS: Windows platform, single-user, commercial license.
- SQL SERVER: Windows platform, client/server mode, commercial license.
- ORACLE: Windows and Linux platforms, client/server mode, commercial license.
- SYBASE: Windows and Linux platforms, client/server mode, commercial license.
- POSTGRESQL: Windows and Linux platforms, client/server mode, free license.
- MYSQL: Windows and Linux platforms, client/server mode, free license

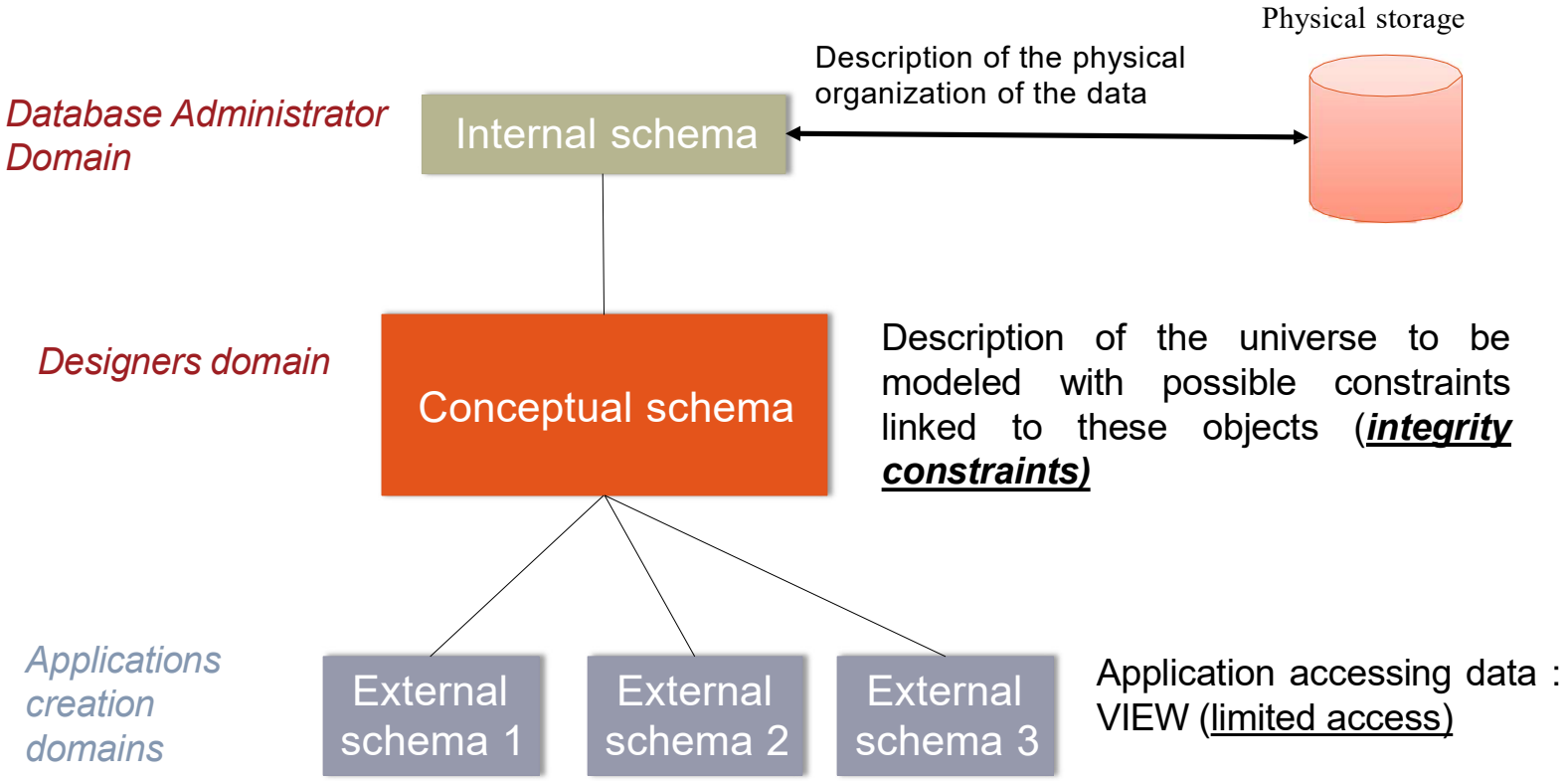
Levels of abstraction of DBMS

- A major objective of DBMS is to provide abstraction of data stored on disks.
- For this purpose, three levels of data description have been distinguished by the ANSI/X3/SPARC group:
- Logical (or conceptual) schema: Description of data and integrity constraints (Data Dictionary). This is the result of modeling. It is independent of any machine representation
- External schemas: each schema describes a part of the database called VIEW. Views adapt data to users by allowing them access to some data and hiding others (useless, sensitive or inadequate).
- Internal schema: takes care of storing data in physical media and managing storage structures (files) and access (index management, keys, ...



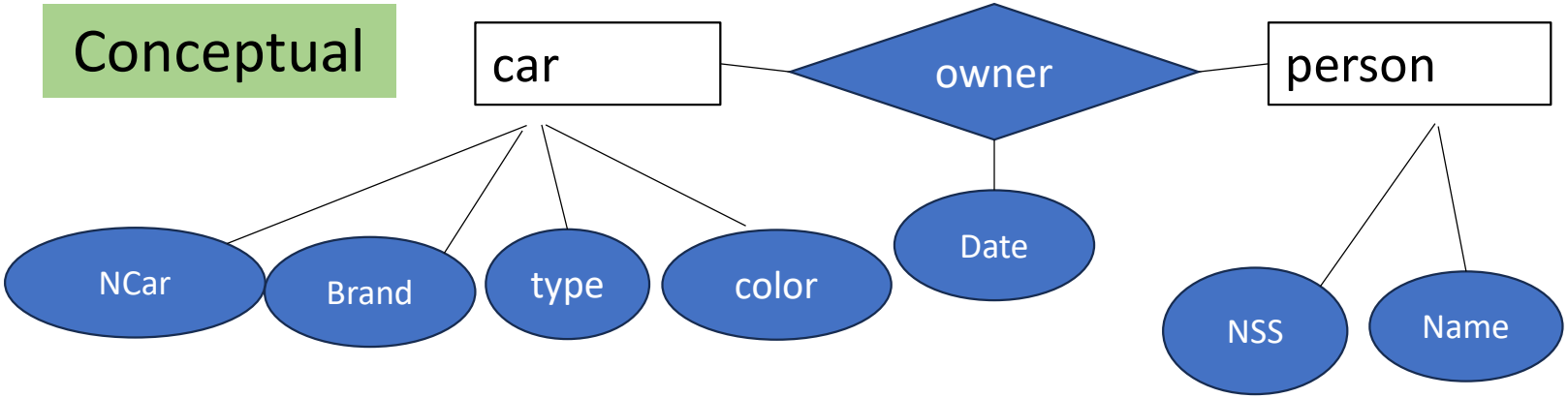
Levels of data description

Conceptual (Logique), Internal and External



Example

Conceptual



Internal Structure

Describe the data as it is stored in the machine: files, file records, access paths (sequential, indexed, etc.)

External Level

Give 2 different external levels:

- one view concerning only the person and the car he owns
- and the other view only information about cars without owner

Data Transformation

- A DBMS must be able to ensure **the passage of data** from the format corresponding to one level into the format corresponding to another level
- This function is called data transformation
- In a DBMS with 3 levels of description there are therefore 2 levels of Transformation:
  - The conceptual/internal transformation
  - The external/conceptual transformation

Conclusion

- To solve the problems caused by the file approach, several objectives have been set for DBMSs:
- Physical independence: The definition of data must be independent of the storage structures used.
- Logical independence: Each user group has a specific view of the database according to the application to be carried out (external schema: view).
- Data manipulation by non-procedural languages: query and update data without specifying access algorithms. (Data Manipulation Language: DML).
- Data administration: A DBMS must allow the creation and management of the database, its log (update history), import/export, security, backup, restoration (in the event of a failure), etc.
- Controlled data redundancy: integration of redundant data, centralized administration and sharing.
- Data consistency: The data is subject to a certain number of integrity constraints that define a consistent state of the database (LDD, triggers).
- Data sharing: This involves allowing multiple users (applications) to simultaneously access the same data in a transparent manner. Need to control concurrent access (transaction concept: sequential processing unit)
- Data security
- Resistance to failures