Tecnologias de Informação

School Year 2020/2021

Databases

Basic concepts and definitions

Organization of data in files (1/3)

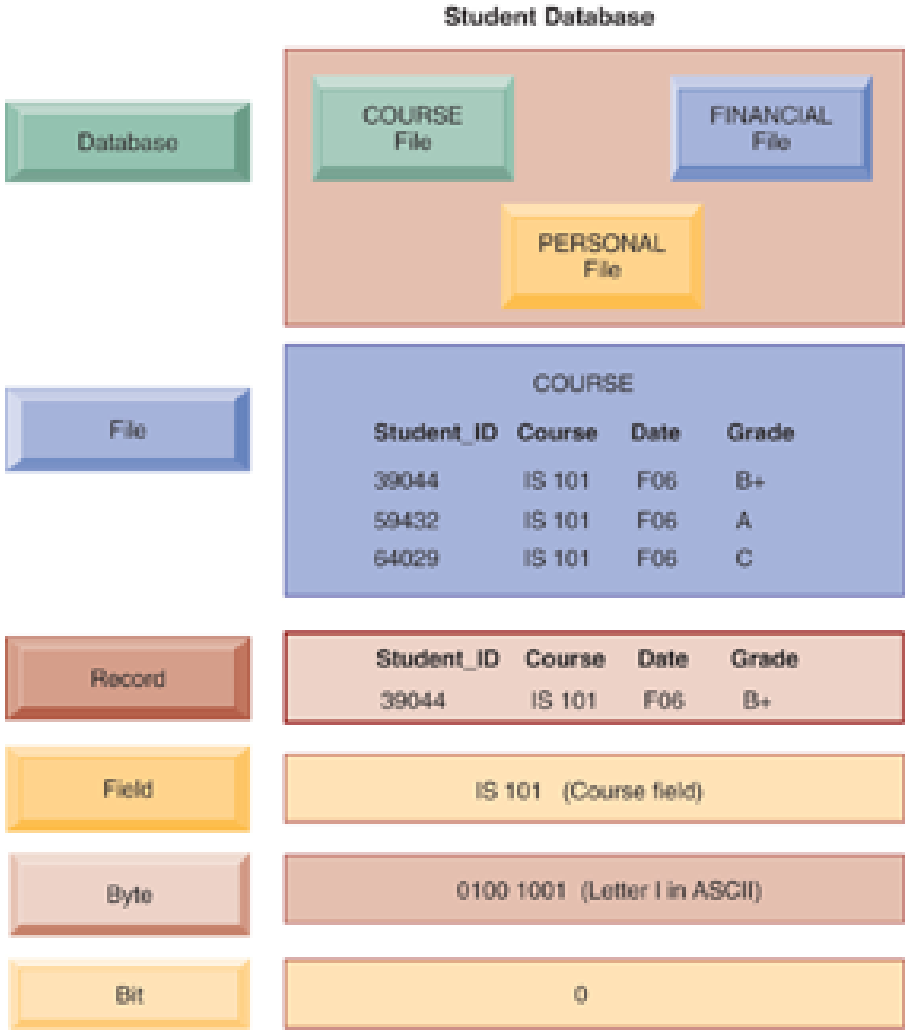
A computer system organizes its data in a **hierarchy**:

- It starts with the bit, which represents a 0 or a 1;
- the bits can be grouped to form a byte (8 bits), which represents a character, number or symbol;
- the bytes can be grouped to form an attribute and related attributes can be grouped in records;
- Related records can be collected and grouped to form a file;
- Related files can be organized in a database.

Laudon, K. C. & Laudon, J. P. (2014) *Management Information Systems Managing the digital firm* (13th edition). Prentice Hall

Organization of data in files (2/3)

Data Hierarcky



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Organization of data in files (3/3)

Problems with the traditional file system:

- Data redundancy and inconsistency:
  - Data redundancy: the same data stored in different files
  - Data inconsistency: different incoherent copies of the same data
- Data-program dependency:
  - Happens when changes in a program require changes in the data accessed by that program
- Lack of flexibility
- Weak security
- Lack of data sharing and availability

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Database (BD) – basic concepts (1/4)

- **Database** is a set of data that are related to each other and that are relevant in a given context.
- **Database Management System** (DBMS) is the *software* that manages the storage, manipulation and the search of data existing in a database.

Database (BD) – basic concepts (2/4)

DBMS **minimize**:

- **Data redundancy**: the same data stored in multiple files
- **Existence of data silos**: applications can hardly access data associated with other applications
- **Data inconsistency**: multiple inconsistent copies of the same data

Rainer Jr., K. & Cegielski, C. G. (2011). *Introduction to information systems: enabling and transforming business* (3rd edition). John Wiley & Sons

Database (BD) – basic concepts (3/4)

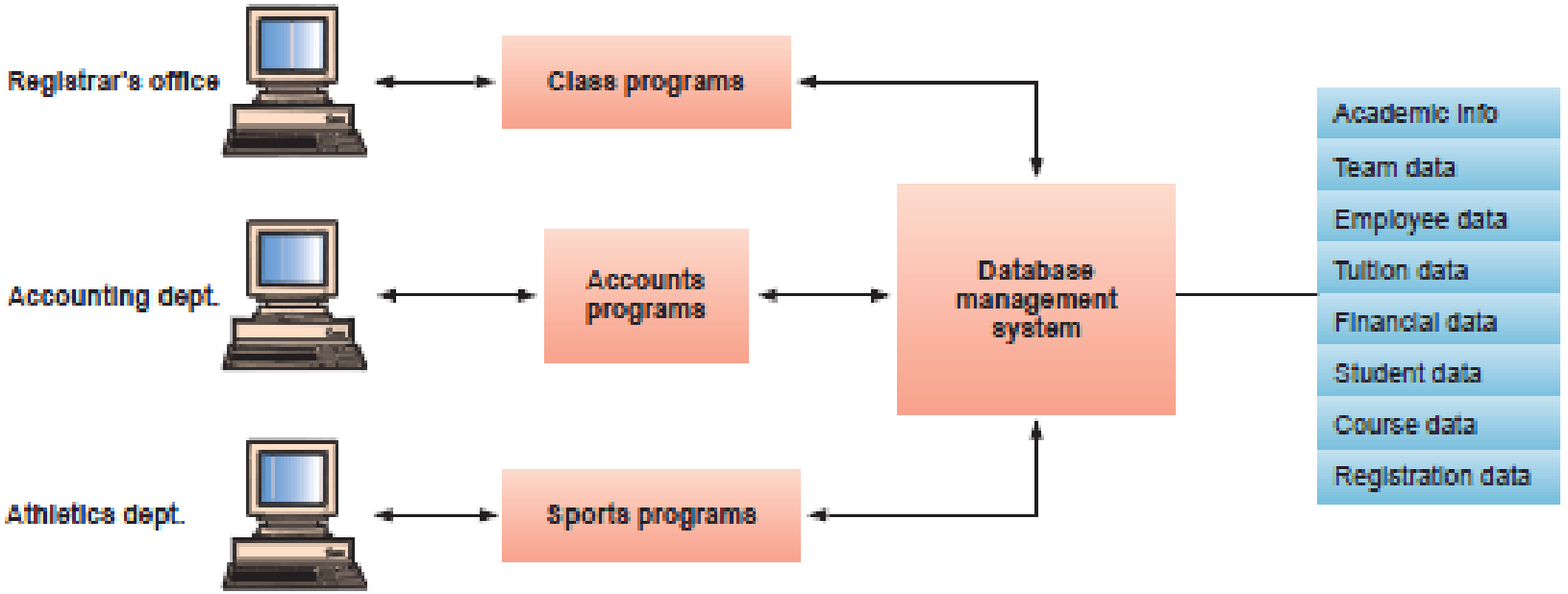
DBMS **maximize**:

- **Data security**: because data is essential for organisations, DBMS provide security measures to stop its misuse;
- **Data integrity**: data has restrictions, such as there are no alphabetic characters in the Citizen ID number;
- **Data independence**: applications and data are independent of each other (multiple applications can access the same data).

Rainer Jr., K. & Cegielski, C. G. (2011). *Introduction to information systems: enabling and transforming business* (3rd edition). John Wiley & Sons

Database (BD) – basic concepts (4/4)

Ilustrating data independency:



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Data Model

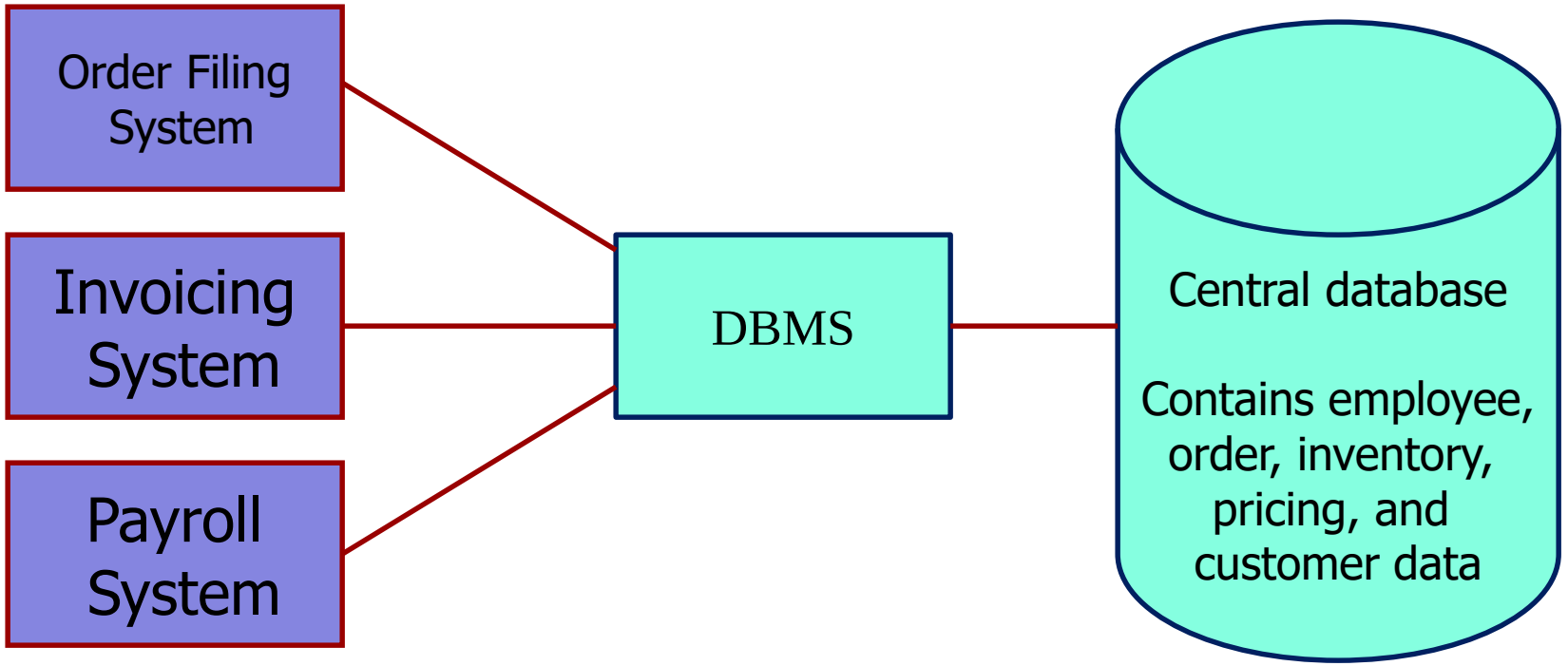
A **data model** is a diagram that represents the entities in the database and their relationships.

A **DBMS** uses a data model that allows describing the structure of the database, in terms of:

- Objects that integrate it (e.g.: Student, Course, Professor) and respective Attributes (e.g.: Professor is described by employee number, name and academic degree)
- Associations between Objects (e.g.: a Course has only one Responsible Teacher)
- Integrity Rules (e.g.: a Student is uniquely identified by its student number)

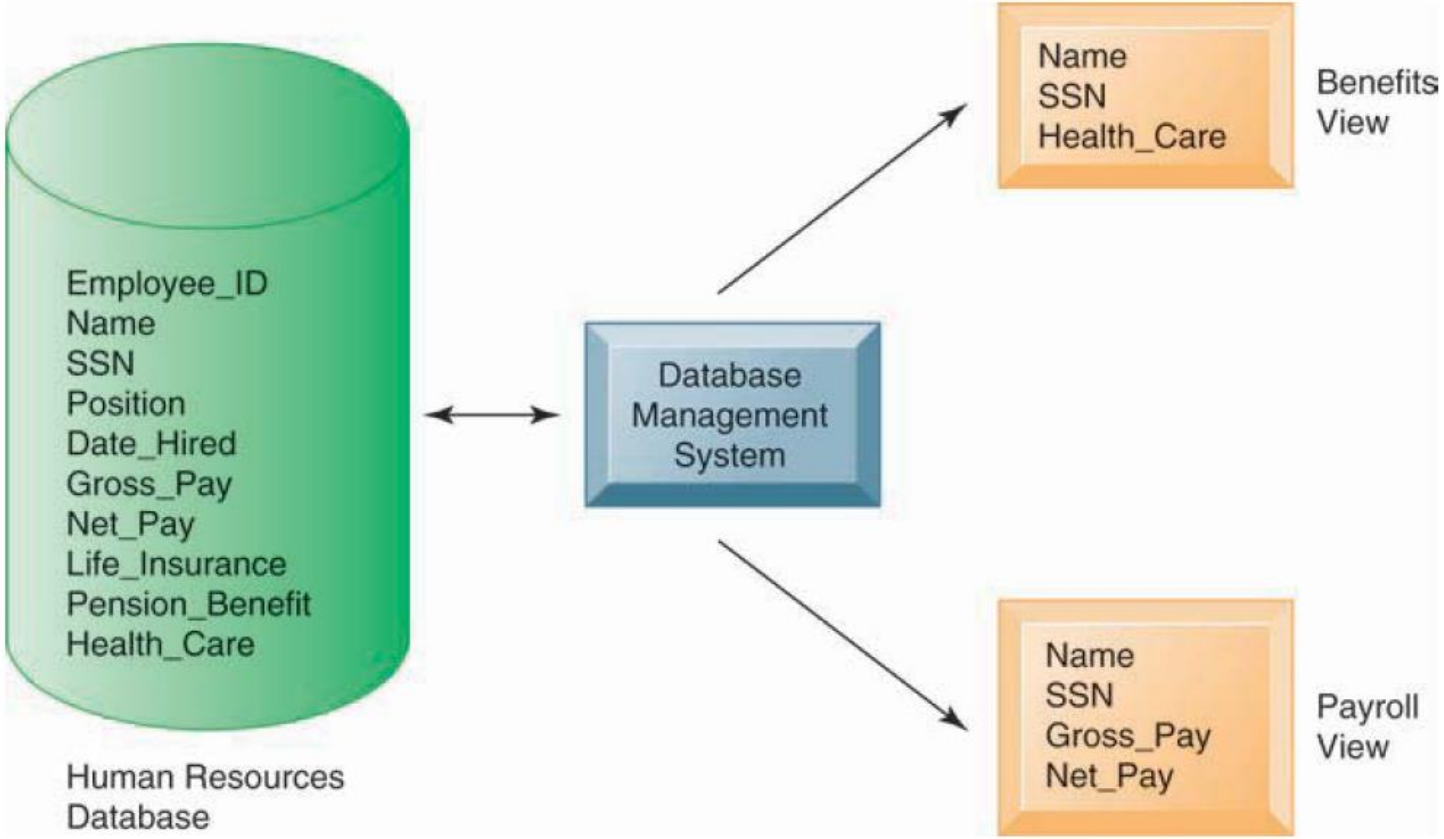
Database System Components

A database system is composed by the **Database** and by the **Database Management System** (DBMS).



Database System Components

In this example, a single human resources database provides two different views of data: one of interest to **benefit specialists** and one to **elements of the payroll area**.



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Database Management System (summary)

- Reduces the **redundancy** and **inconsistency** of an organisation's data, minimizing isolated files or silos in which the same data is repeated;
- Even if there is some **data redundancy**, the DBMS allows you to help control it;
- **Decouples between programs and data**, allowing data to remain independent of who uses it;
- **Reduces the costs** of **developing** and **maintaining programs**, as users and programmers share the same data structures and definitions;
- In short, it allows the organisation to **centrally manage the data**, its use, **consistency** and **access security**.