UNIT I: Introduction to Databases

1.1.- Information System.

1.2.- Database.

1.3.- Database Management System.

1.4.- Database techniques: characteristics.

1.5.- DBMS architecture: database schemas.

Introduction to Databases

OBJECTIVES:

- Introduction to databases and main features.
- Introduction to database management system, its functionalities and components.

1.1.- Information System (IS)

An *information system* is a collection of elements, which are orderly related to each other following some rules, that provide the entity they serve with the necessary information for the completion of its goals.

- Basic functionalities of an IS:
  - Data Gathering.
  - Data Processing.
  - Data Storage.
  - Data Elaboration and Presentation.

1.1.- Information System

An IS is composed of the following elements:

- The contents: the **data**, its description and the programs which manipulate them.
- The hardware: the computer or computers which hold the information system.
- The software: communication systems, database management systems, operating system, ...

- The administrator: person or group of people who are responsible for ensuring the quality and availability of the data.

- Users.

1.2.- Database (DB).

A database is a collection of structured data

1.3.- Database Management System (DBMS)

A database management system is a software tool (collection of programs) that enables users to create, manipulate and maintain a database.

1.4.- DB Techniques: Characteristics.

- Current DBs are characterised by:
  - Integrating all the organisation's information.
  - Data Persistence.
  - Shared accessibility to several users (or applications).
  - Unified data description, independent of the applications.
  - Independence between the applications and data physical representation.
  - Description of partial views of the data for different users.
  - Mechanisms to ensure data integrity and security.

1.4.- DB Techniques: Characteristics.

- DBs pursue a general goal:
  - Global integration of the system's information in order to avoid redundancies, with no loss of the different database perspectives by users.

- Additionally, the software tools (DBMS) specifically designed to apply these techniques must ensure data independence, integrity and security.

- In order to reach this goal DBMSs have a standard architecture: the three-level DBMS architecture.

1.5.- DBMS Architecture.

- A DBMS allows DBs to be defined at three levels of abstraction: logical, physical and external. The definition of the database in each of these levels is known as *schema*.

- At the *logical level*, the data structures which compose the database are defined in a *logical schema*.

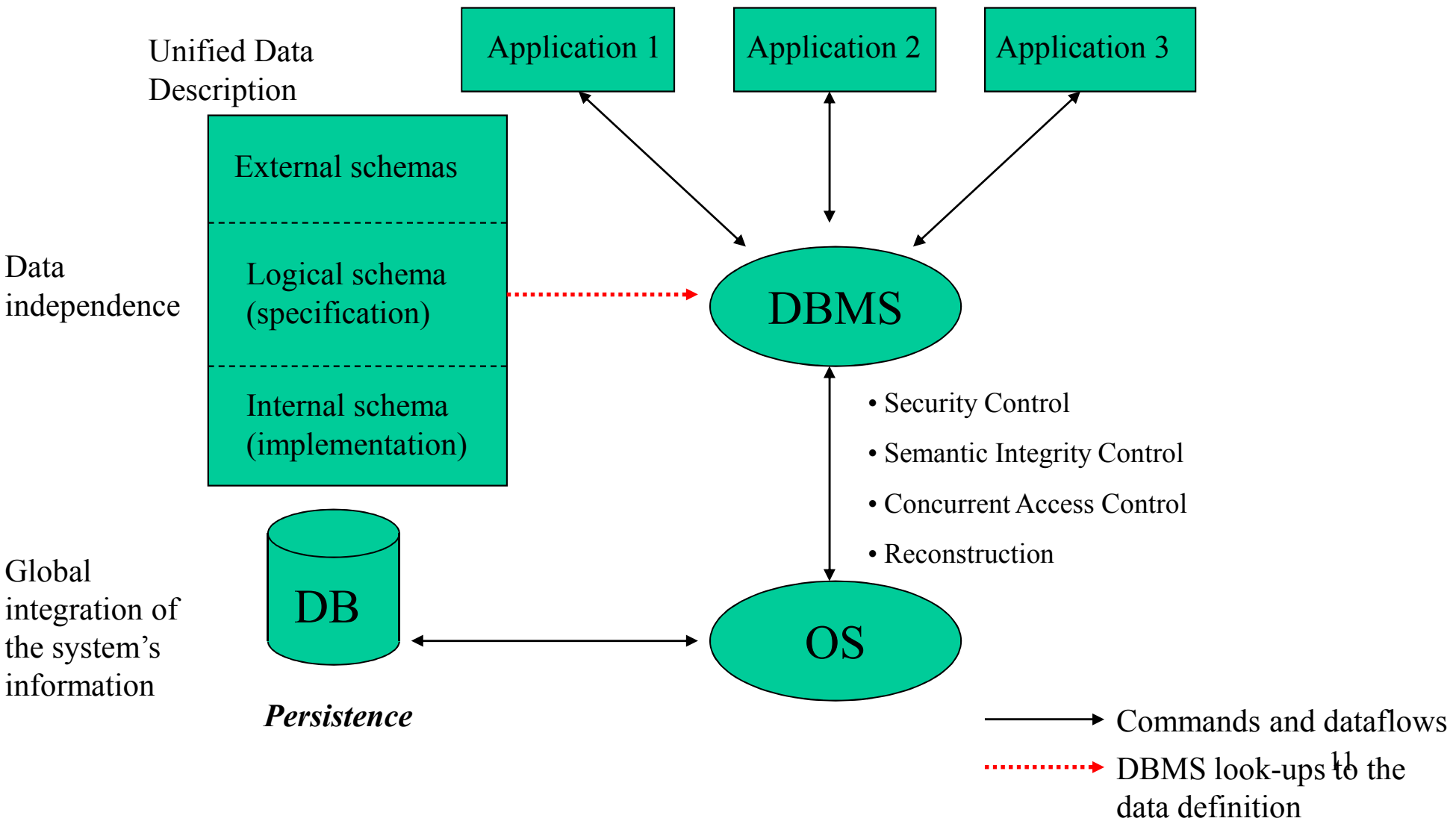
- At the *physical/internal level*, the structures defined in the logical schema are implemented in physical storage. This implementation is called the *physical or internal schema*.

- The *external level* includes a number of *external schemas*. Each external schema includes partial views of the database for a group of users.

1.5.- DBMS Architecture.

DBMS Functionality		DBMS Components
Data definition	→	Languages for database schema definition
Data manipulation	→	Languages for data manipulation
Data management	→	Management tools

1.5.- DBMS Architecture.



Example

Administration's Perspective

Courses

Computer Science Degree (ITIG)					
Term	**Subject**	**Code**	**Dep.**	**Lect.**	**Lab**
1A	Algoritmos y estructuras de datos I	AD1	DSIC	3	3
	Análisis matemático I	AM1	DMA	3	3
	Fundamentos de computadores	FCO	DISCA	4.5	4.5
	Introducción a la programación	IP	DSIC	1.5	1.5
	Matemática discreta	MAD	DMA	3	3
1B	Algoritmos y estructuras de datos II	AD2	DSIC	3	3
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Example

Administration's Perspective

Lecturers

Departament	Code	Name	Tel.
DSIC	LBP	Bos Pérez, Luis	3545
	JCP	Cerdá Pérez, Juan	3222
	PMG	Martí García, Pedro	3412
DISCA	MRC	Ruiz Cantó, María	3675
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Example

Administration's Perspective

Teaching

Term	Courses	Lec. Groups	Lab. Groups	Lecturers	Credits
1ª	AD1	2	4	Cerdá Perez, Juan	9
				Martí García, Pedro	9
	IP	2	4	Bos Pérez, Luis	9
				Cerdá Perez, Juan	9
	AM1	----	----	----	----
1B	AD2	----	---	----	----

Example

Department's Perspective

Lecturers

Code	Name	Address	Category	Tel
LBP	Bos Pérez, Luis	Jesús 91	TEU	3545
JCP	Cerdá Pérez, Juan	Olta 23	TEU	3222
PMG	Martí García, Pedro	Cuenca 12	TEU	3412
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Example

Department's Perspective

Appointed courses

Degree	School	Term	Course	Code	Lec	Lab
ITIG	E.I.	1A	Algoritmos y estructuras de datos I	AD1	3	3
			Introducción a la programación	IP	1.5	1.5
		1B	Algoritmos y estructuras de datos II	AD2	3	3
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Example

Department's Perspective

Teaching arrangement by subject

Term	Degree	School	Course	LecG	LabG	Lecturers	Credits
A	ITIG	E.I.	AD1	2	4	Cerdá Perez, Juan	9
						Martí García, Pedro	9
			IP	2	4	Bos Pérez, Luis	9
						Cerdá Perez, Juan	9
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B	ITIG	E.I.	AD2	----	----	---------	
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Example

Department's Perspective

Teaching arrangement by lecturer

Lecturer	Subject	Degree	School	Term	Credits
Bos Pérez, Luis	IP	ITIG	E.I.	A	9
Cerdá Pérez, Juan	AD1	ITIG	E.I.	A	9
	IP	ITIG	E.I.	A	9
Martí García,Pedro	AD1	ITIG	E.I.	A	9
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Example

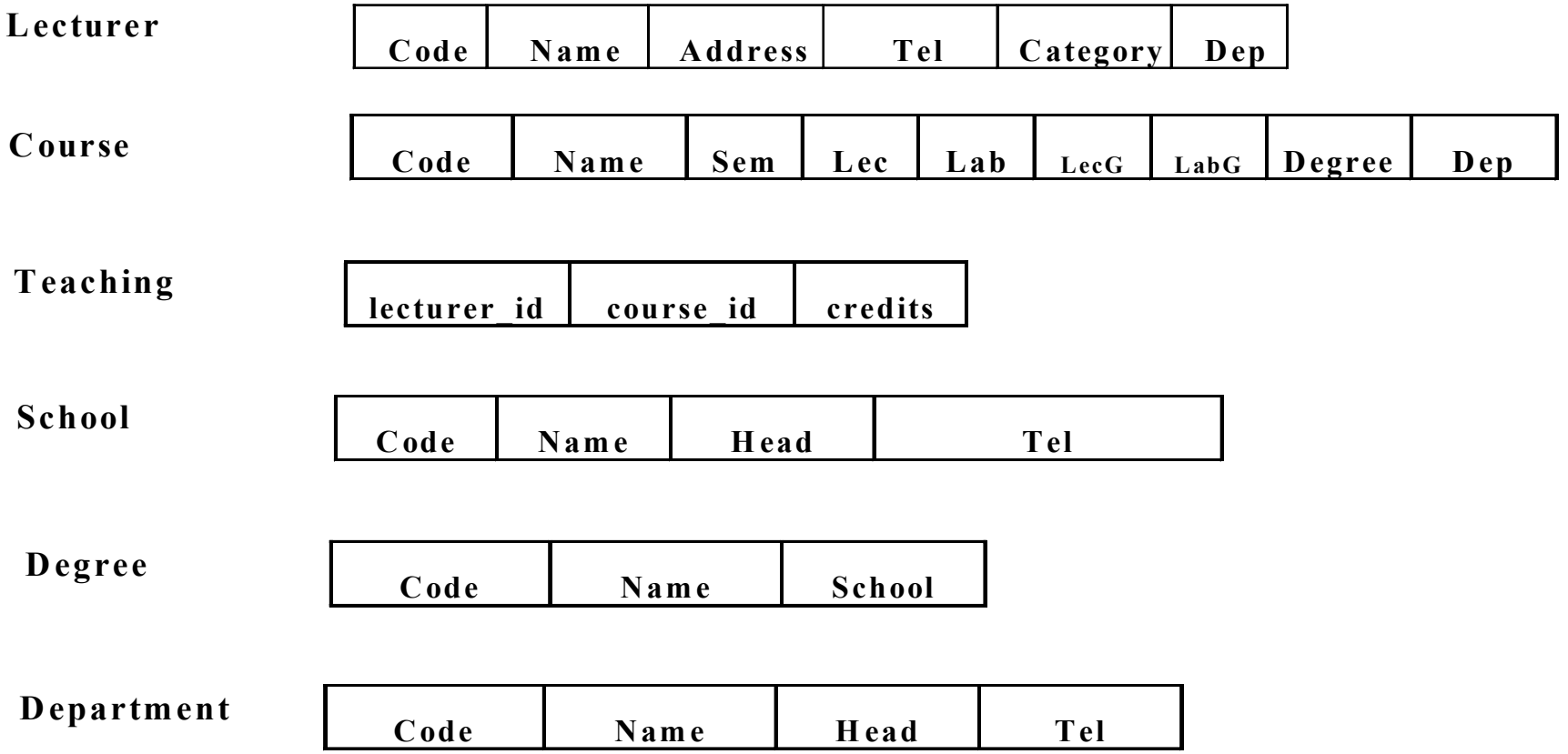
Lecturer's Perspective

Teaching arrangement for José Hernández Orallo

Course	School	Year	Term	Credits
ABD	E*I	3rd	B	6
AMD	FI	5th	B	3
BDA	E*I	2nd	B	6
Extr. Con.	M.Sc.	-	B	2

Example

LOGICAL SCHEMA



Example

RELATIONAL DATABASE

Department Relation

Code	Name	Head	Tel
DSIC	Sistemas Informáticos y Computación	Juan García	3570
DFA	Física Aplicada	José Ruíz	3540
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Example

RELATIONAL DATABASE

Degree Relation

Code	Name	School
ITIG	Ingeniero Técnico en Informática de Gestión	E.I.
ITIS	Ingeniero Técnico en Informática de Sistemas	E.I.
II	Ingeniero Informático	FI
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Example

RELATIONAL DATABASE

School Relation

Code	Name	Head	Tel
E.I.	Escuela Universitaria de Informática	Pedro Ruiz	3578
FI	Facultad de Informática	José Esteban	3776
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Example

RELATIONAL DATABASE

Lecturer Relation

Code	Name	Address	Tel	Category	Dep
JCP	Juan Cerdá Pérez	Olta 23	3222	TEU	DSIC
LBP	Luis Bos Pérez	Jesús 91	3545	TEU	DSIC
PMG	Pedro Martí García	Cuenca 12	3412	TEU	DSIC
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Example

RELATIONAL DATABASE

Course Relation

Code	Name	Sem	Lec	Lab	LecG	LabG	Degree	Dep
AD1	Algoritmos y estructuras de datos I	1A	3	3	2	4	ITIG	DSIC
IP	Introducción a la programación	1A	1.5	1.5	2	4	ITIG	DSIC
AD2	Algoritmos y estructuras de datos II	1B	3	3	--	--	ITIG	DSIC
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Example

RELATIONAL DATABASE

Teaching Relation

lecturer_id	course_id	credits
JCP	AD1	9
JCP	IP	9
LBP	IP	9
PMG	AD1	9
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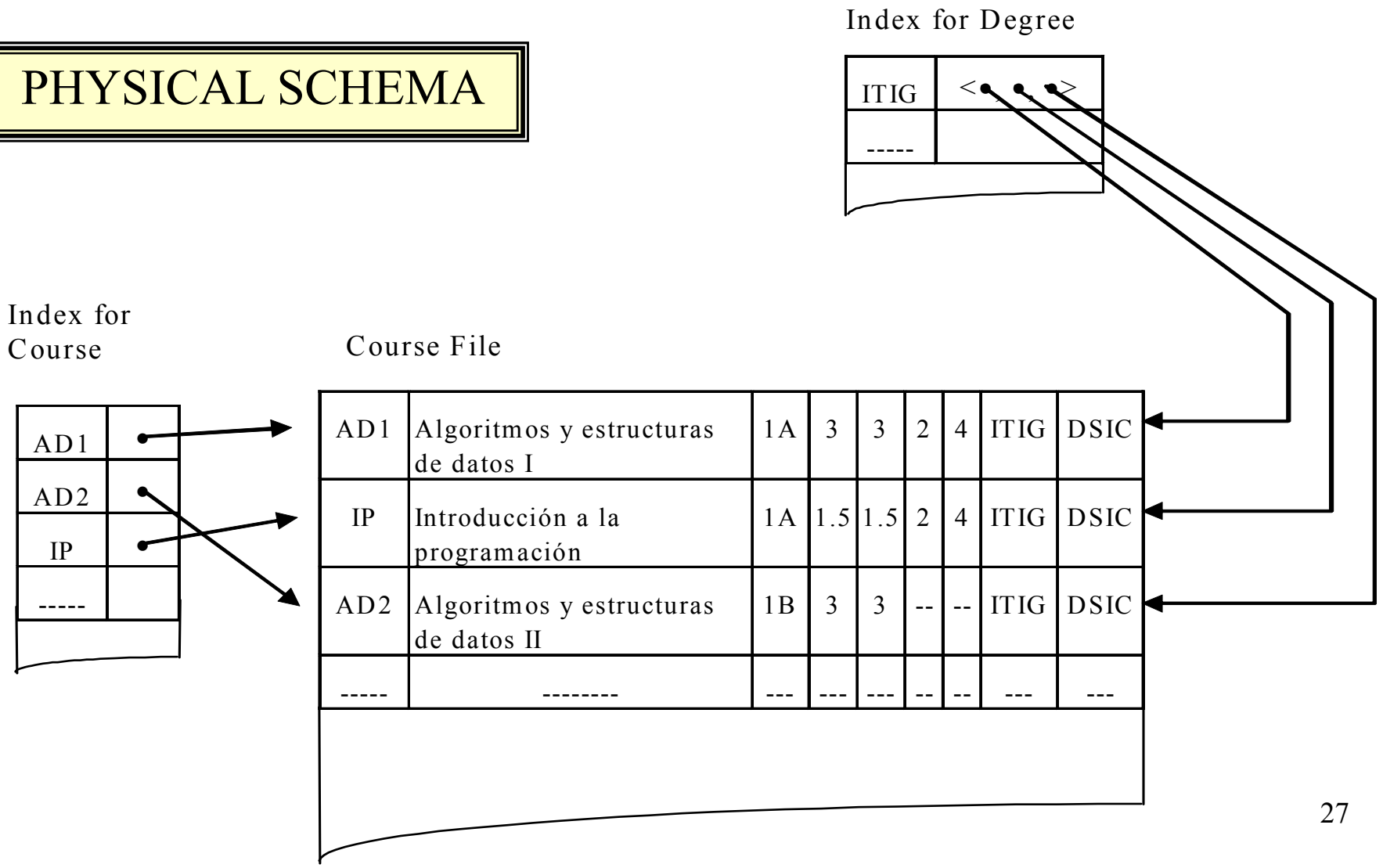
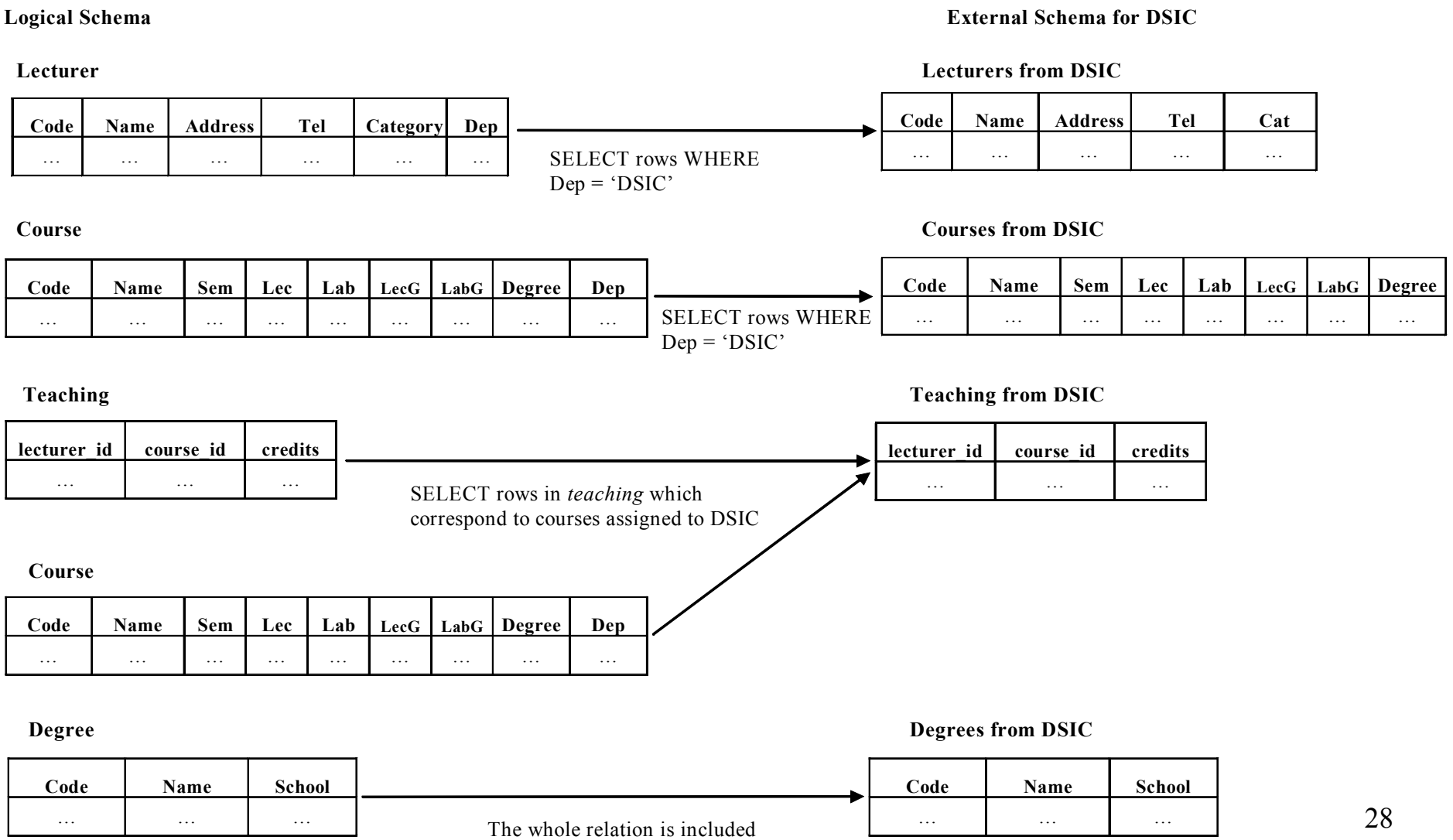
Example

PHYSICAL SCHEMA



Example (Correspondence LS - ES)



One thought about redundancy

What happens if we have duplicated information?

- Storage space is not optimised.
- Higher update cost.
- We can have inconsistencies.

  For instance:
  Slides. 15 and 24. The categories of some teachers differ!