

Study stream : Computer Science
Level: 2nd Year Bachelor's Degree
Module: DataBase
Instructor: Dr. Bouneb M.

Tutorial N°03

Objectives :

- ☞ Understand the concept of functional dependency.*
- ☞ Definition of a universal relational schema of a database.*
- ☞ Definition of a primary key.*
- ☞ Definition of a foreign key.*
- ☞ Normalization of a universal relational schema of a database.*
- ☞ Training on eliminating redundancy in the database.*

Exercise 01:

We consider the following functional dependencies:

$A \rightarrow E, F, G, C$;

$A, B \rightarrow C, M$;

$B \rightarrow I, J$;

$E \rightarrow G, H$;

$J \rightarrow K$

Questions:

- 1. Provide the logical model in the second normal form (2NF) that respects these functional dependencies.*
- 2. Provide the logical model in the third normal form (3NF) that respects these functional dependencies.*

Exercise 02:

Let U be a universe and $X, Y, Z,$ and W be subsets of attributes of U . Do the following logical implications hold? If yes, prove it; if no, provide a counterexample.

- 1. $\{X \rightarrow Y; Z \rightarrow W\} \Rightarrow X, Z \rightarrow Y, W$*
- 2. $\{X, Y \rightarrow Z; Z \rightarrow X\} \Rightarrow Z \rightarrow Y$*
- 3. $\{X \rightarrow Y; Y \rightarrow Z\} \Rightarrow X \rightarrow Y, Z$*

4. $\{X \rightarrow Y; W \rightarrow Z\}$ et $W \supseteq Y \Rightarrow X \rightarrow Z$
5. $\{W \rightarrow Y; X \rightarrow Z\} \Rightarrow W, X \rightarrow Y$
6. $\{X \rightarrow Y\}$ et $Y \supseteq Z \Rightarrow X \rightarrow Z$
7. $\{X \rightarrow Y; X \rightarrow W; W, Y \rightarrow Z\} \Rightarrow X \rightarrow Z$
8. $\{X, Y \rightarrow Z; Y \rightarrow W\} \Rightarrow X, W \rightarrow Z$
9. $\{X \rightarrow Y; X, Y \rightarrow Z\} \Rightarrow X \rightarrow Z$

Exercise 03:

We want to model the management of a library. We need to represent:

✍ **Books** with: book number, book title.

✍ **Authors** with: author's last name, author's first name.

✍ **Publishers** with: publisher code, publisher name.

✍ **Depots** with: depot code, depot name, city.

Note: Here, a "book" is not a unique copy but may have multiple copies of the same book.

The investigation of the domain has defined the following rules:

A book can:

✍ Be written by multiple authors.

✍ Be published by multiple publishers, but only once by each of them in a year. To differentiate the number of times a book is published by the same publisher, the **publication year** is recorded.

✍ Be stored in multiple depots, and this applies to each publisher.

✍ Each stored book is recorded with a specific quantity.

Question:

1. Provide the universal relational schema of the database for this system

2. *Put the schema of this database in the third normal form (3NF) and, of course, define the primary key and possibly the foreign key for each relation.*

Exercise 04:

A merchant wants to reorganize the management of orders from their suppliers, who are defined by a number, a name, and an address. Products have a number, a description, a name, a weight, and a price. The merchant wants to be able to know at any time when and how many products were purchased from a supplier, as well as differentiate between a "not delivered" and a "delivered" status for each order.

Question:

1. *Provide the universal relational schema of the database for this system*
2. *Put the schema of this database in the third normal form (3NF) and, of course, define the primary key and possibly the foreign key for each relation.*

Exercise 05:

The university's computer system uses the following data:

- *For each student: their registration number, last name, first name, and address.*
- *For each course: the course code, title, and a brief summary.*
- *For each professor: their registration number, rank, last name, first name, and address.*
- *For each program: name and code.*

Students must choose a program, and each program is managed by a professor.

Students take courses, and each course is created by a professor.

Question:

3. *Provide the universal relational schema of the database for this system*
4. *Put the schema of this database in the third normal form (3NF) and, of course, define the primary key and possibly the foreign key for each relation.*