University of Larbi Ben Mhidi Oum El Bouaghi
Faculty of Exact Sciences and Life and Natural Sciences
Department of Mathematics and Computer Science

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

Tutorial N°02

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→E, F, G, C ;

A, B→C, M ;

B→I, J ;

E→G, H ;

J→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.*