Lab: Creating a Database

In this lab, we design and develop the database of some school, with a focus on students, courses and enrolments.

1   Database Modeling

The database records the following information. For students: last name, first name, school year (i.e. 1, 2, … , 5); for courses: name, school year (i.e. 1, 2, … , 5), duration (in hours). The database also records the enrollments of students in courses, and the final grade that students get in each course they are enrolled in.

In this part, we assume that (a) the pair of attributes (last name, first name) uniquely identifies the students; (b) there are no two courses with the same name.

Give the relational schema of the database, with all the primary keys and foreign keys involved. Does your schema allows a student to be enrolled in several courses, or a course to have no enrolled student? How is this represented?

2   Database Modeling – Alternate Solution

We now assume that students also have a student ID, and that courses also have a unique code, e.g. INGPA-INF4000-13 for the database course.

Propose a new relational schema based on these new assumptions.

3   Comparing the Two Models

Compare the relational schemas of exercises 1 and 2 with respect to:

- disk space usage
- the query "find the name of the courses *Salim Dupond* is enrolled in"
- the modification "change the course name *databases* for *advanced databases*"

4   Creating and Populating the Database

We now consider the relational schema of exercise 2. Using an SQL interpreter and the « create table… », « insert… » and « select… » statements:

- create the tables of the database **without** the primary and foreign key constraints,
- populate the database with the student #123456789, DUPONT Salim, 4th year, and the course INGPA-INF4000-13, Databases, 27 hours, and Salim being enrolled in the Database course with a final grade of 18,
- check that everything is correct.

Observe that you could modify and query the database without any primary or foreign key defined. Why is that?

5   Database Script

Create a database script named `school.sql`, with all the SQL statements required to create and populate the database.

This time, make sure you define in the script all the primary and foreign key constraints needed. Give a unique name to each constraint using the construct "constraint *myConstraintName* primary key…". In which order must the script create the tables? Is it always possible?

Before creating the table, the script must first drop for a fresh start. In which order must the script drop the table? Is it always possible?

Finally, the script must populate the database with the test data defined in the previous exercise. Again, in which order must the script insert the tuples?

Run your script several times and check that the tables are correctly created and populated from scratch every time you run it.

6   Modifying the Database's Instance

Using an SQL interpreter:

- Insert a new student whose school year is not known (2 methods).
- Change the duration of the Database course from 27 to 30 hours.
- Change the name of the Databases course to Advanced Databases

At each step, check that the update is correct.

7   Checking the Key Constraints

Primary key constraint on table Students:

1. Try to insert the same student twice. Next, try to insert a new student with a NULL ID. Observe the error message that you get and explain it.

2. Drop the primary key constraint on table Students and perform again the two inserts of the previous questions. What do you observe now?

3. Try to restore the primary key constraint on table Students. Explain what you observe.

4. Modify the instance of the table so that you can now restore the primary key constraint.

Foreign key from table Enrollments to table Students

1. In table Enrollments, insert a new tuple with a NULL student ID. Next, insert a new tuple with a student ID that is not listed in table Students. Observe the error messages that you get.

2. Drop the foreign constraint from table Enrollments to table Students and perform again the previous two inserts. Explain what you observe.

3. Try to restore the foreign key constraint you just dopped. Explain what you observe.

4. Modify the instance of the table so that you can now restore the foreign key constraint.

8 Modifying the Database's Schema

We now want to record in the database the course-work grade of each student for each course he/she is enrolled in. In which table does this attribute go? Do we need to drop and re-create this table from scratch?

Use the "alter table…" construct to add this new attribute and display the table. What is the default value of the new attribute?