

Design - Part A

1. The following relations are given (primary keys are underlined):

```
STUDENT(StudentID, Name, DegreeYear, DegreeType, DegreeGrade)
DEPARTMENT(DCode, Name, Scientific-Field, Teacher#)
PHD_COMPETITION(CCode, DCode, PostingDate, ExpirationDate, #ofOpenPositions)
STUDENT_PARTECIPATE_PHD_COMPETITION(CCode, DCode, StudentID, SubmissionDate)
```

Write the following queries

- (a) *Mandatory* exercise in relational algebra (4 points):
Show the identifier and the name of students who achieved a degree grade higher than 105, and who have applied to at least two PhD competitions with the same posting date.
- (b) *Mandatory* exercise in SQL language (5 points):
For the departments that have opened only PhD competitions for 7 open positions or more, show the name of the department, the scientific field and the total number of PhD competitions posted after March 2014 (attribute PostingDate).
- (c) *Optional* exercise in SQL language (6 points):
For each student who has applied to PhD competitions related to at least three different scientific fields, show the student name and the scientific field to which he applied to *all* the opened PhD competitions.

Design - Part B

A research organization wishes to design a database to manage activities related to funded research projects.

- Each funded project is identified by a code, and it is characterized by the title, the total budget, and the start and end dates of the project.
 - Each project consists of many activities. Each activity is characterized by a unique code within the project. Activities are classified as requirement definition, development activity and dissemination activity. For each development activity the list of released software components is stored. Each software component is identified by a code and it is characterized by a brief description, its name and the list of hardware requirements needed to use the component. For each dissemination activity the list of the names of the scientific congresses where the project achievements were presented is stored.
 - The employees of the research institution are identified by their Social Security Numbers (SSN). For each employee, the name, the hiring date, and the URL of the personal webpage (if available) are stored. For each project the employee who is currently the coordinator is known. In addition, the database stores the activities in which each employee has been involved, indicating the time period (start and end dates) and the total number of working hours. Please, consider that the same employee can be involved in the same activity in different time periods. Furthermore, in the same time period, different employees may be involved in the same activity and the same employee may be involved in two or more activities.
 - The project activities are periodically subject to assessments by external auditors. Each auditor is identified by a code and it is characterized by the name and the qualification. Each assessment is characterized by its time period (start and end dates) in which it has been performed, the auditor who performed the assessment, the activity under assessment and the judgment achieved. Please consider that the same auditor cannot perform two assessments simultaneously.
 - Account statements are reported quarterly for the project. Each account statement is identified by the year, 3-month time period and the project for which it has been carried out. The total amount of expenses is also stored.
1. *Mandatory* exercise (9 points): Describe the conceptual schema of a database for the above application by means of an ER diagram.
 2. *Mandatory* exercise (3 points): Derive a normalized relational logical schema for the same database.
 3. *Optional* exercise (1 point): Define referential integrity constraints for 3 relations of your choice among those defined in the conceptual schema.