ORDRE DES ING ÉNIEURS DU QU ÉBEC

MAY 2014 SESSION

Open-book examination
Calculators: only authorized models
Duration: 3 hours

14-IF-B3 Data Bases and File Systems

1. [10 points]
   How many relations are there on a set with n elements?
2. [10 points]
   Consider the following relations on the set of integers : R_1 = {(a, b)|a ≤ b}
   R_2 = {(a, b)|a > b}
   R_3 = {(a, b)|a = b v a = − b}
   R_4 = {(a, b)|a = b}
   R_5 = {(a, b)|a = b + 1}

   Which of these relations are reflexive ?
3. [10 points]
   List the triples in the relation {(a, b, c)|a, b, and c are integers with 0 < a < b < c < 5}.
4. [10 points]
   Let R be the relation on the set {0, 1, 2, 3} containing the ordered pairs (0, 1), (1,1), (1, 2), (2, 0), (2, 2), and (3, 0). Find the reflexive closure of R and the symmetric closure R.
5. [10 points]
   Show that a primary key in a n-ary relation is a primary key projection of this relation that contains this key as one of its fields.
6. [10 points]
   Explain the advantages and disadvantages of database programming approaches. There are 3 main approaches.
7. [10 points]
   Explain what is a functional dependency. What are the possible sources of information that defines the functional dependencies that hold among the attributes of a relation schema?

8. [10 points]
   Consider the following database application DBU:

   (a) A university keeps track of each student's name, student number, social insurance number, current address and phone, permanent addresses and phone, birthday, sex, class (freshman, sophomore, . . . , graduate), major department, minor department (if any), and degree program (B.A., B.S, . . . Ph.D.). Some user applications need to refer to the city, province, and zip of the student's permanent address and to the student's last name. Both social insurance number and student number have unique values for each student.

   (b) Each department is described by a name, department code, office number, office phone, and Faculty. Both name and code have unique values for each department.

   (c) Each course has a course name, description, course number, number of semester hours, level, and offering department. The value of course number is unique for each course.

   (d) Each section has an instructor, semester, year, course, and section number. The section number distinguishes different sections of the same course that are taught during the same semester/year; its values are 1, 2, 3,. . . , up to the number of sections taught during each semester.

   (e) A grade report has a student number, section, letter grade, and numeric grade (0, 1, 2, 3, 4).

   Design an Entity-Relation schema for this application, and draw an Entity-Relation diagram for that schema. Specify key attributes of each entity type and structural constraints on each relationship type. Note any unspecified requirements, and make appropriated assumptions to make the specification complete.

9. [10 points]
   Give the SQL queries to build the database schema for DBU (question ??).

10. [10 points] Using DBU (question ??), give the SQL queries to:

    (a) Retrieve the names of all students in CS (computer science) following the course Databases in 2003 and a grade > 3.

    (b) Retrieve the names of all courses taught by Professor Ullman in 1985 and 1986.

    (c) For each section taught by Professor Date, retrieve the course number, semester, year, and number of students who took the section.

    (d) Retrieve the names and departments of all straight-A students (students who have a grade A in all their courses).

    (e) Find the number of all straight-A students.

End of the exam.