The University of British Columbia  
Computer Science 304  
Midterm Examination  
June 6, 2011

Time: 50 minutes  
Instructor: Rachel Pottinger

Name  ANSWER KEY  
(Student No)  
(Print)  (Last)  (First)

Signature

This examination has 3 doublesided pages.

Check that you have a complete paper.

This is a closed book, closed notes exam. No books or other material may be used.

Answer all the questions on this paper.

Give very short but precise answers.

State any assumptions you make

Work fast and do the easy questions first. Leave some time to review your exam at the end.

Good Luck

<table>
<thead>
<tr>
<th>Question</th>
<th>Mark</th>
<th>Out of</th>
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<tbody>
<tr>
<td>1.a</td>
<td>5</td>
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<tr>
<td>1.b</td>
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<tr>
<td>2.a</td>
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<td>2.b</td>
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<td>2.c</td>
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<td>2.d</td>
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<td>TOTAL</td>
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<td>Out of 30</td>
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All queries for this exam use the same schema as in class and in the SQL exercises in the book:

- Student(snum: integer, sname: string, major: string, level: string, age: integer)
- Class(name: string, meets at: string, room: string, fid: integer)
- Enrolled(snum: integer, cname: string)
- Faculty(fid: integer, fname: string, deptid: integer)

The schema will be repeated on following pages for easy reference. The meaning of these relations is straightforward; for example, Enrolled has one record per student-class pair such that the student is enrolled in the class.

1. {10 marks} Relational Algebra. For each query return EXACTLY the following:
   a. Find the student numbers of the students who have taken classes from teachers with the same name (e.g., you’d return the student ID of the student “Elizabeth Taylor” if she also took a class from “Elizabeth Taylor”)

\[
FT \leftarrow \pi_{fname, name}(\text{Class} \bowtie \text{Faculty})
\]

\[
SE \leftarrow \pi_{sname, cname}(\text{Student} \bowtie \text{Enrolled})
\]

\[
\Pi \ sname(SE \bowtie \sigma_{name = \text{cname} \land sname = fname} FT)
\]

Note: during the exam I clarified that I was asking about student names, not student numbers, otherwise you’d need to modify SE to project snum and then project snum from the answer.

   b. Find the names of all students who have taken all courses taught by Elizabeth Taylor.

\[
\rho(ET(cname), \pi_{name}(\sigma_{fname = ‘Elizabeth Taylor’}(\text{Class} \bowtie \text{Faculty})))
\]

\[
\rho (SE, \pi_{sname, cname}(\text{Student} \bowtie \text{Enrolled}))
\]

\[
SE/ET
\]

Common errors:
- Miss that it’s division
- Have the wrong thing to divide by: it’s student enrollments divided by classes by Elizabeth Taylor
- Forget to project the classes taught by Elizabeth Taylor

Note: it’s just fine to join student with enrolled after the division.
The schema again:

Student(snum: integer, sname: string, major: string, level: string, age: integer)
Class(name: string, meets at: string, room: string, fid: integer)
Enrolled(snum: integer, cname: string)
Faculty(fid: integer, fname: string, deptid: integer)

2. **{20 marks} SQL Queries. For each query return EXACTLY the following (i.e., remove duplicates from your final answers where they are not explicitly requested, and include no extra columns):**
   a. List in reverse alphabetical order the names of all students who have not taken a class with “Intro” in the title
      
      ```sql
      select distinct sname
      from student s
      where s.snum not in (select s2.snum
         from student s2, enrolled e
         where e.snum = s2.snum and cname like '%Intro%')
      order by sname desc
      ```
      
      24 rows:
      Thomas Robinson
      Susan Martin
      Steven Green
      Paul Hall
      Nancy Allen
      Mark Young
      Maria White
      Margaret Clark
      Luis Hernandez
      Lisa Walker
      Kenneth Hill
      Karen Scott
      Juan Rodriguez
      Joseph Thompson
      George Wright
      Edward Baker
      Dorthy Lewis
      Donald King
      Daniel Lee
      Christopher Garcia
      Charles Harris
      Betty Adams
      Angela Martinez
      Ana Lopez

   b. How many classes have an unknown meeting time?
      
      ```sql
      SELECT count(*)
      FROM class
      WHERE meets_at is NULL
      ```
      
      Answer: 2
The schema again:

Student(snum: integer, sname: string, major: string, level: string, age: integer)
Class(name: string, meets at: string, room: string, fid: integer)
Enrolled(snum: integer, cname: string)
Faculty(fid: integer, fname: string, deptid: integer)


c. Find the age of the oldest student who is either a Economics major or enrolled in a course taught by John Williams
   Note: this question is isomorphic to question 5.1.2 in the book
   SELECT MAX(S.age)
   FROM Student S
   WHERE (S.major = 'Economics')
   Or S.snum in (SELECT E.snum
      FROM Class C, Enrolled E, Faculty F
      WHERE E.cname = C.name AND C.fid = F.fid
      AND F.fname = 'John Williams')

   MAX(S.AGE)
   ---------
   21

d. Find the names of the students enrolled in the maximum number of classes.
   Note: this is question 5.1.10 in the book
   SELECT DISTINCT S.sname
   FROM Student S
   WHERE s.snum in (SELECT E.snum
      FROM Enrolled E
      Group By E.snum
      Having Count(*) >= all
      (SELECT COUNT (*)
       FROM  Enrolled E2
       GROUP By E2.snum))

   SNAME
   ------------------
   Ana Lopez
   Juan Rodriguez
   Luis Hernandez