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CMPUT 391: Database Management Systems

Midterm Examination

February 16, 2001

It is a close-book examination and the time for the test is 50 minutes. There are seven (7) questions. The value of each question is indicated and the total is 100. Good luck to all of you.

1. Give an example to demonstrate that allowing users to define methods in object-relational databases can lead to efficiency gains. [6]

2. Consider a relational database about a university with the following three relations

   teach(Prof, Course)
   take(Student, Course, Grade)
   advise (Prof, Student)

   The first relation indicates the courses a prof teaches; the second tells what courses each student takes and the corresponding grades (1-9); and the last indicates advisors of a student.

   Write an SQL query to list all the students who take only courses taught by professors with the heaviest teaching load, i.e., professors who teach no less courses than any other professors. [12]

3. Consider the above database again. Write triggers

   (a) to enforce the constraint that a professor must advise at least five students if she/he teaches less than three courses.

   (b) to assign (or re-assign if there exists one) Discipline as the advisor of any student whose GPA (assume all courses have the same credit) is less than 5. [25]

4. List **ALL** non-trivial multivalued dependencies satisfied by the following relation. (Note that $X \twoheadrightarrow W$ is non-trivial if $X \cap W = \emptyset$ and $XW \subset R$.) [12]

A	B	C
a2	b2	c1
a1	b1	c2
a1	b1	c3
a2	b3	c1

5. Consider the universal relation $R = ABCDEGH$ and the following set F of functional dependencies

   $AB \rightarrow C$
   $A \rightarrow BD$
   $AD \rightarrow E$
   $B \rightarrow DE$
   $E \rightarrow G$

   Find a join loss-less, dependency preserving and 3NF decomposition of R. Is your database schema BCNF ? [15]

6. Consider a universal relation schema $R = ABCDEG$ with the set of functional dependencies $F = \{A \rightarrow G,\ CD \rightarrow B,\ D \rightarrow G,\ D \rightarrow C\}$.

   Find a join loss-less, BCNF decomposition of U with respect to F. Is your decomposition dependency preserving? [15]

7. Consider the following XML document. Define a relational database schema suitable for storing the information in the document in Oracle, and populate your database according to the XML document. You may use a table with column names to show both the schema and instance of the table. The better the schema, the higher the mark [15]

```
<?xml version="1.0" encoding="utf-8"?>
<course number="c391" department = "computing science">
   <title>
        Database Management Systems
   </title>
   <student>
        <student sid = "54321">
             <name>
                 Richard Brewka
             </name>
             <email>
                 brewka@cs.ualberta.ca
             </email>
             <grade>
                  6
             </grade>
         </student>
         <student sid = "12345">
             <name>
                 Charles M. Schulz
             </name>
             <email>
                Schulz@cs.ualberta.ca
             </email>
             <grade>
                 5
             <grade>
        </student>
   </students>
</course>
<course number="c291" department = "computing science">
   <title>
        File and Database Management Systems
   </title>
   <students>
        <student  sid = "12345">
             <name>
                  Charles M. Schulz
             </name>
             <email>
                 schulz@cs.aublerta.ca
             </email>
             <grade>
                 8
             </grade>
        </student>
   </students>
</course>
```