

CMPUT 391: Database Management Systems

Midterm Examination

Feb. 28, 2000

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

1. Compare the use of embedded SQL in a general-purpose language with the use in SQL of functions defined using a general-purpose language. Under what circumstances would you use each of these features? [10]
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; and the last indicates advisors of each student. Write an SQL query to find the number of courses taken by each student that are taught by their advisors, providing that the student take at least one such course. [15]

3. Consider the following relational database schema:

emp(Eid, Ename, Age, Salary)
works(Eid, Did, Pct_tim)
dept(Did, Budget, Manager)

An employee can work in more that one department. Pct.time of the works relation shows the percentage of time that a given employee works in a given department. [15]

Write CREATE TRIGGER statements to enforce each of the following two constraints, considered independently.

- (a) A manager of any Department must be an employee.
- (b) {Eid, Did} is the (primary) key of works. [20]

4. Consider $R = ABCDEFG$ and the set of functional dependencies

$F = \{ BCD \rightarrow A, BC \rightarrow E, A \rightarrow G, G \rightarrow F, B \rightarrow D, A \rightarrow F \}$.

- (a) Find a join loss-less, dependency preserving and 3NF decomposition of R .
- (b) Indicate whether your database schema is in BCNF with respect to F . [20]



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YUAN, L.
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5. A relation is in first normal form (flat relations) if the domains of all attributes are *atomic*, i.e., elements of the domains are considered to be indivisible units. On the other hand, a relation is in non-first normal form (nested relations) if the domains of a attribute may contains a table itself. For example, the following table is in non-first normal form (i.e. it is a nested relation).

professor	course	graduate_student
Korth	{ 291, 114, 391}	{ Sarah, Tom}

The object relational data model extends the relational data model in many different ways, and one of them is to allow non first normal form relations.

Consider a simple database consisting of one table below.

title	author	keyword
sales plan	Smith	profit
sales plan	Smith	strategy
sales plan	Jones	profit
sales plan	Jones	strategy
databases	Korth	computers
databases	Korth	information
databases	Silb	computers
databases	Silb	information

Obviously, this database was designed by someone who fails CMPUT 391. Please redesign this database to eliminate redundancy, into both flat and nested relations.

For each case (flat and nested), you need to specify the new database schema, and present the database instances (real tables). [20]

6. Give a real-world-like (not something with A, B, or C) database schema (i.e., a list of attributes), together with a set of all *reasonable* MVDS that hold on the schema. Your schema should contain at least eight (8) attributes, and two (2) non-trivial MVDs that are not FDs. Is you schema in 4NF? If not, decompose it into a 4NF database schema. [15]