UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For the following qualifications :-

B. Sc. *M.Sci.*

Comp Sci 3C13: Database and Information Management Systems

COURSE CODE	:	COMP3C13
UNIT VALUE	:	*0.50*
DATE	:	*18-MAY-01*
TIME	:	14.30
TIME ALLOWED	:	2 hours 30 minutes

Answer any three out of the following five questions

1. Answer the following three parts.

   a. Briefly argue why the relational algebra (or equivalently SQL) cannot express the transitive closure operation.

      Why do you think the designers of SQL decided to exclude the transitive closure operation from the language ?

      [11 marks]

   b. Given a fixed relation, say r, over a relation schema, R, whose attributes are PARENT and CIRLD give a simple algorithm which computes the transitive closure of the relation r.

      You are allowed to use the following relational algebra operators in your algorithm: projection, natural join, union and renaming.

      [11 marks]

   c. What are the fundamental differences between the relational algebra and SQL ?

      Explain briefly why SQL, as opposed to the relational algebra, has become the industry standard relational database query language.

      [11 marks]

[Total 33 marks]

2. Answer the following three parts.

a. Briefly explain the main difference between Third Normal Form (3NF) and Boyce-Codd Normal Form (BCNF) through a simple example.

Explain why in practice, a database designer might be content with a 3NF database schema that is not in BCNF.

[11 marks]

b. A simple key is a key which consists of only a single attribute.

Give a proof (or a convincing argument) of the assertion that a relation schema R that is in Third Normal Form (3NF) with respect to a set of functional dependencies F over R and such that all the keys for R with respect to F are simple is also in Boyce-Codd Normal Form (BCNF) with respect to F.

[11 marks]

c. Two sets of FDs F and G both over a relation schema R are said to be logically equivalent if they are covers of each other, i.e. the closure of F with respect to Armstrong's axiom system is equal to the closure of G, also with respect to Armstrong's axiom system.

Give an efficient algorithm for testing whether a set of FDs F over R is logically equivalent to a set of FDs G over R.

[11 marks]

[Total 33 marks]

3. Answer the following three parts.

a. What are the two types of null value that are most common ? (Give an example of their use.)

To what extent does SQL support these types of null values ?

[11 marks]

b. Assume a relation schema in the database containing personal information, with primary key PersonlD, and additional attributes such as PersonName, PersonAdrress and PersonEmail.

Suppose that, for each person who is married, you would also like to record who their spouse is and also their spouse's personal information. Suggest two different ways of modelling this situation.

[11 marks]

c. Prove the soundness of the decomposition inference rule using the reflexivity, augmentation and transitivity inference rules of Armstrong's axiom system.

Recall that the decomposition rule states that: if F I- X --+ YZ then F F- X --+ Y and F F- X –; Z, where F is a set of functional dependencies over R and X, Y, Z are subsets of schema(R).

[11 marks]

[Total 33 marks]

4. Answer the following three parts.

   a. Define the notion of serialisability.

   Give an example illustrating why serialisability is an important concept.

   [11 marks]

   b. Give an example of a two-phase locking history and briefly explain the notion of two-phase locking.

   [11 marks]

   c. What are the advantages and disadvantages of the two-phase locking protocol ?

   [11 marks]

   [Total 33 marks]

5. Answer the following three parts.

   a. Suggest why XML is an important standard and how it can affect the evolution of the World-Wide-Web.

   [11 marks]

   b. What are the main differences between the relational data model and the XML data model ? Use an example where appropriate.

   [11 marks]

   c. Give a simple mechanism for the translation of XML data to relational data.

   [11 marks]

   [Total 33 marks]

END OF PAPER