NATIONAL UNIVERSITY OF SINGAPORE

SCHOOL OF COMPUTING
Final examination for
Semester 3 AY2009/2010

CS2102 – DATABASE SYSTEMS

June 2010 Time Allowed: 2 Hours

INSTRUCTIONS TO CANDIDATES

1. This examination paper contains **THREE (3)** exercises and comprises **ELEVEN (11)** printed pages.
2. Answer **ALL** questions.
3. Answer **ALL** questions on the OCR form or within the space provided **ONLY**, as indicated.
4. **Unnecessary** comments will be penalised.
5. This is a **Closed Book** examination.
6. **Please write your Matriculation Number Below.**

MATRICULATION NO: | | | | | | | | | | |

This portion is for examiner's use only

EXERCISE	MARKS	REMARK
E I (46)		OCR
E II (28)		
E III (26)		
Total (100)		

Exercise II. (28 marks) Consider the following self-explanatory database schema. Primary keys are indicated. The natural foreign keys (same or similar attribute names) should be assumed. NULL values are forbidden everywhere.

object(object, description)

property(object, property, value)

relationship(object1, relationship, object2)

We say that "object1 is in relationship with object2" (not "object2 is in relationship with object1").

Use the knowledge of primary keys and foreign keys to simplify queries. Only eliminate duplicates when necessary. It is good practice to always use t-uple variables in SQL.

Question 24. (SQL, 4 marks) Find the objects that are in relationship with object 'XYZ1' and print their different descriptions (where 'XYZ1' is object2.)

Question 25. (SQL, 4 marks) Find the pairs of different objects in relationship with object 'XYZ1' (where 'XYZ1' is object2) and print the different pairs of primary keys.
Make sure not to get symmetrical answers such as ('ABC1', 'EFD2') and ('EFD2', 'ABC1').

Question 26. (TRC, 4 marks) Find the values of the properties 'name' of objects .Print the different values.

Question 27. (SQL, 4 marks) For each different description containing the keyword 'electronic' find the number of objects having this description. Print the different descriptions and the respective number of objects only if this number is strictly bigger than 10.

Question 28. (TRC, 4 marks) Find the objects in relationship with all objects. Print their different primary keys.

Question 29. (SQL, 4 marks) Find the objects in relationship with all objects and print their different primary keys. Do not use aggregate functions.

Question 30. (SQL, 4 marks) Write an integrity constraint that prevents objects to be in relationship with themselves.

Exercise III. (26 marks) Consider the relational scheme R with the set of functional dependencies F.

R = {A, B, C, D, E, G}
F = { {A, B} → {C}, {B, C} → {A}, {A, C} → {B}, {B, D, C} → {E}, {A, C} → {G, B}, {A, B} → {E}, {E} → {G}}

Hint: Note the symmetrical roles of A, B and C.

Question 31. (3 marks) Find the candidate keys of R with F.

In the next 4 questions, we compute minimal covers of F using the algorithm in the lecture.

Question 32. (2 marks) What is F' after simplify F according to step 1 of the algorithm? Do not comment.

Question 33. (2 marks) What is F'' after simplify F' according to step 2 of the algorithm? Do not comment.
Hint: only one functional dependency is replaced.

Question 34. (4 marks) Prove, using the Armstrong axioms, that {A, C} → {G} can be obtained from {{A, C} → {B}, {A, B} → {E}, {E} → {G}}.

(1) {A, C} → {B}
(2) {A, B} → {E}
(3) {E} → {G}

Question 35. (4 marks) What is F''' after simplify F'' according to step 3 of the algorithm? F''' is a minimal cover. Do not comment.

Question 36. (4 marks) There are 2 other minimal covers of F. Which are they? We call them F1 and F2. Just give F1 and F2 without comment.

Hint: One of the two minimal covers can be obtained by a different choice at step 3 of the algorithm. The other one cannot be obtained using the algorithm of the lecture starting from F. We would need to start from F+. Do not compute F+. Find F1 and F2 by looking at the symmetrical roles of A, B and C.

F1 =

F2 =

Question 37. (7 marks) Decompose R into a lossless BCNF decomposition using the algorithm of the lecture. Is it dependency preserving? Indicate at each step the fragments, the sets of projected functional dependencies and the candidate keys.

-- END OF PAPER ---