

NATIONAL UNIVERSITY OF SINGAPORE

SCHOOL OF COMPUTING

HOME ASSIGNMENT 1 FOR
Semester 2 AY2015/16

CS4221 - DATABASE DESIGN & TUNING

Due for Submission during the lecture on Thursday 11 February 2016

INSTRUCTIONS TO CANDIDATES

1. This home assignment paper contains **THREE (3)** questions and comprises **TEN (10)** printed pages, including this page.
2. Answer **ALL** questions as indicated in the space provided on the script.
3. Please write your Matriculation Number below.

MATRICULATION NUMBER: _____

EXAMINER'S USE ONLY		
Question	Marks	Score
1	5	
2	6	
3	4	
3	5	
TOTAL	20	

Question 1 [5 marks]

A real estate company has several agencies. Each agency has a name, but two agencies may have the same name. However each agency has a unique location known by its postal address. Each agency manages a group of agent. The agents work for exactly one agency. We record the names of the agents (two agents may have the same name) and the identification number given by the agency they work for. Note that two agents working for two different agencies may have the same identification number, as these numbers are issued independently by the agencies. Each agency maintains a listing of properties. The same property may be listed by several agencies. Every property is listed at least by one agency. Properties are uniquely identified by their postal address. We also record the valuation of the property. An agent manages properties that are listed by her agency. A property can be managed by agents from different agencies, but it is managed by at most one agent in one agency. Some listed properties are not managed.

- (a) Draw the corresponding Entity-relationship diagram with participation constraints. Use the notations of "Introduction to Database Systems" by Stéphane Bressan and Barbara Catania. Research on the Web the notion of aggregation in Entity-relationship diagrams. (5)

Question 2 [5 marks]

Let us consider the relation $R = \{A, B, C, D, E, F\}$

with the set of functional dependencies

$$\Sigma = \{\{A, B\} \rightarrow \{C, F, D\}, \{A, B, C, D\} \rightarrow \{A, B\}, \{A, B\} \rightarrow \{E\}, \{C, D\} \rightarrow \{A, B\}, \{C, D\} \rightarrow \{F, E\}, \{A, B\} \rightarrow \{F\}, \{F\} \rightarrow \{E\}, \{A, F\} \rightarrow \{A, E\}\}.$$

- (a) Normalize R with Σ using Bernstein algorithm. Show the main steps. Observe and briefly explain the properties of the resulting schema (e.g. losslessness, normal forms, dependencies, etc.). Indicate which properties are guaranteed by Bernstein algorithm (general) and which are coincidental to the case (specific). (5)

Question 3 [4 marks]

Let us consider the relation $R = \{A, B, C, D, E, F, G\}$

with the set of dependencies

$$\Sigma = \{\{F\} \twoheadrightarrow \{A, B, C\}, \{D, E\} \rightarrow \{G\}, \{G\} \rightarrow \{A\}, \{G\} \rightarrow \{B\}\}.$$

- (a) Prove that $\{F\} \rightarrow \{A, B\}$ can be derived using the Armstrong Axioms for functional dependencies and the inference rules for multi-valued dependencies. (2)
- (b) Prove that $\{F\} \twoheadrightarrow \{C\}$ can be derived using the inference rules for functional and multi-valued dependencies. (2)

Question 4 [5 marks]

Let us consider the relation $R = \{A, B, C, D, E, F\}$ with the set of dependencies:

$$\Sigma = \{\{C\} \rightarrow \{B\}, \{D, E\} \rightarrow \{F\}, \{A\} \twoheadrightarrow \{C, F\}\}.$$

- (a) Give an expression of each of these dependencies as an egd or a tgd (ommitting universal quantifiers). (2)

- (b) Using the chase, show that the decomposition of R into $R_1 = \{A, B, C\}$ and $R_2 = \{A, D, E, F\}$ is lossless. (3)