Department of Computer Engineering
University of Peradeniya
CO226 – Database Systems

Tutorial Number	:	2
Topic	:	Normalization & Relational Algebra
Posted on	:	2014-09-03
Due date	:	2014-09-12
Submission	:	Submit your answers as a handwritten hard copy to the department.

Question 1

a) What is normalization?
b) Why should Null values be minimized as much as possible in a relation?
c) Consider the following relation which keeps information about company employees. An employee works for only one department and department may have more than one employee.

EMPLOYEE (EmpID, FirstName, LastName, DepartmentID, DepartmentName, DepartmentAddress)

i. List possible anomalies. Provide examples using the EMPLOYEE relation.
ii. What is a functional dependency? Identify any functional dependencies.
iii. What normal form is the relation in? Justify your answer.
iv. Normalize the relation. Explain the steps.

Question 2

a) Briefly describe the characteristics of a table that violates the first normal form (1NF).
b) Briefly describe the concept of full functional dependency and how this concept is used to define the second normal form (2NF).
c) Briefly describe the concept of transitive dependency and how this concept is used to define the third normal form (3NF).
d) Briefly describe the purpose of Boyce-Codd normal form (BCNF) and describe how BCNF differs from and is stronger than 3NF.
e) Consider the following relation in Figure 01.

A	B	C	D	E	F	G
1	small	silver	new	8	John	foot
2	small	gold	old	8	John	inch
1	medium	silver	new	8	John	foot
1	medium	silver	old	8	John	foot
2	medium	gold	old	7	John	inch

Figure 01

According to the relation given in Figure 01, determine which of the following functional dependencies are apparently true or false.

i. $F \rightarrow A$
ii. $A \rightarrow F$
iii. $\{A, B\} \rightarrow F$
iv. $C \rightarrow G$
v. $\{A, B, G\} \rightarrow \{C, E, F, G\}$

f) Consider a new relation R defined over some attributes A, B, C, D and E with following dependencies. In this relation, the combination of attributes C and E is considered as the key.

i. $\{C,E\} \rightarrow D$
ii. $D \rightarrow B$
iii. $C \rightarrow A$

What normal form is the relation in? Normalize the relation step by step until it satisfied BCNF.

Question 3

a) Answer following questions.

i. What are the relational algebraic operations (other than set operations) developed specifically for a relational algebra?

ii. What are the conditions to be fulfilled for two relations to be involved in a UNION operation? Why do the UNION, INTERSECTION and SET DIFFERENCE operations require the operand relations to be UNION compatible?

b) Consider the following database schema which is used to keep track of some of the entities involved in the faculty and the relationships among them. Primary keys are underlined. Give the following queries in relational algebra.

STUDENT (StuID, StuName, Bdate, Address, AdvisorID, DeptID)
FOLLOWS (StuID, CourseID, Grade, Points)
COURSE (CourseID, CourseName, Credits, Semester, DeptID)
TEACHERS (LecID, CourseID)

LECTURER (LecID, LecName, Salary, DeptID)
DEPARTMENT (DeptID, DeptName, HeadID)
PREREQUISITE (CourseID, PrerequisiteID)

i. List the student ids of the students from the Department of Computer Engineering.

ii. List the lecturer id and lecturer name of the head of the Department of Computer Engineering.

iii. List the student ids of the students who **do not** follow any of the courses offered in semester 5.

iv. List the student id of the students who have satisfied all the prerequisites for the course Database Systems, which has the course id 'CO226'.

Hint: Assume a student has got through a course after he has earned 1.3 points or more for that subject.

v. For every student who follows any course offered by the department of Computer Engineering: list the student id, his/her department id, course id of the course which he/she follows.