

## CSC 355 Database Systems 602

### Assignment 5 (5/13)

**Due 6:00:00pm, Wednesday 5/20.**

**Reading:** The posted Lecture 10-13 Slides, and Sections 3.1-3.5 of Ullman/Widom. Next week: Sections 7.1-7.5 of Ullman/Widom (some of this will be review).

#### Problems:

1. Consider the relation  $R$  with schema  $R(a, b, c, d)$ , and the following set of functional dependencies:  $F = \{ a \rightarrow c ; b, d \rightarrow c ; c \rightarrow a, b \}$ .

- a. For each of the fifteen non-empty subsets  $S$  of the set of attributes  $\{a, b, c, d\}$ , find the closure of  $S$  using the set of functional dependencies  $F$ .
- b. List all of the superkeys of  $R$ .
- c. List all of the candidate keys of  $R$ .
- d. Is  $R$  in BCNF? Explain why or why not.
- e. Is  $R$  in 3NF? Explain why or why not.

2. Consider the following relation with seven attributes:

ASSIGNMENT(ProjectCode, ProjectTitle, EmployeeID, EmployeeName, DeptCode, DeptName, Hours)

The functional dependencies in ASSIGNMENT are:

ProjectCode  $\rightarrow$  ProjectTitle  
EmployeeID  $\rightarrow$  EmployeeID, DeptCode, DeptName  
DeptCode  $\rightarrow$  DeptName  
ProjectCode, EmployeeID  $\rightarrow$  Hours

The only candidate key of ASSIGNMENT is {ProjectCode, EmployeeID}. Construct a decomposition of ASSIGNMENT into a collection of relations in BCNF that has the lossless join property. Use the algorithm given in class, and show your work. (That is, at each step, you state which functional dependency you are removing from which relation, and what the resulting decomposition is after you remove it. Answers that show only the final result without explaining the steps taken to obtain it will receive little or no credit.)

3. Suppose that the relation EMPLOYEE(ID, Team, Project, Salary) has the set of functional dependencies  $F = \{ ID \rightarrow Team, Project ; Project \rightarrow ID ; Team \rightarrow Salary \}$ . Consider the following decomposition of EMPLOYEE:

$R_1(ID, Team, Salary)$   
 $R_2(Team, Project)$

**a.** Give the projections of  $F$  on  $R_1$  and  $R_2$ . Does the decomposition have the dependency preservation property? Give a detailed explanation why or why not. (Don't just state the definition of the dependency preservation property, but rather show why the decomposition either has or does not have this property by showing whether or not each functional dependency in  $F$  can be derived from the union of the projections.)

**b.** Does the decomposition have the lossless join property? Give a detailed explanation why or why not. (Don't just state the definition of the lossless join property but use either the binary lossless join test or the matrix test to demonstrate whether or not it has the property. Show each step of your work; answers that give only the final result without showing the steps taken to obtain it will receive little or no credit.)

### **Remarks:**

1. For all assignments, it is your responsibility to make sure that the files you have uploaded are readable and in the correct locations. You should always check that you can successfully download your submitted files back from the course web site to be sure that they have been uploaded correctly.

2. As is the case for every assignment, all work must be completed individually. No collaboration between students or sharing of answers between students is permitted. Do not post this assignment to any website in search of answers, and do not consult posted answers on any website while completing the assignment. Your assignment must be your own individual work.