

CSc4710 / CSc6710

Fall 2006

Assignment 3

Due Date: October 24th, 2006 @ 5:30PM

Problem 1 (15 points)

Consider the relation schema $EMP_DEPT(ssn, ename, bdate, address, dnumber, dname, dmgrssn)$ and the following set G of functional dependencies on EMP_DEPT :
 $G = \{ssn \rightarrow \{ename, bdate, address, dnumber\}, dnumber \rightarrow \{dname, dmgrssn\}\}$.

- (1). Calculate the closures $\{ssn\}^+$ and $\{dnumber\}^+$ with respect to G .
- (2). Is G minimal? If not, try to find a minimal set of functional dependencies that is equivalent to G . Prove that your set is equivalent to G .

Problem 2 (10 points)

Given a relation $R(E, F, G, H)$ and its FD set $F = \{E \rightarrow G, G \rightarrow E, F \rightarrow EG, H \rightarrow EG, FH \rightarrow E\}$, derive a minimal cover of F .

Problem 3 (30 points)

Consider the relation $R(A, B, C, D, E, G, H)$ and the FD set $F = \{AB \rightarrow C, AC \rightarrow B, AD \rightarrow E, B \rightarrow D, BC \rightarrow A, E \rightarrow G\}$. For each of the following relations, do the following:

- (i) List the set of dependencies F' that hold over the relation and compute a minimal cover of F' .
- (ii) Name the strongest normal form that is not violated by the relation containing these attributes.
- (iii) Decompose it into a collection of BCNF relations if it is not in BCNF.

(a) $R1(A, B, C)$

(b) $R2(A, B, C, D)$

(c) $R3(A, B, C, E, G)$

(d) $R4(D, C, E, G, H)$

(e) $R5(A, C, E, H)$

Problem 4 (15 points)

Consider the relation $R = \{A, B, C, D, E, F, G, H, I\}$ and the set of functional dependencies $F = \{\{A, B\} \rightarrow \{C\}, \{A\} \rightarrow \{D, E\}, \{B\} \rightarrow \{F\}, \{F\} \rightarrow \{G, H\}, \{D\} \rightarrow \{I, J\}\}$. What are the candidate keys for R ? Decompose R into 2NF, then 3NF relations.

Problem 5 (30 points)

Consider the following decompositions for the relation schema R of Problem 4. Determine whether each decomposition D_i has (i) the dependency preservation

property, and (ii) the lossless join property, with respect to F . Also determine which normal form each relation in the decomposition is in.

- a. $D_1 = \{R_1, R_2, R_3, R_4, R_5\}$, where $R_1 = \{A, B, C\}$, $R_2 = \{A, D, E\}$, $R_3 = \{B, F\}$, $R_4 = \{F, G, H\}$, $R_5 = \{D, I, J\}$.
- b. $D_2 = \{R_1, R_2, R_3\}$, where $R_1 = \{A, B, C, D, E\}$, $R_2 = \{B, F, G, H\}$, $R_3 = \{D, I, J\}$.
- c. $D_3 = \{R_1, R_2, R_3, R_4, R_5\}$, where $R_1 = \{A, B, C, D\}$, $R_2 = \{D, E\}$, $R_3 = \{B, F\}$, $R_4 = \{F, G, H\}$, $R_5 = \{D, I, J\}$.