Functional dependencies and Normal forms

EXERCISES

1. Consider the relation scheme with attributes S (store), D (department), I (item), and M (manager), with functional dependencies SI $\rightarrow$ D and SD $\rightarrow$ M.

a) Find all keys for SDIM.

b) Show that SDIM is in second normal form but not third normal form.

2. Consider the relation scheme with attributes CITY, ST, and ZIP, which we here abbreviate C, S, and Z. We observed the dependencies CS $\rightarrow$ Z and Z $\rightarrow$ C. The decomposition of the relation scheme CSZ into SZ and CZ has a lossless join. Does this decomposition preserve dependencies?

3. Let F = {AB $\rightarrow$ C, A $\rightarrow$ D, BD $\rightarrow$ C}.

a) Find a minimal cover for F.

b) Give a 3NF, dependency-preserving decomposition of ABCD into only two schemes (with respect to the set of functional dependencies F).

c) What are the projected dependencies for each of your schemes?

d) Does your answer to (b) have a lossless join? If not, how could you modify the database scheme to have a lossless join and still preserve dependencies?

4. Let F = {AB $\rightarrow$ C, A $\rightarrow$ B}.

a) Find a minimal cover for F.

b) When (a) was given on an exam at a large western university, more than half the class answered G = {A $\rightarrow$ B, B $\rightarrow$ C}. Show that answer is wrong by giving a relation that satisfies F but violates G.

5. Suppose we are given relation scheme ABCD with functional dependencies

{(A $\rightarrow$ B, B $\rightarrow$ C, A $\rightarrow$ D, D $\rightarrow$ C}. Let p be the decomposition (AB, AC, BD).

a) Find the projected dependencies for each of the relation schemes of p.

b) Does p preserve the given dependencies?

6. Consider the relation scheme ABCD with dependencies

F={A $\rightarrow$ B, B $\rightarrow$ C, D $\rightarrow$ B]

We wish to find a lossless-join decomposition into BCNF.

a) Suppose we choose, as our first step, to decompose ABCD into ACD and BD. What are the projected dependencies in these two schemes?

b) Are these schemes in BNCF? If not, what further decomposition is necessary?