CS 348 - Homework 4

Normal Forms
(100 points)

Fall 2019

Due on: 11/08/19 11:59

Note: There will be a 10% penalty for each late calendar day. After five calendar days, the homework will not be accepted.

1. (15 pts) Consider the relation Employee(Ssn, Ename, Pnumber, Plocation, Hours) and following dependencies:

$$\text{Ssn} \rightarrow \text{Ename}$$
$$\text{Hours, Pnumber} \rightarrow \text{Ename, Plocation}$$
$$\text{Plocation, Pnumber} \rightarrow \text{Hours}$$

a. Which is/are the candidate key(s)? (Select all that apply)

A. Ename, Ssn

B. Hours, Plocation, Pnumber

C. Ename, Plocation, Ssn

D. Hours, Pnumber, Ssn

E. Plocation, Pnumber, Ssn

b. What is the highest normal form in this relation? Justify your answer.

A. 1NF

B. 2NF

C. 3NF

D. BCNF

2. (15 pts) Explain the three update anomalies clearly. Please use examples to support your explanation.

3. (20 pts) Consider the relation

$$\mathbf{R} = \{\text{A, B, C, D, E, F, G, H, I ,G , K}\}$$

with following dependencies:

$$\begin{gathered} \text{AB} \rightarrow \text{CD} \\ \text{D} \rightarrow \text{A} \\ \text{A} \rightarrow \text{E} \\ \text{FG} \rightarrow \text{CH} \\ \text{I} \rightarrow \text{JK} \\ \text{K} \rightarrow \text{BE} \end{gathered}$$

a. Identify the candidate key. Show your work.

b. If applicable, find decomposition of R into 3NF and BCNF.

4. (30 pts) Given the relation R and the set of functional dependencies S as below:

$$R = \{A, B, C, D, W, X, Y, Z\}$$

S:

$$A \rightarrow B$$
$$ABCD \rightarrow W$$
$$WX \rightarrow YZ$$
$$ACDX \rightarrow WY$$

a. Identify the candidate key. Show your work.

b. What is the minimum cover for the set of functional dependencies S?

c. Find the decomposition of R into 3NF relations that is lossless-join and dependency preserving. Show your work.

5. (20 pts) Consider the relation R and the set of functional dependencies S:

$$\text{R} = \{\text{X, Y, Z, M, N}\}$$
$$\text{S:}$$
$$\text{XY} \rightarrow \text{Z}$$
$$\text{ZM} \rightarrow \text{N}$$
$$\text{Y} \rightarrow \text{M}$$
$$\text{Z} \rightarrow \text{X}$$

$$R_1 = \{X, Y, Z\}$$
$$R_2 = \{X, Z, M, N\}$$
$$R_3 = \{Y, M\}$$

a. Explain why or why not this decomposition is a lossless-join decomposition.

b. Explain why or why not this decomposition is dependency preserving.