CS 430 Database Systems
Homework Assignment 3 - Due 02/23/2014

1. (a) Does the FD X $\rightarrow$ Z follow from $\{$X $\rightarrow$ Y, X $\rightarrow$ W, WY $\rightarrow$ Z$\}$?
   (b) Does the FD XW $\rightarrow$ Z follow from $\{$XY $\rightarrow$ Z, Y $\rightarrow$ W, WY $\rightarrow$ Z$\}$?

2. Consider the relation *r* below:

A	B	C	D	E
a_1	b_1	c_1	d_1	e_1
a_1	b_2	c_2	d_2	e_1
a_2	b_1	c_3	d_3	e_1
a_2	b_1	c_4	d_3	e_1
a_3	b_2	c_5	d_1	e_1

   Which of the following FDs does *r* satisfy: A $\rightarrow$ B, AD $\rightarrow$ B, C $\rightarrow$ DE, CD $\rightarrow$ A, AE $\rightarrow$ B?

3. Let F = $\{$A $\rightarrow$ B, AB $\rightarrow$ E, BG $\rightarrow$ E, CD $\rightarrow$ I, E $\rightarrow$ C$\}$. Compute A^+, $(AE)^+$, and $(ADE)^+$.

4. Let F = $\{$A $\rightarrow$ C, AC $\rightarrow$ D, E $\rightarrow$ AD$\}$, and let G = $\{$A $\rightarrow$ CD, E $\rightarrow$ AHE$\}$. Are they equivalent?

5. Find a minimal cover for each of the following.
   (a) $\{$ A $\rightarrow$ BC, B $\rightarrow$ C, AB $\rightarrow$ D$\}$
   (b) $\{$A $\rightarrow$ C, AB $\rightarrow$ C, C $\rightarrow$ DI, CD $\rightarrow$ I,EC $\rightarrow$ AB, EI $\rightarrow$ C$\}$

6. Determine if the following decompositions are lossless join decompositions:
   (a) R = ABCD, F = $\{$B $\rightarrow$ C, AD $\rightarrow$ C$\}$, ρ = $\{$AB,BCD$\}$
   (b) R = ABCDEI, F = $\{$A $\rightarrow$ D, B $\rightarrow$ E, C $\rightarrow$ I$\}$, ρ = $\{$ABC, ADI, BDEI, CDEI$\}$.

7. Let F = $\{AB \rightarrow C, C \rightarrow B, A \rightarrow B\}$. Reverse steps 2 and 3 of the minimal cover algorithm given in class, and apply the modified algorithm to F. Is the resulting set a minimal cover of F?

8. Suppose we have a database for an investment firm, consisting of the following attributes: B (broker), O (office of the broker), I (investor), S (stock), Q (quantity of stock owned by an investor), and D (dividend paid by a stock), with the following FDS: $S \rightarrow D$, $I \rightarrow B$, $IS \rightarrow Q$, and $B \rightarrow O$.

   (a) Find a key for the relation scheme R = BOSQID.

   (b) How many keys does R have? Justify your answer.

   (c) Find a lossless join decomposition into BCNF.

   (d) Find a decomposition of R into 3NF, having a lossless join and preserving dependencies.

9. Consider the relation scheme ASSIGN

   (EMP_ID, PROJECT, PROJECT_BUDGET, TIME_SPENT_BY_PERSON_ON_PROJECT)

   containing the following FDs:

   EMP_ID, PROJECT $\rightarrow$ TIME_SPENT_BY_PERSON_ON_PROJECT

   PROJECT $\rightarrow$ PROJECT_BUDGET

   (a) State which attributes of ASSIGN are prime and which are nonprime.

   (b) Is ASSIGN in 3NF?

   (c) What about BCNF?

Please keep in mind:

- This assignment is to be done individually. The honor code is in effect.
- You must submit your homework through RamCT.
- Assignments must be submitted before midnight Thursday, February 20. No late work will be accepted except in exigent situations.
- Your answers must be typed.