Homework Assignment #2

CS 589/689 Principles of Database Systems: Spring 2016

Questions 2A – 2D are due Thursday, 28 April; Questions 2E & 2F are due Tuesday, 3 May, both at the beginning of class. They can be done individually or in a team of two students. (Must be the same team for the both parts.) If you work in a team, then turn in one paper with the names of both team members on it. Make sure your homework is legible. You may seek help from your partner (if you have one), the instructors and the class mailing list, but otherwise work independently.

2A (15 points): Do Exercise 3.14 in the book, but only for sets of 2 or 3 consecutive attributes (for example, BC and DEF).

2B (10 points): Say that a set X of attributes is *closed* for a set of FDs F if $X = X^+$ under F. Prove that, for a given F, the intersection of closed sets is closed. That is, if X and Y are closed sets under F, then so is $X \cap Y$.

2C (15 points): For each of the proposed inference rules below, say whether it is sound or not. If it is sound, give a proof. If it is not sound, provide a counterexample. Note that W, X, Y and Z are *sets* of attributes.

a. (Bi-additivity) If $X \rightarrow Y$ and $Z \rightarrow W$, then $XZ \rightarrow YW$
b. (Replacement) If $XY \rightarrow Z$ and $Z \rightarrow X$, then $Z \rightarrow Y$
c. (Cascade) If $X \rightarrow Y$ and $Y \rightarrow Z$, then $X \rightarrow YZ$

2D. (15 points) Consider relations r(A B), s(A B) and u(B C), where both r and s satisfy the FD $A \rightarrow B$. Which of the relational expressions below satisfy $A \rightarrow B$? Explain why, or provide a counter-example.

a. $r \cup s$
b. $r \cap s$
c. $r - s$
d. $r \bowtie u$
e. $\pi_A(r) \bowtie u$

2E. (10 points): Use the chase to determine whether the dependencies
M = {$A \rightarrow B$, $CE \rightarrow A$, $E \rightarrow D$, $\bowtie$[ABCD, DE]}
imply $\bowtie$[ACE, ADE, BCD].

2F. (15 points): For the partial relations r1 – r6 below, find all cases where $ri \sqsubseteq rj$. You might want to draw a directed graph to show the containments. Here, a '-' represents an "unknown" null.

r1(A B C)

1	2	3
-	2	-

r2(A B C)

1	2	-
-	2	4

r3(A B C)

-	2	3
-	2	4

r4(A B C)

1	2	-

r5(A B C)

1	2	3
1	2	4

r6(A B C)

1	2	3