Homework Assignment #2

CS 589/689 Principles of Database Systems: Fall 2008

This assignment is due Wednesday, 22 October, at the beginning of class. It can be done individually or in a team of two students. 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.

Note: I remarked in class that the process given in the book for determining FD implication using the chase is incorrect. It is probably more accurate to say it is unclear. Theorem 3.30 requires two "winning rows" (as defined on page163) in the chase, but, as Example 3.5 shows, those rows can collapse into one during the chase. I think a better condition in Theorem 3.30 is to say *all* rows in the chase are winning rows.

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.

i. (Left Projectivity) If $XY \rightarrow Z$, then $X \rightarrow Z$
ii. (Right Additivity) If $X \rightarrow Z$ and $Y \rightarrow Z$, then $XY \rightarrow Z$
iii. (Reflexivity) If $X \rightarrow Y$, then $Y \rightarrow X$

2D Let M be a set of FDs and JDs over relation scheme R, and let X be a subset of R. The *closure of* X *under* M, written X*, is the largest set of attributes Y such that M implies $X \rightarrow Y$.

i. (8 points) Explain how to calculate X* given M.
ii. (8 points) Demonstrate your procedure by calculating (AB)* for

$M = \{B \rightarrow D, C \rightarrow E, \bowtie[ABC, BCD, DE]\}$

iii. (4 points) What can you say about X* when M consists only of JDs?

2E. (20 points): Do Exercise 5.3 from the book for two of select, project, union and join. (Note, I don't currently know the complete answer to this one. Also, while the book doesn't require operators to be faithful, that restriction would seem reasonable.)

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