CS589 Principles of Database Systems
Winter 2011, Homework 2
Due: Thursday, 3 February 2011

You may do this assignment with a partner. If you do so, turn in a single submission with both names. You may seek help from your partner, the instructor and the class mailing list, but not other sources.

1. (15 points): Do Exercise 3.14 in the book, but only for sets of 2 or 3 consecutive attributes (for example, BC and DEF).

2. (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 $X \cap Y$.

3. (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.
   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 $X \rightarrow YZ$

4. (10 points): Compute the chase of the tableau U below using the dependencies G = {$A \rightarrow B$, $E \rightarrow D$, $\bowtie$[ABCD, DE]}

U(A	B	C	D	E)
a1	b1	a3	b2	a5
a1	b3	b4	a4	a5
b5	a2	a3	a4	b6

5. (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. $\pi_A(r) \bowtie u$