Homework 2

1. (10 points) Consider the following relation r with attributes A, B, C, and D.

r			
A	B	C	D
6	2	3	4
1	3	8	5
6	7	8	5

(a) Somehow we know that r has a key consisting of a single attribute. With this clue state which single attribute is a key and which cannot be. In each case informally provide good reasons.

(b) Prove that the functional dependency C -> D is satisfied by r. Give the most concise answer you can.

(c) Prove that r does not satisfy C -> B. Give the most concise answer you can.

(d) Prove that B -> ACD is satisfied by r. Give the most concise answer you can.

2. (15 points) Given a set of functional dependencies F = {AG -> B, B -> CD, BD -> E, CE -> F} over R = ABCDEFG.

(a) Prove that F |= AG -> BDF. (This also means that F logically implies AG -> BDF, or AG -> BDF can be deduced from F).

(b) Compute $(B)^+$. (X^+ is the set of all attributes A for which X -> A can be deduced from F.)

(c) Find a key of R.

3. (20 points) Give minimal covers of the following sets of functional dependencies

(a) {A -> B, B -> C, A -> C}

(b) {ABCD -> CDEF}

(c) {A -> BC, C -> D}

(d) {AB -> CD, A -> B, B -> C}

(e) {A -> B, ABCD -> E, EF -> GH, ACDF -> EG}

4. (15 points) Prove or disprove the following rules of inference:

(a) XY -> Z infer X -> Z.

(b) X -> YZ infer X -> Y

(c) {X -> YZ, Y -> W} infer Y -> Z.

5. (15 points) Given a relational schema R with attributes A, B, C, and D, where functional dependencies B -> ACD and C -> D are supposed to hold.
   (a) What are all the keys in ABCD?
   (b) Give example of a superkey in ABCD that is not a key.
   (c) Give example of a trivial functional dependency over ABCD.
6. (25 points) Given a relational schema R with attributes A, B, C and D where the functional dependencies AB -> C, C -> D, and D -> A are supposed to hold.
   (a) Is R in BCNF? If yes, explain why. If not, list all violations.
   (b) If R is NOT in BCNF, give it a lossless BCNF decomposition.
   (c) Does your decomposition in (b) preserve the given functional dependencies? Explain.
   (d) Give a 3NF decomposition for R.
   (e) Does your decomposition in (d) preserve the given functional dependencies? Explain.

Submission Instruction

Please use Microsoft Words or other tools to type your answer. Don't handwrite. Submit your file in pdf format through Canvas.