|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *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.   1. (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. 2. What are all the keys in ABCD? 3. Give example of a superkey in ABCD that is not a key. 4. Give example of a trivial functional dependency over ABCD. 5. (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. 6. Is R in BCNF? If yes, explain why. If not, list all violations. 7. If R is NOT in BCNF, give it a lossless BCNF decomposition. 8. Does your decomposition in (b) preserve the given functional dependencies? Explain. 9. Give a 3NF decomposition for R. 10. 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.*