Database Management System
Assignment 2

Q1. Find the 3rd and BCNF Normal Form of the relation R(A,B,C,D) if the following FDs are satisfied. Explain your answer CLEARLY. F={AB->D, AC->BD, B->C}

Q2. Consider the relation schema R(A, B, C, D, E, F) with functional dependencies AC -> B, BD -> F and F -> CE.

1. How many candidate keys does R have?
2. List all the candidate keys of R. If a candidate key is composite then use parenthesis
3. e.g. (A, B).
4. Is R in 3NF? If yes, justify. If no, specify at least one FD which violates the definition?
5. Which FD(s) (if any) of R violates BCNF? [5 points]
6. Suppose we project R onto S(A, C, D, E). Give one non-trivial FD that holds in S.
7. Out of the 6 subsets of five out of the six attributes (A, B, C, D, E, F), how many and
8. which ones are in BCNF w.r.t. to the given FD's
9. Consider the decomposition of R into R1(A, B, C), R2(C, E, F) and R3(A, D, F). Give YES/NO answers for the following:
    i. Is this decomposition lossless?
    ii. Is this decomposition dependency preserving?
    iii. Is this decomposition in BCNF (i.e. are R1, R2 and R3 all in BCNF)?

Q3.

Consider a database with two elements, X and Y. The initial values of X and Y are both 0. We consider three transactions U, V and W that modify these elements concurrently:

- T_1: $X := 42$
- T_2: $Y := 20$, $X := 10$
- T_3: $X := 100$, $Z := 101$

While the transactions execute, the database system crashes. We consider three recovery mechanisms in turn below; your task is to first complete the missing parts of the log and then answer the following questions:

(a) Using **pure undo logging**:

1. $< START\ \ T_2 >$
2. $< START\ \ T_3 >$
3. $< T_2, X, 0 >$
4. $< T_2, Y, 0 >$
5. $< COMMIT\ \ T_2 >$
6. $< START\ \ CKPT(T_3) >$
7. $< T_3, X, ??? >$
8. $< START\ \ T_1 >$
9. $< T_3, Z, 0 >$
10. $< T_1, X, ??? >$

1. Please complete the undo log by providing in the appropriate values for the log below:
2. If the database crashes immediately after writing the above log entries, then subsequently performs recovery, which of the following statements is true:
    a. After a successful recovery, the state of Y is 0.

b. At the time of crash, the state of X (on disk) must be 10.
c. At the time of crash, the state of Z (on disk) must be 101.
d. After a successful recovery, the state of X is 10.

Q4. What is a transaction. Describe the properties of a transaction.
Q5. Explain the difference between 3NF and BCNF