CS 245, Database Management Systems
Quiz 2, Winter 2022-2023
Department of Computer Science and Engineering
IIT Guwahati
Time: 30 minutes

Name: _____ Roll No.: _____

Important

1. A supplementary sheet is being provided for rough work. **Do not attach your rough work to the answer sheet.**

2. This quiz has 2 questions over 2 pages, with a total of 20 marks.

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1. Consider a schema consisting of two relations $R_1(A, B, C)$ and $R_2(B, D)$.

    (a) Suppose that the only functional dependencies that hold on the relations in this schema are $A \to B$, $A \to C$, $B \to A$, $A \to D$ and all dependencies that follow from these. Is this schema in Boyce-Codd Normal Form (BCNF)? Justify your answer.

    (5)

    > **Solution:** Note that all nontrivial functional dependencies in F^+ have either A or B (possibly with other attributes) on the lhs. Relation R_1 is in BCNF because both A and B are superkeys for R_1. R_2 is also in BCNF because any relation with just two attributes is in BCNF. Hence the schema is in BCNF.

    (b) Suppose that the only functional and multivalued dependencies that hold on the relations in this schema are $A \to BD$, $D \to C$, $C \twoheadrightarrow AB$, $B \twoheadrightarrow D$, and all dependencies that follow from these. Is this schema in Fourth Normal Form (4NF)? Justify your answer.

    (5)

    > **Solution:** The schema is not in 4NF as the relation R_1 violates the 4NF condition. From $D \to C$ we have $D \twoheadrightarrow C$. Then $B \twoheadrightarrow D$ and $D \twoheadrightarrow C$ imply $B \twoheadrightarrow C$. But B is not a superkey for R_1.

2. Construct a B$^+$-tree for the following set of key values that are ordered alphabetically.

$$F, S, Q, K, C, L, H, T, V, W, M$$

Assume that the tree is initially empty and the keys are added in the above order. Take the number n of pointers that fit in one node to be four. It is enough if you show the final configuration of the tree.

(10)

Solution:

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                    K Q T
         ┌──────┬────┴────┬──────┐
       C F H   K L M    Q S    T V W
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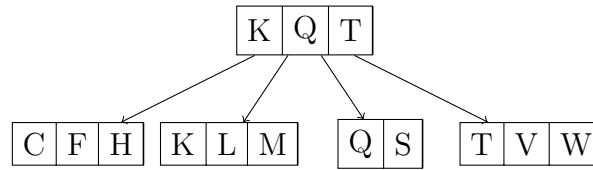
Use the space below to answer any question you may have cancelled.