

**CSc4710 / CSc6710**  
**Spring 2023**  
**Assignment 3**  
**Due Date: April 10, 2023**

**Problem 1 (10 points)**

Consider the relation  $R(M, N, O, P, Q)$  and the FD set  $F = \{M \rightarrow N, O \rightarrow Q, OP \rightarrow M\}$ .

- (i) Compute  $(MO)^+$ .
- (ii) Is  $R$  in 3NF?
- (iii) Is  $R$  in BCNF?

**Problem 2 (30 points)**

Consider the relation  $R(P, Q, S, T, U, V, W)$  and the FD set  $F = \{PQ \rightarrow S, PS \rightarrow Q, PT \rightarrow U, Q \rightarrow T, QS \rightarrow P, U \rightarrow V\}$ . For each of the following relations, do the following:

- (i) List the set of dependencies that hold over the relation and compute a minimal cover.
- (ii) Name the strongest normal form that is not violated by the relation containing these attributes.
- (iii) Decompose it into a collection of BCNF relations if it is not in BCNF.

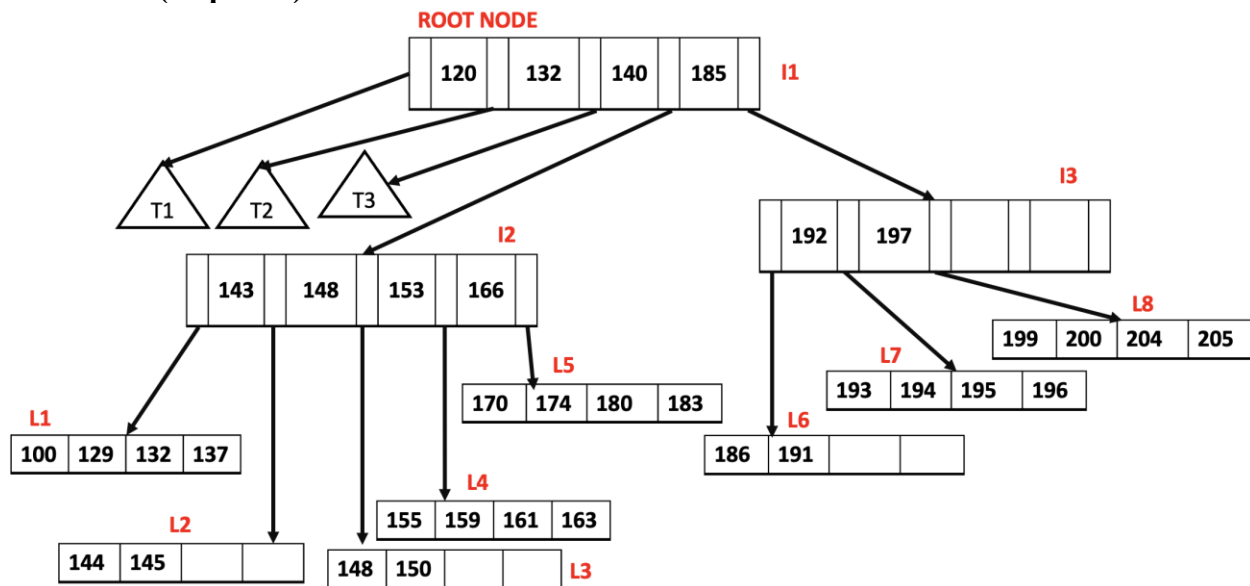
- (a)  $R_1(P, Q, S)$
- (b)  $R_2(P, Q, T)$
- (c)  $R_3(P, T, U, V)$
- (d)  $R_4(P, Q, T, U)$
- (e)  $R_5(P, S, U, V, W)$

**Problem 3 (20 points)**

Decide whether each of the following decomposition of  $R(P, Q, S, T, U, V)$ , with the FD set  $F = \{PQ \rightarrow S, PS \rightarrow Q, PT \rightarrow U, Q \rightarrow T, QS \rightarrow P, U \rightarrow V\}$ , is (i) dependency-preserving. (ii) lossless-join.

- (a)  $R_1(P, Q) R_2(P, S) R_3(P, Q, U) R_4(U, V)$
- (b)  $R_1(P, Q, S) R_2(P, S, T, V) R_3(P, T, U)$

#### Problem 4 (40 points)



LEAF NODES ARE DOUBLE LINKED ALTHOUGH NOT SHOWN IN THE FIGURE

NOTE: Perform all the operations on the original tree provided above. Do not carry forward the changes in each question to the next.

- In the above index, which nodes need to be accessed to find all the data entries which are greater than 180?
- After 203 is inserted, how the structure will be changed?
- After removing 144 from the original index, how the structure will be changed assuming to carry out redistribution from the right sibling?
- After inserting 181, how the structure will be changed? Show the new index.
- What is the height of T1, T2, and T3? What are the entries in each of them?