International Institute of Information Technology, Bangalore
CSE 511 Algorithms: Practice Problems 2
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1. Let T be a binary tree, where each node is assigned an integer value. Design efficient algorithms to compute, for every node $v \in T$, the following quantities:
   (a) The sum of the values of the nodes on the unique path from the root of T to v.
   (b) The maximum value among the nodes on the unique path from the root of T to v.
   (c) The sum of the values of the nodes in the subtree rooted at v.
   (d) The maximum value among the nodes in the subtree rooted at v.
   (e) Given an integer k, the element of rank k among the values of the nodes on the unique path from the root of T to v.
   (f) Given an integer k, the element of rank k among the values of the nodes in the subtree rooted at v.
   (g) The weight of the shortest path from v to any other node in T (where the weight of a path is the sum of node values).
   (h) The weight of the shortest path from v to any leaf node in T.
   (i) If the weight of a path is defined as the maximum node value on that path, compute the weight of the shortest path from v to any other node in T.
   (j) If the weight of a path is defined as the maximum node value on that path, compute the weight of the shortest path from v to any leaf node in T.

2. Let T be a binary tree, where each node stores an integer value. After performing preprocessing in $O(n)$ time, design algorithms that can answer the following queries in $O(\log n)$ time:
   (a) Given two nodes $u, v \in T$, determine their least common ancestor (LCA).
   (b) Given two nodes $u, v \in T$, compute the weight of the shortest path between u and v (where path weight is the sum of node values).