Problem 1. [Recurrences]
Solve the following recurrences.

- \( T(n) = 5T(n/4) + n \) and \( T(n) = 1 \) for \( 1 \leq n < 4 \).
- \( T(n) = 2T(n/2) + \text{nlog} n \)
- \( T(n) = 2T(n/2) + 3T(n/3) + n^2 \)

Problem 2. [Tree Traversal]
Let \( T \) be a rooted binary tree on \( n \) nodes. The nodes have unique labels from 1 to \( n \).

- Given the preorder and postorder node sequences for \( T \), give a recursive algorithm to reconstruct a tree that satisfies the preorder and postorder sequences. Is this reconstruction unique?
- Given the preorder and inorder node sequences for \( T \), give a recursive algorithm to reconstruct a tree that satisfies the preorder and inorder sequences. Is this reconstruction unique?

Problem 3. [Divide and Conquer]
Let \( p = (x, y) \) and \( p' = (x', y') \) be two points in the Euclidean plane given by their coordinates. We say that \( p \) dominates \( p' \) if and only if \( x > x' \) and \( y > y' \). Given a set of \( n \) points \( P = \{p_1, \ldots, p_n\} \), a point \( p_i \in P \) is undominated in \( P \) if there is no other point \( p_j \in P \) such that \( p_j \) dominates \( p_i \).

Describe an algorithm that given \( P \) outputs all the undominated points in \( P \); see figure. Your algorithm should run in time asymptotically faster than \( O(n^2) \).

![Figure 1: The undominated points are shown as unfilled circles.](image-url)