

Design and Analysis of Algorithms

Problem #1.

Develop an algorithm that computes the k th smallest element in a set of n distinct integers in $O(n + k \log n)$ time or better.

Problem #2.

In an art gallery guarding problem, we are given a line L that represents a long hallway in an art gallery. Also, we are given a set $X = \{x_1, x_2, x_3, \dots, x_n\}$ of real numbers that specify the positions of paintings in this hallway. Suppose that a guard can protect all paintings that are within a distance of 1 of their position (on both sides). Design an algorithm for finding a placement of guards that uses the minimum number of guards to guard all paintings with positions in X .

Problem #3.

Execute Prim's minimal spanning tree algorithm on the graph given below using the vertex START as the source.

- Provide an explanation of this execution for the first three iterations.
- Show the final minimal spanning tree.
- Finally, argue that the minimal spanning tree found is unique for this graph. (For arbitrary graphs, minimal spanning trees are usually not unique.)

