Homework 03

CS 624, 2022 Fall

Review the course homework policies before you start!

1. Problem 9.3-8 on p223.

   Let $X[1..n]$ and $Y[1..n]$ be two arrays, each containing n numbers already in sorted order. Give an $O(\lg n)$-time algorithm to find the median of all $2n$ elements in arrays X and Y.

2. Problem 12.2-5 on p293.

   Show that if a node in a binary search tree has two children, then its successor has no left child and its predecessor has no right child.

3. Problem 15.4-5 on p397.

   Give an $O(n^2)$-time algorithm to find the longest monotonically increasing subsequence of a sequence of n numbers.

4. Problem 16.2-2 on p427.

   Give a dynamic-programming solution to the 0-1 knapsack problem that runs in $O(nW)$ time, where n is the number of items and W is the maximum weight of items that the thief can put in his knapsack.

5. Problem 16.1-3 on p422.

   Not just any greedy approach to the activity-selection problem produces a maximum-size set of mutually compatible activities.

   (a) Give an example to show that the approach of selecting the activity of least duration from among those that are compatible with previously selected activities does not work.

   (b) Do the same for the approach of always selecting the compatible activity that overlaps the fewest other remaining activities.

   (c) Do the same for the approach of always selecting the compatible remaining activity with the earliest start time.

6. Problem 16.2-5 on p428.

   Describe an efficient algorithm that, given a set $\{x_1, x_2, \ldots, x_n\}$ of points on the real line, determines the smallest set of unit-length closed intervals that contains all of the given points. Argue that your algorithm is correct.

7. Problem 16.3-3 on p436.

   What is an optimal Huffman code for the following set of frequencies, based on the first 8 Fibonacci numbers?

   $$a : 1 \quad b : 1 \quad c : 2 \quad d : 3 \quad e : 5 \quad f : 8 \quad g : 13 \quad h : 21$$

   Can you generalize your answer to find the optimal code when the frequencies are the first n Fibonacci numbers?