Homework Assignment #4

Note

This assignment is due 2:10PM Monday, October 22, 2018. Please write or type your answers on A4 (or similar size) paper. Drop your homework by the due time in the Algorithms box placed in the IM office on the 7-th floor of Management College Building 1. Late submission will be penalized by 20% for each working day overdue. You may discuss the problems with others, but copying answers is strictly forbidden.

Problems

There are five problems in this assignment, each accounting for 20 points. (Note: problems marked with "(X.XX)" are taken from [Manber 1989] with probable adaptation.)

1. Show the AVL tree formed by inserting numbers 1, 3, 5, 7, 6, 4 in order. For each insertion, show the AVL trees before and after each rotation.

2. (6.4) Construct an example for which interpolation search will use $\Omega(n)$ comparisons for searching in a table of size n. The size n of your example should be larger than 5.

3. (6.19) Given an array of integers $A[1..n]$, such that, for all i, $1 \leq i \leq n$, we have $|A[i] - A[i+1]| \leq 1$. Let $A[1] = x$ and $A[n] = y$, such that $x < y$. Design an efficient search algorithm to find j such that $A[j] = z$ for a given value z, $x \leq z \leq y$. What is the maximal number of comparisons to z that your algorithm takes.

4. (6.22) The input is a set S containing n real numbers, and a real number x. The problem is to determine whether there are two elements of S whose sum is exactly x. Suppose now that the set S is given in a sorted order. Design an algorithm to solve this problem in time $O(n)$.

5. (6.23) Given two sets S_1 and S_2, and a real number x, find whether there exists an element from S_1 and an element from S_2 whose sum is exactly x. The algorithm should run in time $O(n \log n)$, where n is the total number elements in both sets.