

January 2008
Preliminary Exam

Design & Analysis of Algorithms (Questions 5 – 8)

Problem 5

Write a *non-recursive* program to print out the keys from a binary search tree in non-decreasing order. Explain your algorithm. What property of binary search trees did you use?

Problem 6

There are n trading posts along a river. At any of the post you can rent a canoe to be returned at any other post downstream. For each possible departure point i and each possible arrival point j , the cost of a rental from i to j is known. However, it can happen that the cost of renting from i to j is higher than the total cost of a series of shorter rentals. In this case you can return the first canoe at some post k between i and j and continue your journey in a second canoe. There is no extra charge for changing canoes in this way. Give an efficient algorithm to determine the minimum cost of a trip by canoe from each possible departure point i to each possible arrival point j . In terms of n , how much time is needed by your algorithm?

Problem 7

Demonstrate the insertion of the keys 4,27,18,14,19,32,11,16 into a hash table with collisions resolved by *linear probing*. Assume that the table has 9 slots and that the hash function is $h(k) = k \bmod 9$. Draw the state of the hash table after all insertions. Propose strategies other than *linear probing* for handling *collisions* in a hash table. Are they better, worse?

Problem 8

A forensic lab receives a delivery of n samples. They look identical, but in fact, some of them have different chemical composition. There is a device that can be applied to two samples and tells whether they are different or not. It is known in advance that most of the samples (more than 50%) are identical. Find one of the samples in the majority making no more than n comparisons. (Beware: it is possible that two samples are identical but do not belong to the majority of identical samples.)