University of Houston

COSC 3320: Algorithms and Data Structures
Summer 2015

Homework 4

Due July 1, at the start of class

1. You are told that $\pi = A, E, F, B, D, C, G$ is the sequence of nodes of a tree visited by some visit procedure.
   (a) Exhibit one tree T whose node labels are A, B, C, D, E, F, G and whose preorder visit would visit the nodes of T in the order given by π.
   (b) Exhibit one tree T whose node labels are A, B, C, D, E, F, G and whose postorder visit would visit the nodes of T in the order given by π.
   (c) Exhibit one binary tree T whose node labels are A, B, C, D, E, F, G and whose inorder visit would visit the nodes of T in the order given by π.

2. (a) Construct a heap containing the following values, inserted one after the other:

   $$9, 20, 8, 17, 4, 11, 2, 1, 6, 12, 5, 10, 7, 3, 18, 13.$$

   You are to draw the final heap, both as a binary tree and as in its standard array implementation.
   (b) Give a (small) example of two distinct permutations of the same set of values such that the two heaps constructed by inserting one value after the other are different.

3. Given a heap H and a value k, we wish to return all the values in H which are at most k. Let n be the size of H, and m, with $0 \leq m \leq n$, be the number of values to be returned. (Notice that m is unknown at the beginning of the algorithm.)
   (a) Design a simple algorithm of complexity $O(1 + m \log n)$.
   (b) Design an improved algorithm with complexity $O(1 + m)$. (Hint: you should not modify the heap. Rather, you should work directly on the array implementation of H.)

4. (a) Insert the following keys into an initially empty hash table of 11 slots, numbered 0 through 10, using the hash function $h(k) = (3k+5) \bmod 11$ and assuming collisions are handled by linear probing:

   $$13, 8, 33, 2, 20, 7, 15, 42, 9.$$

   You are to draw the final hash table.
   (b) Same as before, but assuming collisions are handled by quadratic probing.
   (c) Same as before, but assuming collisions are handled by double hashing using the secondary hash function $h'(k) = 7 - (k \bmod 7)$.