University of Houston

COSC 3320: Algorithms and Data Structures
Spring 2017

Homework 5
Due March 30, at the start of class

1. Consider the following sequence of keys

$$5, 13, 10, 9, 8, 12, 20, 11, 4, 3, 16, 7.$$

   (a) Construct a heap by inserting the above keys one after the other, using algorithm `Insert` seen in class.

   (b) Assuming the above keys are stored in that order in an array H from position 1 to 12, execute the linear-time algorithm `BottomUpHeap` seen in class to obtain a valid heap.

   In both cases you are to draw the final heap as a complete binary tree and write its standard array implementation.

2. Design and analyze an algorithm that, given a heap H with n entries and an index j with $1 \leq j \leq n$, removes the entry $H[j]$ (restoring the properties of H).

3. Prove that every heap with n entries has exactly $\lceil n/2 \rceil$ leaves. (Hint: consider first the case in which n is odd, and then the case in which n is even.)

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

$$11, 8, 2, 32, 12, 7, 4, 40, 26.$$

   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 $h'(k) = 7 - (k \bmod 7)$.