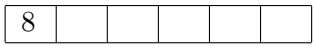
CS240 HW #8

Answers should be written neatly and submitted in class on the due date. NO LATE SUBMISSIONS WILL BE ACCEPTED. Don't forget to provide an honor code statement and to cite any outside sources that you use in developing your solutions.

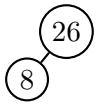
1. Insert the following 6 items into an initially empty Max-Heap: 8, 26, 75, 13, 49, 58. Show the state of the Heap after each insertion, both as a tree, and as an array. Repeat the exercise for a Min-Heap. I've completed the first two insertions for the Max-Heap to get you started: (8pts)

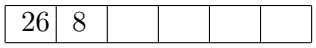
   Insert 8:

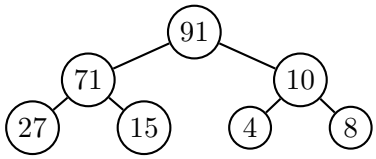
   

   Insert 16:

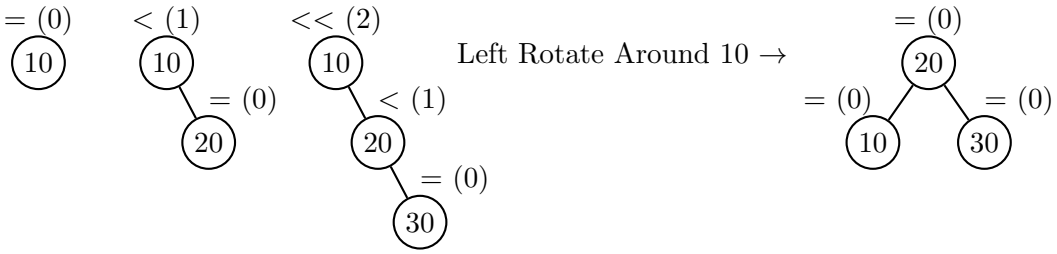
   

2. Remove three values from the following Max-Heap. Show the state of the heap (as a tree) after each removal operation has completed. (4pts)

3. Add the following keys to an initially empty, non-self balancing, binary search tree: 8, 20, 19, 4, 6, 2, 37. Show the state of the tree after each insertion. (4pts)

4. Repeat the previous exercise for an AVL tree. For each insertion, show the tree and the balance factors both before and after any rotation operations. For example, if the inserted keys were 10, 20 and 30, the solution would be as follows. Note that I am showing both the numeric balance factors (in parenthesis) and the symbolic balance factors described in our textbook (<, <<, =, etc.) Feel free to use either convention in your solution. (8pts)



5. Assume an initially empty hash table with 11 entries in which the hash function uses the division method. Show the contents of the hash table after the following keys are inserted (in the order listed), assuming the indicated type of probe is used: 67, 122, 56, 81, 197, 43, 258. (9pts) [1]

   (a) Linear probe (with c = 1)

   (b) Double hashing (with $hp(k) = 1 + (k * 3)$ % 7)

   (c) Separate chaining

6. Consider a hash table of size 2081 that contains 413 keys. (6pts) [2]

   (a) What is the load factor?

   (b) What is the average number of comparisons required to search for a particular key (assuming that the key is in the table) if:

      i. Linear probing is used
      (Note that the formula for calculating this is incorrectly stated in our textbook. In section 11.2.4 the formula for a successful search has been switched with the formula for an unsuccessful search. Obviously, successful searches require fewer comparisons on average.)

      ii. Separate chaining is used

[1] This is a modified version of question 11.1 from *Data Structures and Algorithms Using Python*, Rance Necaise, 2011.

[2] This is a modified version of question 11.4.