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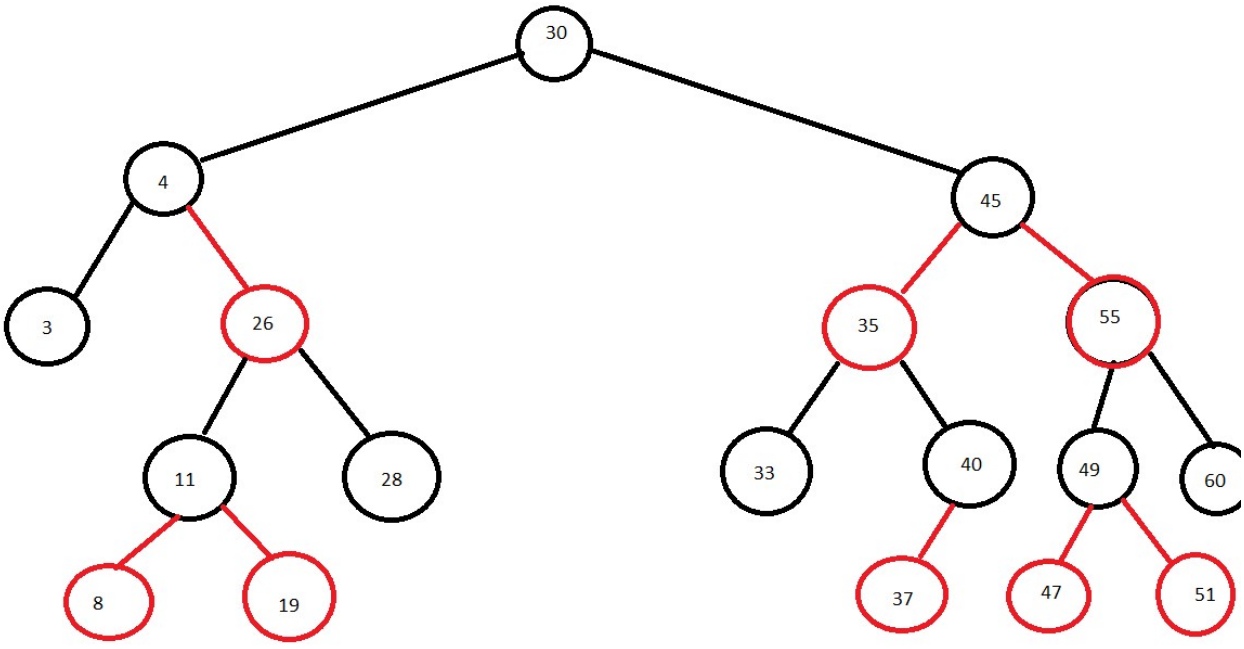
Spring 2019

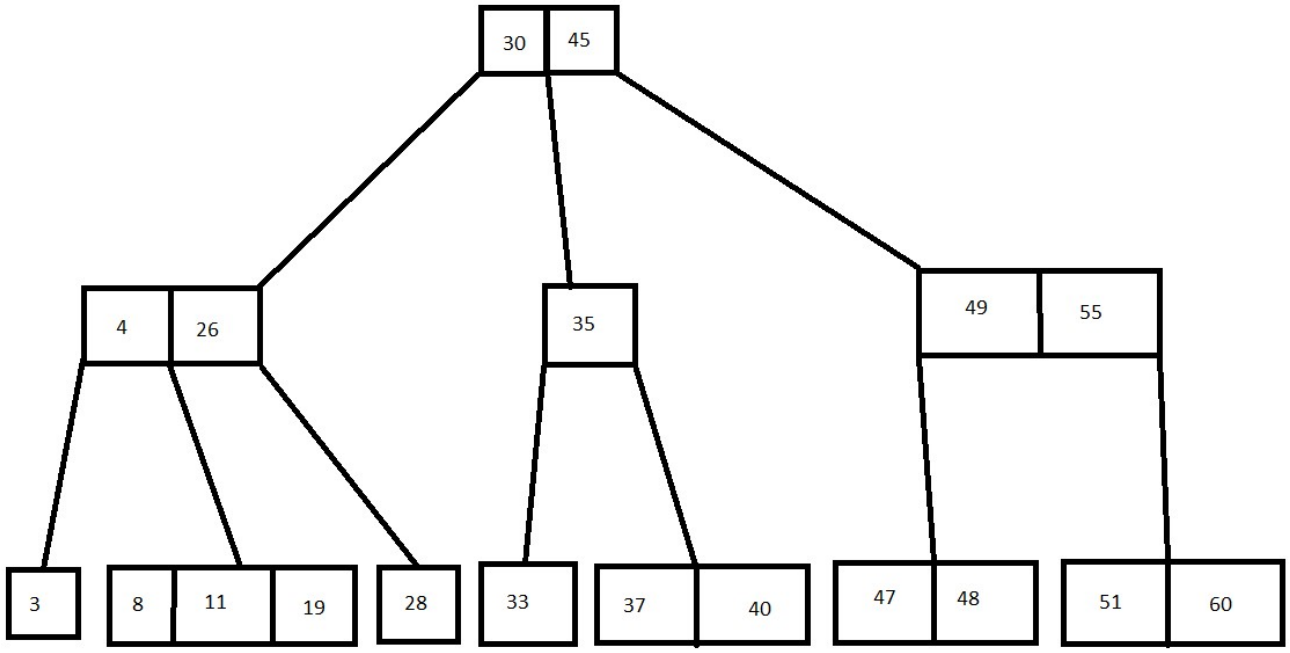
CS 202 – Section 03

HOMEWORK 4

Question 1 (a):



Question 1 (b):



Question 2:

Data structure	insert	extractMin
Unsorted Array	O (1)	O (n)
Red-Black Tree	O (log (n))	O (log(n))
Hashing	O (1)	O (n)
Min-Heap	O (log(n))	O (log(n))
Sorted Linked List	O (n)	O (1)

Question 3 (a):

To find maximum number of keys in 2-3 tree, we select a tree with 3-nodes only. So for a 2-3 tree of height h, the maximum possible number of nodes is.

$$n = 3^h - 1 / 2$$

So since each node is a 3-node and each node has 2 keys, So the maximum number of keys (k) that it can hold is:

$$k = 3^h - 1$$

Question 3 (b):

Every subtree of a red-black tree is not a red-black tree. So the answer is no.

Considering that each subtree of the red-black tree is red-black tree and then consider a subtree with a red root. Since this subtree contradicts with the definition of a red-black tree, so every subtree of a red-black tree cannot be red-black.

Question 3 (c):

To solve this, I use a hash table. First, insert all elements from array into hash table which takes O (n) time. Now we try finding for each element in the array another element which whose sum is the target sum's value.

To check this, I take the array element and then subtract it from the target sum value and then try finding the result in the hash table. Since searching in hash table once in:

$$O(1)$$

the total run time for this loop is:

$$O(n)$$

So the time complexity of this solution is also:

$$O(n)$$