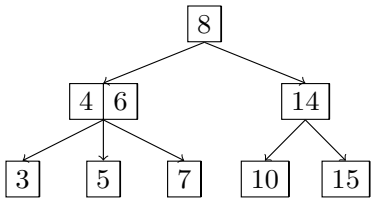
CS 61BL Summer 2021

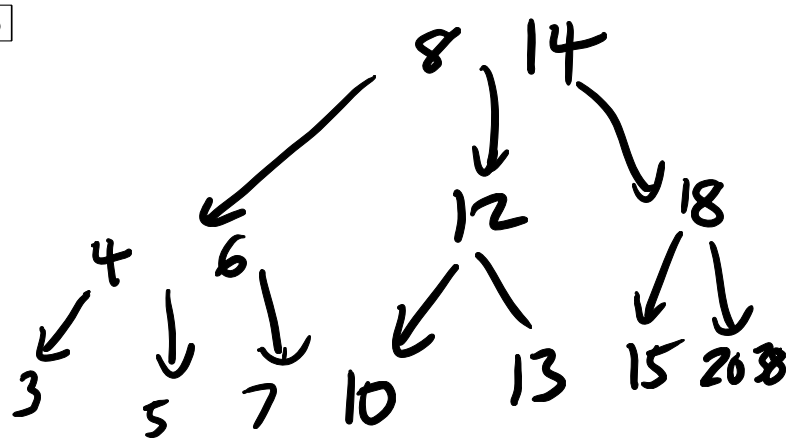
Balanced Search and Tries

Recurring Section 8: Thursday July 22, 2021

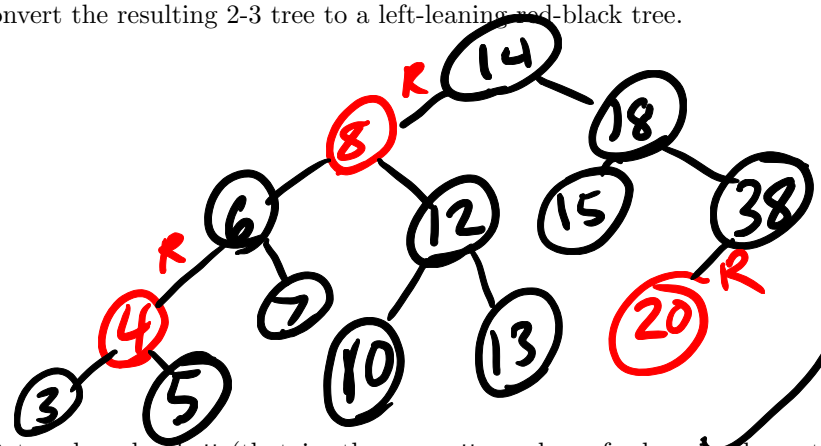
1 2-3 Trees and LLRB's

a) Draw what the following 2-3 tree would look like after inserting 18, 38, 12, 13, and 20.

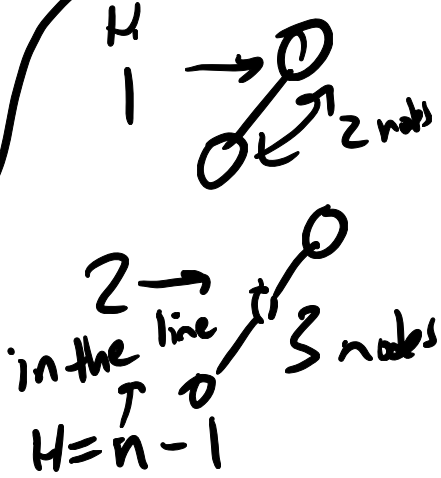




b) Now, convert the resulting 2-3 tree to a left-leaning red-black tree.

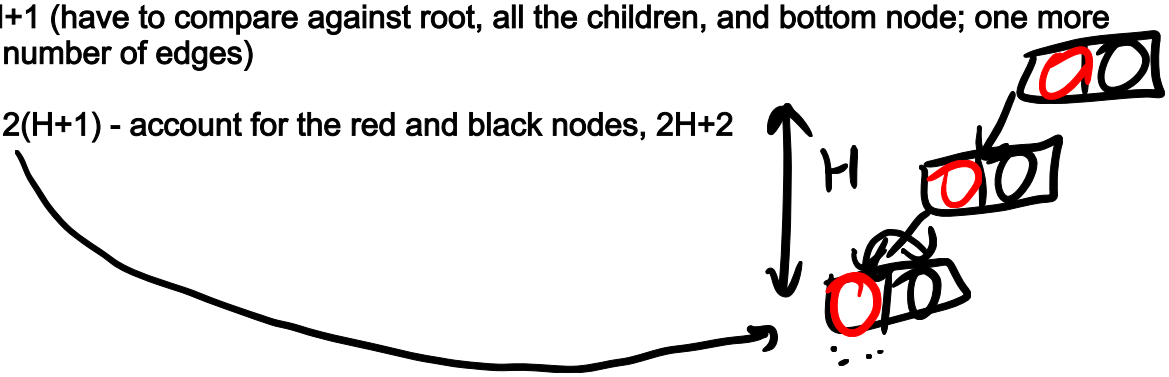


c) If a 2-3 tree has depth H (that is, there are H number of edges in the path from leaf to the root), what is the maximum number of comparisons done in the corresponding red-black tree to find whether a certain key is present in the tree?



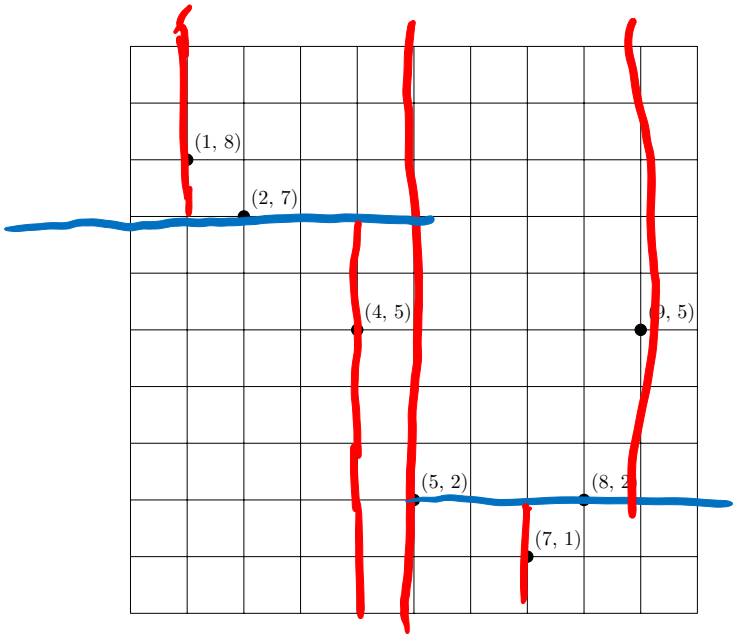
Depth: H+1 (have to compare against root, all the children, and bottom node; one more than the number of edges)

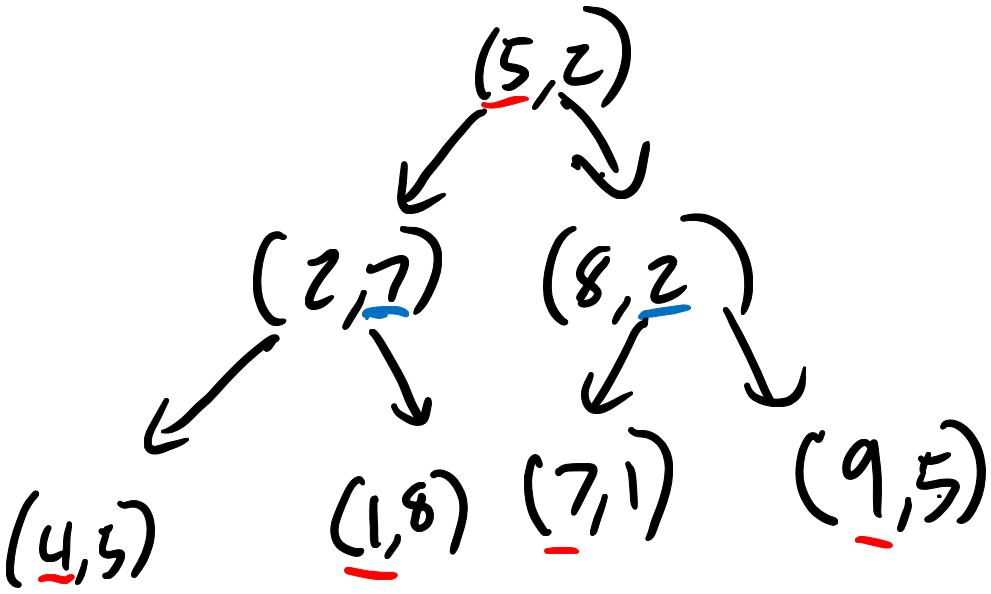
Answer: 2(H+1) - account for the red and black nodes, 2H+2



2 KD Trees

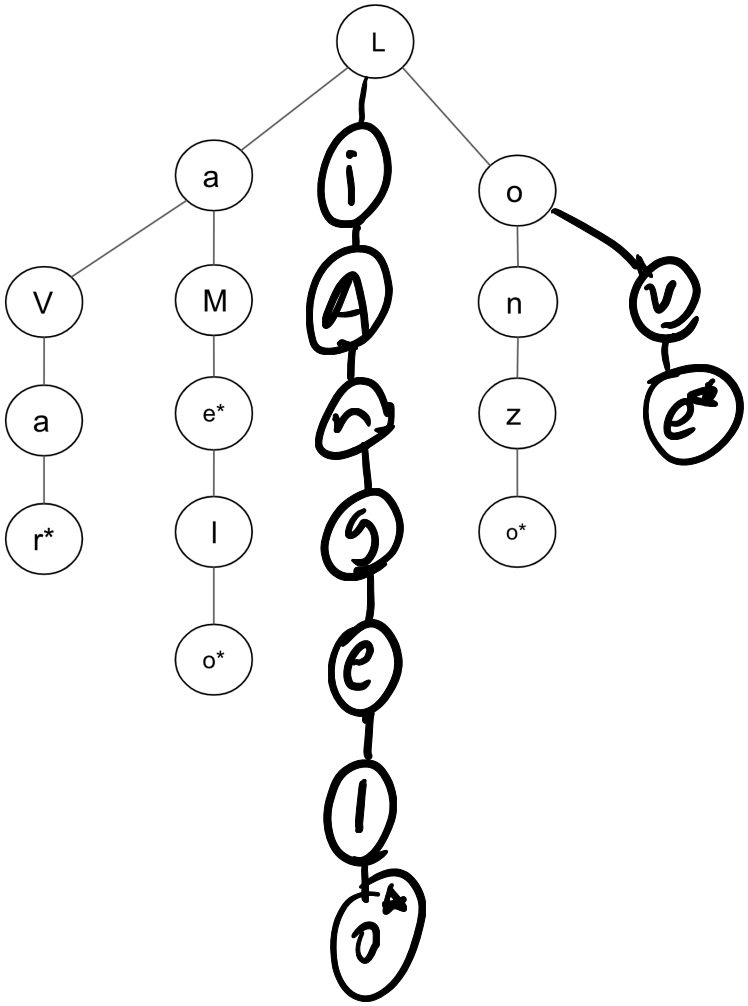
Given the points shown in the grid to the right, draw a perfectly balanced k-d tree. For this tree, first split on the x dimension. The resulting tree should be complete with height 2. Then, draw the corresponding splitting planes on the grid.





3 Trie Me

The Big Baller Brand has decided to use a trie to have fast lookup of their Big Ballers. Currently, the state of the trie is as follows:



1. The Biggest Baller of them all, CEO LaVar Ball, enjoys being reminded of who is a Big Baller. Remind him of who the Big Ballers are by finding all the words in the trie. Note: The nodes with an asterisk denote the end of a word.

   LaVar, LaMe, LaMelo, Lonzo

2. Not again! LaVar Ball has forgotten about his son LiAngelo once again. Help LaVar by inserting "LiAngelo" and "Love" into the trie above so that no Big Baller is forgotten.

   in tree

3. How long does it take to add n words, each of max length L?

   O(nL)

   Big O - not all words have to be of length L. This is an upper bound.

4. What's the best and worst case runtime to check whether a word of length L is in the trie?

   Best Case: Theta(1), first letter might not be there

   Worst Case: Theta(L), go through the entire word if it's there