CS61BL Tutoring Session

K-d Trees and Tries

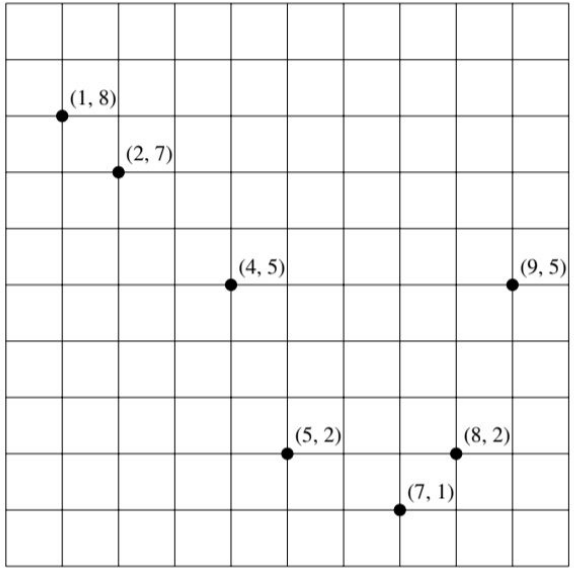
Hongli (Bob) Zhao

Agenda

- Congrats on finishing Proj2! Bearmaps released today.
  - Due 8/9 at midnight
  - K-d trees will be very important (and Trie if you would like the EC)
- MT2 Wednesday!
  - Additional OH tomorrow
- Quick recap of K-d Tree
  - Operations: add, find, nearest
- Tries
  - Motivation
  - Operations: add, find
    - Runtime

1 KD Trees

Given the points shown in the grid to the right, draw a perfectly balanced k-d tree in the box below. 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.



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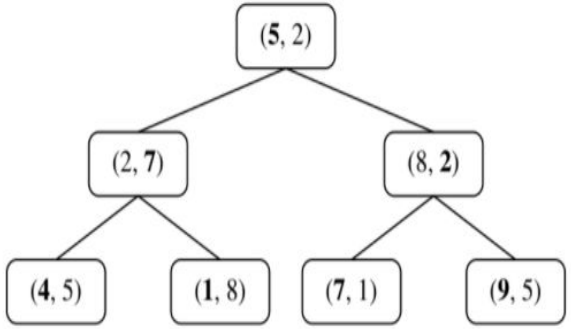
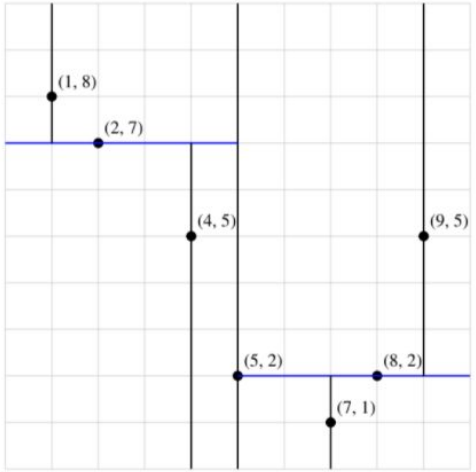
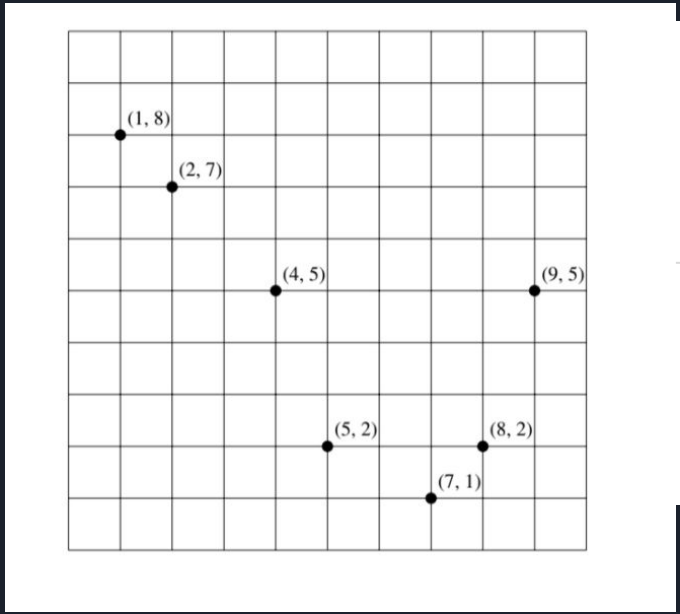


We can also visualize the k-d tree points in space by drawing on the splitting planes as is shown below.

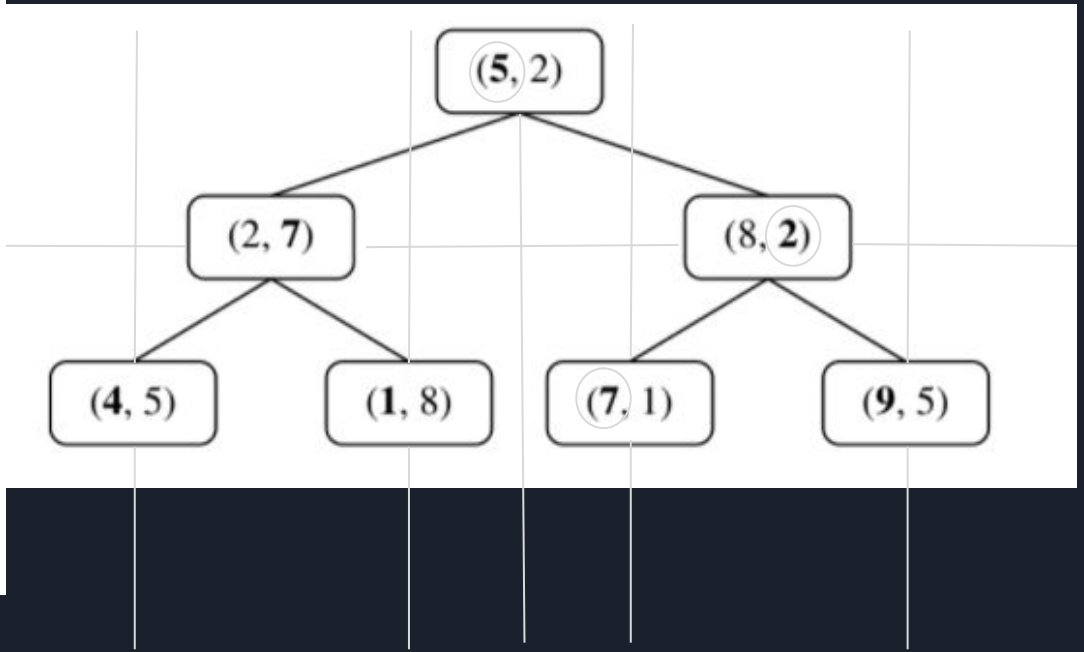


Conceptual Review of KD Tree Operations:

Get / Contains:



contains((7,1))



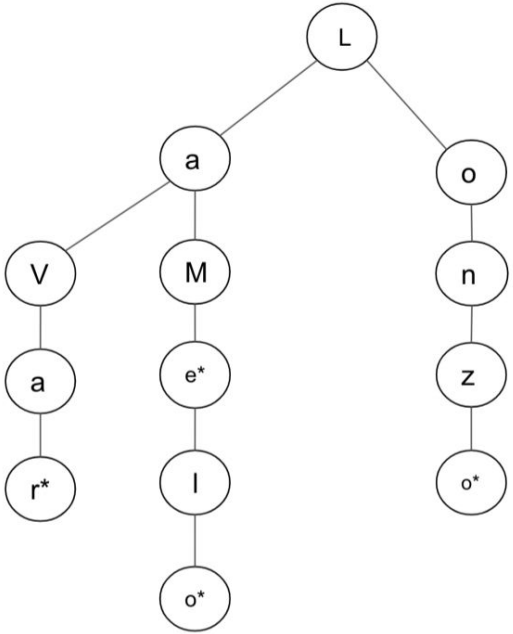
Tries Performance

- Runtime for operations on N strings

Data Structure	Key type	get(String s) / find(String s)	insert(String s)
Linked List	String	Θ(N)	Θ(N)
BST	String	Θ(logN) (if balanced)	Θ(logN) (if balanced)
Trie	char	Θ(L)	Θ(L)
Hash Set	String	Θ(1) (if evenly distributed)	Θ(1) (if evenly distributed)

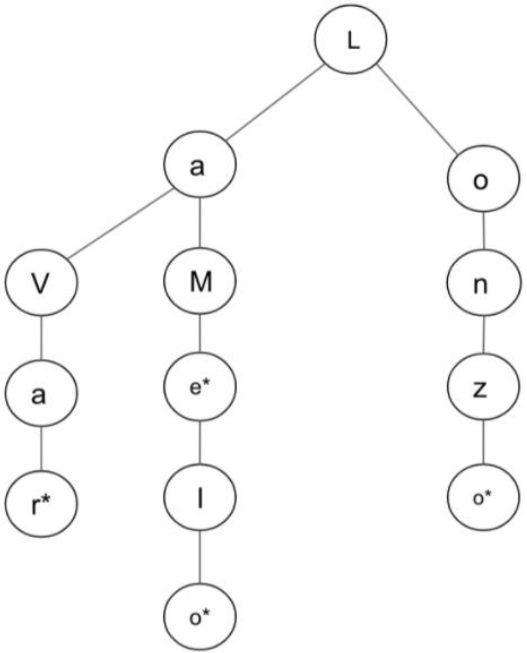
2 Trie Me

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:

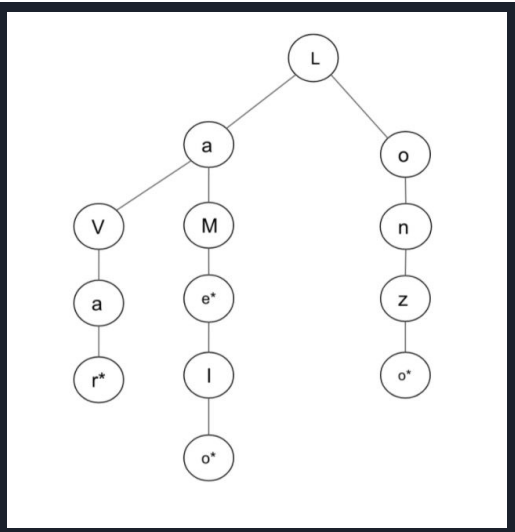


1. The Biggest Baller of them all, CEO LaVar Ball, enjoys being reminded of who is a Big Baller. Remind him of who the Big Ballers are by finding all the words in the trie. Note: The nodes with an asterisk denote the end of a word.

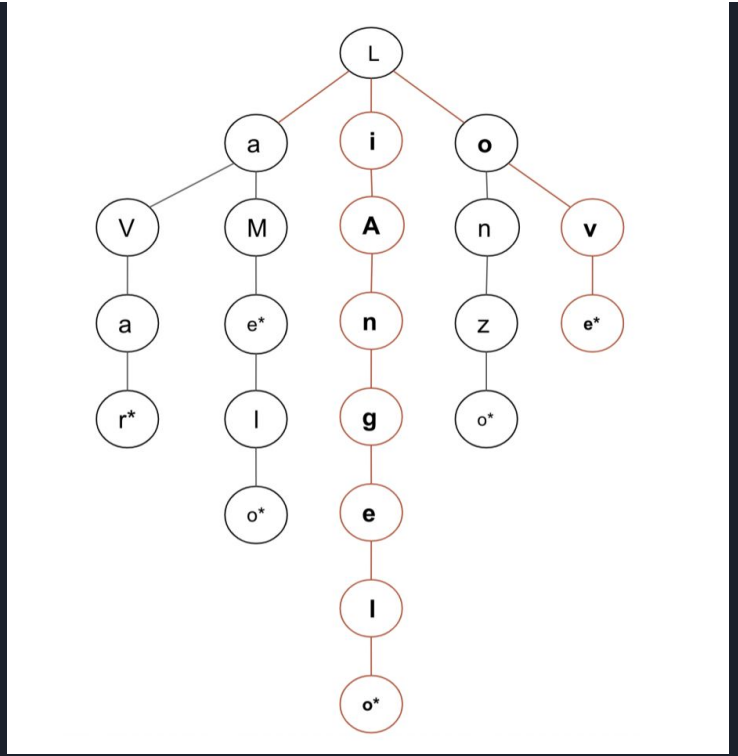
The words are: LaVar, Lame, LaMelo, Lonzo



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.

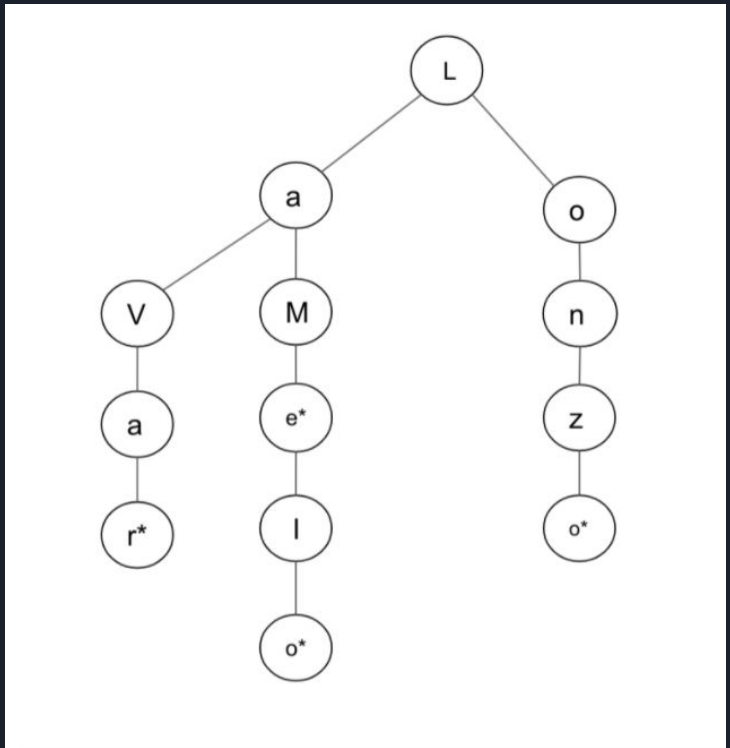


The trie after inserting ”LiAngelo” and ”Love”:



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

Additionally, consider if there is a notion of “best” and “worst” case considering that the Strings are length L.



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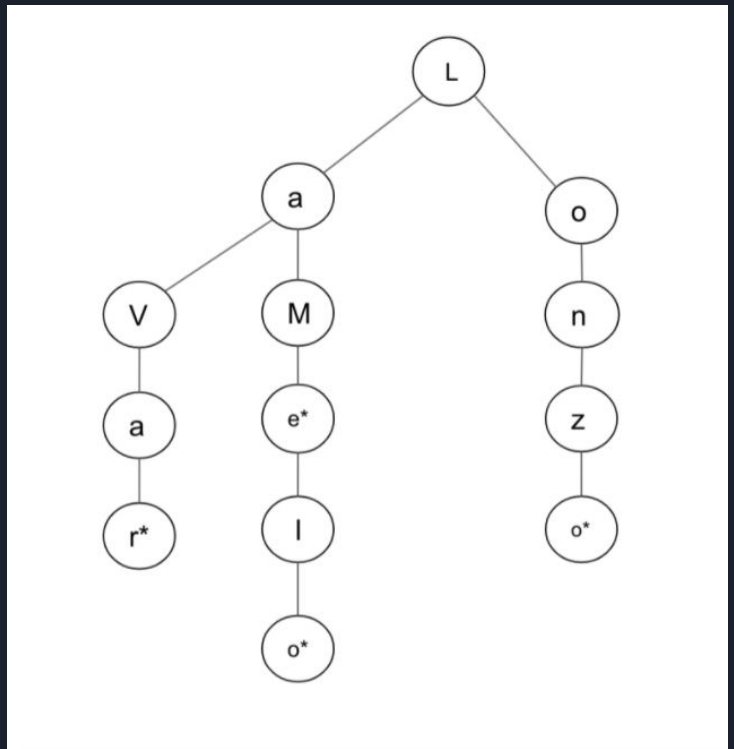
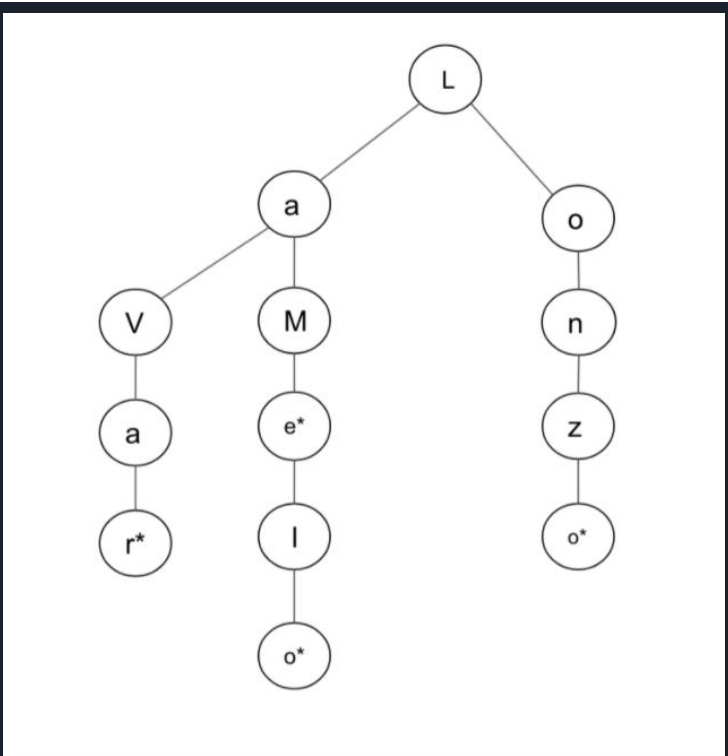
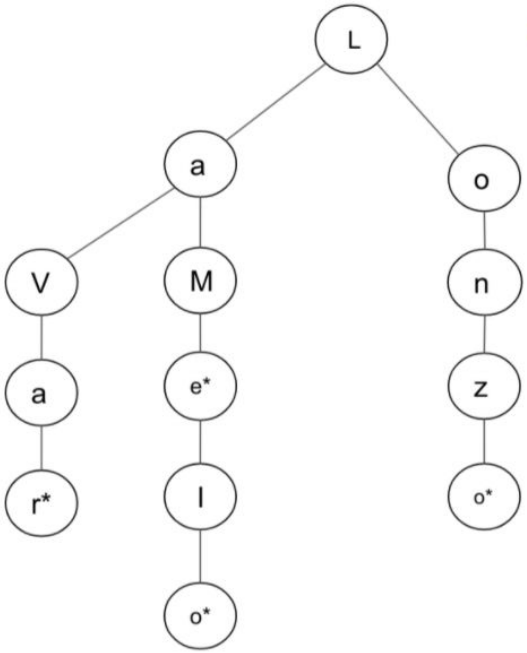


It takes $\theta(nL)$

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



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



Best case $\theta(1)$: the first letter of the word is not in the trie.

Worst case: $\theta(L)$: the word is in the trie, and we have to traverse to the end of the word to confirm.