Introduction

Program that sorts English words into an AVL or Red-Black Tree then has different functions with anagrams applied to those words.

Proposed solution

At first, I had to use the Zybooks implementation of AVL trees and Red-Black Trees. Then I made functions to insert the valid English words into an AVL tree or Red-Black tree. Then, I used one of these implementations to populate Engish_words. With these methods working, I was able to perform some methods with anagrams that included printing, counting, and getting the largest anagram from a file.

Experimental results

The test cases were not very long and are simply using an AVL tree, Red-Black Tree and anagrams. I tested on a file with a couple of words. My program is able to put all 400,000 English words into a tree in about 3 minutes however, takes a very long computing the anagrams

SAMPLE #1: AVL Tree on testw.txt:

```
What type of Binary Tree?

Enter 'A' for AVL Tree or 'B' for Red-Black Tree: a
You have selected AVL Tree, AVL Tree now loading...
Finished
```

SAMPLE #2: Red Black Tree on testw.txt:

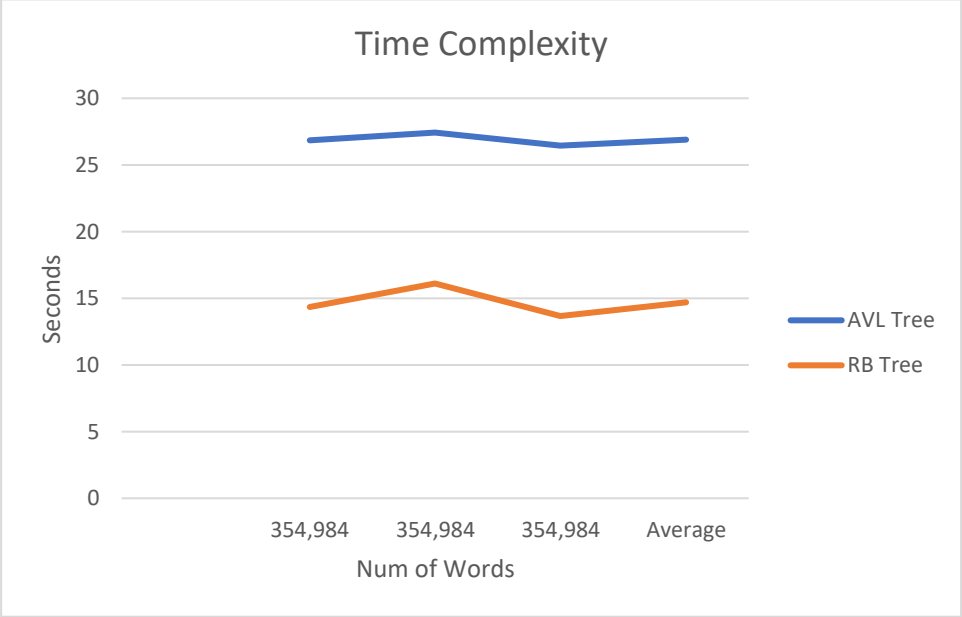
```
What type of Binary Tree?

Enter 'A' for AVL Tree or 'B' for Red-Black Tree: b
You have selected Red-Black Tree, RB Tree now loading...
Finished
```

SAMPLE #3: Test Anagram Functions on testw.txt:

```
Here is a list of spot's anagrams:
spot
stop
post
pots
opts
tops
The amount of anagrams this word has:  6
Word with most anagrams: apers  - 9
```

Time Complexity

The program is assumed to run in $O(n^2)$ time since the tree takes $O(n^2)$ time populating and O(logn) searching. Here is a graph with the specific time.



Conclusion

I learned how to create an AVL and Red-Black tree while also learning how to find, count, and get the largest anagrams from different words.

Appendix

```
#!/usr/bin/env
python3
```

```
# -*- coding: utf-8 -*-
"""
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Lab 3 - Option B
Program that sorts english words into a Binary Search Tree and has
differnt functions with Anagrams
"""
from AVLNode import AVLNode
from AVLTree import AVLTree
from RBTree import RBTree
from RBTNode import RBTNode

fileName = "words.txt"
testFile = "testW.txt"

def main():
    #make sure input is valid
    valid = False
    while(valid == False):
        print("What type of Binary Tree? ")
        answer = input("Enter 'A' for AVL Tree or 'B' for Red-Black Tree: ")
        answer = answer.lower()

        if (answer != 'a' and answer != 'b'):
            valid = False
            print("Error")
        else:
            valid = True

        if(answer == 'a'):
            print("You have selected AVL Tree, AVL Tree now loading...")
            AVL(fileName)
```

```
            print("Finished")
            valid = True

        else:
            print("You have selected Red-Black Tree, RB Tree now loading...")
            RBT(fileName)
            print("Finished")
            valid = True

    #Test functionality of other functions.
#    test()

def test():
    print()
    testWord = "spot"
    print("Here is a list of " + testWord + "'s anagrams:")
    print_anagrams(testWord)
    print("The amount of anagrams this word has: " , count_anagrams("spot")) #should
print out six
    print("Word with most anagrams: " + get_largest(testFile),"-
",count_anagrams(get_largest(testFile)))

def engish_word(word):

    avlTree = AVLTree()
    #opens file and puts into tree
    with open(testFile) as f: #change file to testFile when you want to test

        for line in f:
             if "\n" in line:
                 line = line.replace("\n", "")
             lowerCase = (line.lower()) #this line makes every word a lower case
             node = AVLNode(lowerCase)
             avlTree.insert(node)

    if avlTree.search(word):
        #print("FOUND")
        return True
    else:
        #print("NOT FOUND")
        return False
#function to return the word with the most amount of anagrams
def get_largest(file_name):
```

```
    counter = 0
    with open(file_name) as f:
        for line in f:
            line = line.replace("\n", "")
            cur = count_anagrams(line)
            if cur > counter:
                counter = cur
                large = line
        return large
#counts the number of anagrams a word has
def count_anagrams(word, prefix=""):

    if len(word) <= 1:
        str = prefix + word
        #adds one to count when an anagram is a word
        if engish_word(str):
            return 1
        return 0
    else:
        count = 0
        for i in range(len(word)):
          cur = word[i: i + 1]
          before = word[0: i]
          after = word[i + 1:]
          if cur not in before:
            count += count_anagrams(before + after, prefix + cur)
        return count

#function to print anagrams of a word
def print_anagrams(word, prefix=""):

    if len(word) <= 1:
        str = prefix + word
        if engish_word(str):
            print(prefix + word)
    else:
        for i in range(len(word)):
            cur = word[i: i + 1]
            before = word[0: i] # letters before cur
            after = word[i + 1:] # letters after cur

            if cur not in before: # Check if permutations of cur have not been
generated.
```

```
                print_anagrams(before + after, prefix + cur)
#function to put words into an AVL tree
def AVL(fileName):
    avlTree = AVLTree()
    #opens file and puts into tree
    with open(fileName) as f:

        for line in f:
            if "\n" in line:
                line = line.replace("\n", "")
            lowerCase = (line.lower()) #this line makes every word a lower case
            node = AVLNode(lowerCase)
            avlTree.insert(node)

        return avlTree
#function to put words into a Red and Black tree
def RBT(fileName):
    rbtTree = RBTree()
    with open(fileName) as f:
        for line in f:
            if "\n" in line:
                line = line.replace("\n", "")
            node = (line.lower()) #this line makes every word a lower case
            rbtTree.insert(node)

    return rbtTree

main()
```

“I certify that this project is entirely my own work. I wrote, debugged, and tested the code being presented, performed the experiments, and wrote the report. I also certify that I did not share my code or report or provided inappropriate assistance to any student in the class.”