DATA STRUCTURES AND ALGORITHMS

ASSIGNMENT 3

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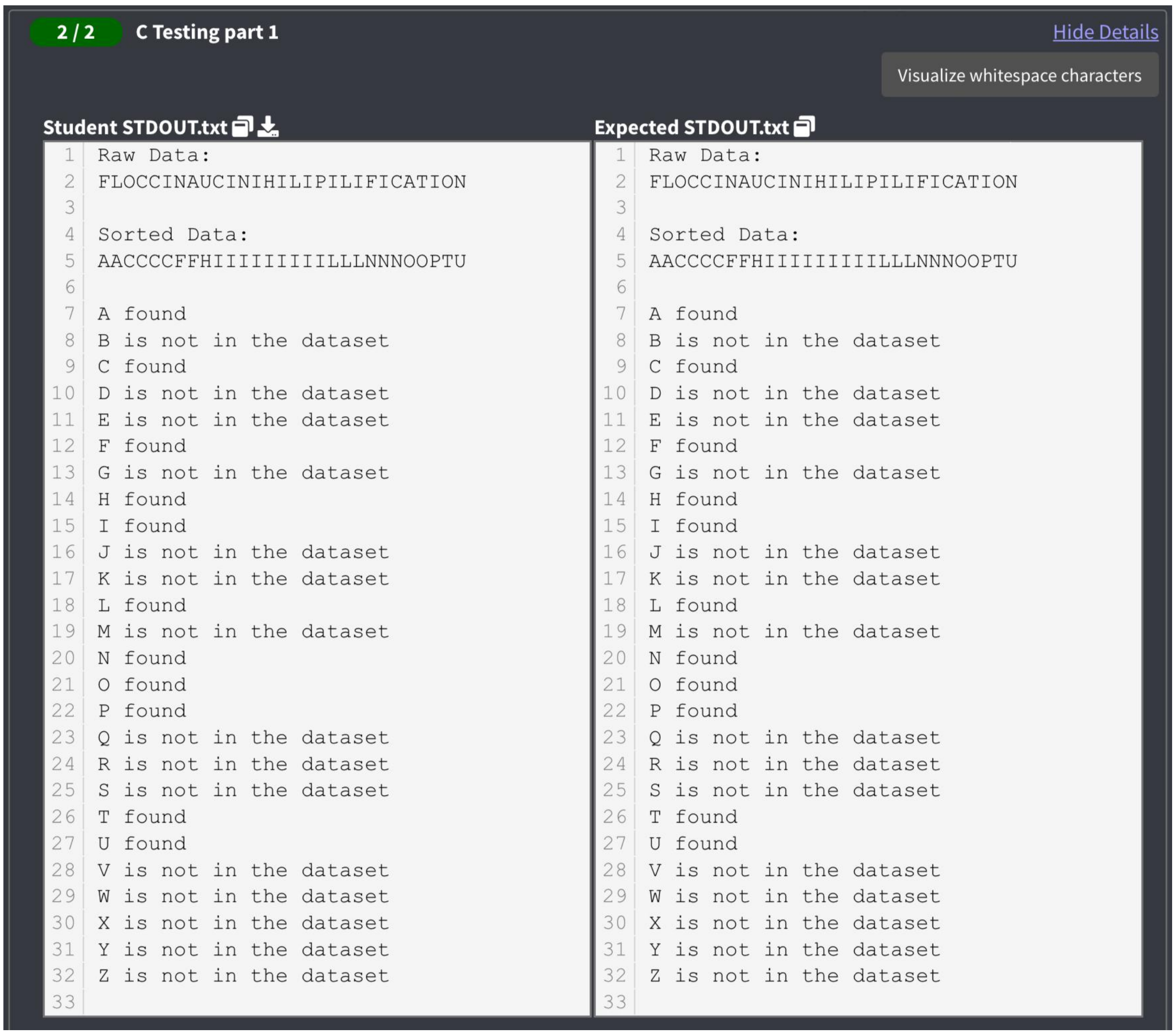
Task 1



Student STDOUT.txt

```
Raw Data:
FLOCCINAUCINIHILIPILIFICATION

Sorted Data:
AACCCCCFFHIIIIIIIIIILLLNNNOOPTU

A found
B is not in the dataset
C found
D is not in the dataset
E is not in the dataset
F found
G is not in the dataset
H found
I found
J is not in the dataset
K is not in the dataset
L found
M is not in the dataset
N found
O found
P found
Q is not in the dataset
R is not in the dataset
S is not in the dataset
T found
U found
V is not in the dataset
W is not in the dataset
X is not in the dataset
Y is not in the dataset
Z is not in the dataset

```

Expected STDOUT.txt

```
Raw Data:
FLOCCINAUCINIHILIPILIFICATION

Sorted Data:
AACCCCCFFHIIIIIIIIIILLLNNNOOPTU

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```

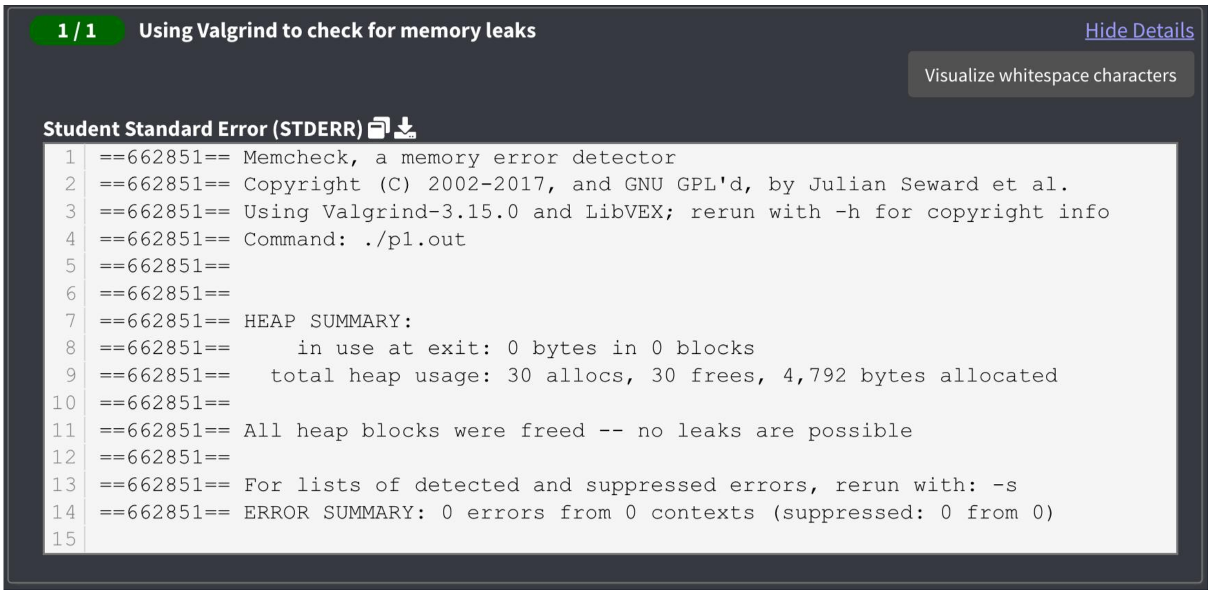
1 / 1
Using Valgrind to check for memory leaks
Hide Details
Visualize whitespace characters

Student Standard Error (STDERR)

```
==662851== Memcheck, a memory error detector
==662851== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==662851== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==662851== Command: ./p1.out
==662851==
==662851==
==662851== HEAP SUMMARY:
==662851==     in use at exit: 0 bytes in 0 blocks
==662851==   total heap usage: 30 allocs, 30 frees, 4,792 bytes allocated
==662851==
==662851== All heap blocks were freed -- no leaks are possible
==662851==
==662851== For lists of detected and suppressed errors, rerun with: -s
==662851== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)

```

Task 2

Result pasted from Submitty:

Even Nodes:

```
Generating 110462 books... OK

Profiling listdb
-------------------------------------------

Total Inserts                :      110462
Num Insert Errors            :           0
Avg Insert Time              :    0.000005 s
Var Insert Time              :    0.000003 s
Total Insert Time            :    1.113133 s

Total Title Searches         :       11046
Num Title Search Errors      :           0
Avg Title Search Time        :    0.001101 s
Var Title Search Time        :    0.005095 s
Total Title Search Time      :   12.242322 s

Total Word Count Searches    :       11046
Num Word Count Search Errors :           0
Avg Word Count Search Time   :    0.001017 s
Var Word Count Search Time   :    0.004608 s
Total Word Count Search Time :   11.310714 s

STAT
Avg comparisons per search  -> 55327.259551
List size matches expected? -> Y

Profiling bstdb
-------------------------------------------

Total Inserts                :      110462
Num Insert Errors            :           0
Avg Insert Time              :    0.000007 s
Var Insert Time              :    0.000052 s
Total Insert Time            :    1.237749 s

Total Title Searches         :       11046
Num Title Search Errors      :           0
Avg Title Search Time        :    0.000006 s
Var Title Search Time        :    0.000000 s
```

```
Total Title Search Time      :   0.097654 s

Total Word Count Searches    :        11046
Num Word Count Search Errors :            0
Avg Word Count Search Time   :   0.000004 s
Var Word Count Search Time   :   0.000000 s
Total Word Count Search Time :   0.062428 s

Balanced
Total Nodes traversed: 349497
Average Number of Nodes traversed: 15.820070
Number of Nodes in the BST are 110462
Duplicates absent
Press Enter to quit...
```

Odd Nodes:

```
Generating 104977 books... OK

Profiling listdb
--------------------------------------------

Total Inserts                 :      104977
Num Insert Errors             :           0
Avg Insert Time               :   0.000005 s
Var Insert Time               :   0.000002 s
Total Insert Time             :   1.045341 s

Total Title Searches          :       10497
Num Title Search Errors       :           0
Avg Title Search Time         :   0.000953 s
Var Title Search Time         :   0.003868 s
Total Title Search Time       :  10.075037 s

Total Word Count Searches     :       10497
Num Word Count Search Errors :           0
Avg Word Count Search Time    :   0.000816 s
Var Word Count Search Time    :   0.003231 s
Total Word Count Search Time :   8.618826 s

STAT
Avg comparisons per search  -> 52504.463942
List size matches expected? -> Y

Profiling bstdb
--------------------------------------------

Total Inserts                 :      104977
Num Insert Errors             :           0
Avg Insert Time               :   0.000006 s
Var Insert Time               :   0.000068 s
Total Insert Time             :   1.163196 s

Total Title Searches          :       10497
Num Title Search Errors       :           0
Avg Title Search Time         :   0.000007 s
Var Title Search Time         :   0.000000 s
Total Title Search Time       :   0.126449 s

Total Word Count Searches    :        10497
Num Word Count Search Errors :            0
Avg Word Count Search Time   :   0.000006 s
Var Word Count Search Time   :   0.000000 s
Total Word Count Search Time :   0.111802 s

Balanced
Total Nodes traversed: 330807
Average Number of Nodes traversed: 14.974063
Number of Nodes in the BST are 104977
Duplicates absent
Press Enter to quit...
```

SUMMARY OF ABOVE RESULTS:

1. No errors in insertion / searching
2. To ensure a balanced tree I used a modified BST which is known as AVL Tree. It is essentially a BST which checks the balance after every insertion and then rotates the tree accordingly. This part of my code was adapted from .GeeksForGeeks. A simple working of this tree is visible here.
3. I included the following in my stat functions
    a. Check if tree is balanced
    b. Total Nodes traversed
    c. Average Nodes traversed per search
    d. Count total number of nodes present in the tree