

1 Contents of testfile4.txt

zzzzz zzzzy zzzzx zzzzw zzzzv zzzzu zzzzt zzzzs zzzzr zzzzq zzzzp
zzzzo zzzzn zzzzm zzzzl zzzzk zzzzj zzzzi zzzzh zzzzg zzzzf zzzze zzzzd
yyyyz yyyyy yyyyx yyyyw yyyyv yyyyu yyyyt yyyys yyyyr yyyyq
yyyyp yyyyoy yyyyn yyyym yyyyl yyyyk yyyyj yyyyi yyyyh yyyyg
yyyyf yyyyey yyyyd xxxxz xxxxy xxxxx xxxxw xxxxv xxxxu xxxxt
xxxxs xxxxr xxxxq xxxxp xxxxo xxxxn xxxxm xxxxl xxxxk xxxxj
xxxxi xxxxh xxxxg xxxxf xxxxe xxxxd wwwwz wwwwy wwwwx
wwwvw wwwwv wwwwu wwwwt wwwws wwwwr wwwwq wwwwp
wwwwo wwwwn wwwwm wwwwl wwwwk wwwwj wwwwi wwwwh
wwwwg wwwwf wwwwe wwwwd vvvvz vvvvy vvvvx vvvvw vvvvv
vvvvu vvvvt vvvvs vvvvr vvvvq vvvvp vvvvo vvvvn vvvvm vvvvl
vvvvk vvvvj vvvvi vvvvh vvvvg vvvvf vvvve vvvvd uuuuz uuuuy
uuuux uuuuw uuuuv uuuuu uuuut uuuus uuuur uuuuq uuuup uuuuo
uuuun uuuum uuuul uuuuk uuuuj uuuui uuuuh uuuug uuuuf uuuue
uuuud ttttz tttty ttttx ttttw ttttv ttttu ttttt tttts ttttr ttttq ttttp
tttto ttttn ttttm ttttl ttttk ttttj tttti tttth ttttg ttttf tttte ttttd ssssz
ssssy ssssx ssssw ssssv ssssu sssst sssss ssssr ssssq ssssp sssso ssssn
ssssm ssssl ssssk ssssj ssssi ssssh ssssg ssssf sssse ssssd rrrrz rrrry rrrrx
rrrrw rrrrv rrrru rrrrt rrrrs rrrrr rrrrq rrrrp rrrro rrrrn rrrrm rrrrl
rrrrk rrrrj rrrri rrrrh rrrrg rrrrf rrrre rrrrd qqqqz qqqqy qqqqx qqqqw
qqqqv qqqqu qqqqt qqqqs qqqqr qqqqq qqqqp qqqqo qqqqn qqqqm
qqqql qqqqk qqqqj qqqqi qqqqh qqqqg qqqqf qqqqe qqqqd ppppz
ppppy ppppx ppppw ppppv ppppu ppppt pppps ppppr ppppq ppppp
ppppo ppppn ppppm ppppl ppppk ppppj ppppi pppph ppppg ppppf
ppppe ppppd ooooz ooooy oooox oooow oooov oooou ooot oooos
oooor oooq oooop ooooo ooon ooom oool oook oooj oooi
oooh ooog ooof oooe oood nnnnz nnnny nnnnx nnnnw nnnnv
nnnu nnnnt nnnns nnnnr nnnnq nnnnp nnnno nnnnn nnnnm nnnnl
nnnk nnnj nnni nnnh nnnng nnnnf nnnne nnnnd mmmmmz mm-
mmy mmmmx mmmmw mmmmv mmmmu mmmmt mmmms mm-
mmr mmmmq mmmmp mmmmo mmmmn mmmmm mmmml mm-
mmk mmmmj mmmmi mmmmh mmmmg mmmmf mmmme mm-
mmd llllz lllly llllx llllw llllv lllu llllt lllls llllr llllq llllp llllo lllln llllm
lllll llllk llllj llli llllh llllg llllf lllle lllld kkkkz kkkky kkkkx kkkkw
kkkkv kkkku kkkkt kkkks kkkkr kkkkq kkkkp kkkko kkkkn kkkkm
kkkkl kkkkk kkkkj kkkki kkkkh kkkkg kkkkf kkkke kkkkd jjjjz jjjjy
jjjjx jjjjw jjjjv jjjju jjjjt jjjjs jjjir jjjjq jjjip jjjjo jjjin jjjzm jjjjl jjjjk jjjjj
jjjji jjjjh jjjjg jjjjf jjjje jjjld iiiz iiy iiix iiiv iiu iiit iiis iiir
iiiq iiip iiio iiii iiiiim iiil iiik iiij iiu iiih iiig iiif iiie iiid hhhhzh
hhhhx hhhhhy hhhhvw hhhhvh hhhhhu hhhhht hhhhhs hhhhhr hhhhq hh-
hhp hhhhho hhhhhn hhhhhm hhhhhl hhhhbk hhhhbj hhhhbi hhhhbb hhhhbg
hhhhhf hhhhhe hhhhhd ggggz ggggy ggggx ggggw ggggv ggggu ggggt
ggggs ggggr ggggq ggggp ggggo ggggn ggggm ggggl ggggk ggggj ggggi
ggggh ggggg ggggf gggge ggggd fffz fffy fffx fffv fffu ffft fffs

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ffffr ffffq ffffp ffffo ffffn ffffm ffffl ffffk fffj fffi fffh fffg ffff fffe fffd
eeeez eeeey eeex eeew eeew eeew eeew eeew eeew eeew eeew eeew eeew eeew eeew
eeeo eeem eeem eeem eeem eeem eeem eeem eeem eeem eeem eeem eeem eeem eeem
eeed ddddz ddddy ddddx ddddw ddddv ddddu ddddt ddds dddr
dddq dddp dddo dddn dddm dddl dddk dddj dddi dddh
dddg dddf ddde dddd ant

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2 Why it works

This testfile works because its contents are in reverse alphabetic order. This means that the element being inserted into the search tree is always lexicographically prior to previous elements and is inserted to the left of all existing nodes. In the unbalanced BST this results in a tree that is essentially equivalent to a singly linked list. Searching for the word “ant” demonstrates the difference in efficiency for worst case scenarios for a BST compared to an AVL Tree.

3 Numerical Results

testfile1.txt - general statistics

| Structure | Total Nodes | Average Node Depth | Single Rotations | Double Rotations |
|-----------|-------------|--------------------|------------------|------------------|
| AVL | 19 | 2.26316 | 6 | 2 |
| BST | 19 | 3.15789 | n/a | n/a |

testfile1.txt - search results

| Word | AVL | | | BST | | |
|----------|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| | Left Links Followed | Right Links Followed | Total Links Followed | Left Links Followed | Right Links Followed | Total Links Followed |
| me | 3 | 1 | 4 | 4 | 2 | 6 |
| kind | 1 | 0 | 1 | 3 | 1 | 4 |
| problems | 1 | 1 | 2 | 2 | 1 | 3 |
| created | 2 | 1 | 3 | 4 | 1 | 5 |

testfile2.txt - general statistics

| Structure | Total Nodes | Average Node Depth | Single Rotations | Double Rotations |
|-----------|-------------|--------------------|------------------|------------------|
| AVL | 16 | 2.5 | 9 | 2 |
| BST | 16 | 6.0625 | n/a | n/a |

testfile2.txt - search results

| Word | AVL | | | BST | | |
|--------|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| | Left Links Followed | Right Links Followed | Total Links Followed | Left Links Followed | Right Links Followed | Total Links Followed |
| caught | 2 | 1 | 3 | 0 | 2 | 2 |
| flying | 1 | 1 | 2 | 0 | 5 | 5 |
| flown | 2 | 2 | 4 | 1 | 5 | 6 |
| mauve | 0 | 1 | 3 | 0 | 9 | 9 |

testfile3.txt - general statistics

| Structure | Total Nodes | Average Node Depth | Single Rotations | Double Rotations |
|-----------|-------------|--------------------|------------------|------------------|
| AVL | 13 | 2.23077 | 5 | 0 |
| BST | 13 | 3.23077 | n/a | n/a |

testfile3.txt - search results

| Word | AVL | | | BST | | |
|-----------|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| | Left Links Followed | Right Links Followed | Total Links Followed | Left Links Followed | Right Links Followed | Total Links Followed |
| misty | 2 | 1 | 3 | 3 | 2 | 5 |
| cobwebs | 1 | 0 | 1 | 1 | 0 | 0 |
| clockwork | 2 | 0 | 2 | 2 | 0 | 2 |
| landscape | 1 | 1 | 2 | 2 | 1 | 3 |

testfile4.txt - general statistics

| Structure | Total Nodes | Average Node Depth | Single Rotations | Double Rotations |
|-----------|-------------|--------------------|------------------|------------------|
| AVL | 530 | 7.08868 | 520 | 2 |
| BST | 530 | 264.5 | n/a | n/a |

testfile4.txt - search results

| Word | AVL | | | BST | | |
|-------|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| | Left Links Followed | Right Links Followed | Total Links Followed | Left Links Followed | Right Links Followed | Total Links Followed |
| ggggs | 6 | 2 | 8 | 444 | 0 | 444 |
| nnnni | 3 | 4 | 7 | 293 | 0 | 293 |
| uuuuo | 6 | 2 | 8 | 126 | 0 | 126 |
| ant | 9 | 0 | 9 | 529 | 0 | 3 |