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Experiment 1 Report (Assignment 2)

Firstly, to create T1 (tall and "skinny" BST) I insert 50000 nodes into it in increasing order; to create T2 (short and "bushy" BST) I perform a random shuffle of array that contains all integers from 0 to 49999 (random shuffle is used to create a simulation of natural order of data insertion).

Secondly, to perform an equivalent membership check on both trees and get average depth of nodes for this check I create a separate "search" array of 10000 random integers in range from 0 to 49999. After that, I record how much time each tree needs to perform depth function with entries from "search" array and sum the depths of all nodes separately for T1 and T2. Dividing time and depths sum by 10000 gives me average time of membership check and average depth of search for both trees.

Here are the results of the test described above:

Average membership test time for T1: 0.298955
Average depth for T1: 24716
Average membership test time for T2: 0.0002726
Average depth for T2: 18

(Time is measured in milliseconds)

Results of the Experiment 1 show that T2 that represents a tree constructed with "natural" sequence of insertions has a significantly lower average depth of the search and performs membership check dramatically faster than T2 which is a BST constructed with intentionally ordered sequence of insertions.

Experiment 2 Report (Assignment 2)

Firstly, I create an array with integers from 0 to 49999 and randomly shuffle all the values to simulate natural sequence of insertions. Then I insert integers from this array to both BST and AVL trees and separately measure the time of insertion. After that, I calculate average depth of nodes (sum of depths of all nodes divided by number of nodes in a tree) and height of AVL and BST trees.

Secondly, I create a separate "search" array of random integers that is used to perform a membership check on both BST and AVL trees. I record time that AVL and BST trees take to perform a sequence membership test at the same time collecting and summing up depths of all searches.

I also keep track of maximum and minimum membership check time and depth of search for both AVL and BST trees. When all the searches from "search" array are performed, I divide sum of search depths and total time taken by number of searches to find mean depth of search and mean membership check time for AVL and BST trees.

Here are the results of the first part of Exp.2 (insertion array is fully random):

BST average insertion time: 0.0004237
BST height: 35
BST average depth: 18.3576
BST min depth: 4
BST max depth: 35
BST mean depth: 18.3054
BST min membership check time: 0
BST max membership check time: 0.488
BST mean membership check time: 0.0014723
Avl average insertion time: 0.00111516

Avl height: 18
Avl average depth: 13.9586
Avl min depth: 1
Avl max depth: 18
Avl mean depth: 13.936
Avl min membership check time: 0
Avl max membership check time: 0.191
Avl mean membership check time: 0.0005995

Conclusion: BST trees perform insertions faster than AVL trees, but AVL trees have lower height and average depth. Correspondingly, AVL trees' maximum, minimum and mean depths of search are also lesser than maximum, minimum and mean depth of search for BST and, therefore, maximum and mean membership check time for AVL are lesser than similar measurements for BST (I assume that minimum membership check time for AVL trees is also lesser than min membership check time for BST, but the compared values are too small to measure them precisely).

Here are the results of the second part of Exp.2 (half of the insertion array is random and other half is ordered):
BST average insertion time: 0.0560021
BST height: 25013
BST average depth: 6265.58
BST min depth: 0
BST max depth: 24999
BST mean depth: 6136.89
BST min membership check time: 0
BST max membership check time: 0.411
BST mean membership check time: 0.0537375
Avl average insertion time: 0.000404
Avl height: 17
Avl average depth: 14.1546
Avl min depth: 0
Avl max depth: 17
Avl mean depth: 14.1458
Avl min membership check time: 0
Avl max membership check time: 0.097
Avl mean membership check time: 0.0004008

Conclusion: This case shows that when significant part of insertion sequence is ordered, BST's average insertion time, height, average depth, maximum depth, mean depth, maximum membership check time, mean membership check time drastically increase comparing to the previous part, while similar measurements for AVL trees stay practically the same.