

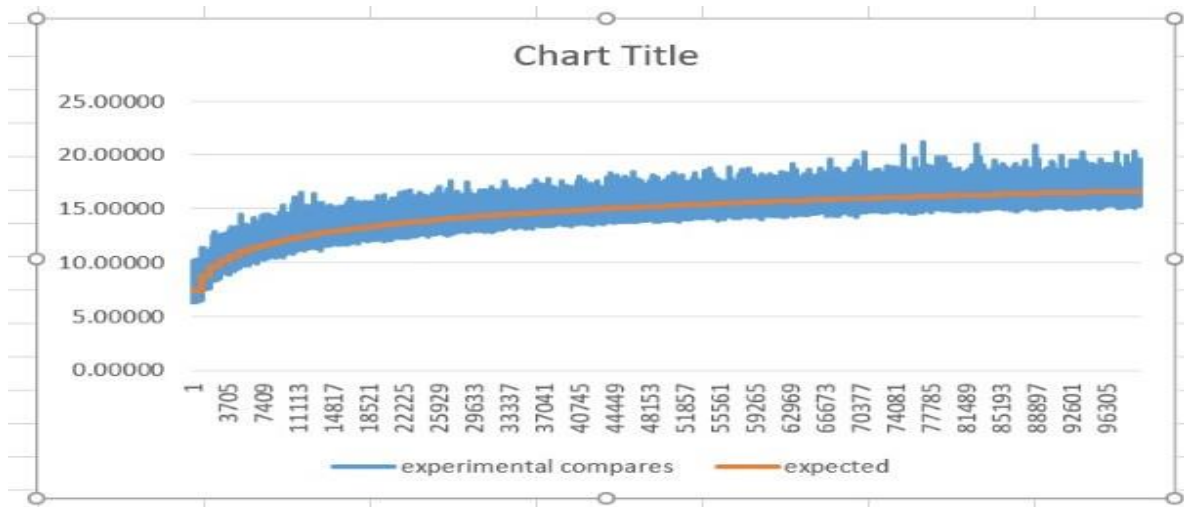
1.)Experimental Setup:

- I. A binary search tree (BST) is a binary tree where each node has a Comparable key (and an associated value) and satisfies the restriction that the key in any node is larger than the keys in all nodes in that node's left subtree and smaller than the keys in all nodes in that node's right subtree.
- II. In this paper, we used the code BST.java in the textbook to perform the experiment requested from us.
- III. The number of comparisons used for a search hit that ends at a given node is 1 plus the depth. Adding the depths of all the nodes, we get a quantity known as the length of the tree's internal path. Therefore, the desired quantity is 1 plus the average internal path length of the BST. Let C be the total internal path length of the BST constructed by inserting N randomly ordered separate keys, such that the average cost of the search hit is $1 + C / N$.
- IV. In this experiment, we will confirm the amount highlighted by computer scientists, $1.39\log N - 1.85$.

2.)Procedure:

- ✓ First of all, we created a class "BSTexperiment".
- ✓ Then, we wrote the necessary methods for this BST class. Such as : **isEmpty()**, **size()**, **get(Node x, Key key)** , **put(Node x, Key key, Value val)**, etc.(This implementation of BST is taken from our text book.
- ✓ Besides these basic methods, we also wrote an extra method called findDepth.
- ✓ The purpose of this method is to return the sum of the depths of all nodes to us as a result.
- ✓ In the main part of the class, we put for $N=100$ to $N=10,000$,iterate 1000 times for each value of N
- ✓ We calculated this quantity: $\text{Comparisons} = 1 + C/N$ (**C =internal path length**
 N =Number of nodes in the BST)
- ✓ We added all values to the excel sheet because we had to draw a graph. In this way we calculated the standard deviation and average of the all values.

3.) Experimental Results:



Operations	Experimental Results	Expected
100	7,92	7,3849601
100	8,73999	7,3849601
100	7,18	7,3849601
100	8,14	7,3849601
100	7,6	7,3849601
100	7,61	7,3849601
100	8,61001	7,3849601
100	7,3	7,3849601
100	6,63	7,3849601
100	8,86	7,3849601

NOTE: We could put only specific part of the table because table is too big to put report.

- ✓ We were very close to the expected result but there is small difference. That's why we created two region for our plot as "expected result" and "experimental result".
- ✓ We did 1000 iterations for each N as it is stated in the homework description.
- ✓ We can easily see that the average path length to the random node in the BST approximately coincides with the graph $f(n)=1.39 \cdot \log n - 1.85$.
- ✓ Standard deviation = 1.93708 compares
- ✓ Average = 14.54931 compares.