Saboo, Srishti: Nu Id (001443101)

INFO 6205
Program Structures & Algorithms
Fall 2018
Assignment 5-Report

In this assignment, I ran an experiment for to test that the depth/height of a Binary Search Tree after *M* (Hibbard) deletions and insertions.

1. Conclusion:

- While doing random insertion and deletion for x times, the height of the tree is coming to be proportional to square root of n.
  h = O(n^1/2)
  Where h = height of the tree
  n = No. of nodes.
  O () = big - Oh

- Initially, the height of tree is equivalent to n^1/2 but as the number of nodes increase the height of tree tends towards Log(n).
  h = Log(n) For higher values of n.

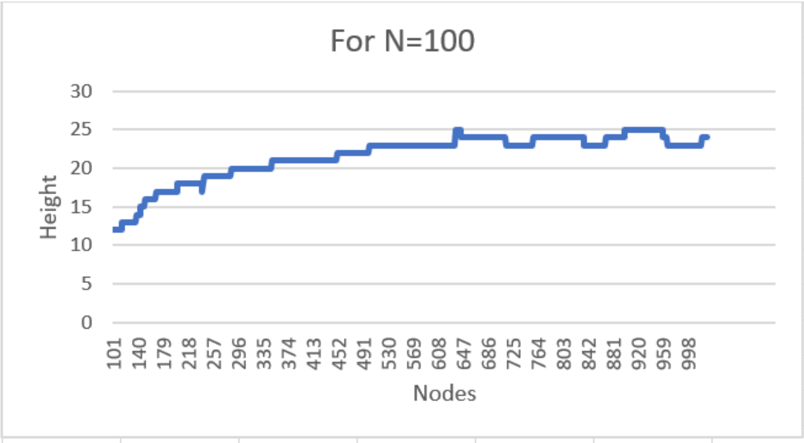
2. Graphical Representation –

I made three different graphs to analyze the behavior.

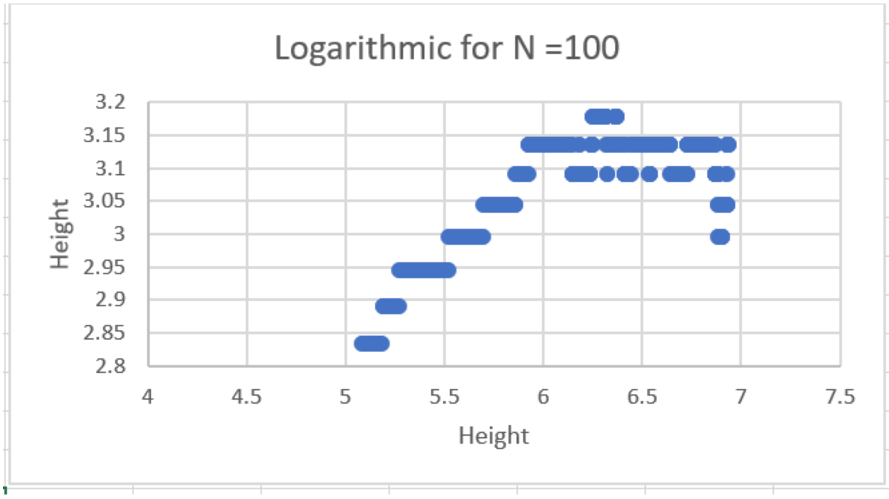
- For node values from N = 100, in this I also generated an initial binary tree with 100 values than performed the operations.
- Second Graph is between Log(n) and Log(height) values.
- Thirdly, I plotted a graph for values from N = 1.

In the below graphical representations (N) = No of Nodes.
The graph is plotted between Nodes and Height. The Y-axis represent the height, whereas the X-axis represent the Nodes.

Graph – 1

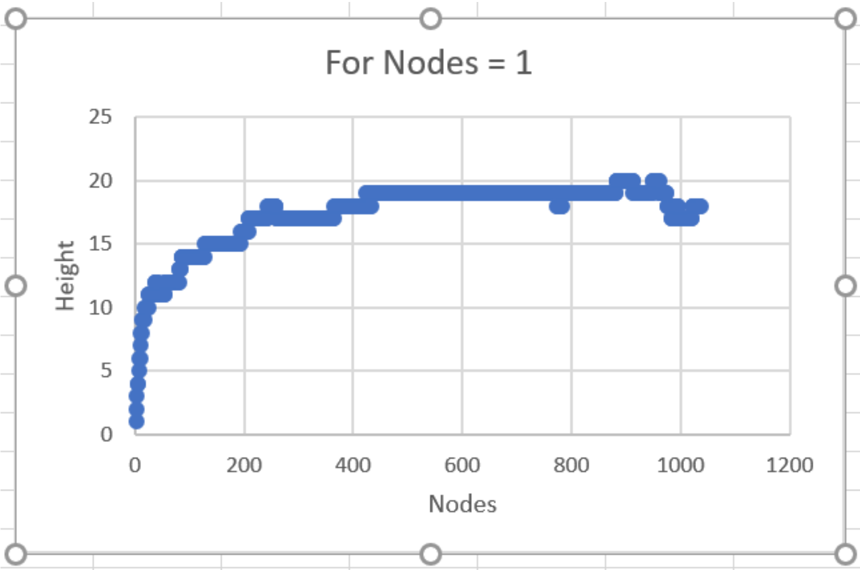


Graph-2



Graph-3

.



3. Proof:

- To prove the above relationship, I have generated number of nodes in an random order.
- I took a value m, for which I performed insertion and deletion operations. I am performing the insertion and deletion too by generating a random Boolean value.
- Lastly, calculated the height of the tree and analyzed the height with respect to the number of nodes or the size of the tree.
- Analyzing the above graphs, we can get the following result-

  From Graph-2, we have plotted a log-log curve, and it appears to be a straight line (although it is not visible properly, because I have plotted the graph of a lot of values and the difference between the values are very less).
  So, we can consider the equation of graph as straight line.
  That is, Log(d) = m*Log(n) + c
  For the values taken from the graph-2
  Log(d) = 3.05
  Log(n) = 5.9

  Putting the above values in the equation:-
  Lets, calculate the slope of the line,

  m = 3.05/5.9
  m = ½ (approx.)

  Now, putting the value back to our equation –

  Log(d) = m* Log(n) + c
  Log(d) = ½ * Log(n) + c

  Considering c to be Log of some value So,

  Log(d) = Log(n^1/2) + Log(c)
  Log(d) = Log(n^1/2*c)

  Taking anti- log on both the sides,

  d = n^1/2 * c

  Since c is a constant so,
  d is proportional to n^1/2.
  Hence Proved Height is proportional to n^1/2.

Hence Proved