# CSC 226 Assignment 1 LLRB BST Hypothesis

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## 1 Left-Leaning Red Black Tree Properties

It is known that the height of a LLRB BST is no more than $2log_2n$. This is because the worst case involves a tree that is composed of all 2-nodes except for the leftmost path is composed of the maximum amount of 3 nodes, which is at most twice as long. This occurs in the assignment when inserting an ordered sequence into a LLRB BST. It is also know that the average path length is approximately $log_2n$.

## 2 Results of the Assignment

The results of the assignment showed the following:

| Input Size | $10^1$ | $10^2$ | $10^3$ |
|---|---|---|---|
| red nodes | 2 | 3 | 6 |
| % red | 20 | 3 | 0.6 |

## 3 Hypothesis

Based on the results of the assignment it appears that a LLRB BST of size n, has approximately $log_2n/2$ red nodes.

## 4 Testing

| Input Size | $10^4$ | $10^5$ | $10^6$ |
|---|---|---|---|
| red nodes | 5 | 6 | 7 |
| % red | 0.05 | 0.006 | 0.0007 |

## 5 Results

The results show a lesser amount of red nodes then hypothesized. The number of red nodes appears to be within $log_2n/2$ and $log_3n/2$.