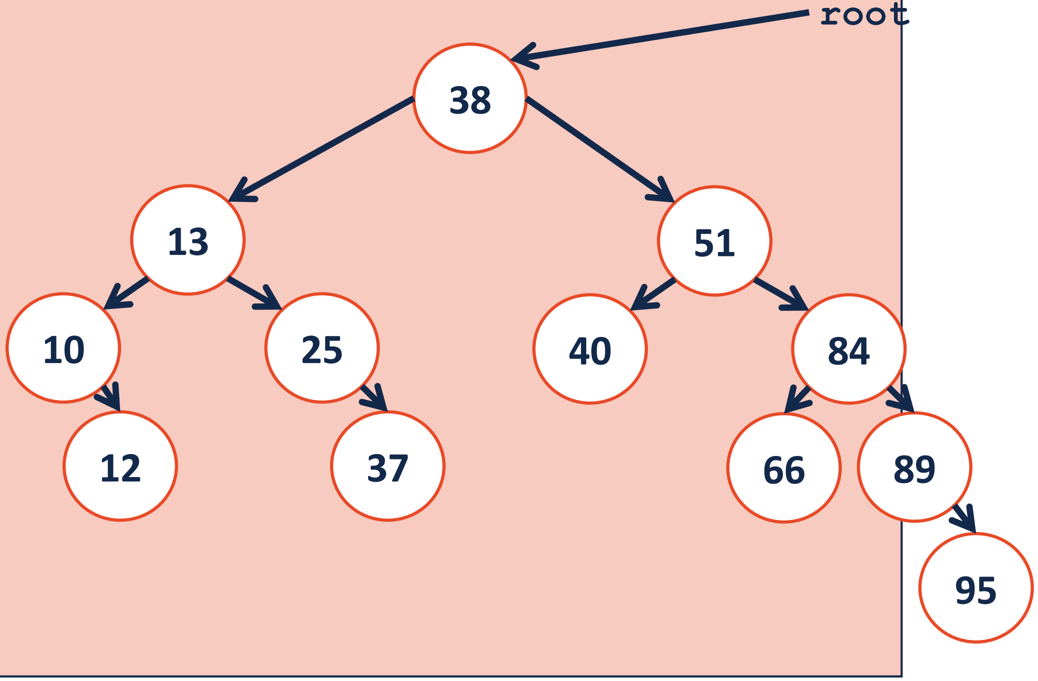
CS 225

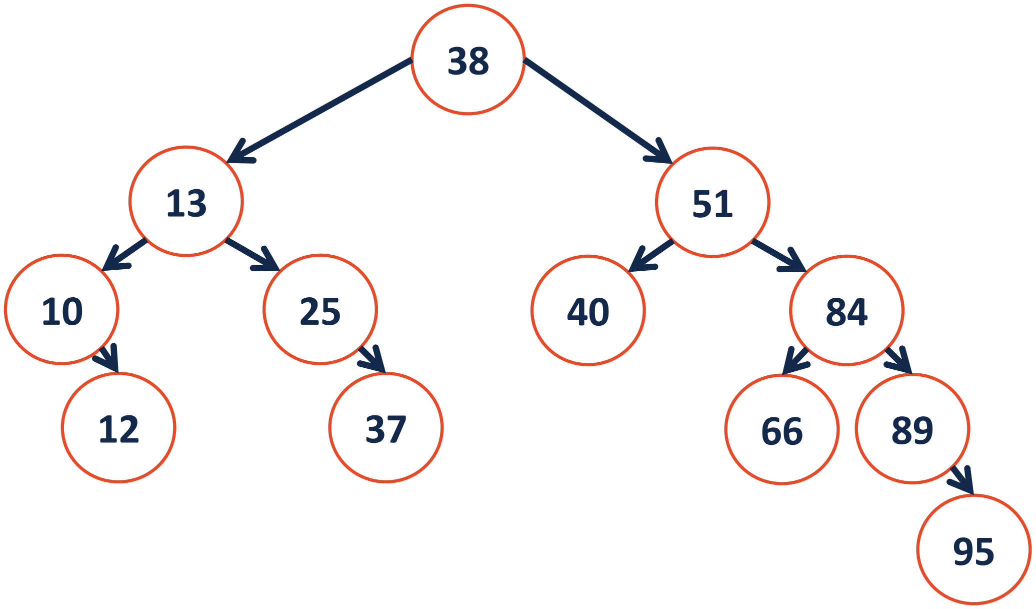
Data Structures

February 15 – BST Remove

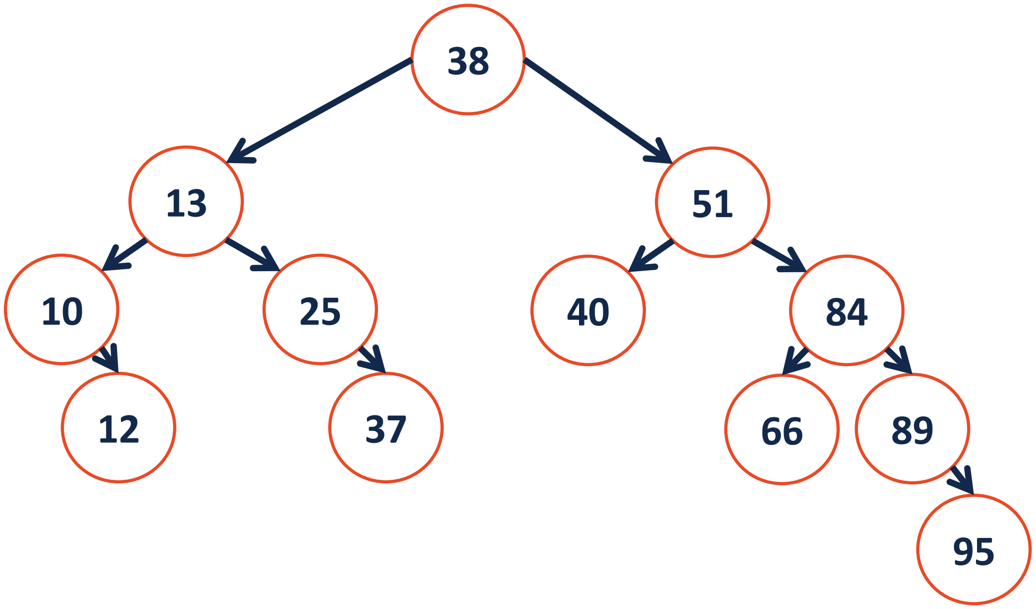
G Carl Evans

```
template<typename K, typename V>

void remove(TreeNode *& root, const K & key) {
























}
```

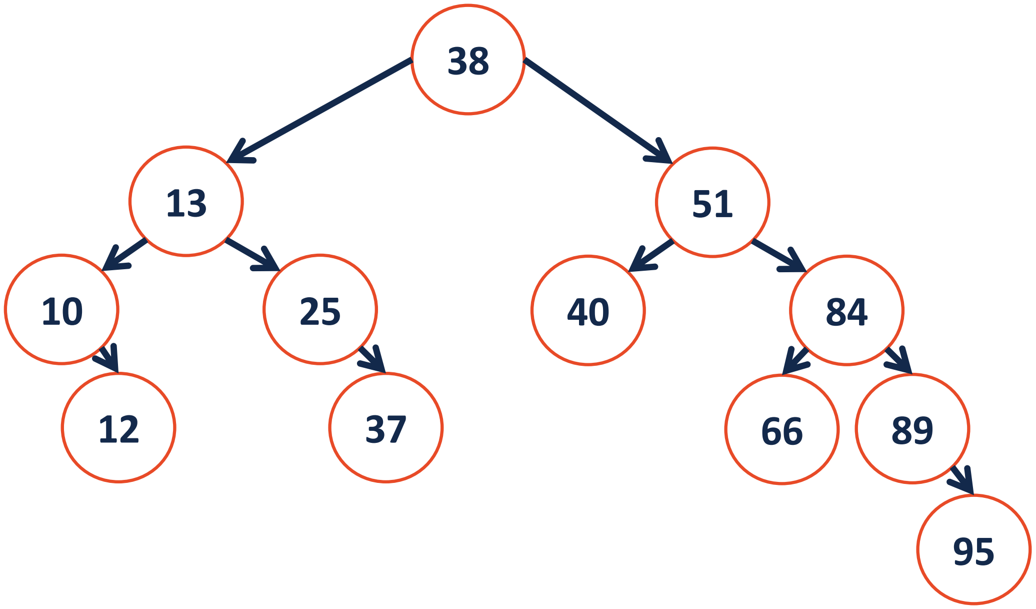




```
remove(40);
```



```
remove(25);
```



```
remove(13);
```

BST Analysis – Running Time

Operation	BST Worst Case
find	
insert	
delete	
traverse	

BST Analysis

Therefore, for all BST:

Lower bound: h >= O(lg(n))

Upper bound: h <= O(n)

BST Analysis

The height of a BST depends on the order in which the data is inserted into it.

ex: 1 3 2 4 5 7 6 vs. 4 2 3 6 7 1 5

Q: How many different ways are there to insert keys into a BST?

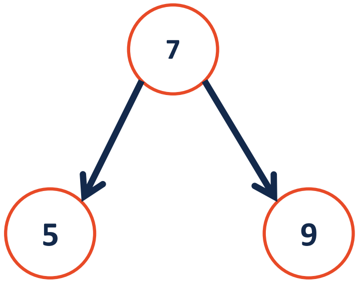
Q: What is the average height of all the arrangements?

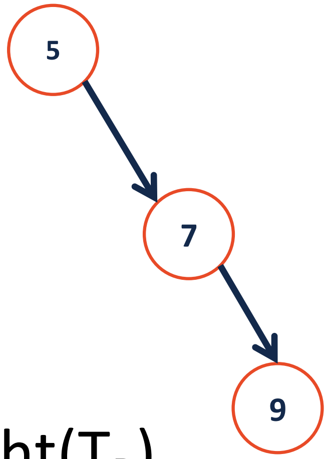
Dictionary Analysis – Running Time

Operation	BST Average case	BST Worst case	Sorted array	Sorted List
find				
insert				
delete				
traverse				

Height-Balanced Tree

What tree makes you happier?





Height balance: b = height(T_L) - height(T_R)

A tree is height balanced if:

BST Rotation

We will perform a rotation that maintains two properties:

1.

2.