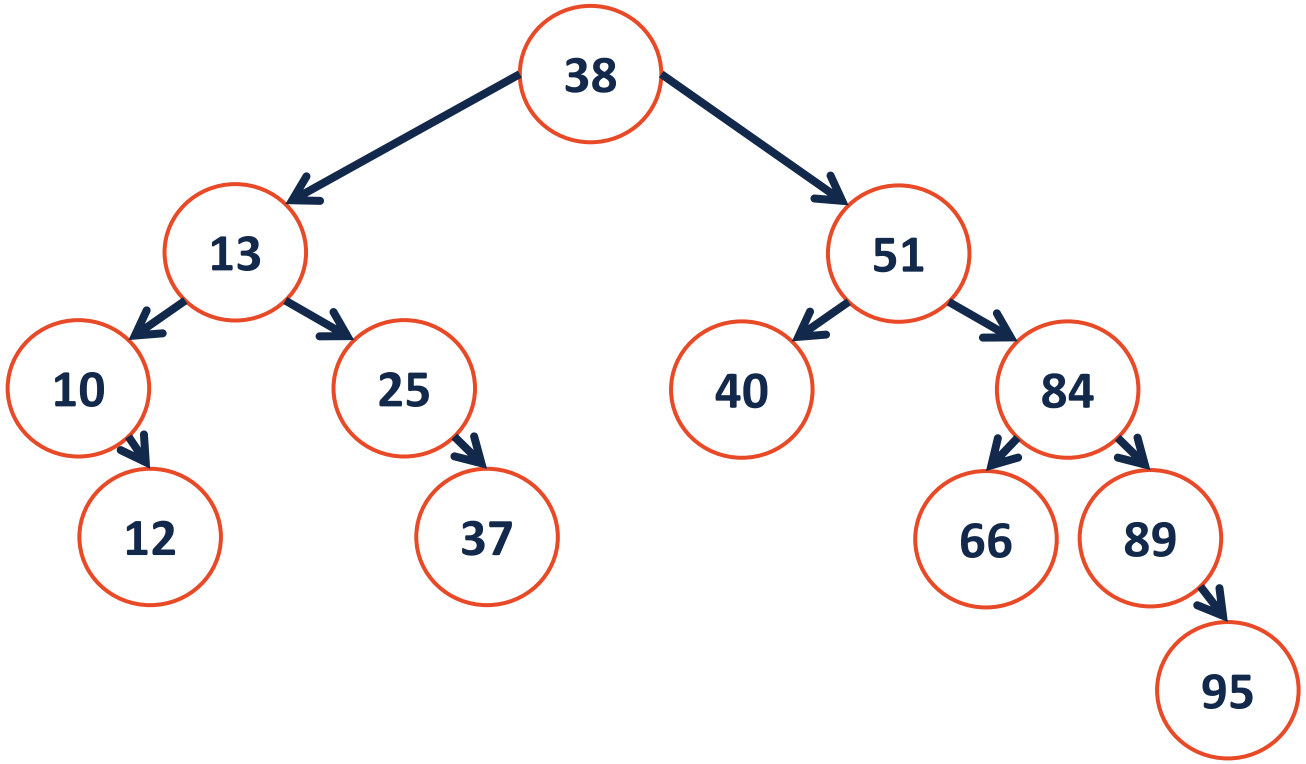
CS 225

Data Structures

Oct. 11 – BST Analysis


38
13
51
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84
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95

```
1  template<class K, class V>
2  _____________________________ _remove(TreeNode *& root, const K & key) {
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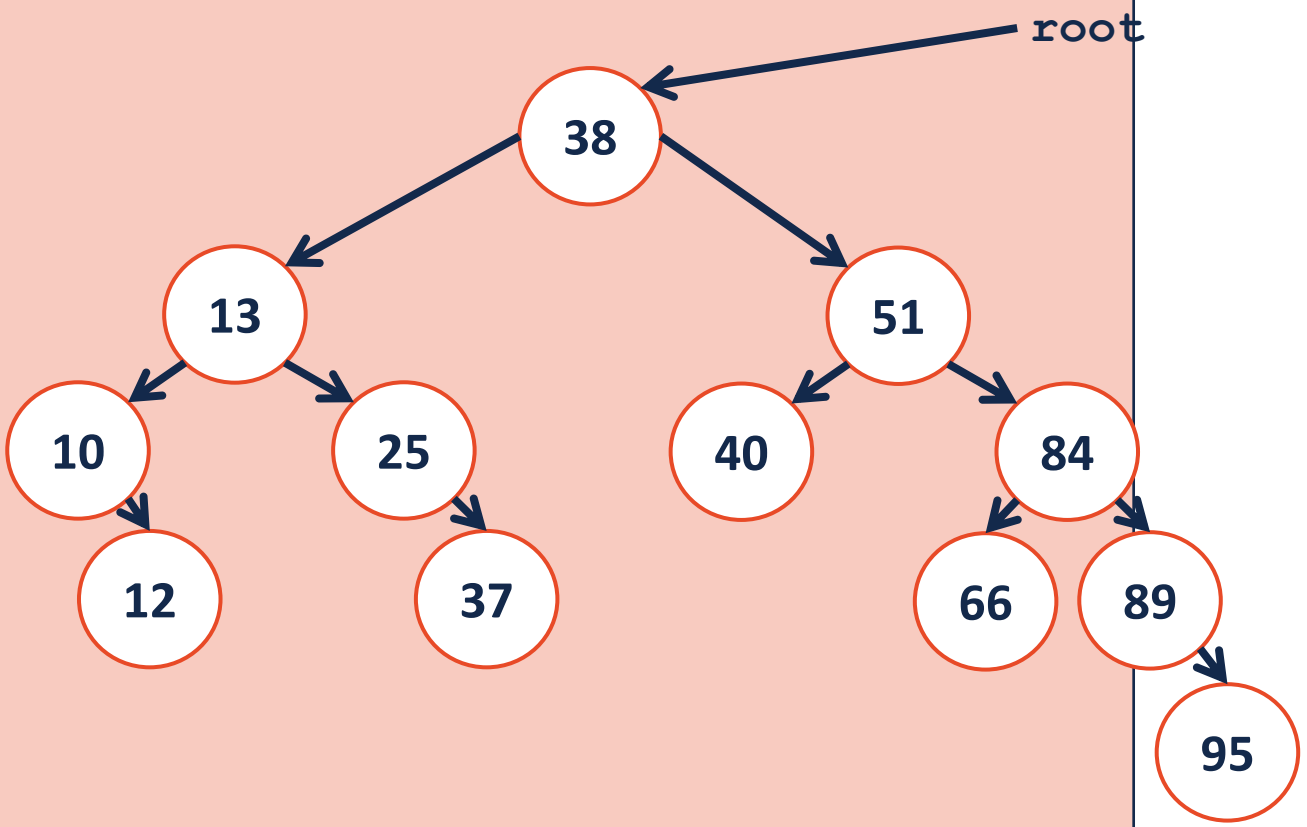
```



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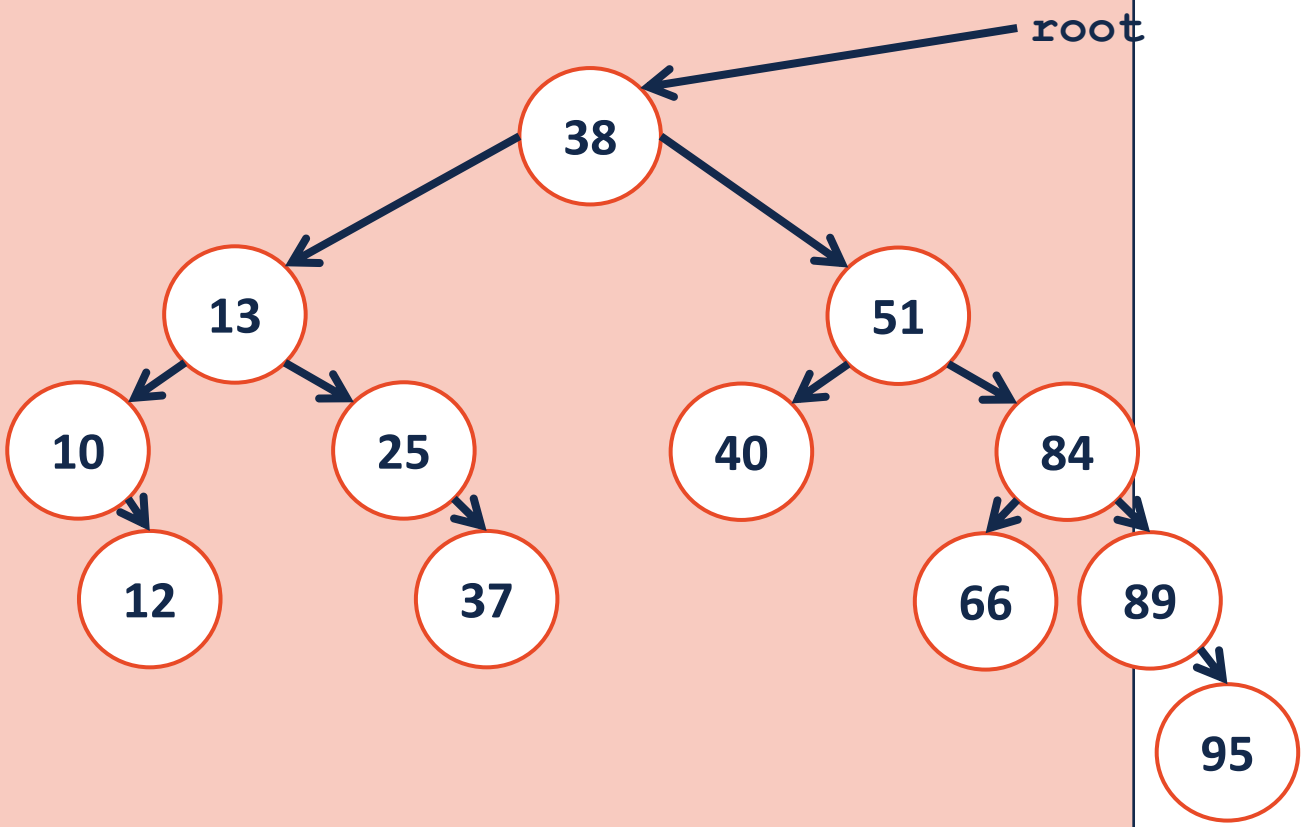
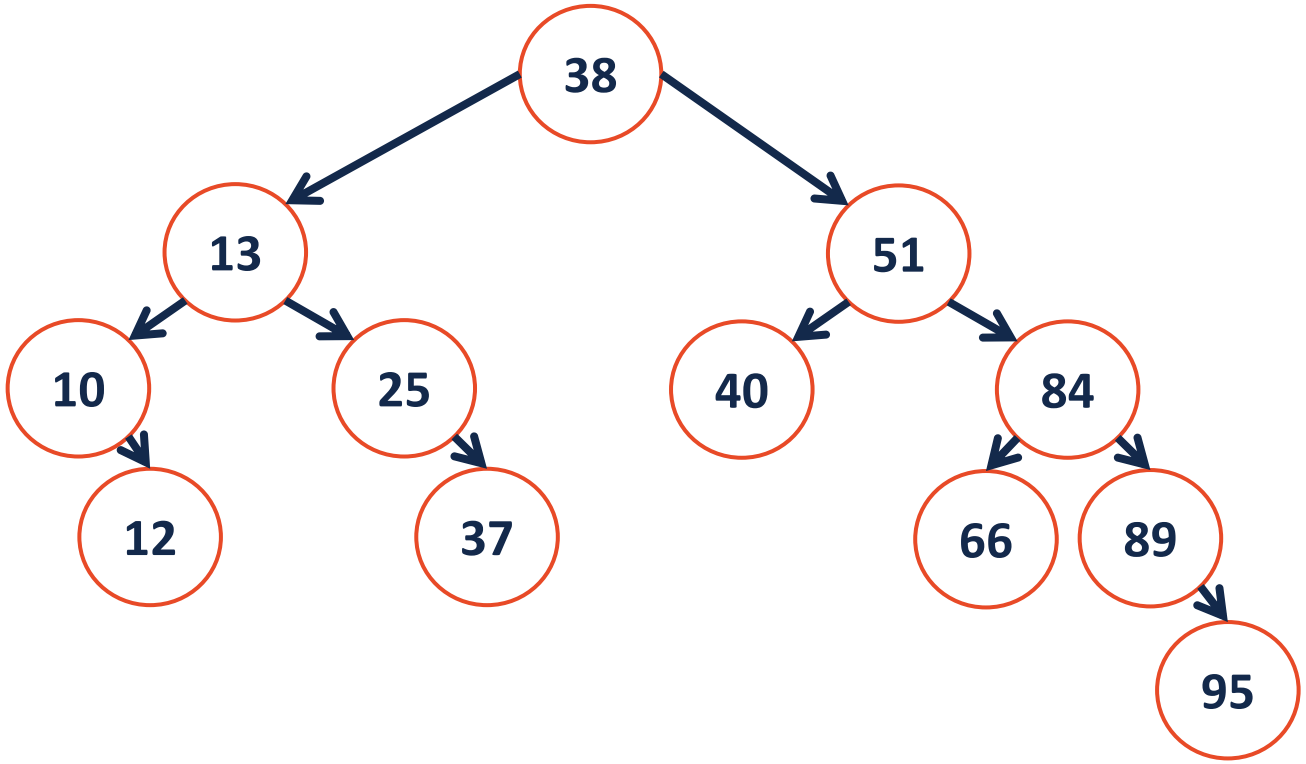
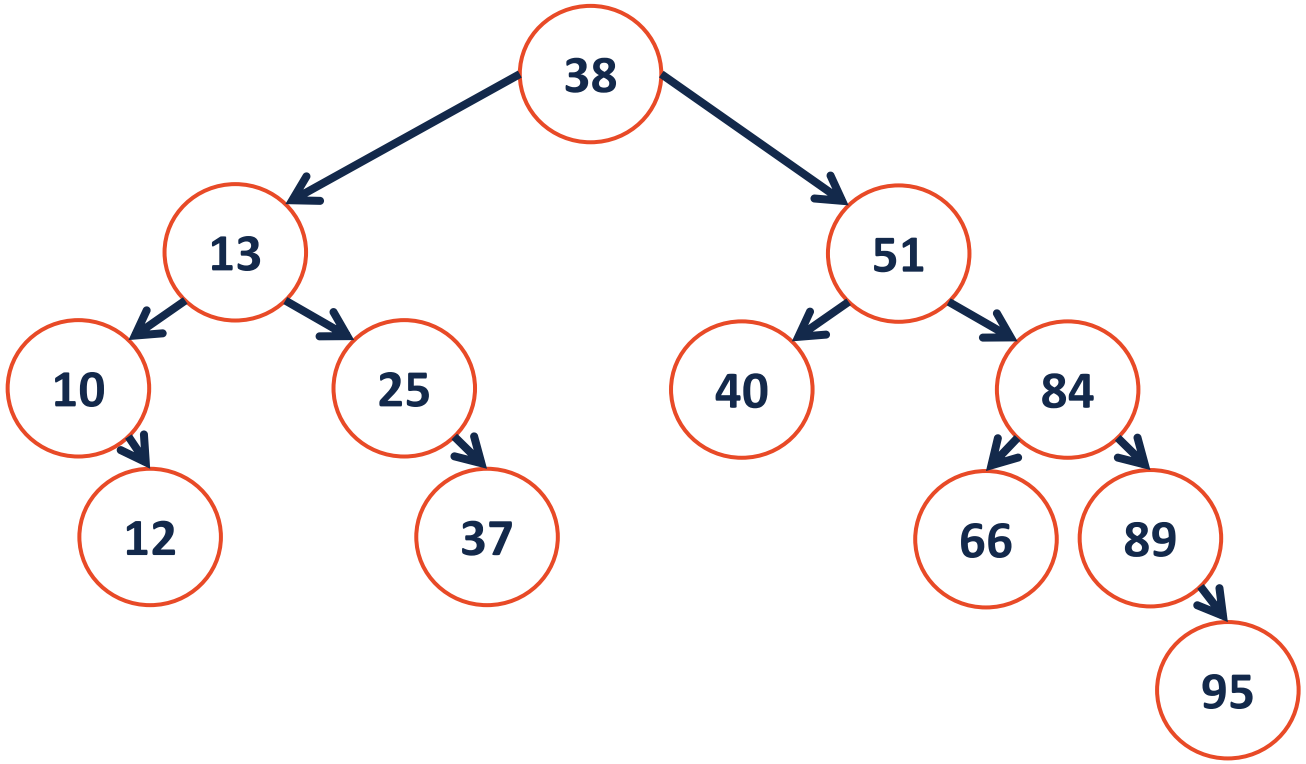
```

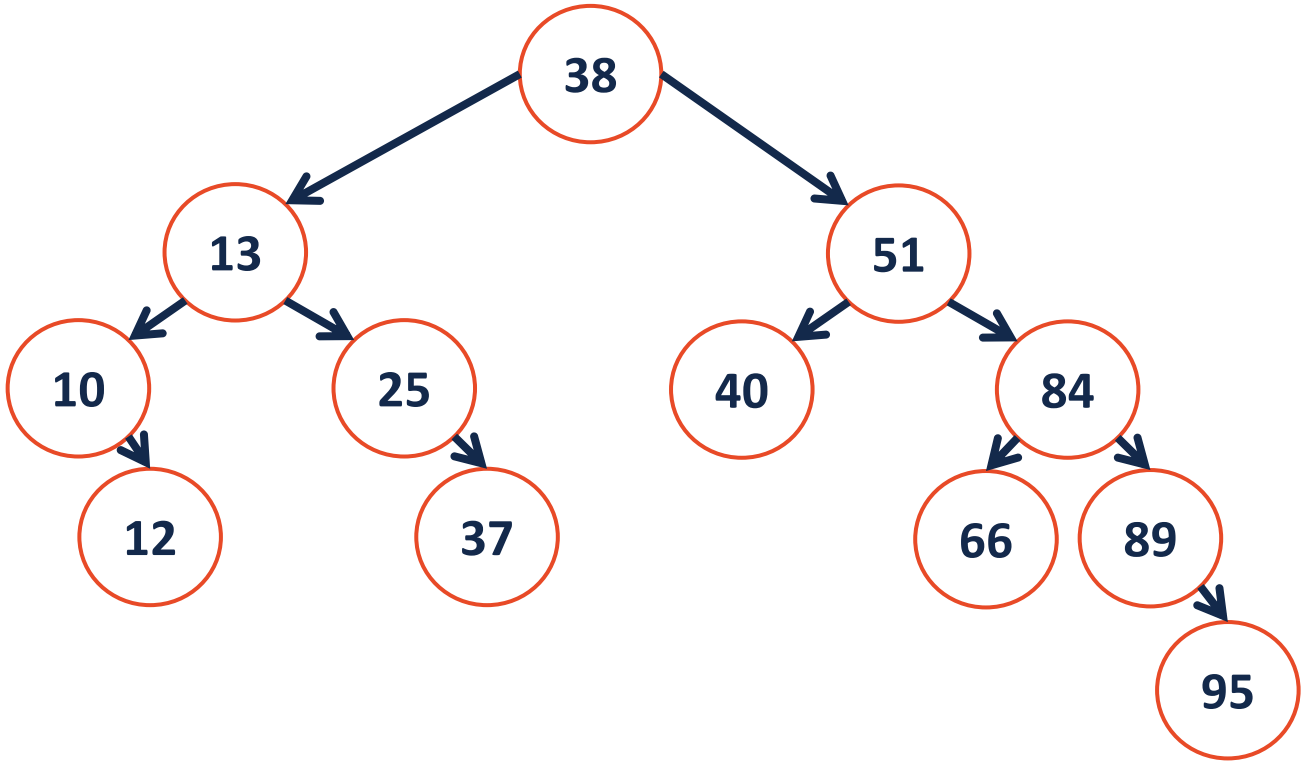




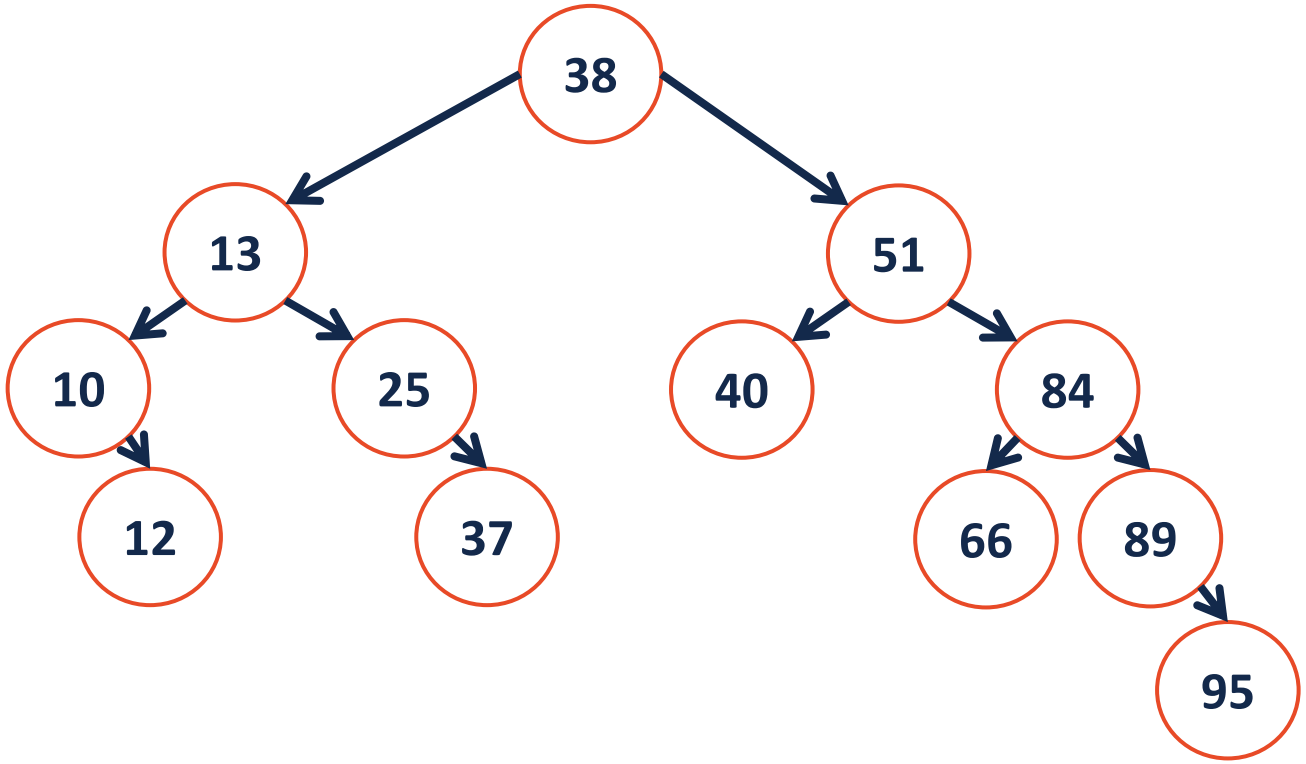

```
remove(40);
```




```
remove(25);
```




```
remove(10);
```




```
remove(13);
```

BST Analysis

Every operation that we have studied on a BST depends on the height of the tree: **O(h)**.

…what is this in terms of **n**, the amount of data?

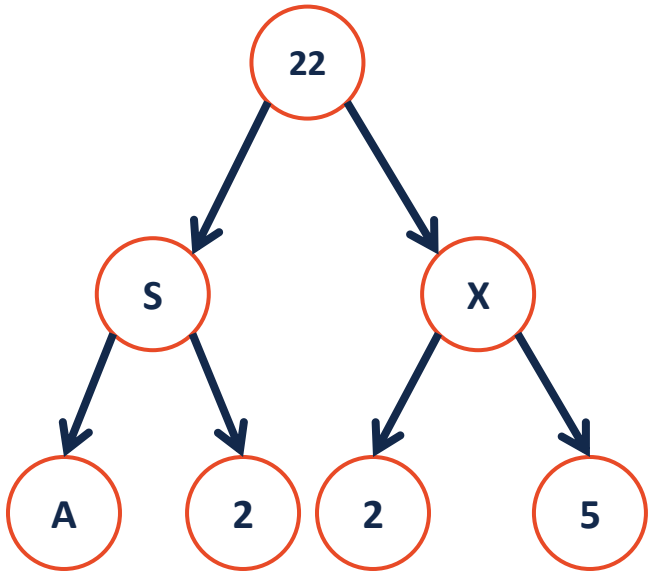
We need a relationship between h and **n**:

$h \geq f(n)$

$h \leq g(n)$

BST Analysis

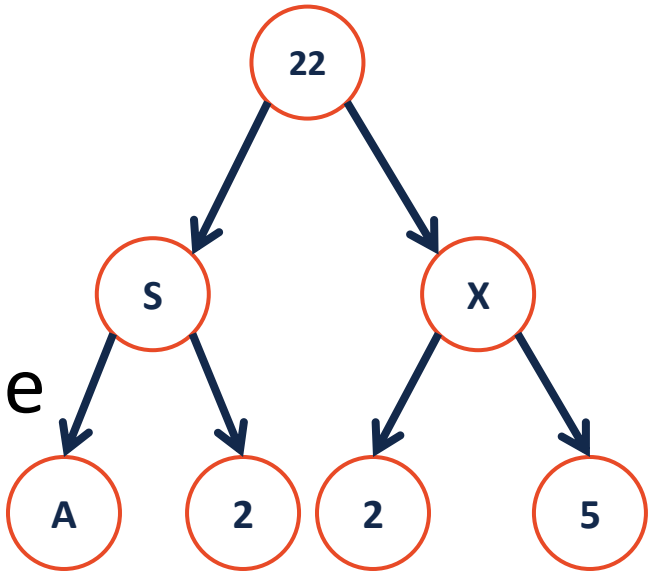
Q: What is the maximum number of nodes in a tree of height **h**?



BST Analysis

Q: What is the minimum number of nodes in a tree of height **h**?

What is the greatest possible height for a tree of **n** nodes?



BST Analysis

Therefore, for all BST:

Lower bound:

U**pper bound:**

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?

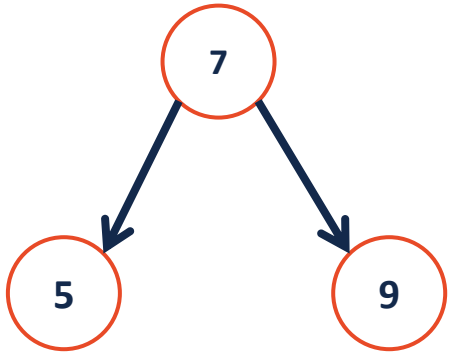
Q: What is the average height of all the arrangements?

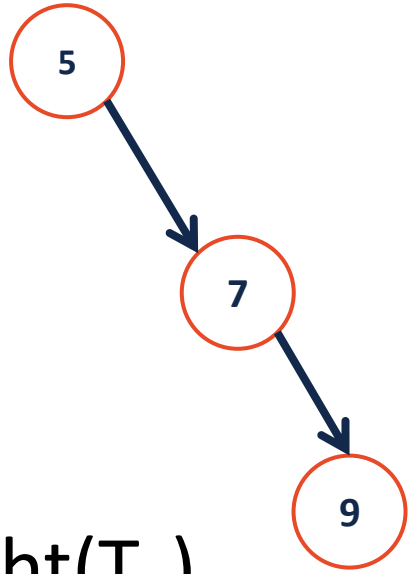
BST Analysis – Running Time

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:

MP4

CS 225 – Things To Be Doing

Exam 5 (Theory) is ongoing!

More Info: https://courses.engr.illinois.edu/cs225/fa2017/exams/

MP4: Available later today!

Due: Monday, Oct. 23 at 11:59pm

Lab!

Due: Sunday, Oct. 15 at 11:59pm

POTD

Every Monday-Friday – *Worth +1 Extra Credit /problem (up to +40 total)*