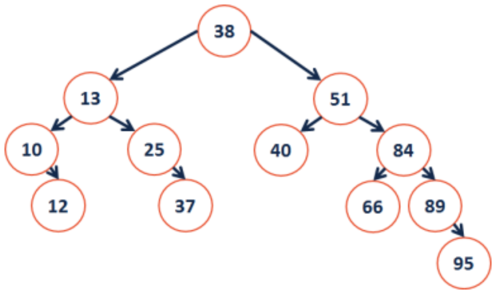
#16: Binary Search Tree (BST)

October 1, 2021 · *G Carl Evans*

Runtime Analysis on a Binary Tree:

A Searchable Binary Tree?

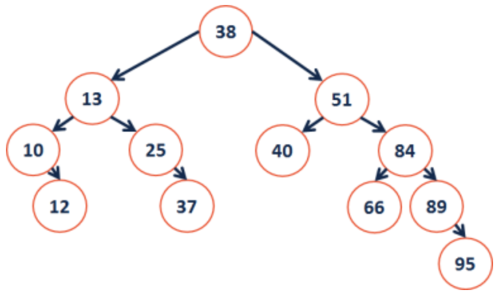


Binary Search Tree Property:

Finding an element in a BST:

```
BST.hpp
template <typename K, typename V>
_______________________________  find(const K & key)
const {



}

template <typename K, typename V>
___________________________________________ _find
     (TreeNode *& root, const K & key) const {











}
```

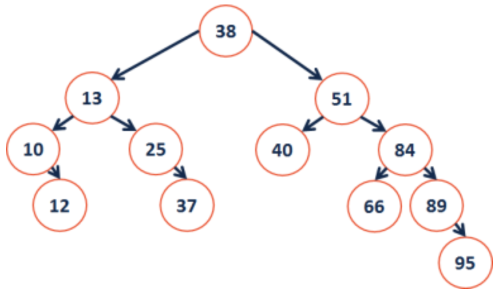
Inserting an element into a BST:



```
BST.hpp
template <typename K, typename V>
void BST<K, V>::_insert(TreeNode *& root, K key, V value)
{















}
```

Running time? ______________ **Bound by?** ______________

What if we did not pass a pointer by reference?



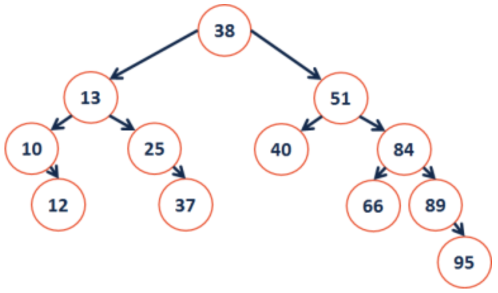
Removing an element from a BST:

`_remove(40)`

`_remove(25)`

`_remove(10)`

`_remove(13)`



One-child Remove	Two-child remove

BinaryTree.hpp

```
template <class K, class V>
void BST<K,V>::_remove(TreeNode *& root, const K & key) {









}
```

Running time? ________________ **Bound by?** _______________

BST Analysis:

Every operation we have studied on a BST depends on:

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

BST – Simple Ideas

Q: Given a height **h**, what is the <u>maximum</u> number of nodes (**n**) in a valid BST of height **h**? Provide an outline of a proof.

Q: Given a height **h**, what is the <u>minimum</u> number of nodes (**n**) in a valid BST of height **h**? Provide an outline of a proof.

Final BST Analysis

For every height-based algorithm on a BST:

Lower Bound:

Upper Bound:

Why use a BST over a linked list?

Q: How does our data determine the height?

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

CS 225 – Things To Be Doing:

1. mp_lists due Monday
2. lab_trees due Sunday
3. Daily POTDs