CS 225

#20: AVL Analysis
March 4, 2022 · *G Carl Evans*

Plan of Action:
Goal: Find a function that defines the lower bound on **n** given **h**.

Given the goal, we begin by defining a function that describes the smallest number of nodes in an AVL of height **h**:

Theorem:
An AVL tree of height **h** has at least ______________________.

I. Consider an AVL tree and let **h** denote its height.

II. Case: _________________

III. Case: __________________

Inductive hypothesis (IH):

Proving our IH:

V. Using a proof by induction, we have shown that:

...and by inverting our finding:

Summary of Balanced BSTs:

Advantages	Disadvantages

Using a Red-Black Tree in C++
C++ provides us a balanced BST as part of the standard library:

```
std::map<K, V> map;
```

The map implements a dictionary ADT. Primary means of access is through the overloaded `operator[]`:

```
V & std::map<K, V>::operator[]( const K & )
```

This function can be used for both insert and find!

Removing an element:

```
void std::map<K, V>::erase( const K & );
```

Range-based searching:

```
iterator std::map<K, V>::lower_bound( const K & );
iterator std::map<K, V>::upper_bound( const K & );
```

Running Time of Every Data Structure So Far:

	Unsorted Array	Sorted Array	Unsorted List	Sorted List
Find				
Insert				
Remove				
Traverse				

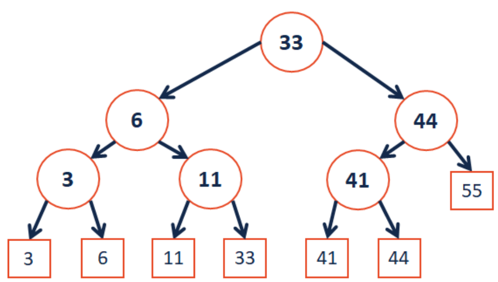
	Binary Tree	BST	AVL
Find			
Insert			
Remove			
Traverse			

Range-based Searches:

Q: Consider points in 1D: $p = \{p_1, p_2, \ldots, p_n\}$.

...what points fall in [11, 42]?

Tree Construction:



Range-based Searches:

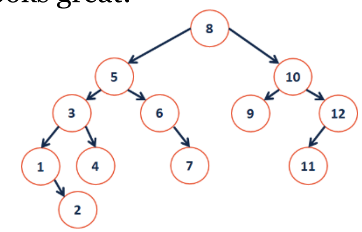
Running Time:

BTree Motivation

Big-O assumes uniform time for all operations, but this isn't always true.

However, seeking data from the cloud may take 100ms+.

...an O(lg(n)) AVL tree no longer looks great:



BTree Motivations

Knowing that we have long seek times for data, we want to build a data structure with two (related) properties:

1.

2.

CS 225 – Things To Be Doing:

1. mp_mosaics due Monday!
2. lab_trees due Sunday!
3. Find a team if you are going to do the Final Project
4. Daily POTDs are ongoing!