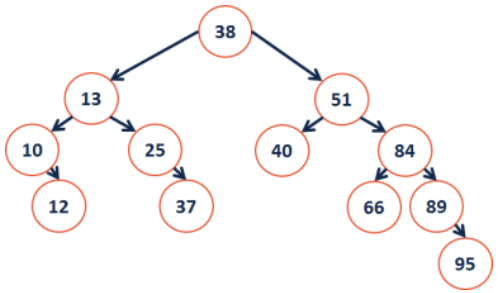
CS 225

# #18: BST Remove

October 4, 2021 · *G Carl Evans*

## Removing an element from a BST:




```
_remove(40)

_remove(25)

_remove(10)

_remove(13)
```

| One-child Remove | Two-child remove |
|---|---|
| | |

BinaryTree.cpp

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









}
```

## 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 Proofs

**Q:** Given a height **h**, what is the maximum 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 minimum 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

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

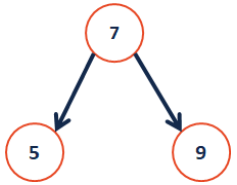
**Q:** What is the average height of every arrangement?

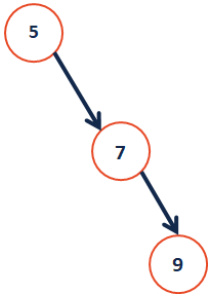
...what is the intuition here?

| operation | BST Avg. Case | BST Worst Case | Sorted Array | Sorted List |
|---|---|---|---|---|
| **find** | | | | |
| **insert** | | | | |
| **delete** | | | | |
| **traverse** | | | | |

## Height Balance on BST

What tree makes you happier?




We define the **height balance** (b) of a BST to be:

We define a BST tree T to be **height balanced** if:

**CS 225 – Things To Be Doing:**

1. Mp_lists due today
2. Honors section starts today
   https://uiuc-cs199-225-fa21.netlify.app/
3. Daily POTDs