Running time? ____________  Bound by? ____________

What happens when we run the bugged code above?

How do we fix the code?

Removing an element from a BST:

_remove(40)
_remove(25)
_remove(10)
_remove(13)

<table>
<thead>
<tr>
<th>One-child Remove</th>
<th>Two-child remove</th>
</tr>
</thead>
</table>

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?

---

<table>
<thead>
<tr>
<th>operation</th>
<th>BST Avg. Case</th>
<th>BST Worst Case</th>
<th>Sorted Array</th>
<th>Sorted List</th>
</tr>
</thead>
<tbody>
<tr>
<td>find</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>insert</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>delete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>traverse</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

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. Theory Exam 2 starts next Thursday (topic list is available now!)
2. MP3 due Monday; MP4 released on Tuesday
3. lab_trees is due Sunday, Feb. 25
4. Daily POTDs