CS 225
Data Structures

Feb. 26 – BST Balance
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Course Logistics Update

CBTF exams will go on as-scheduled:
• Theory Exam 2 starts tomorrow
• Sample Exam available on PL

MPs and Lab assignments will be released on schedule:
• MP3 is due tonight (11:59pm)
• MP4 will be released tomorrow
• lab_huffman will be released on Wednesday

We’ll chat about additional logistics on Wednesday regarding lab sections *(if necessary)*
Interactive Lecture Questions

- Ask Questions: Ask in-lecture questions using this Google Form!
- Detailed Answers After Lecture: If we didn't get to answer your question in lecture, we provide detailed answers to common questions here.
- You must be logged in with an active account to ask questions or be asked to log in.

Lecture Videos

- Recorded on echo360.org, login to view.

Schedule

Monday
- January 15
  - MLK Day
- January 22
  - Memory
BST Analysis

Therefore, for all BST:

Lower bound: $O( \lg(n) )$

Upper bound: $O( n )$
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

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Q: What is the average height of all the arrangements?
### BST Analysis – Running Time

<table>
<thead>
<tr>
<th>Operation</th>
<th>BST Average 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>
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<td></td>
</tr>
<tr>
<td>delete</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>traverse</td>
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<td></td>
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</tr>
</tbody>
</table>
What tree makes you happier?

Height balance: \( b = \text{height}(T_L) - \text{height}(T_R) \)

A tree is height balanced if:
BST Rotation

We will perform a rotation that maintains two properties:

1. 

2.
BST Rotation Summary

- Four kinds of rotations (L, R, LR, RL)
- All rotations are local (subtrees are not impacted)
- All rotations are constant time: O(1)
- BST property maintained

**GOAL:**

We call these trees:
AVL Trees

Three issues for consideration:
- Rotations
- Maintaining Height
- Detecting Imbalance