



CS 225

Data Structures

Oct. 13 – AVL Rotations

BST Reflection

We know the **height** of a tree.

We know if a tree is **full**, **complete**, and/or **perfect**.

We know that every binary tree has _____ NULL pointers.

We know many **traversals** of trees.

We know that a **BST's height is bound by n** such that:

$$\underline{\hspace{2cm}} \leq h \leq \underline{\hspace{2cm}}$$

We know all key **BST operations run in $O(h)$** time.

We know a BST can be used to **implement a Dictionary**.

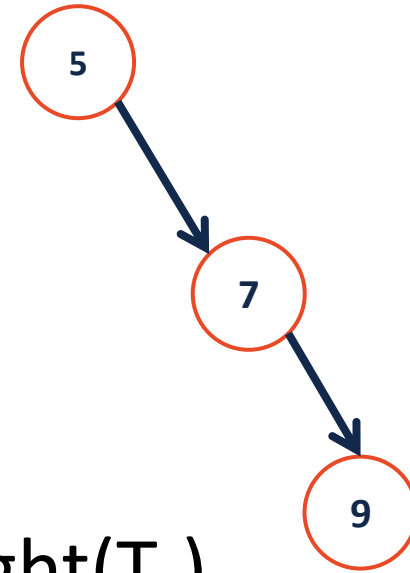
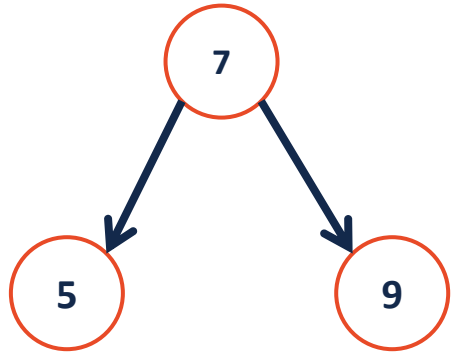
We know that a **random BST has an average height of _____**.

We know that **an inorder traversal** of a BST is a _____.

We know **how to implement a BST** in C++.

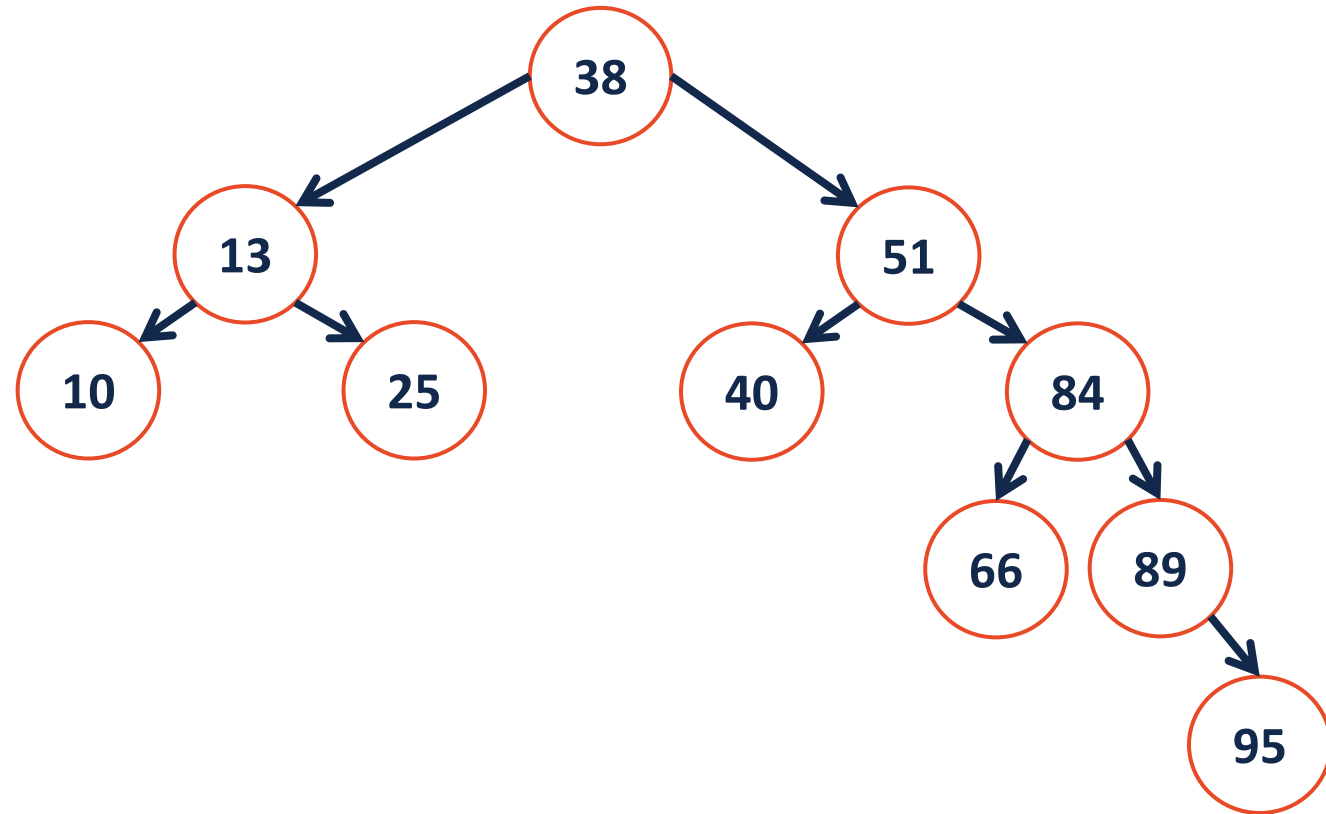
Height-Balanced Tree

What tree makes you happier?



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

A tree is height balanced if:

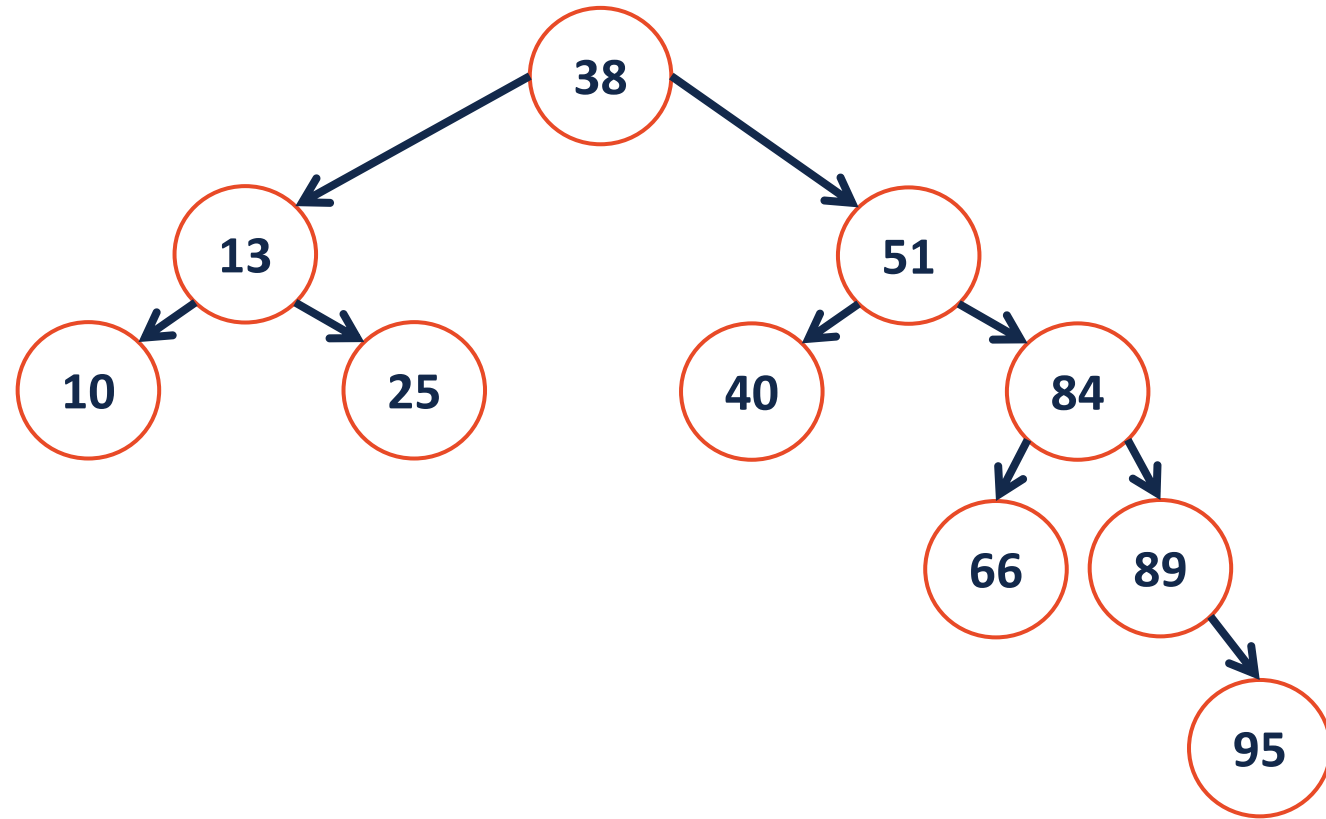


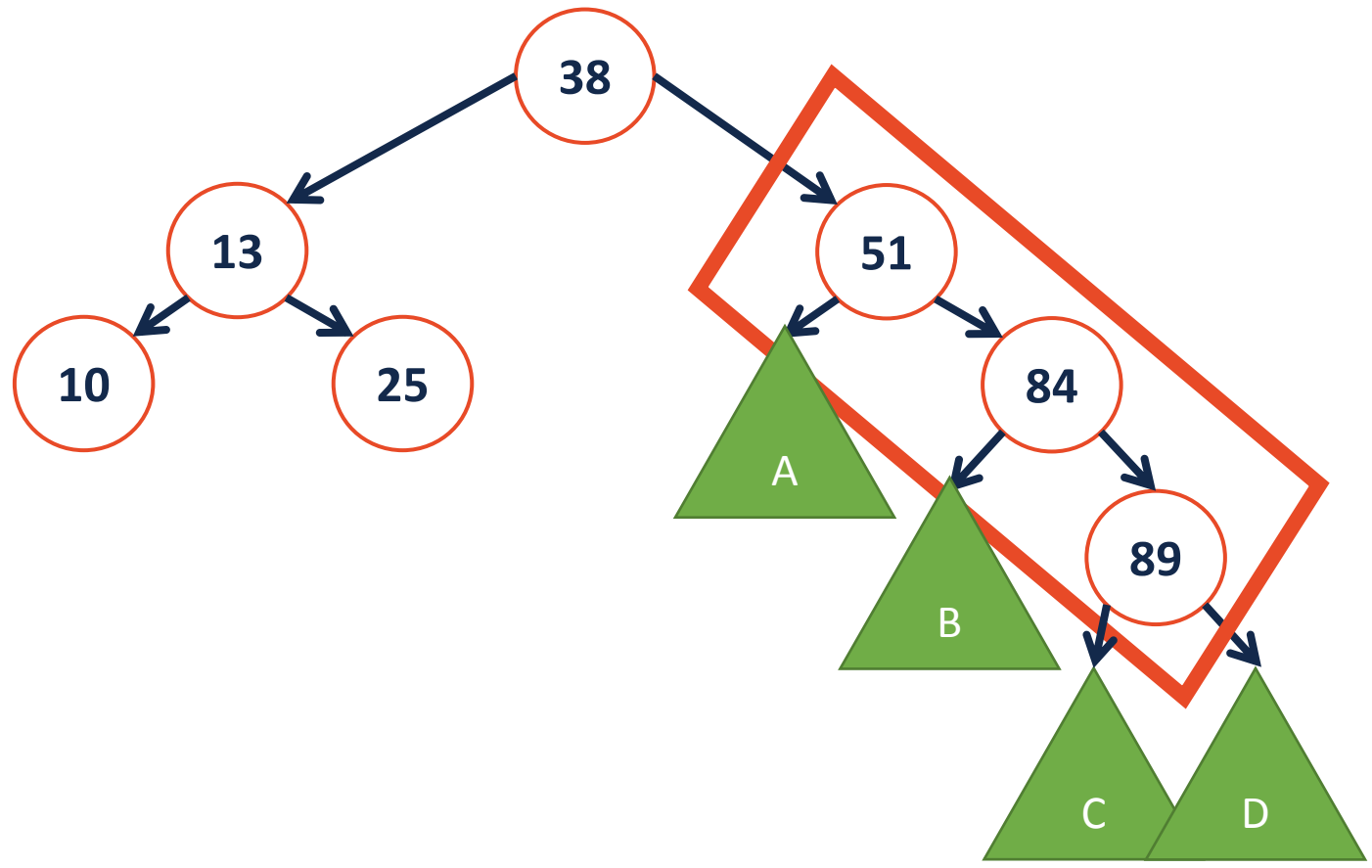
BST Rotation

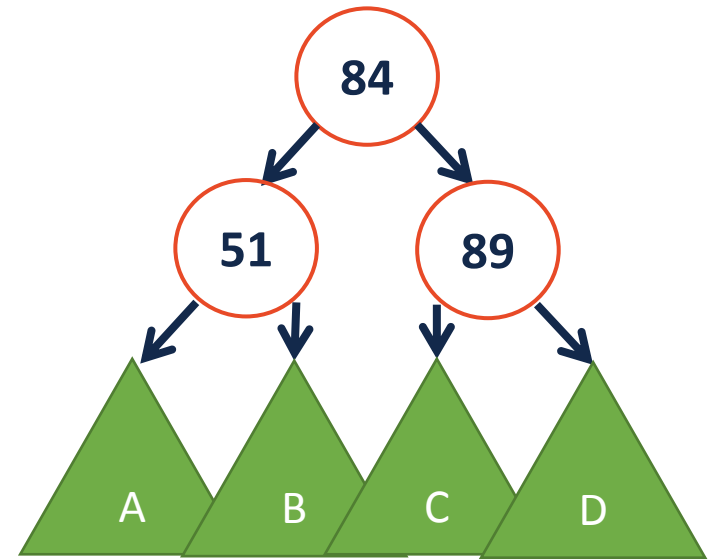
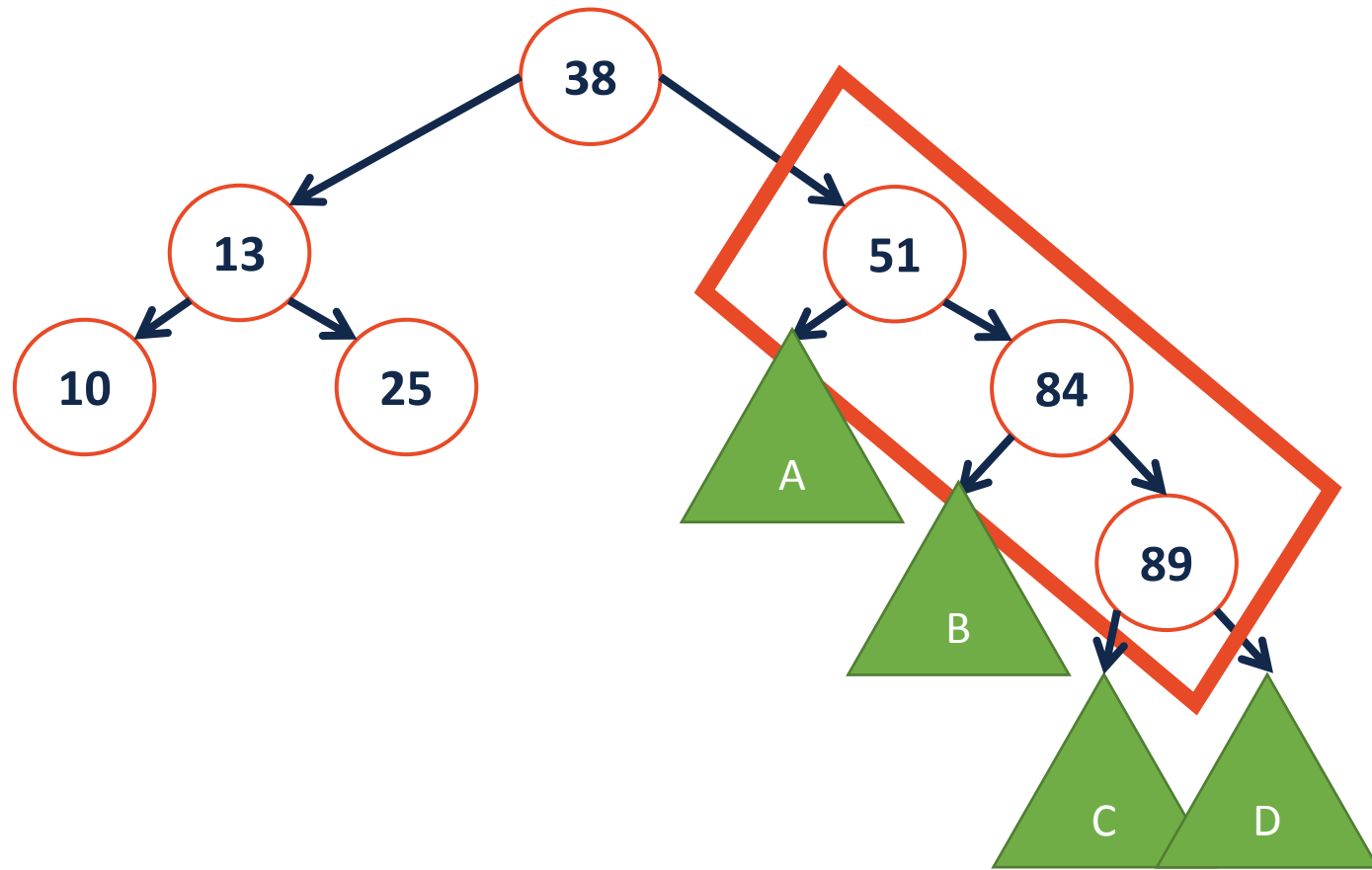
We will perform a rotation that maintains two properties:

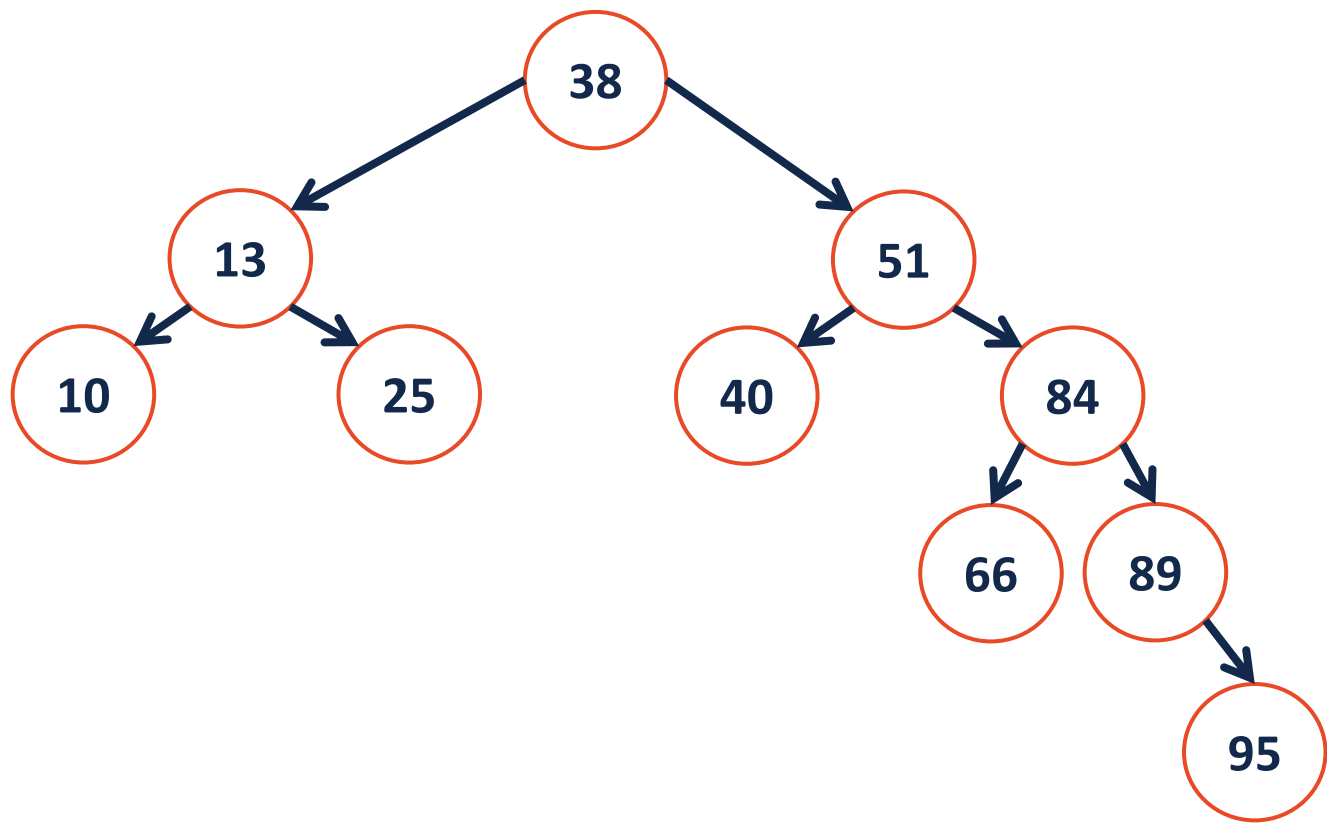
- 1.

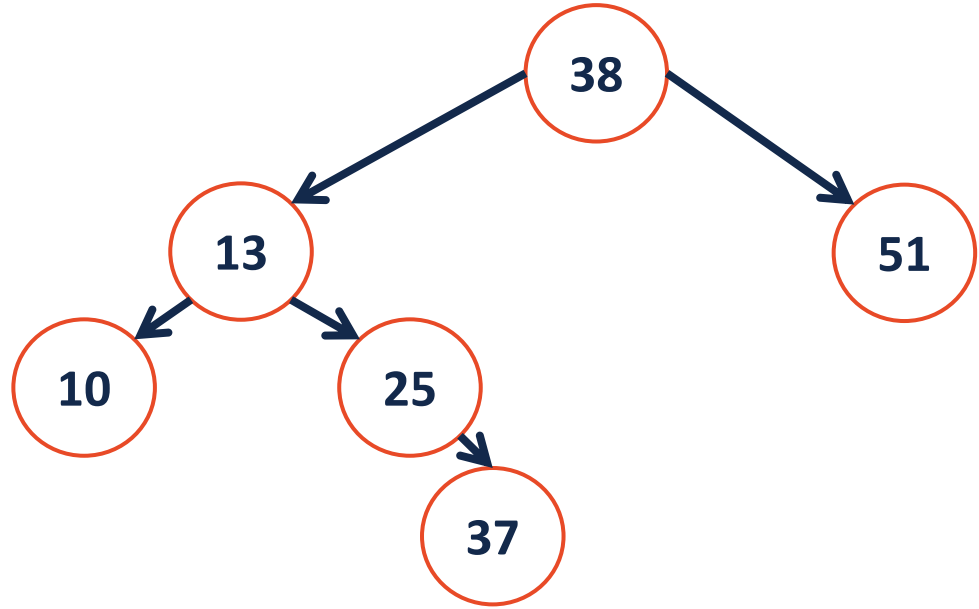
- 2.

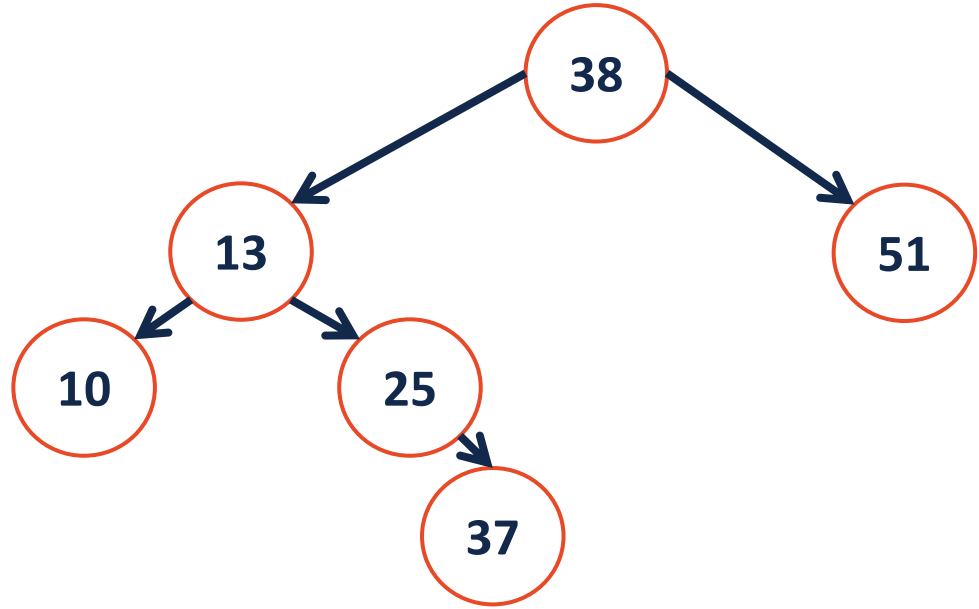












BST Rotation Summary

- 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

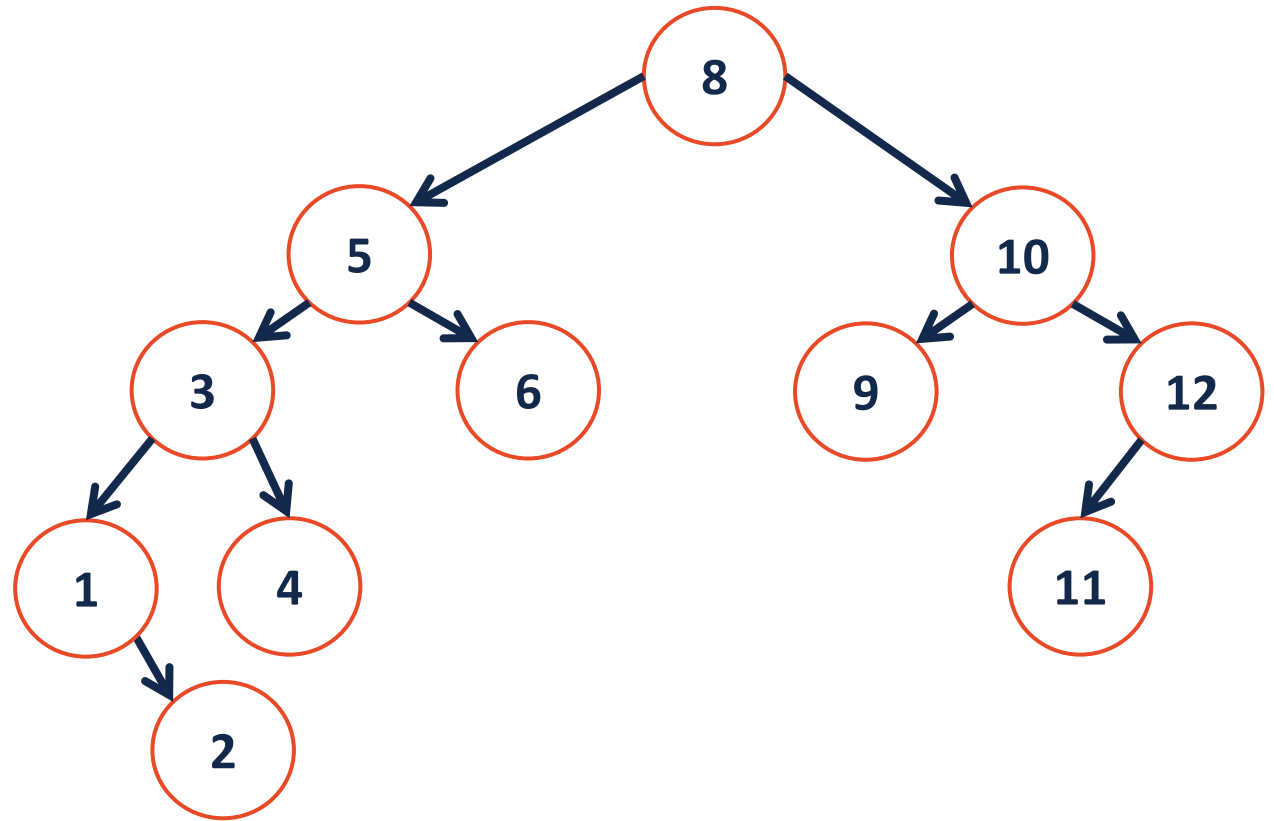
GOAL:

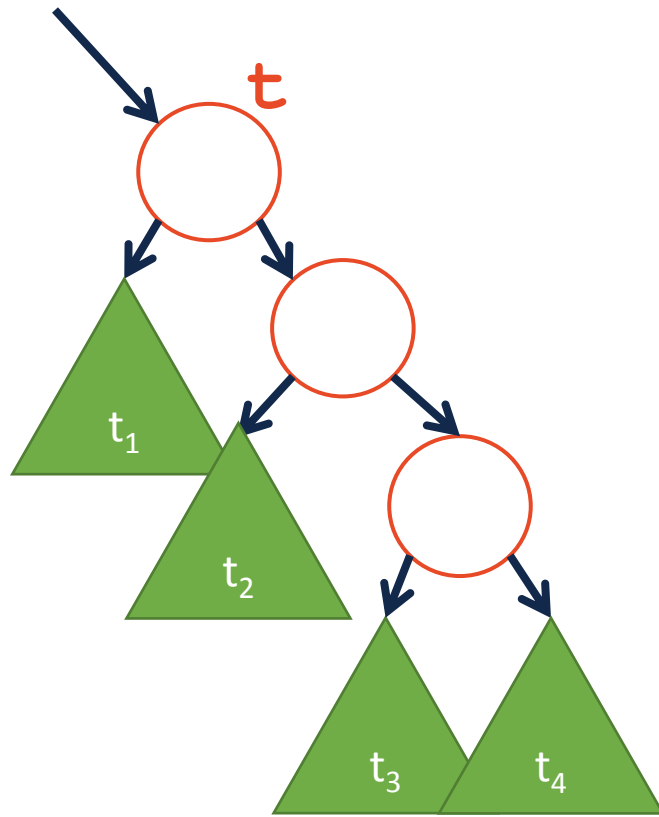
We call these trees:

AVL Trees

Three issues for consideration:

- Rotations
- Maintaining Height
- Detecting Imbalance





Theorem:

If an insertion occurred in subtrees t_3 or t_4 and a subtree imbalance was detected at t , then a _____ rotation about t restores the balance of the tree.

We gauge this by noting the balance factors:

t : $b = \underline{\hspace{2cm}}$

$t \rightarrow \text{right}$: $b = \underline{\hspace{2cm}}$

CS 225 – Things To Be Doing

Exam 5 (Theory) is ongoing!

More Info: <https://courses.engr.illinois.edu/cs225/fa2017/exams/>

MP4: Available later today!

Due: Monday, Oct. 23 at 11:59pm

Lab!

Due: Sunday, Oct. 15 at 11:59pm

POTD

Every Monday-Friday – *Worth +1 Extra Credit /problem (up to +40 total)*