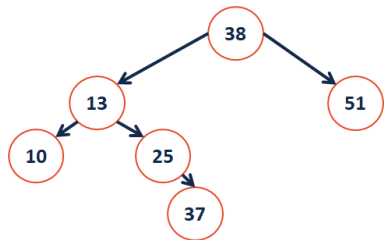
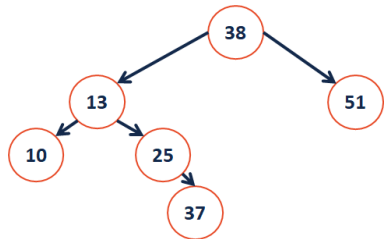
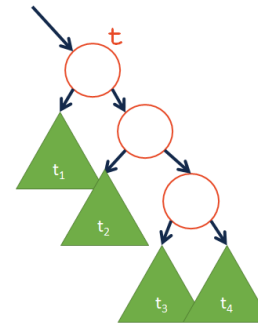


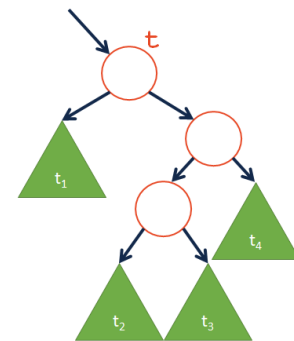
Example 2: A Complex Rotation



AVL Theorem #1: If an insertion occurred in subtrees t_3 or t_4 and a subtree was detected at t , then a _____ rotation about t restores the balance of the tree.



AVL Theorem #2: If an insertion occurred in subtrees t_2 or t_3 and a subtree was detected at t , then a _____ rotation about t restores the balance of the tree.

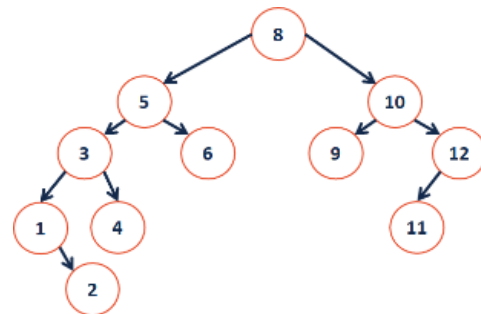


BST Rotation Summary:

1. Four kinds of rotations (L, R, LR, and RL)
2. All rotations are local
3. All rotations run in constant time, $O(1)$
4. BST property is maintained!

Overall Goal:

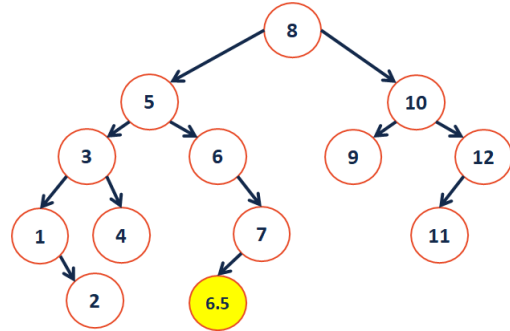
...and we call these trees:



...additional property:

AVL Insertion

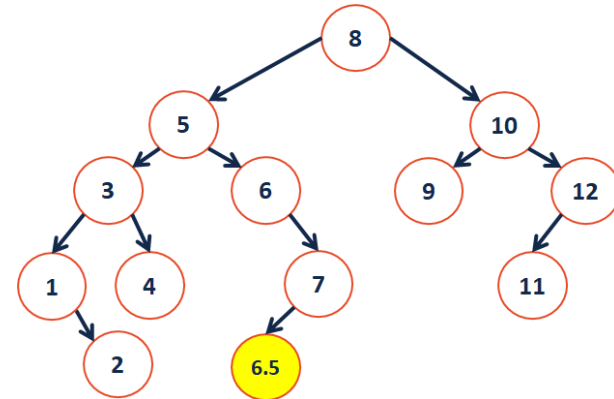
Pseudocode:



```

AVL.h (snippet)
1 struct TreeNode {
2     T key;
3     unsigned height;
4     TreeNode *left;
5     TreeNode *right;
6 }
    
```

AVL Insertion

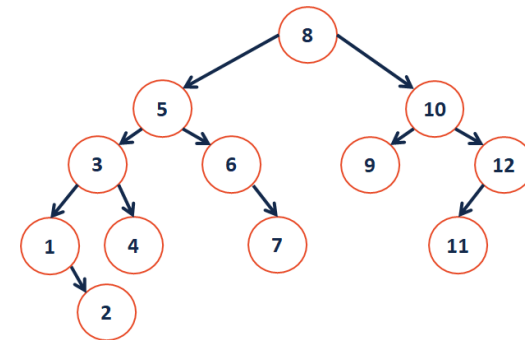


AVL Insertion

```

AVL.cpp (snippet)
1 template <class T>
2 void AVLTree<T>::_insert(const T & x, TreeNode<T> * & t ) {
3     if( t == NULL ) {
4         t = new TreeNode<T>(x, 0);
5     }
6     else if( x < t->key ) {
7         _insert( x, t->left );
8         int balance = height(t->right) - height(t->left);
9         int leftBalance = height(t->left->right)
10            - height(t->left->left);
11         if ( balance == -2 ) {
12             if ( leftBalance == -1 ) { rotate_____ ( t ); }
13             else { rotate_____ ( t ); }
14         }
15     }
16     else if( x > t->key ) {
17         _insert( x, t->right );
18         int balance = height(t->right) - height(t->left);
19         int rightBalance = height(t->right->right)
20            - height(t->right->left);
21         if( balance == 2 ) {
22             if( rightBalance == 1 ) { rotate_____ ( t ); }
23             else { rotate_____ ( t ); }
24         }
25     }
26     t->height = 1 + max(height(t->left), height(t->right));
27 }
    
```

AVL Removal



- CS 225 – Things To Be Doing:**
1. Theory Exam 2 is ongoing
 2. MP4 released today; due Monday, March 12
 3. lab_huffman is due Sunday, March 4
 4. Daily POTDs