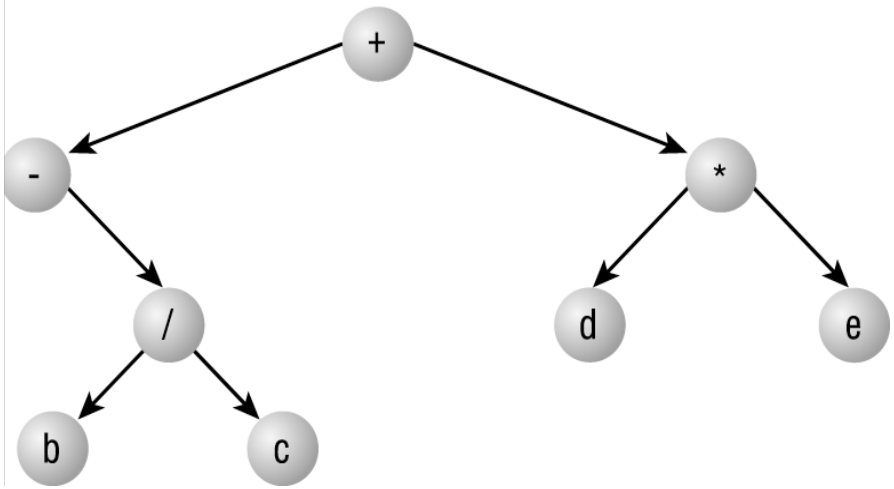
Announcements

MP4 available, due 10/16, 11:59p.



Running time:

```
template<class T>
void binaryTree<T>::levelOrder(treeNode * croot){
        queue<treeNode *> Q;
        Q.enqueue(croot);
        while( !Q.isempty()){
                treeNode * t = Q.dequeue();

                yell(t->data);
                Q.enqueue(t->left);
                Q.enqueue(t->right);

        }
}
```

ADT Dictionary:

Suppose we have the following data…

ID #	Name
103	Jay Hathaway
92	Linda Stencel
330	Bonnie Cook
46	Rick Brown
124	Kim Petersen
…	…

…and we want to be able to retrieve a name, given a locker number.

More examples of key/value pairs:

UIN -> Advising Record

Course Number -> Schedule info

Color -> BMP

Vertex -> Set of incident edges

Flight number -> arrival information

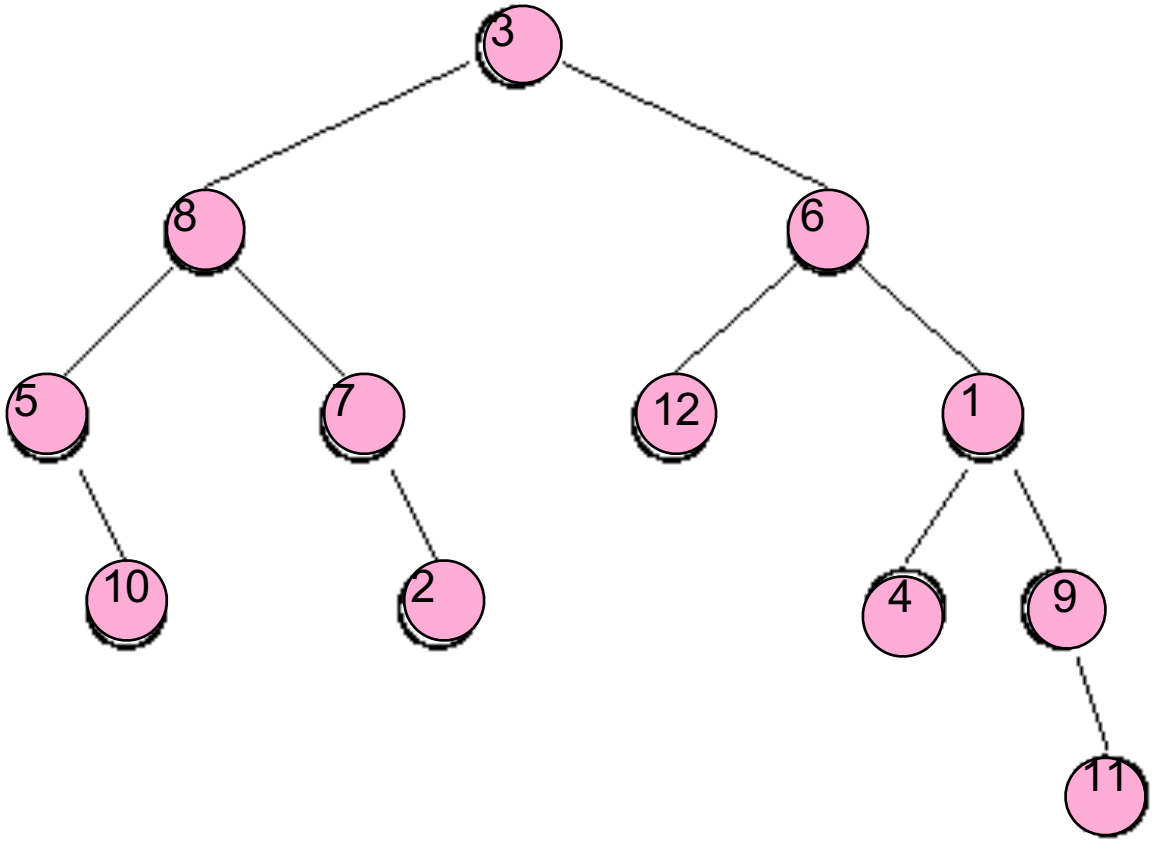
URL -> html page

A *dictionary* is a structure supporting the following:

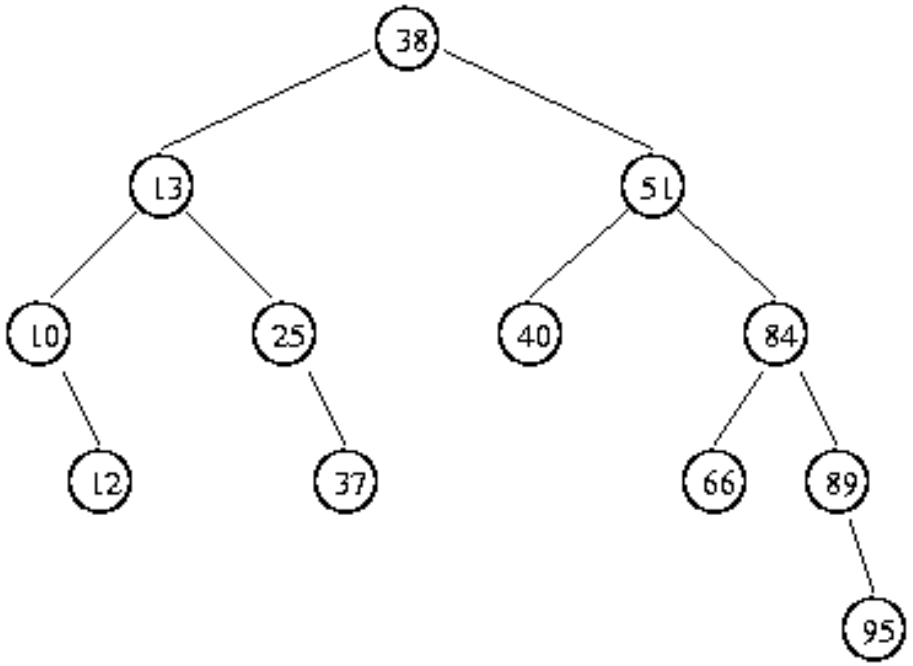
```
void insert(kType & k, dType & d)
void remove(kType & k)
dType find(kType & k)
```

Binary Trees as a search structure (Dictionary)

Find me ...



Binary _____ Tree



A Binary _____ Tree (BST) is a binary tree, T, such that:

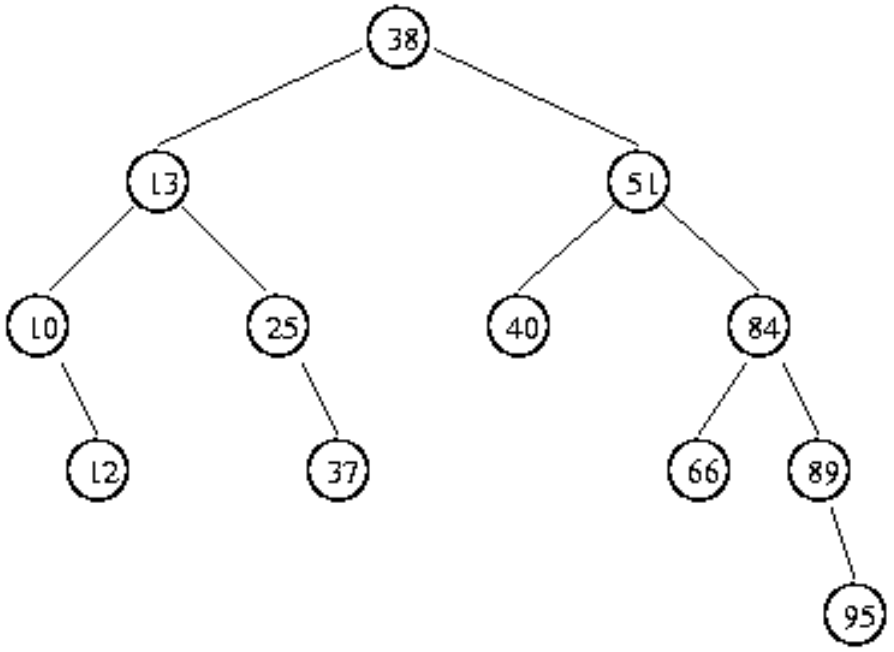
- _____, OR
- $T = \{r, T_L, T_R\}$ and

  $x \in T_L \rightarrow$ _____

  $x \in T_R \rightarrow$ _____

and

Dictionary ADT: (BST implementation)



insert

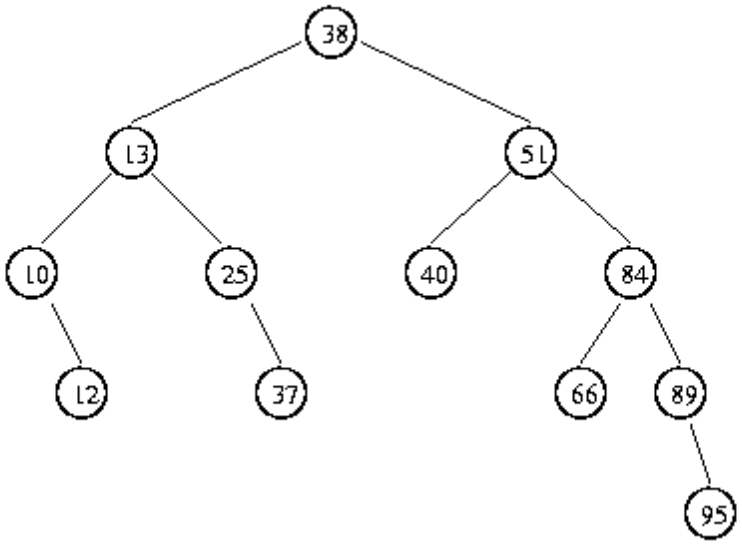
remove

find

traverse

```
template <class K, class D>
class Dictionary{
public:
// constructor for empty tree.
private:
   struct treeNode{
      D data;
      K key;
      treeNode * left;
      treeNode * right;
   };
   treeNode * root
};
```

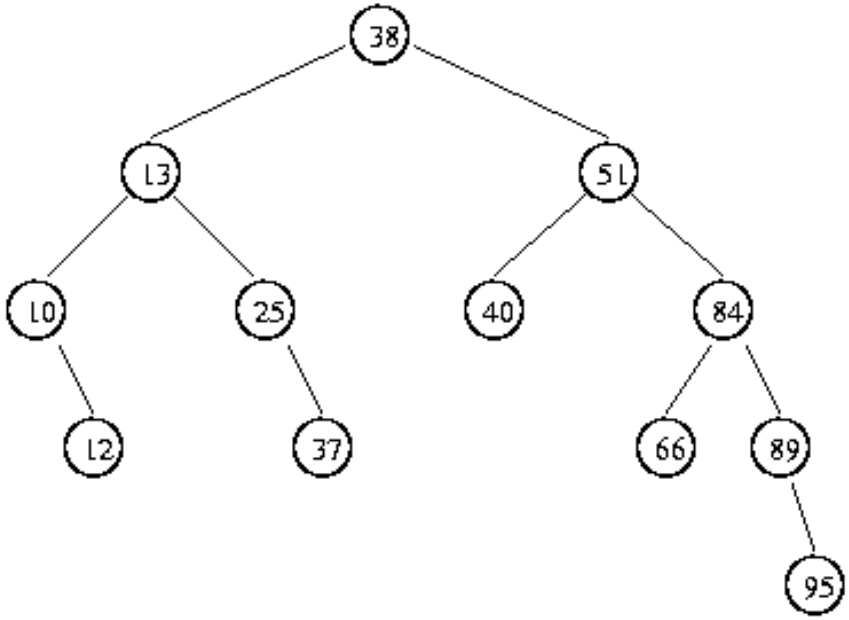
Binary Search Tree - Find



Running time:

```
_____________________________(treeNode * cRoot, const K & key)
{
   if (cRoot == NULL)



   else if (cRoot->key == key)



   else if



   else



}
```

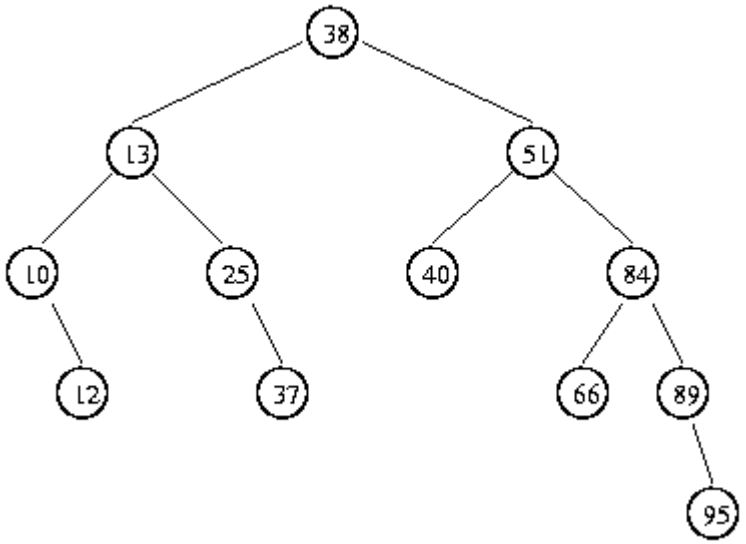
Binary Search Tree - Insert



Running time:

```
_________________________
(treeNode *  cRoot, const K &  key, const D & data){
   if (cRoot == NULL)



   else if (cRoot->key == key)



   else if (key < cRoot->key)



   else



}
```

Binary Search Tree - Remove



Running time:

```
void BST<K>::remove(treeNode * & cRoot, const K & k) {
   if (cRoot != NULL) {
      if (cRoot->key == k)
         doRemoval(cRoot);
      else if (k < cRoot->key)
         remove(cRoot->left, k);
      else
         remove(cRoot->right, k);
  }
}
```