CSM 61B Fall 2020

ADTs and BSTs

Mentoring 7: October 3 - October 9, 2020

1 Abstract Data Types

A **list** is an ordered sequence of items: like an array, but without worrying about the length or size.

```
interface List<E> {
    boolean add(E element);
    void add(int index, E element);
    E get(int index);
    int size();
}
```

A **set** is an unordered collection of unique elements.

```
interface Set<E> {
    boolean add(E element);
    boolean contains(Object object);
    int size();
    boolean remove(Object object);
}
```

A **map** is a collection of key-value mappings, like a dictionary in Python. Like a set, the keys in a map are unique.

```
interface Map<K,V> {
    V put(K key, V value);
    V get(K key);
    boolean containsKey(Object key);
    Set<K> keySet();
}
```

2 Interview Questions

2.1 Define a procedure, `sumUp`, which returns **`true`** if any two values in the `array` sum up to `n`.

```
public static boolean sumUp(int[] array, int n) {




}
```

2.2 Define a procedure, `isPermutation`, which returns **`true`** if a string `s1` is a permutation of `s2`. For example, `"atc"` and `"tac"` are permutations of `"cat"`.

```
public static boolean isPermutation(String s1, String s2) {




}
```

3 Array Lists

3.1 Mallory is designing a resizing `ArrayList` implementation. She needs to decide the amount to resize by. Help her figure out which option provides the best runtime.

Assuming Mallory resizes her `ArrayList` when it's full, what is the average runtime of adding an element to the `ArrayList`?

(a) When full, increase the size of the array by 1 element.

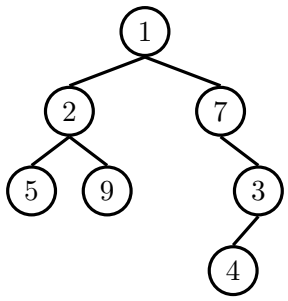
(b) When full, increase the size of array by 10,000 elements.

(c) When full, double the size of the array.

4 Stacks and Queues

A **queue** is a data structure that orders items in a first-in-first-out (FIFO) manner, meaning that the first element you `add` will be at the front and the last item you `add` will be at the tail. Elements are `remove`d from the front.
A **stack** is a data structure that orders items in a last-in-first-out (LIFO) manner, meaning that the first element you `add` will be at the tail and the last item you `add` will be at the front. Elements are `remove`d from the front.

4.1
```
public void treeTraversal(Fringe<Node> fringe) {
    fringe.add(root);
    while (!fringe.isEmpty()) {
        Node node = fringe.remove();
        System.out.print(node.value);
        if (node.left != null) {
            fringe.add(node.left);
        }
        if (node.right != null) {
            fringe.add(node.right);
        }
    }
}
```



What would Java display?

(a) `tree.traversal(new Queue<Node>());`

(b) `tree.traversal(new Stack<Node>());`

5 Binary Search Trees

5.1 Implement `fromSortedArray` for binary search trees. Given a sorted **`int[]`** `array`, efficiently construct a balanced binary search tree containing every element of the array.

```
public class BinarySearchTree<T extends Comparable<T>> {
    protected Node root;
    protected class Node {
        public T value;
        public Node left;
        public Node right;
    }
    public static BinarySearchTree<Integer> fromSortedArray(int[] values) {
        BinarySearchTree<Integer> bst = new BinarySearchTree<>();
        bst.root = bst.fromSortedArray(values, 0, values.length - 1);
        return bst;
    }
    private Node fromSortedArray(int[] values, int lower, int upper) {
```