Name: _____ Andrew Id: _____

15-121 Fall 2022 Quiz 8

Up to 20 minutes. Show your work. No calculators, no notes, no books, no computers, no other people.

1. (5 points) **Binary Search Tree Construction**

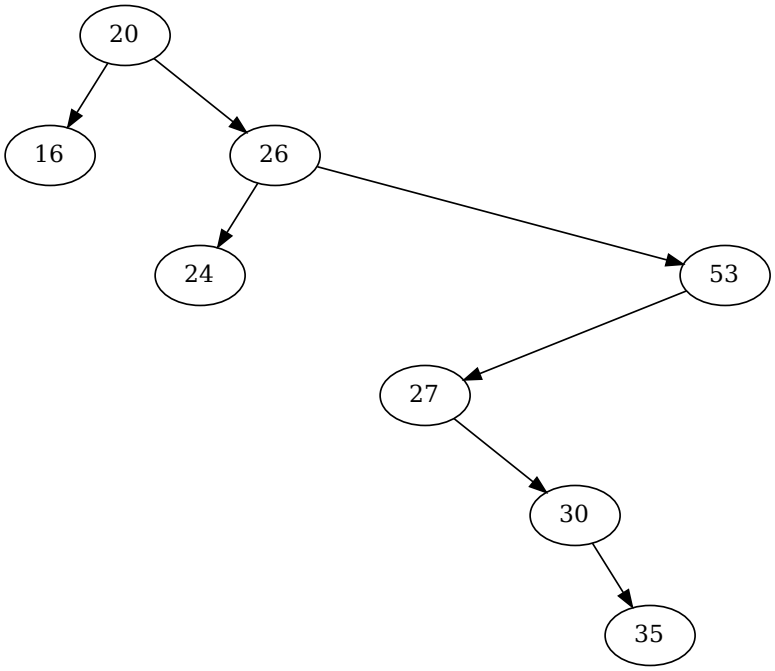
   Imagine you are constructing a binary search tree of integers, and the following integers are added in the following order:

   ```
   16, 67, 85, 55, 11, 43, 71, 87, 3, 44
   ```

   Draw the resulting binary search tree.

2. (3 points) **Binary Search Tree Removal**

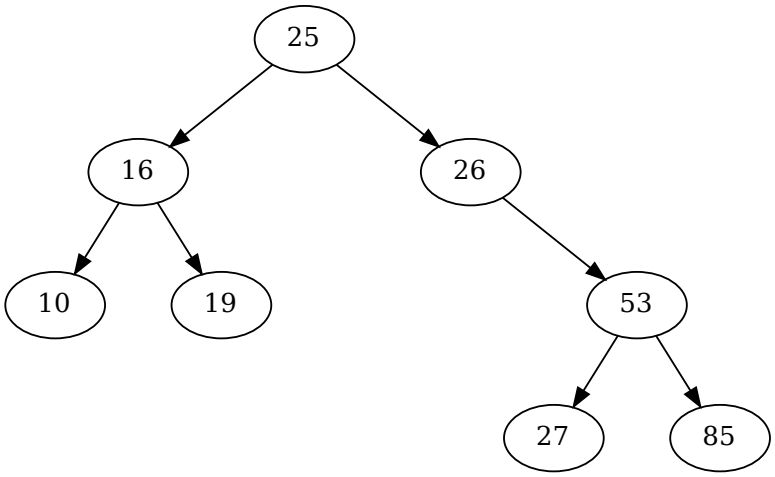
Consider the following binary search tree:



Assuming you are using the in-order successor removal technique discussed in class, draw the state of the tree from after 26 has been removed from it.

3. **Binary Search Tree Traversal**

Consider the following tree:



(a) (2 points) Assuming the tree is traversed *in-order* and the nodes printed, what is the resulting sequence? (Assume that left is followed before right.)

(b) (2 points) Assuming the tree is traversed *pre-order* and the nodes printed, what is the resulting sequence? (Assume that left is followed before right.)

(c) (2 points) Assuming the tree is traversed *post-order* and the nodes printed, what is the resulting sequence? (Assume that left is followed before right.)

4. (6 points) **Binary Search Tree Free Response**

Consider the following code for a binary search tree of integers. (There is nothing special here, the code is provided just in case you forgot how a binary tree is built.)

```
public class BinarySearchTree {
    private TreeNode root;

    private class TreeNode {
        private int data;
        private TreeNode left;
        private TreeNode right;

        private TreeNode(int data) {
            this.data = data;
        }
    }

    public BinarySearchTree() {
        this.root = null;
    }

    public void add(int item) {
        this.root = add(root, item);
    }

    private TreeNode add(TreeNode node, int item) {
        if (node == null) {
            return new TreeNode(item);
        }

        if (item < node.data) {
            node.left = add(node.left, item);
        } else {
            node.right = add(node.right, item);
        }

        return node;
    }
}
```

The rest of the question is on the next page.

Write the code for a new method in this class called `largestEven()`, which returns the largest, positive, even number in the tree. If there are no positive, even numbers in the tree, then return `-1`. You may write additional helper methods, but you may not modify existing methods or add any new instance variables to `BinarySearchTree`. You also may not use any other data structures, such as an array or an `ArrayList`.