CSE 143 SAMPLE FINAL EXAM

1. (10 points) Draw the tree of strings that would give the following traversals:

   pre-order: `time the save a click world one at`
   in-order: `the save time world click one a at`
   post-order: `save the world one click at a time`

2. (40 points) Recall the definitions of the `ListNode` and `LinkedIntList` class:

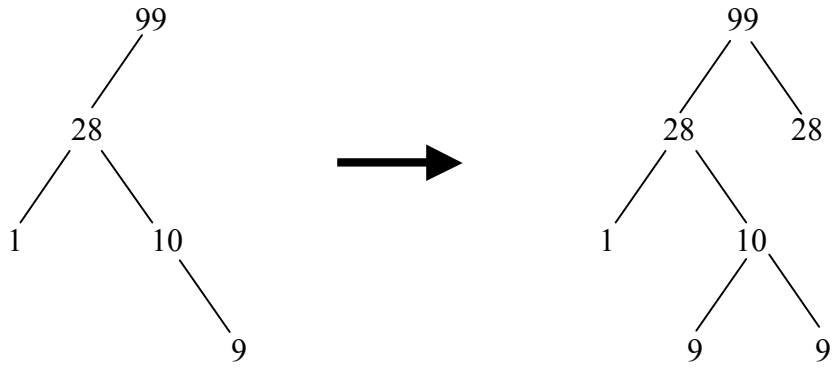
```
public class ListNode {
     int data;
     ListNode next;
}

public class LinkedIntList {
     private ListNode front;

     <methods>
}
```

   Write a method `removeEveryOther(void)` for the `LinkedIntList` class that removes every other node in the list. If the list contained [11,4,34,67,5], then a call to `removeEveryOther` would result in [11,34,5]. If the list is empty or there is only a single node, the method does nothing and simply returns. You may NOT create any new nodes or overwite the `data` variable of any node. You must solve this problem by manipulating the `next` variable in the `ListNode` class. Do NOT use recursion.

3. (40 points) Assume the following definition of binary trees of integers:

```
public class TreeNode {
    public int data;       // data stored at this node
    public TreeNode left;  // reference to left subtree
    public TreeNode right; // reference to right subtree

    // post: constructs a leaf node with given data
    public TreeNode(int data) {
        this(data, null, null);
    }

    // post: constructs a node with the given data and links
    public TreeNode(int data, TreeNode left, TreeNode right) {
        this.data = data;
        this.left = left;
        this.right = right;
    }
}

public class Tree {
    private TreeNode root;

  <methods>
}
```

Write a method `cloneLonelyChildren(void)` in the `Tree` class that takes every node that has *exactly* one child and attaches a new leaf node to the childless branch with the same data as the existing child. For example, a call to `cloneLonelyChildren` would result in the following mutation:



Notice that every node is now a leaf node or has exactly 2 children.

4. (12 points) For the following, either answer True/False or fill in the blank and explain your answer in a short sentence or two.

(a) [DELETED]

(b) Search on a binary search tree takes _____ time.

Explanation:

(c) `add(int index, int value)` in the vanilla `LinkedIntList` (shown below) takes _____ time.

```
public class ListNode {
     int data;
     ListNode next;
}

public class LinkedIntList {
     private ListNode front;

     <methods>
}
```

Explanation:

(d) An $O(n^3+5)$ algorithm is also $O(n^3)$. **True** **False**

Explanation:

5. (12 points) List 4 critical (but simple) errors with the following code and/or declarations. Circle the error and write a brief explanation. Code in bold is correct.

```
public interface Person
{
    public void greet() {
        System.out.println("Hello!");
    }
}

public abstract class Student implements Person
{
    public abstract void doHomework();

    public void greet() {
        System.out.println("sup?");
    }
}

public class HumanitiesStudent extends Student {}

public class EngineeringStudent extends Student
{
    public void doHomework() {
        solveProblems();
    }

    public void solveProblems() { }
}

public class CseStudent extends EngineeringStudent {}


Student alice = new Student();
Student bob = new CseStudent();
CseStudent cynthia = new EngineeringStudent();
CseStudent doug = new CseStudent();
Object emily = new EngineeringStudent();
```

6. (40 points) The following class represents a simple bank account:

```
public class Account {
    private int amount;

    public Account(int initialAmount) {
        if (initialAmount < 0) {
            throw new IllegalArgumentException();
        }
        amount = initialAmount;
    }

    // post: deposits money into this account
    public void deposit(int depositAmount) {
        if (depositAmount < 0) {
            throw new IllegalArgumentException();
        }
        amount += depositAmount;
    }

    // post: withdraws money from this account
    public void withdraw(int withdrawAmount) {
        if (withdrawAmount < 0) {
            throw new IllegalArgumentException();
        }
        int total = amount - withdrawAmount;
        if (total < 0) {
            System.out.println("Not enough money!");
        } else {
            amount = total;
        }
    }
}
```

Design a new class called `SecureAccount` that is a secure version of the `Account` class. The constructor takes as parameters a password and an initial amount. Depositing into a secure account is the same as a regular account (getting more money into your account is always ok!). However, to withdraw money, a password must also be given in addition to the amount to be withdrawn via:

```
public void withdraw(int withdrawAmount, String password)
```

If no password is given (*i.e.*, the `withdraw` method with one parameter is called), then the message "Please enter your password." should be printed. If a password is entered and the password is wrong, the message "Sorry, wrong password." is printed. After 3 failed calls to the `withdraw` method with 2 parameters, the account locks down. Future attempts (including those with the correct password) will print the

message “Your account has been locked.” If before 3 failed tries, the user gets the right password, the counter resets back to 0.

Use inheritance to solve this problem. Redundant code will result in lost points.