CS 61BL Data Structures & Programming Methodology

Summer 2018 — Midterm 1 Solution

This exam has 6 questions worth a total of 25 points and is to be completed in 80 minutes.
The exam is closed book except for one double-sided, handwritten cheat sheet. No calculators or other electronic devices are permitted. Give your answers and show your work in the space provided.
Write the statement below in the blank provided and sign. You may do this before the exam begins.

"I have neither given nor received any assistance in the taking of this exam."

I have neither given nor received any assistance in the taking of this exam.

Signature: Blear Hug

Question	Points
1	½
2	½
3	8
4	9
5	0
6	7
Total	25

Name	Blear Hug
Student ID	1234567890
Lab Section	0 0 1
Name of person to left	Christine Zhou
Name of person to right	Kevin Lin

- There may be partial credit for incomplete answers. Write as much of the solution as you can, but we may deduct points if your answers are much more complicated than necessary.
- **Work through the problems with which you are comfortable first.** Do not get overly captivated by interesting design issues or complex corner cases you're not sure about.
- Not all information provided in a problem may be useful, and **you may not need all lines**. For code-writing questions, **write only one statement per line** and **do not write outside the lines.**
- Unless otherwise stated, all given code on this exam should compile. All code has been compiled and executed, but in the event that we do catch any bugs in the exam, we'll announce a fix. **Unless we specifically give you the option, the correct answer is not, 'does not compile.'**

1. (½ pt) **Your Thoughts** What makes you happy? How do you feel about CS 61BL so far?

The class is a lot of work and the labs are sometimes too long, but it's also pretty fun.

2. (½ pt) **So It Begins** Write the statement on the front page and sign. Write your name, ID, and your lab section. Write the names of your neighbors. Write your name in the corner of every page.

3. **Evaluate**

   (a) (4 pts) In each blank, write what Java would display as the result of running the `main` method.

```
public class Point2D {
    public int x;
    public int y;

    public static void main(String[] args) {
        Point2D p = new Point2D();
        Point2D[] tri = new Point2D[3];
        tri[0] = new Point2D();
        p.x = 1;
        p.y = 3;
        tri[0].x = p.x;
        tri[0].y = p.y;
        p.x = 2;

        System.out.println(p.x + ", " + tri[0].x);     2 , 1

        tri[1] = p;
        tri[1].y = 4;

        System.out.println(p.y + ", " + tri[0].y);     4 , 3

        tri[2] = tri[1];
        p.x = 5;
        tri[2] = new Point2D();
        tri[2].x = 0;
        tri[2].y = tri[1].y;

        System.out.println(p.x + ", " + tri[2].x);     5 , 0

        System.out.println(p.y + ", " + tri[2].y);     4 , 4
    }
}
```

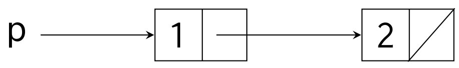
Name: Blear Hug

(b) (4 pts) In each blank, write what Java would display as the result of running the `main` method.

```
public class Dog {
    public String name;

    public Dog(String n) {
        name = n;
    }

    public static void flop(Dog a, Dog b) {
        Dog temp = a;
        a = b;
        b = temp;
        System.out.println(a.name);    Boogie
    }

    public static void swap(Dog a, Dog b) {
        String temp = a.name;
        a.name = b.name;
        b.name = temp;
        System.out.println(a.name);    Doggo
    }

    public static void rename(Dog d, String newName) {
        String oldName = d.name;
        oldName = newName;
        System.out.println(d.name);    Angie
    }

    public static void main(String[] args) {
        Dog a = new Dog("Angie");
        Dog b = new Dog("Boogie");
        Dog c = new Dog("Cocoa");
        Dog d = new Dog("Doggo");
        flop(a, b);
        System.out.println(a.name);    Angie
        swap(c, d);
        System.out.println(c.name);    Doggo
        rename(a, d.name);
        System.out.println(a.name);    Angie
    }
}
```

4. **Linked Lists**

(a) (1 pt) Write a single Java assignment statement that declares and assigns the variable `p` to have the value shown below.



`IntList p = new IntList(1, new IntList(2, null));`

(b) (4 pts) Implement `toIntArray`, which returns a new `int[]` containing the same values as the given `SLList`. For full credit, use recursion. For up to 3 pts partial credit, use iteration.

Remember to write only one statement per line. You may not need all the lines.

```
public class SLList {
    private static class IntNode {
        public int item;
        public IntNode next;
    }
    private IntNode sentinel;
    private int size;

    public int[] toIntArray() {

        return helper(sentinel.next, new int[size], 0);
    }

    private int[] helper(IntNode node, int[] arr, int i) {

        if (i == arr.length) {

            return arr;

        }

        arr[i] = node.item;

        return helper(node.next, arr, i + 1);

        ____________________

        ____________________

        ____________________
    }
}
```

(c) (4 pts) Implement `DLList.duplicate`, which **destructively** copies each node in the list, resulting in a list that's twice as long. For example, if the list initially contained $[1, 2, 3]$, it should contain $[1, 1, 2, 2, 3, 3]$ after the call to `duplicate`.

```
public class DLList<BleepBlorp> {
    private class Node {
        public Node prev;
        public BleepBlorp item;
        public node next;

        public Node(BleepBlorp i, Node p, Node n) {
            item = i;
            prev = p;
            next = n;
        }
    }
    private Node sentinel;
    private int size;

    public void duplicate() {
        Node p = sentinel.next;

        while (p != sentinel______________________________) {

            Node copy = new Node(p.item, p, p.next______________________________);

            copy.prev.next = copy______________________________________________;

            copy.next.prev = copy______________________________________________;

            p = copy.next______________________________________________________;
        }
        size *= 2;
    }
}
```

5. (0 pts) **PNH** In which Martian region did the Mars Express detect an aurora on 14 August 2004?

Terra Cimmeria

6. **Testing & Git** In lab, we designed an `Account` class with an `int balance` and a `parent` account.

   (a) (4 pts) Implement `copyAll`, which takes in an `Account[]` and returns a copy of all the accounts in the same sequence. Each account may have a `parent`, and each `parent` may have more parent accounts in a long chain of accounts. Make sure to copy every `parent` account and setup the parent connections so that changing any of the `Account` objects in either array should have no effect on the other.

   Assume that there are no `null` accounts and no two accounts share the same `parent` account.

```
public class Account {
    public int balance;
    public Account parent;

    public Account(int balance) {
        this.balance = balance;
    }

    public Account(int balance, Account parent) {
        this.balance = balance;
        this.parent = parent;
    }

    public static Account[] copyAll(Account[] accounts) {
        Account[] result = new Account[accounts.length];
        for (int i = 0; i < accounts.length; i += 1) {

            Account acct = accounts[i];

            Account copy = new Account(acct.balance)________________________;

            result[i] = copy__________________________________________;

            while (acct.parent != null_____________________) {

                acct = acct.parent______________________________________;

                copy.parent = new Account(acct.balance)_________________;

                copy = copy.parent______________________________________;
            }
        }
        return result;
    }
}
```

(b) (2 pts) Implement `testMystery`, a JUnit test for an unknown `Account` class method called `mystery` which takes in an `Account[]` and returns an `Account[]`. `testMystery` should make sure that `mystery` is a **non-destructive** method and doesn't change any of the input `accounts`. You may use `Account.copyAll` and assume that it is correctly implemented. Assume that the `Account` class has an `equals` method so you may use `assertArrayEquals` for comparing arrays.

```
public class AccountTest {
    @Test
    public void testMystery() {
        // Randomly generate new Accounts objects for testing purposes.
        Account[] testAccounts = makeTestAccounts();

        Account[] copied = Account.copyAll(testAccounts)________________________;

        Account.mystery(testAccounts)___________________________________________;

        assertArrayEquals(copied, testAccounts)_________________________________;
    }
}
```

(c) (1 pt) A student needs help with Git! `git status` displays the following message.

```
On branch master
Your branch is up to date with 'origin/master'.

Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

        modified:   lab02/Account.java
        modified:   lab02/Path.java

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

        modified:   lab02/Account.java
```

Which **one** command should they run **first** to create a single commit with all of `lab02`?

Choose only one circle and fill it in completely.

- ○ `git reset HEAD lab02/Account.java`
- [✓ ● `git add lab02/Account.java`]
- ○ `git checkout -- lab02/Account.java`
- ○ `git commit -m "Completed lab 2"`
- ○ `git push origin master`