CS56—Final Exam

E03, W16, Phill Conrad, UC Santa Barbara

Wednesday, 03/16/2016

Name: _____

Umail Address: _____@ umail.ucsb.edu

- Please write your name **above AND AT THE TOP OF EVERY PAGE**
- Please put your pages **in order, facing the same way.**
  - All the odd pages have dots (•); these should be upper right, and facing up.
  - All the even numbered pages have crosses (×) at upper right and should be facing down.
- Be sure you turn in every page of this exam.
  - Each of the pages is numbered (e.g. Page 1, Page 2, etc.)
  - The last page clearly says "End of Exam".
- This exam is **closed book, closed notes**, **closed mouth, cell phone off**
- You are permitted **one sheet of paper** (max size 8.5x11") on which to write notes
- This sheet will be collected with the exam, and might not be returned
- Please write your name on your notes sheet

1. In one of the labs this quarter, you wrote a class `Polynomial` that started with the following line of code:

```
public class Polynomial extends ArrayList<Integer> {
```

As you may recall, the class represents a polynomial: $a_n x^n + a_{n-1} x^{n-1} + \cdots + a_2 x^2 + a_1 x + a_0$, with the *i*th element of the ArrayList being the coefficient a_i.

Here is a proposed implementation of a no argument constructor that creates an instance of this class that represents the degree zero polynomial `0`. This question asks you to provide a code review where you critique this code, and then rewrite it to improve it.

To be absolutely clear: the constructor should create an instance of the Polynomial class of the form $a_n x^n + a_{n-1} x^{n-1} + \cdots + a_2 x^2 + a_1 x + a_0$, n=1 (i.e. it only has a constant term) with a_i=0.

In your critique, assume that the choice to build the class `Polynomial` by extending `ArrayList<Integer>` according to the instructions above is *not* up for discussion; only the code of the proposed constructor below.

```
public Polynomial() {
  Polynomial<> coeffs = new Polynomial<>();
  coeffs.set(0,0);
}
```

a. Please critique this code, as diplomatically as possible. You will be awarded points on two dimensions:
   - (5 pts) These points are awarded based on the accuracy of your critique. Decide: Will this code compile? Will this code work correctly? If the answer to either, or both, is no, what should be done to fix the code? If it will comile and produce the correct result, is there nevertheless a style issue? An efficiency issue? Provide accurate feedback to help improve the code.
   - (5 pts) As we rehearsed during the code review exercises early this quarter, please phrase any and all criticisms as a diplomatic question rather than as a blunt statement, *even if* you are 100% sure of the correctness of your answer. "I wonder whether" is a good way to start. These points are awarded based on your diplomacy rather than on the accuracy of your comment.

PROBLEM CONTINUES ON NEXT PAGE

PROBLEM CONTINUED FROM PREVIOUS PAGE

b. (5 pts) Suppose the author of the code says: "You know, I think your critique of the code is completely correct. Let's switch roles; could you rewrite the code, and fix these issues? I'll watch and learn from you."

In the space below, rewrite the code in a way that reflects your critique and improves the code.

2. On a previous exam, you wrote a method for a class `TempSequence` that started with the following line of code:

```
public class TempSequence extends ArrayList<Integer> {
```

As you may recall, the class represents a sequence of temperature values. There were two methods you were asked to write:

- `public double averageTemp()` returns the average temperature across all readings in the ArrayList.
- `public TempSequence aboveAverage()` returns a new TempSequence consisting of only the temperatures that were above the average of the temperatures in the TempSequence object on which the method was invoked.

Here is a proposed implementation that I'm going to ask you critique. I want you to take the implementation of `averageTemp` as "given", and focus on the `aboveAverage` method. NOTE: the method is double spaced to give you more room to make notations on it.

```
import java.util.ArrayList;
public class TempSequence extends ArrayList<Integer> {

    public double averageTemp() {
        int sum=0;
        int length=this.size();
        for (int i=0; i<length; i++) {
            sum+=this.get(i);
        }
        return ((double)(sum))/length;
    }

    public TempSequence aboveAverage() {

        TempSequence result = new TempSequence();

        for (int i=0; i<this.size(); i++) {

            if (this.get(i)> this.averageTemp())

                result.add(this.get(i));

        }

        return result;

    }

}
```

PROBLEM CONTINUES ON NEXT PAGE

Page: 5 Name: _____

PROBLEM CONTINUED FROM PREVIOUS PAGE

a. Please critique this code, as diplomatically as possible. You will be awarded points on two dimensions:

- (5 pts) These points are awarded based on the accuracy of your critique. Decide: Will this code compile? Will this code work correctly? If the answer to either, or both, is no, what should be done to fix the code? If it will comile and produce the correct result, is there nevertheless a style issue? An efficiency issue? Provide accurate feedback to help improve the code. **HINT**: For this question, draw on your ***entire*** **background in Computer Science;** not necessarily just material from CMPSC 56, but from pre-requisite courses as well.
- (5 pts) As we rehearsed during the code review exercises early this quarter, please phrase any and all criticisms as a diplomatic question rather than as a blunt statement, *even if* you are 100% sure of the correctness of your answer. "I wonder whether" is a good way to start. These points are awarded based on your diplomacy rather than on the accuracy of your comment.

b. (5 pts)

Suppose the author of the code says: "You know, I think your critique of the code is completely correct. Let's switch roles; could you rewrite the code, and fix these issues? I'll watch and learn from you."

This time, rather than rewriting the code completely, **just make the necessary changes to the code for `aboveAverage` above by some combination of crossing out code,and adding code on the previous page.** You may use arrows to indicate where code goes, as long as your notations are clear and legible. Make changes that reflect your critique and improve the code as much as possible, focusing ONLY on the single method `aboveAverage`.

←←← ANSWER GOES ON PREVIOUS PAGE

3. (20 pts) Please write at least three paragraphs in response to the following prompt. **Write as if you were answering a question in a job interview.** Be sure that your answer includes **each** of the elements asked for in the question. You may use the space below, plus as much of the next page as you need.

   DO NOT FEEL OBLIGATED TO FILL THE ENTIRE SPACE WITH TEXT IF YOU ARE ABLE TO ANSWER THE QUESTION COMPLETELY WITHOUT DOING SO.

   Question: I understand that in one of your courses at UCSB, you worked with legacy code. Tell me about the project you worked on. I'd like to know what the code you worked on does in terms of some user stories. I'd also like to know what specific contributions you (and your pair partner, if you had one) made to the code during the course. Finally, tell me about how working with legacy code is different from writing code from scratch.

PROBLEM CONTINUES ON NEXT PAGE

PROBLEM CONTINUED FROM PREVIOUS PAGE

4. (4 pts) Which of the following is true about normal git workflow:
    a. The normal sequence is "git add", "git commit", "git push"
    b. The normal sequence is "git commit", "git add", "git push"
    c. The normal sequence is "git add", "git push", "git commit"
    d. The normal sequence is "git push", "git commit", "git add"
    e. The normal sequence is "git push", "git add", "git commit"

5. (4 pts) Consider the following code:

```
try {

   Thread.sleep(2000);

} catch(InterruptedException ex) {

    ex.printStackTrace();

}
```

Assuming there is no interruption that causes an Exception, when the 2000 milliseconds of sleep is over, into what state will this thread go?

    a. running
    b. blocked
    c. runnable
    d. new
    e. awake

6. (4 pts) What does it mean if a class implements the Serializable interface? (Multiple choice, circle one letter):
    a. The class implements methods that allow Object instances can be written to an ObjectOutputStream and read from an ObjectInputStream—in this way, they can be stored to a file, and read from a file, or sent over a network connection from one process to another.
    b. Objects can be put into a strict order (by serial number) and sorted when they occur in Java Collections such as Lists, Sets, ArrayLists, etc.
    c. Objects have serial numbers that can be used in place of references to look up objects—the serial number is accessed through the .serial() method of java.lang.Object
    d. It means that instances of that class inherit methods from the base class Serializable that allow them to be streamed to a file, or over a network, or restored from a file or a network connection.
    e. It marks the object for expedited deletion by the Garbage Collector (through SerialDeletion), thus improving memory performance in programs that create large numbers of objects.

Page: 9 Name: _____

7. The interface `Comparable<T>` contains one and only one method:

```
int compareTo(T o)
```

> Compares this object with the specified object for order. Returns a negative integer, zero, or a positive integer as this object is less than, equal to, or greater than the specified object.

The class TeamPlayer is described on the handout you were given with this exam.

Suppose you have a need for instances of the `TeamPlayer` that implement the Comparable interface. The implementation should compare by jersey number. BUT, you don't have access to the source code of TeamPlayer to modify it! Indeed, you can't even see the source code to TeamPlayer—all you have is the information about the class that is on the handout given with this exam. What can you do?

a. (6 pts) First, describe in 1-2 sentences what your approach is for dealing with this situation, using proper Java and Object-Oriented programming terminology. Describe it as if you were answering a job interview question, i.e. in complete English sentences.

b. (10 pts) In the space below, write ALL of the code necessary to implement your solution. Note: if correct, it should fit easily in the space below.

8. As we discussed in lecture, as as your textbook described in Chapter 16, the interface `Comparator<T>` is used when we want to be able to sort a Collection such as an ArrayList of some type E using different criteria.

   Though there are some complicated details, the main thing you need to know about Comparator is that its an interface, and that you typicallly need to implement just this one method:

   ```
   int compare(T o1, T o2)
   ```

   > Compares its two arguments for order. Returns a negative integer, zero, or a positive integer as the first argument is less than, equal to, or greater than the second.

   The class TeamPlayer is described on the handout you were given with this exam.

   Suppose you want to sort an ArrayList<TeamPlayer> so that the players appear in order first by position (the positions in alphabetical order), then in order of their jersey numbers (when there are ties.)

   If you have a suitable Comparator<TeamPlayer> class called `TeamPlayerPJC`, you can sort an instance of ArrayList<TeamPlayer> called `team` with this code:

   ```
   import java.util.Collections;
   import java.util.ArrayList;
   ...
       // TeamPlayerPJC is short for TeamPlayerPositionJerseyComparator
       // which is way too long to write on a hand written exam :-)
       TeamPlayerPJC tppjc = new TeamPlayerPJC();
       Collections.sort(team, tppjc);
   ```

   You have one job in this question: write the code for the class TeamPlayerPJC. Hint: It is pretty short; about 8-12 lines, so it should fit in the space below. But in case, there there is more room on the next page.

   One more hint: the String class implements the interface `Comparable<String>` so it has a `int compareTo(String o)` method that treturns the negative, zero, or positive result in the usual fashion. You might find that useful.

PROBLEM CONTINUES ON NEXT PAGE

Page: 11 Name: _____

PROBLEM CONTINUED FROM PREVIOUS PAGE

9. Continuing with the idea of sorting an ArrayList<TeamPlayer>, suppose we want to sort by first name. Instead of writing a full comparator class, Java 8 allows us to use a short cut like this.

```
import java.util.Collections;
import java.util.ArrayList;
  ...
  Collections.sort(team,
                (tp1, tp2) -> tp1.getFname().compareTo(tp2.getFname()) ) ;
```

   a. (5 pts) Write a similar call to Collections.sort that sorts by jersey number. You may assume there are no ties in jersey numbers. (You do not need to repeat the import statements.)

   b. (5 pts) In the Collection.sort method call listed above, the following expression is standing in place of a `Comparator<TeamPlayer>` object:

```
      (tp1, tp2) -> tp1.getFname().compareTo(tp2.getFname())
```

   We saw a similar expression in lab08 when writing a simple web application. The lines of code that handled web requests, and returned web responses were of the form:

```
        get("/hello", (req, res) -> "Hello World");
```

   and:

```
        get("/ucsb", (req, res) -> "Go Gauchos");
```

   My question to you is simple: what is the Java 8 terminology for this "thing" that is passed as a shorthand for an object in some instances? The answer I'm looking for is either one word, or a two-word phrase.

10. (4 pts) Assume that the following line of code appears inside a java main() method.

```
Dog [] pets = new Dog[7];
```

Which of the following is a true statement?

a. `pets` is a local variable on the stack that refers to an Array object. This is an array of seven Dog objects, pets[0] through pets[6] each of which is allocated on the heap. This statement is not legal if the Dog class does not contain a default constructor.
b. `pets` is a local variable on the stack that refers to an Array object. That array object is on the heap. The array object contains seven Dog references pets[0] through pets[6], each of which is initially null. No Dog objects are created by this statement.

For the next two questions, consider the following code listing:

```
<?xml version="1.0" encoding="utf-8"?>
1
2  <project default="compile">
3
4    <target name="compile" >
5      <mkdir dir="build" />
6      <javac srcdir="src" destdir="build" debug="true" debuglevel="lines,source">
7       <include name="**/*.java"/>
8      </javac>
9    </target>
10
11   <target name="run" depends="compile" >
12     <java classname="foo" fork="true" classpath="build" />
13   </target>
14
15 </project>
```

11. (4 pts) Consider the word `true` on line 6. What best describes this word?

a. It is the name of an attribute
b. It is the value of an attribute
c. It is an Ant target
d. It is an open tag
e. It is the name of a self closing element

12. (4 pts) Consider the word include on line 7. What best describes this word?

a. It is the name of an attribute
b. It is the value of an attribute
c. It is an Ant target
d. It is an open tag
e. It is the name of a self closing element

End of Exam—total points=100