Name

CS 110

Practice Midterm Exam
(Adapted from the Spring '98 Midterm;
last modified 9 May 2017)

Instructions: closed books, closed notes, open minds,
1 hour 15 minute time limit.
There are 4 sections for a total of 80-ish points:

- Part I: 20-ish points
- Part II: 12-ish points
- Part III: 37-ish points
- Part IV: 8-ish points
Part I  (20 points total)

1. Each of the following contains an error that will cause it to not compile (a syntax error) or to behave other than as expected (a logic error). For each, describe the error.  (1 point each)

   a) int i = 3.14;
   d) for(double d = 0.0, d < 3.0, d++)
       System.out.print(d + " ");

   b) double f = 3.6
   e) for (int k=0; k < 20; k++)
       System.out.println(k);
            System.out.println(k);

   c) while ( k < 3 );
   f) if ( colorint = 0 )
       System.out.println(k);
            fishColor = Color.RED;

2. Fully parenthesize the following expression to indicate the order of evaluation.  (2 pts)

   x * y + a - b / c
3. For each of the following expressions, tell the **type** of the expression, along with its **value**.
   (2 points each)

Assume the following variable definitions and function declaration:

```java
int m = 2;       // m is an int
int pi = (int) 3.14159;   // pi is an int
double c = 3.0, b = 3.0, h = 4.0; // c, b, and h are doubles
double sqrt(double sqr); // returns the square root of sqr
```

a) \(m \times c \times c\)

b) \(\sqrt{b^2 + h^2}\)

c) \(pi\)

4. Give logical (i.e. Boolean) expressions that represent the following phrases.  (2 points each)
   a) i and j are greater than 10

   b) i is positive or less than -10

   c) i is less than j, which is less than k
Part II. (18 points total)

5. Consider the following two code segments. Assume the variable `hour` contains an integer value indicating the time of the day and that the variable `s` is a `String` object.

I) if ( result < 0 )
   s = "Negative result";
   if ( result < 5 )
      s = "Result is small";
      if ( result < 15 )
         s = "Result is medium";
      else
         s = "Result is big";
   else
else if ( result < 5 )
   s = "Negative result";
   else if ( result < 15 )
      s = "Result is small ";
      else
         s = " Result is medium ";
      else
         s = " Result is big ";

Answer each of the following: (1 point each)

a) Are the value of `s` at the end of code segment I and the value of `s` at the end of code segment II always the same for a given value of `hour`, or do the two segments sometimes produce different output?
   - Same
   - Different

b) For which value of `hour` does segment I perform the fewest comparisons? The most comparisons? Or does it perform the same number of comparisons in all cases?

c) For which value of `hour` does segment II perform the fewest comparisons? The most comparisons? Or does it perform the same number of comparisons in all cases?

d) Which of the two code segments (if either) is a better design choice and why?

6. How many times is statement S executed in the following Java code fragments? (2 points each)

   a) for (i = 0; i <= A.size(); i++)
      S
   b) for (i = 1; i < N; i++)
      for (j = 0; j < M; j++)
         S
   c) for (i = 1; i < 5; i++)
      for (j = i; j < 3; j++)
         S
Various questions throughout this practice exam will refer to the classes whose instance variables and method signatures are shown below. (The method bodies are not shown.)

```java
public class CDInfo {
    // instance variables
    private String title;
    private String artist;
    private ArrayList<String> songTitles;
    private double price;

    // constructor
    public CDInfo(String cdTitle, String cdArtistName,
                   ArrayList<String> cdSongs, double cdPrice) {...}

    // observer or accessor methods
    public String getTitle () {...} // title of CD
    public String getArtistName() {...} // name of artist
    public ArrayList<String> getSongs() {...} // list of songs
    public double getPrice(){...} // price of CD
}

public class CDDatabase {
    // instance variables
    private ArrayList<CDInfo> cdList;

    // constructors not shown

    // observer or accessor methods
    public void printAll() {...}
    public int numTitlesBy(String artistName) {...}
    public double costOf(String cdTitle) {...}
    public String cheapestCD(){...}
    public void printSongTitles(String cdTitle) {...}
    public ArrayList<CDInfo> allCDsLessThan(double price) {...}

    // other methods not shown
}
```
Part III. (37 points total)

7. Write the code to implement the CDInfo constructor. (3 points)

8. Write the client code to declare a variable that refers to a CDInfo object and construct and initialize the object with the following information:
   - title: “Rubber Soul”
   - artist: “Beatles”
   - songTitles: assume that the song titles are contained in an ArrayList called songList
   - price: 12.95
   (3 points)

9. Write the client code to print the title of the CDInfo object you constructed above, using the appropriate method (i.e., do not just print “Rubber Soul”). (2 points)

10. Write the code for the CDDatabase method printAll, which prints the artist name, followed by the title and price, for all CDs in the database. (Note that this function does not print the song titles.) Use spaces and line breaks to make your output legible. (4 points)
11. Write the code for the `CDDatabase` method `numTitlesBy`, which returns the number of CDs in the database by the specified artist. (4 points)

12. Write the code for the `CDDatabase` method `costOf`, which returns the price of the CD whose title is provided. If there is no CD in the database with the given title, return a price of 0.0. (4 points)
13. Write the code for the CDDatabase method cheapestCD, which returns the title of the cheapest CD in the database. If there are no CDs in the database, this function should return a null string. If there is more than one CD with the lowest price, you may return any one of them (whichever you find easiest). (5 points)

14. Write the code for the CDDatabase method printSongTitles, which prints the titles of the songs of the CD whose title is provided, one song per line. (6 points)
15. Write the code for the CDDatabase method allCDsLessThan, which returns an ArrayList of all the CDs in the database whose price is less than the parameter. If there are no CDs whose price is less than the parameter, return an empty ArrayList. (6 points)

Part IV. (8 points total)

The final questions in this practice exam refer to the AquaFish class from the Aquarium Lab Series, some of whose method signatures are shown below. (The method bodies are not shown.)

```java
public class AquaFish {
    // constructors
    public AquaFish (Aquarium aqua) {...}
    public AquaFish (Aquarium aqua, Color aColor) {...}

    // partial list of methods
    public boolean atWall() {...} // is fish at wall?
    public void changeDir() {...} // change direction
    public void moveForward() {...} // move forward
...
}
```
16. Assume that you have an Aquarium object in a variable called `aqua`. Construct a random number generator and an empty `ArrayList` of `AquaFish`. Then construct 15 fish with random colors (each fish has a random amount of red, a random amount of green, and a random amount of blue) and add them to your new `ArrayList` and to the aquarium. (4 pts)

```java
public static void main()
{
    // There’s some code that comes before what you need to write.
}
```

17. Using the `ArrayList` from 16, write a loop to move all of the fish in your `ArrayList` forward 20 times. Each time they move, you should first to see if they are at a wall and need to turn before moving. (You do not need to add a random chance of turning if a fish is not at the wall, even though we added that functionality in the Aquarium Lab Series mini-labs.) (4 pts)

```java
// Assume that this is a continuation of the code
// you wrote in 16.
```