

# COE 212 – Engineering Programming

Welcome to Exam I  
Friday November 15, 2013

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## **Instructions:**

1. This exam is **Closed Book**. Please do not forget to write your name and ID on the first page.
2. You have exactly **110 minutes** to complete the **seven** required problems.
3. Read each problem carefully. If something appears ambiguous, please write your assumptions.
4. Do not get bogged-down on any one problem, you will have to work fast to complete this exam.
5. Put your answers in the space provided only. No other spaces will be graded or even looked at.

**Good Luck!!**

**Problem 1: Multiple choice questions (20 minutes) [16 points]**

For each question, choose the **single** correct answer.

- 1) The `.class` extension on a file means that the file:
  - a. contains Java source code
  - b. is produced by the Java interpreter
  - c. **is produced by the Java compiler**
  - d. Both (a) and (c)
- 2) Which of the following is **not** an **instantiation statement**?
  - a. `String str = new String("Java is fun");`
  - b. `String str = "Java is fun";`
  - c. All of the above
  - d. **None of the above**
- 3) What type of methods allows a client of a class to **access** the value of a private instance variable?
  - a. Mutator methods
  - b. **Getter methods**
  - c. Both of the above
  - d. Constructor methods
- 4) Which of the following is **not** in the `Math` class?
  - a. **`PI ()`**
  - b. `abs(int value)`
  - c. `ceil(double value)`
  - d. None of the above
- 5) Consider the following Java statements:

```
String str;  
char letter='L';
```

Which of the following can be used to store the value of the variable called `letter` in `str`?
  - a. `str += letter;`
  - b. `str = str + letter;`
  - c. All of the above
  - d. **None of the above**
- 6) Which of the following statements is **false**?
  - a. **If a method does not return a value, then the return type in the method header can be omitted**
  - b. Forgetting to return a value from a method that has a return type different than `void` is a compile-time error
  - c. Using an uninitialized variable leads to a syntax error
  - d. Both (a) and (b) are false
- 7) Which statement below can be used to simulate the outputs of tossing a coin to get heads or tails? Suppose `randomNumbers` is a `Random` object.
  - a. `randomNumbers.nextInt(1);`
  - b. **`randomNumbers.nextInt(2);`**
  - c. `(int) Math.random() * 2 + 1;`
  - d. Both (b) and (c)

- 8) Which of the following statements creates a random value from the sequence 2, 5, 8, 11, and 14? Suppose `randomNumbers` is a `Random` object.
- `2 + 5*randomNumbers.nextInt(3);`
  - `3 + 2*randomNumbers.nextInt(5);`
  - `5 + 3*randomNumbers.nextInt(2);`
  - `2 + 3*randomNumbers.nextInt(5);`**
- 9) Which of the following correctly computes:  $5 + 10^{15}$ ?
- `double result = 5 + 10^15;`
  - `double result = 5 + Math.pow(15, 10);`
  - `double result = math.pow(10, 15) + 5;`
  - None of the above**
- 10) Which of the following refers to the automatic conversion from a wrapper class to its corresponding primitive data type?
- Aliasing
  - Casting
  - Unboxing**
  - Autoboxing
- 11) Which of the following extracts the last character of a `String` called `listing`?
- `listing.substring(listing.length()-1, listing.length());`**
  - `listing.charAt(listing.length());`
  - `listing.substring(listing.length());`
  - None of the above
- 12) If you want to output the text "hi there", including the quote marks, which of the following could do that?
- `System.out.print("\\hi there\\");`
  - `System.out.print("\\hi" + "there\\");`
  - `System.out.print("\\hi" + "there\\");`
  - None of the above**
- 13) What output is produced by the following Java statement:  
`System.out.print(10 + 5 + " ");`
- 15**
  - 10 5
  - 105
  - None of the above
- 14) Consider having two `String` variables `str1` and `str2`. The statement `str1+=str2;` can be achieved using:
- `str1 = str2.concat(str1);`
  - `str2 = str1.concat(str2);`
  - `str1 = str1.concat("").concat(str2);`**
  - None of the above
- 15) Of the following types, which one cannot store the value of `Math.sqrt(4)`?
- `int`
  - `float`
  - `double`
  - Both (a) and (b)**
- 16) A variable whose scope is restricted to a method is known as
- parameter
  - instance variable
  - local variable**
  - None of the above

**Problem 2: True or false questions (10 minutes) [10 points]**

1. The output of the following statements is: 10 Done  

```
int y = 10, z =0;
System.out.print("" + z + y + " Done");
```

Answer: **True**    **False**
2. The following two ways of setting up a String yield identical results:  
a) `String str = "12345";`  
b) `String str = "1"+"2"+3+'45';`  

Answer: **True**    **False**
3. A method defined in a class can access the instance variables of that class without needing to pass them as parameters or declare them as local variables.  

Answer: **True**    **False**
4. If `x` is the String "HI THERE", then `x.toLowerCase().toUpperCase();` will return the original version of `x`.  

Answer: **True**    **False**
5. The output of the following code fragment below is: exam is fun  

```
String exam = "exam"; String isFun = " is fun";
exam = isFun; System.out.print("exam" + isFun);
```

Answer: **True**    **False**
6. If no visibility modifier is placed in front of a method, the method cannot be called from outside of the class containing it.  

Answer: **True**    **False**
7. The following assignment statement is a valid Java statement:  

```
Integer string = 23;
```

Answer: **True**    **False**
8. After running the code shown below, the value stored in the variable `y` is 13  

```
int y = 7;
y = --y + y;
```

Answer: **True**    **False**
9. The output of the code shown below is: e  

```
String str = "Hello There";
DecimalFormat fmt = new DecimalFormat("0.#");
Double index = Double.parseDouble(fmt.format(9.89)) ;
int i=index.intValue(); System.out.print(str.charAt(i));
```

Answer: **True**    **False**
10. The output of the following statement is: 4.5  

```
System.out.print((double) (9/2));
```

Answer: **True**    **False**

**Problem 3: Long true or false question (10 minutes) [12 points]**

In the following questions, check **all** the correct answers. There is at least one correct answer per question, but **there may be more**.

1. Which of the following are **true**:
  - a. A `final` variable in Java must have a name consisting of all capitals.
  - b. **`final` is a reserved word in Java.**
  - c. `final` is a visibility modifier in Java.
2. Which of the following are **false**:
  - a. **A client of an object is normally able to access that object's instance variables directly.**
  - b. **To ensure encapsulation, all instance variables should be declared as private and all methods should be declared as public.**
  - c. An accessor method is also known as a getter method.
3. Which of the following statements are **true**:
  - a. **Consider the statement: `int a = Math.abs(10) + Math.abs(-5);` when executing the statement: `System.out.println(Math.ceil(a/2.0));` the output on-screen would be 8.0**
  - b. Given the statement: `int a = 2, b = 4;` the following statement: `Math.ceil(Math.sqrt(Math.pow(a, b)));` produces a value of 5.0
  - c. **Given the statement: `Random gn = new Random();` the following statement: `Math.pow(gn.nextInt(4), 2);` produces at random one of the following values: 0, 1, 4, or 9.**
4. Which of the following are **true**:
  - a. **The data type for a value returned from a method must be consistent with the return type specified in the method header.**
  - b. Every method must end with a return statement.
  - c. The formal parameters of a method are the values passed to it when it is invoked.
5. Which of the following are **true**:
  - a. Not including a constructor in a class definition leads to a compile-time error.
  - b. **The methods in a class define the behavior of objects belonging to the class.**
  - c. **All methods of the `Math` class are static.**
6. Which of the following are **false**:
  - a. **All classes of the `java.text` package are automatically imported for every program.**
  - b. It is possible to create an object instance without using the new operator.
  - c. **Dividing by zero is called a syntax error.**
7. Which of the following are **true**:
  - a. Any error detected by the compiler is called a run-time error.
  - b. **If a Java program is not syntactically correct, the compiler will not produce an executable version of the program.**
  - c. In the case of a syntax error, the program compiles without complaint.
8. Which of the following are **true**:
  - a. Unboxing provides automatic conversions from a primitive value to the corresponding wrapper class.
  - b. **Local variables must be initialized before being used in an expression for the first time.**
  - c. Two primitive type variables that are assigned to each other are called aliases of each other and refer to the same object.

### **Problem 4: Debugging (20 minutes) [15 points]**

Assume the code shown in the box below is stored in a file named:

Problems.java

Assume that the runIt method ran correctly, its output should be as follows:

2 4 8

eschew surplusage

End

```
public class Problem {
    public int runIt() {
        runOnce();
        System.out.println("End");
    }
    public void runOnce(int a) {
        i = 1;
        System.out.println(i*2 + " ");
        i*=2;System.out.print(i*2 + " ");
        i*=2; System.out.print(i*2);
        System.out.print(eschew");
        System.out.println("surplusage")
    }
}
```

1. How many errors in total are there in this code?

- a. 7
- b. 8
- c. 9
- d. 10**
- e. None of the above

2. How many of these errors are syntax errors?

- a. 7**
  - b. 8
  - c. 9
  - d. 10
  - e. None of the above
- Error1. Class has to be called problems  
 Error2. runIt() does not have a return statement, hence return type should be void  
 Error3. runOnce(); requires input parameter  
 Error4. i=1 =("surplusage") not initialized  
 Error5. eschew" => "eschew"  
 Error6. ("surplusage") => ("surplusage");  
 Error7. Missing brace at the end

3. How many of these errors are logical errors?

- a. 2
- b. 3**
- c. 4
- d. 5
- e. None of the above

4. Write the correct version of the code given earlier in the box enclosed below.

```
public class Problems {  
    public void runIt() {  
        runOnce();  
        System.out.println("End");  
    }  
  
    public void runOnce() {  
        int i = 1;  
        System.out.print(i*2 + " ");  
        i*=2; System.out.print(i*2 + " ");  
        i*=2; System.out.println(i*2 + " ");  
        System.out.print("eschew ");  
        System.out.println("surplusage");  
    }  
}
```

5. Write a driver class that invokes the `runIt` method of the previously introduced `Problems` class. Use the box provided below.

```
class SolvingProblem{  
  
    public static void main(String [] args)  
    {  
  
        Problems P = new Problems();  
        P.runIt();  
    }  
}
```

**Problem 5: Code analysis (10 minutes) [10 points]**

1) Consider the class given below, along with the driver class for it.

<pre>public class ClassA {     private int value;      public ClassA() {         value = 1;     }      public void         setValue(int val){             value += val;         } }</pre>	<pre>public class ClassADriver {     public static void         main(String[] args) {         int nb = 2;         ClassA a=new ClassA();         a.setValue(nb);         nb = a.value;         System.out.println(             "value is: "+nb);         } }</pre>
---	--

When running the ClassADriver class, what output is produced?

- a. value is: 1
- b. value is: 2
- c. value is: 3
- d. It doesn't compile correctly**
- e. None of the above

2) Consider the class given below, along with a driver class for it.

<pre>public class ClassB {     public int x;      public ClassB(int val) {         x = val;         addValue(x);     }      public void         addValue(int val){             x = x+val;         } }</pre>	<pre>public class ClassBDriver {     public static void         main(String[] args) {         int y = 2;          ClassB b=new ClassB(4);         b.addValue(y);          System.out.println(             "value is: "+ b.x);         } }</pre>
---	---

When running the ClassBDriver class, what output is produced?

- a. value is: 4
- b. value is: 6
- c. value is: 8
- d. It doesn't compile correctly**
- e. None of the above**

**Problem 6: Evaluating Java expressions (10 minutes) [7 points]**

For each of the following code fragments, what is the value of x after the statements are executed?

```
(1) String str = "15 minutes";
    char x = str.charAt(str.length() -
        str.substring(6, 8).length());
```

**Answer: x= 'e'**

```
(2) int y = (int) Math.random()*9;
    int x = 2*y + (++y);
```

**Answer: x= 1**

```
(3) DecimalFormat fmt = new DecimalFormat("00.###");
    double z = 23;
    z %= 5;
    String x = fmt.format(z);
    x += 70;
```

**Answer: x= "0370"**

```
(4) String str = "Exam One - Spring 2013";
    str = str.replace('E', 'x');
    String x = str.concat(str.toLowerCase().charAt(0));
```

**Answer: x="xxam One - Spring 2013 x"**

```
(5) int m = 18, n = 4;
    double x = (--m)/(++n);
    x += m % n;
```

**Answer: x= 5.0**

```
(6) int a=0, b=4;
    String str = "Good Afternoon Lebanon";
    String x = "\""str.substring(a, b)\";"
```

**Answer: x= "\"str.substring(a, b)\";"**

```
(7) double val1 = 23.4567;
    double val2 = Math.floor(23.4567*100);
    double x = val2 - (int) val1*100;
```

**Answer: x= 45.0**

**Problem 7: Coding (30 minutes) [30 points]**

1. Design and implement a Java program called `RandomString` that reads a `String` from the user and creates a new `String` by randomly selecting four characters from the `String` obtained from the user. Then, the program must print the newly formulated 4-character long `String` to the screen.

**Sample run:****Enter a String: Matrix****Randomly generated String is: txxM**

```
import java.util.Scanner;
import java.util.Random;

class RandomString {

    public static void main(String [] args)
    {
        Scanner scan = new Scanner(System.in);
        Random gen = new Random();

        System.out.println("Enter input string");
        String S1 = scan.nextLine();

        char c1= S1.charAt(gen.nextInt(S1.length()));
        char c2= S1.charAt(gen.nextInt(S1.length()));
        char c3 = S1.charAt(gen.nextInt(S1.length()));
        char c4 = S1.charAt(gen.nextInt(S1.length()));

        String S2 = ""+ c1 + c2 + c3 + c4;

        System.out.println("The new string = " + S2);

    }
}
```

2. A ball thrown with an initial speed  $V_0$  and an initial angle  $\alpha$ , travels a distance  $d$  given by:

$$d = \frac{V_0^2 \sin 2\alpha}{g}$$

Where  $g$  is a constant given by  $g=9.8$ .

Write a class called `Projectile` that reads the initial speed and the initial angle in degrees and prints out the distance travelled by the ball. You must format the output to 2 significant digits. Note to change an angle from degrees to radians, you have to use the following equation:

$$\alpha(\text{radian}) = \alpha(\text{degrees}) \cdot \frac{\pi}{180}$$

### Sample output

**Enter the initial speed (m/s): 10**

**Enter the initial angle (degrees): 45**

**The distance travelled is: 10.2 meters**

```
import java.util.Scanner;
import java.text.DecimalFormat;

class Projectile{

    public static void main(String [] args)
    {
        final double g = 9.8;

        double speed, angleDeg, angleRad, distance;

        Scanner scan = new Scanner(System.in);

        // Reading input
        System.out.println("Enter the initial speed (m/s):");
        speed = scan.nextDouble();
        System.out.println("Enter the initial angle (degrees)");
        angleDeg = scan.nextDouble();

        // Computation
        angleRad = angleDeg * Math.PI/180;
        distance = (Math.pow(speed, 2) * Math.sin(2*angleRad))/g;

        // Displaying output
        DecimalFormat fmt = new DecimalFormat("#.##");
        System.out.println("The distance travelled is: " + fmt.format(distance) + " meters");

    }
}
```

1. Consider a Circle defined by the following equation:

$$x^2 + y^2 + ax + by + c = 0$$

One can determine the coordinates of its center E as follows:

$$x_E = \frac{-a}{2}; y_E = \frac{-b}{2}$$

The radius of that circle is given by:

$$R = \sqrt{\frac{a^2 + b^2}{4} - c}$$

Write a Java program called `CircleStats` that reads 3 `int` values representing the **a**, **b**, and **c** coefficients of the above-presented equation. Your program should then output the coordinates of the center of the circle, its radius **R**, its area given by  $\pi R^2$ , and finally its perimeter given by  $2\pi R$ . Make sure that you format the output area and perimeter values to 3 decimal places.

**Sample run:**

**Enter a: 2**

**Enter b: 2**

**Enter c: 1**

**Center: E(-1, -1)**

**Radius: 1.0**

**Area: 3.142**

**Perimeter: 6.282**

```
import java.util.Scanner;
import java.text.DecimalFormat;

class CircleStats{

    public static void main(String [] args)
    {
        int a, b, c, x, y;
        double radius, area, perimeter;

        Scanner scan = new Scanner(System.in);

        // Reading input
        System.out.println("Enter integer a");
        a = scan.nextInt();
        System.out.println("Enter integer b");
        b = scan.nextInt();
        System.out.println("Enter integer c");
        c = scan.nextInt();

        // Computation
        x = -a/2;
        y = -b/2;
        radius = Math.sqrt(((Math.pow(a, 2) + Math.pow(b,2))/4)-c);
        area = Math.PI * radius;
        perimeter = 2 * Math.PI * radius;

        // Displaying output
        System.out.println("Center: E(" + x+ ", " + y + ")");

        DecimalFormat fmt = new DecimalFormat("#.###");
        System.out.println("Radius: " + radius);
        System.out.println("Area: " + fmt.format(area));
        System.out.println("Perimeter: " + fmt.format(perimeter));

    }
}
```