Midterm Examination 2
CS170: Introduction to Computer Science

Observe the Emory College Honor Code while taking this test.

Question 1. (20 pts)
For each question, circle the best answer.

1. Suppose a is of the type double [] and we have created an array for a. The following expression will return the length (number of elements) of array a:
   - length
   - length()
   - a.length
   - a.length()

2. Suppose a is of the type String and we have assigned a with a (unspecified) string (i.e.: a = "... "); The following expression will return the length (number of characters) of the string a:
   - length
   - length()
   - a.length
   - a.length()

3. A local variable is:
   - defined using the keyword static inside a class, outside every method
   - defined using the keyword static inside a method
   - defined without using the keyword static inside a class, outside every method
   - defined without using the keyword static inside a method

4. A class variable is:
   - defined using the keyword static inside a class, outside every method
   - defined using the keyword static inside a method
   - defined without using the keyword static inside a class, outside every method
   - defined without using the keyword static inside a method

5. A scope of local variable is:
   - from the start of the method to the end of the method
   - from the location of its definition to the end of the method.
• from the location of its definition to the end of the defining block
• from the location of its definition to the end of the statement

6. A lifetime of local variable is:
   • from the start of the method to the end of the method
   • from the location of its definition to the end of the method.
   • from the location of its definition to the end of the defining block
   • from the location of its definition to the end of the statement

7. Suppose a is a 2-dimensional rectangular shaped array of the type char[][] a. Then you can find the size of the first dimension of the array as:
   • a.length
   • a.length()
   • a[0].length
   • a[0].length()

8. Suppose a is a 2-dimensional rectangular shaped array of the type char[][] a. Then you can find the size of the second dimension of the array as:
   • a.length
   • a.length()
   • a[0].length
   • a[0].length()

9. Suppose a and b are variables of type char[]. The statement b = a will:
   • Make a copy of the array a into array b
   • Make the array elements in array b equal to the array elements in array a
   • Only copy the first the first array element in array a to array b
   • Make array b an alias of array a

10. When a parameter is passed by reference, the following information about the actual parameter is copied into the formal parameter variable:
    • The location of the actual parameter variable.
    • The content of the actual parameter variable.
    • The value of the actual parameter variable.
    • The type of the actual parameter variable.
Question 2. (10 pts)

You are given the Java program:

```java
public class Question2 {
    public static String a = "100";
    public static void main( String[] args ) {
        System.out.println( a ); // 1. 100
        int a = 789;
        System.out.println( a ); // 2. 789
    }
    System.out.println( a ); // 3. 100
    System.out.println( a ); // 4. 100
    boolean a = true;
    System.out.println( a ); // 5. true
}
```

For each of the `System.out.println` statement, state whether it will result in a compiler error message. If it does not result in an error message, then give the value that will be printed by the `System.out.println` statement.

1. Error / No error If no error: x = 100
2. Error / No error If no error: x = 789
3. Error / No error If no error: x = 100
4. Error / No error If no error: x = 100
5. Error / No error If no error: x = true
Question 3. (10 pts)

You are given the Java program:

```java
public class Question3 {

    public static int z;

    public static void f( int x )
    {
        x = x + 2;
        z = x;
    }

    public static void main( String[] args )
    {
        int x, z;
        x = 11;
        z = 44;
        Question3.f( x );
        System.out.println( "x = " + x );
        System.out.println( "z = " + z );
        System.out.println( "Question3.z = " + Question3.z );
    }
}
```

Questions:

- If the parameter `x` is passed by `value`, what will be printed by the program:

  \[
  \begin{align*}
  x &= 11 \quad \text{(unchanged)} \\
  z &= 44 \quad \text{(because `z` refers to the local variable `z = 44`) \\
  \text{Question3.z} &= 13 \quad \text{(because the class variable `z` was updated by `f`!)}
  \end{align*}
  \]

- If the parameter `x` could be passed by `reference`, what will be printed by the program:

  \[
  \begin{align*}
  x &= 13 \quad \text{(`x` would have been updated by `f`)} \\
  z &= 44 \quad \text{(`z` still refers to the local variable `z = 44`) \\
  \text{Question3.z} &= 13 \quad \text{(because the class variable `z` was updated by `f`!)}
  \end{align*}
  \]
Question 4 (10 pts)
You are given the Java program:

```java
public class Question4
{
    public static void f( int x )
    {
        x = 444;
    }

    public static void g( int[] x )
    {
        x[0] = 777;
    }

    public static void main( String[] args )
    {
        int[] a = { 1, 2, 3 };
        System.out.println( a[0] );  // 1. ===> 1
        f(a[0]);
        System.out.println( a[0] );  // 2. ===> 1 (a[0] is a double)
        // double is passed by value
        g(a);
        System.out.println( a[0] );  // 3. ===> 777 (array a was passed
to g, g can update array elem's)
    }
}
```

Questions:
What will be printed by the program at program locations:

1. a[0] = 1 (2 pts)
2. a[0] = 1 (4 pts)
3. a[0] = 777 (4 pts)
Question 5 (25 pts)

In mathematics, the dot product is an algebraic operation that takes two equal-length sequences of numbers (called vectors) and returns a single number obtained by multiplying corresponding entries and then summing those products.

Example:
\[
\begin{pmatrix} 2 \\ 4 \\ 3 \end{pmatrix} \cdot \begin{pmatrix} 3 \\ 2 \\ 5 \end{pmatrix} = 2 \times 3 + 4 \times 2 + 3 \times 5 = 6 + 8 + 15 = 29
\]

Define a class method named dotProduct inside the class Question5 below that receives 2 vectors (represented as arrays of double typed variables) and returns dot product of the vectors.

NOTE: Make sure the parameter(s) and return type of the dotProduct method corresponds to the sample usage given in the main() method.

```java
public class Question5 {
    /*  -----------------------------------------------
      Write the dotProduct() method here
      ----------------------------------------------- */
    public static double dotProduct( double[] a, double[] b )
    {
        double r = 0;
        for ( int i = 0; i < a.length; i++ )
            r = r + a[i]*b[i];
        return r;
    }

    /*  -----------------------------------------------
      The dotProduct() method is used as follows...
      ----------------------------------------------- */
    public static void main( String[] args )
    {
        double[] a = { 2, 4, 3 };        
double[] b = { 3, 2, 5 };        
double[] c = { 7, 4, 5, 8 };        
double[] d = { 1, 2, 1, 2 };        
double r;
        r = dotProduct( a, b ); // returns 2*3 + 4*2 + 3*5
        r = dotProduct( c, d ); // returns 7*1 + 4*2 + 5*1 + 8*2
    }
}
```
**Question 6 (25 pts)**

Define a class method named `numberOfA` inside the class `Question6` below that receives a number of strings passed as an array of `String` typed variable and returns number of character 'a' in all the strings.

**NOTE:** Make sure the parameter(s) and return type of the `numberOfA` method corresponds to the sample usage given in the `main()` method.

```java
public class Question6
{
   /* -------------------------------
       Write the numberOfA() method here
    ------------------------------- */
   public static int numberOfA( String[] s )
   {
      int r = 0;
      for ( int i = 0; i < s.length; i++ )
         for ( int j = 0; j < s[i].length(); j++ )
            if ( s[i].charAt(j) == 'a' )
               r++;

      return r;
   }

   /* -------------------------------
       The numberOfA() method is used as follows...
    ------------------------------- */
   public static void main( String[] args )
   {
      String[] a = { "abc", "aabb" };
      String[] b = { "xyz", "aax", "bad", "aap" };
      int r;

      r = numberOfA( a ); // returns 3
      r = numberOfA( b ); // returns 5
   }
}
```