NAME: _____

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:

```
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:

```
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:

```
x =  11           (unchanged)

z =  44           (because z refers to the local variable z = 44)

Question3.z = 13  (because the class variable z was updated by f !)
```

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

```
x =  13            (x would have been updated by f)

z =  44            (z still refers to the local variable z = 44)

Question3.z = 13   (because the class variable z was updated by f !)
```

Question 4 (10 pts)

You are given the Java program:

```
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:

$$\begin{pmatrix} 2 \\ 4 \\ 3 \end{pmatrix} . \begin{pmatrix} 3 \\ 2 \\ 5 \end{pmatrix} = 2 \times 3 + 4 \times 2 + 3 \times 5 = 6 + 8 + 15 = 29$$

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.

```
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.

```
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
   }
}
```