

MACS 261J
Final Exam
May 5, 2009

Name: _____

Question:	1	2	3	4	5	Total
Points:	20	15	35	5	25	100
Score:						

Question 1 (20 points)

What is printed by the following program fragments?

```
int i = 2 * 4 - 4 / 4;
int j = i/3;
int k = i%3;
System.out.println("i="+i+" j="+j+" k="+k);
```

```
for (i=0,j=1; j<10; ++i,j=j*2)
    System.out.println(i+","+j);
```

```
i=0; j=1; k=2;
while (i<3) {
    ++i;
    j = j - 1;
    k = k * 2;
}
System.out.println("i="+i+" j="+j+" k="+k);
```

```
for (i=0,j=9; i<j; ++i,--j)
    k = (i+j)/2;
System.out.println("i="+i+" j="+j+" k="+k);
```

Question 2 (15 points)

Identify and fix eight errors in the following program fragments.

```
float fsqrt2 = Math.sqrt(2.0);
double dsqrt3 = Math.sqrt(3.0);
float fratio = fsqrt2/dsqrt3;
double dratio = dsqrt3/fsqrt2;
```

```
double[] a = {1.1,2.2,3.3}
int n = a.length();
double avg = (a[1]+a[2]+a[3])/n;
System.out.println("average =",avg);
```

```
public class Util {
    public static final double 2PI = 2.0*Math.PI;
    public static void equals(float x, float y) {
        return x==y;
    }
}
```

Question 3..... (35 points)

Complete the following methods.

```
// Returns the smallest of the values a, b, and c.  
public static float min(float a, float b, float c) {
```

```
}
```

```
// Returns the largest of the values in the array a.  
public static float max(float[] a) {
```

```
}
```

```
// Returns a clipped copy of the array a. In the returned array,  
// any values in the array a less than 0 are replaced by 0, and  
// any values greater than 255 are replaced by 255.  
public static float[] clip(float[] a) {
```

```
}
```

(Question 3 continued.)

```
// Returns a 1D array containing all values in a specified 2D image.  
public static float[] packImage(float[][] image) {
```

```
}
```

```
// Reads an image from a binary file containing exactly w*h floats,  
// where w and h are the image width and height, respectively.  
// Returns a new 2D array float[h][w] that represents the image.  
// Throws a new RuntimeException if any IOException is thrown.  
public static float[][] readImage(String fileName, int w, int h) {
```

```
}
```

Question 4 (5 points)

- How many *bits* in a Java `byte`?
- How many bytes in a Java `int`?
- How many bytes in a Java `short`?
- How many bytes in a Java `float`?
- How many bytes in a Java `double`?

Question 5 (25 points)

Complete the classes and methods described below. Before completing the class `Minimizer`, please see the interface `Function` defined on the following page.

```
/**
 * Finds the value x that minimizes an arbitrary function y = f(x).
 */
public class Minimizer {

    /**
     * Constructs a function minimizer.
     * @param neval the number of different x values at which to
     * evaluate the function when searching for the minimizing x.
     */
    public Minimizer(int neval) {

    }

    /**
     * Finds a value x that minimizes the specified function y = f(x).
     * This method searches for the minimizing x by simply evaluating
     * the function for different x values in the interval [a,b].
     * @param a the lower bound on x; must be less than b.
     * @param b the upper bound on x; must be greater than a.
     * @param func the function y = f(x) to be minimized.
     * @return the x (not y) for which y = f(x) is minimized.
     */
    public double findMin(double a, double b, Function func) {

    }

    private          // number of function evaluations
}
```

(Question 5 continued.)

```
/**
 * A generic function  $y = f(x)$ .
 */
public interface Function {
    public double y(double x);
}

/**
 * A cosine function  $y = \cos(x)$ .
 */
public class Cosine implements Function {

}

/**
 * Tests the class Minimizer using a cosine function.
 * This class has only one main method that
 * (1) Constructs a cosine function.
 * (2) Constructs a minimizer that evaluates functions 1,000,000 times.
 * (3) Uses the minimizer to find  $x$  in  $[0, 2\pi]$  that minimizes  $\cos(x)$ .
 * (4) Prints both the  $x$  found and the correct minimizing  $x$ .
 */
public class MinimizerTest {

}
```

What fundamental principle (one word) of object-oriented programming enables the class `Minimizer` to be written without having to know what type of `Function` will be minimized?