PRINCETON UNIVERSITY

School of Engineering and Applied Science
Department of Computer Science

COURSE	***Computer Science : Programming with a Purpose***
LESSON	***Basic Programming Concepts***
INSTRUCTOR	***Ph.D Robert Sedgewick***

MODULE 01 - PROGRAMMING ASSIGNMENT

The purpose of this assignment is to introduce you to programming in Java and familiarize you with the mechanics of preparing and submitting assignment solutions.

1. ***Install our Java programming environment (recommended).***

   Install our novice-friendly Java programming environment on your computer by following these step-by-step instructions for Mac OS X, Windows, or Linux.

   As part of these instructions, you will write, compile, and execute the program HelloWorld.java.

```
~/Desktop/hello> javac HelloWorld.java

~/Desktop/hello> java HelloWorld
Hello, World
```

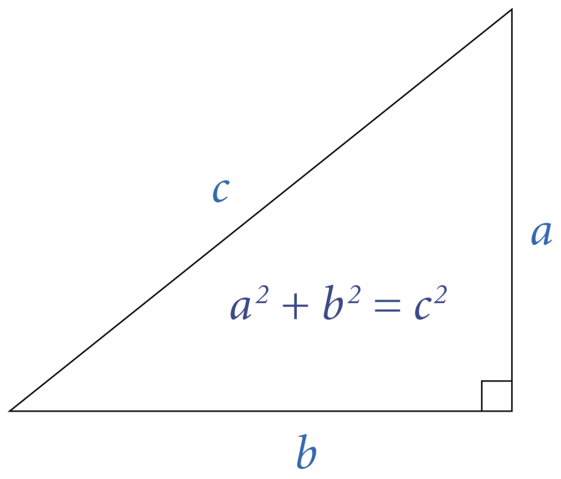
2. ***Strings and command-line arguments***

   Write a program HelloGoodbye.java that takes two names as command-line arguments and prints hello and goodbye messages as shown below (with the names for the hello message in the same order as the command-line arguments and with the names for the goodbye message in reverse order).

```
~/Desktop/hello> javac HelloGoodbye.java

~/Desktop/hello> java HelloGoodbye Kevin Bob
Hello Kevin and Bob.
Goodbye Bob and Kevin.

~/Desktop/hello> java HelloGoodbye Alejandra Bahati
Hello Alejandra and Bahati.
Goodbye Bahati and Alejandra.
```

3. *Integers and booleans.*

Write a program `RightTriangle` *that takes three* `int` *command-line arguments and determines whether they constitute the side lengths of some right triangle.*



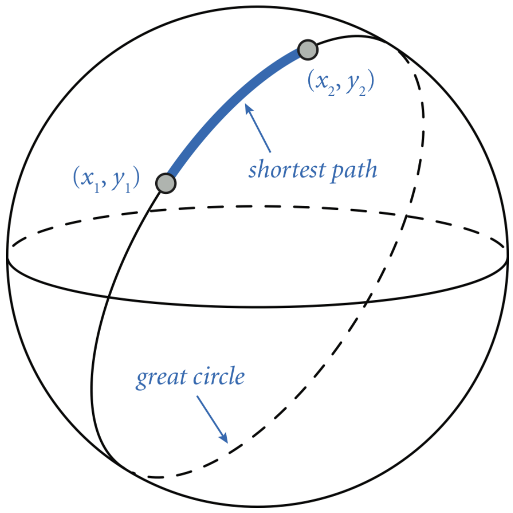
The following two conditions are necessary and sufficient:

- *Each integer must be positive.*
- *The sum of the squares of two of the integers must equal the square of the third integer.*

```
~/Desktop/hello> javac RightTriangle.java

~/Desktop/hello> java RightTriangle 3 4 5
true

~/Desktop/hello> java RightTriangle 13 12 5
true

~/Desktop/hello> java RightTriangle 1 2 3
false

~/Desktop/hello> java RightTriangle -3 4 -5
false
```

4. *Floating-point numbers and the Math library.*

The great-circle distance is the length of the shortest path between two points (x1,y1) and (x2,y2) on the surface of a sphere, where the path is constrained to be along the surface.



Write a program `GreatCircle.java` *that takes four* `double` *command-line arguments* x_1 , y_1 , x_2 and y_2 *—the latitude and longitude (in degrees) of two points on the surface of the earth—and prints the great-circle distance (in kilometers) between them. Use the following* ***Haversine formula***

$$distance = 2r \arcsin\left(\sqrt{\sin^2\left(\frac{x_2 - x_1}{2}\right) + \cos x_1 \cos x_2 \sin^2\left(\frac{y_2 - y_1}{2}\right)}\right)$$

where ***r=6,371.0*** *is the mean radius of the Earth (in kilometers).*

```
~/Desktop/hello> javac GreatCircle.java

~/Desktop/hello> java GreatCircle 40.35 74.65 48.87 -2.33    // Princeton to Paris
5902.927099258561 kilometers

~/Desktop/hello> java GreatCircle 60.0 15.0 120.0 105.0      // for debugging
4604.53989281927 kilometers
```

Hint: The command-line arguments are given in degrees but Java's trigonometric functions use radians. Use `Math.toRadians()` *to convert from degrees to radians.*

Although the Earth is not a perfect sphere, this formula is a good approximation to the true distance.

5. ***Type conversion.***

Several different formats are used to represent color. For example, the primary format for LCD displays, digital cameras, and web pages—known as the RGB format—specifies the level of red (R), green (G), and blue (B) on an integer scale from 0 to 255. The primary format for publishing books and magazines—known as the CMYK format—specifies the level of cyan (C), magenta (M), yellow (Y), and black (K) on a real scale from 0.0 to 1.0.

Write a program `CMYKtoRGB.java` *that converts from CMYK format to RGB format using these mathematical formulas:*

$$\begin{aligned} white &= 1 - black \\ red &= 255 \times white \times (1 - cyan) \\ green &= 255 \times white \times (1 - magenta) \\ blue &= 255 \times white \times (1 - yellow) \end{aligned}$$

Your program must take four `double` *command-line arguments* `cyan`, `magenta`, `yellow`, *and* `black`*; compute the corresponding RGB values, each rounded to the nearest integer; and print the RGB values, as in the following sample executions:*

```
~/Desktop/hello> javac CMYKtoRGB.java

~/Desktop/hello> java CMYKtoRGB 0.0 1.0 0.0 0.0    // magenta
red   = 255
green = 0
blue  = 255

~/Desktop/hello> java CMYKtoRGB 0.0 0.4392156862745098 1.0 0.0    // Princeton orange
red   = 255
green = 143
blue  = 0
```