ComS 207: Programming I
Homework 3
Out: Wed. Sep 5, 2007
Due: Fri. Sep 14, 2007 (WebCT submission; due @ 8pm)

Student Name:

Recitation Section:

1. **Review Questions**

   (a) What is the role of the new operator.

   (b) Why don't we have to import the Math class before we can use it in any java program?

   (c) What is an alias?

   (d) In the context of Java, what is garbage collection?

   (d) What is a reference variable?

(e) What is a class?

(f) What is an object?

(g) What it the difference between a class and an object?

2. **Random Numbers**

(a) Assuming that a Random object has been created called generator, what is the range of the result of each of the following expressions? [Same as Exercise 3.6 in the textbook.]

   - i.   generator.nextInt(20)

   - ii. generator.nextInt(8)+1

   - iii. generator.nextInt(45) +10

   - iv. generator.nextInt(100) -50

(b) Write code to declare and instantiate an object of the Random class (call the object reference variable rand). Then write a list of expressions using the nextInt method that generates random numbers in the following specified ranges, including the endpoints. Use the version of the nextInt method that accepts a single integer parameter. [Same as Exercise 3.7 in the textbook.]

- i.   0 to 10

- ii.   0 to 500

- iii. 1 to 10

- iv.   1 to 500

- v.   25 to 50

- vi.   -10 to 15

(c) This is the same as (b) but with floating point numbers. The upper boundary in not inclusive in this case however.

- i.   0.0 to 1.0

- ii.   2.5 to 3.5

- iii. 1.2 to 1.4

- iv.   -100.0 to +100.0

3. **Snippets of Code**

For all questions below write a single java statement that produces the desired result.

(a) Prints the absolute value of the variable total.

(b) Computes the square root of the sum of num1 and num2 and assignes the result to num3.

(c) Creates the Integer object myInt and gives it an initial value of 150.

(d) Creates a DecimalFormat object that can later be used to round numbers up to 5 decimal places.

(e) Given the double variable num, prints out the smallest whole number that is greater than or equal to num.

(f) Given the string variable myString, prints the same string but changes all small 'a' letters to large 'A' letters.

4. **Programming Projects**

Choose ***three of the following five*** programming projects and implement them. Your grade will NOT depend on which ones you choose. Just puck the ones that you like.

(a) Gas Mileage

Write a program that will compute the gas mileage (i.e., fuel efficiency) for an automobile. The user will have to input four values:

    1. The initial odometer reading (in miles)
    2. The final odometer reading (in miles)
    3. The amount of gas used (in gallons).
    4. The cost per gallon of gas (in dollars).

The program will then compute and print out the following four output values:

    1. The total miles driven.
    2. The fuel efficiency in miles/gallon
    3. The fuel efficiency in kilometers/liter
    4. The amount spent per mile driven (in dollars)

Format your output such that all miles are rounded up to 1 digit after the decimal point, all dollar amounts are rounded up to two digits after the decimal point, and all other numbers are rounded up to 3 digits after the decimal point. Here are some constants that you need: there are 1.609344 kilometers per mile and 3.7854118 liters per gallon.

SAMPLE EXECUTION:

```
Enter the initial odometer reading: 105820
Enter the final odometer reading: 106103
Enter the amount of gas used (in gallons): 14.347
Enter the price of gas per gallon: 2.999

You spent $2.99 per gal on 14.347 gals of gas from mileage 105820 to 106103
You traveled 283.0 miles
Your fuel efficiency is 19.725 miles/gallon
Your fuel efficiency is 8.386 kilometers/liter
You spent $0.15 per mile driven
```

(b) Triangles

Write an application that reads three pairs of floating point numbers which represent the x and y coordinates of three points: $P_1 = (x_1, y_1)$, $P_2 = (x_2, y_2)$, $P_3 = (x_3, y_3)$. The program must then calculate the area of the triangle that is formed by these three points using Heron's formula:

$$Area = \sqrt{s(s-a)(s-b)(s-c)}$$

where s represents half of the perimeter of the triangle, and a, b, and c represent the lengths of the three sides. The program must print the area to three decimal places.

[Similar to Programming Project 3.6 in the textbook.]

(c) Cash Register

Write a java program that calculates the amount of change that must be returned to a customer at a grocery store. The program must ask the user to type in the price of the purchased product and the amount of money that the customer paid. The program must then calculate and print out how many 20-dollar bills, 10-dollar bills, 5-dollar bills, and 1-dollar bills must be returned to the customer.

Hint: For this program you can assume that all product prices are integers in the range [1,100]. You can also assume that this grocery store accepts only paper bills and no coins.

(d) Random Phone Numbers

Write an application that creates and prints a random phone number of the form xxx-xxx-xxxx. Include the dashes in the output. Do not let the first three digits contain an 8 or a 9 (but don't be more restrictive than that), and make sure that the second set of three digits is not greater than 742.

[Same as Programming Project 3.3 in the textbook.]

(e) Date Translation

Write a program that translates a date from the American format to the standard format. For example, suppose that the user entered: "January 25, 2006". Your program must perform string manipulations on that input and then print out "2006-JAN-25". In other words, it must print the year, followed by the capitalized three letter abbreviation for the month, followed by the day, separated with '-'.

Hint: Use the methods of the String class to find the positions of the separators in the original string. Then chop that string into three separate pieces and print them in the desired order and format.

5. *** For Advanced (or Bored) Students Only!**

Write a Java applet that plots the graph of the function $y = \frac{1}{2}x - 1$, where x is in the interval [0,4]. Draw the X and Y axes as well (drawing arrows on each axis is optional). The size of your applet window must be 200×200, and your drawing must be scaled to fill most of that space. In other words, don't draw the graph at a 1:1 scale which will be hard to see.

Note: We have not covered applets yet but if you are an advanced student your should be able to learn how to use them on your own. Read sections 2.7 - 2.9 of the textbook. You only need to know how to draw lines in applets for this problem.

6. **What to Submit**

For parts 1, 2, and 3 write your answers in a text file and upload it on WebCT.

For part 4 (and 5 if you chose to do it) submit your code electronically using WebCT. The procedure will be explained during the recitation sessions.

IMPORTANT: Once again, no late homeworks will be accepted.

That's it. Good Luck!