CS161: Introduction to Computer Science
Homework Assignment 3
due 9/13 by 11:59pm

The purpose of this homework assignment is to give you practice writing and calling methods.

Warm-Up

Create a Java class named `WarmUp` and inside complete the following questions:

- Write a method that takes in three integers and returns their average.

- Write a method that takes in a person's speed (in miles per hour) and the distance to travel (in miles) and returns the time required for the trip.

- Write a method that takes in a person's name, age, and pet's name and prints the following paragraph:

  > Hello, my name is `name` and I am `age` years old.
  > I'm enjoying my time at Puget Sound, though
  > I miss my pet `pet's name` very much!

Call each method inside of `main()`. Add print statements so that when I run your code it is clear what method is being called, what input arguments (if any) are being passed in, and what value (if any) was returned.

Pseudo-Random Numbers

Generating random numbers has many applications – e.g., board games, video games, encrypting information, selecting jurors, scientific simulations, etc.

In reality, it is quite difficult to generate a sequence of numbers that is truly random. For many applications, however, it suffices to instead generate *pseudo-random numbers* – that is, a sequence of numbers that appears random.

One of the simplest methods for computing a sequence of pseudo-random numbers uses the following iterative equation:

$$r_i = \left(a \cdot r_{i-1} + c\right) \% m$$

where a, c, and m are all integers chosen by the user. This equation says that to generate the ith random number in the sequence (denoted r_i), you must take the $(i-1)$st random number (denoted r_{i-1}) and multiply it by a, then add on c, and then mod by m. The result will be an integer between 0 and $m - 1$.

This equation requires us to start with some initial number which we will denote as r_0. This value is often called the "seed" because it seeds the entire process. If we start with a seed of 1 and $a = 5$, $c = 2$, and $m = 4$ then the first number in the sequence is given by:

$$\begin{aligned} r_1 &= (5 \cdot 1 + 2) \% 4 \\ &= 7 \% 4 \\ &= 3 \end{aligned}$$

The next number in the sequence is then:

$$r_2 = (5 \cdot 3 + 2) \% 4$$
$$= 17 \% 4$$
$$= 1$$

so on and so forth.

Implementing the `Random` Class

Create a Java class named `Random` and inside write the following methods:

- A method called `generateRandom()` that takes in r_{i-1}, a, c, and m and uses the above equation to generate and return a single random number

- A method called `printSequence()` that takes in the r_0, a, c, and m and uses these values to generate and **print to the screen** 10 random numbers. This method should call the `generateRandom()` method.

- Finally, in the `main()` method find a setting of the integers r_0, a, c, and m that

  - Produces the same number again and again – e.g., it might produce the sequence $\{1, 1, 1, 1, \ldots\}$
  - Produces a sequence of numbers that repeats – e.g., for some settings of the variables the equation above will cycle through the same 3 or 4 numbers
  - Produces at least 10 unique numbers

  You should call the method `printSequence()` to print each of these sequences to the screen.

The last page shows an example of what my program prints to the screen. (Note: you must find a different setting of the integers r_0, a, c, and m than the ones I used in my example!)

Style Guide

Before you submit your assignment, double check the following:

- You have a Javadoc comment at the top of the class with a brief description (written in full English sentences), you and your partner's name, and the date.

- All variable names are lower cased (remember, only classes are capitalized in Java)

- Use inline comments (`//`) to explain any complicated code

Submitting your assignment

Please make sure to rename your folder <u>before</u> zipping. You should rename your folder using both of your first and last names. For example, `hw3_Jane_Doe_John_Doe`.

Submit your zipped folder via Canvas.

```
●●●                    BlueJ: Terminal Window - hw3_methods

seed = 1, a = 5, c = 3, m = 7
A sequence of the same number:
1
1
1
1
1
1
1
1
1

seed = 1, a = 5, c = 2, m = 4
A sequence that repeats:
3
1
3
1
3
1
3
1
3

seed = 1, a = 5, c = 0, m = 1024
A sequence of 10 unique numbers:
5
25
125
625
53
265
301
481
357
```