Introduction to Java Section I
CS9053
Thursday 6:00 PM – 8:30 PM
Prof. Dean Christakos
Feb. 1st, 2024
Due: Feb. 8th, 2024 11:59 PM

Assignment 2

Part I - Loops

1. The reciprocals of the squares converge to $\frac{\pi^2}{6}$:

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

   Figure out how many iterations of n it takes for the sum to estimate π to within .0001.

   You should print out something like this:

   `Pi is estimated as <x> after <y> iterations`

   where `<x>` is the estimation of π to within .0001

Part II: Arrays

1. Matrix multiplication with arrays:

   What you're going to do is input the dimensions of a two dimensional array of doubles (a matrix), create another matrix with compatible dimensions, create random values within the matrices, and multiply them together.

   Two dimensional arrays are straightforward. To declare a matrix with 4 rows and five columns, write:

```
double[][] matrix = new double[4][5];
```

   This is an array which contains 4 arrays of length 5. That is, it has 4 rows and 5 columns. All values are zero:

```
[0.0, 0.0, 0.0, 0.0, 0.0]
[0.0, 0.0, 0.0, 0.0, 0.0]
[0.0, 0.0, 0.0, 0.0, 0.0]
[0.0, 0.0, 0.0, 0.0, 0.0]
```

Two matrices are compatible for multiplication if the number of columns in the first equals the number of rows in the second. So if we have a matrix M1 with 4 rows and 5 columns, it is a 4x5 matrix, and can be multiplied with M2 if M2 has 5 rows and any number of columns. Is M2 is a 5xN matrix, then the result matrix will be 5xN;

For this assignment, if M1 is NxM, then M2 will be MxN, creating an MxN result matrix M3.

The contents of M1 and M2 will be randomly generated doubles from 0 to less than 10.

Remember that the method `Math.random()` generates a random number from 0 to less than 1.0.

In a readable format, print out M1, M2, and the result M3.

Part III: Strings

1. For a given a string(str), find and return the highest occurring character.

   Example:
   Input String: “abcdeapapqarr”
   Expected Output: “a”

   Since ”a” has appeared four times in the string which happens to be the highest frequency character, the answer would be “a”.

   If there are two characters in the input string with the same frequency, return the character which comes first in the String.

   Assumption:

   Assume all the characters in the given string to be in lowercase.

   I have included a method `randomStringGenerator` so you can create arbitrary strings to test out your `charFrequency` method.

2. Take an arbitrary string of words. Take the example: “The quick brown fox jumps over the lazy dog”

Create a new String that is reverse the word ordering of the original string, while retaining the case ordering. Thus, the example string would be:

“Dog lazy the over jumps fox brown quick the”

You can use any String methods you like. (see https://docs.oracle.com/javase/8/docs/api/java/lang/String.html for full documentation). **Don’t worry about the existence of punctuation. Just assume there is no punctuation.**

Hint: The split and join methods you may find useful and will want to consider using.

Rule: a sentence starts with an upper case letter always, even when reversed, but a word elsewhere in a sentence should maintain its capitalization. (That means that the first word in the original sentence will lose its capitalization when moved to the end, even if it’s a proper noun, but that’s ok)