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INFO 6205

Program Structures & Algorithms

Fall 2021

Assignment 1

This assignment will begin to build your algorithmic skills. It will also give you some experience with random number generation in Java.

An important example of a practical experiment is called the "random walk" experiment.

Imagine a drunken man who, starting out leaning against a lamp post in the middle of an open space, takes a series of steps of the same length: 1 meter. The direction of these steps is randomly chosen from North, South, East or West. **After n steps, how far (d), generally speaking, is the man from the lamp post?** Note that d is the Euclidean distance of the man from the lamp-post.

It turns out that there is a relationship between d and n which is typically applicable to many different types of stochastic (randomized) experiments. Your task is to implement the code for the experiment and, most importantly, to **deduce the relationship**.

Please clone/pull from the class repository and work on RandomWalk.java andRandomWalkTest.java each of package randomwalk and each under the appropriate source directory. [You may have to remove other java files from the classpath in order to allow the whole project to compile. In IntelliJ/IDEA you can do this for entire packages by right-clicking and choosing "Mark Directory As... Excluded"]. Once you have all the unit tests running, you can do the experiment by running RandomWalk as a main program (provide the value of n as the first argument).

For this particular assignment, it is **necessary but not sufficient** to ensure that the unit tests all run. You must demonstrate via image files, graphs, whatever, what experiments you made in order to come up with the required expression. You will run the experiment for at least six values of n and will run each of these at least ten times. That's to say, you will run the program at least 60 separate times. Feel free to change the main program so that it will run all your experiments in one shot instead of 60 different runs.

Your submission should include:

1. Your **conclusion** about the relationship between dandn;
2. Your **evidence** to support that relationship (screen shot and/or graph and/or spreadsheet);
3. Your **code** (RandomWalk.java plus anything else that you changed or created);
4. A **screen shot** of the unit tests all passing.

**1. Your conclusion about the relationship between *d*and*n***

*Deducing Relationship between d (distance) and n (steps):*

From the equation:

d=sqrt(dx^2+dy^2) ---------------------------------------------------------------------------------- (1)  
We know that dx=(x2-x1) and dy=(y2-y1)  
We also know that we have 4 directions (North (+1,0) , East (0,+1), South(-1,0), West(0,-1)  
Each step corresponds to one of above directions.   
Hence, we can conclude that x ∝ n and y ∝ n => x=(k1) n and y=(k2) n where k1 and k2 are integral constants which can be positive, negative or a Zero.  
Substituting the above conclusion in equation (1):

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So, it is reasonable to conclude that d ∝ sqrt(n)­

**2. Your evidence to support that relationship**

*A graph is plotted with n (Steps) in x axis and d (Distance) in y axis which turns out to be a sqrt(n) curve.*

*Values for the various n values which is calculated over 30 experiments:*

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*Running each of above experiments 10 times which amounts to 60 times*

**Table

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**Table

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*The Graph:*

**Chart, line chart

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**3.Your code**

**A picture containing graphical user interface

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**4. A**screen shot**of the unit tests all passing.**

Graphical user interface, text, application, email

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