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Program Structures & Algorithms

Fall 2021

Assignment No. 1

- **Task :**

  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**.

  - Conclusion about the relationship between d and n
  - Evidence to support that relationship
  - Code
  - Screenshot of unit tests

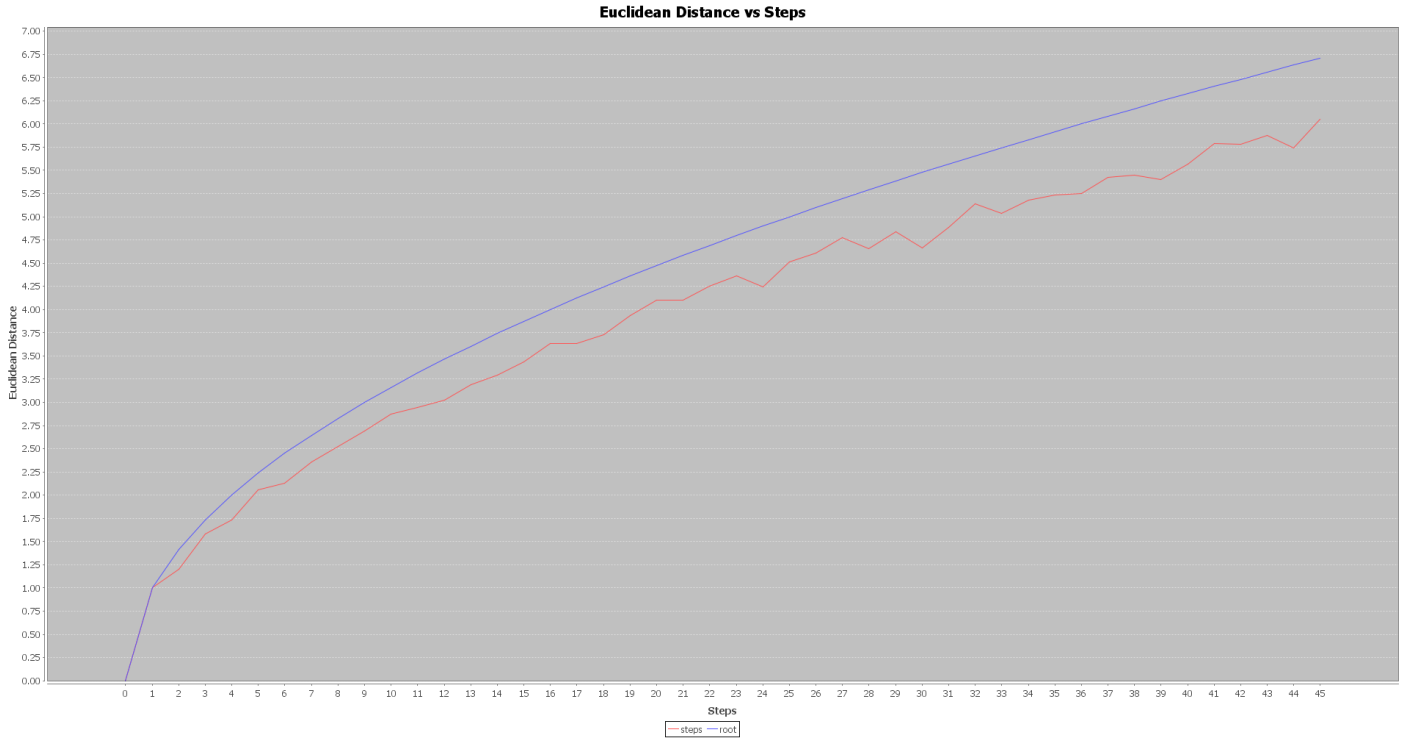
- **Relationship Conclusion:**

  - $\boldsymbol{d \approx \sqrt{n}}$

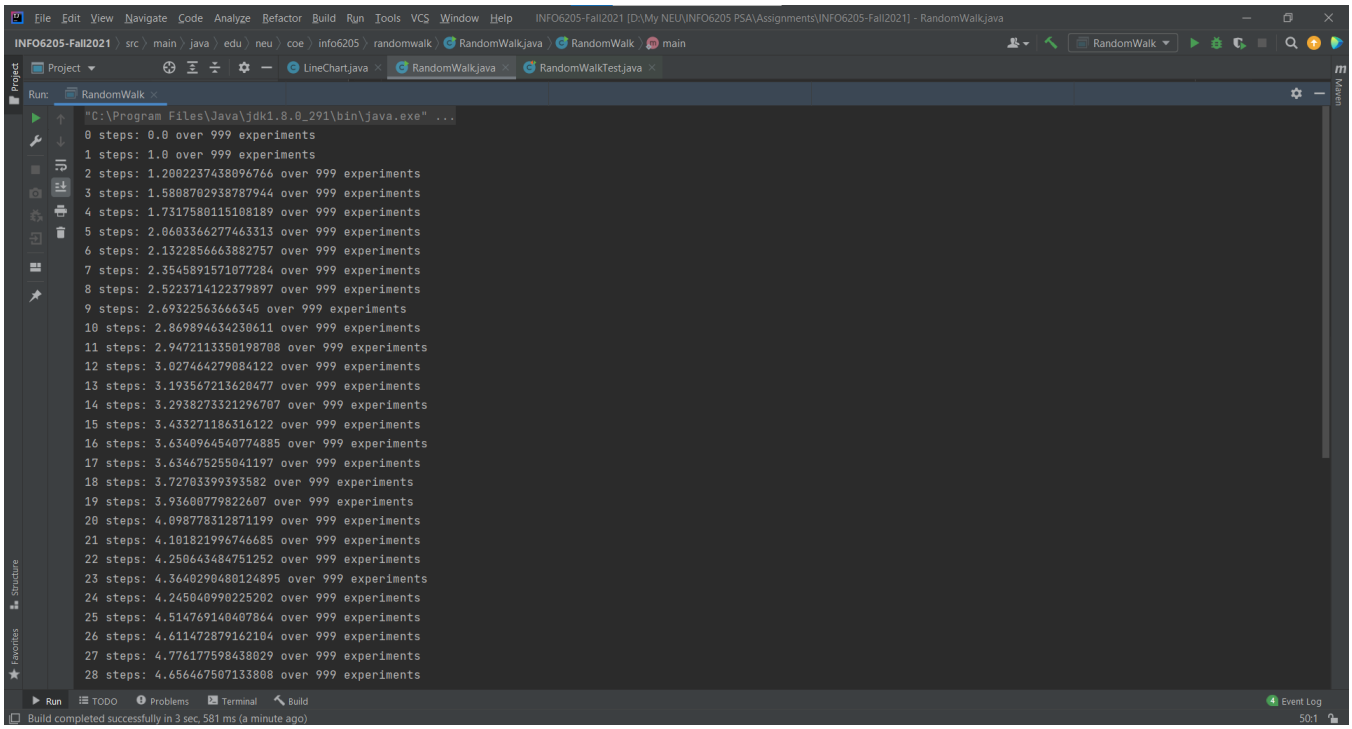
    d = Euclidean Distance

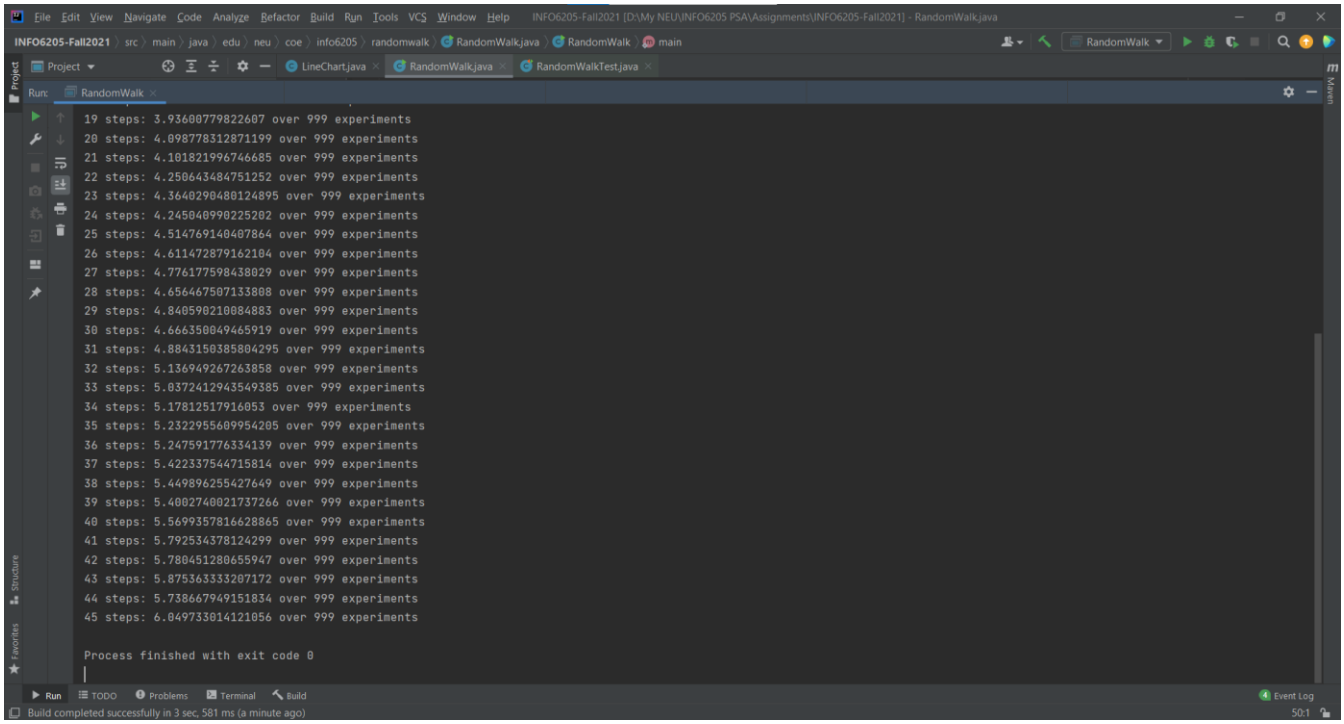
    n = Number of Steps

⊙ Evidence to support the conclusion:



1. Output (Snapshot of Code output in the terminal):



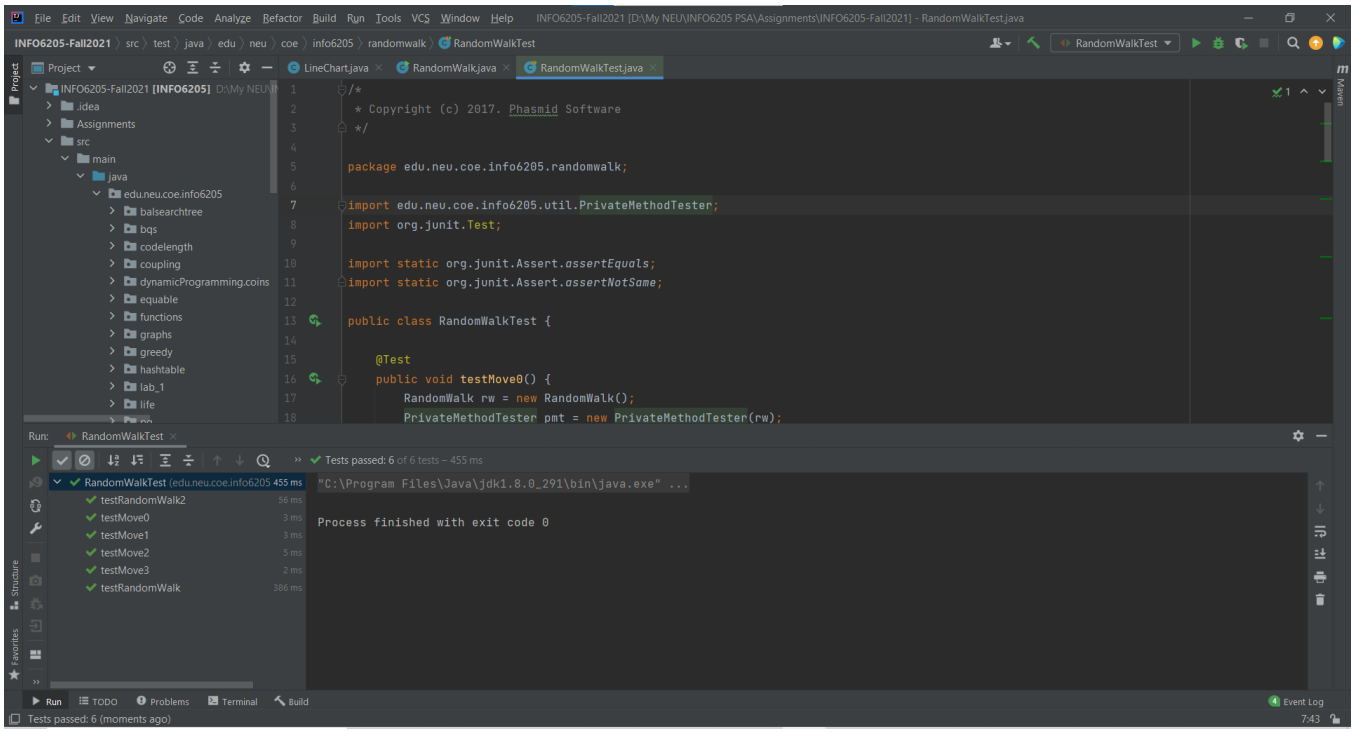


2. **Graphical Representation(Observations from experiments should be tabulated and analyzed by plotting graphs(usually in excel) to arrive on the relationship conclusion)**

    - I've plotted graph using JFreeChart framework, I did not use excel separately to store my *n* and *d* values, instead I computed and analyzed the relationship in the java program itself. There was a lot errors in the distance, and I was able to conclude that it is somewhere near root(n).

	A	B	C	D
1	**Steps**	**Mean Distance**	**d=sqrt(n)**	**No of Experiments**
2	0	0	0	999
3	1	1	1	999
4	2	1.238428471	1.4142136	999
5	3	1.58586213	1.7320508	999
6	4	1.760367958	2	999
7	5	2.002321351	2.236068	999
8	6	2.139422831	2.4494897	999
9	7	2.357786963	2.6457513	999
10	8	2.476075714	2.8284271	999
11	9	2.692375736	3	999
12	10	2.743769507	3.1622777	999
13	11	2.94266497	3.3166248	999
14	12	3.129744959	3.4641016	999
15	13	3.188978833	3.6055513	999
16	14	3.341791599	3.7416574	999
17	15	3.514766974	3.8729833	999
18	16	3.631529894	4	999
19	17	3.673500572	4.1231056	999
20	18	3.831038323	4.2426407	999
21	19	3.891384571	4.3588989	999
22	20	4.041374358	4.472136	999
23	21	4.002332021	4.5825757	999
24	22	4.245532248	4.6904158	999
25	23	4.254422083	4.7958315	999
26	24	4.39034724	4.8989795	999
27	25	4.351062462	5	999
28	26	4.468504437	5.0990195	999
29	27	4.584308435	5.1961524	999
30	28	4.775706424	5.2915026	999
31	29	4.738802396	5.3851648	999
32	30	4.851732966	5.4772256	999
33	31	4.925415141	5.5677644	999
34	32	5.06407529	5.6568542	999
35	33	5.215494412	5.7445626	999
36	34	5.155422905	5.8309519	999
37	35	5.186627991	5.9160798	999
38	36	5.251515166	6	999
39	37	5.331112444	6.0827625	999
40	38	5.366775088	6.164414	999
41	39	5.472002862	6.244998	999
42	40	5.64863556	6.3245553	999
43	41	5.721377047	6.4031242	999
44	42	5.781758567	6.4807407	999
45	43	5.812175234	6.5574385	999
46	44	5.804526995	6.6332496	999
47	45	5.695023254	6.7082039	999

- **Unit tests result:(Snapshot of successful unit test run)**


File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
INFO6205-Fall2021 [D:\My NEU\INFO6205 PSA\Assignments\INFO6205-Fall2021] - RandomWalkTest.java
INFO6205-Fall2021 › src › test › java › edu › neu › coe › info6205 › randomwalk › RandomWalkTest
RandomWalkTest
Project
INFO6205-Fall2021 [INFO6205] D:\My NEU\I
.idea
Assignments
src
main
java
edu.neu.coe.info6205
balsearchtree
bqs
codelength
coupling
dynamicProgramming.coins
equable
functions
graphs
greedy
hashtable
lab_1
life
LineChart.java
RandomWalk.java
RandomWalkTest.java
/*
* Copyright (c) 2017. Phasmid Software
*/
package edu.neu.coe.info6205.randomwalk;
import edu.neu.coe.info6205.util.PrivateMethodTester;
import org.junit.Test;
import static org.junit.Assert.assertEquals;
import static org.junit.Assert.assertNotSame;
public class RandomWalkTest {
@Test
public void testMove0() {
RandomWalk rw = new RandomWalk();
PrivateMethodTester pmt = new PrivateMethodTester(rw);
Run: RandomWalkTest
Tests passed: 6 of 6 tests – 455 ms
RandomWalkTest (edu.neu.coe.info6205 455 ms
testRandomWalk2 56 ms
testMove0 3 ms
testMove1 3 ms
testMove2 5 ms
testMove3 2 ms
testRandomWalk 386 ms
"C:\Program Files\Java\jdk1.8.0_291\bin\java.exe" ...
Process finished with exit code 0
Run
TODO
Problems
Terminal
Build
Event Log
Tests passed: 6 (moments ago)
7:43