

Sutiksh Verma (002122052)

Program Structure and Algorithms

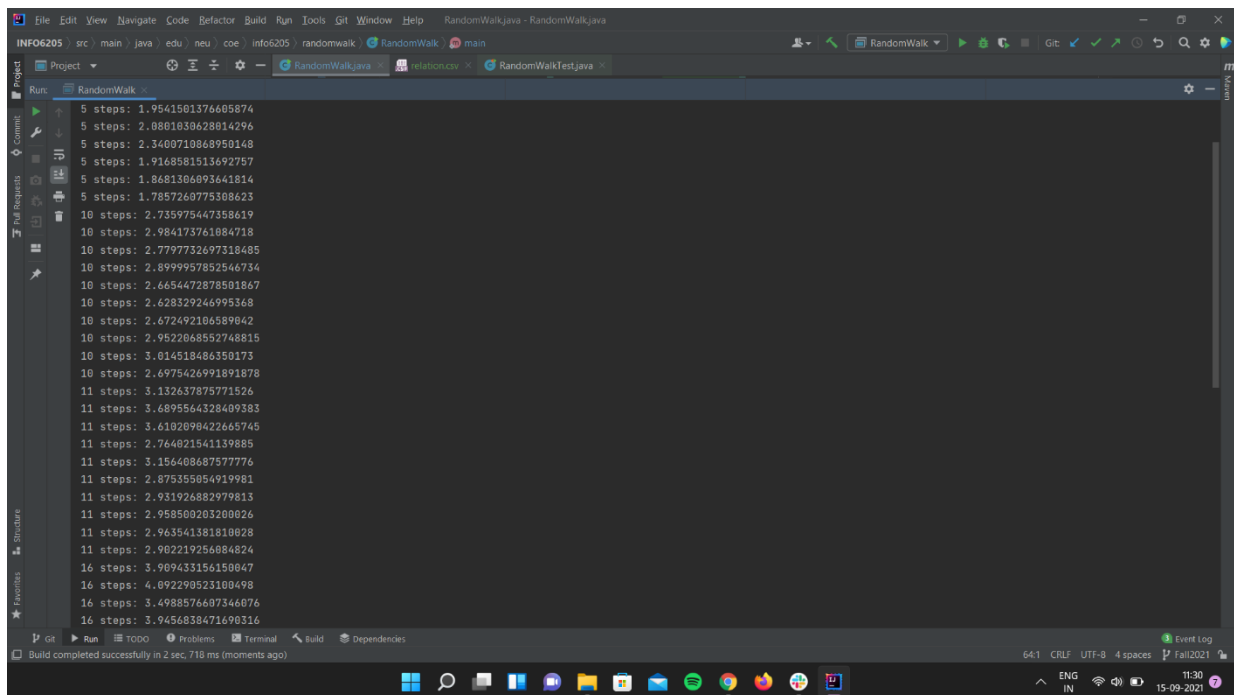
Assignment No. 1

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?**

Output:

Below is the output received from n number of steps with 6 different values ran 10 times each to prove the relationship:



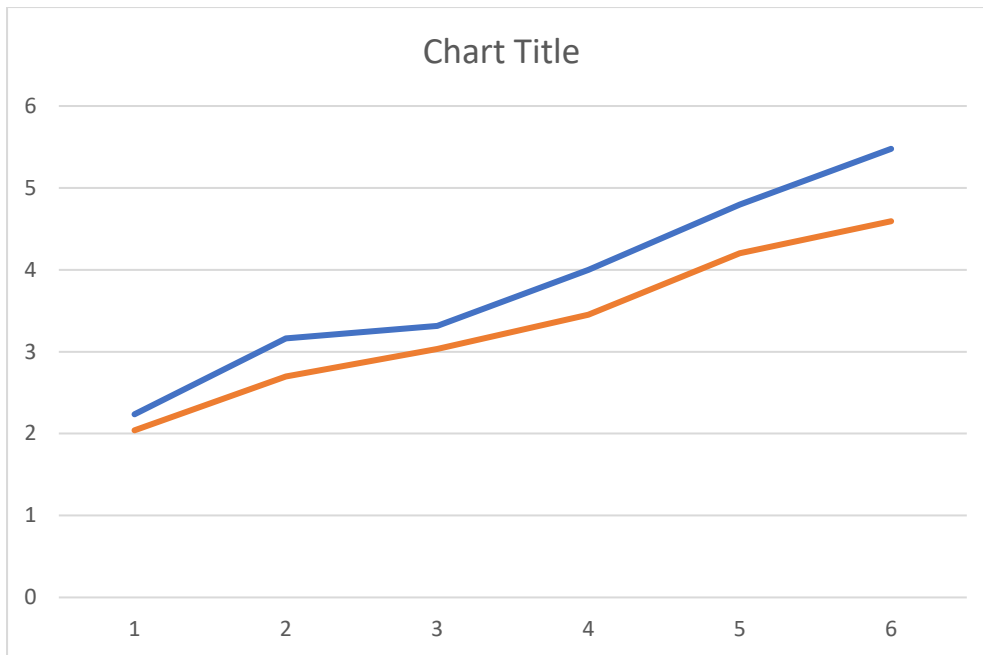
```
5 steps: 1.9541501376605074
5 steps: 2.0801030628014296
5 steps: 2.3400710868950148
5 steps: 1.9168581513692757
5 steps: 1.8681306093641814
5 steps: 1.7857260775308623
10 steps: 2.735975447350619
10 steps: 2.984173761084718
10 steps: 2.7797732697318485
10 steps: 2.8999957852546734
10 steps: 2.6654472870501867
10 steps: 2.628329246995368
10 steps: 2.672492106589042
10 steps: 2.9522068552748815
10 steps: 3.014518486350173
10 steps: 2.6975426991891878
11 steps: 3.132637875771526
11 steps: 3.6095564328409383
11 steps: 3.6102090422665745
11 steps: 2.764021541139885
11 steps: 3.156408687577776
11 steps: 2.875355054919981
11 steps: 2.931926882979813
11 steps: 2.958500203200026
11 steps: 2.963541381810028
11 steps: 2.902219256084824
16 steps: 3.909433156150047
16 steps: 4.092290523100498
16 steps: 3.4988576607346076
16 steps: 3.9456830471690316
```

```
INFO6205 src / main / java edu / neu / coe / info6205 / randomwalk / RandomWalk main
Project
Run: RandomWalk
16 steps: 3.9456838471690316
16 steps: 4.286621709412496
16 steps: 3.74873349678038
16 steps: 3.6180706712670188
16 steps: 3.2685166976111173
16 steps: 3.6183265969647476
16 steps: 2.677336094397485
23 steps: 4.93416639896787
23 steps: 3.7783563887201833
23 steps: 4.30108493868627
23 steps: 3.8733126739763435
23 steps: 4.650252673704695
23 steps: 3.9575076099438173
23 steps: 4.443233930857683
23 steps: 4.483732335031155
23 steps: 5.025365184885475
23 steps: 5.07110016449083
30 steps: 4.614205674452484
30 steps: 4.811774784381709
30 steps: 4.9896638762975885
30 steps: 5.516220497683764
30 steps: 4.9632911483009545
30 steps: 5.442453262515369
30 steps: 4.704053230521731
30 steps: 5.028323869536025
30 steps: 5.5671438236614765
30 steps: 4.83666251676196
Process finished with exit code 0
Build completed successfully in 2 sec, 718 ms (a minute ago)
```

Relationship Conclusion: to conclude, the results of the experiments show that the Euclidean distance between the last position and the first position of a drunken man moving is approximately equal to the square root of the number of steps taken or in other words, the root mean square of the distance d , between the two points should be approximately root of the number of steps i.e. \sqrt{N} . So $D = \sqrt{N}$.

Evidence: I have attached a chart and a table showing the data of the different output observed for the different set of inputs of N . As a result, we can see proportionate increase in the distance covered. Hence supporting our observation that D is the root mean square of N .

Number Of Steps	Expected Distance	Mean of Actual Distance	Error(%)
5	2.236067	2.040362	8.7522
10	3.162277	2.697317	14.7033
11	3.316624	3.033947	8.52303
16	4.000000	3.453777	13.6556
23	4.795831	4.204211	12.3361
30	5.477225	4.593267	16.1388

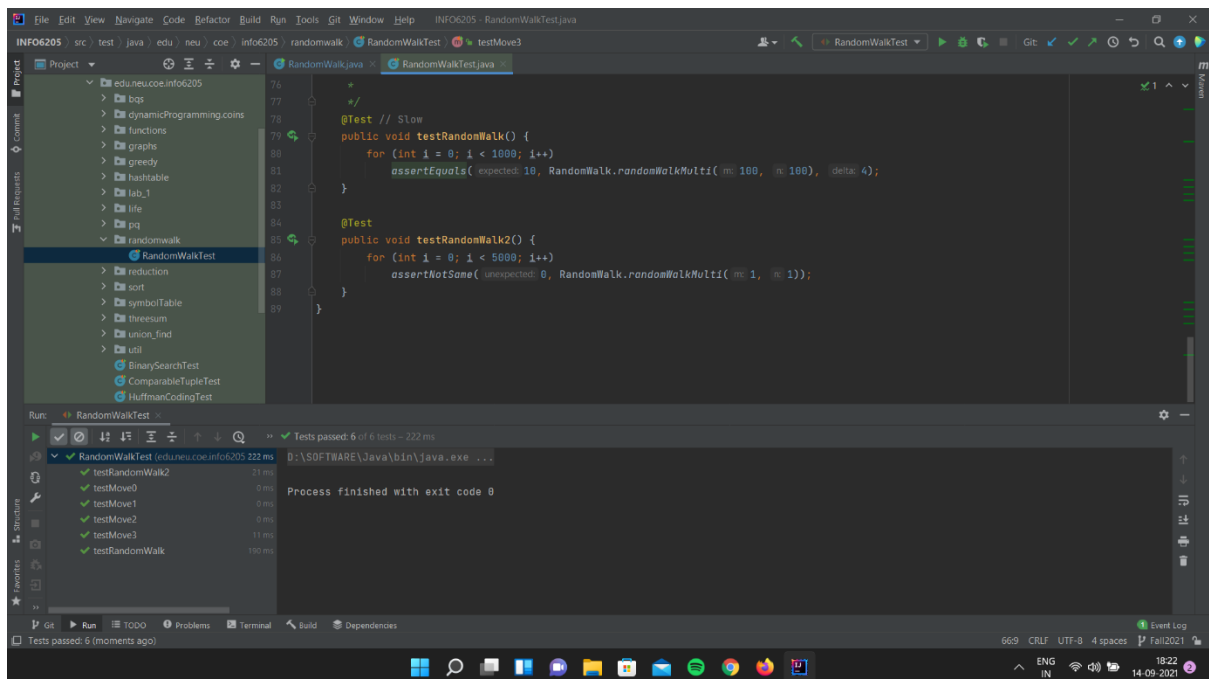


The Blue Line is the expected distance

The Orange Line is the actual distance

Passed Unit Test Cases:

All my test cases got accepted. Here is a screenshot of the passed test cases.



References I took:

Euclidean Distance:

1) https://en.wikipedia.org/wiki/Euclidean_distance

Random Walk

1) <https://www.youtube.com/watch?v=stgYW6M5o4k>

2) <https://www.youtube.com/watch?v=BfS2H1y6tzQ>

Files:

1) **Relation.csv**

2) **Observation.csv**