Program Structures & Algorithms

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Assignment – 1

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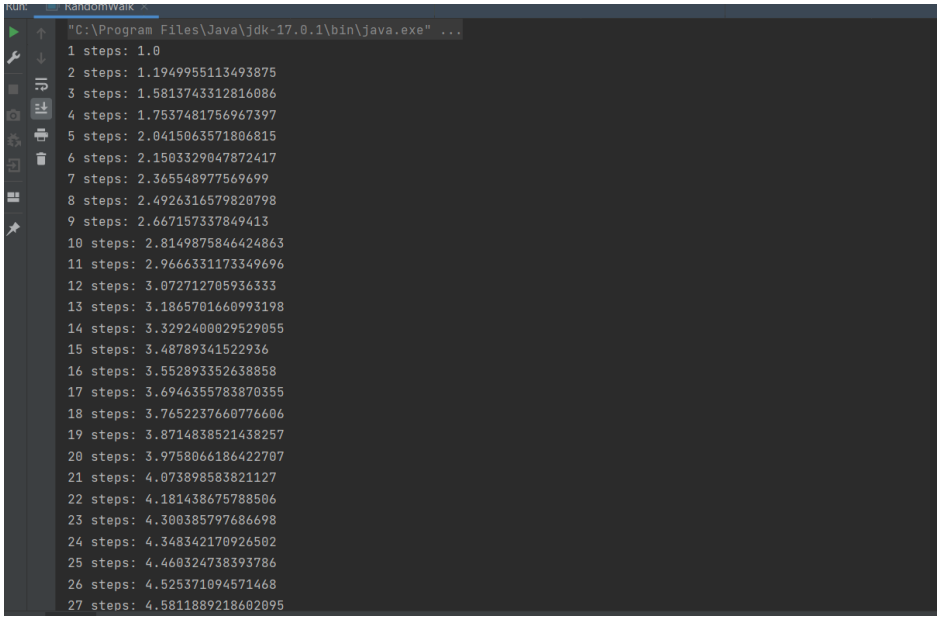
Task –

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.

Output –

To conclude the statement that if the relationship exists between d and n, I executed the code for a range of (1 to 40) with each step being repeated for 1000 experiments. After that, I averaged the value for each step. Since the program was executed a total of 40*1000 times i.e. 40000 times, we can use this analysis to establish the relationship between d and n.



Relationship Conclusion –

We can conclude the following relationship –

$$Average\ Euclidean\ Distance \propto \sqrt{Number}\ of\ Steps$$

or

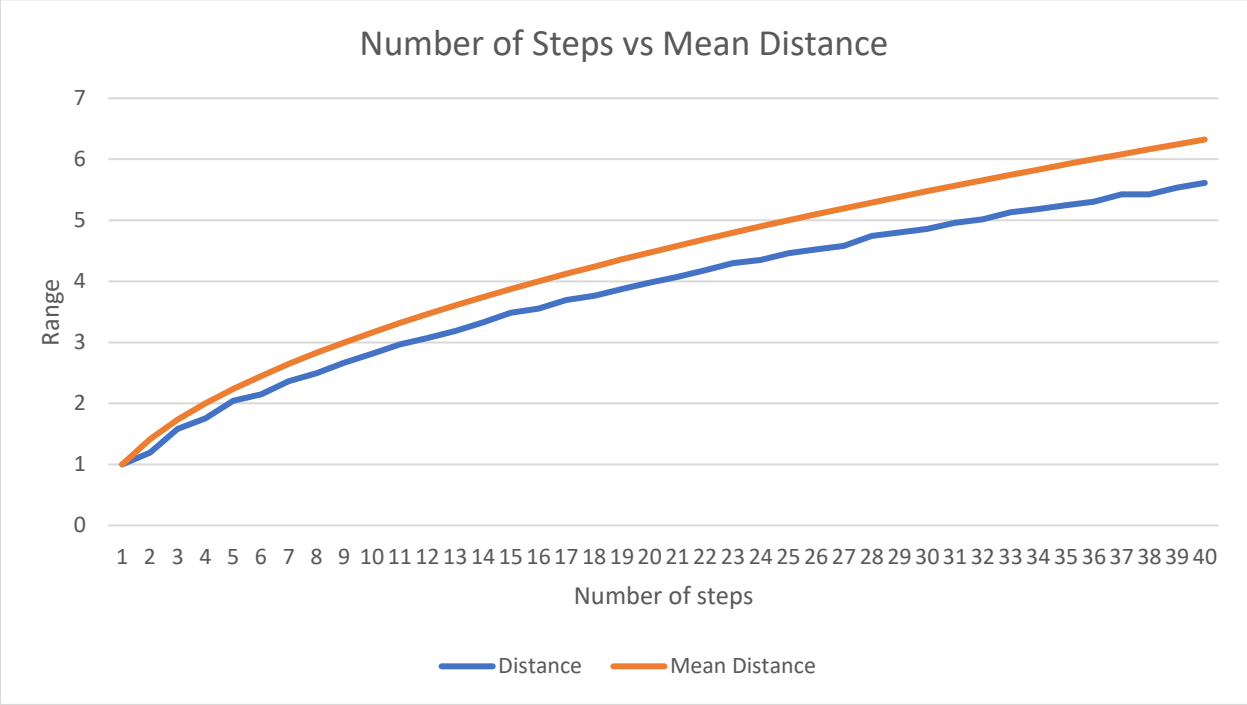
$$Average\ Euclidean\ Distance = k * \sqrt{Number}\ of\ Steps$$

$$Where\ k = 0.8865675444083764\ or\ \sqrt{\pi}/2$$

We will see this in the below evidence.

Evidence –

The graph plotted below between mean distance & no. of steps shows that the drunk man moves about the square root of the number of steps(n).



From above we can see that as the value of n increases, the distance walked by drunken man is very close to the mean distance. Hence, we can conclude that Euclidean Distance is proportional to the square root of the number of steps.

$$Average\ Euclidean\ Distance = k * \sqrt{Number\ of\ Steps}$$

To calculate the value of k, taking the ratio between the Euclidean distance and the sqrt root gives a value of 0.8865675.

Unit Test Result –

Here is a screenshot of unit test results.