

# Program Structures & Algorithms

## Spring 2022

### Assignment No. 1 (Random Walk)

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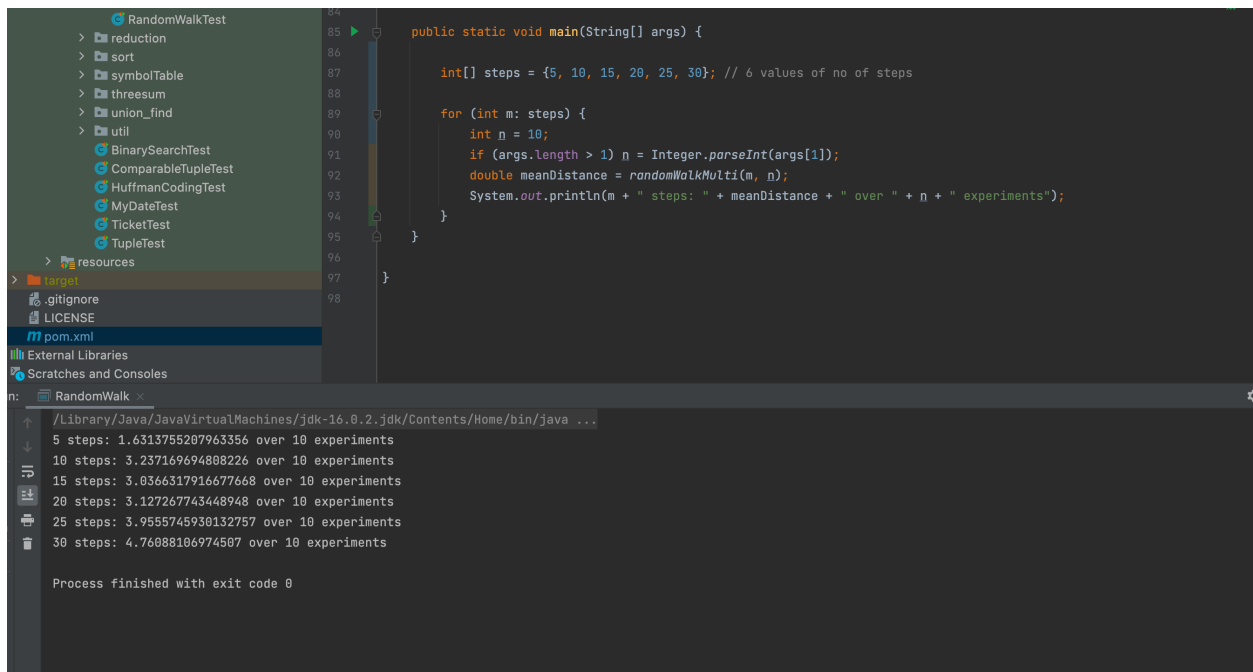
- **Task**

Completed the RandomWalk.java file which had below methods implemented.

- move() – void method which increments x and y variables as the drunken person moves in north, south, east or west direction.
- distance() – returns the Euclidean distance (using Pythagoras Theorem) of the drunken man from the pole (origin) to a point (d)
- randomWalk() – void method where the randomMove() method is called for the m no of steps in random direction

- **Output screenshot**

The below output is tested on 6 different steps and running the experiment 10 times for each no. of tests.



The screenshot shows an IDE with a project named 'RandomWalkTest'. The code in 'RandomWalk.java' defines a 'main' method that takes an array of step counts (5, 10, 15, 20, 25, 30) and runs the 'randomWalkMulti' method for each. The output console shows the results of these experiments, displaying the mean distance for each step count over 10 experiments.

```
public static void main(String[] args) {  
    int[] steps = {5, 10, 15, 20, 25, 30}; // 6 values of no of steps  
  
    for (int m: steps) {  
        int n = 10;  
        if (args.length > 1) n = Integer.parseInt(args[1]);  
        double meanDistance = randomWalkMulti(m, n);  
        System.out.println(m + " steps: " + meanDistance + " over " + n + " experiments");  
    }  
}
```

Output:

```
5 steps: 1.6313755207963356 over 10 experiments  
10 steps: 3.237169694808226 over 10 experiments  
15 steps: 3.0366317916677668 over 10 experiments  
20 steps: 3.127267743448948 over 10 experiments  
25 steps: 3.9555745930132757 over 10 experiments  
30 steps: 4.76088106974507 over 10 experiments  
  
Process finished with exit code 0
```

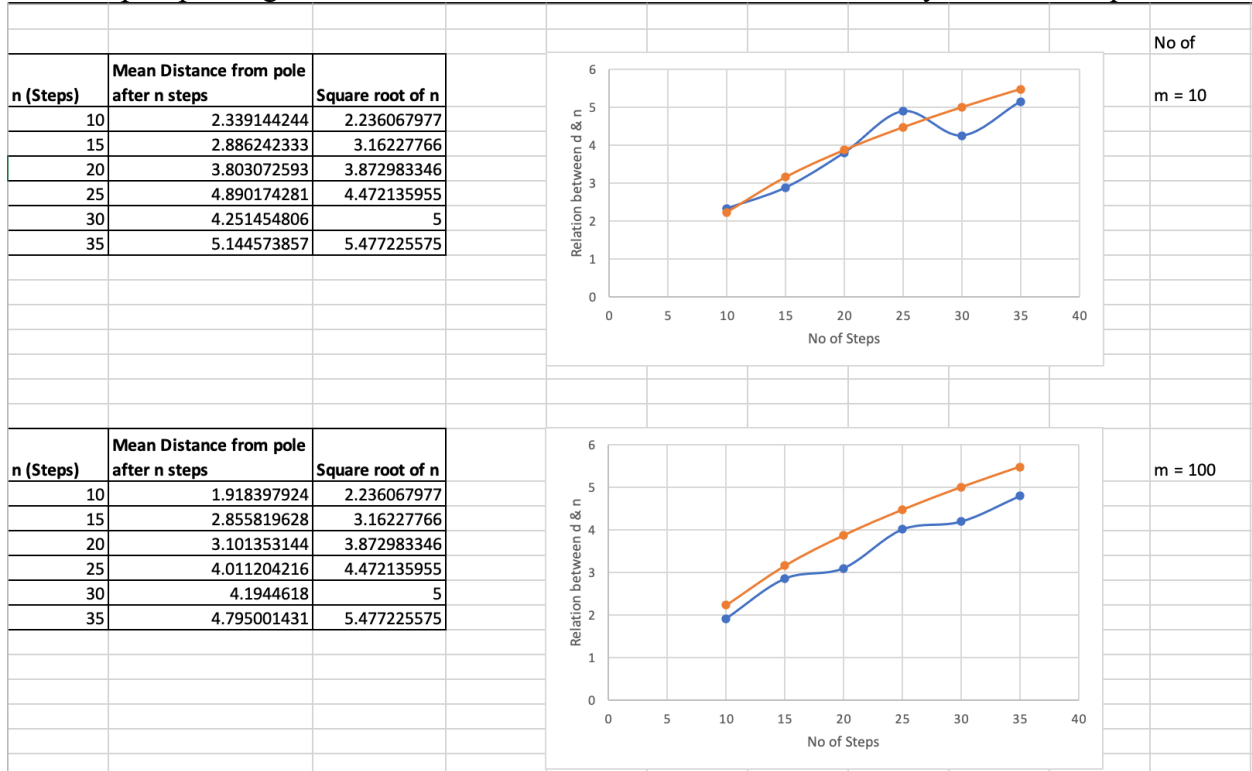
- **Relationship Conclusion**

The relationship between the Euclidean Distance (d) from the pole and number of steps taken to reach position by n steps is

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

- **Evidence / Graph**

Mapped the values of the mean distance from pole after n steps and the square root of n steps on a scatter plot proving the relation between d & n has no outliers and they are almost equal.



- **Unit tests result**

Below screenshot of all test cases ran successfully.

Additionally showing the git history that the RandomWalkTest.java file is not modified.

