

# Program Structures and Algorithms

## Spring 2024

NAME: PRANAV ARUN KAPSE

NUID: 002871241

GITHUB LINK: [https://github.com/kapsep/INFO6205\\_PSA](https://github.com/kapsep/INFO6205_PSA)

TASK: Assignment 1 (Random Walk)

### 1. Conclusion regarding d and m's relationship:

In the random walk experiment, there appears to be an increasing pattern in the relationship between the Euclidean distance (d) and the number of steps (m). In normal circumstances, the drunkard's mean distance traveled tends to increase as the number of steps increases. In other words, the observed trend shows that as the number of steps (m) in the random walk experiment rises, the Euclidean distance from the beginning point (lamp post) increases on average.

But the random walk's stochastic character includes an element of uncertainty. Every step is selected at random, and as a result, there may be differences between measurements. As a result, for a given step count, certain studies may show distances that are shorter than expected.

This behavior can be expressed mathematically and is frequently denoted by the formula:

$$d = c \cdot \sqrt{m}$$

where d is nothing but Euclidean distance, n is number of steps and c is a constant that depends on the parameters of the random walk.

## 2. Evidence for above d and m's relationship:

### a. Clustered Column:

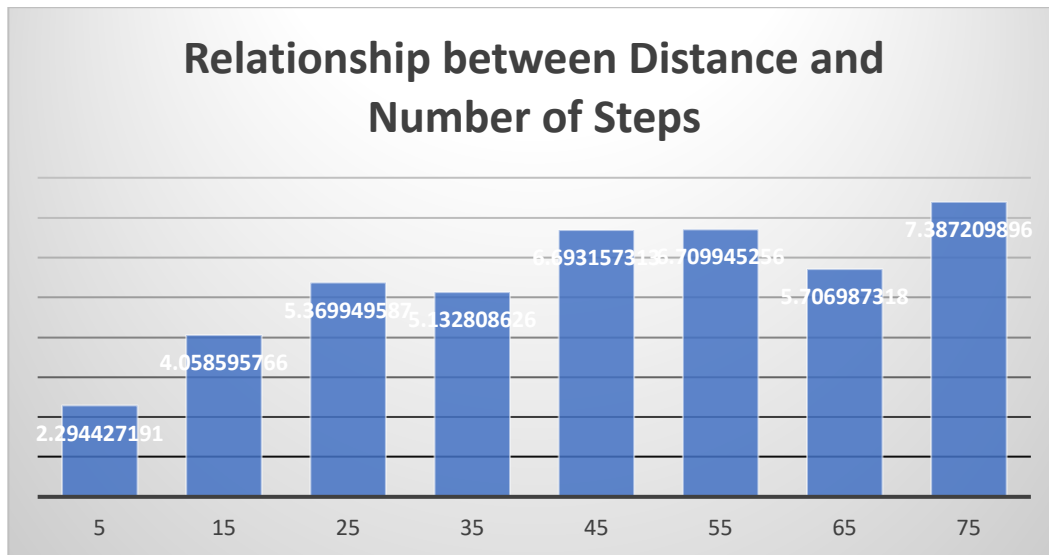


Fig: Clustered Column describes relationship between Distance(d) and no of steps(m).

### b. Scatter Diagram:

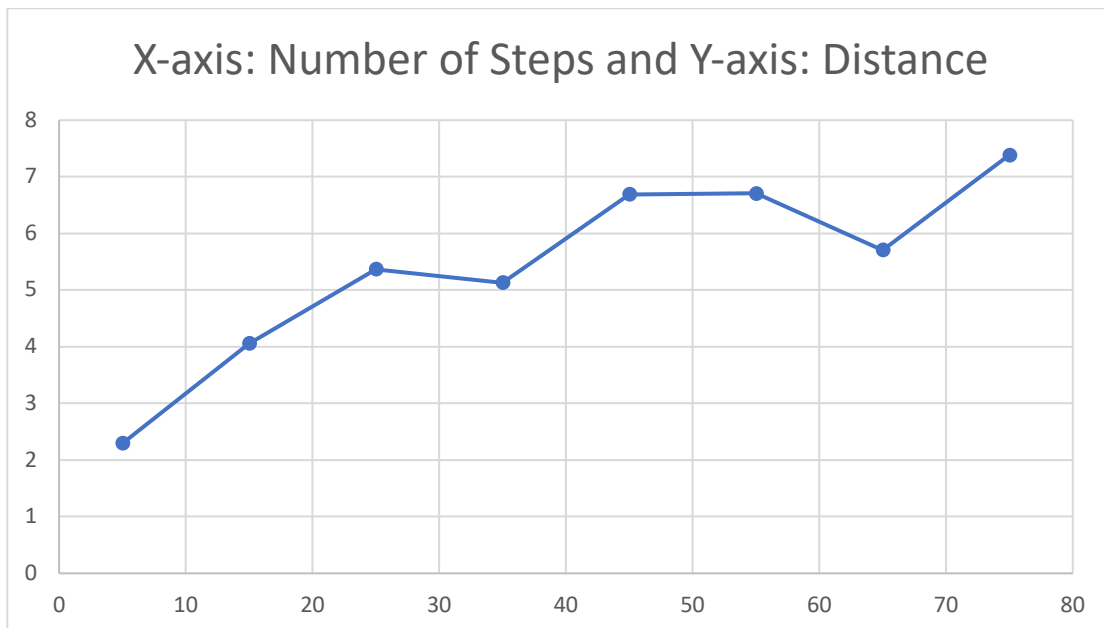
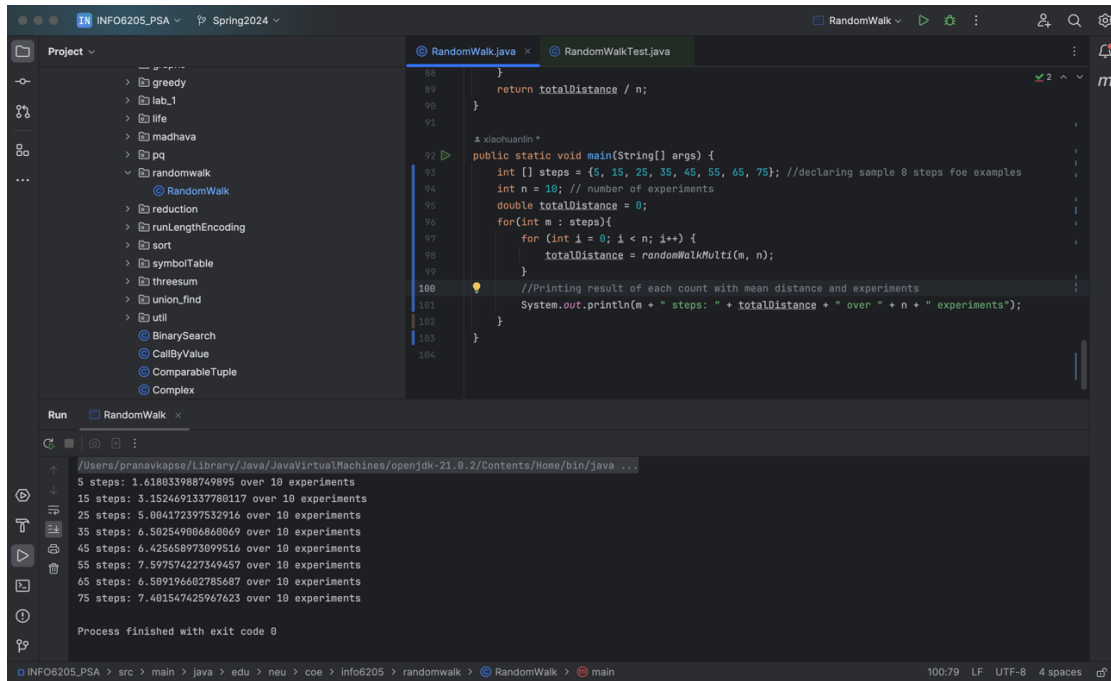


Fig: Scatter diagram describes relationship between Distance(d) and no of steps(m).

### c. Output Console

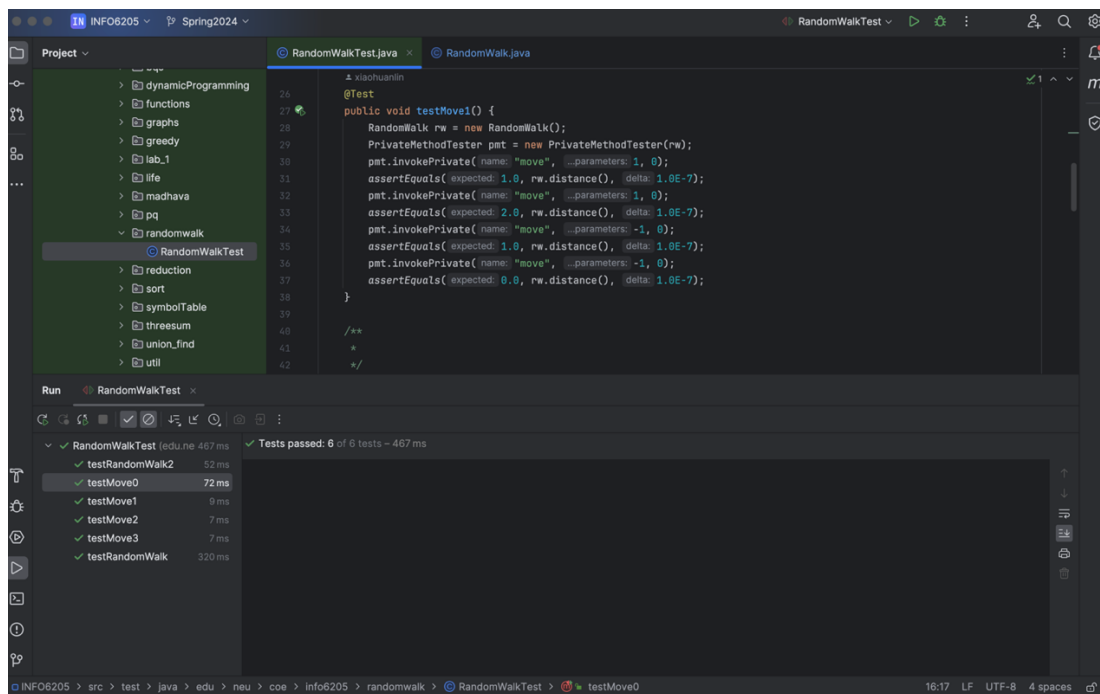


```
5 steps: 1.618633988749895 over 10 experiments
15 steps: 3.1524691337786117 over 10 experiments
25 steps: 5.004172397532916 over 10 experiments
35 steps: 6.502549068680649 over 10 experiments
45 steps: 6.425458973099516 over 10 experiments
55 steps: 7.597574227349457 over 10 experiments
65 steps: 6.509196682785687 over 10 experiments
75 steps: 7.401547425967623 over 10 experiments

Process finished with exit code 0
```

Fig: Output Console for given steps

### 3. Unit tests passing



```
public void testMove1() {
    RandomWalk rw = new RandomWalk();
    PrivateMethodTester pmt = new PrivateMethodTester(rw);
    pmt.invokePrivate("move", 1, 0);
    assertEquals("expected: 1.0, rw.distance(), delta: 1.0E-7);", 1.0, rw.distance(), delta: 1.0E-7);
    pmt.invokePrivate("move", 1, 0);
    assertEquals("expected: 2.0, rw.distance(), delta: 1.0E-7);", 2.0, rw.distance(), delta: 1.0E-7);
    pmt.invokePrivate("move", -1, 0);
    assertEquals("expected: 1.0, rw.distance(), delta: 1.0E-7);", 1.0, rw.distance(), delta: 1.0E-7);
    pmt.invokePrivate("move", -1, 0);
    assertEquals("expected: 0.0, rw.distance(), delta: 1.0E-7);", 0.0, rw.distance(), delta: 1.0E-7);
}

/**
 *
 */
```

Tests passed: 6 of 6 tests - 467 ms

Test Name	Duration
testRandomWalk2	52 ms
testMove0	72 ms
testMove1	9 ms
testMove2	7 ms
testMove3	7 ms
testRandomWalk	320 ms

Fig: All Unit tests passing result (IntelliJ)