

Program Structures and Algorithms
Spring 2023(SEC 3)

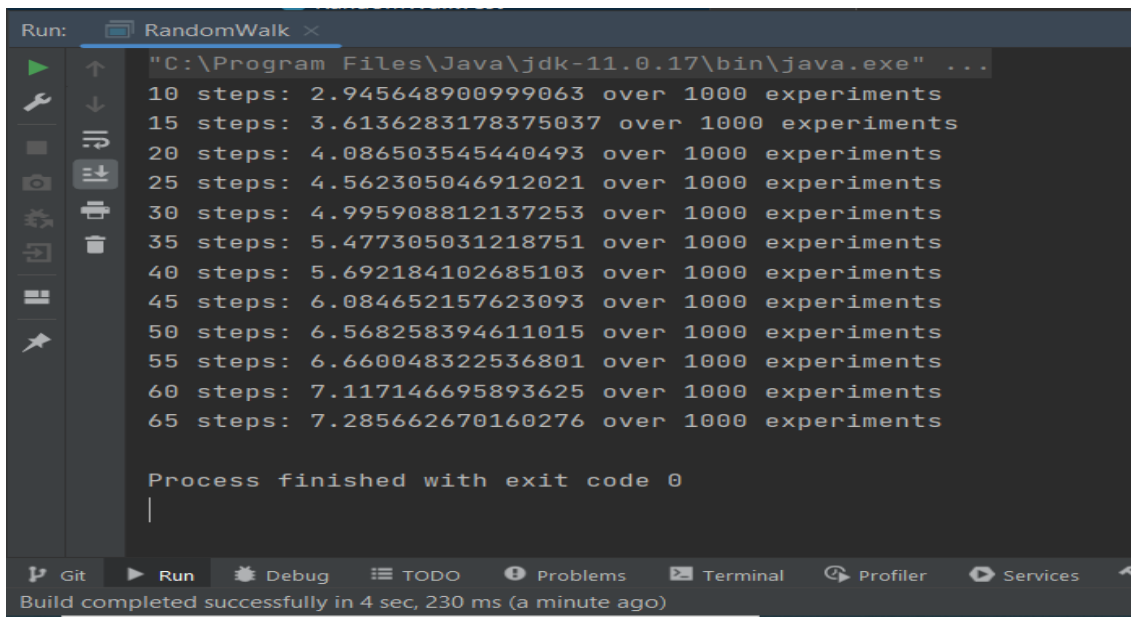
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Task: Assignment 1 - Random Walk – To find the relationship between d and m

Relationship Conclusion: The total mean distance (d) is directly proportional to the square root of number of steps (m).

$$d = k(m)^{0.5}, \text{ where } k \text{ is any constant}$$

Evidence to support that conclusion: As the number of steps (m) increases the mean distance (d) increases as a product of the square root of the value.



```
Run: RandomWalk x
"C:\Program Files\Java\jdk-11.0.17\bin\java.exe" ...
10 steps: 2.945648900999063 over 1000 experiments
15 steps: 3.6136283178375037 over 1000 experiments
20 steps: 4.086503545440493 over 1000 experiments
25 steps: 4.562305046912021 over 1000 experiments
30 steps: 4.995908812137253 over 1000 experiments
35 steps: 5.477305031218751 over 1000 experiments
40 steps: 5.692184102685103 over 1000 experiments
45 steps: 6.084652157623093 over 1000 experiments
50 steps: 6.568258394611015 over 1000 experiments
55 steps: 6.660048322536801 over 1000 experiments
60 steps: 7.117146695893625 over 1000 experiments
65 steps: 7.285662670160276 over 1000 experiments

Process finished with exit code 0
Build completed successfully in 4 sec, 230 ms (a minute ago)
```

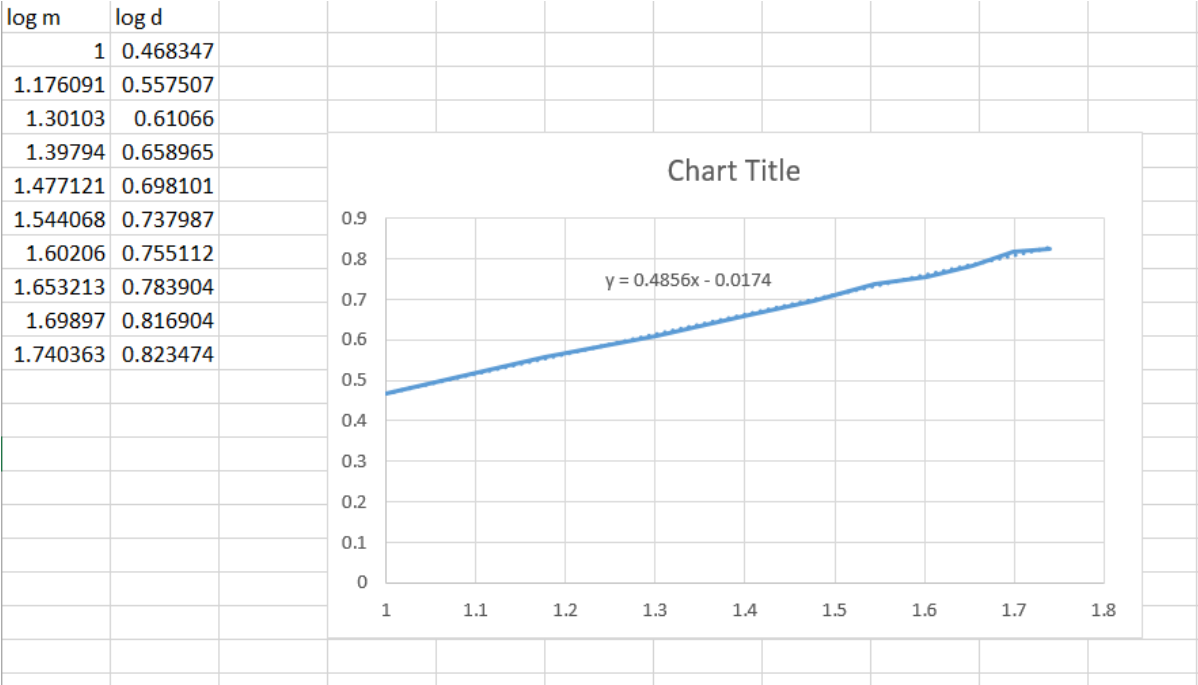
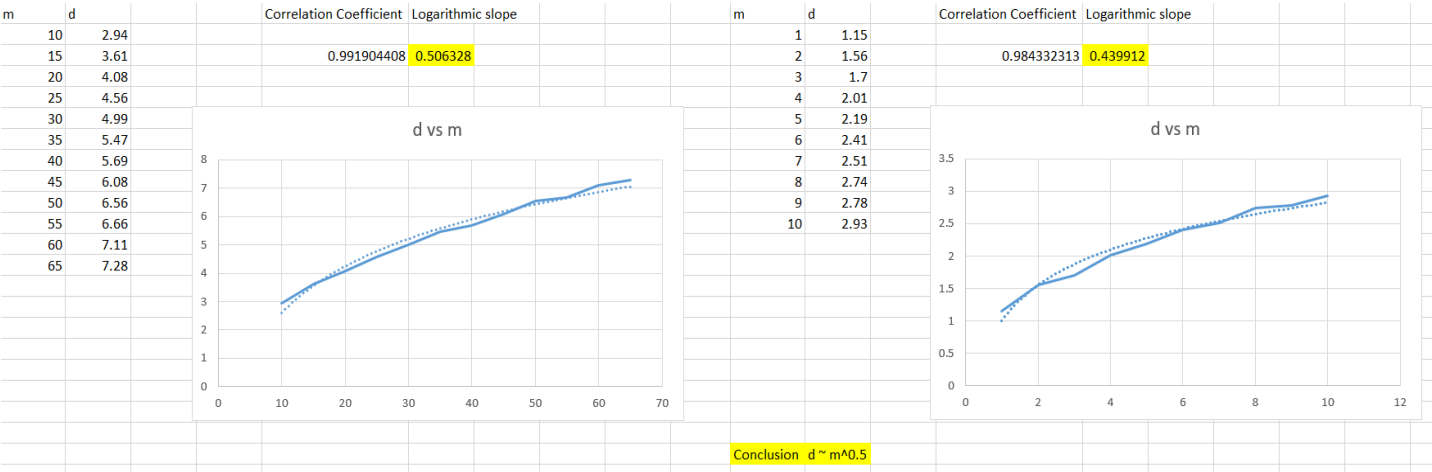


```
Run: RandomWalk x
"C:\Program Files\Java\jdk-11.0.17\bin\java.exe" ...
1 steps: 1.155006276123164 over 1000 experiments
2 steps: 1.5648041320124193 over 1000 experiments
3 steps: 1.7033757819486521 over 1000 experiments
4 steps: 2.0166639906696187 over 1000 experiments
5 steps: 2.1997071640842742 over 1000 experiments
6 steps: 2.4185004614609436 over 1000 experiments
7 steps: 2.5121870669522925 over 1000 experiments
8 steps: 2.7427294536576654 over 1000 experiments
9 steps: 2.7878953808431692 over 1000 experiments
10 steps: 2.9363947705336315 over 1000 experiments

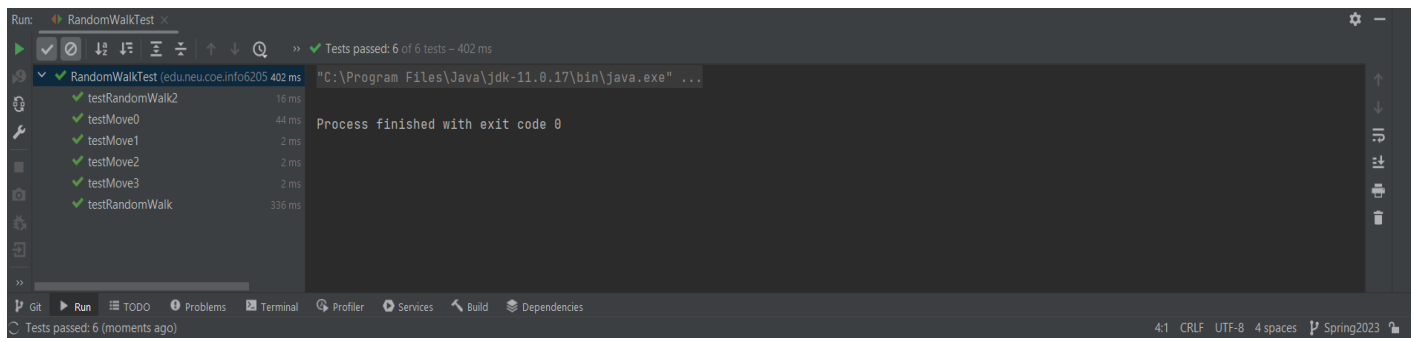
Process finished with exit code 0
Build completed successfully in 3 sec, 789 ms (today 11:07)
```

Graphical Representation: The below image shows the comparison of the two parameters d and m in a graphical format.

- The correlation coefficient (~ 1), confirms that m and d have a direct proportionality
- The graph resembles a logarithmic plot
- By converting the graph to $(\log m)$ vs $(\log d)$, we get a linear curve
- The calculated slope of the plot is 0.485 which is approximately 0.5
- Logarithmic slope relation equation is $x = k (y)^m$, where k is a constant and m is the slope of the graph
- Thus $d = k (m)^{0.5}$, where k is any constant



Unit Tests Screenshot:



Code Snippet:

```
private void move(int dx, int dy) {  
    // FIXME do move by replacing the following code  
    x += dx;  
    y += dy;  
    // END  
}
```

```
private void randomWalk(int m) {  
    // FIXME  
    while(m >= 0) {  
        randomMove();  
        m--;  
    }  
    // END  
}
```

```
public double distance() {  
    // FIXME by replacing the following code  
    double distance = Math.sqrt((x * x) + (y * y));  
    return distance;  
    // END  
}
```