Program Structures and Algorithms

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GITHUB LINK: <https://github.com/basupatil1213/INFO6205/tree/main/src/main/java/edu/neu/coe/info6205/randomwalk>

**Task:**

Implementing the random walk algorithm to establish a connection between the number of steps a drunken man has taken and the Euclidean distance (d) that the man covered during the process. The Euclidean distance (d) between two points (0,0) and (x,y) is calculated using the formula .

**Relationship Conclusion:**

1. Let’s assume that the points he has covered to take n steps is p1, p2, p3 …… pn.
2. The distance covered will be d = p1 + p2 + p3 + …… + pn assuming we are calculating it for 1 dimension.
3. The value for p can be 1 or -1 and as we are choosing value randomnly both values have a equal chance of being choosen. From this we can say the mean distance would be zero

<d> = <p1> + <p2> + <p3> +…… + <pn> = 0 + 0 + 0 + … + 0 = 0

1. To avoid this, the average square of the mean distance is calculated by adding the squares of the averages. Here square of will be 1 an product of two different p value would like to be 1 or – 1.This leads to:

<> = (*p*1​+*p*2​+…+*pn*​)2>=<*p1*2​>+<*p*22​>+…+<*pn*2​>+2(<*p*1​*p*2​>+<*p*1​*p*3​>+…+<*p*2​*pn*>)

As is 1 and the average of the products of two different p value is 0 (as the product is equally likely to be -1 or +1)

<> =<*p1*2​>+<*p*22​>+…+<*pn*2​>+2(<*p*1​*p*2​> = 1 + 1 + 1 + …….. + 1

<> = n where n is the number of steps

So if we take root on both sides result would be  
d = and it holds true for 2 dimension also.

**Evidence to support that conclusion:**

Upon multiple iterations of the above experiment, I could derive a relationship between d and n which is 𝑑 = 𝑙 ∗ 𝑤ℎ𝑒𝑟𝑒 m 𝑖𝑠 𝑡ℎ𝑒 𝑁𝑜. 𝑜𝑓 𝑠𝑡𝑒𝑝𝑠. Since the value of 𝑙 is unity, we can say that 𝑑 = . below is the screenshot of the graph and the values of Number of steps taken(m) and the Euclidean distance (d) and the square root of m.

A screenshot of a graph

Description automatically generated

**Unit Test Screenshots:**

A screenshot of a computer

Description automatically generated

Custom m value output:A screenshot of a computer

Description automatically generated