Program Structures and Algorithms

Summer I 2023(SEC – 1)

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**Task:**

* **Implement algorithm for random walk.**
* **Run experiment for steps ‘m’.**
* **Deduce relationship between steps (m) and distance (d).**
* **Plot graph to represent the relationship between d and m.**

**Relationship Conclusion:**

In conclusion, through multiple experiments and analysis of a random walk, I observed a relationship between the mean distance (d) and the number of steps (m). By taking the average of the distance values for each m and plotting them, I noticed that as m increases, d also increases but at a slower rate, forming a graph that resembles the square root of m. Furthermore, I examined the relationship between the logarithm of d and the logarithm of m, which resulted in a straight line on the graph. This linear trend indicates that the original data follows a power law relationship.

Overall, these findings indicate that the distance travelled in a random walk tends to increase as the number of steps increases at a slower rate and tends to form a relationship that can be represented by the following equation:

d = √m

It's important to note that this equation represents an **approximation**.

The findings indicate that:

* With an increase in number of steps the respective distance we get through the algorithm defined method ‘randomWalkMulti’ does not increase linearly.
* The delta between subsequent values of distance ‘d’ keep reducing.

**Evidence to support that conclusion:**

The flowing spread sheet contains data for:

* For equation 2\*i
* Random walk experiment for up to 20000 steps.
* Each iteration doubles the number of steps (2\*i where i is the iteration number (1=<i<10000)).
* Experiments were run for 1000 times for each step to calculate the mean distance.

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* For equation f 2^n (Where 1<=n<15)
* Random walk experiment for up to 2^15 steps.
* Each iteration is power of 2.
* Experiments were run for 1000 times for each step to calculate the mean distance.

**Graphical Representation:**

* Scatter plot graph has been used to visualize the data set.
* This graph represents the relationship between mean distance for each step.
* The delta between the subsequent values of mean distance (d2-d1) decreases as the number of steps increases, there relationship is captured in column F of the spresheet attached.
* This relationship is similar to the relationship between a number and its square root which can be seen in graph number 2 in this analysis report.
* **For 2\*i**

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**Graph 1**

**For 2^i**

**Graph 2**

* The following graph represents the relationship between steps (m) in x axis and the square root of the step in y axis.
* It can be seen that the following graph is similar to the graph that depits the relationship between mean distance and steps above.

**For 2\*i**

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**Graph 3**

**For 2^i**

**Graph 4**

* The following graph represents the relationship between the log of mean distance and log of steps m.
* The graph deduces that log(d) and log (m) have a linear relationship.

**For 2\*i**

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**Graph 5**

**For 2^i**

**Graph 6**

**Screenshots of Unit Tests run:**

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