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Program Structures & Algorithms

Fall 2021

Assignment No. 1

Task (List down the tasks performed in the Assignment)

Radom Walk

Relationship Conclusion: $d = \sqrt{n}$

Evidence to support the conclusion:

1. Output (Snapshot of Code output in the terminal)

The screenshot shows an IDE with a Java file named `RandomWalk.java`. The code implements a random walk simulation. It includes a `main` method that runs 60 experiments, each with 100,000 steps. The terminal output at the bottom shows the result: "We walked 1000000 steps in 60 experiments and the mean distance is 1052.0304685427187".

```
2 * Copyright (c) 2017, Phasmid Software
3
4
5 package Assignment1.Assignment1;
6 import java.util.Random;
7
8
9 public class RandomWalk {
10
11     int x = 0;
12     int y = 0;
13
14     private final Random random = new Random();
15
16     /**
17      * Private method to move the current position, that's to say the drunkard moves
18      *
19      * @param dx the distance he moves in the x direction
20      * @param dy the distance he moves in the y direction
21      */
22     private void move(int dx, int dy) {
23         // TO BE IMPLEMENTED
24         x += dx;
25         y += dy;
26     }
27
28     /**
29      * Perform a random walk of n steps
30      *
31      * @param n the number of steps the drunkard takes
32      */
33     private void randomWalk(int n) {
34         // TO BE IMPLEMENTED
35         if(n <= 0) {
36             return;
37         }
38         for(int i=0; i<n; i++) {
39             randomMove();
40         }
41     }
42
43     /**
44      * Private method to generate a random move according to the rules of the
45      * situation. That's to say, moves can be (+1, 0) or (0, +1).
46      */
47     private void randomMove() {
48         boolean ns = random.nextBoolean();
49         int step = random.nextBoolean() ? 1 : -1;
50         move(ns ? step : 0, ns ? 0 : step);
51     }
52
53     /**
54      * Method to compute the distance from the origin (the lamp-post where the
55      * drunkard starts) to his current position.
56     */
57     double distance() {
58         return Math.sqrt(x*x + y*y);
59     }
60
61     /**
62      * Main method to run the simulation
63      */
64     public static void main(String[] args) {
65         RandomWalk walk = new RandomWalk();
66         int experiments = 60;
67         double totalDistance = 0.0;
68         for(int i=0; i<experiments; i++) {
69             walk.randomWalk(100000);
70             totalDistance += walk.distance();
71         }
72         double meanDistance = totalDistance / experiments;
73         System.out.println("We walked 1000000 steps in 60 experiments and the mean distance is " + meanDistance);
74     }
75 }
```

Task List 11

- Assignment1 Assignment1
 - RandomWalk
 - x : int
 - y : int
 - random : Random
 - randomWalk(int) : void
 - randomMove() : void
 - distance() : double
 - randomWalkMulti(int, int) : double
 - main(String[]) : void

Problems | JavaDoc | Declaration | Console 11 | Progress | Coverage

<terminated> RandomWalk [Java Application] | Library | Java | Java | Virtual Machines | JDK 1.8.0_162 | JDK | Contents | Home | bin | java (Sep 18, 2021, 2:13:41 PM)

We walked 1000000 steps in 60 experiments and the mean distance is 1052.0304685427187

2. **Graphical Representation(Observations from experiments should be tabulated and analyzed by plotting graphs(usually in excel) to arrive on the relationship conclusion)**

$$d_1 = \sqrt{(x_1 - 0)^2 + (y_1 - 0)^2} d^2$$

$$= \frac{1}{p} \left(\sum_{i=1}^p (x_{i1} + x_{i2} + x_{i3} + \dots + x_{in})^2 + (y_{i1} + y_{i2} + y_{i3} + \dots + y_{in})^2 \right)$$

$$d1 = \frac{1}{p} \sum_{i=1}^p (x_{i1}^2 + x_{i1}x_{i2} + x_{i1}x_{i3} + \dots + x_{i2}^2 + x_{i1}x_{i2} + \dots x_{in}^2 + y_{i1}^2 + y_{i1}y_{i2} + y_{i1}y_{i3} + \dots + y_{i2}^2 + y_{i1}y_{i2} + \dots y_{in}^2)$$

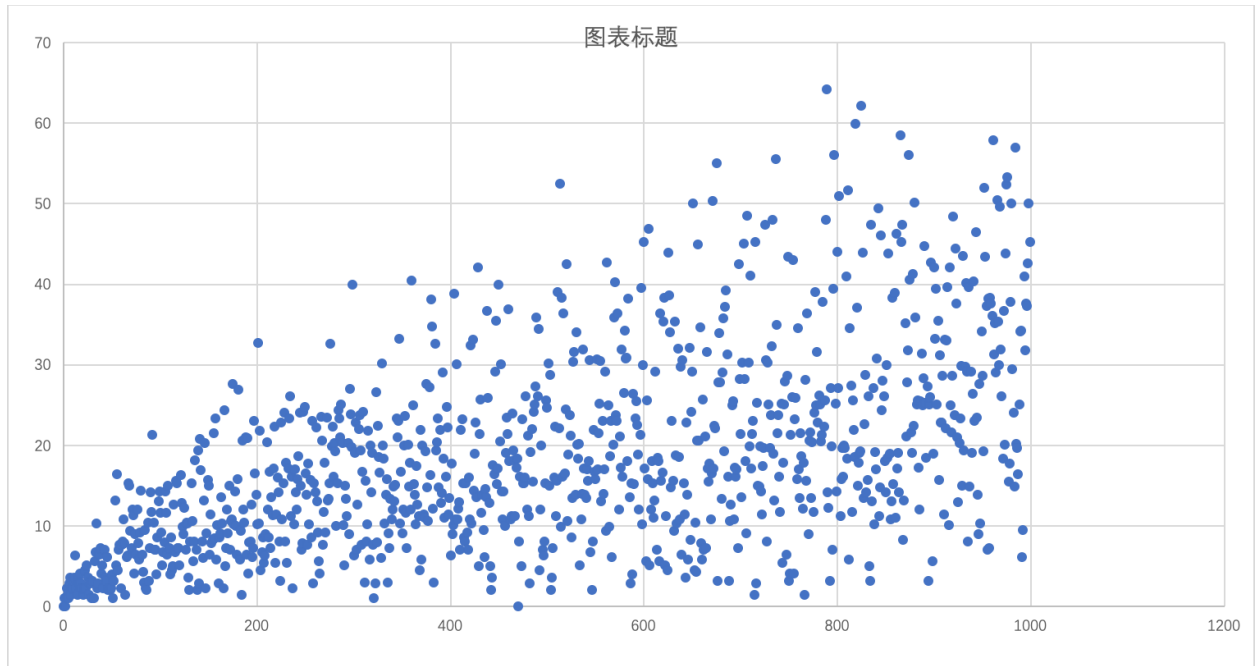
$$d^2 = \frac{1}{p} \sum_{i=1}^p (x_{i1}^2 + x_{i1}x_{i2} + x_{i1}x_{i3} + \dots + x_{i2}^2 + x_{i1}x_{i2} + \dots x_{in}^2 + y_{i1}^2 + y_{i1}y_{i2} + y_{i1}y_{i3} + \dots + y_{i2}^2 + y_{i1}y_{i2} + \dots y_{in}^2)$$

$$d^2 = \frac{1}{p} \sum_{i=1}^p (x_{i1}^2 + y_{i1}^2 + x_{i2}^2 + y_{i2}^2 + \dots x_{in}^2 + y_{in}^2)$$

$$d^2 = \frac{1}{p} \sum_{i=1}^p (n)$$

$$d^2 = n$$

$$d = \sqrt{n}$$



◦ Unit tests result:(Snapshot of successful unit test run)

