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**Program Structures & Algorithms**  
**Fall 2021**  
**Assignment No. 1**

- Task (List down the tasks performed in the Assignment)
  - Completed the missing code in the move, randomWalk and distance methods as per the below screenshots -

```
private int x = 0;
private int y = 0;
private int[] xCoordinate = {1, 0, -1, 0};
private int[] yCoordinate = {0, 1, 0, -1};
private final Random random = new Random();

/**
 * Private method to move the current position,
 *
 * @param dx the distance he moves in the x direction
 * @param dy the distance he moves in the y direction
 */
private void move(int dx, int dy) {
    x += dx;
    y += dy;
}
```

```
private void randomWalk(int m) {
    while ((m --) != 0) {
        move(xCoordinate[random.nextInt(4)], yCoordinate[random.nextInt(4)]);
    }
}
```

```
public double distance() {
    return Math.sqrt((this.x * this.x) + (this.y * this.y));
}
```

- Ran the tests successfully
- Added code in the main method to perform the experiments as below -

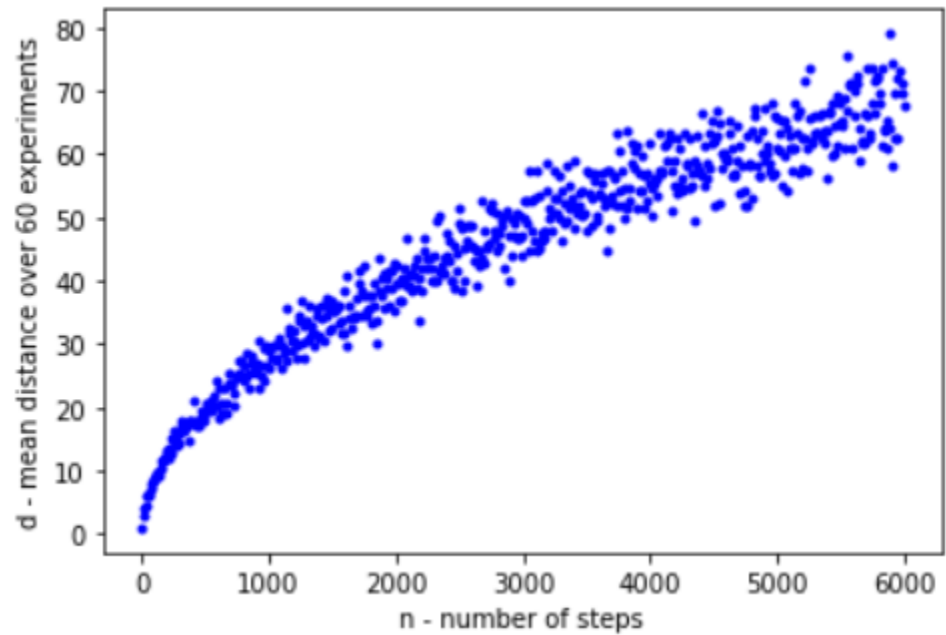
```
public static void main(String[] args) {
    try {
        FileWriter writer = new FileWriter( fileName: "E:\\proj\\random_walk.csv");
        writer.write( str: "n,d\n");
        Random rand = new Random();
        for (int step = 1; step < 6000; step += 10) {
            double meanDistance = (new RandomWalk()).randomWalkMulti(step, n: 60);
            writer.write( str: step + "," + meanDistance + "\n");
            System.out.println(step + "," + meanDistance);
        }
        writer.close();
    }
    catch (IOException e) {
        e.printStackTrace();
    }
}
```

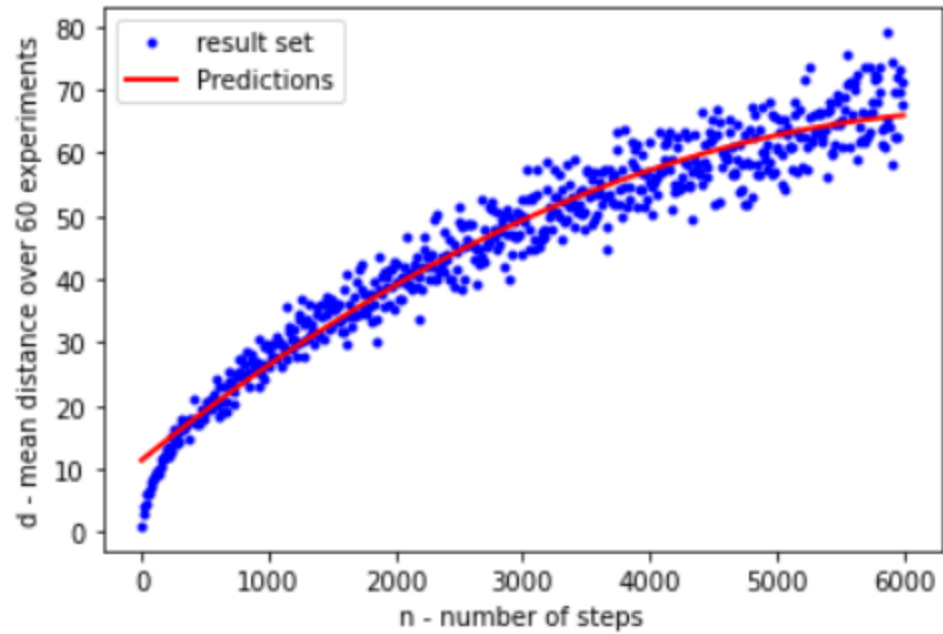
- Plotted the result with matplotlib and performed polynomial regression on the data set as per the attached jupyter notebook.
- Relationship Conclusion: (For ex :  $z = a * b$ )
  - $d = a * \sqrt{n}$  (where d: the mean euclid's distance, n: the number of steps, a: constant) this is a parabolic relation.

- Evidence to support the conclusion:
  1. Output (Snapshot of Code output in the terminal)

```
INFO6205 src \ main \ java \ edu \ neu \ coe \ info6205 \ randomwalk \ RandomWalk
Project
  INFO6205 E:\proj\INFO6205
    .idea
    src
    main
Run: RandomWalk
  "C:\Program Files\Java\jdk-16.0.2\bin\java.exe" ...
1,0.8397462718475038
11,3.0013907308736645
21,4.186852926770146
31,4.901891398714976
41,5.428070490312289
51,6.542108250987075
61,7.948653412717425
71,7.28956297056622
81,7.685248353210702
91,8.566945066165097
101,8.677577010449394
111,7.977123723461599
121,9.946281688425
131,9.406488996903478
141,11.021627151294142
151,10.046306433389766
161,10.978406442909456
171,12.486281316364728
181,12.642839341288084
191,12.547751893286959
201,12.393647581605373
211,12.623146415536727
221,13.147930317922993
231,12.89479104486136
241,12.4243897621624
Build completed successfully in 4 sec, 398 ms (a minute ago)
```

2. Graphical Representation(Observations)





### 3. Unit tests result:(Snapshot of successful unit test run)

