

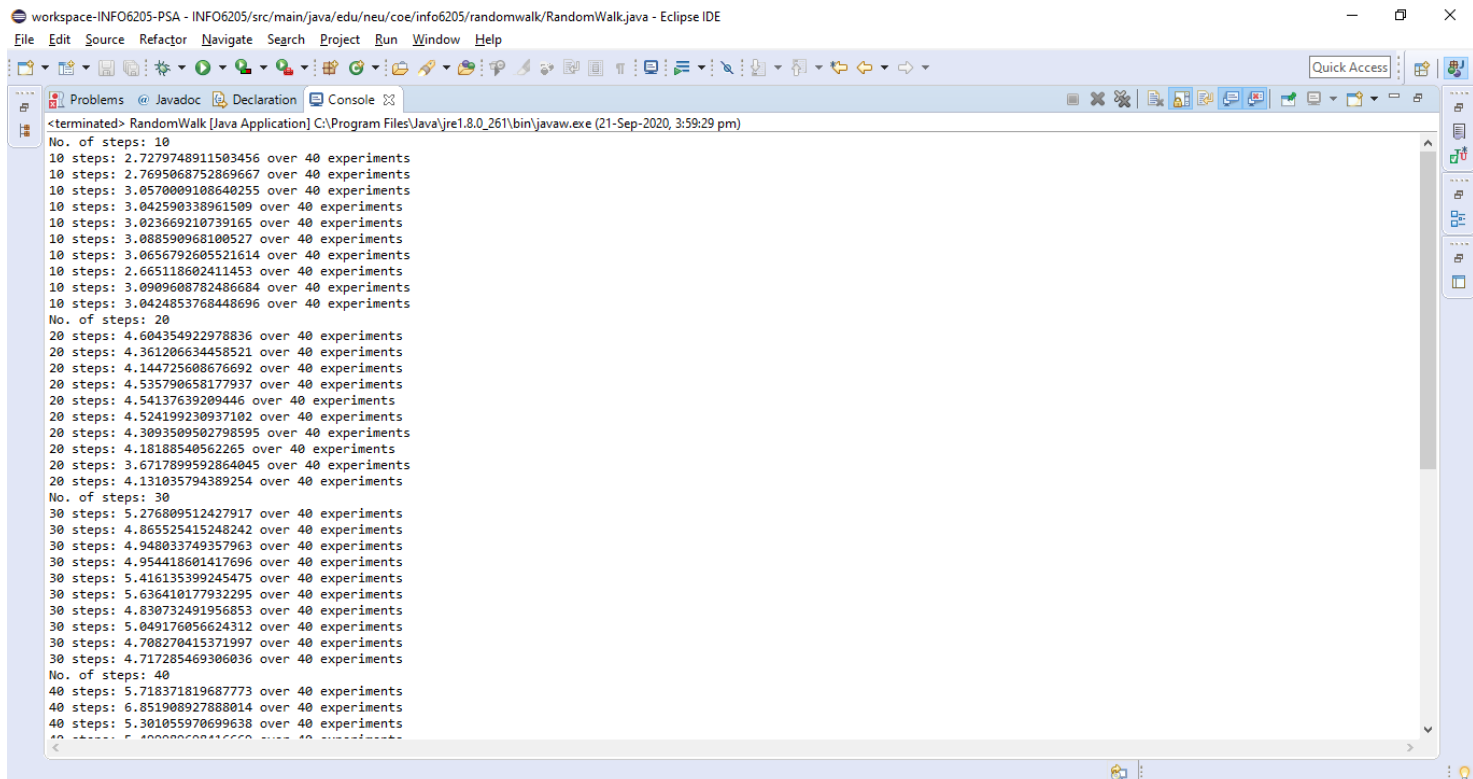
INFO 6205

Program Structures & Algorithms

Fall 2020

Assignment No: 1

- **Task:** To implement the code and deduce the relationship between number of steps (n) and Euclidean distance (d) of a drunken man from the lamp post through many different types of randomized experiments.
- **Output:** Below is the output received for 6 different values of n (number of steps) ran 10 times each to prove the relationship –



```
workspace-INFO6205-PSA - INFO6205/src/main/java/edu/neu/coe/info6205/randomwalk/RandomWalk.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
<terminated> RandomWalk [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (21-Sep-2020, 3:59:29 pm)
No. of steps: 10
10 steps: 2.7279748911503456 over 40 experiments
10 steps: 2.7695068752869667 over 40 experiments
10 steps: 3.0570009108640255 over 40 experiments
10 steps: 3.042590338961509 over 40 experiments
10 steps: 3.023669210739165 over 40 experiments
10 steps: 3.088590968100527 over 40 experiments
10 steps: 3.0656792605521614 over 40 experiments
10 steps: 2.665118602411453 over 40 experiments
10 steps: 3.0909608782486684 over 40 experiments
10 steps: 3.0424853768448696 over 40 experiments
No. of steps: 20
20 steps: 4.604354922978836 over 40 experiments
20 steps: 4.361206634458521 over 40 experiments
20 steps: 4.144725608676692 over 40 experiments
20 steps: 4.535790658177937 over 40 experiments
20 steps: 4.54137639209446 over 40 experiments
20 steps: 4.524199230937102 over 40 experiments
20 steps: 4.3093509502798595 over 40 experiments
20 steps: 4.18188540562265 over 40 experiments
20 steps: 3.6717899592864045 over 40 experiments
20 steps: 4.131035794389254 over 40 experiments
No. of steps: 30
30 steps: 5.276809512427917 over 40 experiments
30 steps: 4.865525415248242 over 40 experiments
30 steps: 4.948033749357963 over 40 experiments
30 steps: 4.954418601417696 over 40 experiments
30 steps: 5.416135399245475 over 40 experiments
30 steps: 5.636410177932295 over 40 experiments
30 steps: 4.830732491956853 over 40 experiments
30 steps: 5.049176056624312 over 40 experiments
30 steps: 4.708270415371997 over 40 experiments
30 steps: 4.717285469306036 over 40 experiments
No. of steps: 40
40 steps: 5.718371819687773 over 40 experiments
40 steps: 6.851908927888014 over 40 experiments
40 steps: 5.301055970699638 over 40 experiments
40 steps: 5.48080608145550 over 40 experiments
```

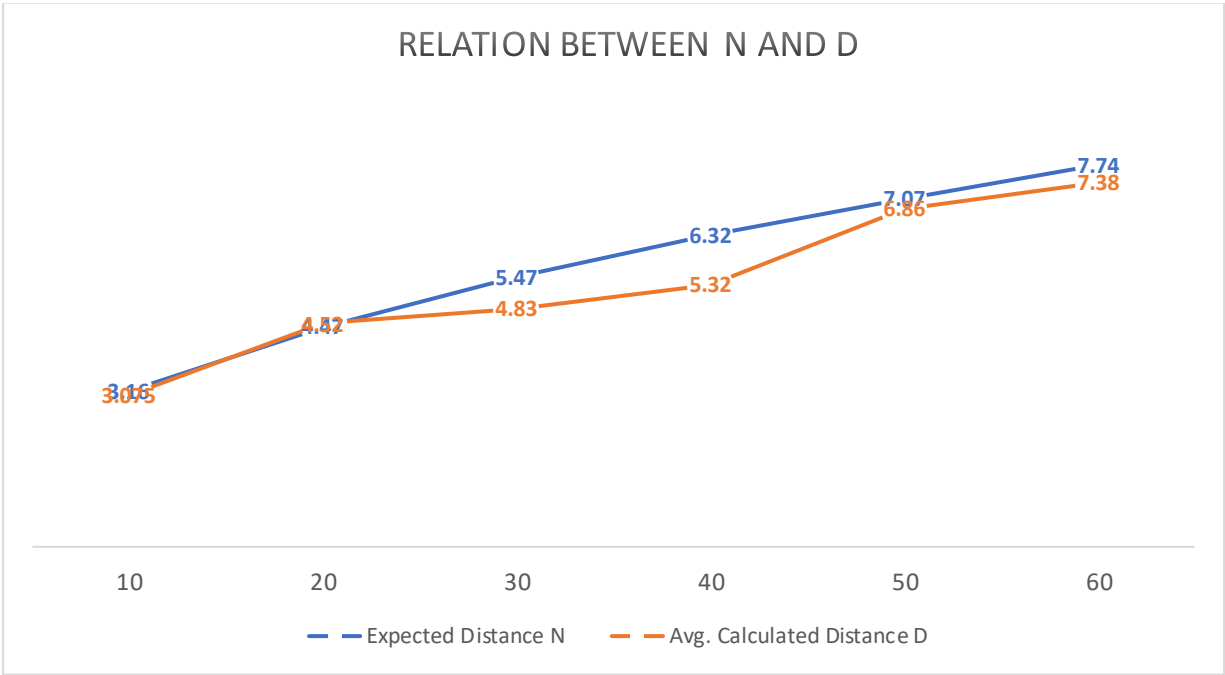
```

workspace-INFO6205-PSA - INFO6205/src/main/java/edu/neu/coe/info6205/randomwalk/RandomWalk.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
<terminated> RandomWalk [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (21-Sep-2020, 3:59:29 pm)
10 steps: 4.060732491530033 over 40 experiments
30 steps: 5.049176056624312 over 40 experiments
30 steps: 4.708270415371997 over 40 experiments
30 steps: 4.717285469306036 over 40 experiments
No. of steps: 40
40 steps: 5.718371819687773 over 40 experiments
40 steps: 6.851908927888014 over 40 experiments
40 steps: 5.301055970699638 over 40 experiments
40 steps: 5.499989698416669 over 40 experiments
40 steps: 6.105638652029498 over 40 experiments
40 steps: 5.340946875574948 over 40 experiments
40 steps: 5.641754814466279 over 40 experiments
40 steps: 4.58653428685693 over 40 experiments
40 steps: 6.535016762205807 over 40 experiments
40 steps: 5.631135544117302 over 40 experiments
No. of steps: 50
50 steps: 6.82653391793937 over 40 experiments
50 steps: 6.781238907438608 over 40 experiments
50 steps: 6.860902821702483 over 40 experiments
50 steps: 6.032294359909606 over 40 experiments
50 steps: 5.808951571084256 over 40 experiments
50 steps: 7.080931699855076 over 40 experiments
50 steps: 6.448221828348113 over 40 experiments
50 steps: 6.625715216003842 over 40 experiments
50 steps: 6.365135054605464 over 40 experiments
50 steps: 7.012347907678487 over 40 experiments
No. of steps: 60
60 steps: 6.678295960268898 over 40 experiments
60 steps: 6.518560065235472 over 40 experiments
60 steps: 7.380500782923354 over 40 experiments
60 steps: 7.465327772402093 over 40 experiments
60 steps: 6.833353780598108 over 40 experiments
60 steps: 6.88922016734342 over 40 experiments
60 steps: 7.063619804667125 over 40 experiments
60 steps: 7.011290455284387 over 40 experiments
60 steps: 7.218832564794499 over 40 experiments
60 steps: 6.027185555153854 over 40 experiments

```

- Relationship conclusion:** It can be concluded from the results of the experiments that the Euclidean distance between the final position and the initial position of a drunken man moving is approximately equal to the root of the number of steps taken Or in other words, the root mean square of the distance d , between the two points should be approximately root of the number of steps i.e. \sqrt{N} . So, $D = \sqrt{N}$
- Evidence to support relationship:** I have attached a chart and a table stating the data of the different output observed for the different set of inputs of N . As a result, we can see proportionate increase in the distance covered. Hence supporting our observation that D is the root mean square of N .

Number of Steps (n)	Expected Distance \sqrt{N}	Avg. Calculated Distance D	Error (%)
10	3.16	3.075	2.68
20	4.47	4.52	1.18
30	5.47	4.83	11.7
40	6.32	5.32	15.8
50	7.07	6.86	2.97
60	7.74	7.38	4.65



- **Screenshot of Unit test passing:** Below is the screenshot of all the unit tests which ran successfully

