

002133899

## **Program Structures & Algorithms**

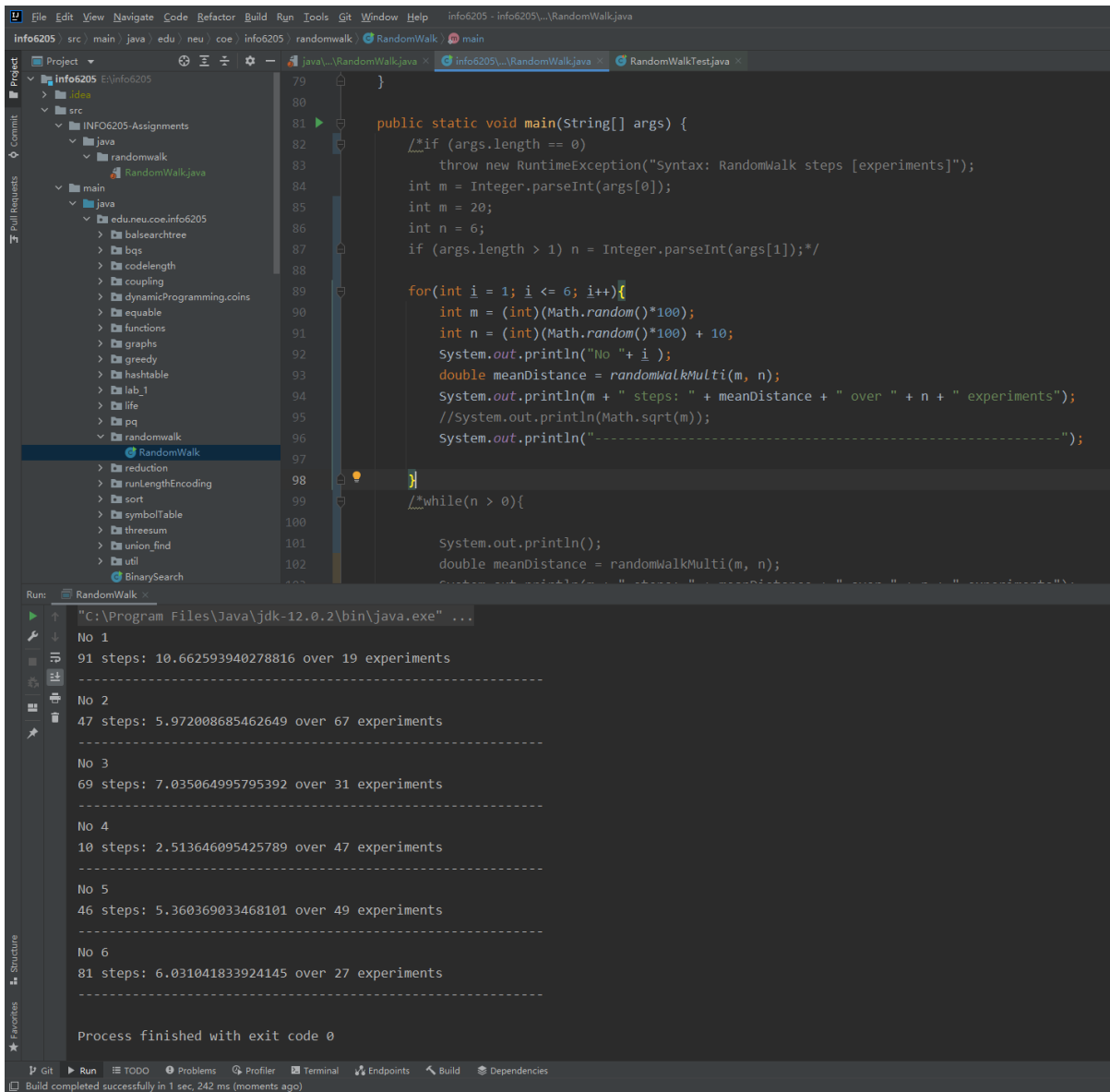
**Fall 2021**

### **Assignment No. 1**

- ⊙ **Task 1. m = 91, n = 19, mean distance = 10.662593940278816**
- ⊙ **Task 2. m = 47, n = 67, mean distance = 5.972008685462649**
- ⊙ **Task 3. m = 69, n = 31, mean distance = 7.035064995795392**
- ⊙ **Task 4. m = 10, n = 47, mean distance = 2.513646095425789**
- ⊙ **Task 5. m = 46, n = 49, mean distance = 5.360369033468101**
- ⊙ **Task 6. m = 81, n = 27, mean distance = 6.031041833924145**
  
- ⊙ **Relationship Conclusion:  $d = \sqrt{n}$**

## ◉ Evidence to support the conclusion:

### 1. Output



The screenshot displays an IDE with a project named 'info6205'. The left sidebar shows the project structure, including a 'main' directory with a 'java' subdirectory. The main editor window shows the file 'RandomWalk.java' with the following code:

```
79 }
80
81 public static void main(String[] args) {
82     /*if (args.length == 0)
83         throw new RuntimeException("Syntax: RandomWalk steps [experiments]");
84     int m = Integer.parseInt(args[0]);
85     int m = 20;
86     int n = 6;
87     if (args.length > 1) n = Integer.parseInt(args[1]);*/
88
89     for(int i = 1; i <= 6; i++){
90         int m = (int)(Math.random()*100);
91         int n = (int)(Math.random()*100) + 10;
92         System.out.println("No " + i);
93         double meanDistance = randomWalkMulti(m, n);
94         System.out.println(m + " steps: " + meanDistance + " over " + n + " experiments");
95         //System.out.println(Math.sqrt(m));
96         System.out.println("-----");
97     }
98 }
99
100 /*while(n > 0){
101
102     System.out.println();
103     double meanDistance = randomWalkMulti(m, n);
104     System.out.println(m + " steps: " + meanDistance + " over " + n + " experiments");
105 }*/
```

The bottom panel shows the output of the program, which is a list of results for six experiments:

```
"C:\Program Files\Java\jdk-12.0.2\bin\java.exe" ...
No 1
91 steps: 10.662593940278816 over 19 experiments
-----
No 2
47 steps: 5.972008685462649 over 67 experiments
-----
No 3
69 steps: 7.035064995795392 over 31 experiments
-----
No 4
10 steps: 2.513646095425789 over 47 experiments
-----
No 5
46 steps: 5.360369033468101 over 49 experiments
-----
No 6
81 steps: 6.031041833924145 over 27 experiments
-----
Process finished with exit code 0
```

The status bar at the bottom indicates that the build completed successfully in 1 sec, 242 ms (moments ago).

## 2. Graphical Representation

Distance:  $d$  Steps:  $n$  Position  $(x_i, y_i)$

$$d = \sqrt{x_n^2 + y_n^2} \quad x_n = \sum_{i=0}^n x_i \quad y_n = \sum_{i=0}^n y_i$$

$$x_n^2 + y_n^2 = \left( \sum_{i=0}^n x_i \right)^2 + \left( \sum_{i=0}^n y_i \right)^2$$

$$= [x_0^2 + y_0^2 + x_1^2 + y_1^2 + \dots + x_n^2 + y_n^2 + 2x_0x_1 + 2y_0y_1 + \dots + 2x_{n-1}x_n + 2y_{n-1}y_n]$$

$$\downarrow$$

$$\because x_i^2 + y_i^2 = 1$$

$$\therefore \text{part 1} = n$$

$x_0$	$x_1$	$x_0x_1$	$\left. \begin{array}{l} P(x_0x_1 = -1) = \frac{2}{9} \\ P(x_0x_1 = 0) = \frac{5}{9} \\ P(x_0x_1 = 1) = \frac{2}{9} \\ (y_0y_1) \text{ same} \end{array} \right\}$
-1	-1	1	
-1	0	0	
-1	1	-1	
0	-1	0	
0	0	0	
0	1	0	
1	-1	-1	
1	0	0	
1	1	1	

$$\text{part 2} = 2x \left( \frac{2}{9}x + \frac{5}{9}x + \frac{2}{9}x \right) \times n$$

$$\text{part 1} + \text{part 2} = n + 0 = n$$

$$d = \sqrt{n}$$

## Unit tests result:

```
1  ../../
2
3
4
5  package edu.neu.coe.info6205.randomwalk;
6
7  import ...
8
9
10
11
12
13  public class RandomWalkTest {
14
15      @Test
16      public void testMove0() {
17          RandomWalk rw = new RandomWalk();
18          PrivateMethodTester pmt = new PrivateMethodTester(rw);
19          pmt.invokePrivate( name: "move", ...parameters: 1, 0);
20          assertEquals( expected: 1.0, rw.distance(), delta: 1.0E-7);
21      }
22
23      /**
24       *
25       */
26      @Test
27      public void testMove1() {
28          RandomWalk rw = new RandomWalk();
29          PrivateMethodTester pmt = new PrivateMethodTester(rw);
30          pmt.invokePrivate( name: "move", ...parameters: 1, 0);
31          assertEquals( expected: 1.0, rw.distance(), delta: 1.0E-7);
32          pmt.invokePrivate( name: "move", ...parameters: 1, 0);
33          assertEquals( expected: 2.0, rw.distance(), delta: 1.0E-7);
34          pmt.invokePrivate( name: "move", ...parameters: -1, 0);
35          assertEquals( expected: 1.0, rw.distance(), delta: 1.0E-7);
36          pmt.invokePrivate( name: "move", ...parameters: -1, 0);
37      }
38  }
```

Run: RandomWalkTest

Test	Duration
RandomWalkTest (edu.neu.coe.info6205.randomwalk)	215 ms
testRandomWalk2	38 ms
testMove0	3 ms
testMove1	1 ms
testMove2	2 ms
testMove3	2 ms
testRandomWalk	169 ms

Tests passed: 6 of 6 tests - 215 ms

"C:\Program Files\Java\jdk-12.0.2\bin\java.exe" ...

Process finished with exit code 0

Tests passed: 6

Tests passed: 6 (moments ago)