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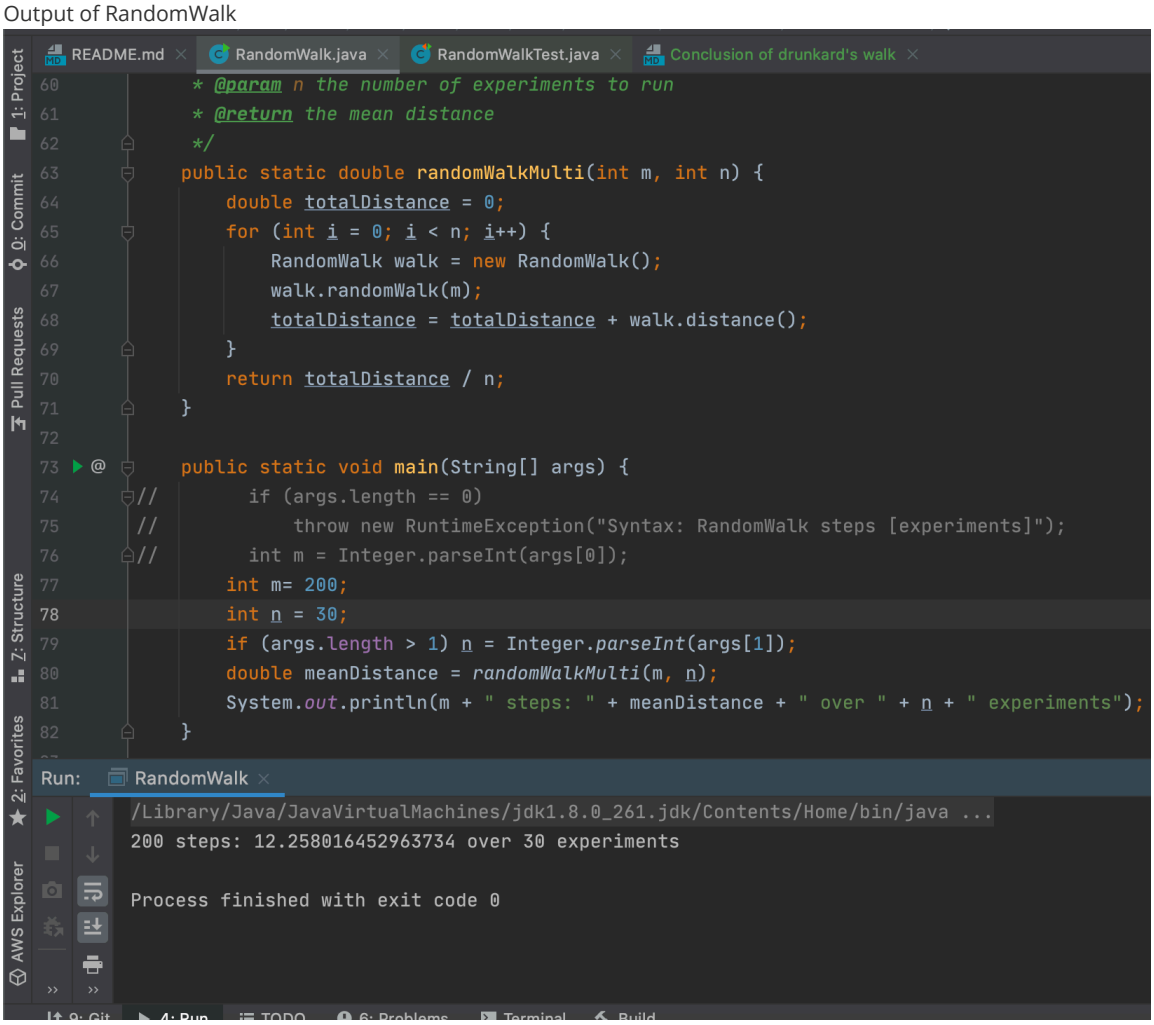
Task

Question:

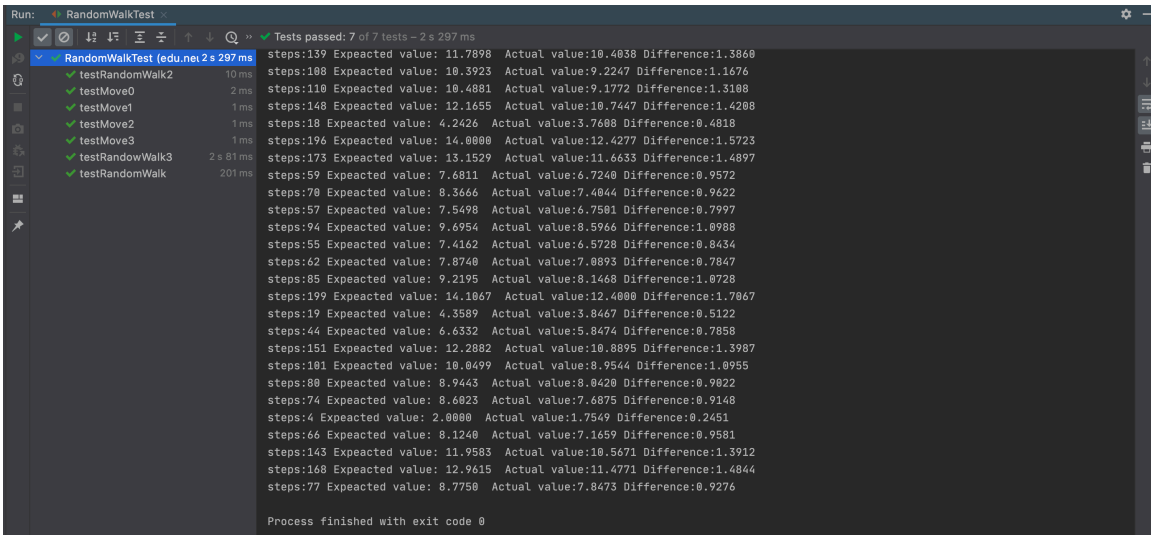
Your submission should include:

1.Your conclusion about the relationship between d and n;
2.Your evidence to support that relationship (screen shot and/or graph and/or spreadsheet);
3.Your code (RandomWalk.java plus anything else that you changed or created);
4.A screen shot of the unit tests all passing.

- Output of RandomWalk



- Tests Results



- My own test

Conclusion

> **n : number of steps**
>
> **d : the distance between the man and the lamp post.**

Delta is the difference between the expected value and the actual value. The more tests, the more likely Delta will be to zero

$$\sqrt{n} = d \pm \Delta$$

Prove

According to the given topic, we can only get the expected value of the distance, that is, to find the following expected value

$$E_n(X^2 + Y^2) = \sum (x^2 + y^2) P(X = x, Y = y)$$

According to the same possibility of the four directions, it can be concluded that

$$P(X = x + 1, Y = y) = P(X = x + 1, Y = y | X = x, Y = y) P(X = x, Y = y) = \frac{1}{4} P(X = x, Y = y)$$

Therefore，for N=n+1 :

$$E_{n+1}(X^2 + Y^2) = \frac{1}{4} \sum [(x+1)^2 + y^2] + [x^2 + (y+1)^2] + [(x-1)^2 + y^2] + [x^2 + (y-1)^2] P(X = x, Y = y)$$

A fter simplificated, we got :

$$E_{n+1}(X^2 + Y^2) = \sum (x^2 + y^2 + 1) P(X = x, Y = y) = E_n(X^2 + Y^2) + \sum P(X = x, Y = y)$$

Absolutely

$$\sum P(X = x, Y = y) = 1$$

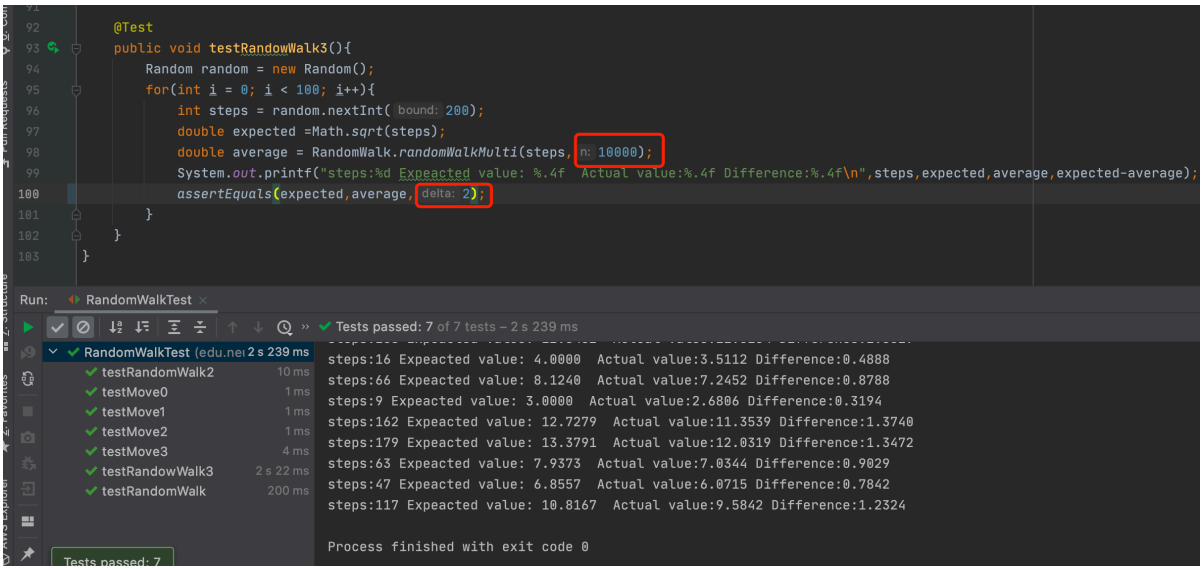
So, we get

$$E_n(X^2 + Y^2) = n$$

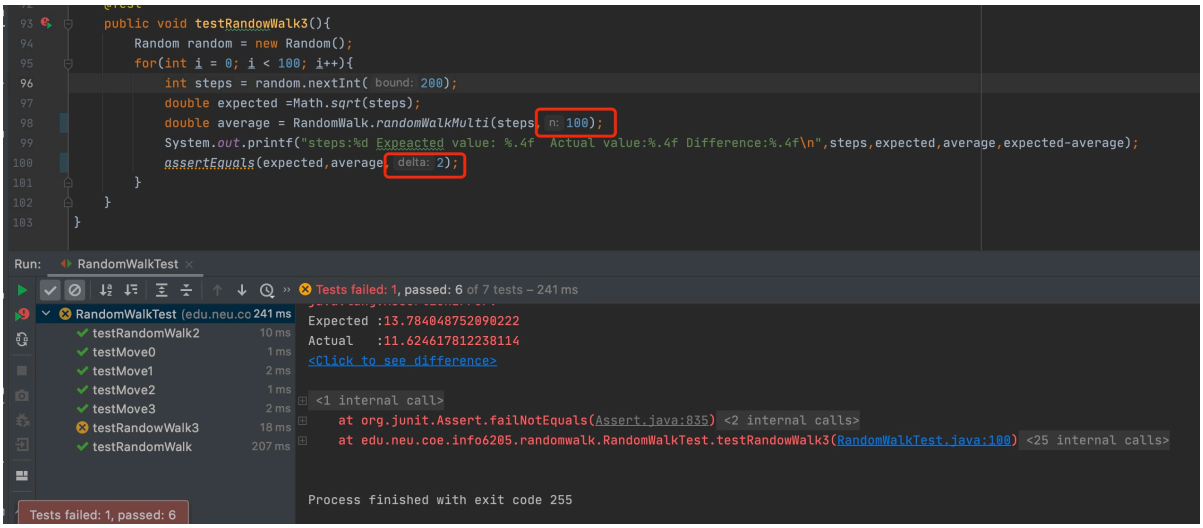
That is to say, the number of steps is the square of the expected Euclidean distance

Provement of the test results

- When n=10000, delta=2 could pass the test successfully;



- When n=100, delta=2 failed to pass the test;



That is to say, as the number of test getting bigger, delta will tend to 0.