

Random Numbers in Python

Random variable is a variable whose value is subject to variations due to chance.

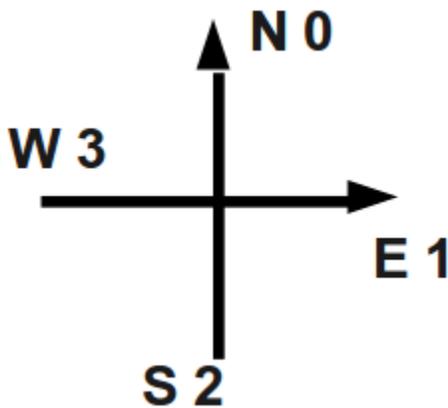
In Python module `random` provides the ability to generate random numbers.

```
import random
a=random.randint(2,6)
```

Once you run this program, the variable `a` will have a random integer that the computer made for you, between 2 and 6 (including 2 and including 6).

Exercise 1. A drunkard's walk.

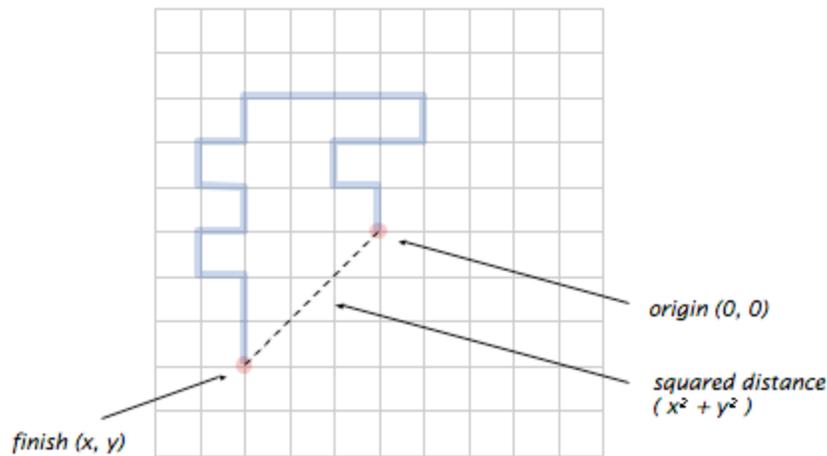
A drunkard begins walking aimlessly, starting at a lamp post. At each time step, the drunkard forgets where he or she is, and takes one step at random, either north, east, south, or west, with probability 25%. How far will the drunkard be from the lamp post after N steps?



In order to emulate drunkard's steps we can encode each direction with the number so that when the random variable is equal to 0 the drunkard moves north, if random variable is equal to 1 the drunkard moves east and so on (see the picture above).

Task a

Use the skeleton `DrunkardRandomWalkA.py`. Write a program that takes an integer argument N and simulates the motion of a random walker for N steps. After each step, print the location of the random walker, treating the lamp post as the origin $(0, 0)$. Also, print the final squared distance from the origin.



Example:

N=10	N=8
(0, -1)	(0, 1)
(0, 0)	(-1, 1)
(0, 1)	(-1, 2)
(0, 2)	(0, 2)
(-1, 2)	(1, 2)
(-2, 2)	(1, 3)
(-2, 1)	(0, 3)
(-1, 1)	(0, 2)
(-2, 1)	squared distance=4
(-3, 1)	
squared distance= 10	

To test your application, run the program file `DrunkardRandomWalkTest.py`

Task b

Write a program using skeleton `DrunkardRandomWalkB.py` that takes two integers N and T as an input. In each of T independent experiments, simulate a random walk of N steps and compute the squared distance. Output the mean squared distance (the average of the T squared distances).

Example:

N=100 T=10000	N=400 T=2000
98.7246	398.456
N=200 T=1000	N=800 T=5000

Example:

201.048

788.4784

Remark: this process is a discrete version of a natural phenomenon known as Brownian motion. It serves as a scientific model for an astonishing range of physical processes from the dispersion of ink flowing in water, to the formation of polymer chains in chemistry, to cascades of neurons firing in the brain.

Disclaimer: This exercise is taken from the University of Arizona Computer Science

Program Design and Development course

<https://www.cs.arizona.edu/classes/cs227/fall14/assignments.html>