

Home-work 3- Report

Name: Neel Haria

1. Rectangular.py

Code:

```
1  #1.1
2  import numpy as np
3  class Rectangular():
4
5      def __init__(self,length,breadth): #initializing length and breadth
6          self.length = length
7          self.breadth = breadth
8
9      def area(self):
10         return self.length * self.breadth #Calculating area i.e length*breadth
11
12     def perimeter(self):
13         return 2*(self.length+self.breadth) #Calculating perimeter i.e 2(length+breadth)
14
15
16  #1.2
17
18  if __name__ == "__main__":
19      length= np.random.randint(1,100,10) #Generating random values for length
20      width = np.random.randint(1,100,10) #Generating random values for width
21
22      a = np.array(length) #Entering length values into array
23      b = np.array(width) #Entering width values into array
24
25      print("length: ",a)
26      print("breadth: ",b)
27
28      myRec = Rectangular(a,b) #Creating method for class
29      print("area: ",myRec.area()) #Calling function in class
30      print("perimeter: ",myRec.perimeter()) #Calling function in class
```

Output:

```
C:\Users\neelh\AppData\Local\Programs\Python\Python37\python.exe "C:/
length:  [44  7 61 87  2 52 63 61 96  3]
breadth:  [23 45 22 90 41 39 86  1 11 16]
area:    [1012  315 1342 7830  82 2028 5418  61 1056  48]
perimeter:  [134 104 166 354  86 182 298 124 214  38]

Process finished with exit code 0
```

2. Time.py

Code:

```
1  #2
2  class Time():
3      def __init__(self, hour, minute, second): #Initializing hour minute and second values
4          self.hour = hour
5          self.minute = minute
6          self.second = second
7
8      def addTime(self, time): #Calculating total time after addition
9          self.second += time.second
10         if self.second >= 60: #Convert to mins if seconds greater than 60
11             self.second, self.minute = self.second % 60, self.minute + self.second // 60 #assign remainder as seconds beyond 60
12
13         self.minute += time.minute
14         if self.minute >= 60: #Convert to hours if mins greater than 60
15             self.minute, self.hour = self.minute % 60, self.hour + self.minute // 60
16
17         self.hour += time.hour
18
19     def DisplayTime(self): #Call function to display
20         return (f'{self.hour} hr {self.minute} mins and {self.second} seconds')
21
22     def DisplaySecond(self): #Call function to convert time into seconds and display
23         self.second = self.hour * 3600 + self.minute * 60 + self.second
24         return (self.second)
25
26 if __name__ == "__main__":
27     t1 = Time(2, 12, 45) #Creating instance t1 for Time class
28     t2 = Time(2, 44, 45)
29     t1.addTime(t2) #Calling function addtime
30     print("Add Time: ", t1.DisplayTime())
31     print("Seconds t1: ", t1.DisplaySecond())
32     print("Seconds t2: ", t2.DisplaySecond())
```

Output:

```
C:\Users\neelh\AppData\Local\Programs\Python\Python37\python.exe "C:/Users/neelh/Time.py"
Add Time:  4 hr 57 mins and 30 seconds
Seconds t1:  17850
Seconds t2:  9885

Process finished with exit code 0
```

3. Random Number Generator

Code:

```
1  #3 Random Number Generator
2  import matplotlib.pyplot as plt
3  class LCG():
4      def __init__(self, seed, multiplier, increment, modulus): #Initializing seed, multiplier, increment and modulus
5          self.seed = seed
6          self.multiplier = multiplier
7          self.increment = increment
8          self.modulus = modulus
9
10     def getSeed(self): #Return seed value
11         return (self.seed)
12
13     def iter(self):
14         return self
15
16     def SetSeed(self, inputSeed): #Used to set seed, if seed needs to be changed
17         self.seed = inputSeed
18         return (self.seed)
19
20     def generate(self): #Generate Random Numbers
21         self.seed = (self.seed*self.multiplier +self.increment)%self.modulus, # Replicating  $X_{n+1} = (X_n(X_n + 1)) \bmod M$ 
22         self.SetSeed(self.seed)
23         return(self.seed)
24
25     def __next__(self): #Return next Random Number
26         return self.generate()
27
28     def nextNumbers(self, n): #Return next n Random Numbers
29         a=[] #List to store random numbers
30         for i in range(n):
31             a.append(self.generate()) #Storing the random numbers
32             plt.scatter(self.generate(), i) #Visualization of the uniform distribution of the random numbers
33         plt.xlabel("Random Number") #X axis
34         plt.ylabel("Iteration") #Y axis
35         plt.show()
36         return a
37
38
39     class SCG(LCG): #Inherited class SCG
40         def __init__(self, seed, multiplier, increment, modulus): #Initialization of variables
41             self.seed = seed
42             self.multiplier = multiplier
43             self.increment = increment
44             self.modulus = modulus
45             if self.seed%4!=2:
46                 print("error")
47             # else:
48
49     def generate(self): # Function to generate random numbers
50         if self.seed%4!=2: #Checks for conditions i.e  $(X_0 \bmod 4 = 2)$ 
51             ValueError("error") #Returns error if condition is false
52         else:
53             self.seed = (self.seed*(self.seed + 1))%self.modulus #Generation of Random number if satisfies condition. Formula :  $X_{n+1} = (X_n(X_n + 1)) \bmod M$ 
54             return (self.seed)
```

```

57  ► if __name__ == "__main__":
58      a = LCG(2,1103515245,12345,2**32)
59      b = SCG(2,1103515245,12345,2**32)
60      print("LCG Next Number: ",a.__next__())
61      print("SCG Next Number: ",b.__next__())
62      print("LCG Next n Numbers: ",a.nextNumbers(100))
63      print("SCG Next n Numbers: ",b.nextNumbers(100))
64      #print("\n")

```

Output:

```

C:\Users\neelh\AppData\Local\Programs\Python\Python37\python.exe "C:/Users/neelh/OneDrive
LCG Next Number:  2207042835
SCG Next Number:  6

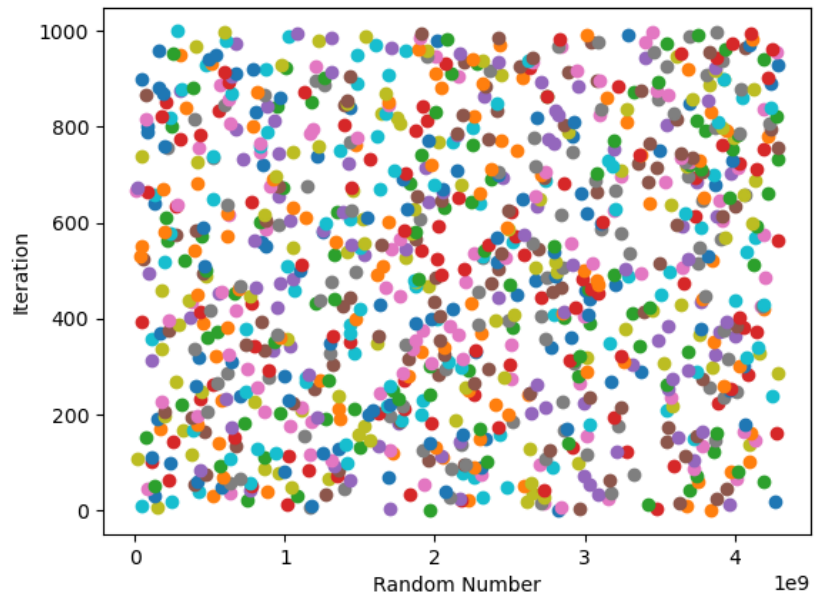
```

LCG Next n Numbers:

```

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```

Visualization of LCG Uniform Distribution of Random n(n =1000) Numbers

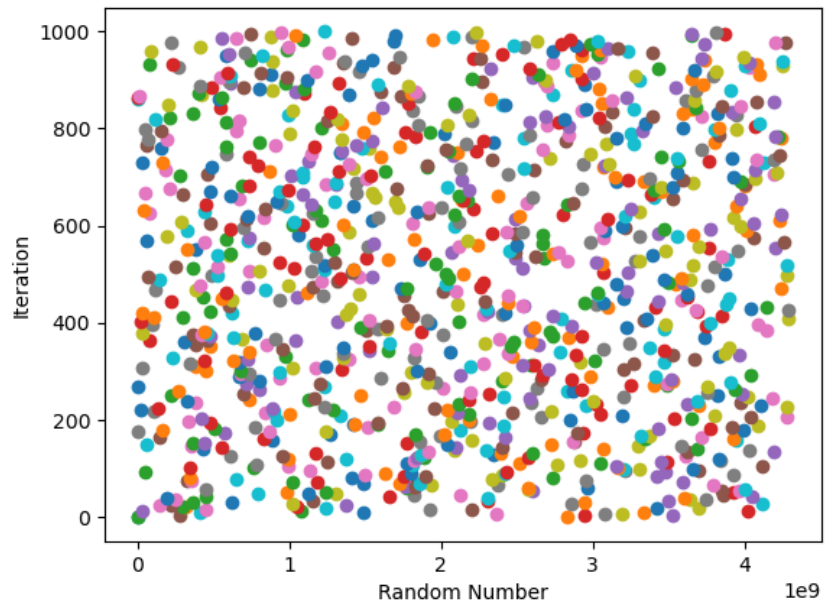


SCG Next n Numbers:

SCG Next n Numbers: [42, 3263442, 3537057274, 1232959906, 2824681930, 1987019122, 1272169370, 3699563330, 1878723434, 2377187090, 1918224698, 3007440098, 1536505098, 433849522, 1430849242, 114579074, 214922922, 2931708498, 3146071162, 3845910562, 3426062410, 3725436914, 1439312410, 392327618, 3812311530, 3311912338, 1086295994, 1461295970, 1178356618, 3964824370, 3606392154, 3575328002, 2390519082, 1916491986, 3538076410, 252241570, 1143432906, 2356694642, 3236434074, 4117530690, 2018572394, 1413942290, 3243038266, 1639436770, 2935284234, 3838661042, 2587939802, 3695477634, 418833322, 3373850450, 433834362, 2991873314, 505593162, 3122623730, 3357374234, 1544625058, 925642474, 2898186898, 3907886266, 848070754, 397342858, 800897074, 3457940058, 1975540226, 674159146, 432465362, 2036355066, 2727236514, 1343722442, 2272467826, 2388286874, 415249738, 264037738, 692001042, 2492588858, 285720290, 3931803402, 3784351410, 2306253018, 3808342146, 538202282, 2998234194, 3261093498, 2603010594, 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Visualization of SCG Uniform Distribution of Random n(n =1000) Numbers



4. point.py

Code:

```
1  #4point.py
2  import math
3  class Point():
4      def __init__(self,x,y): #Initializing co-ordinates x and y
5          self.x = x
6          self.y = y
7
8      def cal(self):
9          return math.sqrt(self.x**2 + self.y**2) #Calculating distance
```

5. MCTest.py

Code:

```
1  import time
2  import numpy as np
3  import math
4  from generator import LCG, SCG #import functions from generator.py
5  from point import Point
6
7  def test(gen, num_points=1000000): # Tests a generator by estimating the ratio of points that fall within a circle.
8      start = time.time() #Start Counter
9
10     it = iter(gen) #Iterate over generated numbers using LCG and SCG
11     points = np.fromiter(it, float, count=num_points) #Get Points
12     points = 2 * ((points - min(points)) / (max(points) - min(points))) - 1
13     circle_count = 0
14     for i in range(0, num_points):
15         p = Point(points[i], points[i])
16         circle_count += 1 if p.cal() <= 1 else 0
17
18     end = time.time() #End Counter
19
20     print(f'\nTested {num_points} points in {(end - start):.5f} seconds.')
21     print(f'Result: {(math.pi / 4 - circle_count / num_points):.5f}\n')
22
23     if __name__ == '__main__':
24         lcg = LCG(1, 1103515245, 12345, 2 ** 32)
25         scg = SCG(1, 1103515245, 12345, 2 ** 32)
26         print("LCG Test: ")
27         test(lcg.nextNumbers(1000000))
28         #Tested 1000000 points in 19.67703 seconds.
29         #Result: 0.07810
30         print("SCG Test: ")
31         test(scg.nextNumbers(1000000))
32         #Tested 1000000 points in 18.53158 seconds.
33         #Result: 0.78540
```

Output:

LCG Test:

Tested 10000000 points in 20.43961 seconds.

Result: 0.07810

SCG Test:

Tested 10000000 points in 18.87053 seconds.

Result: 0.78540

Process finished with exit code 0