

BIO 480/680 Computer programming exercise III

This exercise is based on a program that might have been used for our project that tested the random number generator for uniformity. This program is listed on the next page of this exercise. The line numbers have just been added for reference purposes.

- 1) What is the purpose of lines 3 - 5 in the program?
- 2) As noted in the comment in line 7, why would we want the system time used as a seed for the random number generator?
- 3) The variable *number* appears in lines 10, 11, and 13. What is this value use for?
- 4) The variable *count* is an integer array. What is it used for in this program? Why does it only need 10 rows, as indicated in line 11.
- 5) In line 15, what is the “ += 1” part doing?
- 6) In line 14, what is the “ (0, 9) “ part specifying?
- 6) Why does line 10 specify that the variable *x* has to be an integer variable?
- 7) What is the purpose of the for loop in lines 17 – 18? It uses the “range” function. What values does this function return?
- 8) What would we have to change to get the program to look at the uniformity over 1000 random integers?

```
1  # Generate a few random numbers for a uniformity test
2
3  import numpy as np
4  import matplotlib.pyplot as plt
5  import random
6
7  # By default, the system time is used as a seed
8
9  number = 100
10 x = np.zeros(number, dtype=int)
11 count = np.zeros(10, dtype=int)
12
13 for i in range(number):
14     x[i] = random.randint(0, 9)
15     count[x[i]] += 1
16
17 for i in range(10):
18     print (f"Count of integer {i} is {count[i]}")
19
20 plt.bar(range(10), count)
21 plt.xlabel( 'Values' )
22 plt.ylabel( 'Frequency' )
23 plt.show()
```

For the second part of this exercise, a program has been written as shown. This program could have been used to solve the logistic population model as part of our Lab 6 project using Euler's method. The line numbers have been added to identify each line.

```
1      # Logistic ODE with Euler's method
2
3      import numpy as np
4      import matplotlib.pyplot as plt
5
6      r = 1.5
7      k = 100
8      tfinal = 30
9      dt = 0.5
10     steps = int(tfinal / dt)
11     N = np.zeros(steps+1)
12     t = np.zeros(steps+1)
13     N(0) = 2.0
14     t = 0.0
15     for i in range(steps):
16         dN = r * N[i] * (1 - N[i] / k * dt
17         N[i+1] = N[i] + dN
18         t[i+1] = t[i] + dt
19
20     # Display data
21     for i in range(steps+1):
22         print( f"{t[i]:.1f} \t {N[i]:.2f}")
23
24     # plot results
25     plt.plot(t,N)
26     plt.xlabel('Time')
27     plt.ylabel('N')
28     plt.show()
29
30     # Save results to a file
31     np.savetxt('LogODEEulers.txt', np.transpose([t,N]),
                fmt='%4.1f, %8.4f', newline='\n')
```

You see error messages at lines 13 and 14, fix the errors.

There is also an error in line 16, fix the error.

Why does line 10 have “int” before that calculation?

What is the purpose of that “\t” in line 22?

If the value for dt is 0.1, how many steps would be needed to find the solution to a time of 50?