Python Programming for Engineers

Assignment # 4

Due date: Tuesday, Dec. 28th, 2021

IMPORTANT!

1. Submit your HWs **ONLINE** before the due date
2. HW reports should contain:
    a. The description of the problem and proposed solution
    b. The program code
    c. Any program outputs
3. Submitted codes should be well-commented.

Problem 1:

Design a Python class named **HomogenEquation** for a system of 2x2 linear homogeneous equations:

$$ax + by = 0$$
$$cx + dy = 0$$

The class should contain:

- The data fields **a**, **b**, **c** and **d**.
- A constructor with the arguments for **a**, **b**, **c** and **d**.
- A method named **isSolvable()** that returns **true** if $ad - bc$ is not **0**.
- The method **getXY()** that returns the solution for the equation.

Write a test program that prompts the user to enter **a**, **b**, **c** and **d** and displays the result. If the equation is not solvable, report that "The equation has no solution."

Problem 2:

Write a Python class and methods to simulate a neighborhood containing two types of animals, Dogs and Cats. The neighborhood consists of a large list of locations. Each element of the list should be a Dog object, a Cat object, or None. In each time step, based on a random process, each animal either attempts to move into a random empty (i.e., previously None) location or stay where it is. If two animals of the same type are about to collide in the same location, then they stay where they are, but they create a new instance of that type of animal, which is placed in the collision location in the list. If a Dog and a Cat collide, however, then the Cat escapes to the closest empty location in the list. Each animal is assigned a random amount of life span (between 1 to 10 time steps), after which it dies.

Simulate a neighborhood of 40 locations, with initially 5 dogs and 5 cats, for 100 time steps. Print the neighborhood, total number of cats and dogs after each 10 time step.

Problem 3:

The following table shows the annual prices of 1 gram of gold.

1. By using *interpolate.interp1d* method of SciPy package, do the following questions.
    a. Estimate the annual prices of 1 gram gold for all years between 1991 and 2012 by using **linear** and **cubic** interpolation.
    b. Plot the given list of prices and the interpolated results vs. years, using *matplotlib.pyplot.plot* method.

1991	0.05 TL
1994	0.45 TL
1999	4.90 TL
2003	20 TL
2006	28 TL
2009	54 TL
2012	98 TL

2. Consider the table above again. Estimate and display the annual price of 1 gram gold for all years between 1991 and 2012 by using polymonial regression methods *polyfit* and *polyval* of NumPy package.
    a. Use **first, third** and **fifth** order polynomial regression.

    (Hint: First model the given data by using *polyfit* method. Once you obtain a polynomial which models the data, evaluate the value of the polynomial for the given years using *polyval* method.)

    b. Plot the given list of prices and the estimated results vs. years, using *matplotlib.pyplot.plot* method.