ME 228 (S2): Hackathon 16-Mar-2022

In a geographical region, the populations of *leopanet* and *paldore* (some creatures) are measured and recorded as follows. The population of these two creatures are affected by each other - since *paldore* feeds on *leopanet*.

The data (.csv file) sent via webmail individually contains 2 columns (x_1 and x_2). You may consider the first row to be at time 0, and consider successive rows at a time interval of 0.1. See below. You may wish to create the time column if you need, but this can be solved without explicitly having the time column.

time	x_1	x_2
0	Value 1	Value 1
0.1	Value 2	Value 2
0.2	.	.
0.3	.	.
…	.	.

From the data given**, obtain a governing ordinary differential equation** for the evolution of **each of the creatures**, that models *the rate of change of population*. You may consider all linear and non-linear terms to be a part of the governing equation, up to 2nd degree.

Hint 1: In usual problems seen so far, we have Xw=y, where w and y are column vectors. In this problem, they may be multiple column matrices.

Hint 2: For estimation of derivatives of given population data, use central difference method.

$$f'(a) = \frac{f(a+t) - f(a-t)}{2t}$$

Submission needs to contain the following (single .ipynb file only, NO pdf file needed):

a. Create a new .ipynb file. Note down the problem statement clearly. Identify what is given and what is to be found. Plot the given data with time. [5]
b. In the same file, Briefly present your hypothesis and approach to solve this problem. [10]
c. Write the solution methodology and/or the pseudocode. [5]
d. Show the final result solution by your own coding (you may also typeset the equation thus discovered, in python notebook and show the equation in the . ipynb file. Displaying this is not mandatory). [20]
e. Demonstrate the train-test performance by splitting the input data. You may wish to consider 3 different splits in total. Note that it's a time-series data – splitting is to be done with caution [10]

The following part is optional, exploratory work and will not be graded.

Can you also derive or explain the governing ODE by looking at the problem? Explore this for fun. You may also plot numerical solution of the same for verification, by keeping a time step of 0.1. There are also libraries available to be employed directly.