IE614: Linear Systems **Jan-Apr 2021**

In-class Assignment 1: Due Today (15-January-2020 03:30 PM IST)

1 Instructions and Questions

See the attached Python code implementing Euler's method for solving the Malthusian model of population. Write (or print) all your answers in the `.ipynb` file shared at Google colab. Use plots wherever required.

For questions 1 to 6, use a single `.ipynb` file named as `YOURROLLNO_IE614_ICA1_Q1to6.ipynb`.

Use different `.ipynb` files for Questions 7(a) and 7(b). Your `.ipynb` files for Questions 7(a) and 7(b) should be named `YOURROLLNO_IE614_ICA1_Q7a.ipynb` and `YOURROLLNO_IE614_ICA1_Q7b.ipynb` respectively.

1. Read the code and understand the functionality of code.
2. Choose $h \in \{0.1, 0.01, 0.001, 0.0001, 0.00001\}$. For each value of h tabulate the actual and predicted population values after time $final\_T = 1$.
3. Comment on the accuracy of the values obtained by Euler's method against the true values. Can you empirically verify that the errors behave as $\sim O(h^2)$? Explain.
4. For each value of h, plot the actual and predicted values. Comment on the behavior you observe.
5. With $h = 0.1$, choose $final\_T \in \{2, 5, 10, 50\}$. Tabulate the actual and predicted population values for each value of $final\_T$.
6. Comment on the behavior of plots you obtained by fixing $h = 0.1$ and by varying $final\_T$.
7. Write similar code to solve the following linear first order ODEs:
   (a) $\frac{d}{dt}y(t) + y(t) = t,\ y(0) = 2.$
   (b) $t^2 \frac{d}{dt}y(t) + 2ty(t) = 1,\ y(2) = -4.$

   Perform similar experiments as mentioned above and report the results.

Download all your `.ipynb` files into a single folder named `YOURROLLNO_IE614_ICA1`, compress the folder into a single `zip` file, name the `zip` file as `YOURROLLNO_IE614_ICA1.zip` and upload in moodle by the deadline.