Management Mathematics

Assignment 1

Due Date: Mar. 31, 2022, 5pm

Please solve the following questions and justify your answer by using Python. Show all your analysis result in your report. **Upload your "HTML" file including the answers and Python code with file name: MM01_StudentID_Name" to *NTU COOL*** by due. The late submission is not allowed.

Note:

- 電腦作業使用 Jupyter Lab/Notebook 完成。
- 文件轉成 HTML 格式，上傳至 NTU COOL 作業區。
- It is highly encouraged to discuss the homework with classmates, but DO NOT COPY programs from others. The copying behavior will result in a reduced score according to the discretion of the teaching assistant.
- NTU COOL 上傳是唯一的繳交方式。不能印出來以紙本繳交或帶隨身碟要求拷貝檔案。
- 我們不只關心你的程式碼，更關心你對問題的理解與詮釋。如果你的作業只有程式碼，沒有任何其他的說明，會被扣大部分的分數。
- 檔案名稱：MM##_StudentID_NAME (eg. MM01_A12345678_李大岩)
- 作業最前面應註明這是哪次作業 (如 MM01)，你的學號與姓名、題目題號清楚標明
- 使用「三明治」答題法: (1)說你要做什麼；(2)程式碼；(3)說你的結果是什麼，以及你的觀察與結論。

Please answer following questions and justify your answer. Show all your works in details.

1. (**40%**) Matrix Multiplication and Solve a Linear System

   Please read the following materials about the python with NumPy.

   - NUMPY ARRAY BASICS A: https://www.bogotobogo.com/python/python_numpy_array_tutorial_basic_A.php
   - NUMPY ARRAY BASICS B: https://www.bogotobogo.com/python/python_numpy_array_tutorial_basic_B.php
   - NUMPY MATRIX AND LINEAR ALGEBRA: https://www.bogotobogo.com/python/python_numpy_matrix_tutorial.php

   (a) (**10%**) Build the matrix $\boldsymbol{A}$ and vector $\boldsymbol{b}$ for the following linear system with $\boldsymbol{Ax} = \mathbf{b}$.

   $$-5x_1 + 4x_2 + 0x_3 + 1x_4 = -17$$
   $$-30x_1 + 27x_2 + 2x_3 + 7x_4 = -102$$
   $$5x_1 + 2x_2 + 0x_3 + 2x_4 = -7$$
   $$10x_1 + 1x_2 - 2x_3 + 1x_4 = -6$$

   (b) (**10%**) Based on (a), solve the system with numpy.linalg.

   (c) (**10%**) Based on (a), find the inverse of matrix $\boldsymbol{A}$ with numpy.linalg; that is, $\boldsymbol{A}^{-1}$?

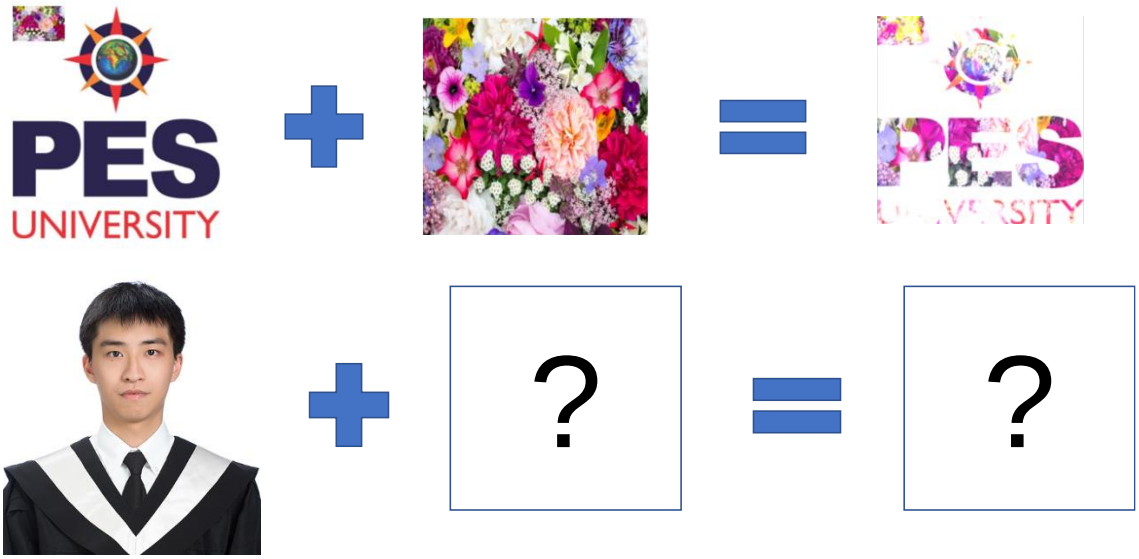
   (d) (**10%**) Based on (a) and (c), calculate $\boldsymbol{A}^{-1}\boldsymbol{b}$. What's the result you obtain?

2. (**60%**) Image Processing and Filters

   Please read the following materials about the python.

   - Applications of Linear Algebra in Image Filters [Part I]- Operations: https://medium.com/swlh/applications-of-linear-algebra-in-image-filters-part-i-operations-aeb64f236845
   - basic_image_processing/Linear_Algebra_filters.ipynb: https://github.com/hemanth-nag/basic_image_processing/blob/master/Linear_Algebra_filters.ipynb
   - Image Processing in Python (Scaling, Rotating, Shifting and Edge Detection): https://www.geeksforgeeks.org/image-processing-in-python-scaling-rotating-shifting-and-edge-detection/
   - Image-Processing-Python: https://github.com/ravi089/Image-Processing-Python

   (a) (**15%**) Follow the linkages mentioned above, suggest an image "?" and use "Matrix Addition" to decorate the TA Yi-Tao's picture. (picture credits: Hemanth Nag, 2020)



   (b) (**15%**) Based on (a), use "Matrix Subtraction" to decorate the TA Yi-Tao's picture.

   (c) (**15%**) Use Open CV (https://opencv.org/) to rotate the matrix (i.e. TA Yi-Tao's picture) with respect to (w.r.t) center to clockwise 60 degree with double scaling (i.e. 2 times).

   (d) (**15%**) Use Canny Edge Detection (in Open CV) for TA Yi-Tao's picture.
   (Hint: https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_imgproc/py_canny/py_canny.html)

Note

1. Show all your work in detail. **Innovative** idea is encouraged.
2. If your answer refers to any external source, please "must" give an academic citation. Any "plagiarism" is not allowed.