

Management Mathematics

Assignment 1

Due Date: Mar. 29, 2021, 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 \mathbf{A} and vector \mathbf{b} for the following linear system with $\mathbf{Ax} = \mathbf{b}$.

$$3x_1 + 2x_2 + 0x_3 = 2$$

$$1x_1 - 1x_2 + 0x_3 = 4$$

$$0x_1 + 5x_2 + 1x_3 = -1$$

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

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

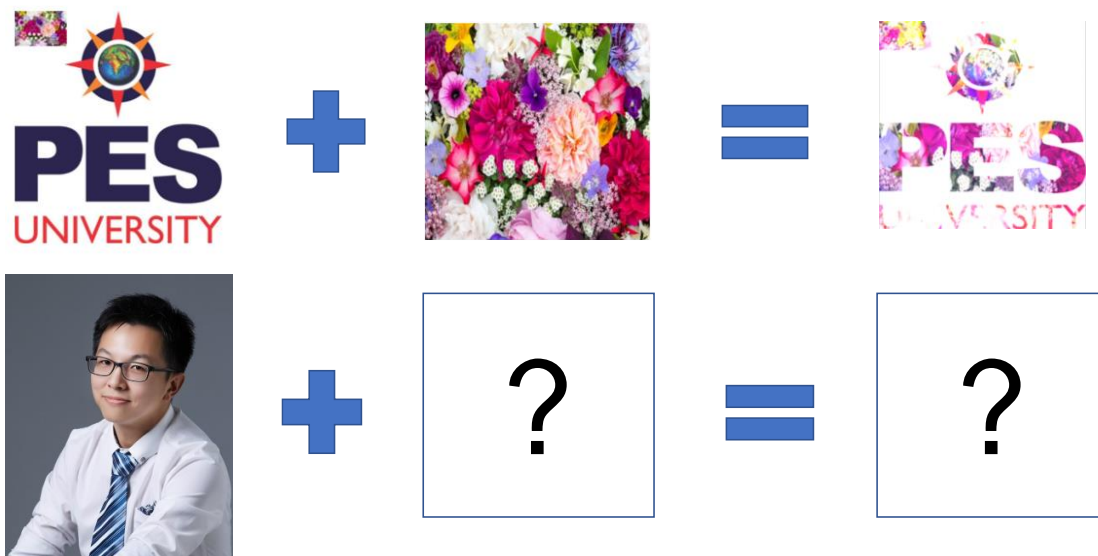
(d) (10%) Based on (a) and (c), calculate $\mathbf{A}^{-1}\mathbf{b}$. What's the result you obtain?

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 Dr. Lee’s picture. (picture credits: Hemanth Nag, 2020)



- (b) (15%) Based on (a), use “Matrix Subtraction” to decorate the Dr. Lee’s picture.
- (c) (15%) Use Open CV (<https://opencv.org/>) to rotate the matrix (i.e. Dr. Lee’s picture) with respect to (w.r.t) center to 45 degree without scaling.
- (d) (15%) Use Canny Edge Detection (in Open CV) for Dr. Lee’s picture.

(Hint:

https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_imgproc/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.