National Cheng Kung University   Department of Engineering Science

Instructor: Chi-Hua Yu

Lab 7

Programming, Due 10:00, Wednesday, April 20th , 2022

注意事項：

1. Lab 的時間為授課結束(Lab 當天 10:00)。

2. Lab 的分數分配：出席 20%，Lab 分數 100%，Bonus 20%。

3. 請儘量於 Lab 時段完成練習，完成後請找助教檢查，經助教檢查後沒問題者請用你的學號與 Lab number 做一個檔案夾 (e.g., N96091350_Lab24, 將你的全部 ipynb 檔放入檔案夾，壓縮後上傳至課程網站 (e.g., N96091350_Lab4.zip)。

4. 上傳後即可離開。

5. 未完成者可於隔日 11:55 pm 前上傳至 Moodle，惟補交的分數將乘以 0.8 計，超過期限後不予補交。

6. Bouns 只需要在每週四的 11:55 pm 上傳即可。

Lab Submission Procedure (請仔細閱讀)

1. You should submit your Jupyter notebook and Python script (`*.py`, in Jupyter, click File, Download as, Python (`*.py`)).
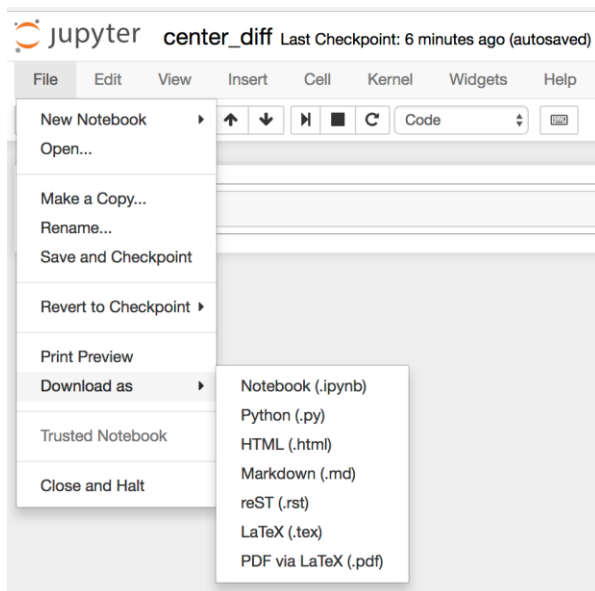
2. Name a folder using your student id and lab number (e.g., n96081494_lab1), put all the python scripts into the folder and zip the folder (e.g., n96081494_lab1.zip).

3. Submit your lab directly through the course website.

1. **(100%)** Name your Jupyter notebook `trapezoid_rule.ipynb` and Python script `trapezoid_rule.py`.

   (1) Write a Python program to approximate $\int_{-2}^{4} 4x^2 + \frac{1}{3}x + 5\,dx$ with 3, 11 and 21 evenly spaced grid points over the whole interval with the trapezoid rule. Compare this value to the exact value of 128.

   (2) Please plot the trapezoid integral procedure. The area below the curve is approximated by an areas of trapezoids that approximate the function. (hint: `Matplotlib.pyplot.fill()` can be used to fill the area enclosed by polygon. The color order of the area of the trapezoid region is `['darkorange','forestgreen','royalblue']` and `alpha = 0.5`.)

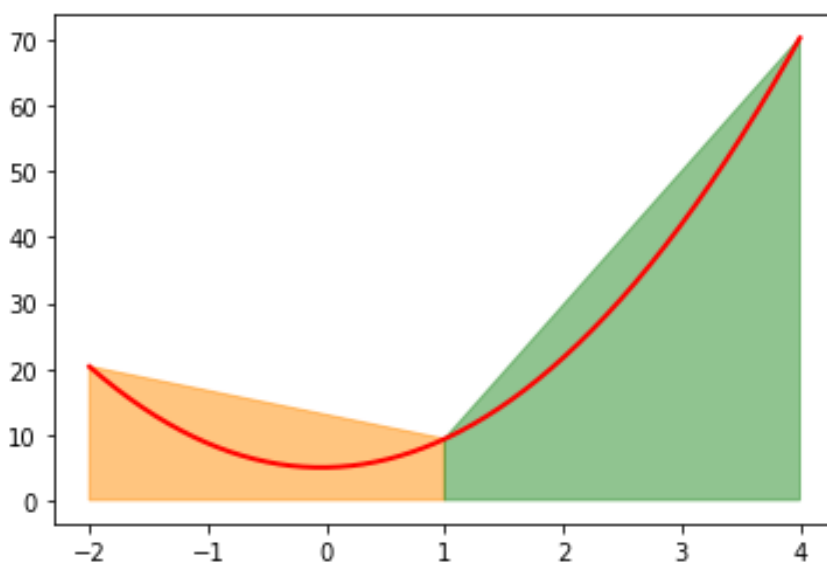   Use the below code to plot curve (red line):

```
def function(x):
    f = 4*(x**2) + (1/3)*x + 5
    return f
x_curve = np.linspace(a, b, 1000)
plt.plot(x_curve , function(x_curve), linewidth=2, c = 'r').
```

   Below is the running example:

   Sample 1

   Spaced grid points are 3.

```
I_trap: 164.0
err_trap: -36.0
```

Sample 2

Spaced grid points are 11.

```
I_trap: 129.439
err_trap: -1.439
```
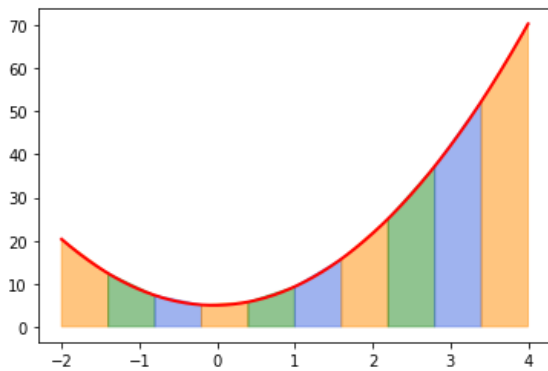
Spaced grid points are 21.

```
I_trap: 128.359
err_trap: -0.359
```