Numerical Method

National Cheng Kung University Department of Engineering Science

Instructor: Chi-Hua Yu

Lab 8

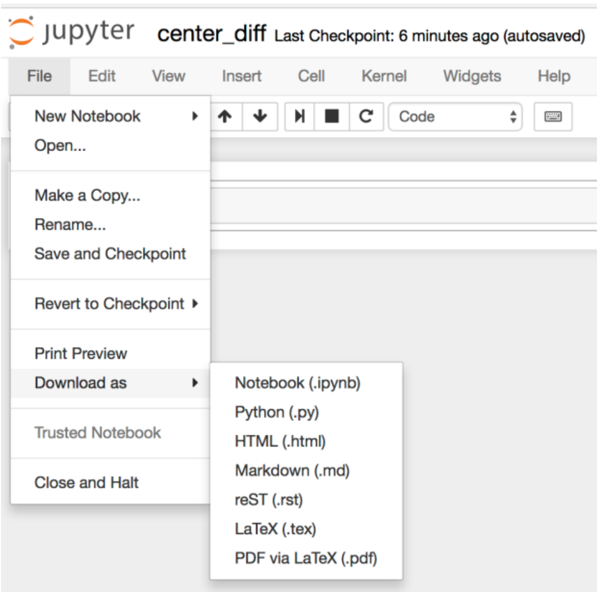
Programming, Due 10:00, Wednesday, April 27th, 2022

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_Lab8, 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_Lab8.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.

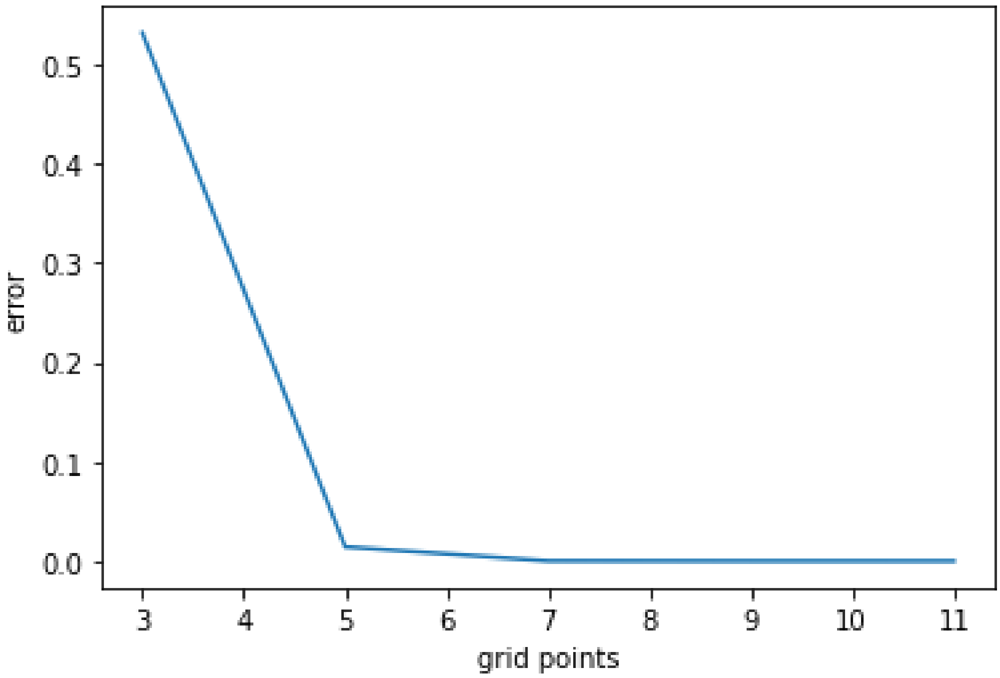
1. (50%) Name your Jupyter notebook `Simpson_rule.ipynb` and Python script `Simpson_rule.py`. Use Simpson's rule to approximate $\int_0^{\pi} e^{\sin(x)}dx$ and compare this value to the exact value of 6.208758035711. Compare the error of the approximation with the exact value using grid points in the range 3 to 12 according to **Simpson's rule**. Please print the minimum error and plot the error of grid points

```
def function(x):
    f = np.exp(np.sin(x))
    return f

a = 0
b = np.pi
h = (b - a) / (n - 1)
x = np.linspace(a, b, n)
f = function(x)
```

Below is the running example:

```
minimum error: 1.0880791458056649e-05
```



2. **(50%)** Name your Jupyter notebook `Euler_method.ipynb` and Python script `Euler_method.py`. The differential equation $\frac{df(t)}{dt} = e^{-2t}$ with initial condition $f_0 = -\frac{1}{2}$ has the exact solution $f(t) = -\frac{1}{2}e^{-2t}$. Approximate the solution to this initial value problem between zero and 1 in increments of 0.1 using the explicit Euler formula. Please plot the difference between the approximated solution and the exact solution.

Below is the running example: