Numerical Method

National Cheng Kung University Department of Engineering Science

Instructor: Chi-Hua Yu

Lab 9

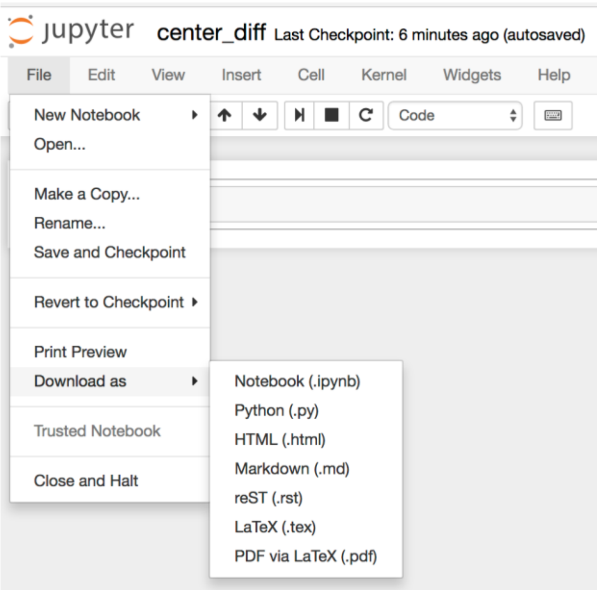
Programming, Due 10:00, Wednesday, Mat 25th, 2022

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`)).

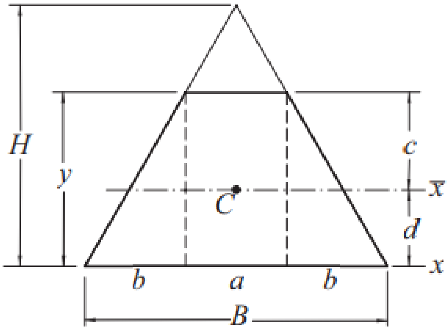


2. Name a folder using your student id and lab number (e.g., n96081494_lab1), put all the python scripts into the folder and zip the folder (e.g., n96081494_lab1.zip).

3. Submit your lab directly through the course website.

1. (50%) Name your Jupyter notebook `max_sectionModulus.ipynb` and Python script `max_sectionModulus.py`. The trapezoid shown is the cross section of a beam. It is formed by removing the top from a triangle of base B = 48 mm and height H = 60 mm. Please use `goldSearch` find the height y of the trapezoid that maximizes the section modulus

$$S = \frac{I_{\bar{x}}}{c}.$$



where $I_{\bar{x}}$ is the second moment of the cross-sectional area about the axis that passes through the centroid C of the cross section. Considering the area of the trapezoid as a composite of a rectangle and two triangles, the section modulus is found through the following sequence of computations:

Base of rectangle	$a = B(H - y) / H$
Base of triangle	$b = (B - a) / 2$
Area	$A = (B + a)y / 2$
First moment of area about x-axis	$Q_x = (ay)y / 2 + 2(by / 2)y / 3$
Location of centroid	$d = Q_x / A$
Distance involved in S	$c = y - d$
Second moment of area about x -axis	$I_x = ay^3 / 3 + 2(by^3 / 12)$
Parallel axis theorem	$I_{\bar{x}} = I_x - Ad^2$
Section modulus	$S = I_{\bar{x}} / c$

Below is the running example:

```
Optimal y = 52.17627387056691
Optimal S = 7864.430941364856
S of triangle = 7200.0
```

2. **(50%)** Name your Jupyter notebook `smallest_distance.ipynb` and Python script `smallest_distance.py`. Please use `powell` to determine the smallest distance from the point (5, 8) to the curve $xy = 5$. This is a constrained optimization problem: Minimize

$$F(x,y) = (x - 5)^2 + (y - 8)^2$$

(the square of the distance) subject to the equality constraint $xy - 5 = 0$.

Below is the running example:

```
Intersection point = [0.73306761 7.58776385]
Minimum distance = 4.28679958766998
xy = 5.562343874620907
Number of cycles = 5
```