Numerical Method

National Cheng Kung University Department of Engineering Science

Instructor: Chi-Hua Yu

LAB 7

Programming, Due 17:00, Tuesday, April 18th , 2023

注意事項

1. Lab 的繳交期限為**星期二(4/18) 17:00 p.m.**。
2. Lab 的分數分配：Lab 分數 100%、Bonus 分數 20%。
3. 請儘量於 Lab 時段完成練習，完成後請找助教檢查，檢查後即可離開。
4. 檔名規定：檔名錯誤將記為 0 分
   i. Lab: 請用 **學號_LabNumber** 為檔名做一個資料夾**(e.g.,N96091350_Lab7)**，將 **ipynb 檔**放入資料夾，壓縮後上傳至課程網站**(e.g., N96091350_Lab7.zip)**。
   ii. Bonus: 請用 **學號_bonus** 為檔名做一個資料夾**(e.g.,N96091350_bonus)**，將 **ipynb 檔**放入資料夾，壓縮後上傳至課程網站**(e.g., N96091350_bonus.zip)**。
5. **Code 中需有註解。**
6. 未完成者可於**下周一 (4/24) 09:00 a.m.** 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。
7. Bonus 需於**下周一 (4/24) 09:00 a.m.** 前上傳至 Moodle，不予補交。
8. 準時繳交者，請交至「Lab7 準時繳交區」；補交者，請交至「Lab7 補交區」；bonus 請繳交至「bonus 繳交區」。

請勿抄襲，抄襲者與被抄襲者本次作業皆 0 分計算

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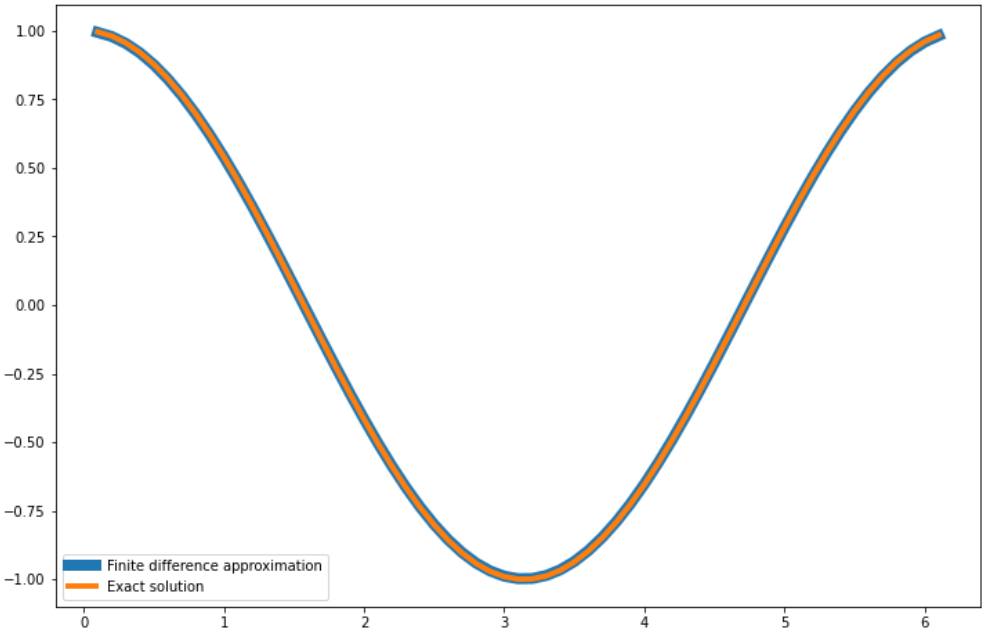
1. **(100%)** Name your Jupyter notebook `Central_Difference.ipynb`. Consider the function $f(x) = \sin(x)$. We know that the derivative of $\sin(x)$ is $\cos(x)$. Write a Python program to differentiate $f(x) = \sin(x)$ without using the function `np.diff`. Please write a function which name `my_central_diff` to complete the differentiation. Plot the difference and print the value of maximum error between the aforementioned numerical differentiation methods and their accuracy.

   Below is the running example:

   The wide of the blue line is 8

   The wide of the orange line is 4




```
The maximum error is 0.001664392836042916
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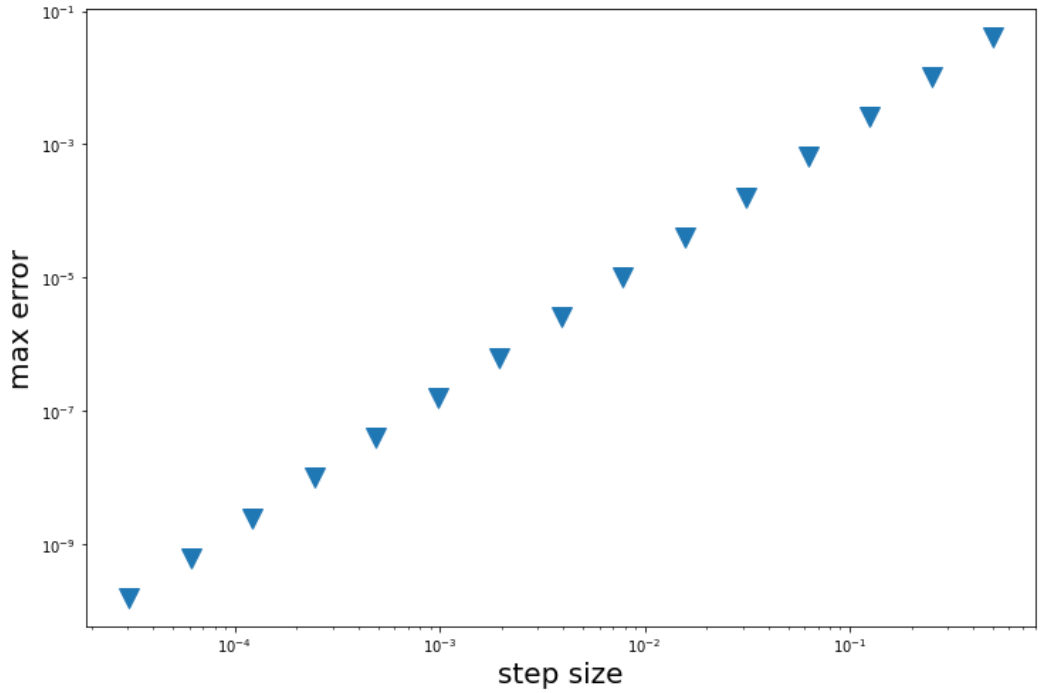
2. **Bonus(20%)** Continue the previous question, compute the numerical derivative of $f(x) = \sin(x)$ using the central-difference formula for decreasing step size, h. Please plot the maximum error between the approximated derivative and the true derivative versus h.

   Below is the running example:

   The number of iterations is 15

   The decreasing size of step is h/2


max error
step size
10^{-1}
10^{-3}
10^{-5}
10^{-7}
10^{-9}
10^{-4}
10^{-3}
10^{-2}
10^{-1}