Lab 13

Ch En 263 – Numerical Tools

Due: 5 Mar. 2024

Instructions

- Complete the exercise(s) below, and submit the following files to Learning Suite:
  - Handwritten portion: scan each page (or take a picture) and combine them into a single pdf named: `LastName_FirstName_Lab13.pdf`
  - Excel portion: submit a workbook named `LastName_FirstName_Lab13.xlsx` where each worksheet tab is named "Problem_1", "Problem_2", etc.
  - Python portion: submit a separate file for each problem named `LastName_FirstName_Lab13_ProblemXX.py` where XX is the problem number.
- Warning: the LS assignment will close promptly at 11:59 pm and late assignments will only receive 50% credit.

Lab Exercises

In this lab we are going to find the roots of function,

$$f(x) = x^2 - \frac{8}{3}x + \frac{3}{2}$$

(that is where $f(x) = 0$) using both Picard's method and Newton's method

1. Do the following in Excel.
   (a) Plot $f(x)$ in the range $x \in [0, 3]$. Use your plot to find approximate values for the two roots of the function. These will be your starting guesses for parts (b) and (c).
   (b) Use Picard's method to find one of the roots of the function. Let the cell at the top of the column be your guess value $x^{(0)}$. Evaluate $g(x^{(0)})$ in the row below, $g(x^{(1)})$ in the next row, and so on until the value converges to the root. Highlight the cell with the root so that the grader can easily locate it.
   (c) Use Newton's method to find the other root in an additional column. Follow the same procedure as with Picard's method, but use the $g(x)$ function appropriate for Newton's method. Again, highlight the cell with the converged value so that the grader can easily locate it.

   Hint: Picard's method is only stable for one of the roots. It will not converge for the other. There is more we could say about numerical stability to explain why, but we unfortunatly don't have enough time in this class.
2. Do the following in Python.
   (a) Write a Python function that performs Picard's method. Use your function to find one of the roots of $f(x)$ and print it to the console.
   (b) Write a function that performs Newton's method, and use it to find the other root of $f(x)$. Print the value of the root to the console.
   (c) Plot the $f(x)$ in the range $x \in [0, 3]$. To your plot, add the points $(x_0, f(x_0))$ and $(x_0, f(x_0))$ where x_0 and x_1 are the two roots.