CST8233: Lab #4

Taylor Series Expansion

Objective

The objective of this lab is to familiarize the student with the theory topics covered in week 3. Mainly, this lab focuses on Taylor Series expansion.

Earning

To earn your mark for this lab, each student should finish the lab's requirements within the lab session and demonstrate the working code to the instructor.

Discussion

Before starting the lab, the student has to show the instructor the steps of developing Taylor series in general. Then, each student should derive Taylor series for the function $f(x) = \ln x$ around $a = 1$.

Laboratory Problem Description

The Taylor series expansion of $f(x) = \ln x$ around C is given as:

$$\ln x = \sum_{n=1}^{\infty} (-1)^{n-1} \frac{(x-a)^n}{n}$$

Part A: Write a C\C++ program which takes x as input and computes the series for up to 10 terms. Your program should print the final value of $f(x) = \ln x$ obtained along with the absolute and relative errors. Your program needs to get the true value of $f(x) = \ln x$ using the built-in function in C.

Part B: Run your program for x = 0.5, 1.5, 2.0, and 3.3. Report the results you get for each one. How accurate are your results?

Part C: Run your program for the same value of x as in part B but change the number of terms to be 100. Report the results you get for each one. How accurate are your results?

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Part B Test:

Enter the value of x: 0.5

The number 0f terms: 10
True value = -0.693147
Taylor value = -0.692967
Absolute error=0.000180
Relative error =-0.025966

Enter the value of x:1.5

The number 0f terms :10
True value = 0.405465
Taylor value = 0.405532
Absolute error =0.000067
Relative error =0.016573

Enter the value of x:2.0

The number 0f terms :10
True value = 0.693147
Taylor value = 0.745635
Absolute error =0.052488
Relative error =7.572380

Enter the value of x:3.3

The number 0f terms :10
True value = 1.193922
Taylor value = 135.794385
Absolute error =134.600462
Relative error =11273.802614