CST8233: Lab #5

Maclurin Series Expansion

Objective

The objective of this lab is to familiarize the student with the theory topics covered in week 4. Mainly, this lab focuses on Maclaurin Series expansion and Reminder theorem.

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 Maclaurin series in general. Then, each student should derive Maclaurin series for the function $f(x) = \cos x$

Laboratory Problem Description

The Maclaurin series expansion of $f(x) = \cos x$ is given as:

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} - \cdots$$

Or,

$$\cos x = \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n}}{2n!}$$

Part A: Write a C program to compute the function $f(x) = \cos x$ using the series shown above. Inputs to your program will be: 1) the value of x (in radians), and 2) a pre-specified approximate relative error (%). Your program should print the final value of $f(x) = \cos x$ obtained along with the true and approximate errors. Your program needs to get the true value of $f(x) = \cos x$ using the built-in $\cos x$ function in C.

Part B: Run your program to estimate the value of $f\left(\pi/3\right)$ with relative error of less than 0.5%. In other words, choose your inputs as $x = \pi/3$ and the relative error equals 0.5%. Print your result along with the final error values (true and approximate percent relative errors). You need to add the terms in the Maclaurin series until the approximate percent relative error falls below 0.5%.