

CS3113, Fall 2008, Homework 4

Due October 15, 2008 (before start of class)

You should use the same file naming convention as before. For example, if your last name is Bush, then you must name the file for homework 2 problem 3 as `BushHW02P03.m`. Submit them using the electronic dropbox in Blackboard.

Problem 1

Write a script to accomplish the following task.

The **sine** function has the following Taylor series expansion:

$$\sin(x) = \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n+1}}{(2n+1)!} = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots,$$

where $k!$ is the factorial function defined so that

$$k! = k(k-1)\dots 3 \times 2 \times 1.$$

The factorial function can also be define recursively by the relations

$$k! = k(k-1)! \quad \text{with} \quad 1! = 1 \quad \text{and} \quad 0! = 1.$$

For example, we have

$$3! = 3 \times 2 \times 1 = 6, \quad 5! = 5 \times 4 \times 3 \times 2 \times 1 = 120.$$

For this problem you **cannot** use MATLAB's factorial function, `factorial(n)`.

For each value of x ranging from 0.1 to 1.5 in steps of 0.2, compute the corresponding value of $\sin(x)$, and store it in an appropriate vector. Make sure that the absolute error is no bigger than the tolerance, `tol = 1e-6`. Keep track of the total number of terms that must be summed to achieve this level of accuracy, and store this information in an appropriate vector.

Your program should not display anything from inside the loops. Instead the results should be displayed only after all relevant quantities have been computed.

Display a table showing the values of x , the value of $\sin(x)$ computed, the "exact" value of $\sin(x)$ (according to MATLAB's sine function), and the total number of terms that was used in computing the sum. There should be one row of output numbers for each value of x .