Assessment 2 – Homework assignment 2

General comments

The objective of this second assessment is to test your ability to use **loops**, to organise your code into **suitable functions**, and to utilise simple **arrays**. All inputs to your code must have appropriate sanity checks. Remember that you must produce code in agreement with the general expectations detailed in the introduction to the module (code structure, indentation, sensible variable names, etc.).

Instructions

The aim of this project is to investigate the Taylor series of the trigonometric function sin(x):

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots$$

1. Taylor series. First, write a function called `factorial()` that takes an integer `n` and returns its factorial. Next, write a function called `sum_sin_series()` that takes a point `x` and an integer `n` and returns the above Taylor series approximation of sin(x) using the first `n` terms. This function should call your factorial function. Make sure both your functions include suitable checks on their input parameters and appropriate responses for invalid parameter values. **[25 marks]**

2. User input. In `main()`, read in 5 values of `x` in degrees (not radians) from the user and store them in an array. Make sure that 5 does not appear as a magic number in your code. Also ask the user for the number of terms, `n`. Then, for all 5 user `x` values, print the values of both sin(x) and the Taylor series approximation of sin(x) using `n` terms. Make sure your output is accompanying by appropriate text to explain what is displayed. **[10 marks]**

3. Plots. Extend your program to also print out the values of both sin(x) and its Taylor series approximation with `n=6` terms for $x = 0°, 1°, 2°, \ldots, 360°$. Then (using some plotting software such as Excel, MATLAB, Python or gnuplot) plot sin(x) and its Taylor series for `n=6` (on the same axes) from 0° to 360°. Make sure your plot has appropriate axis labels, a legend and a title. **[15 marks]**

4. Assignment report. Write a short report (no more than two pages in pdf format) on your code. You should describe how your program works, including its use of functions, loops, arrays, constants and input checking. Briefly discuss how your program could be changed in future so that it would run quicker. Also include the plot from part 3 (within the two pages) along with a discussion of how well the Taylor series with `n=6` approximates sin(x). **[34 marks]**

The remaining marks will be given if the code:

a) Has an appropriate layout **[4 marks]**
b) Has appropriate indentation **[4 marks]**
c) Uses variables of the correct type **[4 marks]**
d) Has been properly commented **[4 marks]**

Your final submission should include one .c file and one .pdf file.