MACM 316 COMPUTING ASSIGNMENT #1

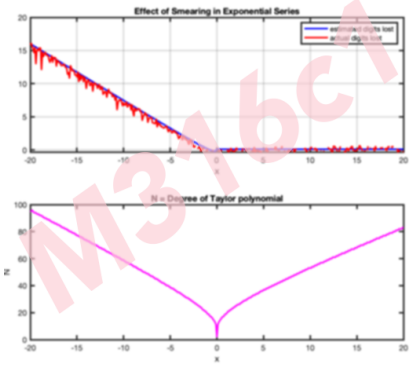
Submit on Crowdmark by Tuesday, May 26, 2020, 11pm

Upload one .pdf file with 2 pages: Page 1 is your typed report (your discussions, data and figures on a single page); Page 2 is a listing of your code(s). The assignment is due at 11:00pm. You will receive a Crowdmark link for the upload.

Matlab scripts and functions for this assignment can be downloaded form the Canvas Homework page. Make sure to either set your "Matlab path", or run Matlab in the directory where your scripts and functions are located.

C1. This is a "warm-up exercise". You are given the Matlab function `expseries.m` and script `expserieserrorT.m`, illustrating Example 1.8 on page 12 of your course text.

For x in the interval $[-20, 20]$ plot the estimated and actual number of digits lost (somewhat nonintuitively, it's fine for this to not be an integer), as well as the number of terms used in the Taylor series expression. Your output plot should look like the picture on the right (without the watermark). The second plot shows the number of terms used in the Taylor series approximation.



To get there you will have to change the following in `expserieserrorT.m`:

- Interval boundaries
- Find and fix the error in the code
- Add the plotting command for the second subplot
- Add titles and labels to the graph

I am also sharing a Matlab script `plotpubl.m` which plots thicker lines to produce figures suitable for "publication". You can set the line width to 2 by typing `plotpubl(2)`.

C2. Now that you've modified Matlab code and executed a script, you are ready to write a script from scratch. Consider Example 1.9, page 13 of your text. This example provides four different ways to compute the numbers

$$y_n = \int_0^1 \frac{x^n}{x+a}\,dx.$$

Take $a = 10$; because we are now working with 16 decimal digits of accuracy, we will compute the y_n for $n = 0, 1, \ldots$ **20**. Hand in a table of your computed values similar to Table 1.1 on page 14. Briefly comment on your results, and explain why your numbers differ from those in Table 1.1 (which were computed on the same HP pocket calculator used for Example 1.7 in the text).
Note: Array indices in Matlab always start at 1, so the mathematical y_0 would correspond to, say `y(1)` in Matlab. To format your table, print out the results with the `fprintf` command. See the Matlab documentation, or simply type `help fprintf` at the command prompt.

C3. Evaluate $s = \displaystyle\sum_{n=1}^{\infty} \frac{1}{n^2+1}$ with an error less than 10^{-13}. Report your answer (14 digits), and comment. How many terms of the series **would you need if you used this series directly**?
How much faster can you compute s by rewriting the series (compute $\dfrac{1}{n^2+1} - \dfrac{1}{n^2} + \dfrac{1}{n^4}$) and using the values $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}, \qquad \sum_{n=1}^{\infty} \frac{1}{n^4} = \frac{\pi^4}{90}.$