

MATH 3340 - Scientific Computing Homework 7

Due: Friday, 04/23/2021, 11:59 PM

The deadline will be strictly enforced. If you do not submit in time there will be a 20% penalty for each day you're late. If you do not submit in time there will be a 20% penalty upfront plus another 20% for each day you're late. Remember that you are allowed to work in teams of two on this assignment. You are encouraged to prepare your work in \LaTeX ; a template will be provided to help you put it all together. If you choose to submit a hard copy, you may submit only one copy for a team, indicating the names of both contributors. Online submission is encouraged, however, in that case both members of a team should submit the PDF file containing their work and showing both their names.

All plots generated in this homework should have a title, legend, and labeled x and y -axes.

Instruction

1. Go to <https://www.overleaf.com> and sign in (required).
2. Open [template](#), click *Menu* (up left corner), then *Copy Project*.
3. Go to `LaTeX/meta.tex` (the file `meta.tex` under the folder `LaTeX`) to change the section and your name, e.g.,
 - change title to `\title{MATH 3340-01 Scientific Computing Homework 7}`
 - change author to `\author{Albert Einstein \& Carl F. Gauss}`
4. For Problem 1 and 2, you are encouraged to type solutions in \LaTeX . But if you want to write it on the printout, make sure your scanned work is *clear* enough, and compile all solutions *in order*, i.e., 1, 2, 3, in a single PDF (failure to do so will lead to points deduction).
5. For Problem 3, you need to write function/script files, store results to output files, and save graphs to figure files. Here are suggested names for function files, script files, output files, and figure files:

Problem	Function File	Script File	Output File	Figure File
3	<code>gauss_quad.m</code>	<code>hw7_p3.m</code>	<code>hw7_p3.txt</code>	

Once finished, you need to upload these files to the folder `src` on Overleaf. If you have different filenames, please update the filenames in `\lstinputlisting{./src/your_script_name.m}` accordingly. You can code in the provided files in [hw7.zip](#), and use the MATLAB script `save_results.m` to generate the output files and store the graphs to `.pdf` files automatically (the script filenames should be exactly same as listed above).

6. Recompile, download and upload the generated PDF to WyoCourses.
7. You may find [\$\text{\LaTeX}\$.Mathematical.Symbols.pdf](#) and the second part of [Lab 01 Slides](#) and [Lab 02 Slides](#) helpful.

Problem 1. Calculate, by hand, the value of

$$\int_0^{2\pi} x^2 \sin^2 x \, dx$$

using both the composite trapezoidal rule and the composite Simpson's rule. For a fair comparison, keep the same number of function evaluations at five equally spaced points: $\{x_0, x_1, x_2, x_3, x_4\}$. Keep a minimum of four decimal places in all your calculations.

Problem 2. This computation should again be done by hand. Use Gauss quadrature with $N = 2$, $N = 3$ and $N = 4$ to compute the approximate value for

$$I = \int_1^3 (x^3 - 1)e^{-x^2} \, dx.$$

Perform all calculations by rounding off to four decimal places.

Problem 3. Write a MATLAB code that implements the Gauss quadrature calculation in the problem above, but allows for a wider range of values of N , from $N = 1$ through $N = 5$.