Name: _____

Date: _____

Collaborators: _____

(If applicable, the collaborators submit their individually written assignments together)

Question:	1	2	Total
Points:	50	25	75
Score:			

Instructor/grader comments:

1. Simpson's quadrature used for numerical evaluation of integrals, is as following:

$$\int_a^b f(x)\,\mathrm{d}x \approx \frac{h}{3}\left(f(x_1)+4f(x_2)+2f(x_3)+4f(x_4)+\ldots+4f(x_{n-1})+f(x_n)\right)+O(h^p), \quad (1)$$

where

$$h = \frac{b-a}{n-1}, \quad (2)$$

$$x_i = a + h(i-1), \quad i = 1,\ldots,n\,, \quad (3)$$

and p is the order of accuracy of the quadrature. Note that the number of nodes, n, in Eq. (1) is an odd number (larger than 1).

(a) (10 points) Create a directory for your homework project (`mkdir hw03`), change to that directory (`cd hw03`), create an empty README.md file (`echo " " > README.md`). Download .gitignore sample file and properly rename it: (`wget https://.../sample.gitignore; mv sample.gitignore .gitignore`). For the first time only: start julia inside the folder, activate the project (`] activate .`) and add packages you will use (`] add IJulia, PyPlot`). Exit julia and start jupyter server (`ijulia`).

(b) (20 points) write a function `mysimpsons(fun, a, b, n)` that accepts the integrand (a julia function of a single argument), the integration limits, and the number of nodes, and returns the approximate numerical value of the integral. Test your function, evaluate the following elementary integrals using $n = 11$.

$$\int_0^1 e^x\,\mathrm{d}x = e - 1 \approx 1.72, \quad (4)$$

$$\int_1^2 x^2\,\mathrm{d}x = \frac{7}{3} \approx 2.33\,. \quad (5)$$

(c) (20 points) Consider the integral,

$$\int_0^\pi \sin(x)\,\mathrm{d}x = 2\,. \quad (6)$$

Evaluate this integral numerically for multiple values of h using your function `mysimpsons(fun, a, b, n)`. Use $n = 2^{i+1}+1$ for $i = 1,\ldots,10$. Plot the absolute errors of the result, $\Delta(h)$, in appropriate axis (linear, semilog, loglog, etc.), and "experimentally" determine the order of accuracy, p, of the Simpson's quadrature. Provide the legend, grid, title, axes labels for your plot. Describe your reasoning and the result of your numerical experiment in the README.md file of your git project.

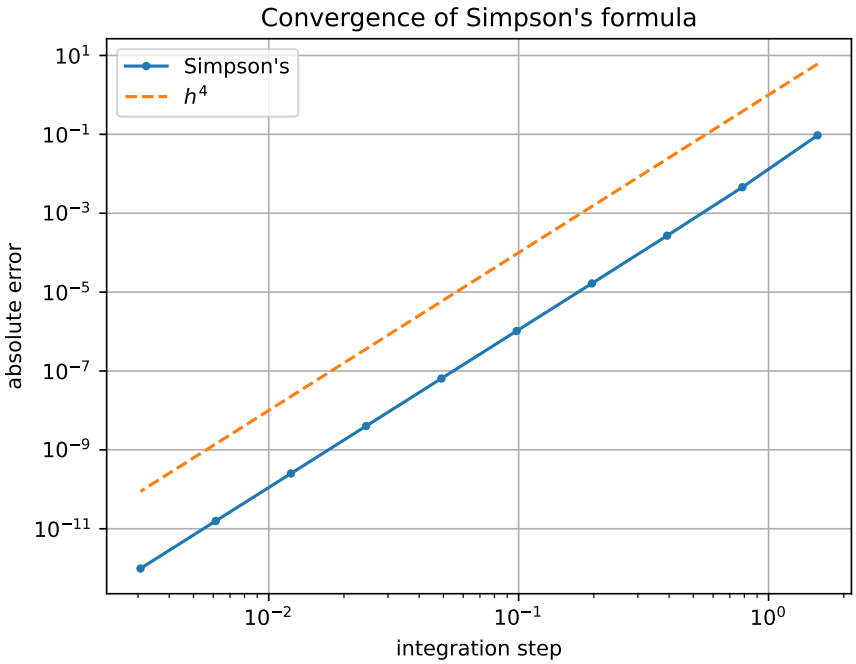

Figure 1: Expected graph in Problem 1.

2. (25 points)

    1. On the GitLab "side": Create an empty GitLab project called **hw03** (name it exactly as shown).
    2. On the VM "side" (use the instructions shown to you in the previous step): Clean the cells of your jupyter notebook and save the notebook. Give it a meaningful name. Delete unneeded notebooks if you created ones (e.g. `Untitled.ipynb`). Initialize a git repository for hw02. Check in your notebook, Project.toml and Manifest.toml, an empty README.md file, and your .gitignore file into the repository. Provide a meaningful commit message. Push the content of git repository you created in Problem 1 to GitLab hw03 project.
    3. On the GitLab "side": Edit README.md file as requested in Problem 1.
    4. On the VM "side": Pull the README.md file to your local git repository (`git pull`).
    5. On the GitLab "side": Share the project with the instructor (GitLab user name p2200_23f_in) and grant him **Reporter** privileges.