Name: _____

Date: _____

Collaborators: _____

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

Question:	1	2	3	4	Total
Points:	15	20	25	10	70
Score:					

Instructor/grader comments:

Floating point numbers

1. Floating point numbers typically represented in computers in the following *binary* form:

$$(-1)^{b_0} \times \left(1 + \frac{b_1}{2} + \frac{b_2}{2^2} + \ldots + \frac{b_d}{2^d}\right) \times 2^E,$$

where b_i, $i = 0, \ldots, d$ can have values 0 or 1.

   (a) (5 points) What is the (approximate) value of machine epsilon for a microprocessor that uses $d = 12$? Briefly explain. Express your answer as a power of 2 (exactly) and as a nearest power of 10 (approximately).

   Write your answer in the homework project's README.md file.

   (b) (5 points) For the same microprocessor, how many floating point numbers x, such that $1 \le x < 2$ are there? How many floating point numbers x, such that $8 \le x < 16$ are there? Briefly explain.

   Write your answer in the homework project's README.md file.

   (c) (5 points) For the same microprocessor, assuming that the smallest possible value of E is -15 and the largest possible value of E is 16, what are (approximately) the smallest and the largest positive floating point number? Briefly explain. Express your answer as a power of 2 and as a nearest power of 10 (approximately).

   Write your answer in the homework project's README.md file.

Matlab

2. (20 points) Write a script (place it into a file **hw03p2.m**) that uses the function `hw03p2data` (available for download from the class website) to plot a figure consisting of four subplots that represent the data provided by the function using linear, loglog and semilogx/semilogy axes. (Use `subplot` matlab function.) Each subfigure should have grid, a title, and axes labels. Use a linestyle that marks the data points and connects them with a line.

   Place the commands

```
clear
clf
```

   at the top of your script.

   Inspect the graphs in the subplots. Determine the type of functional dependence $y(x)$ of the data provided by `hw03p2data` (e.g. whether the dependence is $y = \log(x)$, $y = e^{\alpha x}$,

$y = x^p$, etc.). Explain in your README.md file your reasoning, as well as indicate which type of graph is the best to represent the data in this problem.

Hints: To produce a figure with four subplots arranged in the grid 2x2, use the following matlab commands:

```
subplot(2, 2, 1)
...
subplot(2, 2, 2)
...
subplot(2, 2, 3)
...
subplot(2, 2, 4)
...
```

To plot a graph in double logarithmic axes, use the command `loglog(...)`; for semi-logarithmic axes, use `semilogx(...)` or `semilogy(...)`.

Stability of the algorithms

3. Modify the recurrence algorithm from Problem 1 of the homework assignment 2 and turn it into a stable one.

   (a) (15 points) Write matlab function `hw03p3integral` (place the code in the file named **hw03p3integral.m**) that accepts a positive integer parameter k and returns a vector containing the values of the integral (A) for $n = 1, 2, \ldots, k$. The function must use the stable version of relation (B). Your function must preallocate the array that it returns. Use `for` loop when writing your code. Provide the help text for the function.

   (b) (10 points) Write matlab script (place it into a file **hw03p3.m**) that does the similar calculations and measurements as the script **hw02p1.m**. Describe the results (primary whether you achieved stability while keeping the performance) in your README.md file.

Gitlab

4. (10 points) Create a gitlab project called **hw03** (name it exactly as shown). Upload **all** matlab files that are required to run your code. **Do not** upload other types of files (e.g. no graphics files). Create README.md file and write your answers. Share the project with the instructor (gitlab user name `m3510_21f_in`) and the TA (gitlab user name `m3510_21f_ta`) and grant them the **Reporter** privileges.