Name: \_\_\_\_\_

Date: \_\_\_\_\_

Section: \_\_\_\_\_

Collaborators:

(Collaborators submit their individually written assignments together)

Question:	1	2	3	Total
Points:	40	40	5	85
Score:				

Instructor/grader comments:

## Numerical derivatives

1. (a) (20 points) Determine the weights in the following one-sided formula for the first derivative of a function f(x):

$$\frac{\mathrm{d}f}{\mathrm{d}x} = af(x) + bf(x+h) + cf(x+2h) + df(x+3h).$$

Use the Fornberg method as described in the class handout. Show your work in the space below. Use a computer algebra system to calculate the needed Taylor expansion coefficients.

(b) (20 points) Conduct numerical experiment to determine leading error term of

HW 9

your formula  $\delta \sim h^{\alpha}$ : Write a matlab script, **hw09p1** that for  $h = 1, \frac{1}{\sqrt{2}}, \frac{1}{2}, \dots, \frac{1}{2^{7}}$ calculates the absolute value of the error for the first derivative of f(x) = sin(x)at x = 1 when using your formula. On the same graph, in double logarithmic axes, plot the graph of the error vs. *h*. In addition, as a guide, plot the graphs of  $y(h) = h^k$ , for k = 1, 2, 3, 4. Analyze your figure and by visual inspection determine the constant  $\alpha$ . Describe your results in gitlab's README.md file.

Follow the course requirements for writing matlab scripts and producing graphs.

2. (40 points) Conduct the research similar to Problem 1 for the central third derivatives, given by the following formula.

$$\frac{d^3 f}{dx^3} = a f(x-2h) + b f(x-h) + c f(x) + d f(x+h) + e f(x+2h).$$

Show your analytic calculations in the space below.

## Gitlab

3. (5 points) Create a gitlab project called **hw09** (name it exactly as shown). Upload **all** matlab files that are required to run your code. Share the project with the instructor and the TAs and grant them **Reporter** privileges.