

Name: _____

Date: _____

Collaborators: _____

(Collaborators submit their individually written assignments together)

Question:	1	2	3	Total
Points:	40	40	10	90
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 $f(x)$:

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

Use the Fornberg method. 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 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 α . Describe your results in gitlab's README.md file.
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. (10 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 TA and grant them **Reporter** privileges.