

- 1) (6 pts) For this problem, you will compare 2 methods for approximating the derivative of a function. Using the code in the notes as a guide, generate a table of values of  $f(x)$  for  $x \in [a, b]$ . In addition, at each  $x$ -coordinate, generate approximations for  $f'(x)$  using the formulas:

$$f'(x) \approx \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

and

$$f'(x) \approx \frac{f(x + \Delta x) - f(x - \Delta x)}{2\Delta x}.$$

Compute the relative errors in your approximations. Note that you will have a relative error for each point in the table and some of the relative errors will need special attention.

Test your program using  $f(x) = x \sin(x)$  on the interval  $x \in [0, \pi]$ . Use  $n = 10$  and  $\Delta x = 0.0001$ . Which derivative approximation is more accurate? If you try to print out  $x, f(x)$ , both approximations for  $f'(x)$  and their relative errors on one line, your output will wrap at the screen boundary so you may need to experiment with your data output.

- 2) What happens to your errors in Problem 1 if you try and use  $\Delta x = 10^{-11}$ ? Note that  $10^{-11} = 1.0d-11$ . Why does this happen?