

# Homework 1

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- Prepare a short document summarizing the main points of the lab classes on:
  - floating point representation and round-off errors
  - numerical derivatives

Make sure to include the main results obtained during the lab classes in the forms of tables / plots. The `matlab-prettifier` L<sup>A</sup>T<sub>E</sub>X package could be useful to insert code snippets (and tables printouts). Make sure to use vector graphics for plots, i.e., .pdf or .eps formats.

- Derive second-order accurate, i.e.,  $\mathcal{O}(\Delta^2)$  one-sided (forward/backward) formulas for first-order derivatives.

Expected results:

$$\left. \frac{df}{dx} \right|_k = \frac{-3f_k + 4f_{k+1} - f_{k+2}}{2\Delta x} + \mathcal{O}(\Delta_x^2) \quad (1)$$

$$\left. \frac{df}{dx} \right|_k = \frac{3f_k - 4f_{k-1} + f_{k-2}}{2\Delta x} + \mathcal{O}(\Delta_x^2) \quad (2)$$

**Hint** Try to combine the following two forward/backward Taylor expansions, e.g.,:

$$f_{k+1} = f_k + \dots \quad (3)$$

$$f_{k+2} = f_k + \dots \quad (4)$$