Numerical Approximation of PDEs by Finite Differences and Finite Volumes
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Exercise sheet 1 4. April 2023

Exercise 1

Consider the following finite difference approximations

1. First order forward difference approximation of the first derivative of u

$$D_1 u(x) = \frac{u(x + \Delta x) - u(x)}{\Delta x} \tag{1}$$

2. Second order central difference for second order derivative of u

$$D_2 u(x) = \frac{u(x + \Delta x) - 2u(x) + u(x - \Delta x)}{\Delta x^2}$$

3. Second order central difference for multi-variate function

Analyze the order of accuracy of the above approximation schemes. Compare the accuracy of (1) with the center difference scheme (?? in lecture notes).

Exercise 2

Find the coefficients of some scheme.

Exercize 3

Implement numerically. Compare again real derivative computed via known formula and computed via automatic differentiation.

Hint to SimPy.

Exercize 4

Solve a differential equation.