Introduction to computational thinking and programming for CFD (13251)

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Sheet 1

Goals

- Introduction to the Python programming language

- Executing and editing Python programs

- Importing and using Python modules such as `numpy` and `matplotlib`

Tasks

1. Install a Python distribution and Spyder on your system (see Moodle for hints).

2. Introduction to Python

   - A Python *program* is given by a human-readable source file ($(script)$), e.g., `my_program.py`. The compilation and execution of this script is handled by the Python *interpreter* (shell and kernel). There is **no need to manually compile** the source file. This is done on-the-fly by the interpreter.

   - Take a look at the *Minimal Python* handout (available on Moodle) and type the commands into Spyder's Python shell. Hit enter submit a command.

3. Numerical data operations and plotting: Using the `numpy` and `matplotlib.pyplot` modules

   (a) Create a new Python source file (e.g. `myplot.py`) and open it with `Spyder`. Load `numpy` and `matplotlib.pyplot`.

   (b) Create an array `x` with linearly increasing values $[0.0, 0.1, 0.2, \ldots 1.0]$. The size N of the array should be $N = 11$.

   (c) Modify N such that the step size is $\Delta x = x_{i+1} - x_i = 0.025$.

   (d) Plot the following three functions:

$$f_1(x) = 1 - 2x, \qquad f_2(x) = (x - 0.4)^2, \qquad f_3(x) = \sin(2\pi x)$$

   Note: The sine function can be found in `numpy`.

   (e) Plot the functions. The figure should contain:
       - title "Figure 1"

- y-axis limits $y_{\text{low}} = -1.2$ and $y_{\text{hi}} = 1.2$
- x-axis label "x" and y-axis label "y"
- grid lines
- legend with labels "f_1", "f_2", "f_3"

(f) *Additional task:* Plot $f_3(x)$ only over the range $0 \leq x \leq 0.5$.

Hints and remarks

- Basic Python commands can be found in the *Minimal Python* handout in Moodle.

- Detailed help and examples for `numpy` and `matplotlib` can be found online:
  numpy.org   matplotlib.org   pythontutor.com   ... (see Moodle)