



## Exercise sheet 1

The exercise sheet won't be discussed in person and is intended as a self-study primer on python.

### Exercise 1.1

In the following, we will test your Python knowledge:

- a)
  - i. Assign the value 3, the sequence from 1 to 10, the vector  $(1, 5, 10.2, -54)$ , and the vector  $(1, 1, 1, 2, 3, 4, 1, 1, 5, 6)$  to the variables `x`, `y`, `z`, and `r`, respectively.
  - ii. Display `x` and `y`; furthermore, calculate and display `x + y` and `y2`.
  - iii. Replace the second entry of `z` with twice the fourth entry of `z` and display `z`.
  - iv. Display the indices of `r`'s entries which are equal to 1, replace the corresponding values in `r` with the value 9, and display `r`.
- b)
  - i. Create two  $3 \times 3$  matrices `x` and `y` with numeric values of your choice.
  - ii. Multiply `x` and `y` element-wise and display the results.
  - iii. Use loops to calculate the matrix product `x * y`, store the result in `z`, and display `z`.
- c) Write a function, `rcnorm`, with arguments `n`, `mean`, `sd`, and `c`, that draws `n` i.i.d. samples from the distribution with the density

$$f(x) = \frac{1}{\sigma \cdot (1 - \Phi([c - \mu]/\sigma))} \phi([x - \mu]/\sigma) \mathbb{1}_{\{x > c\}},$$

where  $\phi$  and  $\Phi$  are the density and probability distribution function of a standard normal distribution. *Hint: To create one sample, use an infinite `while`-loop in which a normal sample is drawn; break out of the `while`-loop if the drawn number is larger than `c`.*

- d) Create a histogram of an i.i.d. sample from the standard normal distribution with  $n = 1000$ .
- e) Write a function that integrates a smooth function  $f : [0, 1] \rightarrow [0, 1]$  with
  - i. the trapezoidal-rule with `n` grid-points,
  - ii. Monte-Carlo integration with `n` simulations, and
  - iii. the `scipy.integrate.quad` function.
- iv. Integrate the function  $f(x) = \sin(x)$  with the functions from i), ii) and iii) with  $n = 100$ .