

## Session 1

### 23.10.2025

#### Exercise 1.0 - Setup

- Familiarize yourself with MATLAB on the compass computers.
- Make sure you are enrolled in the *Moodle* website of the course.
- Read the submission instructions for the exercises which can be found in *Moodle*.
- Find a partner with whom you would like to solve LAB1 problems. You can also work by yourself. Groups should stay fixed throughout the course.

#### Exercise 1.1 - Elementary operations

- Define a  $(4 \times 4)$ -matrix  $A$  with integer elements in MATLAB which is **not** a diagonal matrix. Verify that  $A$  is not a singular matrix, i.e. that it is invertible [Hint: try the online-help for `det`], otherwise choose a new matrix. Compute  $A * A$ ,  $A^2$ ,  $A / A$  and the corresponding *element-wise* operations ( $A . * A$ ,  $A . ^2$ ,  $A . / A$ ).
- Given a positive real number  $c$  and a real  $n \times n$  matrix  $A$ , what is the meaning of  $c^A$  and  $c . ^A$  in MATLAB?
- Compute  $0/0$  and  $1/0$ . Use the online-help to explain the results you obtain. Depending on the matrix  $A$ , this may have already occurred.

### Exercise 1.2 - Numerical precision

Predict the outcome of the following lines, before trying them out.

- `-1+1+1e-21`
- `-1+(1+1e-21)`
- `(-1+1)+1e-22`
- `-1+1e-22+1`
- `12345678910111213 - 12345678910111212`
- `000000000000000003 - 000000000000000002`
- `0.000000000000000003 - 0.000000000000000002`

### Exercise 1.3 - Maximum path sum

A triangle of numbers is defined by a matrix `x`. E.g.

```
x = [3 0 0 0
      7 4 0 0
      2 4 6 0
      8 5 9 3]
```

corresponds to the triangle

```
      3
     / \
    7   4
   / \ / \
  2   4   6
 / \ / \ / \
8   5 9   3
```

Different paths from top to bottom are possible, e.g.  $3 \rightarrow 7 \rightarrow 2 \rightarrow 8$  or  $3 \rightarrow 7 \rightarrow 4 \rightarrow 5$ . The sums of the numbers along these paths are 20 and 19. Write a function `tril` that, for a given triangle, returns the highest possible path sum. In the example above, the result is 23 ( $3 + 7 + 4 + 9 = 23$ ). You can test your function using `x = tril(magic(100)^2)` (the result is 251716502500).