

Introduction to Matlab programming

Class 1: *Matrices*

All the exercises in this guide are to be performed using the **Command Window** in Matlab unless stated differently.

1. Create the following three matrices by typing in the command window

$$a = \begin{pmatrix} 1 & -2 \\ 0 & 4 \end{pmatrix}, \quad b = (1 \ 2 \ 3 \ 4), \quad c = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{pmatrix}$$

a is called “square matrix”

b is called “horizontal vector”

2. Use the *size* function to obtain the matrices dimensions of the previous exercise.
3. Obtain the corresponding transpose matrices for a , b , and c (from exercise 1)
 - a) Use the *transpose* function
 - b) Use the *'* operator.
 - c) Use the *ctranspose* function
 - d) What is the difference between *transpose* and *ctranspose*?

The transpose of b (or b') is a “vertical vector”

4. Create a variable d and assign the number 7 given by the second row and third column of the matrix c in exercise 1.

Note: You cannot type the number 7 for doing this, i.e. $d = 7$ is not allowed!

5. Create the following variables based on the information of the matrices a , b , and c . As in exercise 3, you do not have to type the information of the matrix but the corresponding reference to the existing matrices.

- a) $col1$ = the third column of c
- b) $Row2$ = the second row of c
- c) b_short = vertical vector with the first three elements of b
- d) f = 2×2 matrix given by the values 6, 7, 10, 11 in matrix c
- e) ff = 3×2 matrix whose columns are the columns 2 and 4 of matrix c

6. Use the functions *zeros*, *ones*, *eye*, *rand* to create the following matrices

- a) 3×3 matrix with only zeros
- b) Vertical vector of 4 elements (4×1 matrix) with only ones
- c) Horizontal vector of 3 elements (1×3 matrix) with only zeros
- d) 3×3 matrix with ones in the main diagonal and zeros elsewhere
- e) 5×5 matrix of uniformly random values between with 0 and 1

7. The colon (:) can be used to create vectors. For example: $p = 1:2:10$ results in
- $$p = (1 \quad 3 \quad 5 \quad 7 \quad 9)$$

By using a similar approach, please, create

- a vector (with the name *evens100*) with all the even numbers between 1 and 100
 - a vector (with the name *Desc*) with all the numbers between 10 and -10, in this order.
8. The colon (:) can also be used to access non-consecutive elements in a vector. Extract all the multiples of 4 between 1 and 100 from the vector *evens100*, created in the previous exercise.
9. Operations between matrices and a **scalar** (number). Consider the matrix *a* in exercise 1
- Add the value 2
 - Subtract the value 10
 - Multiply by -2
 - Divide by 3
 - Raise every element to the power of 2 (Use the operator with the point: `.^`)
 - Apply the square root (check the function `sqrt`)
 - Create a new 5×3 matrix whose values are -10
10. Operations between two matrices (**element-by-element**). Consider the matrix *a* of exercise 1 and the matrix *f* of exercise 5
- Add them
 - Subtract *a* from *f*
 - Multiply them. Are the result values right?
 - Divide *a* from *f*. Are the result values right?
 - Repeat the operation, but use matrix *c* instead of *a*. What happens? What are the conditions to operate element-by-element between two matrices?
11. Concatenation. Consider the following two vectors
- $$v1 = (1 \quad 2 \quad 3 \quad 4), \quad v2 = (10 \quad 20 \quad 30 \quad 40)$$
- Run $m1 = [v1 ; v2]$ to vertically concatenate them and create a matrix.
 - What happens if you concatenate them horizontally? What is the resulting matrix size?
 - Under what conditions can two matrices be concatenated?
12. Simulation and plot of a ramp signal.
- Create a 20 element vector *y1* with increasing elements from 1 to 20.
 - Create a 100 element vector *y2* by concatenating *y1* five times.
 - Plot the vector *y2* by applying `plot(y2)`

Study the documentation of the *plot* function and perform the following task:

- Imagine that *y2* was a signal recorded over time in intervals of 5 seconds. Correct the x axis of the plot accordingly.
- Either graphically or programmatically, change the color, line width and type, axis labels, title, font size of the axis ticks, etc.
- Zoom in some part of the signal (Use the figure menu/toolbar).
- Copy the image to a Word document (Use the figure menu).