Introduction to Matlab: exercises

Create Matlab scripts for solving these exercises:

1. Create and define your own folder "Es_Matlab"
2. Open Matlab and select as current directory "Es_Matlab"
3. Generate the row vector v and the column vector w with elements: 1,2 ...10 and 10,9,....1 respectively. Compute the scalar product of v and w.
4. Create the following vectors with equally spaced elements:

```
x=linspace(0,10,5);
x=logspace(1,3,3)
```

and create the same vectors with the syntax ":".

5. Create $A=\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 3 & 4 & 5 \\ 1 & 3 & 6 & 10 & 15 \\ 1 & 4 & 10 & 20 & 35 \\ 1 & 5 & 15 & 35 & 70 \end{pmatrix}$ and check the following instructions:

A(1:4,3), A(:,3), A(1:4,[2,4]),
A=A([2,3,3,4,5],:), A=A(:,[2,3,3,4,5]);

6. Create $A=\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$.
    1. Get the size and the number of elements of A
    2. Create in an efficient way the matrix $B=\begin{pmatrix} 7 & 8 & 9 \\ 4 & 5 & 6 \\ 1 & 2 & 3 \end{pmatrix}$.
    3. Extract from B the first column $x=(7,4,1)$ and the third row $y=(1,2,3)^t$.
    4. Delete the second column of A.

7. . Uses the `diag` Matlab function to create the following symmetric tridiagonal matrix:

$$D=\begin{pmatrix} 2 & -1 & 0 & 0 \\ -1 & 2 & -1 & 0 \\ 0 & -1 & 2 & -1 \\ 0 & 0 & -1 & 2 \end{pmatrix}.$$

8. Create the following matrices: $A=\begin{pmatrix} 9 & -2 \\ 3 & 1 \\ -3 & 7 \end{pmatrix}, B=\begin{pmatrix} 2 & -2 \\ -1 & 1 \\ 4 & 4 \end{pmatrix}$, and use A and B to get:

$$C=\begin{pmatrix} 9/2 & -2/-2 \\ -3 & 1 \\ -3/4 & 7/4 \end{pmatrix}, D=\begin{pmatrix} (9-2^2) & -6 \\ 2 & 0 \\ -19 & -9 \end{pmatrix}$$

9 Create a matrix A with random numbers in the interval [-2,2]. Extract the diagonal and antidiagonal of A.

10 Create the matrices A and B:

$$A=\begin{pmatrix} 1 & 2 & 3 \\ 0.1 & 0.2 & 0.3 \\ 10 & 20 & 30 \end{pmatrix} \boldsymbol{B}=\begin{pmatrix} 4 & 5 \\ 0.4 & 0.5 \\ 40 & 50 \end{pmatrix}$$

and :

19. sum A and B and store the result in C
20. subtract B from A and store the result in D
21. multiply A and B element by element and store the result in E
22. divide A and B element by element and store the result in F
23. multiply A and B in the matrix space and store the result in G

11. Create the vectors v1=(1,2,3,4,5) and v2=(10,20,30,40,50) and:
    1. sum v1 and v2 and store the result in vs
    2. subtract v2 from v1 and store the result in vd
    3. compute the scalar product of v1 and v2 and store the result in s.

12 Look ath the online help of the Matlab function **ones** and execute the following instructions:

a)
```
A=ones(3,2);B=2*ones(2,3);A*B
A(2,3)=2
A*B
```

Why there is an error message?

b)
```
u=0:3
v=(-3:-1:0)'
W=u.*v
```

Why there is an error message?

13 Given the matrix $A=\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ and the vector $b=\begin{pmatrix} 3 \\ 7 \end{pmatrix}$, compute:

A+A, A-A, A*A, A^2, A*b, A.*A, A.^2,
b*A(1,:), A(:,2).*b

14 Let $A=\{\sin(x), \quad x=1,2,\ldots,10000\}$. Using the Matlab function `sum`, compute how many elements of A are greater than or equal than ½.

15 Create the matrix:

$$A = \begin{bmatrix} 3 & 7 & -4 & 12 \\ -5 & 9 & 10 & 2 \\ 6 & 13 & 8 & 11 \\ 15 & 5 & 4 & 1 \end{bmatrix}$$

a) Compute the minimum of each coulumn of A^t

f) Compute the maximum of all the elements of A

16. Write a script that, given a natural number n, create a vector with elements multiple of 3 (without using a for loop).

17. Write a script that, given in input a natural number k, compute the first k elements of the Fibonacci series, given by the recurrence formula:

$$F_0 = 1, F_1 = 1, \quad F_i = F_{i-1} + F_{i-2} \quad \forall i \geq 2$$

18. Write a script computing, for a natural number k, the ratio:

$$r_k = \frac{F_{k+1}}{F_k}$$

(where F_k are the Fibonacci numbers defined in the previous exercise).

Verify that, for a large k, r_k converges to the value $1+\sqrt{5}/2$

19 Write a Matlab script to produce the following output in the command window (use the **`fprintf`** command)

22 Write a function that, given three values a,b (a<=b) and h>0, compute the values of the function

$$f(x) = 2\sin(8x) - \log(x^2+1)$$

on a grid of equally spaced points in the interval [a,b], with step h.

23 Modify the previous function in order to have a general function f(x) as input.

24 Write a function **area** computing the surface of a square or a rectangle, depending on the number of input data (one or two respectively) .

25 Make a plot of the following functions in the given intervals (in three different Matlab figures) using the **`plot`** function:

1. x^3 in [-1,1]
2. exp(x) in [-2,5]
3. sin(x)/x in [-20,20]

In each figure, insert the title.

26 Plot the graph of a function given by the maximum of the three following functions for each t:

$$y_1 = \sin(t)$$

$$y_2 = \sin(t + \frac{2}{3}\pi)$$

$$y_3 = \sin(t + \frac{4}{3}\pi)$$

Put a label on the axis with the commands **xlabel** e **ylabel**

27 Plot the graph of the following functions in [0, π] in the SAME MATLAB figure with lines of different colors and type:

$$f(x) = \sin(x)$$

$$g(x) = \cos(x)$$

$$h(x) = \sin(x)\cos(x)$$

Complete the plot with a titel and a legend using the **title** and **legend** commands.