Matlab - Exercises

Test your understanding on how MATLAB works with these short questions. Each question should not require more than a single line of command or explanation.

1. Write down the commands for each of the following operations:
   a. create a row vector x of 5 equally spaced elements between 2 and 3
   b. add 1 to the second element
   c. create a second row vector y of same dimension with elements equal to the successive even integers starting with 4.
   d. create the matrix A, whose first row is equal to x, whose second row is a line of ones, and whose third row is equal to y.
   e. define a row vector z, whose elements are equal to the mean value of the columns of A.
   f. define a column vector zz, whose elements are the sum of the elements in each rows of A.

2. Create two matrices $\mathbf{A}$ and $\mathbf{B}$:

$$\mathbf{A} = \begin{pmatrix} 1 & 2 \\ 4 & -1 \end{pmatrix}, \quad \mathbf{B} = \begin{pmatrix} 4 & -2 \\ -6 & 3 \end{pmatrix},$$

   a. Compute $\mathbf{C}_1 = \mathbf{A} + \mathbf{B}$ and $\mathbf{C}_2 = \mathbf{A} - \mathbf{B}$.
   b. Compute the matrix products $\mathbf{D_1} = \mathbf{AB}$ and $\mathbf{D_2} = \mathbf{BA}$.
   c. Using element by element operations, compute the matrix $\mathbf{F}$ whose elements are obtained as follows $f_{ij} = b_{ij} + a_{ij} b_{ij}^{1/3}$.
   d. Are $\mathbf{A}$ and $\mathbf{B}$ singular? If no, compute their inverse.
   e. Compute the eigenvalues of $\mathbf{B}$. Comment in light of your previous answer.
   f. In $\mathbf{A}$, subtract to the second row, the first row multiplied by 3.

3. Create a vector `a`with elements

$$a_n = \frac{(-1)^n \pi^{2n}}{(2n)!} \quad 0 \leq n \leq 100.$$

   (You can use the MATLAB function `factorial(n)` to compute $n!$). Compute the sum of the elements of a. Was this result predictible? Why?

4. Create two column vectors x and y of three elements with random values between 0 and 10.

   a. Compute the cross product of x and y.

   b. Compute their dot product without using the MATLAB routine but arrays operations. Compare your results with results of `dot(x,y)`.

   c. Compute the vector z satisfying

$$z_i = \frac{x_i^2 + y_i^3}{(x_i - y_i)\mathrm{e}^{-x_i}}$$

5. Given a vector `t=[0:.01:1]` write down the MATLAB command that will compute:

   a. $\log(1 + \sqrt{t})$

   b. e^{t+t^2}

   c. $\cos^{-1}(t)$ (inverse cosine function)

   d. $\sqrt{1 + \log(t).^2}$

   e. $\tan^2(t) - 1$

6. Create a square matrix $\mathbf{A}$ of size $n = 200$ with random elements between -1 and 1. Compute the mean value of all the elements of $\mathbf{A}$. Repeat the operation several times; you should find that the mean value is close to zero.

7. Given the following arrays `x=[0 2 3]'`, `y=[2 -3 4]`, `A=[0 8;-4 3;-2 5]` and `B=[9 7 6;8 5 -1]`, determine for each command whether it can execute correctly; in the case it doesn't explain why; in the case it does, predict the size of the result. Check your answer with MATLAB.

   a. `x+y`

   b. `x+y.'`

   c. `x*y`

   d. `y*x`

   e. `A*y`

   f. `A'*x`

   g. `B'*A`

   h. `y*A*B*x`

8. Given the array `A=[2 8 4+i 5; 0 -i -1 4; 3 -1 3 -1]`, explain the results of each of the following commands:

   a. `A'`

   b. `A.'`

c. `A(:,[1:3])`

d. `A([1 3],[3 2]`

e. `[A;A(end,:)]`

f. `A(:,[2 4 1 3])`

g. `sum(A)`

h. `sum(A,2)`

i. `sum(A.')`

j. `[A;sum(A)]`

9. Given `x=[7 6 1 2]` and `y=[8 4 1 3]`, explain the results of each of the following commands:

   a. `x>y`

   b. `find(x>y)`

   c. `(x>3)&(y<7)`

   d. `(x<2)|(y>=8)`

   e. `find(x==y)`

   f. `(~x)&y`

10. Given `x=[7 6 1 2 0 -1 4 3 -2 0]` what are the commands that will execute the following operations:

    a. Sets the negative values of `x` to zero.

    b. Extract the values of `x` greater than 3 in a vector `y`.

    c. Add 3 to the values of `x` that are even.

    d. Set the values of `x` that are less than the mean to zero.

    e. Set the values of `x` that are greater than the mean to their difference with the mean.