POLITECNICO DI MILANO





Introduction to Matlab

Computer Aided Manufacturing

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Some simple commands

Calculate:

$1+2$

$1-2$

$1*2$

$1/2$

2^2

$\left[20-\left(6+7\right)/12\right]*13-10/\left(3*4\right)$

$\sin^2 30^\circ+\cos^2 30^\circ$

$\sqrt{15}$

$e^{i\pi}+1$

Save the previous commands in a script and run them from the script

Variables and vectors

Define a = 1, b = 2, and calculate a + b

Store the vectors

$$\mathbf{a} = \begin{bmatrix} 1 \\ 4 \\ 2 \\ 6 \end{bmatrix} \quad \mathbf{b} = \begin{bmatrix} 1 & 4 & 2 & 6 \end{bmatrix}$$

$$\mathbf{c} = \mathbf{b} * \mathbf{a}$$

Store the vectors

$$\mathbf{a} = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix} \quad \mathbf{b} = \begin{bmatrix} 0 & 0.1 & 0.2 & 0.3 \end{bmatrix}$$

Store a row vector **a** constituted by 100 linearly spaced values from 0 to 2π (hint: use linspace)

Matrices

Store the matrices (hint: use eye, zeros, ones, repmat)

$$\mathbf{A}=\begin{bmatrix}1 & 2 & 3 & 4\\ 4 & 6 & 7 & 8\\ 9 & 10 & 11 & 12\\ 13 & 14 & 15 & 16\end{bmatrix} \quad \mathbf{B}=\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\end{bmatrix} \quad \mathbf{C}=\begin{bmatrix}1 & 1 & 1 & 1\\ 1 & 1 & 1 & 1\\ 1 & 1 & 1 & 1\\ 1 & 1 & 1 & 1\end{bmatrix} \quad \mathbf{D}=\begin{bmatrix}0 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & 0\end{bmatrix}$$

$$\mathbf{E}=\mathbf{A}+\mathbf{B}$$
$$\mathbf{F}=\mathbf{A}-\mathbf{B}$$
$$\mathbf{G}=3\mathbf{AC}$$

Extract the element in the second column and in the first row of matrix **A**.

Generate a 12 x 8 matrix, whose elements come from the statistical distribution N(0,1). (hint: use randn)

Generate a 12 x 8 matrix, whose elements come from the statistical distribution N(10,16). (hint: use normrnd)

Solve the systems (hint: avoid using inv, use \)

$$\begin{aligned} x+y+z&=2\\ 2x+3y-z&=0\\ -x-3y+2z&=4 \end{aligned} \qquad \begin{aligned} x+y&=2\\ 2x+3y&=0\\ -x-3y&=4 \end{aligned}$$

Special matrix operators

Create two 3 x 3 matrices **A**, **B**, whose elements come from a random distribution N(0,1)

Calculate the element-wise product, ratio, and power of **A**, **B**.

Calculate the matrix whose elements are the elements of **A** to the power of 2.

Estimate the sum, the arithmetical average and the sample standard deviation of the columns of **A**. (hint: use sum, mean, std)

Estimate the sum, the arithmetical average and the sample standard deviation of the rows of **A.**

Verify which elements of **A** are greater than 0. Define a matrix **B** as

$$b_{ij} = \begin{cases} a_{ij} & a_{ij} > 0 \\ 0 & a_{ij} \leq 0 \end{cases}$$

(hint: use logical indexing)

Flow control operators

Create a 100 elements vector **a** from a distribution N(0,1). Verify if **a** contains either more positive or negative values, or the same number of positive and negative values. (Suggestion: use if… elseif… else… end, disp)

Generate a series of numbers from a statistical distribution N(3,1) and continue adding these points to a column vector **a** until a negative value appears. (Suggestion: use while… end).

Generate one hundred numbers from a statistical distribution N(0,1) and store them in column vector **a**. Then, copy positive values into vector **ap**, negative values into vector **an**. (Suggestion: use for… end).

Functions

Write a function that, given a vector **a**, copies positive values into vector **ap**, negative values into vector **an**.

Write a function that, given a point in cartesian coordinate x, y, z, returns point coordinate in cylindrical form z, θ, r. (suggestion: use function atan). Remember:

$$x = r\cos\theta$$

$$y = r\sin\theta$$

$$z = z$$

Write a function which sorts a vector.

Graphical representation

Plot the following mathematical functions (xϵ[-1,1]) (hint: use plot)

$$y = x$$

$$y = x^2$$

$$y = \begin{cases} 0 & x < 0 \\ 1 & x \geq 0 \end{cases}$$

Plot these functions on a single graph. (hint: use hold)

Add labels to the axes and a suitable legend. (hint: use xlabel, ylabel, legend)

3D Graphical representation

Plot the following mathematical function (xϵ[-1,1], y ϵ[-1,1]) (hint: use surf, meshgrid)

$$z = \sin\left(4\pi x - 7\pi y + 2\right)$$

Plot the same function in wire frame. (hint: use mesh)

Plot the following function in a circular domain centered around zero, with a radius one. (hint: use trisurf, delaunay, pol2cart)

$$z = x^2 + y^2 - 0.5$$

Plot a cube. (hint: use patch).

Graphical representation - vectors

Plot the following vector field (xϵ[-1,1], y ϵ[-1,1]) (hint: use quiver)

$$\begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} \sin(2\pi x) + \cos(2\pi y) \\ \cos(2\pi x) + \sin(2\pi y) \end{bmatrix}$$

Plot the following vector field (xϵ[-1,1], y ϵ[-1,1], zϵ[-1,1]) (hint: use quiver3)

$$\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} \sin(2\pi x) + \cos(2\pi y) \\ \cos(2\pi x) + \sin(2\pi y) \\ z^2 \end{bmatrix}$$