

# Matlab Beginner's Sheet

Carvalho Estéban

**MATLAB** is a software used for numerical computation and graphic visualization. The origin of its name comes from **MAT**rix **LAB**oratory, indicating that one will be able to manipulate and work with matrices. We will often try to avoid for loops, test loops, etc. and instead use the power of matrix computation. MATLAB includes many functions for manipulating, processing, calculating, displaying data, and so on. In addition, there are Toolbox that allow you to work in many areas such as: automation, optimization, signal processing, image processing, etc.

This document is a non-exhaustive list of the basic functions of MATLAB so that you can get a good start and learn a few tricks quickly. It is by no means complete; here the "basic" use of the functions is presented. In general, the functions can take many additional or optional parameters that can be used for a wider range of purposes, in different ways but also for customization, for plotting for example. A more comprehensive use requires the use of the documentation.

## 1 - Documentation

<code>doc function_name</code>	Opens a window providing the function's documentation
<code>help function_name</code>	Briefly describes the use of the function in the console
<code>lookfor keyword</code>	Search for functions related to the keyword

## 2 - Constants

<code>pi</code>	3.1415...
<code>eps</code>	epsilon machine = 2.2204e-16
<code>Inf</code>	Infinite
<code>NaN</code>	Not a Number
<code>i</code> or <code>j</code>	imaginary number

## 3 - Command Window

<code>ans</code>	last answer
<code>clc</code>	clear command window
<code>home</code>	resets the cursor position and view without deleting the history

## 4 - Workspace Variables

<code>who</code>	lists the variables of the workspace
<code>whos</code>	... and their properties
<code>clear</code>	delete all variables from the workspace
<code>clear name</code>	deletes the variable name (it is possible to cumulate the variables)

## 5 - Operations and Operators

=	assign a value
+ -	addition, subtraction
* / ^	multiplication, division, power
.* ./ .^	term to term operations
mod(a,b)	rest of the euclidean division of a by b
A \ b	solution of Ax=b
b / A	solution of xA=b
<, <=	greater than, equal to or greater than
>, >=	less than, equal to or less than
==, ~=	equality, different
&   ~	and, or, not

## 6 - Vecteurs et Matrices

x = [1; 2; 3]	create a column vector
x = [1, 2, 3]	create a line vector
x = [1 2 3]	(space or commas)
x'	transpose
x = a:h:b	create a vector from a to b with steps of h
x = [1 ;2;3 4]	create a matrix (; goes to the next line)
y = [x ;x]	matrix concatenation
x = []	creation of an empty vector / matrix
x(i,j)	component i row, j column
x(:,j)	selects all the rows of column j
x(i,:)	selects all the columns of row i
x(:,j) = []	deletion of column j
x(i,:) = []	deletion of row i

## 7 - Particular matrices

eye(n)	identity matrix of order n
zeros(m,n)	null matrix of size (m,n)
ones(m,n)	matrix filled of 1 of size (m,n)
diag(x)	diagonal matrix formed from x vector
diag(x,k)	matrix whose k <sup>th</sup> diagonal is formed of the elements of x (k = 0, represents the main diagonal)
blkdiag(x1,...,xn)	diagonal matrix formed from the matrices $x_1, \dots, x_n$
tril(x)	returns the lower triangular part of the matrix x
triu(x)	returns the upper triangular part of the matrix x
magic(n)	magic square of order n
rand(n)	matrix (m,n) of random numbers uniformly distributed in the interval (0,1)
randi(imax,n)	nth-order square matrix of pseudo-random integers of discrete uniform distribution over the interval [1,imax].
randn(n)	matrix (m,n) of normally distributed random numbers

## 8 - Vector Functions

length(x)	returns the largest dimension of x
size(x)	dimension of x : vector [nb row,nb column].
rank(x)	rank
det(x)	determinant
trace(x)	trace (sum of diagonal elements)
inv(x)	inverse
poly(x)	characteristic polynomial
eig(x)	eigenvalues
[V,D] = eig(x)	eigenvalues and eigenvectors
norm(x)	norm 2
reshape(x,m,n)	create a matrix (m,n) from x
For the following functions if x is not a vector, the operation is performed according to the first dimension	
sum(x)	sum the elements of x
mean(x)	returns the average or mean value of x
var(x)	returns the variance of x
std(x)	renvoie l'écart type de x
median(x)	returns the standard deviation of x
sort(x)	sorts the elements of x
min(x)	returns the minimum elements of x
max(x)	returns the maximum elements of x
find(x)	returns the indices of the non-zero elements of x

## 9 - Math Functions

sign(x)	sign of x (+1 or -1)
sqrt(x)	square root of x
sin(x) or sind(x)	sine of x in radian or degree
cos(x) or cosd(x)	cosine of x in radian or degree
tan(x) or tand(x)	tangent of x in radian or degree
asin(x) or asind(x)	inverse sine of x in radian or degree
acos(x) or acosd(x)	inverse cosine of x in radian or degree
atan(x) or atand(x)	inverse tangent of x in radian or degree
exp(x)	exponential
log(x)	natural logarithm
log10(x)	common logarithm (base 10)
abs(x)	absolute value or complex magnitude
angle(x)	phase angle
real(x)	real part of complex number
imag(x)	imaginary part of complex number

## 10 - Rounding Functions

round(x,n)	rounds each element of x to the nearest integer with n decimals
ceil(x,n)	rounds each element of x to the nearest integer greater than or equal to it
floor(x,n)	rounds each element of x to the nearest integer less than or equal to it

## 11 - Plotting

### 11.1 - Fonctions de tracés

<code>plot(x,y)</code>	plots y versus x
<code>plot3(x,y,z)</code>	3D coordinate plotting
<code>stem(x,y)</code>	plot discrete sequence data
<code>stairs(x,y)</code>	stairstep graph
<code>bar(x,y)</code>	bar graph
<code>histogram(x)</code>	histogram plot
<code>line(x,y)</code>	line drawing
<code>surf(X,Y,Z)</code>	drawing of a 3D surface (painted)
<code>mesh(x,y,z)</code>	drawing of a 3D surface

### 11.2 - Caption functions

<code>title('txt')</code>	defines the title of the figure
<code>xlabel('txt')</code>	caption on x
<code>ylabel('txt')</code>	caption on y
<code>zlabel('txt')</code>	caption on z
<code>xlim([xmin xmax])</code>	defines the limits of the x axis
<code>ylim([ymin ymax])</code>	defines the limits of the y axis
<code>zlim([zmin zmax])</code>	defines the limits of the z axis
<code>axis([xmin xmax ymin ymax zmin zmax])</code>	defines the limits of the specified axis
<code>legend('txt', ..., 'txt n')</code>	add a legend
<code>grid</code>	activates the grid
<code>grid on</code> or <code>off</code>	activates or deactivates the grid

### 11.3 - Manage Plots

<code>figure</code> or <code>figure(nb)</code>	create a figure or figure no. <i>nb</i>
<code>subplot(m,n,p)</code> or <code>subplot(mnp)</code>	divides the current figure into a grid m by n and create axis at the position p
<code>hold on</code> or <code>off</code>	maintains or not the next plot on the same figure
<code>shg</code>	displays the current figure in the foreground
<code>gca</code>	returns the current axis
<code>gcf</code>	returns the current figure
<code>close all</code>	closes all open figures
<code>close</code>	closes the current figure
<code>clf</code>	deletes the content of the current figure

## 12 - Loops

### 12.1 - If Loop

<code>if condition 1</code> <code>instruction 1</code> <code>elif condition 2</code> <code>instruction 2</code> <code>else condition 3</code> <code>instruction 3</code> <code>end</code>
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### 12.2 - For Loop

<code>for index = value</code> <code>instruction</code> <code>end</code>
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## 12.3 - Switch

```
switch expression
case cas_expression 1
    instruction 1
case cas_expression 2
    instruction 2
...
otherwise
    instruction
end
```

## 12.4 - While Loop

```
while condition
    instruction
end
```

# 13 - Defining Functions

## 13.1 - Functions

```
function [y1,...,yN] = name(x1,...,xM)
% [y1,...,yN] = name(x1,...,xM)
% Description of the function in comments
% Allows you to generate the documentation for the help / doc functions.
% Descriptions of input and output variables, etc.
% Authors, date
instructions
end
```

## 13.2 - Around Functions

<pre>fun = @(x) x*exp(-x)  fun(x) fun = @cos fun = @(x,y) cos(x)+sin(y)  nargin nargin(function)  nargout nargout(function)</pre>	<p>'function handle' to create or call existing or anonymous functions call the function (other examples)</p> <p>number of inputs (use in function only) number of inputs of the specified function</p> <p>number of outputs (use in function only) number of outputs of the specified function</p>
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# 14 - Time Evaluation

<pre>tic time = toc clock profile start  profile viewer</pre>	<p>start stopwatch timer read elapsed time from stopwatch returns the current date and time (advanced function) starts the time evaluation: allows to get detailed information about the use time of the called functions, number of calls, etc. displays the results of the profiler in a window</p>
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## 15 - Shortcuts

Ctrl + R	comment
Ctrl + T	uncomment
Ctrl + I	auto-indent
Ctrl + C	abort
Ctrl + S	save
Ctrl + Tab	move to the next visible pane
Ctrl + Enter	run section (section are defined with %%)
F5	run