

MATLAB Quick Reference

Operators

Matrix Operations		Array or Element by Element	
+	Addition		
-	Subtraction		
*	Matrix Multiplication	.*	Element by Element Multiplication
/	Right Matrix Division $b/A = bA^{-1}$	./	Element by Element Right Division
\	Left Matrix Division $A \setminus b = A^{-1}b$	.\	Element by Element Left Division $A \setminus B = B./A$
^	Raise Matrix to a power	.^	Raise each Element to a power
'	Transpose matrix (conjugate if complex) A'	.'	Transpose matrix (no complex conjugation) $A.'$

Relational Operators		Logical Operators	
<	Less Than	&	And
<=	Less Than or Equal		Or
>	Greater Than	~	NOT
>=	Greater Than or Equal		
==	Equal		
~=	Not Equal		

Special Number Symbols

pi	π
inf	∞
NaN	Not a number ie 0/0

i	$\sqrt{-1}$
j	$\sqrt{-1}$

Entering Matrices

$x = [1\ 2\ 3; 4\ 5\ 6; 7\ 8\ 9]$	Comma or space between elements. Semicolon or return for new row. Enclosed in square brackets.
$x = [1,2,3,4,5,6,7,8,9]$	
$a = [\exp(0)\ \sqrt{4}\ 1+2]$	Each element can be an expression.
$C = [A\ B]$	A and B are matrices with the same number of rows.
$C = [A;\ B]$	A and B are matrices with the same number of columns.

Indexing

Vector Indexing	
variable(V)	V is a vector of indexes
Examples	
A(3)	The third element in vector A.
A([3 8 11])	The third, eighth and eleventh elements of A.
A(3:11)	The third to eleventh elements of A.
A(11:end)	All elements from the eleventh to the last element

Matrix Indexing	
variable(R,C)	R is a vector of rows and C a vector of Columns
Examples	
M(2,3)	The element in the second row and third column of M.
M(2, [3 8 11])	Second row, third, eighth and eleventh column.
M(4,3:11)	Fourth row, third to eleventh column.
M(11:end,2)	Eleventh to the last row, second column.
M(5,:)	Fifth row, all columns.
M(11:end,:)	Eleventh to the last row, all columns.

Output Display Format

format short	4 decimal places	format long	15 decimal places
format	Same as above		
format shortE	Scientific notation, 4 decimal places	format longE	Scientific notation, 15 decimal places
format shortEng	Engineering notation, 4 decimal places	format longEng	Engineering notation, 15 decimal places

Generating Vectors

<start> : <end>	x = 1 : 5 generates x = [1 2 3 4 5]
<start> : <separation> : <end>	y = 0:5:20 generates y = [0 5 10 15 20]
linspace(start,end,n) n = number of elements	linspace(0,10,5) generates [0 2.5 5 7.5 10]
logspace(d1,d2,n) n elements logarithmically spaced between 10^{d1} and 10^{d2} .	logspace(-1,2,4) generates [0.1 1 10 100]

Utility Matrices

zeros(n)	n by n matrix where each element is zero.
zeros(m,n)	m by n matrix where each element is zero.
zeros(a,b,c)	3 dimensional array, a by b by c.
ones(m,n)	m by n matrix where each element is one.
rand(m,n)	m by n matrix of random numbers.
eye(n)	n by n identity matrix.

Variable Control

who	List all variables in memory.
whos	Same as above but with more information.
clear	Remove all variables from memory.
clear <variable>	Remove specified variables from memory.

File Control Commands

dir	List contents of current directory.
ls	List contents of current directory.
what	List the Matlab files in the current directory.
cd <directory>	Change the current directory.
type <filename>	Display the contents of a text or .m file.
delete <filename>	Delete a file.
diary <filename>	Record all commands and results to a file.
diary off	Stop above.

Help

help	Display help topics.
help <function>	Help on a particular function.
lookfor <word>	Look for word in function descriptions.
doc <function>	Full documentation on function.

In Built Functions

Hit **fx** icon next to prompt for function browser. Only selected functions shown here.

abs(x)	The absolute value. Modulus	round(x)	Round to the nearest integer.
sqrt(x)	The square root.	ceil(x)	Round up.
exp(x)	The exponential base e. e^x	floor(x)	Round down.
log(x)	The natural logarithm. $\log_e(x)$	fix(x)	Round towards zero.
log10(x)	The log base 10. $\log_{10}(x)$	rem(x,b)	Remainder of x divided by b.

Trigonometry

sin(x)	Sine. x in radians.		
sind(x)	Sine. x in degrees.		
asin(x)	The arcsine. The inverse of sin(x). Radians		
asind(x)	The arcsine. Degrees		
sinh(x)	Hyperbolic Sine.		
asinh(x)	The inverse Hyperbolic Sine.		
The above variations are also available for the following functions.			
cos(x)	Cosine		
tan(x)	Tangent	cot(x)	Cotangent
sec(x)	Secant	csc(x)	Cosecant

Complex Numbers

real(z)	The real part of z.	imag(z)	The imaginary part of z.
abs(z)	The modulus of z.	angle(z)	The phase angle of z.
conj(z)	The complex conjugate of z.		

Matrix

det(A)	Determinant	sqrtm(A)	The matrix square root.
norm(A)	Norm	expm(A)	The matrix exponential base e.
inv(A)	Inverse	logm(A)	The matrix natural logarithm.
[v,d]=eig(A)	d = Eigenvalues, v = Eigenvectors		

Statistics

max(x)	Maximum	median(x)	Median	var(x)	Variance
min(x)	Minimum	mean(x)	Average	std(x)	Standard Deviation

Polynomials

$p = [1 \ 2 \ 3 \ 4 \ 5]$; can represent the polynomial $x^4 + 2x^3 + 3x^2 + 4x + 5$	
y = polyval(p,x)	Evaluate polynomial for each value in x.
roots(p)	Roots of polynomial.
p = poly(<roots>)	Polynomial with given roots.
p = polyfit(x,y,n)	Best fit of x,y data points to n^{th} order polynomial.

Saving, Exporting and Importing Data

save <filename>	Save all variable to the file <i>filename.mat</i>
load <filename>	Load in variables from the file <i>filename.mat</i>
save <filename> <variable>	Save only the variable <i>variable</i> to the file <i>filename.mat</i>
save <filename> <variable> -ascii	Save <i>variable</i> to the text file <i>filename</i>
load <filename>.<ext>	Load from the text file, to a variable called <i>filename</i>

Misc

x = input('What is x ? ')	Ask the user for a number.
[x,y] = ginput(1)	Graph coordinates of a clicked on point.
pause	Wait for the user to press a key.
pause(5)	Wait for 5 seconds
! command	Execute an operating system command
display(a)	Suppose a = 5. This would print "a = 5";
disp(a)	Same as above, but with out the "a = ".

fprintf Formatting

%f	Fixed point	%5f	5 characters wide	\n	New line
%e	Exponential Notation	%5.2f	2 decimal places (dp)	\t	Horizontal tab
%g	auto chooses %f or %e	%-5.2f	Left justify	\\	Back slash
%s	String of Characters	%+5.2f	Print sign (+ or -)	%%	Percent character
%d	Integer (Whole numbers only)				

Examples	What is printed	Comment
fprintf(' x = %f ',pi)	x = 3.141593	No new line after
fprintf(' x = %f \n',pi)	x = 3.141593	Moves to a new line after
fprintf(' L%6.2fR \n',pi)	L 3.14R	Number is 6 chars wide with 2 dp
fprintf('%s L%-6.2fR','Hi',pi)	Hi L3.14 R	The string 'Hi', then left justify number
S = sprintf(' x = %f ',pi);	NOTHING	S is a string containing ' x = 3.141593'

Graph Commands

plot(y)	Plot y against index number.
plot(x,y)	Plot y against x
plot(x1,y1,x2,y2)	Plot y1 against x1 and y2 against x2.
plot(x,y,'r+')	Plot y against x using red plus signs.
plot(x1,y1,'r+',x2,y2,'go')	Red plus signs for x1 and y1, Green circles for x2 y2.

Symbol	Line Type or Mark	Symbol	Colour	Other Types of Plot	
.	Point	r	Red	fill(x,y,'r')	Red filled graph
o	Circle	g	Green	bar(x,y)	Bar graph
x	X mark	b	Blue	loglog(x,y)	x & y log scale
+	Plus sign	y	Yellow	semilogx(x,y)	x log, y linear
*	Stars	m	Magenta	semilogy(x,y)	x linear, y log
-	Solid line	c	Cyan	polar(theta,r)	Polar plot
:	Dotted line	w	White	surf(x,y,z)	3D surface
.-	Dash dot line	k	Black	mesh(x,y,z)	3D mesh
--	Dash Line			plot3(x,y,z)	3D line plot

Other Graphics Commands

title('Title')	Graph title.		
xlabel('X axis')	Label the x-axis.		
ylabel('Y axis') zlabel('Z axis')	Label y and z axis.		
text(x,y,'My Text')	Place text at coordinates x,y.		
grid	Place a grid on the graph.		
hold on	Add any new plot to the current graph.		
hold off	Replace current plot with any new plot.		
subplot(r,c,n)	Split figure into r rows by c columns of subplots.		
	subplot(2,3,1)	subplot(2,3,2)	subplot(2,3,3)
	subplot(2,3,4)	subplot(2,3,5)	subplot(2,3,6)
axis([minX maxX minY maxY])	Set the limits of the graph in X and Y. (Note 4 element vector)		
h = figure	New graphics window.		
figure(h)	Change to plotting in figure h.		
delete(h)	Delete figure h.		
clf	Clear current figure.		
drawnow	Force the graph to update now.		

Programming

Enumerated Loops (for)

The general form of a **for** loop is :-

```
for <variable> = <vector>
    <statement>
    <statement>
    etc
end
```

Examples

```
A = rand(1,5);
for a = A
    disp(a)
end
```

```
for k = [ 1 7 3 pi i]
    disp(k)
end
```

Precondition Loops (while)

Below is the general form of a **while** loop.

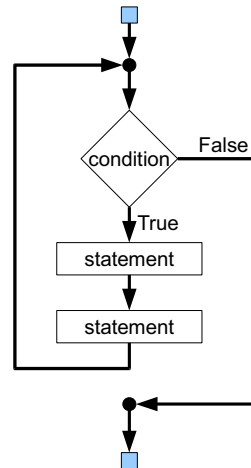
```
while(<condition>)
    <statement>
    <statement>
    etc
end
```

Example

```
A = 7;      %Find the square root of A.
x=1;       %First guess
err=1;     %Set error to get started

% Newton Raphson Iteration
while(err>0.0001)
    x = (x.^2+A)./(2*x);
    % calculate the error
    err = abs(A-x.^2);
end

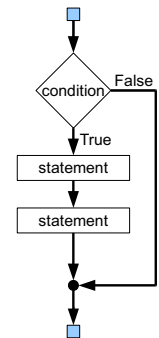
disp(x);
```



Conditional Execution (if)

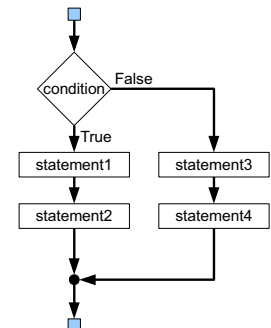
General form of a simple **if** statement.

```
if <condition>
    <statement>
    <statement>
    etc
end
```



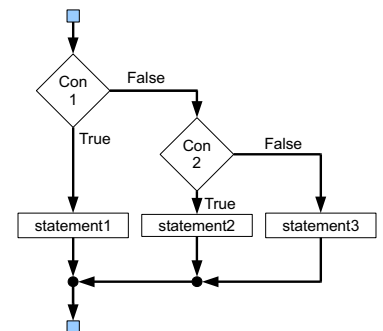
The form of **if** statement with **else**

```
if <condition>
    <statement1>
    <statement2>
    etc
else
    <statement3>
    <statement4>
    etc
end
```



You can also have as many **elseif** parts as you like.

```
if <condition1>
    <statement1>
    etc
elseif <condition2>
    <statement2>
    etc
else
    <statement3>
    etc
end
```



Switch

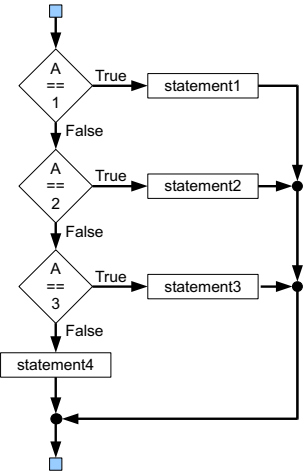
Execution depends on the value of a variable.

```
switch <variable>
case 1
  <statement1>
  etc
case 2
  <statement2>
  etc
case 3
  <statement3>
  etc
otherwise
  <statement4>
  etc
end
```

The case values can be any value that the switch variable can take. You can also put multiple values after the case.

```
case {1,2,3,4,5}
  <statement>
  etc
```

On the right A is the switch variable.



Functions

Function Definition	Using the Function
<pre>function sum = myadd(a,b) % The first block of comments % defines what is printed out when % you type help myadd % Comment not part of help sum = a + b;</pre>	<pre>s = myadd(<expression>,<expression>)</pre>
<pre>function [sum,diff] = add_sub(a,b) sum = a + b; diff = a - b;</pre>	<pre>[s,d] = add_sub(<expression>,<expression>)</pre>