

MANAGING COMMANDS AND FUNCTIONS	
help	help facility
what	list M-files on disk
type	list named M-file
lookfor	keyword search through the help entries
which	locate functions and files
demo	run demonstrations
path	control MATLAB's search path
cedit	set parameters for command line editing and recall
version	display MATLAB version you are running
whatsnew	display toolbox README files
info	info about MATLAB and The MathWorks
why	receive flippant answer

MANAGING VARIABLES AND THE WORKSPACE	
who	list current variables
whos	list current variables, long form
save	save workspace variables to disk
load	retrieve variables from disk
clear	clear variables and functions from memory
pack	consolidate workspace memory
size	size of matrix
length	length of vector
disp	display matrix or text

WORKING WITH FILES AND THE OPERATING SYSTEM	
cd	change current working directory
pwd	show current working directory
dir, ls	directory listing
delete	delete file
getenv	get environment variable
!	execute operating system command
unix	execute operating system command; return result
diary	save text of MATLAB session

CONTROLLING THE COMMAND WINDOW	
clc	clear command window
home	send cursor home—to top of screen
format	set output format
echo	echo commands inside script commands
more	control paged output in command window

STARTING AND QUITTING FROM MATLAB	
quit	terminate MATLAB
startup	M-file executed when MATLAB is started
matlabrc	master startup M-file

MATRIX OPERATORS		ARRAY OPERATORS	
+	addition	+	addition
-	subtraction	-	subtraction
*	multiplication	.*	multiplication
^	power	.^	power
/	right division	./	right division
\	left division	.\	left division
'	conjugate transpose		
.'	transpose		
kron	Kronecker tensor product		

RELATIONAL AND LOGICAL OPERATORS			
<	less than	&	and
<=	less than or equal		or
>	greater than	~	not
>=	greater than or equal	xor	exclusive or
==	equal		
~=	not equal		

SPECIAL CHARACTERS	
=	assignment statement
[]	used to form vectors and matrices; enclose multiple function output variables
()	arithmetic expression precedence; enclose function input variables
.	decimal point
..	parent directory
...	continue statement to next line
,	separate subscripts, function arguments, statements
;	end rows, suppress printing
%	comments
:	subscripting, vector generation
!	execute operating system command

SPECIAL VARIABLES AND CONSTRAINTS	
ans	answer when expression not assigned
eps	floating point precision
realmax	largest floating point number
realmin	smallest positive floating point number
pi	π
i, j	imaginary unit
inf	infinity
NaN	Not-a-Number
flops	floating point operation count
nargin	number of function input arguments
nargout	number of function output arguments
computer	computer type

MATRIX MANIPULATION	
diag	create or extract diagonals
rot90	rotate matrix 90 degrees
flipr	flip matrix left-to-right
flipud	flip matrix up-to-down
reshape	change size
tril	lower triangular part
triu	upper triangular part
.'	transpose
:	convert matrix to single column; A(:)

TIME AND DATE	
date	current date
clock	wall clock
etime	elapsed time function
tic, toc	stopwatch timer functions
cputime	elapsed CPU time

SPECIAL MATRICES	
zeros	matrix of zeros
ones	matrix of ones
eye	identity
diag	diagonal
toeplitz	Toeplitz
magic	magic square
compan	companion
linspace	linearly spaced vectors
logspace	logarithmically spaced vectors
meshgrid	array for 3-D plots
rand	uniformly distributed random numbers
randn	normally distributed random numbers
hilb	Hilbert
invhilb	inverse Hilbert (exact)
vander	Vandermonde
pascal	Pascal
hadamard	Hadamard
hankel	Hankel
rosser	symmetric eigenvalue test matrix
wilkinson	Wilkinson's eigenvalue test matrix
gallery	two small test matrices

LOGICAL FUNCTIONS	
exist	check if variables or functions exist
any	true if any element of vector is true
all	true if all elements of vector are true
find	find indices of non-zero elements
isnan	true for NaNs
isinf	true for infinite elements
finite	true for finite elements
isieee	true for IEEE floating point arithmetic
isempty	true for empty matrix
issparse	true for sparse matrix
isstr	true for text string
strcmp	compare string variables

SOUND PROCESSING FUNCTIONS	
saxis	sound axis scaling
sound	convert vector to sound
auread	Read Sun audio file
auwrite	Write Sun audio file
lin2mu	linear to mu-law conversion
mu2lin	mu-law to linear conversion

CONTROL FLOW	
if	conditionally execute statements
else	used with if
elseif	used with if
end	terminate if, for, while
for	repeat statements for a specific number of times
while	repeat statements while condition is true
break	terminate execution of for or while loops
return	return to invoking function
error	display message and abort function

PROGRAMMING	
input	prompt for user input
keyboard	invoke keyboard as if it were a script file
menu	generate menu of choices for user input
pause	wait for user response
function	define function
eval	execute string with MATLAB expression
feval	evaluate function specified by string
global	define global variables
nargchk	validate number of input arguments

TEXT AND STRINGS	
string	about character strings in MATLAB
abs	convert string to numeric values
blanks	a string of blanks
eval	evaluate string with MATLAB expression
num2str	convert number to string
int2str	convert integer to string
str2num	convert string to number
isstr	true for string variables
strcmp	compare string variables
upper	convert string to uppercase
lower	convert string to lowercase
hex2num	convert hex string to floating point number
hex2dec	convert hex string to decimal integer
dec2hex	convert decimal integer to hex string

DEBUGGING	
dbstop	set breakpoint
dbclear	remove breakpoint
dbcont	remove execution
dbdown	change local workspace context
dbstack	list who called whom
dbstatus	list all breakpoints
dbstep	execute one or more lines
dbtype	list M-file with line numbers
dbup	change local workspace context
dbdown	opposite of dbup
dbquit	quit debug mode

SPECIAL FUNCTIONS	
bessel	bessel function
beta	beta function
gamma	gamma function
rat	rational approximation
rats	rational output
erf	error function
erfinv	inverse error function
ellipke	complete elliptic integral
ellipj	Jacobian elliptic integral
expint	exponential integral
log2	dissect floating point numbers
pow2	scale floating point numbers

TRIGONOMETRIC FUNCTIONS

sin, asin, sinh, asinh	sine, arcsine, hyperbolic sine, hyperbolic arcsine
cos, acos, cosh, acosh	cosine, arccosine, hyperbolic cosine, hyperbolic arccosine
tan, atan, tanh, atanh	tangent, arctangent, hyperbolic tangent, hyperbolic arctangent
cot, acot, coth, acoth	cotangent, arccotangent, hyperbolic cotan., hyperbolic arccotan.
sec, asec, sech, asech	secant, arcsecant, hyperbolic secant, hyperbolic arcsecant
csc, acsc, csch, acsch	cosecant, arccosecant, hyperbolic cosecant, hyperbolic arccosecant

MATRIX DECOMPOSITIONS AND FACTORIZATIONS

inv	inverse
lu	factors from Gaussian elimination
rref	reduced row echelon form
chol	Cholesky factorization
qr	orthogonal-triangular decomposition
nnls	nonnegative least squares
lsqov	least squares in presence of known covariance
null	null space
orth	orthogonalization
eig	eigenvalues and eigenvectors
hess	Hessenberg form
schur	Schur decomposition
cdf2rdf	complex diagonal form to real block diagonal form
rsf2csf	real block diagonal form to complex diagonal form
balance	diagonal scaling for eigenvalue accuracy
qz	generalized eigenvalues
polyeig	polynomial eigenvalue solver
svd	singular value decomposition
pinv	pseudoinverse

ELEMENTARY MATH FUNCTIONS

abs	absolute value or complex magnitude
angle	phase angle
sqrt	square root
real	real part
imag	imaginary part
conj	complex conjugate
gcd	greatest common divisor
lcm	least common multiple
round	round to nearest integer
fix	round toward zero
floor	round toward $-\infty$
ceil	round toward ∞
sign	signum function
rem	remainder
exp	exponential base e
log	natural logarithm
log10	log base 10

MATRIX CONDITIONING

cond	condition number in 2-norm
rcond	LINPACK reciprocal condition number estimator
condst	Hager/Higham condition number estimator
norm	1-norm, 2-norm, F-norm, ∞ -norm
normest	2-norm estimator
rank	rank

ELEMENTARY MATRIX FUNCTIONS	
expm	matrix exponential
expm1	M-file implementation of expm
expm2	matrix exponential via Taylor series
expm3	matrix exponential via eigenvalues and eigenvectors
logm	matrix logarithm
sqrtm	matrix square root
funm	evaluate general matrix function
poly	characteristic polynomial
det	determinant
trace	trace

POLYNOMIALS	
poly	construct polynomial with specified roots
roots	polynomial roots—companion matrix method
roots1	polynomial roots—Laguerre's method
polyval	evaluate polynomial
polyvalm	evaluate polynomial with matrix argument
conv	multiply polynomials
deconv	divide polynomials
residue	partial-fraction expansion (residues)
polyfit	fit polynomial to data
polyder	differentiate polynomial

COLUMN-WISE DATA ANALYSIS	
max	largest component
min	smallest component
mean	average or mean value
median	median value
std	standard deviation
sort	sort in ascending order
sum	sum of elements
prod	product of elements
cumsum	cumulative sum of elements
cumprod	cumulative product of elements
hist	histogram

SIGNAL PROCESSING	
abs	complex magnitude
angle	phase angle
conv	convolution and polynomial multiplication
deconv	deconvolution and polynomial division
corrcoef	correlation coefficients
cov	covariance matrix
filter	one-dimensional digital filter
filter2	two-dimensional digital filter
cplxpair	sort numbers into complex pairs
unwrap	remove phase angle jumps across 360° boundaries
nextpow2	next higher power of 2
fft	radix-2 fast Fourier transform
fft2	two-dimensional FFT
ifft	inverse fast Fourier transform
ifft2	inverse 2-D FFT
fftshift	zero-th lag to center of spectrum

FINITE DIFFERENCES AND DATA INTERPOLATION

diff	approximate derivatives
gradient	approximate gradient
del2	five point discrete Laplacian
subspace	angle between two subspaces
spline	cubic spline interpolation
interp1	1-D data interpolation
interp2	2-D data interpolation
interpft	1-D data interpolation via FFT method
griddata	data gridding

NUMERICAL INTEGRATION

quad	adaptive 2-panel Simpson's Rule
quad8	adaptive 8-panel Newton-Cotes Rule
trapz	trapezoidal method

DIFFERENTIAL EQUATION SOLUTION

ode23	2nd/3rd order Runge-Kutta method
ode23p	solve via ode23 , displaying plot
ode45	4th/5th order Runge-Kutta-Fehlberg method

NONLINEAR EQUATIONS AND OPTIMIZATION

fmin	minimize function of one variable
fmins	minimize function of several variables
fsolve	solution to a system of nonlinear equations (find zeros of a function of several variables)
fzero	find zero of function of one variable
fplot	plot graph of a function

TWO DIMENSIONAL GRAPHS

plot	linear plot
loglog	log-log scale plot
semilogx	semilog scale plot
semilogy	semilog scale plot
fill	draw filled 2-D polygons
polar	polar coordinate plot
bar	bar graph
stairs	stairstep plot
errorbar	error bar plot
hist	histogram plot
rose	angle histogram plot
compass	compass plot
feather	feather plot
fplot	plot function

GRAPH ANNOTATION

title	graph title
xlabel	x-axis label
ylabel	y-axis label
zlabel	z-axis label for 3-D plots
grid	grid lines
text	text annotation
gtext	mouse placement of text
ginput	graphical input from mouse

FIGURE WINDOW/AXIS CREATION AND CONTROL	
figure	create figure (graph window)
gcf	get handle to current figure
clf	clear current figure
close	close figure
hold	hold current graph
ishold	return hold status
subplot	create axes in tiled positions
axes	create axes in arbitrary positions
gca	get handle to to current axes
axis	control axis scaling and appearance
caxis	control pseudocolor axis scaling

GRAPH HARDCOPY AND STORAGE	
print	print graph or save graph to file
printopt	configure local printer defaults
orient	set paper orientation

THREE DIMENSIONAL GRAPHS	
mesh	3-D mesh surface
meshc	combination mesh/contour plot
meshz	3-D mesh with zero plane
surf	3-D shaded surface
surfc	combination surface/contour plot
surfl	3-D shaded surface with lighting
plot3	plot lines and points in 3-D space
fill3	draw filled 3-D polygons in 3-D space
contour	contour plot
contour3	3-D contour plot
clabel	contour plot elevation labels
contourc	contour plot computation (used by contour)
pcolor	pseudocolor (checkerboard) plot
quiver	quiver plot
image	display image
waterfall	waterfall plot
slice	volumetric visualization plot

3-D GRAPH APPEARANCE	
view	3-D graph viewpoint specification
viewmtx	view transformation matrices
hidden	mesh hidden line removal mode
shading	color shading mode
axis	axis scaling and appearance
caxis	pseudocolor axis scaling
specular	specular reflectance
diffuse	diffuse reflectance
surfnorm	surface normals
colormap	color lookup table (see below)
brighten	brighten or darken color map
spinmap	spin color map
rgbplot	plot colormap
hsv2rgb	hsv to rgb color map conversion
rgb2hsv	rgb to hsv color map conversion

COLOR MAPS	
hsv	hue-saturation-value (default)
jet	variant of hsv
gray	linear gray-scale
hot	black-red-yellow-white
cool	shades of cyan and magenta
bone	gray-scale with tinge of blue
copper	linear copper tone
pink	pastel shades of pink
flag	alternating red, white, blue, and black

3-D OBJECTS	
sphere	generate sphere
cylinder	generate cylinder
peaks	generate demo surface

MOVIES AND ANIMATION	
moviein	initialize movie frame memory
getframe	get movie frame
movie	play recorded movie frames

HANDLE GRAPHICS OBJECTS	
figure	create figure window
axes	create axes
line	create line
text	create text
patch	create patch
surface	create surface
image	create image
uicontrol	create user interface control
uimenu	create user interface menu

HANDLE GRAPHICS OPERATIONS	
set	set object properties
get	get object properties
reset	reset object properties
delete	delete object
drawnow	flush pending graphics events

LOW-LEVEL I/O FUNCTIONS	
fclose	close file
fopen	open file
fread	read binary data from file
fwrite	write binary data to file
fgetl	readline from file, discard newline character
fgets	readline from file, keep newline character
fprintf	write formatted data to file
fscanf	read formatted data from file
sprintf	write formatted data to string
sscanf	read string under format control
ferror	inquire file I/O error status
frewind	rewind file
fseek	set file position indicator
ftell	get file position indicator

SPARSE MATRIX FUNCTIONS

spdiags	sparse matrix formed from diagonals
speye	sparse identity matrix
sprandn	sparse random matrix
spones	replace nonzero entries with ones
sprandsym	sparse symmetric random matrix
spfun	apply function to nonzero entries
sparse	create sparse matrix; convert full matrix to sparse
full	convert sparse matrix to full matrix
find	find indices of nonzero entries
spconvert	convert from sparse matrix external format
issparse	true if matrix is sparse
nnz	number of nonzero entries
nonzeros	nonzero entries
nzmax	amount of storage allocated for nonzero entries
spalloc	allocate memory for nonzero entries
spy	visualize sparsity structure
gplot	plot graph, as in “graph theory”
colmmd	column minimum degree
colperm	order columns based on nonzero count
dmperm	Dulmage-Mendelsohn decomposition
randperm	random permutation vector
symmmd	symmetric minimum degree
symrcm	reverse Cuthill-McKee ordering
condest	estimate 1-norm condition
normest	estimate 2-norm
sprank	structural rank
spaugment	form least squares augmented system
spparms	set parameters for sparse matrix routines
sybifact	symbolic factorization analysis
sparsefun	sparse auxillary functions and parameters