

## Managing Commands And Functions

<b>help</b>	help facility
<b>what</b>	list M-files on disk
<b>type</b>	list named M-files
<b>lookfor</b>	keyword search through the help entries
<b>which</b>	locate functions and files
<b>demo</b>	run demonstration
<b>path</b>	control Matlab's search path
<b>cedit</b>	set parameters for command line editing
<b>version</b>	display Matlab version you are running
<b>whatsnew</b>	display toolbox Readme files
<b>info</b>	info about Matlab and The MathWorks
<b>why</b>	receive flippant answer

## Managing Variables And The Workspace

<b>who</b>	list current variables
<b>whos</b>	list current variables, long form
<b>save</b>	save workspace variables to disk
<b>load</b>	retrieve variables from disk
<b>clear</b>	clear variables and functions from memory
<b>pack</b>	consolidate workspace memory
<b>size</b>	size of matrix
<b>length</b>	length of vector
<b>disp</b>	display matrix or text

## Working With Files And The Operating System

<b>cd</b>	change current working directory
<b>pwd</b>	show current working directory
<b>dir, ls</b>	directory listing
<b>delete</b>	delete file
<b>getenv</b>	get environment variable
<b>!</b>	execute operating system command
<b>unix</b>	execute operating system command; return result
<b>diary</b>	save text of Matlab session

## Controlling The Command Window

<b>clc</b>	clear command window
<b>home</b>	send cursor home – to top of screen
<b>format</b>	set output format
<b>echo</b>	echo commands inside script commands
<b>more</b>	control paged output in command window

## Starting And Quitting from Matlab

<b>quit</b>	terminate Matlab
<b>startup</b>	M-file executed when Matlab is started
<b>matlabrc</b>	master startup M-file

### Matrix Operators

+	addition	+	addition
-	subtraction	-	subtraction
*	multiplication	.*	multiplication
^	power	.^	power
/	right division	./	right division
\	left division	.\	left division
,	conjugate transpose		
.,	transpose		
<b>kron</b>	Kronecker tensor product		

### Array Operators

### Relational And Logical Operators

<	less than	&	and
<=	less than or equal		or
>	greater than	~	not
>=	greater than or equal	<b>xor</b>	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

<b>ans</b>	answer when expression not assigned
<b>eps</b>	floating point precision
<b>realmax</b>	largest floating point number
<b>realmin</b>	smallest positive floating point number
<b>pi</b>	$\pi$
<b>i, j</b>	imaginary unit
<b>inf</b>	infinity
<b>NaN</b>	Not-a-Number
<b>flops</b>	floating point operation count
<b>nargin</b>	number of function input arguments
<b>nargout</b>	number of function output arguments
<b>computer</b>	computer type

## Time And Date

<b>date</b>	current date
<b>clock</b>	wall clock
<b>etime</b>	elapsed time function
<b>tic, toc</b>	stopwatch timer functions
<b>cputime</b>	elapsed CPU time

## Special Matrices

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

## Matrix Manipulation

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

## Logical Functions

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

## Control Flow

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

## Programming

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

## Text And Strings

<b>string</b>	about character strings in Matlab
<b>abs</b>	convert strings to numeric values
<b>blanks</b>	a string of blanks
<b>eval</b>	evaluate string with Matlab expression
<b>num2str</b>	convert number to string
<b>in2str</b>	convert integer to string
<b>str2num</b>	convert string to number
<b>isstr</b>	true for string variables
<b>strcmp</b>	compare string variables
<b>upper</b>	convert string to uppercase
<b>lower</b>	convert string to lowercase
<b>hex2num</b>	convert hex string to floating point number
<b>hex2dec</b>	convert hex string to decimal integer
<b>dec2hex</b>	convert decimal integer to hex string

## Debugging

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

## Sound Processing Functions

<b>saxis</b>	sound axis scaling
<b>sound</b>	convert vector to sound
<b>auread</b>	Read Sun audio file
<b>auwrite</b>	Write Sun audio file
<b>lin2mu</b>	linear to mu-law conversion
<b>mu2lin</b>	mu-law to linear conversion

### Elementary Math Functions

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

### Trigonometric Functions

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

### Special Functions

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

## Matrix Decompositions And Factorizations

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

## Matrix Conditioning

<b>cond</b>	condition number in 2-norm
<b>rcond</b>	Linpack reciprocal condition number estimator
<b>condest</b>	Hager/Higham condition number estimator
<b>norm</b>	1-norm, 2-norm, F-norm, $\infty$ -norm
<b>normest</b>	2-norm estimator
<b>rank</b>	rank

## Elementary Matrix Functions

<b>expm</b>	matrix exponential
<b>expm1</b>	M-file implementation of <b>expm</b>
<b>expm2</b>	matrix exponential via Taylor series
<b>expm3</b>	matrix exponential via eigenvalues and eigenvectors
<b>logm</b>	matrix logarithm
<b>sqrtn</b>	matrix square root
<b>funm</b>	evaluate general matrix function
<b>poly</b>	characteristic polynomial
<b>det</b>	determinant
<b>trace</b>	trace

## Polynomials

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

## Column-Wise Data Analysis

<b>max</b>	largest component
<b>min</b>	smallest component
<b>mean</b>	average or mean value
<b>median</b>	median value
<b>std</b>	standard deviation
<b>sort</b>	sort in ascending order
<b>sum</b>	sum of elements
<b>prod</b>	product of elements
<b>cumsum</b>	cumulative sum of elements
<b>cumprod</b>	cumulative product of elements
<b>hist</b>	histogram

## Signal Processing

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



### Finite Differences And Data Interpolation

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

### Numerical Integration

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

### Differential Equation Solution

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

### Nonlinear Equations And Optimization

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

### Two Dimensional Graphs

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

### Graph Annotation

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

### Figure Window / Axis Creation And Control

<b>figure</b>	create figure (graph window)
<b>gcf</b>	get handle to current figure
<b>clf</b>	clear current figure
<b>close</b>	close figure
<b>hold</b>	hold current graph
<b>ishold</b>	return hold status
<b>subplot</b>	create axes in tiled positions
<b>axes</b>	create axes in arbitrary positions
<b>gca</b>	get handle to current axes
<b>axis</b>	control axis scaling and appearance
<b>caxis</b>	control pseudocolor axis scaling
<b>whitebg</b>	change default background color to white
<b>cinvert</b>	invert black/white objects

### Graph Hardcopy And Storage

<b>print</b>	print graph or save graph to file
<b>printopt</b>	configure local printer defaults
<b>orient</b>	set paper orientation

### Three Dimensional Graphs

<b>mesh</b>	3-D mesh surface
<b>meshc</b>	combination mesh/contour plot
<b>meshz</b>	3-D mesh with zero plane
<b>surf</b>	3-D shaded surface
<b>surfz</b>	combination surface/contour plot
<b>surf1</b>	3-D shaded surface with lighting
<b>plot3</b>	plot lines and points in 3-D space
<b>fill3</b>	draw filled 3-D polygons in 3-D space
<b>contour</b>	contour plot
<b>contour3</b>	3-D contour plot
<b>clabel</b>	contour elevation plot labels
<b>contourc</b>	contour plot computation (used by <b>contour</b> )
<b>pcolor</b>	pseudocolor (checkerboard) plot
<b>quiver</b>	quiver plot
<b>image</b>	display image
<b>waterfall</b>	waterfall plot
<b>slice</b>	volumetric visualization plot

### 3-D Graph Appearance

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

### Color Maps

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

### 3-D Objects

<b>sphere</b>	generate sphere
<b>cylinder</b>	generate cylinder
<b>peaks</b>	generate demo surface

### Movies And Animation

<b>moviein</b>	initialize movie frame memory
<b>getframe</b>	get movieframe
<b>movie</b>	play recorded movie frames

### Handle Graphics Objects

<b>figure</b>	create figure window
<b>axes</b>	create axes
<b>line</b>	create line
<b>text</b>	create text
<b>patch</b>	create patch
<b>surface</b>	create surface
<b>image</b>	create image
<b>uicontrol</b>	create user interface control
<b>uimenu</b>	create user interface menu

## Handle Graphics Operations

<b>set</b>	set object properties
<b>get</b>	get object properties
<b>reset</b>	reset object properties
<b>delete</b>	delete object
<b>drawnow</b>	flush pending graphics events

## Sparse Matrix Functions

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