MATLAB Quick Reference

Introduction

This appendix lists the MATLAB functions as they are grouped in the Help Desk by subject. Each table contains the function names and brief descriptions. For complete information about any of these functions, refer to the Help Desk and either:

- Select the function from the MATLAB Functions list (By Subject or By Index), or
- Type the function name in the **Go to MATLAB function** field and click **Go**.

Note If you are viewing this book from the Help Desk, you can click on any function name and jump directly to the corresponding MATLAB function page.

General Purpose Commands

This set of functions lets you start and stop MATLAB, work with files and the operating system, control the command window, and manage the environment, variables, and the workspace.

Managing Commands and Functions	
addpath	Add directories to MATLAB's search path
doc	Display HTML documentation in Web browser
docopt	Display location of help file directory for UNIX platforms
help	Online help for MATLAB functions and M-files
helpdesk	Display Help Desk page in Web browser, giving access to extensive help
helpwin	Display Help Window, providing access to help for all commands
lasterr	Last error message
lastwarn	Last warning message
lookfor	Keyword search through all help entries
partialpath	Partial pathname
path	Control MATLAB's directory search path
pathtool	Start Path Browser, a GUI for viewing and modifying MATLAB's path
profile	Start the M-file profiler, a utility for debugging and optimizing code
profreport	Generate a profile report
rmpath	Remove directories from MATLAB's search path
type	List file

Managing Commands and Functions (Continued)	
ver	Display version information for MATLAB, Simulink, and toolboxes
version	MATLAB version number
web	Point Web browser at file or Web site
what	Directory listing of M-files, MAT-files, and MEX-files
whatsnew	Display README files for MATLAB and toolboxes
which	Locate functions and files

Managing Variables and the Workspace	
clear	Remove items from memory
disp	Display text or array
length	Length of vector
load	Retrieve variables from disk
mlock	Prevent M-file clearing
munlock	Allow M-file clearing
openvar	Open workspace variable in Array Editor for graphical editing
pack	Consolidate workspace memory
save	Save workspace variables on disk
saveas	Save figure or model using specified format
size	Array dimensions
who, whos	List directory of variables in memory
workspace	Display the Workspace Browser, a GUI for managing the workspace

Controlling the Command Window	
clc	Clear command window
echo	Echo M-files during execution
format	Control the output display format
home	Move the cursor to the home position
more	Control paged output for the command window

Working with Files and the Operating Environment	
cd	Change working directory
copyfile	Copy file
delete	Delete files and graphics objects
diary	Save session in a disk file
dir	Directory listing
edit	Edit an M-file
fileparts	Filename parts
fullfile	Build full filename from parts
inmem	Functions in memory
ls	List directory on UNIX
matlabroot	Root directory of MATLAB installation
mkdir	Make directory
open	Open files based on extension
pwd	Display current directory
tempdir	Return the name of the system's temporary directory
tempname	Unique name for temporary file
!	Execute operating system command

Starting and Quitting MATLAB	
matlabrc	MATLAB startup M-file
quit	Terminate MATLAB
startup	MATLAB startup M-file

Operators and Special Characters

These are the actual operators you use to enter and manipulate data, for example, matrix multiplication, array multiplication, and line continuation.

Operators and Special Characters	
+	Plus
-	Minus
*	Matrix multiplication
.*	Array multiplication
^	Matrix power
.^	Array power
kron	Kronecker tensor product
\	Backslash or left division
/	Slash or right division
./ and .\	Array division, right and left
:	Colon
( )	Parentheses
[ ]	Brackets
{}	Curly braces
.	Decimal point
...	Continuation
,	Comma
;	Semicolon
%	Comment
!	Exclamation point
'	Transpose and quote
.'	Nonconjugated transpose
=	Assignment

Operators and Special Characters (Continued)	
==	Equality
< >	Relational operators
&	Logical and
|	Logical or
~	Logical not
xor	Logical exclusive or

Logical Functions

This set of functions performs logical operations such as checking if a file or variable exists and testing if all elements in an array are nonzero. “Operators and Special Characters” contains other operators that perform logical operations.

Logical Functions	
all	Test to determine if all elements are nonzero
any	Test for any nonzeros
exist	Check if a variable or file exists
find	Find indices and values of nonzero elements
is*	Detect state
isa	Detect an object of a given class
logical	Convert numeric values to logical
mislocked	True if M-file cannot be cleared

Language Constructs and Debugging

These functions let you work with MATLAB as a programming language. For example, you can control program flow, define global variables, perform interactive input, and debug your code.

MATLAB as a Programming Language	
builtin	Execute builtin function from overloaded method
eval	Interpret strings containing MATLAB expressions
evalc	Evaluate MATLAB expression with capture
evalin	Evaluate expression in workspace
feval	Function evaluation
function	Function M-files
global	Define global variables
nargchk	Check number of input arguments
persistent	Define persistent variable
script	Script M-files

Control Flow	
break	Terminate execution of for loop or while loop
case	Case switch
catch	Begin catch block
else	Conditionally execute statements
elseif	Conditionally execute statements
end	Terminate for, while, switch, try, and if statements or indicate last
error	Display error messages
for	Repeat statements a specific number of times
if	Conditionally execute statements
otherwise	Default part of switch statement
return	Return to the invoking function

Control Flow (Continued)	
switch	Switch among several cases based on expression
try	Begin try block
warning	Display warning message
while	Repeat statements an indefinite number of times

Interactive Input	
input	Request user input
keyboard	Invoke the keyboard in an M-file
menu	Generate a menu of choices for user input
pause	Halt execution temporarily

Object-Oriented Programming	
class	Create object or return class of object
double	Convert to double precision
inferiorto	Inferior class relationship
inline	Construct an inline object
int8, int16, int32	Convert to signed integer
isa	Detect an object of a given class
loadobj	Extends the load function for user objects
saveobj	Save filter for objects
single	Convert to single precision
superiorto	Superior class relationship
uint8, uint16, uint32	Convert to unsigned integer

Debugging	
dbclear	Clear breakpoints
dbcont	Resume execution
dbdown	Change local workspace context
dbmex	Enable MEX-file debugging
dbquit	Quit debug mode

Debugging (Continued)	
dbstack	Display function call stack
dbstatus	List all breakpoints
dbstep	Execute one or more lines from a breakpoint
dbstop	Set breakpoints in an M-file function
dbtype	List M-file with line numbers
dbup	Change local workspace context

Elementary Matrices and Matrix Manipulation

Using these functions you can manipulate matrices, and access time, date, special variables, and constants, functions.

Elementary Matrices and Arrays	
blkdiag	Construct a block diagonal matrix from input arguments
eye	Identity matrix
linspace	Generate linearly spaced vectors
logspace	Generate logarithmically spaced vectors
ones	Create an array of all ones
rand	Uniformly distributed random numbers and arrays
randn	Normally distributed random numbers and arrays
zeros	Create an array of all zeros
: (colon)	Regularly spaced vector

Special Variables and Constants	
ans	The most recent answer
computer	Identify the computer on which MATLAB is running
eps	Floating-point relative accuracy
flops	Count floating-point operations
i	Imaginary unit

Special Variables and Constants (Continued)	
Inf	Infinity
inputname	Input argument name
j	Imaginary unit
NaN	Not-a-Number
nargin, nargout	Number of function arguments
pi	Ratio of a circle's circumference to its diameter,
realmax	Largest positive floating-point number
realmin	Smallest positive floating-point number
varargin, varargout	Pass or return variable numbers of arguments

Time and Dates	
calendar	Calendar
clock	Current time as a date vector
cputime	Elapsed CPU time
date	Current date string
datenum	Serial date number
datestr	Date string format
datevec	Date components
eomday	End of month
etime	Elapsed time
now	Current date and time
tic, toc	Stopwatch timer
weekday	Day of the week

Matrix Manipulation	
cat	Concatenate arrays
diag	Diagonal matrices and diagonals of a matrix
fliplr	Flip matrices left-right
flipud	Flip matrices up-down
repmat	Replicate and tile an array
reshape	Reshape array

Matrix Manipulation (Continued)	
rot90	Rotate matrix 90 degrees
tril	Lower triangular part of a matrix
triu	Upper triangular part of a matrix
: (colon)	Index into array, rearrange array

Specialized Matrices

These functions let you work with matrices such as Hadamard, Hankel, Hilbert, and magic squares.

Specialized Matrices	
compan	Companion matrix
gallery	Test matrices
hadamard	Hadamard matrix
hankel	Hankel matrix
hilb	Hilbert matrix
invhilb	Inverse of the Hilbert matrix
magic	Magic square
pascal	Pascal matrix
toeplitz	Toeplitz matrix
wilkinson	Wilkinson's eigenvalue test matrix

Elementary Math Functions

These are many of the standard mathematical functions such as trigonometric, hyperbolic, logarithmic, and complex number manipulation.

Elementary Math Functions	
abs	Absolute value and complex magnitude
acos, acosh	Inverse cosine and inverse hyperbolic cosine

Elementary Math Functions (Continued)	
acot, acoth	Inverse cotangent and inverse hyperbolic cotangent
acsc, acsch	Inverse cosecant and inverse hyperbolic cosecant
angle	Phase angle
asec, asech	Inverse secant and inverse hyperbolic secant
asin, asinh	Inverse sine and inverse hyperbolic sine
atan, atanh	Inverse tangent and inverse hyperbolic tangent
atan2	Four-quadrant inverse tangent
ceil	Round toward infinity
complex	Construct complex data from real and imaginary components
conj	Complex conjugate
cos, cosh	Cosine and hyperbolic cosine
cot, coth	Cotangent and hyperbolic cotangent
csc, csch	Cosecant and hyperbolic cosecant
exp	Exponential
fix	Round towards zero
floor	Round towards minus infinity
gcd	Greatest common divisor
imag	Imaginary part of a complex number
lcm	Least common multiple
log	Natural logarithm
log2	Base 2 logarithm and dissect floating-point numbers into exponent and
log10	Common (base 10) logarithm
mod	Modulus (signed remainder after division)
nchoosek	Binomial coefficient or all combinations

Elementary Math Functions (Continued)	
real	Real part of complex number
rem	Remainder after division
round	Round to nearest integer
sec, sech	Secant and hyperbolic secant
sign	Signum function
sin, sinh	Sine and hyperbolic sine
sqrt	Square root
tan, tanh	Tangent and hyperbolic tangent

Specialized Math Functions

This set of functions includes Bessel, elliptic, gamma, factorial, and others.

Specialized Math Functions	
airy	Airy functions
besselh	Bessel functions of the third kind (Hankel functions)
besseli, besselk	Modified Bessel functions
besselj, bessely	Bessel functions
beta, betainc, betaln	beta, betainc, betaln
ellipj	Jacobi elliptic functions
ellipke	Complete elliptic integrals of the first and second kind
erf, erfc, erfcx, erfinv	Error functions
expint	Exponential integral
factorial	Factorial function
gamma, gammainc, gammaln	Gamma functions
legendre	Associated Legendre functions
pow2	Base 2 power and scale floating-point numbers
rat, rats	Rational fraction approximation

Coordinate System Conversion

Using these functions you can transform Cartesian coordinates to polar, cylindrical, or spherical, and vice versa.

Coordinate System Conversion	
cart2pol	Transform Cartesian coordinates to polar or cylindrical
cart2sph	Transform Cartesian coordinates to spherical
pol2cart	Transform polar or cylindrical coordinates to Cartesian
sph2cart	Transform spherical coordinates to Cartesian

Matrix Functions - Numerical Linear Algebra

These functions let you perform matrix analysis including matrix determinant, rank, reduced row echelon form, eigenvalues, and inverses.

Matrix Analysis	
cond	Condition number with respect to inversion
condeig	Condition number with respect to eigenvalues
det	Matrix determinant
norm	Vector and matrix norms
null	Null space of a matrix
orth	Range space of a matrix
rank	Rank of a matrix
rcond	Matrix reciprocal condition number estimate
rref, rrefmovie	Reduced row echelon form
subspace	Angle between two subspaces
trace	Sum of diagonal elements

Linear Equations	
chol	Cholesky factorization
inv	Matrix inverse
lscov	Least squares solution in the presence of known covariance
lu	LU matrix factorization
lsqnonneg	Nonnegative least squares
pinv	Moore-Penrose pseudoinverse of a matrix
qr	Orthogonal-triangular decomposition

Eigenvalues and Singular Values	
balance	Improve accuracy of computed eigenvalues
cdf2rdf	Convert complex diagonal form to real block diagonal form
eig	Eigenvalues and eigenvectors
gsvd	Generalized singular value decomposition
hess	Hessenberg form of a matrix
poly	Polynomial with specified roots
qz	QZ factorization for generalized eigenvalues
rsf2csf	Convert real Schur form to complex Schur form
schur	Schur decomposition
svd	Singular value decomposition

Matrix Functions	
expm	Matrix exponential
funm	Evaluate functions of a matrix
logm	Matrix logarithm
sqrtm	Matrix square root

Low Level Functions	
qrdelete	Delete column from QR factorization
qrinsert	Insert column in QR factorization

Data Analysis and Fourier Transform Functions

Using the data analysis functions, you can find permutations, prime numbers, mean, median, variance, correlation, and perform convolutions and other standard array manipulations. A set of vector functions lets you operate on vectors to find cross product, union, and other standard vector manipulations. The Fourier transform functions let you perform discrete Fourier transformations in one or more dimensions and their inverses.

Basic Operations	
convhull	Convex hull
cumprod	Cumulative product
cumsum	Cumulative sum
cumtrapz	Cumulative trapezoidal numerical integration
delaunay	Delaunay triangulation
dsearch	Search for nearest point
factor	Prime factors
inpolygon	Detect points inside a polygonal region
max	Maximum elements of an array
mean	Average or mean value of arrays
median	Median value of arrays
min	Minimum elements of an array
perms	All possible permutations
polyarea	Area of polygon
primes	Generate list of prime numbers
prod	Product of array elements

Basic Operations (Continued)	
sort	Sort elements in ascending order
sortrows	Sort rows in ascending order
std	Standard deviation
sum	Sum of array elements
trapz	Trapezoidal numerical integration
tsearch	Search for enclosing Delaunay triangle
var	Variance
voronoi	Voronoi diagram

Finite Differences	
del2	Discrete Laplacian
diff	Differences and approximate derivatives
gradient	Numerical gradient

Correlation	
corrcoef	Correlation coefficients
cov	Covariance matrix

Filtering and Convolution	
conv	Convolution and polynomial multiplication
conv2	Two-dimensional convolution
deconv	Deconvolution and polynomial division
filter	Filter data with an infinite impulse response (IIR) or finite impulse response
filter2	Two-dimensional digital filtering

Fourier Transforms	
abs	Absolute value and complex magnitude
angle	Phase angle
cplxpair	Sort complex numbers into complex conjugate pairs
fft	One-dimensional fast Fourier transform
fft2	Two-dimensional fast Fourier transform
fftshift	Shift DC component of fast Fourier transform to center of spectrum
ifft	Inverse one-dimensional fast Fourier transform
ifft2	Inverse two-dimensional fast Fourier transform
ifftn	Inverse multidimensional fast Fourier transform
ifftshift	Inverse FFT shift
nextpow2	Next power of two
unwrap	Correct phase angles

Vector Functions	
cross	Vector cross product
intersect	Set intersection of two vectors
ismember	Detect members of a set
setdiff	Return the set difference of two vector
setxor	Set exclusive or of two vectors
union	Set union of two vectors
unique	Unique elements of a vector

Polynomial and Interpolation Functions

These functions let you operate on polynomials such as multiply, divide, find derivatives, and evaluate. The data interpolation functions let you perform interpolation in one, two, three, and higher dimensions.

Polynomials	
conv	Convolution and polynomial multiplication
deconv	Deconvolution and polynomial division
poly	Polynomial with specified roots
polyder	Polynomial derivative
polyeig	Polynomial eigenvalue problem
polyfit	Polynomial curve fitting
polyval	Polynomial evaluation
polyvalm	Matrix polynomial evaluation
residue	Convert between partial fraction expansion and polynomial coefficients
roots	Polynomial roots

Data Interpolation	
griddata	Data gridding
interp1	One-dimensional data interpolation (table lookup)
interp2	Two-dimensional data interpolation (table lookup)
interp3	Three-dimensional data interpolation (table lookup)
interpft	One-dimensional interpolation using the FFT method
interpn	Multidimensional data interpolation (table lookup)
meshgrid	Generate X and Y matrices for three-dimensional plots
ndgrid	Generate arrays for multidimensional functions and interpolation
spline	Cubic spline interpolation

Function Functions - Nonlinear Numerical Methods

Using these functions you can solve differential equations, perform numerical evaluation of integrals, and optimize functions.

Function Functions - Nonlinear Numerical Methods	
`dblquad`	Numerical double integration
`fminbnd`	Minimize a function of one variable
`fminsearch`	Minimize a function of several variables
`fzero`	Zero of a function of one variable
`ode45, ode23, ode113, ode15s, ode23s, ode23t, ode23tb`	Solve differential equations
`odefile`	Define a differential equation problem for ODE solvers
`odeget`	Extract properties from options structure created with odeset
`odeset`	Create or alter options structure for input to ODE solvers
`quad, quad8`	Numerical evaluation of integrals
`vectorize`	Vectorize expression

Sparse Matrix Functions

These functions allow you to operate on a special type of matrix, sparse. Using these functions you can convert full to sparse, visualize, and operate on these matrices.

Elementary Sparse Matrices	
`spdiags`	Extract and create sparse band and diagonal matrices
`speye`	Sparse identity matrix
`sprand`	Sparse uniformly distributed random matrix
`sprandn`	Sparse normally distributed random matrix
`sprandsym`	Sparse symmetric random matrix

Full to Sparse Conversion	
`find`	Find indices and values of nonzero elements
`full`	Convert sparse matrix to full matrix
`sparse`	Create sparse matrix
`spconvert`	Import matrix from sparse matrix external format

Working with Nonzero Entries of Sparse Matrices	
`nnz`	Number of nonzero matrix elements
`nonzeros`	Nonzero matrix elements
`nzmax`	Amount of storage allocated for nonzero matrix elements
`spalloc`	Allocate space for sparse matrix
`spfun`	Apply function to nonzero sparse matrix elements
`spones`	Replace nonzero sparse matrix elements with ones

Visualizing Sparse Matrices	
`spy`	Visualize sparsity pattern

Reordering Algorithms	
`colmmd`	Sparse column minimum degree permutation
`colperm`	Sparse column permutation based on nonzero count

Reordering Algorithms (Continued)	
dmperm	Dulmage-Mendelsohn decomposition
randperm	Random permutation
symmmd	Sparse symmetric minimum degree ordering
symrcm	Sparse reverse Cuthill-McKee ordering

Norm, Condition Number, and Rank	
condest	1-norm matrix condition number estimate
normest	2-norm estimate

Sparse Systems of Linear Equations	
bicg	BiConjugate Gradients method
bicgstab	BiConjugate Gradients Stabilized method
cgs	Conjugate Gradients Squared method
cholinc	Sparse Incomplete Cholesky and Cholesky-Infinity factorizations
cholupdate	Rank 1 update to Cholesky factorization
gmres	Generalized Minimum Residual method (with restarts)
luinc	Incomplete LU matrix factorizations
pcg	Preconditioned Conjugate Gradients method
qmr	Quasi-Minimal Residual method
qr	Orthogonal-triangular decomposition
qrdelete	Delete column from QR factorization
qrinsert	Insert column in QR factorization
qrupdate	Rank 1 update to QR factorization

Sparse Eigenvalues and Singular Values	
eigs	Find eigenvalues and eigenvectors
svds	Find singular values

Miscellaneous	
spparms	Set parameters for sparse matrix routines

Sound Processing Functions

The sound processing functions let you convert signals, and read and write .au and .wav sound files.

General Sound Functions	
lin2mu	Convert linear audio signal to mu-law
mu2lin	Convert mu-law audio signal to linear
sound	Convert vector into sound
soundsc	Scale data and play as sound

SPARCstation-Specific Sound Functions	
auread	Read NeXT/SUN (.au) sound file
auwrite	Write NeXT/SUN (.au) sound file

.WAV Sound Functions	
wavread	Read Microsoft WAVE (.wav) sound file
wavwrite	Write Microsoft WAVE (.wav) sound file

Character String Functions

This set of functions lets you manipulate strings such as comparison, concatenation, search, and conversion.

General	
abs	Absolute value and complex magnitude
eval	Interpret strings containing MATLAB expressions
real	Real part of complex number
strings	MATLAB string handling

String Manipulation	
deblank	Strip trailing blanks from the end of a string
findstr	Find one string within another
lower	Convert string to lower case
strcat	String concatenation
strcmp	Compare strings
strcmpi	Compare strings ignoring case
strjust	Justify a character array
strmatch	Find possible matches for a string
strncmp	Compare the first n characters of two strings
strrep	String search and replace
strtok	First token in string
strvcat	Vertical concatenation of strings
symvar	Determine symbolic variables in an expression
texlabel	Produce the TeX format from a character string
upper	Convert string to upper case

String to Number Conversion	
char	Create character array (string)
int2str	Integer to string conversion
mat2str	Convert a matrix into a string
num2str	Number to string conversion
sprintf	Write formatted data to a string
sscanf	Read string under format control
str2double	Convert string to double-precision value
str2num	String to number conversion

Radix Conversion	
bin2dec	Binary to decimal number conversion
dec2bin	Decimal to binary number conversion
dec2hex	Decimal to hexadecimal number conversion
hex2dec	IEEE hexadecimal to decimal number conversion
hex2num	Hexadecimal to double number conversion

Low-Level File I/O Functions

The low-level file I/O functions allow you to open and close files, read and write formatted and unformatted data, operate on files, and perform other specialized file I/O such as reading and writing images and spreadsheets.

File Opening and Closing	
fclose	Close one or more open files
fopen	Open a file or obtain information about open files

Unformatted I/O	
fread	Read binary data from file
fwrite	Write binary data to a file

Formatted I/O	
fgetl	Return the next line of a file as a string without line terminator(s)
fgets	Return the next line of a file as a string with line terminator(s)
fprintf	Write formatted data to file
fscanf	Read formatted data from file

File Positioning	
feof	Test for end-of-file
ferror	Query MATLAB about errors in file input or output
frewind	Rewind an open file
fseek	Set file position indicator
ftell	Get file position indicator

String Conversion	
sprintf	Write formatted data to a string
sscanf	Read string under format control

Specialized File I/O	
dlmread	Read an ASCII delimited file into a matrix
dlmwrite	Write a matrix to an ASCII delimited file
hdf	HDF interface
imfinfo	Return information about a graphics file
imread	Read image from graphics file
imwrite	Write an image to a graphics file
textread	Read formatted data from text file

Specialized File I/O (Continued)	
wk1read	Read a Lotus123 WK1 spreadsheet file into a matrix
wk1write	Write a matrix to a Lotus123 WK1 spreadsheet file

Bitwise Functions

These functions let you operate at the bit level such as shifting and complementing.

Bitwise Functions	
bitand	Bit-wise AND
bitcmp	Complement bits
bitor	Bit-wise OR
bitmax	Maximum floating-point integer
bitset	Set bit
bitshift	Bit-wise shift
bitget	Get bit
bitxor	Bit-wise XOR

Structure Functions

Structures are arrays whose elements can hold any MATLAB data type such as text, numeric arrays, or other structures. You access structure elements by name. Use the structure functions to create and operate on this array type.

Structure Functions	
deal	Deal inputs to outputs
fieldnames	Field names of a structure
getfield	Get field of structure array
rmfield	Remove structure fields
setfield	Set field of structure array
struct	Create structure array
struct2cell	Structure to cell array conversion

Object Functions

Using the object functions you can create objects, detect objects of a given class, and return the class of an object.

Object Functions	
`class`	Create object or return class of object
`isa`	Detect an object of a given class

Cell Array Functions

Cell arrays are arrays comprised of cells, which can hold any MATLAB data type such as text, numeric arrays, or other cell arrays. Unlike structures, you access these cells by number. Use the cell array functions to create and operate on these arrays.

Cell Array Functions	
`cell`	Create cell array
`cellfun`	Apply a function to each element in a cell array
`cellstr`	Create cell array of strings from character array
`cell2struct`	Cell array to structure array conversion
`celldisp`	Display cell array contents
`cellplot`	Graphically display the structure of cell arrays
`num2cell`	Convert a numeric array into a cell array

Multidimensional Array Functions

These functions provide a mechanism for working with arrays of dimension greater than 2.

Multidimensional Array Functions	
`cat`	Concatenate arrays
`flipdim`	Flip array along a specified dimension
`ind2sub`	Subscripts from linear index
`ipermute`	Inverse permute the dimensions of a multidimensional array
`ndgrid`	Generate arrays for multidimensional functions and interpolation
`ndims`	Number of array dimensions
`permute`	Rearrange the dimensions of a multidimensional array
`reshape`	Reshape array
`shiftdim`	Shift dimensions
`squeeze`	Remove singleton dimensions
`sub2ind`	Single index from subscripts

Plotting and Data Visualization

This extensive set of functions gives you the ability to create basic graphs such as bar, pie, polar, and three-dimensional plots, and advanced graphs such as surface, mesh, contour, and volume visualization plots. In addition, you can use these functions to control lighting, color, view, and many other fine manipulations.

Basic Plots and Graphs	
`bar`	Vertical bar chart
`barh`	Horizontal bar chart
`hist`	Plot histograms
`hold`	Hold current graph
`loglog`	Plot using log-log scales
`pie`	Pie plot
`plot`	Plot vectors or matrices.
`polar`	Polar coordinate plot
`semilogx`	Semi-log scale plot

Basic Plots and Graphs (Continued)	
semilogy	Semi-log scale plot
subplot	Create axes in tiled positions

Three-Dimensional Plotting	
bar3	Vertical 3-D bar chart
bar3h	Horizontal 3-D bar chart
comet3	Three-dimensional comet plot
cylinder	Generate cylinder
fill3	Draw filled 3-D polygons in 3-space
plot3	Plot lines and points in 3-D space
quiver3	Three-dimensional quiver (or velocity) plot
slice	Volumetric slice plot
sphere	Generate sphere
stem3	Plot discrete surface data
waterfall	Waterfall plot

Plot Annotation and Grids	
clabel	Add contour labels to a contour plot
datetick	Date formatted tick labels
grid	Grid lines for 2-D and 3-D plots
gtext	Place text on a 2-D graph using a mouse
legend	Graph legend for lines and patches
plotedit	Start plot edit mode to edit and annotate plots
plotyy	Plot graphs with Y tick labels on the left and right
title	Titles for 2-D and 3-D plots
xlabel	X-axis labels for 2-D and 3-D plots

Plot Annotation and Grids (Continued)	
ylabel	Y-axis labels for 2-D and 3-D plots
zlabel	Z-axis labels for 3-D plots

Surface, Mesh, and Contour Plots	
contour	Contour (level curves) plot
contourc	Contour computation
contourf	Filled contour plot
hidden	Mesh hidden line removal mode
meshc	Combination mesh/contourplot
mesh	3-D mesh with reference plane
peaks	A sample function of two variables
surf	3-D shaded surface graph
surface	Create surface low-level objects
surfc	Combination surf/contourplot
surfl	3-D shaded surface with lighting
trimesh	Triangular mesh plot
trisurf	Triangular surface plot

Volume Visualization	
coneplot	Plot velocity vectors as cones in 3-D vector field
contourslice	Draw contours in volume slice plane
isocaps	Compute isosurface end-cap geometry
isonormals	Compute normals of isosurface vertices
isosurface	Extract isosurface data from volume data
reducepatch	Reduce the number of patch faces
reducevolume	Reduce number of elements in volume data set
shrinkfaces	Reduce the size of patch faces
smooth3	Smooth 3-D data

Volume Visualization (Continued)	
stream2	Compute 2-D stream line data
stream3	Compute 3-D stream line data
streamline	Draw stream lines from 2- or 3-D vector data
surf2patch	Convert surface data to patch data
subvolume	Extract subset of volume data set

Domain Generation	
griddata	Data gridding and surface fitting
meshgrid	Generation of X and Y arrays for 3-D plots

Specialized Plotting	
area	Area plot
box	Axis box for 2-D and 3-D plots
comet	Comet plot
compass	Compass plot
convhull	Convex hull
delaunay	Delaunay triangulation
dsearch	Search Delaunay triangulation for nearest point
errorbar	Plot graph with error bars
ezcontour	Easy to use contour plotter
ezcontourf	Easy to use filled contour plotter
ezmesh	Easy to use 3-D mesh plotter
ezmeshc	Easy to use combination mesh/ contour plotter
ezplot	Easy to use function plotter
ezplot3	Easy to use 3-D parametric curve plotter
ezpolar	Easy to use polar coordinate plotter
ezsurf	Easy to use 3-D colored surface plotter

Specialized Plotting (Continued)	
ezsurfc	Easy to use combination surface/ contour plotter
feather	Feather plot
fill	Draw filled 2-D polygons
fplot	Plot a function
inpolygon	True for points inside a polygonal region
pareto	Pareto char
pcolor	Pseudocolor (checkerboard) plot
pie3	Three-dimensional pie plot
plotmatrix	Scatter plot matrix
polyarea	Area of polygon
quiver	Quiver (or velocity) plot
ribbon	Ribbon plot
rose	Plot rose or angle histogram
scatter	Scatter plot
scatter3	Three-dimensional scatter plot
stairs	Stairstep graph
stem	Plot discrete sequence data
tsearch	Search for enclosing Delaunay triangle
voronoi	Voronoi diagram

View Control	
camdolly	Move camera position and target
camlookat	View specific objects
camorbit	Orbit about camera target
campan	Rotate camera target about camera position
campos	Set or get camera position
camproj	Set or get projection type
camroll	Rotate camera about viewing axis
camtarget	Set or get camera target
camup	Set or get camera up-vector
camva	Set or get camera view angle

View Control (Continued)	
camzoom	Zoom camera in or out
daspect	Set or get data aspect ratio
pbaspect	Set or get plot box aspect ratio
view	Three-dimensional graph viewpoint specification.
viewmtx	Generate view transformation matrices
xlim	Set or get the current x-axis limits
ylim	Set or get the current y-axis limits
zlim	Set or get the current z-axis limits

Lighting	
camlight	Create or position a light
lightangle	Spherical position of a light
lighting	Lighting mode
material	Material reflectance mode

Color Operations	
brighten	Brighten or darken color map
caxis	Pseudocolor axis scaling
colorbar	Display color bar (color scale)
colordef	Set up color defaults
colormap	Set the color look-up table
graymon	Graphics figure defaults set for grayscale monitor
hsv2rgb	Hue-saturation-value to red-green-blue conversion
rgb2hsv	RGB to HSV conversion
rgbplot	Plot color map
shading	Color shading mode
spinmap	Spin the colormap

Color Operations (Continued)	
surfnorm	Three-dimensional surface normals
whitebg	Change axes background color for plots

Colormaps	
autumn	Shades of red and yellow color map
bone	Gray-scale with a tinge of blue color map
contrast	Gray color map to enhance image contrast
cool	Shades of cyan and magenta color map
copper	Linear copper-tone color map
flag	Alternating red, white, blue, and black color map
gray	Linear gray-scale color map
hot	Black-red-yellow-white color map
hsv	Hue-saturation-value (HSV) color map
jet	Variant of HSV
lines	Line color colormap
prism	Colormap of prism colors
spring	Shades of magenta and yellow color map
summer	Shades of green and yellow colormap
winter	Shades of blue and green color map

Printing	
orient	Hardcopy paper orientation
print	Print graph or save graph to file
printopt	Configure local printer defaults
saveas	Save figure to graphic file

Handle Graphics, General	
copyobj	Make a copy of a graphics object and its children
findobj	Find objects with specified property values
gcbo	Return object whose callback is currently executing
gco	Return handle of current object
get	Get object properties
ishandle	True for graphics objects
rotate	Rotate objects about specified origin and direction
set	Set object properties

Handle Graphics, Object Creation	
axes	Create axes object
figure	Create figure (graph) windows
image	Create image (2-D matrix)
light	Create light object (illuminates Patch and Surface)
line	Create line object (3-D polylines)
patch	Create patch object (polygons)
rectangle	Create rectangle object (2-D rectangle)
surface	Create surface (quadrilaterals)
text	Create text object (character strings)
uicontextmenu	Create context menu (pop-up associated with object)

Handle Graphics, Figure Windows	
capture	Screen capture of the current figure
clc	Clear figure window
clf	Clear figure
close	Close specified window
gcf	Get current figure handle

Handle Graphics, Figure Windows (Continued)	
newplot	Graphics M-file preamble for NextPlot property
refresh	Refresh figure
saveas	Save figure or model to desired output format

Handle Graphics, Axes	
axis	Plot axis scaling and appearance
cla	Clear axes
gca	Get current axes handle

Object Manipulation	
reset	Reset axis or figure
rotate3d	Interactively rotate the view of a 3-D plot
selectmoveresize	Interactively select, move, or resize objects

Interactive User Input	
ginput	Graphical input from a mouse or cursor
zoom	Zoom in and out on a 2-D plot

Region of Interest	
dragrect	Drag XOR rectangles with mouse
drawnow	Complete any pending drawing
rbbox	Rubberband box

Graphical User Interface Creation

The graphical user interface functions let you build your own interfaces for your applications.

Dialog Boxes	
dialog	Create a dialog box
errordlg	Create error dialog box

Dialog Boxes (Continued)	
helpdlg	Display help dialog box
inputdlg	Create input dialog box
listdlg	Create list selection dialog box
msgbox	Create message dialog box
pagedlg	Display page layout dialog box
printdlg	Display print dialog box
questdlg	Create question dialog box
uigetfile	Display dialog box to retrieve name of file for reading
uiputfile	Display dialog box to retrieve name of file for writing
uisetcolor	Interactively set a ColorSpec using a dialog box
uisetfont	Interactively set a font using a dialog box
warndlg	Create warning dialog box

User Interface Objects	
menu	Generate a menu of choices for user input
uicontextmenu	Create context menu
uicontrol	Create user interface control
uimenu	Create user interface menu

Other Functions	
dragrect	Drag rectangles with mouse
gcbo	Return handle of object whose callback is executing
rbbox	Create rubberband box for area selection
selectmoveresize	Select, move, resize, or copy axes and uicontrol graphics objects
textwrap	Return wrapped string matrix for given uicontrol
uiresume	Used with uiwait, controls program execution

Other Functions (Continued)	
uiwait	Used with uiresume, controls program execution
waitbar	Display wait bar
waitforbuttonpress	Wait for key/buttonpress over figure