

MATLAB PRODUCTS OVERVIEW

MATLAB® is a high-performance environment for applications in engineering and science that includes tools for mathematical computation, analysis, visualization, and algorithm development. The intuitive MATLAB language—available in both interactive and runtime modes—enables technical professionals to express their ideas and solutions naturally and faster than they could with C and other traditional programming languages.

MATLAB environment

The MATLAB desktop front end includes a portfolio of tools for accessing MATLAB features and functions:

- Command Window for interactive analysis, visualization, and programming
- Command History for viewing and reusing commands from previous sessions
- Launch Pad for accessing demos, help, and tools for all installed MathWorks products
- Help to read and search documentation, including cutting and pasting sample code
- Current Directory browser to open, run, and view files
- Workspace Browser to view and change MATLAB data variables
- Array Editor to view and edit array data
- M-file Editor/Debugger to create, edit, and debug MATLAB files

Additional interactive tools are available for importing data, performing basic curve-fitting operations, and editing, viewing, and annotating graphics.

Help and documentation

Built-in help browser with search facility, online documentation (PDF format), examples, and demonstrations. Viewing or printing of PDF-formatted documentation requires Adobe Acrobat Reader (available on the MATLAB CD).

Supported operating systems

Windows 95/98/2000/NT; UNIX: Solaris, HP-UX, IRIX, IRIX64, AIX, Digital UNIX; Linux. MATLAB is also compatible with operating systems that support multibyte characters.

Supported computer platforms

Intel 486 or Pentium PCs, SunSPARC, SunULTRA, DEC Alpha, SGI, IBM RS/6000

Multiplatform interoperability

MATLAB applications are fully transportable across platforms without modification. MATLAB data files (MAT-files) from different environments are converted automatically.

MATLAB toolboxes

Communications, Control System, Data Acquisition, Database, Datafeed, Filter Design, Financial, Financial Derivatives, Financial Time Series, Fuzzy Logic, GARCH, Image Processing, Instrument Control, LMI Control, Mapping, Model Predictive Control, μ -Analysis and Synthesis, Neural Network, Optimization, Partial Differential Equation, Robust Control, Signal Processing, Spline, Statistics, Symbolic Math, System Identification, Wavelet

MATLAB compatible products

Excel Link, MATLAB Compiler, MATLAB C/C++ Math Library, MATLAB C/C++ Graphics Library, MATLAB Report Generator, MATLAB Runtime Server, MATLAB Web Server

Simulink®

Simulink® is an interactive environment for modeling, simulating, and analyzing dynamic systems. Built on top of MATLAB, Simulink offers immediate access to an extensive range of tools for model-based and system-level design.

Simulink blocksets

CDMA Reference, Communications, Dials & Gauges, DSP, Fixed-Point, Nonlinear Control Design, Power System

Simulink compatible products

Motorola DSP Developer's Kit, Real-Time Workshop®, Real-Time Workshop Ada Coder, Real-Time Workshop Embedded Coder, Real-Time Windows Target, Requirements Management Interface, Simulink Performance Tools, Simulink Report Generator, Stateflow®, Stateflow Coder, xPC Target

NUMERIC COMPUTATION

Matrix operators

Add, subtract, multiply, power, left and right divide, transpose, conjugate transpose, Kronecker tensor product

Array operators

Add, subtract, multiply, left and right divide, power, transpose, conjugate transpose

Relational operators

Equal to, not equal to, less than, greater than, less than or equal to, greater than or equal to

Logical operators

AND, OR, NOT, exclusive OR (XOR)

Bit operations

AND, OR, XOR, complement, maximum floating-point integer, set bit, get bit, bit-wise shift

Set operators

Union, unique, intersection, difference, XOR

Elementary matrices

Zeros, ones, identity, uniformly and normally distributed random numbers, linearly and logarithmically spaced vectors, diagonal matrix

Special matrices

Companion, Hadamard, Hankel, Higham, Hilbert, inverse Hilbert, magic square, Pascal, Rosser, Toeplitz, Vandermonde, Wilkinson

Matrix manipulation

Extract diagonal; flip left/right; flip up/down; reshape; rotate; permute; extract lower and upper triangular part; index into matrix; concatenate; select elements, columns, and submatrices; last index; find indices of nonzeros

Elementary functions

Sin, cos, tan, sec, csc, cot, sinh, cosh, tanh, sech, csch, coth, asin, acos, atan, 4-quadrant atan, asec, acsc, acot, asinh, acosh, atanh, asech, acsch, acoth, ceil, fix, floor, round, rem, abs, angle, sqrt, exp, natural log, log base-10, log base-2, signum, modulus, complex conjugate, real part, imaginary part

Specialized math functions

Airy, Bessel, Hankel, beta, incomplete beta, log beta, Jacobi elliptic, complete elliptic integral, error function, complementary error function, scaled complementary error function, inverse error, exponential integral, gamma, incomplete gamma, log gamma, rational approximation and output, Legendre, cross product, least common multiple, greatest common divisor, factorial, prime factors, prime numbers, all possible permutations, coordinate transforms

Numerical linear algebra

Condition number, reciprocal condition estimate, norm, rank, determinant, trace, null space, orthogonalization, reduced row echelon form, linear equation solution, Cholesky factorization, LU factorization, matrix inverse, QR decomposition, non-negative and known covariance least-squares, pseudo inverse, eigenvalues, eigenvectors, characteristic polynomial, Hessenberg form, block form conversions, Schur decomposition, balancing, singular value decomposition, matrix exponential, matrix logarithm, matrix square root

Statistics

Maximum, minimum, mean, median, standard deviation, variance, sort, sum, product, cumulative sum, cumulative product, histogram, numerical integration, difference functions, gradient, Laplacian, correlation coefficients, covariance matrix

Signal processing

1-D and 2-D digital filter; 1-D, 2-D, and multidimensional (N-D) fast Fourier transform (FFT), inverse FFT, and convolution; deconvolution; magnitude; phase angle; phase unwrap

Interpolation

1-D, 2-D, and N-D table lookup and interpolation (methods: linear, cubic, nearest, and spline), 1-D interpolation using FFT method, 1-D piecewise cubic Hermite interpolating polynomial, data gridding, hypersurface fitting

Geometric analysis

2-D, 3-D, and N-D Delaunay triangulation; 2-D and N-D search triangulation for nearest point, closest triangle search, convex hull, Voronoi diagram; rectangle intersection area; area of polygon

Polynomials

Roots, characteristic polynomial, piecewise polynomial, evaluate, evaluate with matrix, partial-fraction expansion, polynomial fit, differentiate, integrate, multiply, divide

Differential equations

Initial value problems: one-step and multistep, low, medium, and variable order solvers for nonstiff and stiff ordinary differential equations (ODEs) and differential-algebraic equations (DAEs)

Time-series, 2-D and 3-D phase plane plots; event location capability; problems involving mass matrices (time- and state-dependent, sparse, singular); consistent initial conditions for DAEs

Boundary value problems: two-point boundary value problems (BVPs) for ODEs; collocation method; general, nonseparated boundary conditions; determining unknown parameters

Partial differential equations (PDEs): initial-boundary value problems for systems of parabolic and elliptic PDEs in 1-D

Sparse matrix operations

Sparse identity matrix; uniform, normally distributed, and symmetric random matrix; diagonal matrix; conversion to full; conversion to external format; nonzero elements and indices; replace nonzeros with ones; allocate memory for nonzeros; test if sparse; visualize sparse pattern; graph theory plot; column and symmetric minimum degree permutation; column and symmetric approximate minimum degree permutation; symmetric indefinite; reverse Cuthill-McKee, Dulmage-Mendelsohn, column, and random permutation; norm and condition estimate; rank; symbolic factorization analysis; least-squares; least-squares augmented system; selective eigenvalues and singular values; incomplete LU and Cholesky factorization; estimation of matrix 2-norm

Iterative methods for sparse linear equations: preconditioned conjugate gradients, biconjugate gradients, biconjugate gradients stabilized, conjugate gradients squared, conjugate gradients on the normal equations via LSQR, minimum residual, generalized minimum residual, quasi-minimal residual, symmetric LQ

Nonlinear numerical methods

1-D and 2-D integral evaluation (methods: Simpson's rule and Lobatto rule), minimize function of several variables, find zero of function, plot function

Time and date

Serial date number, date string, date vector, current date and time (number, string, and vector), calendar, day of week, end of month, date formatted tick labels, wall clock, CPU clock, date, elapsed time, stopwatch, wait time

Miscellaneous variables and constants

Most recent answer, machine epsilon, largest number, smallest number, pi, i, j, infinity, NaN, computer type

GRAPHICS AND VISUALIZATION

2-D graphics

Linear plot, loglog plot, semilog plot, scatter plot, filled-area plot, polar plot, vertical and horizontal bar graph, stem plot, pie chart, stairstep plot, error bars, histogram, angle histogram, Pareto chart, stem plot, compass plot, comet plot, feather plot, quiver plot, function plot

3-D graphics

Line plot, filled polygon, contour plot, ribbon plot, stem plot, comet plot, scatter plot, pseudocolor plot, quiver plot, mesh surface plot, triangular mesh and surface plot, combination mesh and contour plot, parametric surface contour, mesh plot with zero plane, vertical and horizontal bar graph, pie chart, shaded surface, combination surface and contour plot, waterfall plot, cylinder, sphere, ellipsoid, patch

Surface and patch properties

Vectorized patch, face coloring and lighting, edge coloring and lighting, surface or wire frame, hidden line removal mode, mesh style (row, column, or both), line style, line width, texture mapping, marker style, marker face and edge color, marker size, face and edge transparency and visibility

Volume and vector visualization

Isosurface extraction, isosurface normals, isosurface end caps, contours in slice planes, streamlines from 2-D or 3-D vector data, 3-D cone plot, extract subset of volume dataset, reduce volume dataset, smooth 3-D data, reduce number of patch faces, reduce size of patch faces, convert surface data to patch data, 2-D and 3-D quiver plot, vector field divergence, curl and angular velocity of vector field, streamtube, streamribbon, streamslice, streamparticle, interpolate streamline vertices from speed

Image display and file I/O

Display image (indexed, grayscale, and RGB), display data as image with arbitrary scaling, display image with color calibration scale, set colormap, read image from file, read header information from image file, write image to file

Supported file formats: TIFF, JPEG, GIF, BMP, PNG, XWD, PCX, HDF, HDF-EOS, CUR, ICO

Color and rendering

Built-in and user-definable colormaps, pseudocolor axis scaling, shading, lighting, HSV/RGB conversion, brighten, spin colormap, plot colormap, custom pointers, transparency

Renderers: Painters, Z-buffer, OpenGL

Lighting control

Face and edge lighting models (Phong, Gouraud, and flat), reflectance properties (ambient, diffuse, and specular), create light object, light position, direction, color, material reflectance (shiny, dull, metal, and user-defined)

Camera control

Perspective and orthographic projection; 3-D data aspect ratio; transformation matrix; camera position, target, upvector, view-point, and angle control; orbit, pan/tilt, dolly, zoom, roll, walk, or interactively move camera

Camera Toolbar allows you to interactively control motion, select axis, set scene light, and set projection type.

Graphical object control

Create figure, axes, tiled axes, line, text, patch, rectangle, surface, image, user interface control, user interface menu, user interface context menu

Get current figure and axes handles, close figure, clear figure, clear axes, control axis scaling, control pseudocolor axis scaling, hold graph, get and set object properties, reset object properties, delete object, flush pending graphics events, modal figures, print graph, save graph to file, set paper orientation and position

Axis control

Position, limits, and units; axis direction; tick mark spacing, direction, length, and labels; scaling (log/linear); pseudocolor axis scaling; grid lines; grid line style; color; visibility; axis color; current point; 3-D axis aspect ratio; zoom; camera position; label font style and size

Graph annotation

Title, axes labels, text annotation, grid lines, colorbar, legend, contour plot elevation labels, LaTeX-style subscripts and superscripts, mixed fonts and sizes, multiline text, Greek symbols

Animation

Get movie frame, play recorded movie, convert frame to indexed image, convert indexed image to movie frame, read/write AVI movie files

Sound

Play sound, read/write Sun audio (.au) file, convert linear to μ -law encoding, convert μ -law encoding to linear, read/write 8- or 16-bit WAV files, play sound using Windows output device, record sound using Windows input device

Exportable graphics format

Encapsulated PostScript (EPS), EPS with TIFF preview, Adobe Illustrator EPS, Enhanced Windows metafile, Windows bitmap (BMP), HDF, PCX, PPM, JPEG, PNG, HPGL, and TIFF

PROGRAMMING

Data types

Complex double-precision; single-precision; unsigned and signed 8-, 16-, and 32-bit integers; character/string; sparse; cell arrays; structures; objects; multidimensional; logical; empty; user-defined; function handle array; Java array; Java object

Multidimensional arrays

Create, assign, index, concatenate, reshape, number of dimensions, permute, shift dimensions, remove singleton dimensions, flip along specified dimension, pointwise elementary math operations, interpolation, data gridding

Cell arrays and structures

Create, reshape, replace lists of variables, apply functions and operators, nest, display, display cells graphically, get field names, get and set field contents, remove field, convert to double, numeric

Object-oriented programming

Create object class, display class method names, convert object to structure array, loading prebuilt JAVA objects

Overloadable operators for arrays and matrices: add, subtract, multiply, left/right divide, power, equal to, not equal to, less than, greater than, less than or equal to, greater than or equal to, AND, OR, NOT, XOR, subscripting, transpose, colon, concatenation, assignment, referencing, indexing

Programming constructs and argument handling

If, else, elseif, end, for, while, break, continue, return, error, warning, global and persistent variables, switch, case, otherwise, try, catch, evaluate, run, validate number of input and output arguments, number of function input and output arguments

File I/O

Open file, close file, read/write binary data, read/write formatted data, read line, inquire status, get/set file-position indicator, rewind, seek to any relative or absolute file position, read/write formatted string, read/write ASCII delimited file, read/write spreadsheet (.wk1) file, read spreadsheet (.xls) file, read/write

image to/from graphics file, read/write Sun (.au) sound file, read/write Windows (.wav) sound file, read movie (.avi) file, create movie (.avi) file, read/write via serial port, gateways to HDF and HDF-EOS libraries, load Handle Graphics® objects from file, append to binary/text file

Import Wizard allows you to interactively import ASCII text data, AVI, GIF, CUR, HDF, ICO, JPEG, MATLAB MAT, PNG, WAV, AU, SND, CSV, XLS, WK1, and PCX files

String manipulation

Convert number, integer, or matrix to string; convert string to double precision value or numeric array; convert binary and base B to decimal integer; test for string; execute; compare; convert to uppercase or lowercase; convert hexadecimal to IEEE floating-point number or decimal integer; convert decimal to hexadecimal, binary, or base B string; search and replace; identify first token in a string; concatenate; find one string in another; replace string; find match; remove blanks

Graphical user interface (GUI) development

GUI controls: list boxes, pull-down menus, push buttons, radio buttons, check boxes, pop-up menus, editable textboxes, fixed textboxes, sliders, frames, context menus

GUI events: wait for event, mouse-button events, callbacks, rubberband box, mouse selection

Dialog boxes: generic with user-specifiable icon, platform-specific load/save file, input, list, warning, error, help, print, page position/setup, question, message, open/close file, color, font selection

Interactive GUI design interface (GUIDE) includes layout editor, alignment tool, callback editor, property editor, menu editor, and object browser

M-file programming tools

Integrated M-file Editor/Debugger, M-file execution profiler, profiler textual and graphic summary reports in HTML, M-file to P-file (pre-parsed pseudo-code to maintain privacy) converter, list functions in memory, save MATLAB session text, access source control systems

Debugging

Interactive editor and debugger, set and clear breakpoints, continue execution, change workspace context, display stack, show status, single and multiple line step, list file with line numbers, exit debug mode

Files and operating system

List directory, list MATLAB specific files, display M-file contents, edit M-file, search all M-files for keyword, change working directory, print working directory, delete file, get environment variable, execute operating system command, time, date, open Web browser

External interfaces

MATLAB provides interfaces to external protocols, applications, and languages such as C, C++, Fortran, and Java. These interfaces allow you to:

- Transparently call and exchange data with C, C++, Fortran, and Java routines directly from MATLAB
- Communicate and exchange data with devices and instruments via the serial communications port
- Call MATLAB from C and Fortran programs, using it as a math and graphics engine
- Use ActiveX components and DDE (Dynamic Data Exchange)
- Incorporate prebuilt Java objects into MATLAB applications

The MATLAB Notebook (Windows only)

The Notebook combines the word processing of Microsoft Word with the numeric computation and graphics of MATLAB to create live technical reports, electronic class notes, and homework assignments incorporating any MATLAB commands, data, calculations, or graphics.

Hardcopy printers and plotters

PostScript printers, color PostScript printers, Level-2 PostScript printers, HP LaserJet, HP DeskJet, HP PaintJet, Epson 9-pin printers, Epson 24-pin printers, HP 7475A plotter, QuickDraw printers

Desktop publishing support

Supports Microsoft Word, PowerPoint, TeX, QuarkXPress, FrameMaker, PageMaker, and other standard desktop publishing software

For demos, application examples, tutorials, user stories, and pricing:

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