

**MATLAB** (an abbreviation of "MATrix LABoratory") is a proprietary multi-paradigm programming language and numeric computing environment developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages.

Although MATLAB is intended primarily for numeric computing, an optional toolbox uses the MuPAD symbolic engine allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

As of 2020, MATLAB has more than 4 million users worldwide.<sup>[21]</sup> MATLAB users come from various backgrounds of engineering, science, and economics.

Contents

History

Origins

Commercial development

Recent history

Syntax

Variables

Vectors and matrices

Structures

Functions

Function handles

Classes and object-oriented programming

Graphics and graphical user interface programming

MATLAB and other languages

Withdrawal from China

Release history

See also

Notes

Further reading

External links

History

Origins

MATLAB was invented by mathematician and computer programmer Cleve Moler.<sup>[22]</sup> The idea for MATLAB was based on his 1960s PhD thesis.<sup>[22]</sup> Moler became a math professor at the University of New Mexico and started developing MATLAB for his students<sup>[22]</sup> as a hobby.<sup>[23]</sup> He developed MATLAB's initial linear algebra programming in 1967 with his one-time thesis advisor, George Forsythe.<sup>[22]</sup> This was followed by Fortran code for linear equations in 1971.<sup>[22]</sup>

In the beginning (before version 1.0) MATLAB "was not a programming language; it was a simple interactive matrix calculator. There were no programs, no toolboxes, no graphics. And no ODEs or FFTs."<sup>[24]</sup>

The first early version of MATLAB was completed in the late 1970s.<sup>[22]</sup> The software was disclosed to the public for the first time in February 1979 at the Naval Postgraduate School in California.<sup>[23]</sup> Early versions of MATLAB were simple matrix calculators with 71 pre-built functions.<sup>[25]</sup> At the time, MATLAB was distributed for free<sup>[26][27]</sup> to universities.<sup>[28]</sup> Moler would leave copies at universities he visited and the software developed a strong following in the math departments of university campuses.<sup>[29]: 5</sup>

In the 1980s, Cleve Moler met John N. Little. They decided to reprogram MATLAB in C and market it for the IBM desktops that were replacing mainframe computers at the time.<sup>[22]</sup> John Little and programmer Steve Bangert re-programmed MATLAB in C, created the MATLAB programming language, and developed features for toolboxes.<sup>[23]</sup>

Commercial development

MATLAB was first released as a commercial product in 1984 at the Automatic Control Conference in Las Vegas.<sup>[22][23]</sup> MathWorks, Inc. was founded to develop the software<sup>[27]</sup> and the MATLAB programming language was released.<sup>[25]</sup> The first MATLAB sale was the following year, when Nick Trefethen from the Massachusetts Institute of Technology bought ten copies.<sup>[23][30]</sup>

MATLAB (programming language)

<b>Paradigm</b>	multi-paradigm: functional, imperative, procedural, object-oriented, array
<b>Designed<span> </span>by</b>	Cleve Moler
<b>Developer</b>	MathWorks
<b>First<span> </span>appeared</b>	late 1970s
<b>Stable<span> </span>release</b>	<div>R2021b<sup>[1]</sup> <span><span></span></span> / September 22, 2021</div>
<b>Typing discipline</b>	dynamic, weak
<b>Filename extensions</b>	.m, .p, <sup>[2]</sup> .mex*, <sup>[3]</sup> .mat, <sup>[4]</sup> .fig, <sup>[5]</sup> .mlx, <sup>[6]</sup> .mlapp, <sup>[7]</sup> .mltbx, <sup>[8]</sup> .mlappinstall, <sup>[9]</sup> .mlpkginstall <sup>[10]</sup>
<b>Website</b>	<span>mathworks.com</span> (https://www.mathworks.com/products/matlab.html)
<b>Influenced<span> </span>by</b>	APL · EISPACK · LINPACK · PL/O · Speakeasy <sup>[11]</sup>
<b>Influenced</b>	Julia <sup>[12]</sup> · Octave <sup>[13]</sup> · Scilab <sup>[14]</sup> · INTLAB <sup>[15][16][17][18]</sup>
<span><span></span></span>	<span><span></span></span> MATLAB Programming at Wikibooks

MATLAB (software)

<div><div><span></span></div><div>L-shaped membrane logo<sup>[19]</sup></div></div>	
<b>Developer(s)</b>	MathWorks
<b>Initial<span> </span>release</b>	1984
<b>Stable<span> </span>release</b>	<div>R2021b<sup>[1]</sup> <span><span></span></span> / September 22, 2021</div>
<b>Written<span> </span>in</b>	C/C++, MATLAB
<b>Operating<span> </span>system</b>	Windows, macOS, and Linux <sup>[20]</sup>
<b>Platform</b>	IA-32, x86-64
<b>Type</b>	Numerical computing
<b>License</b>	Proprietary commercial software
<b>Website</b>	<span>mathworks.com</span> (https://www.m

By the end of the 1980s, several hundred copies of MATLAB had been sold to universities for student use.<sup>[23]</sup> The software was popularized largely thanks to toolboxes created by experts in various fields for performing specialized mathematical tasks.<sup>[26]</sup> Many of the toolboxes were developed as a result of Stanford students that used MATLAB in academia, then brought the software with them to the private sector.<sup>[23]</sup>

athworks.com/p  
roducts/matlab.  
html)

Over time, MATLAB was re-written for early operating systems created by Digital Equipment Corporation, VAX, Sun Microsystems, and for Unix PCs.<sup>[23][25]</sup> Version 3 was released in 1987.<sup>[31]</sup> The first MATLAB compiler was developed by Stephen C. Johnson in the 1990s.<sup>[25]</sup>

In 2000, MathWorks added a Fortran-based library for linear algebra in MATLAB 6, replacing the software's original LINPACK and EISPACK subroutines that were in C.<sup>[25]</sup> MATLAB's Parallel Computing Toolbox was released at the 2004 Supercomputing Conference and support for graphics processing units (GPUs) was added to it in 2010.<sup>[25]</sup>

## Recent history

Some especially large changes to the software were made with version 8 in 2012.<sup>[32]</sup> The user interface was reworked and Simulink's functionality was expanded.<sup>[33]</sup> By 2016, MATLAB had introduced several technical and user interface improvements, including the MATLAB Live Editor notebook, and other features.<sup>[25]</sup>

## Syntax

The MATLAB application is built around the MATLAB programming language. Common usage of the MATLAB application involves using the "Command Window" as an interactive mathematical shell or executing text files containing MATLAB code.<sup>[34]</sup>

## Variables

Variables are defined using the assignment operator, `=`. MATLAB is a weakly typed programming language because types are implicitly converted.<sup>[35]</sup> It is an inferred typed language because variables can be assigned without declaring their type, except if they are to be treated as symbolic objects,<sup>[36]</sup> and that their type can change. Values can come from constants, from computation involving values of other variables, or from the output of a function. For example:

```
>> x = 17
x =
    17

>> x = 'hat'
x =
    hat

>> x = [3*4, pi/2]
x =
    12.0000    1.5708

>> y = 3*sin(x)
y =
   -1.6097    3.0000
```

## Vectors and matrices

A simple array is defined using the colon syntax: *initial* : *increment* : *terminator*. For instance:

```
>> array = 1:2:9
array =
     1     3     5     7     9
```

defines a variable named `array` (or assigns a new value to an existing variable with the name `array`) which is an array consisting of the values 1, 3, 5, 7, and 9. That is, the array starts at 1 (the *initial* value), increments with each step from the previous value by 2 (the *increment* value), and stops once it reaches (or is about to exceed) 9 (the *terminator* value).

The *increment* value can actually be left out of this syntax (along with one of the colons), to use a default value of 1.

```
>> ari = 1:5
ari =
     1     2     3     4     5
```

assigns to the variable named `ari` an array with the values 1, 2, 3, 4, and 5, since the default value of 1 is used as the increment.

Indexing is one-based,<sup>[37]</sup> which is the usual convention for matrices in mathematics, unlike zero-based indexing commonly used in other programming languages such as C, C++, and Java.

Matrices can be defined by separating the elements of a row with blank space or comma and using a semicolon to terminate each row. The list of elements should be surrounded by square brackets `[ ]`. Parentheses `( )` are used to access elements and subarrays (they are also used to denote a function argument list).

```
>> A = [16 3 2 13; 5 10 11 8; 9 6 7 12; 4 15 14 1]
A =
    16     3     2    13
     5    10    11     8
     9     6     7    12
     4    15    14     1

>> A(2,3)
ans =
    11
```

Sets of indices can be specified by expressions such as `2:4`, which evaluates to `[2, 3, 4]`. For example, a submatrix taken from rows 2 through 4 and columns 3 through 4 can be written as:

```
>> A(2:4, 3:4)
ans =
    11     8
     7    12
    14     1
```

A square identity matrix of size  $n$  can be generated using the function `eye`, and matrices of any size with zeros or ones can be generated with the functions `zeros` and `ones`, respectively.

```
>> eye(3,3)
ans =
     1     0     0
     0     1     0
     0     0     1

>> zeros(2,3)
ans =
     0     0     0
     0     0     0

>> ones(2,3)
ans =
     1     1     1
     1     1     1
```

Transposing a vector or a matrix is done either by the function `transpose` or by adding dot-prime after the matrix (without the dot, prime will perform conjugate transpose for complex arrays):

```
>> A = [1 ; 2], B = A.', C = transpose(A)
A =
     1
     2
B =
     1     2
C =
     1     2

>> D = [0 3 ; 1 5], D.'
D =
     0     3
     1     5
ans =
     0     1
     3     5
```

Most functions accept arrays as input and operate element-wise on each element. For example, `mod(2*J, n)` will multiply every element in  $J$  by 2, and then reduce each element modulo  $n$ . MATLAB does include standard `for` and `while` loops, but (as in other similar applications such as `R`), using the vectorized notation is encouraged and is often faster to execute. The following code, excerpted from the function `magic.m`, creates a magic square  $M$  for odd values of  $n$  (MATLAB function `meshgrid` is used here to generate square matrices  $I$  and  $J$  containing  $1:n$ ):

```
[J,I] = meshgrid(1:n);
A = mod(I + J - (n + 3) / 2, n);
B = mod(I + 2 * J - 2, n);
M = n * A + B + 1;
```

## Structures

MATLAB supports structure data types.<sup>[38]</sup> Since all variables in MATLAB are arrays, a more adequate name is "structure array", where each element of the array has the same field names. In addition, MATLAB supports dynamic field names<sup>[39]</sup> (field look-ups by name, field manipulations, etc.).

## Functions

When creating a MATLAB function, the name of the file should match the name of the first function in the file. Valid function names begin with an alphabetic character, and can contain letters, numbers, or underscores. Variables and functions are case sensitive.<sup>[40]</sup>

## Function handles

MATLAB supports elements of lambda calculus by introducing function handles,<sup>[41]</sup> or function references, which are implemented either in `.m` files or anonymous<sup>[42]</sup>/nested functions.<sup>[43]</sup>

## Classes and object-oriented programming

MATLAB supports object-oriented programming including classes, inheritance, virtual dispatch, packages, pass-by-value semantics, and pass-by-reference semantics.<sup>[44]</sup> However, the syntax and calling conventions are significantly different from other languages. MATLAB has value classes and reference classes, depending on whether the class has *handle* as a super-class (for reference classes) or not (for value classes).<sup>[45]</sup>

Method call behavior is different between value and reference classes. For example, a call to a method:

```
object.method();
```

can alter any member of *object* only if *object* is an instance of a reference class, otherwise value class methods must return a new instance if it needs to modify the object.

An example of a simple class is provided below:

```
classdef Hello
    methods
        function greet(obj)
            disp('Hello!')
        end
    end
end
```

When put into a file named `hello.m`, this can be executed with the following commands:

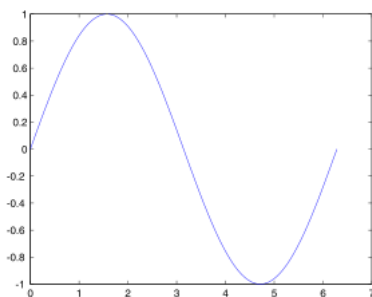
```
>> x = Hello();
>> x.greet();
Hello!
```

## Graphics and graphical user interface programming

MATLAB has tightly integrated graph-plotting features. For example, the function `plot` can be used to produce a graph from two vectors  $x$  and  $y$ . The code:

```
x = 0:pi/100:2*pi;
y = sin(x);
plot(x,y)
```

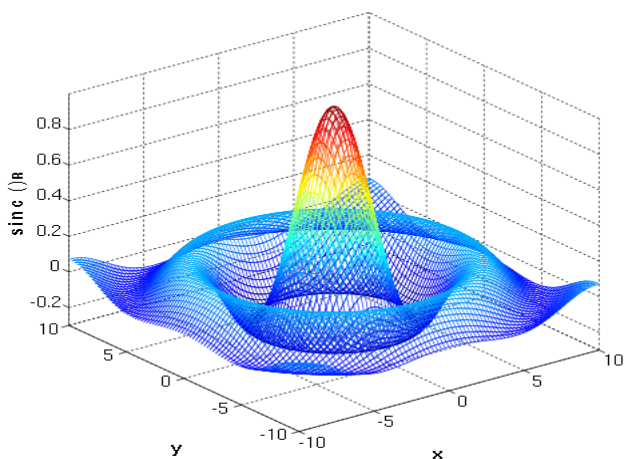
produces the following figure of the sine function:



MATLAB supports three-dimensional graphics as well:

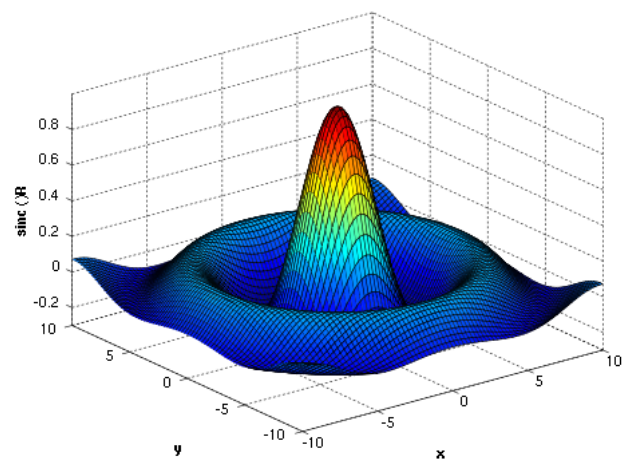
```
[X,Y] = meshgrid(-10:0.25:10,-10:0.25:10);
f = sinc(sqrt((X/pi).^2+(Y/pi).^2));
mesh(X,Y,f);
axis([-10 10 -10 10 -0.3 1])
xlabel('\bfx')
ylabel('\bfy')
zlabel('\bfsinc ({\bfR})')
hidden off
```

This code produces a **wireframe** 3D plot of the two-dimensional unnormalized sinc function:



```
[X,Y] = meshgrid(-10:0.25:10,-10:0.25:10);
f = sinc(sqrt((X/pi).^2+(Y/pi).^2));
surf(X,Y,f);
axis([-10 10 -10 10 -0.3 1])
xlabel('\bfx')
ylabel('\bfy')
zlabel('\bfsinc ({\bfR})')
```

This code produces a **surface** 3D plot of the two-dimensional unnormalized sinc function:



MATLAB supports developing graphical user interface (GUI) applications.<sup>[46]</sup> UIs can be generated either programmatically or using visual design environments such as *GUIDE* and *App Designer*.<sup>[47][48]</sup>

## MATLAB and other languages

---

MATLAB can call functions and subroutines written in the programming languages [C](#) or [Fortran](#).<sup>[49]</sup> A wrapper function is created allowing MATLAB data types to be passed and returned. [MEX files](#) (MATLAB executables) are the dynamically loadable object files created by compiling such functions.<sup>[50][51]</sup> Since 2014 increasing two-way interfacing with [Python](#) was being added.<sup>[52][53]</sup>

Libraries written in Perl, Java, [ActiveX](#) or [.NET](#) can be directly called from MATLAB,<sup>[54][55]</sup> and many MATLAB libraries (for example [XML](#) or [SQL](#) support) are implemented as wrappers around Java or ActiveX libraries. Calling MATLAB from Java is more complicated, but can be done with a MATLAB toolbox<sup>[56]</sup> which is sold separately by [MathWorks](#), or using an undocumented mechanism called JMI (Java-to-MATLAB Interface),<sup>[57][58]</sup> (which should not be confused with the unrelated [Java Metadata Interface](#) that is also called JMI). Official MATLAB API for Java was added in 2016.<sup>[59]</sup>

As alternatives to the [MuPAD](#) based Symbolic Math Toolbox available from MathWorks, MATLAB can be connected to [Maple](#) or [Mathematica](#).<sup>[60][61]</sup>

Libraries also exist to import and export [MathML](#).<sup>[62]</sup>

While MATLAB is the most popular commercial numerical computation software package,<sup>[63]</sup> other alternatives are available, such as the open source computation language [GNU Octave](#), the statistics programming language [R](#), the computing environment [Maple](#) and the computational language [Julia](#).<sup>[63][64]</sup>

## Withdrawal from China

---

In 2020, Chinese state media reported that MATLAB had withdrawn services from two Chinese universities as a result of US sanctions, and said this will be responded to by increased use of open-source alternatives and by developing domestic alternatives.<sup>[65]</sup>

## Release history

---

MATLAB is updated twice per year.<sup>[66]:517[33]</sup> In addition to new features and other improvements, each release has new bug fixes and smaller changes.<sup>[67]</sup>

Version <sup>[68]</sup>	Release name	Number	Bundled JVM	Year	Release date	Notes
MATLAB 1.0				1984		
MATLAB 2				1986		
MATLAB 3				1987		First Matlab toolbox introduced; support for <u>ordinary differential equations</u> added. <sup>[25]; 81</sup>
MATLAB 3.5				1990		Ran on <u>DOS</u> but needed at least a <u>386</u> processor; needed a <u>math coprocessor</u> .
MATLAB 4				1992		Ran on <u>Windows 3.1x</u> and Macintosh.
MATLAB 4.2c				1994		Ran on Windows 3.1x; needed a <u>math coprocessor</u> .
MATLAB 5.0	Volume 8			1996	December 1996	Unified releases across all platforms.
MATLAB 5.1	Volume 9			1997	May 1997	
MATLAB 5.1.1	R9.1					
MATLAB 5.2	R10			1998	March 1998	Last version working on classic Macs.
MATLAB 5.2.1	R10.1					
MATLAB 5.3	R11			1999	January 1999	
MATLAB 5.3.1	R11.1				November 1999	
MATLAB 6.0	R12	12	1.1.8	2000	November 2000	First release with bundled Java virtual machine (JVM).
MATLAB 6.1	R12.1		1.3.0	2001	June 2001	Last release for Windows 95.
MATLAB 6.5	R13	13	1.3.1	2002	July 2002	
MATLAB 6.5.1	R13SP1			2003		
MATLAB 6.5.2	R13SP2					Last release for Windows 98, Windows ME, IBM/AIX, Alpha/TRU64, and SGI/IRIX. <sup>[69]</sup>
MATLAB 7	R14	14	1.4.2	2004	June 2004	Introduced anonymous and nested functions; <sup>[70]</sup> re-introduced for Mac (under Mac OS X).
MATLAB 7.0.1	R14SP1				October 2004	
	R14SP1+			2004	November 2004	Parallel Computing Toolbox introduced. <sup>[25]; 4[71]:3</sup>
MATLAB 7.0.4	R14SP2		1.5.0	2005	March 7, 2005	Support added for memory-mapped files. <sup>[72]</sup>
MATLAB 7.1	R14SP3	1.5.0			September 1, 2005	First 64-bit version available for Windows XP 64-bit.
MATLAB 7.2	R2006a	15	1.5.0	2006	March 1, 2006	
MATLAB 7.3	R2006b	16	1.5.0		September 1, 2006	<u>HDF5</u> -based MAT-file support added.
MATLAB 7.4	R2007a	17	1.5.0_07	2007	March 1, 2007	New bsxfun function added to apply element-by-element binary operation with singleton expansion enabled. <sup>[73]</sup>
MATLAB 7.5	R2007b	18	1.6.0		September 1, 2007	Last release for Windows 2000 and <u>PowerPC</u> Mac; License Server support for Windows Vista; <sup>[74]</sup> new internal format for P-code.
MATLAB 7.6	R2008a	19	1.6.0	2008	March 1, 2008	Major enhancements to object-oriented programming abilities with a new class definition syntax; <sup>[75]</sup> ability to manage namespaces with packages. <sup>[76]</sup>
MATLAB 7.7	R2008b	20	1.6.0_04		October 9, 2008	Last release for processors w/o SSE2; New Map data structure; <sup>[77]</sup> upgrades to random number generators. <sup>[78]</sup>
MATLAB 7.8	R2009a	21	1.6.0_04	2009	March 6, 2009	First release for Microsoft 32-bit & 64-bit Windows 7; new external interface to .NET Framework. <sup>[79]</sup>
MATLAB 7.9	R2009b	22	1.6.0_12		September 4, 2009	First release for Intel 64-bit Mac, and last for <u>Solaris SPARC</u> ; new use for the tilde operator (~) to ignore arguments in function calls. <sup>[80][81]</sup>
MATLAB 7.9.1	R2009bSP1		1.6.0_12		April 1, 2010	Bug fixes.
MATLAB 7.10	R2010a	23	1.6.0_12	2010	March 5, 2010	Last release for Intel 32-bit Mac.
MATLAB 7.11	R2010b	24	1.6.0_17		September 3, 2010	Added support for enumerations; <sup>[82]</sup> added features for running MATLAB code on NVIDIA CUDA-based GPUs. <sup>[83]</sup>
MATLAB 7.11.1	R2010bSP1		1.6.0_17	2011	March 17, 2011	Bug fixes and updates.
MATLAB 7.11.2	R2010bSP2		1.6.0_17		April 5, 2012 <sup>[84]</sup>	Bug fixes.

MATLAB 7.12	R2011a	25	1.6.0_17		April 8, 2011	New rng function to control random number generation. <sup>[85][86][87]</sup>
MATLAB 7.13	R2011b	26	1.6.0_17		September 1, 2011	Added ability to access/change parts of variables directly in MAT-files, without loading into memory; <sup>[88]</sup> increased maximum local workers with Parallel Computing Toolbox from 8 to 12. <sup>[89]</sup>
MATLAB 7.14	R2012a	27	1.6.0_17	2012	March 1, 2012	Last version with 32-bit Linux support. <sup>[90]</sup>
MATLAB 8	R2012b	28	1.6.0_17		September 11, 2012	First release with Toolstrip interface; <sup>[91]</sup> MATLAB Apps introduced; <sup>[92]</sup> redesigned documentation system.
MATLAB 8.1	R2013a	29	1.6.0_17	2013	March 7, 2013	New unit testing framework. <sup>[93]</sup>
MATLAB 8.2	R2013b	30	1.7.0_11		September 6, 2013 <sup>[94]</sup>	Built in Java Runtime Environment (JRE) updated to version 7; <sup>[95]</sup> New table data type. <sup>[96]</sup>
MATLAB 8.3	R2014a	31	1.7.0_11	2014	March 7, 2014 <sup>[97]</sup>	Simplified compiler setup for building MEX-files; USB Webcams support in core MATLAB; number of local workers no longer limited to 12 with Parallel Computing Toolbox.
MATLAB 8.4	R2014b	32	1.7.0_11		October 3, 2014	New class-based graphics engine (a.k.a. HG2); <sup>[98]</sup> tabbing function in GUI; <sup>[99]</sup> improved user toolbox packaging and help files; <sup>[100]</sup> new objects for time-date manipulations; <sup>[101]</sup> Git-Subversion integration in IDE; <sup>[102]</sup> big data abilities with MapReduce (scalable to Hadoop); <sup>[103]</sup> new py package for using Python from inside MATLAB; <sup>[104]</sup> new engine interface to call MATLAB from Python; <sup>[105]</sup> several new and improved functions: webread (RESTful web services with JSON/XML support), tcpclient (socket-based connections), histcounts, histogram, animatedline, and others.
MATLAB 8.5	R2015a	33	1.7.0_60	2015	March 5, 2015	
MATLAB 8.5	R2015aSP1		1.7.0_60		October 14, 2015	Last release supporting Windows XP and Windows Vista.
MATLAB 8.6	R2015b	34	1.7.0_60		September 3, 2015	New MATLAB execution engine (a.k.a. LXE); <sup>[106]</sup> graph and digraph classes to work with graphs and networks; <sup>[107]</sup> MinGW-w64 as supported compiler on Windows; <sup>[108]</sup> last version with 32-bit support.
MATLAB 9.0	R2016a	35	1.7.0_60	2016	March 3, 2016	Released Live Scripts: interactive documents that combine text, code, and output (in the style of <u>Literate programming</u> ); <sup>[109]</sup> App Designer introduced: a new development environment for building apps (with new kind of UI figures, axes, and components); <sup>[110]</sup> pause execution of running programs using a Pause Button.
MATLAB 9.1	R2016b	36	1.7.0_60		September 15, 2016	Added ability to define local functions in scripts; <sup>[111]</sup> automatic expansion of dimensions (previously provided via explicit call to bsxfun); tall arrays for Big data; <sup>[112]</sup> new string type; <sup>[113]</sup> new functions to encode/decode JSON; <sup>[114]</sup> official MATLAB Engine API for Java. <sup>[59]</sup>
MATLAB 9.2	R2017a	37	1.7.0_60	2017	March 9, 2017	Released MATLAB Online: cloud-based MATLAB desktop accessed in a web browser; <sup>[115]</sup> double-quoted strings; new memoize function for Memoization; expanded object properties validation; <sup>[116]</sup> mocking framework for unit testing; <sup>[117]</sup> MEX targets 64-bit by default; new heatmap function for creating <u>heatmap charts</u> . <sup>[118]</sup>
MATLAB 9.3	R2017b	38	1.8.0_121		September 21, 2017	Introduced a GPU Coder that converts MATLAB code to CUDA code for Nvidia. <sup>[119]</sup>
MATLAB 9.4	R2018a	39	1.8.0_144	2018	March 15, 2018 <sup>[120]</sup>	Improvements to the Live editor; introduction of the C++ MEX interface; ability to customize tab completion; web applications. <sup>[121]</sup>
MATLAB 9.5	R2018b	40	1.8.0_152		September 12, 2018	Added support for cloud providers, such as Amazon Web Services; Neural Network Toolbox replaced with Deep Learning Toolbox. <sup>[122]</sup>
MATLAB 9.6	R2019a	41	1.8.0_181	2019	March 20, 2019	Released MATLAB Projects; added state machine programming with Stateflow. <sup>[123]</sup>
MATLAB 9.7	R2019b	42	1.8.0_202		September 11, 2019	Introduction of 'arguments' block for input validation; enabling of dot indexing into function outputs; introduction of Live Editor Tasks. <sup>[124]</sup>
MATLAB 9.8	R2020a	43		2020	March 19, 2020	Removal of Mupad notebook; improved support for AMD CPUs (AVX2); <sup>[125]</sup> default UTF-8 encoding for MATLAB code files; <sup>[126]</sup> ability to create stand-alone applications with Simulink. <sup>[127]</sup>
MATLAB 9.9	R2020b	44			September 17, 2020	Improved support for AMD CPUs (AVX2); <sup>[125]</sup> online version of Simulink. <sup>[128]</sup>
MATLAB 9.10	R2021a	45		2021	March 11, 2021	
MATLAB 9.11	R2021b				September 22, 2021	

The number (or release number) is the version reported by Concurrent License Manager program FLEXlm. For a complete list of changes of both MATLAB and official toolboxes, consult the MATLAB release notes.<sup>[129]</sup>

## See also

- Comparison of numerical analysis software
- List of numerical analysis software

## Notes

- [https://www.mathworks.com/help/pdf\\_doc/matlab/rn.pdf](https://www.mathworks.com/help/pdf_doc/matlab/rn.pdf).
- "Protect Your Source Code" ([https://www.mathworks.com/help/matlab/matlab\\_prog/protect-your-source-code.html](https://www.mathworks.com/help/matlab/matlab_prog/protect-your-source-code.html)). MathWorks. Retrieved November 1, 2019.
- "MEX Platform Compatibility" ([https://www.mathworks.com/help/matlab/matlab\\_external/platform-compatibility.html](https://www.mathworks.com/help/matlab/matlab_external/platform-compatibility.html)). MathWorks. Retrieved November 1, 2019.

4. "MAT-File Versions" ([https://www.mathworks.com/help/matlab/import\\_export/mat-file-versions.html](https://www.mathworks.com/help/matlab/import_export/mat-file-versions.html)). MathWorks. Retrieved November 1, 2019.
5. "Save Figure to Reopen in MATLAB Later" ([https://www.mathworks.com/help/matlab/creating\\_plots/save-figure-to-reopen-in-matlab-later.html](https://www.mathworks.com/help/matlab/creating_plots/save-figure-to-reopen-in-matlab-later.html)). MathWorks. Retrieved November 1, 2019.
6. "Live Code File Format (.mlx)" ([https://www.mathworks.com/help/matlab/matlab\\_prog/live-script-file-format.html](https://www.mathworks.com/help/matlab/matlab_prog/live-script-file-format.html)). MathWorks. Retrieved November 1, 2019.
7. "MATLAB App Designer" (<https://www.mathworks.com/help/matlab/ref/appdesigner.html>). MathWorks. Retrieved November 1, 2019.
8. "Toolbox Distribution" ([https://www.mathworks.com/help/matlab/creating\\_help.html](https://www.mathworks.com/help/matlab/creating_help.html)). MathWorks. Retrieved November 1, 2019.
9. "MATLAB App Installer File" ([https://www.mathworks.com/help/matlab/creating\\_guis/what-is-an-app.html](https://www.mathworks.com/help/matlab/creating_guis/what-is-an-app.html)). MathWorks. Retrieved November 1, 2019.
10. "Support Package Installation" ([https://www.mathworks.com/help/matlab/matlab\\_external/support-package-installation.html](https://www.mathworks.com/help/matlab/matlab_external/support-package-installation.html)). MathWorks. Retrieved November 1, 2019.
11. "An interview with CLEVE MOLER Conducted by Thomas Haigh On 8 and 9 March, 2004 Santa Barbara, California" (<https://web.archive.org/web/20141227140938/http://archive.computerhistory.org/resources/access/text/2013/12/102746804-05-01-acc.pdf>) (PDF). Computer History Museum. Archived from the original (<http://archive.computerhistory.org/resources/access/text/2013/12/102746804-05-01-acc.pdf>) (PDF) on December 27, 2014. Retrieved December 6, 2016. "So APL, Speakeasy, LINPACK, EISPACK, and PL0 were the predecessors to MATLAB."
12. Bezanson, Jeff; Karpinski, Stefan; Shah, Viral; Edelman, Alan (February 14, 2012). "Why We Created Julia" (<http://julialang.org/blog/2012/02/why-we-created-julia>). Julia Language. Retrieved December 1, 2016.
13. Eaton, John W. (May 21, 2001). "Octave: Past, Present, and Future" (<https://web.archive.org/web/20170809034614/http://jbrwww.che.wisc.edu/tech-reports/twmcc-2001-03.pdf>) (PDF). Texas-Wisconsin Modeling and Control Consortium. Archived from the original (<http://jbrwww.che.wisc.edu/tech-reports/twmcc-2001-03.pdf>) (PDF) on August 9, 2017. Retrieved December 1, 2016.
14. "History" (<https://web.archive.org/web/20161201171246/http://www.scilab.org/scilab/history>). Scilab. Archived from the original (<https://www.scilab.org/scilab/history>) on December 1, 2016. Retrieved December 1, 2016.
15. S.M. Rump: INTLAB – INTerval LABoratory. In Tibor Csendes, editor, Developments in Reliable Computing, pages 77–104. Kluwer Academic Publishers, Dordrecht, 1999.
16. Moore, R. E., Kearfott, R. B., & Cloud, M. J. (2009). Introduction to Interval Analysis. Society for Industrial and Applied Mathematics.
17. Rump, S. M. (2010). Verification methods: Rigorous results using floating-point arithmetic. *Acta Numerica*, 19, 287–449.
18. Hargreaves, G. I. (2002). Interval analysis in MATLAB. Numerical Algorithms, (2009.1).
19. "The L-Shaped Membrane" (<http://www.mathworks.com/company/newsletters/articles/the-l-shaped-membrane.html>). MathWorks. 2003. Retrieved February 7, 2014.
20. "System Requirements and Platform Availability" (<http://www.mathworks.com/products/availability/index.html#ML>). MathWorks. Retrieved August 14, 2013.
21. The MathWorks (February 2020). "Company Overview" (<https://uk.mathworks.com/content/dam/mathworks/handout/2020-company-factsheet-8-5x11-8282v20.pdf>) (PDF).
22. Chonacky, N.; Winch, D. (2005). "Reviews of Maple, Mathematica, and Matlab: Coming Soon to a Publication Near You". *Computing in Science & Engineering*. Institute of Electrical and Electronics Engineers (IEEE). 7 (2): 9–10. doi:10.1109/mcse.2005.39 (<https://doi.org/10.1109%2Fmcse.2005.39>). ISSN 1521-9615 (<https://www.worldcat.org/issn/1521-9615>). S2CID 29660034 (<https://api.semanticscholar.org/CorpusID:29660034>).
23. Haigh, Thomas. "Cleve Moler: Mathematical Software Pioneer and Creator of Matlab" (<http://www.tomandmaria.com/Tom/Writing/MolerBio.pdf>) (PDF). *IEEE Annals of the History of Computing*. IEEE Computer Society.
24. "A Brief History of MATLAB" (<https://www.mathworks.com/company/newsletters/articles/a-brief-history-of-matlab.html>). *www.mathworks.com*. Retrieved September 4, 2021.
25. Moler, Cleve; Little, Jack (June 12, 2020). "A history of MATLAB" (<https://doi.org/10.1145%2F3386331>). *Proceedings of the ACM on Programming Languages*. Association for Computing Machinery (ACM). 4 (HOPL): 1–67. doi:10.1145/3386331 (<https://doi.org/10.1145%2F3386331>). ISSN 2475-1421 (<https://www.worldcat.org/issn/2475-1421>).
26. Xue, D.; Press, T.U. (2020). *MATLAB Programming: Mathematical Problem Solutions* (<https://books.google.com/books?id=0Y7ZDWAAQBAJ&pg=PP21>). De Gruyter STEM. De Gruyter. p. 21. ISBN 978-3-11-066370-9. Retrieved September 16, 2020.
27. Press, CRC (2008). *Solving Applied Mathematical Problems with MATLAB* (<https://books.google.com/books?id=V4vulPEc29kC&pg=PA6>). CRC Press. p. 6. ISBN 978-1-4200-8251-7. Retrieved September 16, 2020.
28. Woodford, C.; Phillips, C. (2011). *Numerical Methods with Worked Examples: Matlab Edition* (<https://books.google.com/books?id=L90JVxlvA0YC&pg=PA1>). SpringerLink : Bücher. Springer Netherlands. p. 1. ISBN 978-94-007-1366-6. Retrieved September 16, 2020.
29. Tranquillo, J.V. (2011). *MATLAB for Engineering and the Life Sciences* (<https://books.google.com/books?id=ofWpMryW0lgC>). Synthesis digital library of engineering and computer science. Morgan & Claypool Publishers. ISBN 978-1-60845-710-6. Retrieved September 17, 2020.
30. LoTurco, Lori (January 28, 2020). "Accelerating the pace of engineering" (<https://news.mit.edu/2020/accelerating-pace-engineering-mathworks-fellows-0128>). MIT News. Massachusetts Institute of Technology. Retrieved September 16, 2020.
31. Gatto, Marino; Rizzoli, Andrea (1993). "Review of MATLAB, Version 4.0". *Natural Resource Modeling*. Wiley. 7 (1): 85–88. doi:10.1111/j.1939-7445.1993.tb00141.x (<https://doi.org/10.1111%2Fj.1939-7445.1993.tb00141.x>). ISSN 0890-8575 (<https://www.worldcat.org/issn/0890-8575>).
32. Cho, M.J.; Martinez, W.L. (2014). *Statistics in MATLAB: A Primer* (<https://books.google.com/books?id=X0IqBgAAQBAJ>). Chapman & Hall/CRC Computer Science & Data Analysis. CRC Press. ISBN 978-1-4665-9657-3. Retrieved September 17, 2020.
33. Xue, D.; Chen, Y. (2013). *System Simulation Techniques with MATLAB and Simulink* (<https://books.google.com/books?id=6d7IAAAQBAJ&pg=PT17>). No Longer used. Wiley. p. 17. ISBN 978-1-118-69437-4. Retrieved October 15, 2020.
34. "MATLAB Documentation" (<http://www.mathworks.com/help/matlab/index.html>). MathWorks. Retrieved August 14, 2013.
35. "Comparing MATLAB with Other OO Languages" ([http://www.mathworks.com/help/matlab/matlab\\_oop/matlab-vs-other-oo-languages.html](http://www.mathworks.com/help/matlab/matlab_oop/matlab-vs-other-oo-languages.html)). MATLAB. MathWorks. Retrieved August 14, 2013.
36. "Create Symbolic Variables and Expressions" (<http://www.mathworks.com/help/symbolic/creating-symbolic-variables-and-expressions.html>). *Symbolic Math Toolbox*. MathWorks. Retrieved August 14, 2013.
37. "Matrix Indexing" (<http://www.mathworks.com/help/matlab/math/matrix-indexing.html>). MathWorks. Retrieved August 14, 2013.
38. "Structures" (<http://www.mathworks.com/help/matlab/structures.html>). MathWorks. Retrieved August 14, 2013.
39. "Generate Field Names from Variables" ([http://www.mathworks.com/help/matlab/matlab\\_prog/generate-field-names-from-variables.html](http://www.mathworks.com/help/matlab/matlab_prog/generate-field-names-from-variables.html)). MathWorks. Retrieved August 14, 2013.
40. "Case and Space Sensitivity" ([https://www.mathworks.com/help/matlab/matlab\\_prog/case-and-space-sensitivity.html](https://www.mathworks.com/help/matlab/matlab_prog/case-and-space-sensitivity.html)). MathWorks. Retrieved November 1, 2019.
41. "Function Handles" (<http://www.mathworks.com/help/matlab/function-handles.html>). MathWorks. Retrieved August 14, 2013.
42. "Anonymous Functions" ([http://www.mathworks.com/help/matlab/matlab\\_prog/anonymous-functions.html](http://www.mathworks.com/help/matlab/matlab_prog/anonymous-functions.html)). MathWorks. Retrieved August 14, 2013.
43. "Nested Functions" ([http://www.mathworks.com/help/matlab/matlab\\_prog/nested-functions.html](http://www.mathworks.com/help/matlab/matlab_prog/nested-functions.html)). MathWorks.
44. "Object-Oriented Programming" (<http://www.mathworks.com/help/matlab/object-oriented-programming.html>). MathWorks. Retrieved August 14, 2013.
45. "Comparing Handle and Value Classes" ([http://www.mathworks.com/help/matlab/matlab\\_oop/comparing-handle-and-value-classes.html](http://www.mathworks.com/help/matlab/matlab_oop/comparing-handle-and-value-classes.html)). MathWorks.
46. "MATLAB GUI" (<http://www.mathworks.com/discovery/matlab-gui.html>). MathWorks. April 30, 2011. Retrieved August 14, 2013.
47. "Create a Simple GUIDE GUI" ([http://www.mathworks.com/help/matlab/creating\\_guis/about-the-simple-guide-gui-example.html](http://www.mathworks.com/help/matlab/creating_guis/about-the-simple-guide-gui-example.html)). MathWorks. Retrieved August 14, 2014.



48. "MATLAB App Designer" (<https://www.mathworks.com/products/matlab/app-designer.html>). MathWorks. Retrieved November 1, 2019.
49. "Application Programming Interfaces to MATLAB" (<http://www.mathworks.com/help/matlab/programming-interfaces-for-c-c-fortran-com.html>). MathWorks. Retrieved August 14, 2013.
50. "Create MEX-Files" (<http://www.mathworks.com/help/matlab/create-mex-files.html>). MathWorks. Retrieved August 14, 2013.
51. Spielman, Dan (February 10, 2004). "Connecting C and Matlab" (<http://www.cs.yale.edu/homes/spielman/ECC/cMatlab.html>). Yale University, Computer Science Department. Retrieved May 20, 2008.
52. "MATLAB Engine for Python" (<http://www.mathworks.com/help/matlab/matlab-engine-for-python.html>). MathWorks. Retrieved June 13, 2015.
53. "Call Python Libraries" (<http://www.mathworks.com/help/matlab/call-python-libraries.html>). MathWorks. Retrieved June 13, 2015.
54. "External Programming Language Interfaces" (<http://www.mathworks.com/help/matlab/external-interfaces.html>). MathWorks. Retrieved August 14, 2013.
55. "Call Perl script using appropriate operating system executable" (<http://www.mathworks.com/help/matlab/ref/perl.html>). MathWorks. Retrieved November 7, 2013.
56. "MATLAB Builder JA" (<http://www.mathworks.com/products/javabuilder/>). MathWorks. Retrieved June 7, 2010.
57. Altman, Yair (April 14, 2010). "Java-to-Matlab Interface" (<https://web.archive.org/web/20150905153327/http://undocumentedmatlab.com/blog/jmi-java-to-matlab-interface>). Undocumented Matlab. Archived from the original (<http://undocumentedmatlab.com/blog/jmi-java-to-matlab-interface/>) on September 5, 2015. Retrieved June 7, 2010.
58. Kaplan, Joshua. "matlabcontrol JMI" (<https://code.google.com/p/matlabcontrol/wiki/JMI>).
59. "MATLAB Engine API for Java" (<http://www.mathworks.com/help/matlab/matlab-engine-api-for-java.html>). MathWorks. Retrieved September 15, 2016.
60. Germundsson, Roger (September 30, 1998). "MaMa: Calling MATLAB from Mathematica with MathLink" (<http://library.wolfram.com/infocenter/MathSource/618/>). Wolfram Research. Wolfram Library Archive.
61. rsmenon; szhorvat (2013). "MATLink: Communicate with MATLAB from Mathematica" (<http://matlink.org/>). Retrieved August 14, 2013.
62. Weitzel, Michael (September 1, 2006). "MathML import/export" (<http://web.archive.org/web/20110225010921/http://www.mathworks.com/matlabcentral/fileexchange/7709-mathml-importexport>). MathWorks - File Exchange. Archived from the original (<http://www.mathworks.com/matlabcentral/fileexchange/7709-mathml-importexport>) on February 25, 2011. Retrieved August 14, 2013.
63. Popuri, SK; Gobbart, MK (2017). "A comparative evaluation of Matlab, Octave, R, and Julia on Maya" (<https://mdsoar.org/handle/11603/11302>). UMBC Faculty Collection. doi:10.13016/M2Q23R39S (<https://doi.org/10.13016/M2Q23R39S>). Retrieved April 1, 2021.
64. Shaukat, Kamran, et al. "A Comparative Study of Numerical Analysis Packages." International Journal of Computer Theory and Engineering 10.3 (2018): 67-72.
65. "US military ban locks two Chinese universities out of popular software" (<https://www.scmp.com/news/china/diplomacy/article/3088854/us-military-ban-locks-two-chinese-universities-out-popular>). South China Morning Post. June 12, 2020. Retrieved November 6, 2020.
66. Bober, W. (2013). *Introduction to Numerical and Analytical Methods with MATLAB for Engineers and Scientists* (<https://books.google.co.uk/books?id=OWLSBQAAQBAJ&pg=PA517>). CRC Press. p. 517. ISBN 978-1-4665-7609-4. Retrieved October 15, 2020.
67. Altman, Y.M. (2014). *Accelerating MATLAB Performance: 1001 tips to speed up MATLAB programs* (<https://books.google.co.uk/books?id=9oqZBQAAQBAJ&pg=PA215>). Taylor & Francis. p. 215. ISBN 978-1-4822-1129-0. Retrieved October 15, 2020.
68. Moler, Cleve (January 2006). "The Growth of MATLAB and The MathWorks over Two Decades" (<http://www.mathworks.com/company/newsletters/articles/the-growth-of-matlab-and-the-mathworks-over-two-decades.html>). News & Notes Newsletter. MathWorks. Retrieved August 14, 2013.
69. "MATLAB System Requirements - Release 13" (<http://www.mathworks.com/support/sysreq/release13/unix.html>). MathWorks. Retrieved October 6, 2015.
70. "Dynamic Function Creation with Anonymous and Nested Functions" (<http://www.mathworks.com/company/newsletters/articles/dynamic-function-creation-with-anonymous-and-nested-functions.html>). MathWorks. Retrieved January 15, 2016.
71. *MATLAB Parallel Computing Toolbox User's Guide* (<http://godzilla.kennedykrieger.org/penguin/distcomp.pdf>) (PDF)
72. "Memory Mapping" (<http://www.mathworks.com/help/matlab/memory-mapping.html>). MathWorks. Retrieved January 22, 2014.
73. "MATLAB bsxfun" (<http://www.mathworks.com/help/matlab/ref/bsxfun.html>). MathWorks. Retrieved January 22, 2014.
74. "Do MATLAB versions prior to R2007a run under Windows Vista?" (<http://www.mathworks.com/support/solutions/en/data/1-43EHE5/>). MathWorks. September 3, 2010. Retrieved February 8, 2011.
75. "OOP Compatibility with Previous Versions" ([http://www.mathworks.com/help/matlab/matlab\\_oop/compatibility-with-previous-versions.html](http://www.mathworks.com/help/matlab/matlab_oop/compatibility-with-previous-versions.html)). MathWorks. Retrieved March 11, 2013.
76. "Packages Create Namespaces" ([http://www.mathworks.com/help/matlab/matlab\\_oop/scoping-classes-with-packages.html](http://www.mathworks.com/help/matlab/matlab_oop/scoping-classes-with-packages.html)). MathWorks. Retrieved January 22, 2014.
77. "Map Containers" (<http://www.mathworks.com/help/matlab/map-containers.html>). MathWorks. Retrieved January 22, 2014.
78. "Creating and Controlling a Random Number Stream" (<http://www.mathworks.com/help/matlab/math/creating-and-controlling-a-random-number-stream.html>). MathWorks. Retrieved January 22, 2014.
79. "New MATLAB External Interfacing Features in R2009a" (<http://www.mathworks.com/support/2013b/matlab/8.2/demos/New-MATLAB-External-Interfacing-Features-in-R2009a.html>). MathWorks. Retrieved January 22, 2014.
80. "Ignore Function Outputs" ([http://www.mathworks.com/help/matlab/matlab\\_prog/ignore-function-outputs.html](http://www.mathworks.com/help/matlab/matlab_prog/ignore-function-outputs.html)). MathWorks. Retrieved January 22, 2014.
81. "Ignore Function Inputs" ([http://www.mathworks.com/help/matlab/matlab\\_prog/ignore-function-inputs.html](http://www.mathworks.com/help/matlab/matlab_prog/ignore-function-inputs.html)). MathWorks. Retrieved January 22, 2014.
82. "Working with Enumerations" ([http://www.mathworks.com/help/matlab/matlab\\_oop/enumerations.html](http://www.mathworks.com/help/matlab/matlab_oop/enumerations.html)). MathWorks. Retrieved January 22, 2014.
83. "MathWorks Announces Release 2010B Of The MATLAB And Simulink Product Families – EEJournal" (<https://www.eejournal.com/article/20100903-01/>). EEJournal – Electronic Engineering Journal. September 3, 2010. Retrieved November 24, 2020.
84. "What's New in Release 2010b" ([http://www.mathworks.com/products/new\\_products/release2010b.html](http://www.mathworks.com/products/new_products/release2010b.html)). MathWorks. Retrieved January 22, 2014.
85. "New RNG Function for Controlling Random Number Generation in Release 2011a" (<http://www.mathworks.com/support/2013b/matlab/8.2/demos/new-rng-function-in-r2011a.html>). MathWorks. Retrieved January 22, 2014.
86. "MATLAB rng" (<http://www.mathworks.com/help/matlab/ref/rng.html>). MathWorks. Retrieved January 22, 2014.
87. "Replace Discouraged Syntaxes of rand and randn" (<http://www.mathworks.com/help/matlab/math/updating-your-random-number-generator-syntax.html>). MathWorks. Retrieved January 22, 2014.
88. "MATLAB matfile" (<http://www.mathworks.com/help/matlab/ref/matfile.html>). MathWorks. Retrieved January 22, 2014.
89. "MATLAB max workers" (<http://www.mathworks.com/matlabcentral/answers/25987>). Retrieved January 22, 2014.
90. MathWorks Support Team (June 4, 2015). "Is MATLAB supported on 32-bit Linux?" (<https://www.mathworks.com/matlabcentral/answers/222489-is-matlab-supported-on-32-bit-linux>). "Versions of MATLAB prior to R2012a are fully supported on 32-bit Linux. After R2012a, MATLAB is no longer supported on 32-bit Linux."
91. Shure, Loren (September 2012). "The MATLAB R2012b Desktop – Part 1: Introduction to the Toolstrip" (<http://blogs.mathworks.com/lore/2012/09/12/the-matlab-r2012b-desktop-part-1-introduction-to-the-toolstrip/>).
92. "MATLAB Apps" (<http://www.mathworks.com/discovery/matlab-apps.html>). MathWorks. Retrieved August 14, 2013.
93. "MATLAB Unit Testing Framework" (<http://www.mathworks.com/help/matlab/matlab-unit-test-framework.html>). MathWorks. Retrieved August 14, 2013.
94. "MathWorks Announces Release 2013b of the MATLAB and Simulink Product Families" (<http://www.mathworks.com/company/newsroom/mathworks-announces-release-2013b-of-the-matlab-and-simulink-product-families.html>). MathWorks. September 2013.
95. "R2013b Release Notes" (<https://www.mathworks.com/help/matlab/release-notes.html?ntext=&startrelease=R2013b&endrelease=R2013b&category=desktop>). MathWorks. Retrieved September 17, 2018.

96. "MATLAB Tables" (<http://www.mathworks.com/help/matlab/tables.html>). MathWorks. Retrieved September 14, 2013.
97. "MathWorks Announces Release 2014a of the MATLAB and Simulink Product Families" (<http://www.mathworks.com/company/newsroom/mathworks-announces-release-2014a-of-the-matlab-and-simulink-product-families.html>). MathWorks. Retrieved March 11, 2014.
98. "Graphics Changes in R2014b" (<http://www.mathworks.com/help/matlab/graphics-changes-in-r2014b.html>). MathWorks. Retrieved October 3, 2014.
99. "uitab: Create tabbed panel" (<http://www.mathworks.com/help/matlab/ref/uitab.html>). MathWorks. Retrieved October 3, 2014.
100. "Create and Share Toolboxes" ([http://www.mathworks.com/help/matlab/matlab\\_prog/create-and-share-custom-matlab-toolboxes.html](http://www.mathworks.com/help/matlab/matlab_prog/create-and-share-custom-matlab-toolboxes.html)). MathWorks. Retrieved October 3, 2014.
101. "Dates and Time" (<http://www.mathworks.com/help/matlab/date-and-time-operations.html>). MathWorks. Retrieved October 3, 2014.
102. "Source Control Integration" (<http://www.mathworks.com/help/matlab/source-control.html>). MathWorks. Retrieved October 3, 2014.
103. "MATLAB MapReduce and Hadoop" (<http://www.mathworks.com/discovery/matlab-mapreduce-hadoop.html>). MathWorks. Retrieved October 3, 2014.
104. "Call Python Libraries" (<http://www.mathworks.com/help/matlab/call-python-libraries.html>). MathWorks. Retrieved October 3, 2014.
105. "MATLAB Engine for Python" (<http://www.mathworks.com/help/matlab/matlab-engine-for-python.html>). MathWorks. Retrieved October 3, 2014.
106. "MATLAB Execution Engine" (<http://www.mathworks.com/products/matlab/matlab-execution-engine/>). MathWorks. Retrieved September 15, 2016.
107. "Graph and Network Algorithms" (<http://www.mathworks.com/help/matlab/graph-and-network-algorithms.html>). MathWorks. Retrieved September 15, 2016.
108. "Install MinGW-w64 Compiler" ([http://www.mathworks.com/help/matlab/matlab\\_external/install-mingw-support-package.html](http://www.mathworks.com/help/matlab/matlab_external/install-mingw-support-package.html)). MathWorks. Retrieved September 15, 2016.
109. "What Is a Live Script?" ([http://www.mathworks.com/help/matlab/matlab\\_prog/what-is-a-live-script.html](http://www.mathworks.com/help/matlab/matlab_prog/what-is-a-live-script.html)). MathWorks. Retrieved September 15, 2016.
110. "MATLAB App Designer" (<http://www.mathworks.com/products/matlab/app-designer/>). MathWorks. Retrieved September 15, 2016.
111. "Add Functions to Scripts" ([http://www.mathworks.com/help/matlab/matlab\\_prog/local-functions-in-scripts.html](http://www.mathworks.com/help/matlab/matlab_prog/local-functions-in-scripts.html)). MathWorks. Retrieved September 15, 2016.
112. "Tall Arrays" (<http://www.mathworks.com/help/matlab/tall-arrays.html>). MathWorks. Retrieved September 15, 2016.
113. "Create String Arrays" ([http://www.mathworks.com/help/matlab/matlab\\_prog/create-string-arrays.html](http://www.mathworks.com/help/matlab/matlab_prog/create-string-arrays.html)). MathWorks. Retrieved September 15, 2016.
114. "JSON Format - MATLAB & Simulink" (<http://mathworks.com/help/matlab/json-format.html>). *mathworks.com*. Retrieved August 20, 2017.
115. "MATLAB Online" (<https://www.mathworks.com/products/matlab-online.html>). MathWorks. Retrieved April 10, 2017.
116. "Validate Property Values" ([https://www.mathworks.com/help/matlab/matlab\\_oop/validate-property-values.html](https://www.mathworks.com/help/matlab/matlab_oop/validate-property-values.html)). MathWorks. Retrieved April 10, 2017.
117. "Mocking Framework" (<https://www.mathworks.com/help/matlab/mocking-framework.html>). MathWorks. Retrieved April 10, 2017.
118. "Create Heatmap from Tabular Data" ([https://www.mathworks.com/help/matlab/creating\\_plots/create-heatmap-from-tabular-data.html](https://www.mathworks.com/help/matlab/creating_plots/create-heatmap-from-tabular-data.html)). MathWorks. Retrieved April 10, 2017.
119. Morris, Kevin. "Deep Learning with MATLAB" (<https://www.eejournal.com/article/deep-learning-with-matlab/>). *Electronic Engineering Journal*. Retrieved November 23, 2020.
120. "MathWorks Announces Release 2018a of the MATLAB and Simulink Product Families" (<https://www.mathworks.com/company/newsroom/mathworks-announces-release-2018a-of-the-matlab-and-simulink-product-families.html>). MathWorks. Retrieved April 5, 2018.
121. "MATLAB adds new capabilities with Release R2018a" (<https://insidehpc.com/2018/03/matlab-adds-new-capabilities-release-r2018a/>). *insideHPC*. March 18, 2018. Retrieved November 23, 2020.
122. Michel, Stefanie (October 15, 2018). "Mathworks erweitert Deep-Learning-Funktionen im neuen Release" (<https://www.maschinenmarkt.vogel.de/mathworks-erweitert-deep-learning-funktionen-im-neuen-release-a-765980/>). *MM MaschinenMarkt* (in German). Retrieved November 23, 2020.
123. "MathWorks announces release 2019b of MATLAB and Simulink" (<https://www.evaluationengineering.com/instrumentation/software/article/21106170/mathworks-announces-release-2019b-of-matlab-and-simulink>). *Evaluation Engineering*. Retrieved November 23, 2020.
124. Schlichtmeier, Tobias (September 20, 2019). "Mathworks stellt Update vor: Release 2019b für Matlab und Simulink" (<https://www.elektroniknet.de/embedded/entwicklungstools/release-2019b-fuer-matlab-und-simulink.169439.html>). *Elektroniknet* (in German). Retrieved November 23, 2020.
125. "Crippled No Longer: Matlab Now Runs on AMD CPUs at Full Speed - ExtremeTech" (<https://www.extremetech.com/computing/308501-crippled-no-longer-matlab-2020a-runs-amd-cpus-at-full-speed>). *www.extremetech.com*. Retrieved October 29, 2020.
126. "MathWorks delivers AI capabilities to engineers and scientists" (<https://www.manmonthly.com.au/features/mathworks-delivers-additional-ai-capabilities-engineers-scientists/>). *Manufacturers' Monthly*. May 8, 2020. Retrieved November 23, 2020.
127. "MathWorks Delivers Additional AI Capabilities with Release 2020a of MATLAB and Simulink" (<https://www.hpcwire.com/off-the-wire/mathworks-delivers-additional-ai-capabilities-with-release-2020a-of-matlab-and-simulink/>). *HPCwire*. May 8, 2020. Retrieved November 23, 2020.
128. Manners, David (September 24, 2020). "MathWorks updates Simulink and MATLAB families" (<https://www.electronicweekly.com/news/business/mathworks-updates-simulink-matlab-families-2020-09/>). *Electronics Weekly*. Retrieved November 23, 2020.
129. "MATLAB Release Notes" (<http://www.mathworks.com/help/releasenotes/index.html>). MathWorks. Retrieved January 25, 2014.

## Further reading

- Gilat, Amos (2004). *MATLAB: An Introduction with Applications 2nd Edition*. John Wiley & Sons. ISBN 978-0-471-69420-5.
- Quarteroni, Alfio; Saleri, Fausto (2006). *Scientific Computing with MATLAB and Octave*. Springer. ISBN 978-3-540-32612-0.
- Ferreira, A.J.M. (2009). *MATLAB Codes for Finite Element Analysis*. Springer. ISBN 978-1-4020-9199-5.
- Lynch, Stephen (2004). *Dynamical Systems with Applications using MATLAB*. Birkhäuser. ISBN 978-0-8176-4321-8.

## External links

- **Official website** (<https://www.mathworks.com/products/matlab.html>)
- **MATLAB** (<https://curlie.org/Science/Math/Software/MATLAB>) at Curlie

Retrieved from "https://en.wikipedia.org/w/index.php?title=MATLAB&oldid=1051079837"

This page was last edited on 21 October 2021, at 13:34 (UTC).

Text is available under the Creative Commons Attribution-ShareAlike License; additional terms may apply. By using this site, you agree to the Terms of Use and Privacy Policy. Wikipedia® is a registered trademark of the Wikimedia Foundation, Inc., a non-profit organization.