What's New In Maple™ 17

The Möbius Project™

The Möbius Project makes it easy to create rich, interactive Maple™ applications, share them with everyone, and automatically grade the application to assess understanding. Many of the additions and improvements in Maple 17 are designed to support The Möbius Project, especially in the area of Math App development. These enhancements include:

- The Embedded Video Component, which lets you add rich multimedia content to your applications and trigger actions as the video plays.
- Major updates to the Explore command, which can be used to create a Math App with a single command.
- A new public group in the MapleCloud™ for sharing your Math Apps through The Möbius Project.
- A new advanced code editor that provides syntax highlighting, automatic indenting, and more, making code development even easier for more complex applications.
- Many new Math Apps, which serve as excellent demonstrations on their own and can also be used as building blocks for your own Apps.
- A more powerful Maple Player that can be used to easily access and interact with Math Apps as well as view any Maple document.

Many of these features are described in more detail in this document.

Embedded Video

Maple 17 gives you the ability to include videos right inside your Maple document and trigger actions as the video plays.

- Add videos simply by dragging the new interactive video component from the Components palette into your document and then selecting the video file.
- Trigger actions as the video plays by specifying Maple commands to be run at specific intervals during playback, such as updating plots, activating buttons, executing computations, and more.
- Drive the video component interactively or from your Maple code.
- Store the video locally, on a website, or embed it in the document file.

Maple 17: By the Numbers

434 new commands for mathematical problem-solving

52 new Clickable Math™ tools, including more Smart Pop-ups™ and new Math Apps included right in the product

8 times faster polynomial operations

3 ways to access a brand new code editor that makes writing code even easier

400 enhancements to the user interface, including a more powerful Exploration Assistant and the ability to embed and programmatically control videos inside a Maple document

100 times faster sparse matrix and vector calculations

1 entirely new class of differential equations that can be completely solved

47 routines for signal processing

3.36 times better speedups on multicore machines due to improved parallel memory management

38 tools for linguistic analysis and grading of essays

1 Maple Player that can be used to easily access and interact with Math Apps as well as view any Maple document

5565 changes and enhancements overall

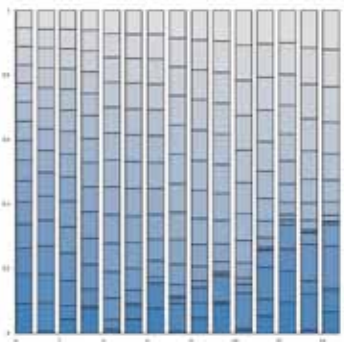
Advanced Code Editor

Maple 17 features a completely new editor for writing Maple code. The editor includes many features to make it easier to write, read, and debug Maple code, and is available for managing startup code, code edit regions, and code attached to embedded components.

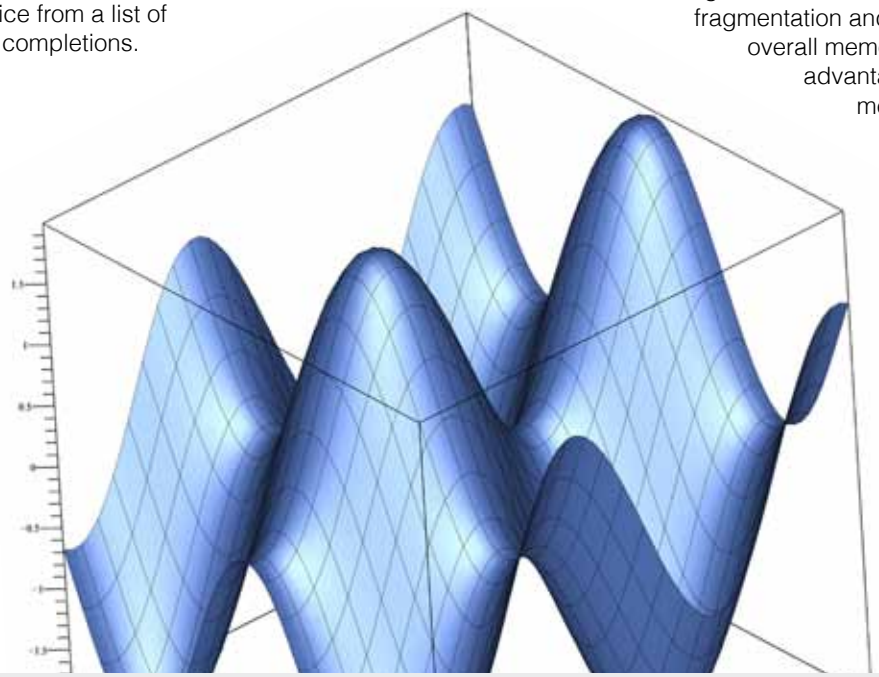
- **Syntax Highlighting:** Maple keywords and operators are colored, making it easier to spot typographical errors and identify code blocks.
- **Bracket Matching:** Typing a new bracket character or positioning the cursor next to an existing one highlights its counterpart, so they are easier to match up.
- **Quote Matching:** Mismatched or missing single-, double-, and back-quote characters are highlighted.
- **Automatic Indentation:** After entering the first line of a new module, procedure, or if/then statement, subsequent lines are automatically indented.
- **Command Completion:** Commands can be entered more quickly and without error by typing in the first few letters of your command, and then selecting your choice from a list of possible completions.
- **Error Checking:** Code is checked for errors continuously as you type, making it easier to identify problems quickly.
- **Import/Export:** Easily import code from .mpl or other text formats directly into your code editor and export the contents of a code editor to a text file.

Performance

With every new release, Maplesoft strives to improve the efficiency and speed of its mathematical computations. This involves making improvements in the most frequently called routines and algorithms, as well as in the low-level infrastructure.



- New algorithms result in faster calculations with complex floating-point numbers, with some calculations up to 2000 times faster.
- Performance enhancements for floating-point linear algebra operations include improved use of multiple cores and CPUs as well as faster operations with sparse vectors and matrices.
- Memory usage in Maple is much improved with the combination of multiple memory regions and parallel memory management. The use of multiple memory regions reduces fragmentation and makes much more efficient use of overall memory. Parallel memory management takes advantage of multiple processors to perform memory management tasks more quickly. As a result of these improvements, you can solve bigger problems, get better performance for your computations, and have more available memory for other programs running on the same machine.
- Numerous improvements in underlying routines combined with a new high performance data structure for distributed multivariate polynomials drastically improves the speed and scalability of most polynomial computations.

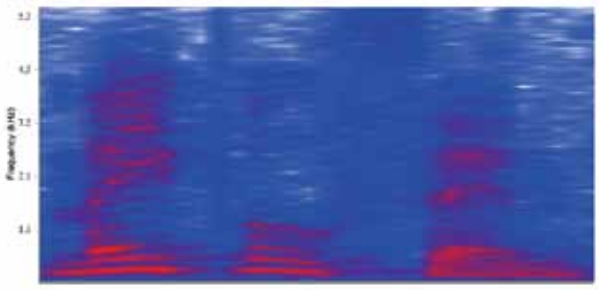


Signal Processing

Maple 17 offers new signal processing tools for analyzing and manipulating data in the frequency and time domains. The SignalProcessing package can be used for diverse applications such as creating a speech spectrogram, removing noise from polluted signals, and identifying the periodicity of data.

This package includes tools for:

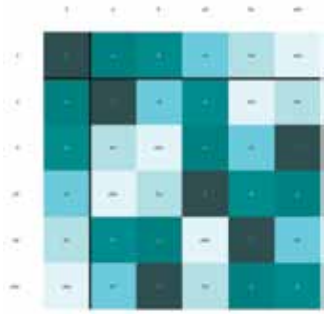
- Cosine, fast Fourier, and wavelet transforms
- Bartlett, Blackman, Kaiser, Hann, and Hanning windows
- Signal generation
- Cross-correlation, autocorrelation, data statistics, and upsampling/downsampling
- FIR, IIR, and Butterworth filters



Group Theory

Maple 17 introduces an extensive new package for working with groups. The new package has over 150 commands for constructing groups, examining their properties, performing operations, and visualization. This package includes:

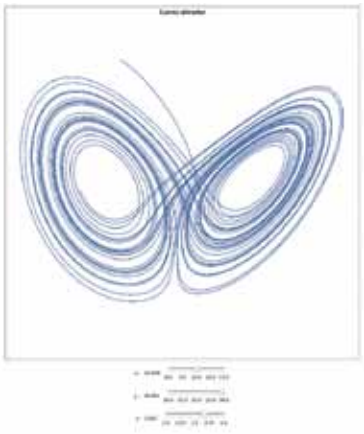
- Large set of group constructors and databases of standard groups so it is easy to get started
- Support for alternating and symmetric groups; cyclic, dicyclic, and dihedral groups; linear, orthogonal, and unitary groups over finite fields; quaternions; the group of the Rubik's cube; Galois groups; and many more



- Numerous operations, including isomorphism testing; examining subgroup lattices; splitting a group into conjugacy classes; factoring a group element into a coset representative and a subgroup element; computing if a group is simple, nilpotent, or soluble; identifying isomorphisms for groups up to order 200; computing standard subgroups, such as Sylow subgroups, the center, and the derived subgroup; and many more
- Easy visualization of Cayley tables and subgroup lattices
- Symbolic groups, in which some properties of the group are expressed as variable parameters while other characteristics are known

Math Apps

Math Apps are interactive demonstrations that give students and teachers the ability to explore and illustrate a wide variety of mathematical and scientific concepts. These demonstrations can be incorporated into any learning environment, such as classroom demonstrations or independent studying. There are now close to 200 Math Apps in Maple, which are also available through The Möbius Project.



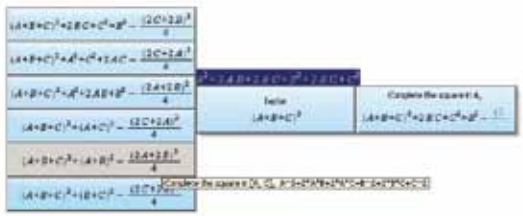
Maple 17 includes more than 45 new Math Apps to engage students with math and science concepts. The new Math Apps explore a variety of topics including:

- Spherical coordinates
- Roots of unity
- Password security
- Kinematics quantities
- Letter frequencies
- Linear approximations of functions
- Tide heights
- And many more!

Clickable Math™: Smart Popups and Drag-to-Solve™

Maple 17 continues the tradition of providing Clickable Math techniques to make it easy to learn, teach, and do mathematics. Maple 17 builds on the Smart Popups and Drag-to-Solve technology first introduced in Maple 16, which offer new ways to explore math with only your mouse. Drag-to-Solve lets you solve your equations step-by-step simply by dragging terms to where you want them to be, while Smart Popups suggest common operations that can be applied to the entire expression or just part of it, and let you preview the result before going ahead. You can use Smart Popups to easily determine if your subexpression can be factored, what its plot looks like, what mathematical identities could be applied, and more.

In Maple 17, the Smart Popups menus have been expanded, offering new choices for completion of the square and simplification options based on expression size. Other improvements have been made to the generation and display of the menus for Smart Popups and Drag-to-Solve, including visual improvements, internationalization, and display time.



One-Step App Creation

The Explore command gives you a quick and easy way to create interactive applications and demonstrations. With a single command, you can create a fully interactive application to explore arbitrary mathematical expressions and plots. These applications let you use sliders to change the parameters of your expression and immediately see the results. The resulting application can be saved and shared with others, including through The Möbius Project.

The Explore command has been updated in Maple 17 to provide new and enhanced functionality, allowing you to:

- Specify the exploration parameters programmatically as well as through the Exploration Assistant.
- Include references to other variables and data.
- Insert the exploration components into either the current document or a new one.

Ease of Use Enhancements

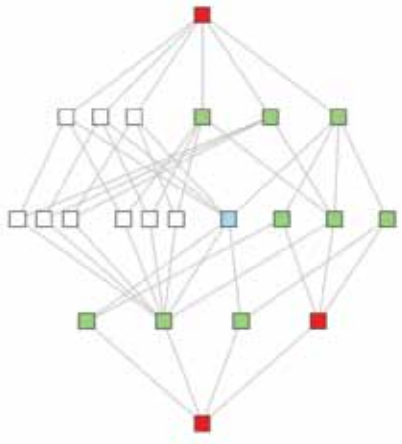
Maple has always been a pioneer in math software usability, and continually strives to ensure that new and occasional users are immediately productive while experienced users have the tools and flexibility they need to work efficiently. Usability enhancements in Maple 17 include:

- Automatic command completion is available while entering commands in standard mathematical notation.
- Search and replace has been enhanced to search for names that appear inside mathematical expressions.
- Subscript handling is more intuitive.
- Previously protected variable names, such as I and D, can now be used in your own calculations, even at the top level.

Parallelism

Maple 17 introduces parallelism into its memory management system, taking advantage of multiple processors to perform its job more quickly. This change can lead to a reduction of running times for all computations, not just parallel algorithms. With no code changes required, your computations will run 10% faster on average, with memory-intensive computations running up to 400% faster.

In addition, new programming constructs were added to make it easier to write parallel code. Variables and procedure remember tables can be declared local to the thread, so that each instance can store different values. This allows for complex algorithms that need to maintain state to be written in a thread-safe manner.

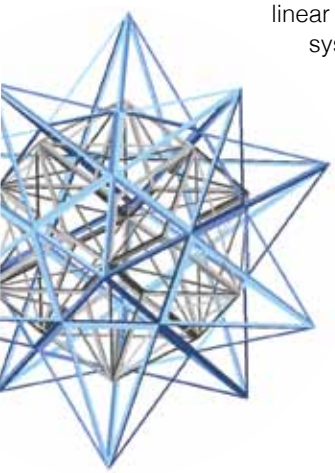


Advanced Mathematics

Maple 17 is the result of many thousands of hours of work by world-class mathematicians at Maplesoft as well as experts in research labs and universities all around the world. Maple 17 offers numerous advancements in a variety of branches of mathematics that push the frontiers of mathematical knowledge and Maple's capabilities.

In addition to the work done in group theory, statistics, physics, differential geometry, and more, introduced elsewhere in this document, Maple 17 also provides:

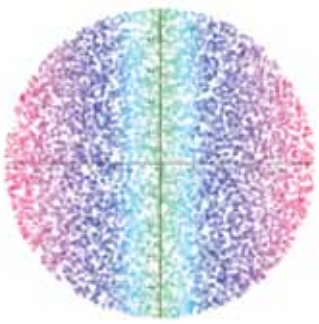
- Ground-breaking achievements in solving a whole new class of differential equations
- Major advancements in solving systems of equations, introducing new solution methods for systems of linear equations and inequalities and for systems involving nonlinear polynomial inequalities
- New algorithms for finding limits of bivariate rational functions
- Advancements in working with algebraic curves
- Significant improvements in graph theory, including new algorithms and scalability improvements
- More functionality for handling and exploring branch cuts



Statistics

Maple contains a wealth of functionality for doing statistics, combining the ease of working in a high-level, interactive environment with a very large and powerful set of algorithms. Support for statistics has been further expanded in Maple 17. The new release includes:

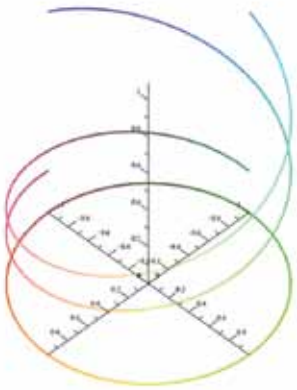
- A new algorithm for fitting data in an overdetermined system for use in predictive models.
- New robust measure of dispersion that is more suitable for asymmetric distributions than the median absolute deviation.



Differential Geometry

The many additions and updates in differential geometry include:

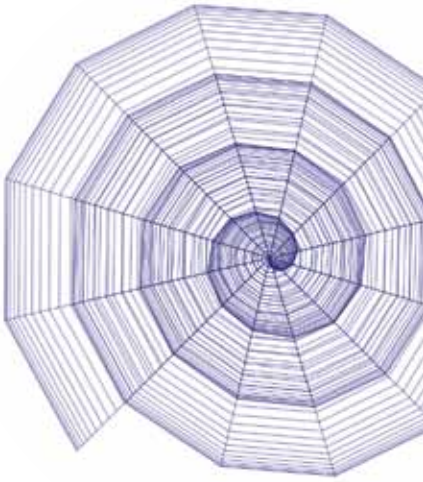
- New commands for calculating properties of vectors, tensors, differential forms, quaternions, and octonions; solving equations whose unknowns are tensors or differential forms; noncommutative multiplication for general algebras; and more
- Over 100 new metrics in the database of solutions to the Einstein equations
- Extensions to the Lie algebra package to work with more general algebras
- New and improved commands for calculating more types of tensors and other values of interest
- A new package for the study of exterior differential systems



Physics

Substantial improvements to the Physics package further enhance Maple's state-of-the-art environment for algebraic computations in physics.

- New commands for working with tensors and special and general relativity
- A programming library that gives you access to almost 100 internal commands you can use to write your own programs or extend the capabilities of the Physics package
- Enhanced support for vector analysis, Dirac matrices, commutator and anticommutator algebras, and more
- Improved entry and display to make the computational experience even more natural



Control Design

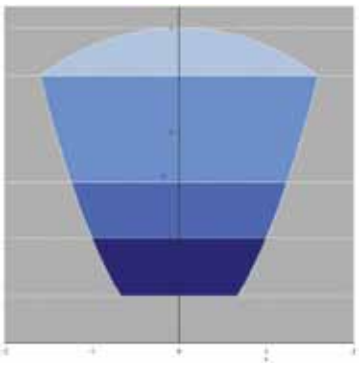
Control design tools in Maple have been enhanced to become even more flexible. Improvements to the DynamicSystems package include:

- The FrequencyResponse routine handles differential equations with input derivatives.
- All models now accept linear, non-differential systems.
- A new frequencies option for all frequency-based plots enables you to specify the precise frequencies at which expressions are evaluated.
- The Grammians command has been extended to work with discrete systems.
- Nichols plots are now accessible from the context-sensitive menu.

Visualization

Visualization improvements in Maple 17 include:

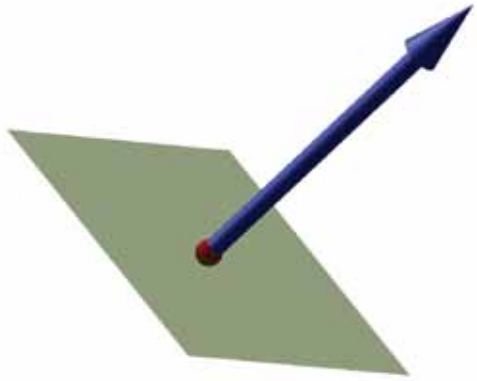
- The enhanced Plot Builder, which lets you easily embed interactive plots whose parameters are controlled by sliders directly into your document
- Automatic 3-D axes are shown by default for all 3-D plots
- Improved plotting of inequalities, which supports the plotting of nonlinear inequalities and makes it easier to specify the style of the plotted region and to combine plots of multiple regions
- Easy visualization of branch cuts in 2-D and 3-D plots
- New visualizations for drawing Cayley tables of finite groups



Multivariate Calculus for Students

Maple Student packages are designed explicitly for teaching and learning concepts in mathematics. In Maple 17, the student package for multivariate calculus has been expanded to provide more tools for exploring problems involving lines and planes.

- Work with lines and planes in two and three dimensions.
- Specify objects in a variety of ways, such as defining a line as going through two given points, as the solution of two equations, as containing a specified point and being orthogonal to a given plane, and more.
- Define lines and planes using specific values or unknown variables.
- Calculate the distance to other objects, relative position, the intersection between multiple objects, and many other values of interest.
- Visualize lines, planes, intersections, and more.



Essay Tools

Maple 17 includes a new package for linguistic analysis and grading of essays. The ability for a computer to successfully grade essays is inherently mathematical. Given a set of essays that have already been graded by hand, the computer looks for patterns in the essays and tries to weight them according to the given scores. Maple's scoring model can pick from up to 20 algorithms, each measuring dozens of properties to formulate a model that can be used to predict scores for new essays.

The EssayTools package contains functions for:

- Grading essays
- Plagiarism detection and similarity comparisons
- Analysis of English word forms and sentence reduction
- Checking spelling

Maple Player

As part of The Möbius Project, the free Maple Player is now more powerful and can be used with all Maple documents. Anyone can use the Maple Player together with interactive Math Apps to solve problems, visualize solutions, and explore concepts.

With the free Maple Player, you can:

- Use interactive Maple applications to perform computations and visualize results.
- Easily access the collection of Möbius Apps through built-in access to the MapleCloud.
- View any Maple document, regardless of author or source.
- Perform any operation that uses interactive components, including entering mathematical expressions, moving sliders, playing videos, and interacting with plots, with limitations only on the length of input allowed in entry boxes.

Customer Wish List

Details are important. Many improvements in Maple 17 are the direct result of specific requests from customers, including a number of smaller changes that enhance the overall user experience. These improvements include:

- Axes on by default for 3-D plots.
- Automatic command completion while using math notation.
- Faster access to the code behind embedded components.
- Improved subscripts.
- Freeing up reserved variable names.
- The Finance package is now also available on 64-bit Windows®.
- Larger file sizes on the MapleCloud, which now accepts files up to 10MB.

For more infomation please visit: www.maplesoft.com

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