Maple™ 16

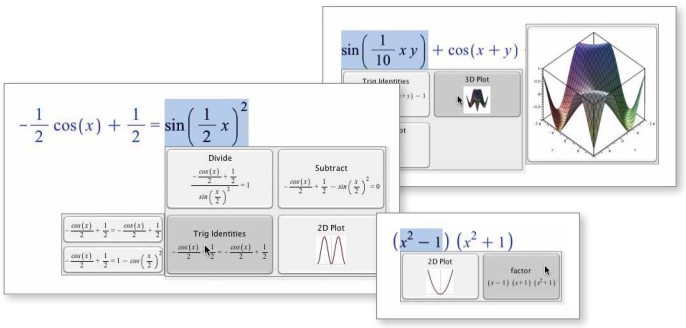
What's New

Clickable Math™ 3.0

Discover the Next Phase in Math Software Usability!

For years, Maple has led the way in making math software easy to use. With its collection of Clickable Math tools, including palettes, interactive assistants, context-sensitive menus, tutors, and more, Maple has set the standard for making it easy to learn, teach, and do mathematics. Now, Maple 16 will raise the bar even higher, introducing new, innovative ways to explore mathematics.

- **Introducing Drag-to-Solve™**
  - Solve your equations step-by-step by simply dragging terms to where you want them to be
  - Easily take complete control over each individual step of your calculation
  - Let Maple apply the appropriate addition, subtraction, division, or multiplication operation to both sides of your equation, to avoid mechanical errors
  - Keep the full record of steps produced by Maple to document your work
- **Introducing Smart Popups**
  - Select operations to apply to just one part of your equation or mathematical expression, leaving the rest unchanged
  - Preview the result of the operation before going ahead
  - Explore your expression to deepen your understanding of the problem. 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.



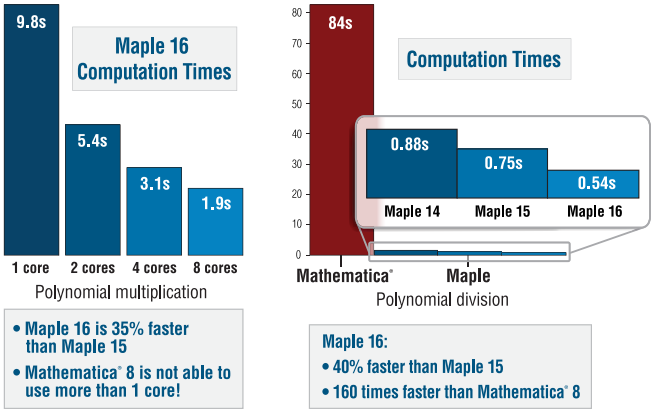
Top 10 Reasons to Upgrade

1. **Clickable Math 3.0!** Smart Popups and Drag-to-Solve™ join assistants, tutors, context menus, and other Clickable Math tools in the next phase of math software usability
2. **Over 4500 additions and improvements** throughout the entire product
3. **Important enhancements to visualization**, including a smart plot view that automatically focuses on points of interest, rubber-band zooming, higher impact 2-D and 3-D plot defaults, and 3-D interpolation
4. **Significantly faster performance** for many fundamental Maple operations, as well as for calculations involving multiple cores and multi-threading, for tackling larger problems than ever before
5. **World-leading algorithms** for solving ODEs, PDEs, and computational physics problems that are beyond the reach of any other software system
6. **Over 100 new Math Apps** to provide insight into concepts from math, statistics, physics, and finance
7. **Snippet Palettes** to easily reuse pieces of a Maple document
8. **Live Data Plots** for insight, understanding, and publication, all at the click of a button
9. **New statistical algorithms and visualizations** for deeper explorations and analysis
10. **Major enhancements to the Maple programming language**, further help when writing libraries and custom code

Computational Efficiency

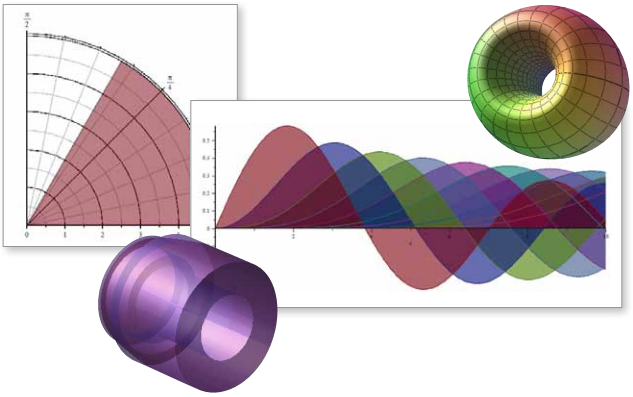
Tremendous performance gains for many algorithms in Maple 16, including core polynomial operations, numeric differential equation solving, linear algebra computations, and more, allow you to solve larger problems than ever before.

In addition to introducing faster algorithms, Maple 16 also continues to improve on scalability to multi-core computers. As the only system among its competitors that supports not just grid computing but also multi-threaded computations within its math engine and programming language, Maple 16 sets the standard for large-scale computing.



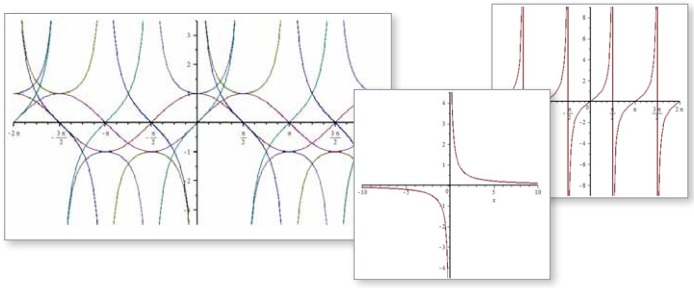
High-Impact Visualization

Optimized color schemes, light models, surface properties, and grid lines in Maple 16 ensure that your visualizations look stunning and have high impact, every time. All of Maple's 170 different types of 2-D and 3-D plots and animations benefit from these major visual enhancements.



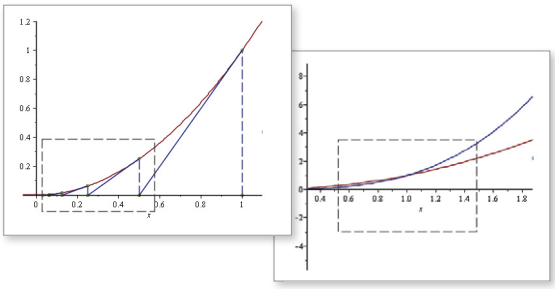
Smart 2-D Plot View

A new intelligent algorithm for 2-D plots in Maple 16 automatically focuses on the region of the plot that is most meaningful. Essential for plots with asymptotes and whenever just showing all data points would eclipse the important features of a graph, the smart view algorithm delivers maximum insight at a glance.



Rubber-Band Zooming

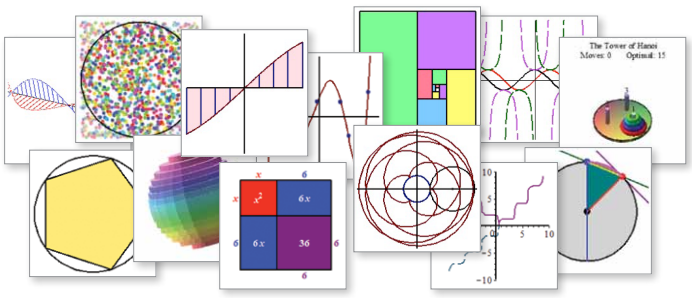
Quickly zoom into a 2-D graph by selecting the region of interest with your mouse. An animated view transition ensures that you always keep track of which area of the plot you are zooming into.



Over 100 New Math Apps

Since their inception in Maple 15, the Math Apps in Maple have given students and teachers the ability to explore and illustrate a wide variety of mathematical and scientific concepts. With dials, buttons, and sliders, these fully interactive applications make it easy for students to gain mathematical insight and understanding.

In Maple 16, we've added 100 new Math Apps ranging in scope from precalculus and calculus, statistics to physics!

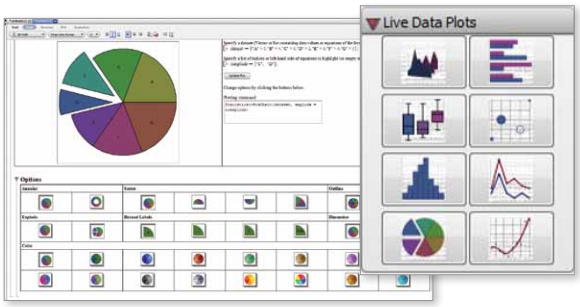


Live Data Plots

New Live Data Plots in Maple 16 help with insight, understanding, and publication of your data, all at the click of a button. These plots make it even easier for you to present your data in a form that is visually appealing and conveys meaning. Using the new Live Data Plots you can quickly generate and modify:

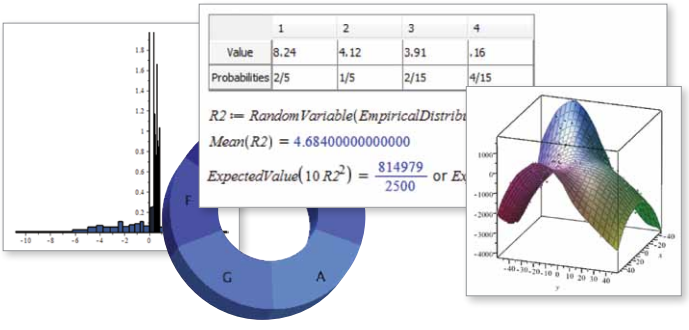
- Area charts
- Bar charts
- Box plots
- Bubble plots
- Histograms
- Line charts
- Pie charts
- Scatter plots

You can interactively change data, colors, perspective, gridlines, and other options, and instantly see the results.



Statistics

Statistical computations in Maple combine the ease of working in a high-level, interactive environment with a very large and powerful set of algorithms. Large data sets can be handled efficiently with 35 built-in statistical distributions, sampling, estimations, data smoothing, hypothesis testing, and visualization algorithms. In addition, integration with the Maple symbolic engine means that you can easily specify custom distributions by combining existing distributions or simply by giving a formula for the probability or cumulative distribution function.



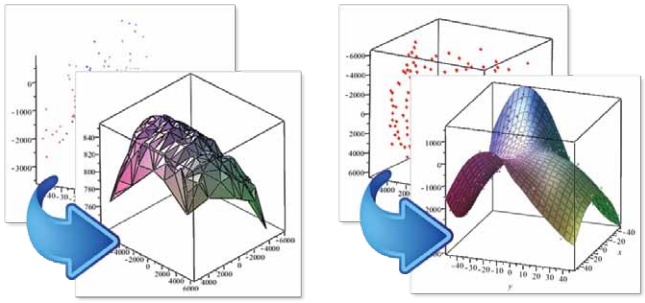
New in Maple 16:

- Discrete distributions, which are important in many areas from game theory to algorithm analysis, are significantly enhanced, with support for non-integer values as well as sampling of custom discrete distributions.
- Maximum likelihood estimation now allows for multiple parameters and is significantly faster.
- It is easier to split data into subsets based on particular criteria, enhancing your ability to analyze data and identify patterns.
- Statistical visualization is easier than ever before. In addition to the new Live Data Plots, enhancements like variable bin-width histograms and new options for pie charts provide you with extra control over how data is presented.

3-D Interpolation

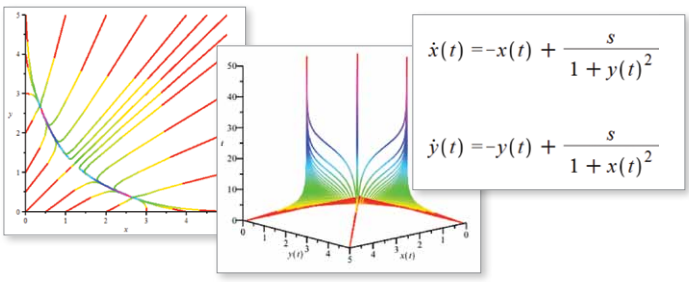
Creating 3-D plots from discrete data has never been easier using the new smoothing and interpolation techniques in Maple 16.

- The smoothing algorithm allows you to generate a smooth surface that approximates your noisy data.
- The interpolation method generates a surface which matches your data points exactly, regardless of whether the data points lie on a uniform or non-uniform grid.



Polynomial System Solving

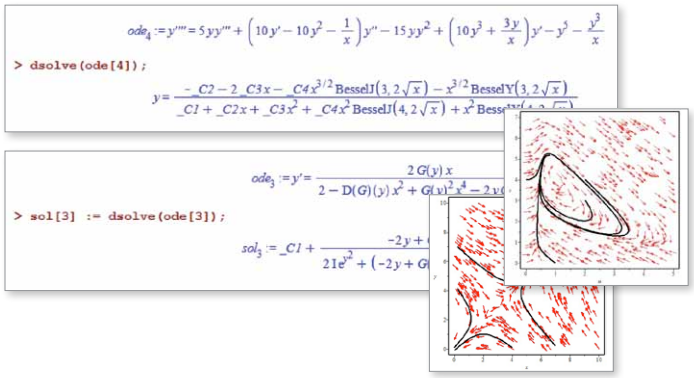
Computing and manipulating the real solutions of a polynomial system is a requirement for many application areas, such as biological modeling, robotics, program verification, and control design, to name just a few. For example, an important problem in computational biology is to study the stability of the equilibria (or steady states) of biological systems. This question can often be reduced to solving a parametric system of polynomial equations and inequalities.



The RegularChains package in Maple 16 provides a collection of tools for studying systems of polynomial equations, inequations, and inequalities. It is particularly useful for solving and working with the real solutions of polynomial systems, such as the steady-state problem. The new RegularChains features in Maple 16 include set theoretical operations for semi-algebraic sets, new solvers for popular types of systems, a new command for heuristically selecting a good variable order for computing a triangular decomposition of a polynomial system, and significant enhancements and performance improvements for many commands. With these improvements, this package can be used to solve more problems of this kind.

Differential Equations

Maple 16 continues to push the frontiers in differential equation solving and extends its lead in computing closed-form solutions to differential equations, adding in even more classes of problems that can be handled. The numeric ODE, DAE, and PDE solvers also continue to evolve. Maple 16 shows significant performance improvements for these solvers, as well as enhanced event handling.

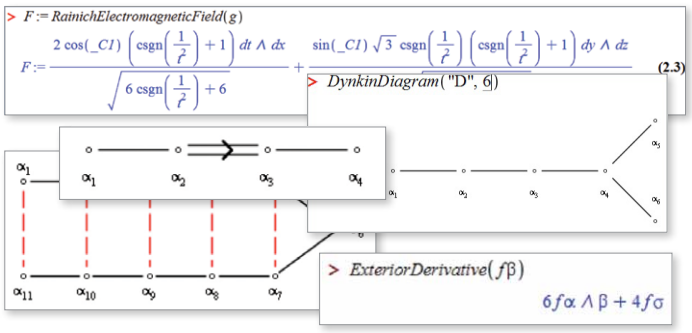


- Maple 16 integrates new solving methods for 1st, 2nd, and higher order nonlinear ODEs. The new methods can solve additional 1st order Abel and other families of equations, and a number of 2nd and higher order families of equations not admitting point symmetries.
- For both ordinary and partial differential equations, all symmetry algorithms have been extended to automatically handle problems involving anti-commutative variables, making all this DE functionality easily available for problems that involve non-commutative variables, as occur frequently, for example, in physics.
- Event handling for the numeric ODE and DAE solvers has been significantly enhanced to avoid triggering on spurious events as well as to increase performance.
- The numeric PDE solvers are now able to take advantage of the compiler, yielding a tremendous performance boost and allowing you to handle larger problems.

Differential Geometry

With over 250 commands, the DifferentialGeometry package allows sophisticated computations from basic jet calculus to the realm of the mathematics behind general relativity. In addition, 19 differential geometry lessons, from beginner to advanced level, and 6 tutorials illustrate the use of the package in applications.

In Maple 16, the DifferentialGeometry package introduces important new functionalities for working with abstractly defined differential forms, general relativity, and Lie algebras.



- You can now work with differential forms which are defined without reference to any underlying system of coordinates.
- The new MetricSearch assistant provides a simple method for searching the database of solutions to the Einstein equations.
- New commands for analyzing the geometric properties of spacetime are introduced.
- A new tutorial for differential geometry and general relativity has been added.
- Twenty-four new commands allow working with simple and semi-simple Lie algebras, including performing a complete analysis of the structure theory for any semi-simple Lie algebra.

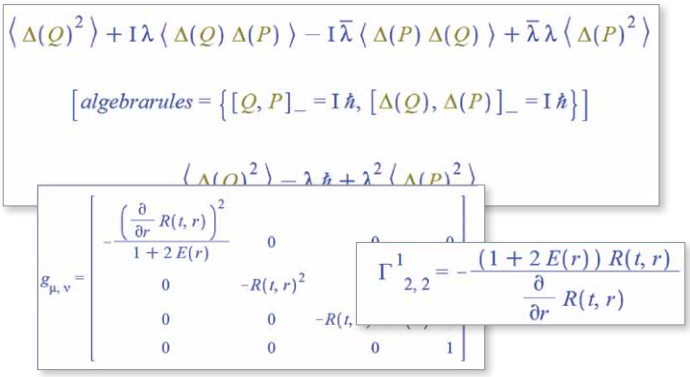
Physics

The Maple Physics package delivers world-leading tools for performing calculations in theoretical physics. It works naturally with a large class of physics constructs, including:

- Spacetime metrics
- Kronecker and Levi-Civita symmetric and antisymmetric symbols
- Pauli and Dirac matrices
- Spacetime differentiation operators
- d'Alembertian, an *n*-dimensional Dirac function
- Christoffel, Einstein, Ricci, Riemann, and Weyl tensors
- Bras, Kets, and commands for performing vector calculus in a space of quantum states

Maple's capabilities in this area are unmatched. Maple supports the widest breadth of concepts that can be represented and operated on. Maple supports conventional notation for physics objects and computations, so that your work in Maple matches how you would write the problems and solutions by hand.

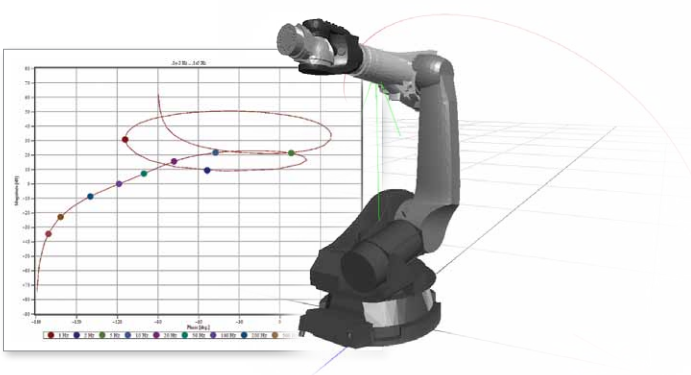
Maple 16 introduces major enhancements in the areas of tensor and vector analysis, quantum fields, and general relativity. In addition, new natural notation for input and output are making these sophisticated algorithms more accessible than ever.



Control Design

When it comes to control design, Maple, together with MapleSim™ and the MapleSim Control Design Toolbox, provides a very effective environment for working with both linear and non-linear systems. Use these tools to:

- Define linear and nonlinear systems using transfer functions, state-space matrices, zero-pole-gain, and differential equations, and easily convert between these representations.
- Work with continuous and discrete systems with multiple discretization schemes.
- Access numerous analysis tools, from Bode, Nyquist, zero pole, root locus and root contour plots to observability, controllability, and Routh tables.
- Compute operating points and effectively linearize your system.



- Develop PID controllers using Ziegler-Nichols (time and frequency response) as well as the Cohen-Coon method.
- Take advantage of powerful analysis and tuning methods, such as dominant pole placement for PID tuning, state-feedback control methods that include LQR and multiple input pole placement, state estimation using Kalman filters, and much more.

The analysis and computation capabilities for control design have been extended in Maple 16, with built-in support for Nichols plots and improved efficiency of linearization routines for large systems.

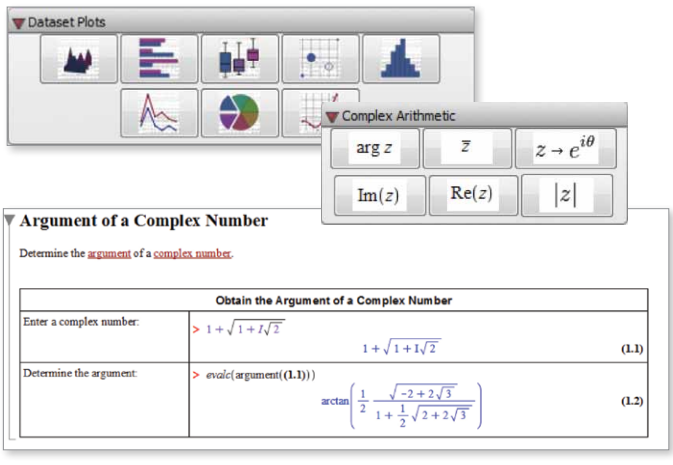
Snippets Palettes

Maple puts over 30 different palettes at your disposal to help with numerous tasks, including building and editing mathematical expressions, keeping track of variables, and sharing documents with other users. Palettes make you instantly productive without having to remember Maple syntax or commands. Now, in Maple 16, new palette technology lets you create and distribute your own custom Maple "snippets" palettes, so you can easily reuse fragments of a Maple document.

You can use snippets palettes to:

- Insert frequently used text and graphics, such as headers, standard introductions, and author information.
- Turn frequently used commands or combinations of commands into fill-in-the-blank templates that can be inserted at the click of a button.
- Insert objects with particular properties, such as tables that have a specific number of rows and columns, headings already filled in, and colored rows.
- Reuse any portion of your document that you wish, including commands, code, images, plots, and text.

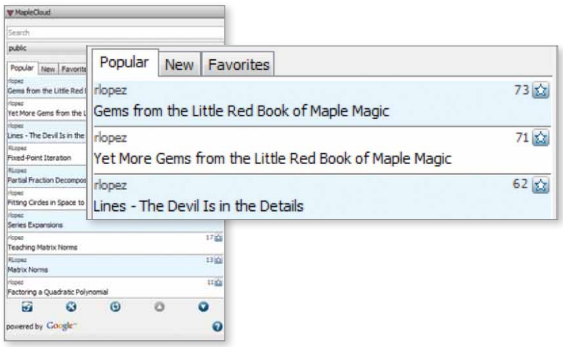
Snippets palettes can be created interactively or programmatically, and can be shared with other users.



MapleCloud

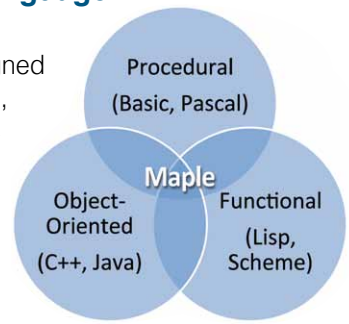
Since its launch two years ago, the MapleCloud™ Document Exchange has transformed the way people share documents with each other. Thousands of documents have been exchanged by our user community through the MapleCloud, and the numbers continue to grow. New features in Maple 16 make it easy to find popular content and keep track of your favorites.

- You can now "like" documents in the MapleCloud.
- In the new Popular tab of the MapleCloud, you can browse the most popular shared worksheets.
- All worksheets that you "like" are conveniently bookmarked in the new Favorites tab.



Maple Programming Language

The Maple language is a full programming language designed for mathematical computation, combining the best principles from procedural, functional, and object-oriented programming.



Approximately 95% of Maple's mathematical algorithms are implemented using the Maple programming language, so all users have access to the same programming power that Maple is built on. Because of Maple's pervasive use of powerful, high-level constructs, the same algorithm in Maple needs on average ten times less code compared to implementing it in the C language. In addition, because it is an interpreted language, you get immediate feedback, making it an ideal prototyping environment.

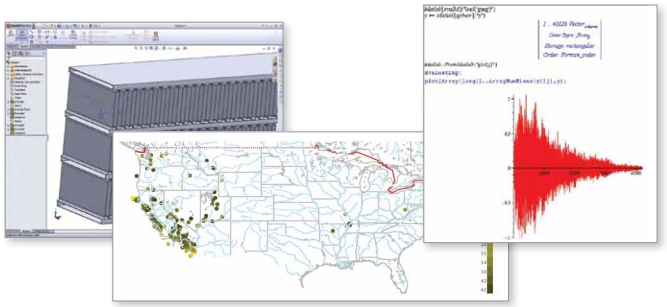
Maple 16 adds support for light-weight objects for enhanced object-oriented programming. Such objects integrate closely with Maple using operator overloading, making your objects almost indistinguishable from built-in Maple types. With the object model, Maple becomes an even more open and extensible system, perfect for both small and large scale mathematical application development.

Connectivity

Maple can be easily integrated into your development projects using a wide range of connectivity features. With code generation, external calling, the OpenMaple™ API, extensive import and export tools, and connectivity with other software, Maple can fit seamlessly into your toolchain.

New in Maple 16:

- Maple offers a technical computing solution that is tightly integrated with MATLAB®, providing direct access to all the commands, variables, and functions of each product while working in either environment. Important enhancements in Maple 16 include easier creation of matrices with symbolic entries, and support for the latest version of MATLAB®.
- Connectivity to major CAD systems allows you to exchange parameter values and connect Maple calculations to a live CAD design. Maple 16 now supports new versions of Siemens NX® 8 and Autodesk Inventor®, as well as Solidworks®.
- Integration into the Symbolic Computation Software Composability Protocol (SCSCP) framework allows interoperability with special-purpose computer algebra systems.

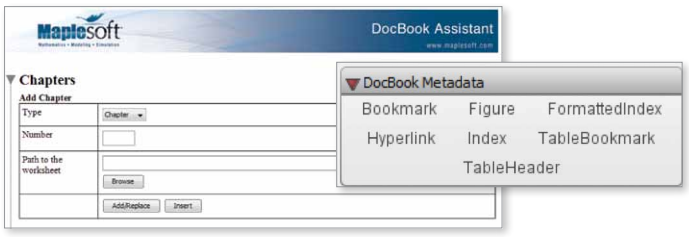


eBook Publisher

Technology Preview

The new eBookTools package provides users with the ability to convert a collection of Maple documents, such as course notes, lab material, or technical reports, to PDF, HTML, or ePUB formats. An assistant will guide you through the process of creating your book in a step-by-step manner, including support for the creation of cross-references, a table of contents, and an index.

Maplesoft uses this same technology to produce the Maple manuals and user guides, and is now making these tools available to all Maple users.



Customer Wish List

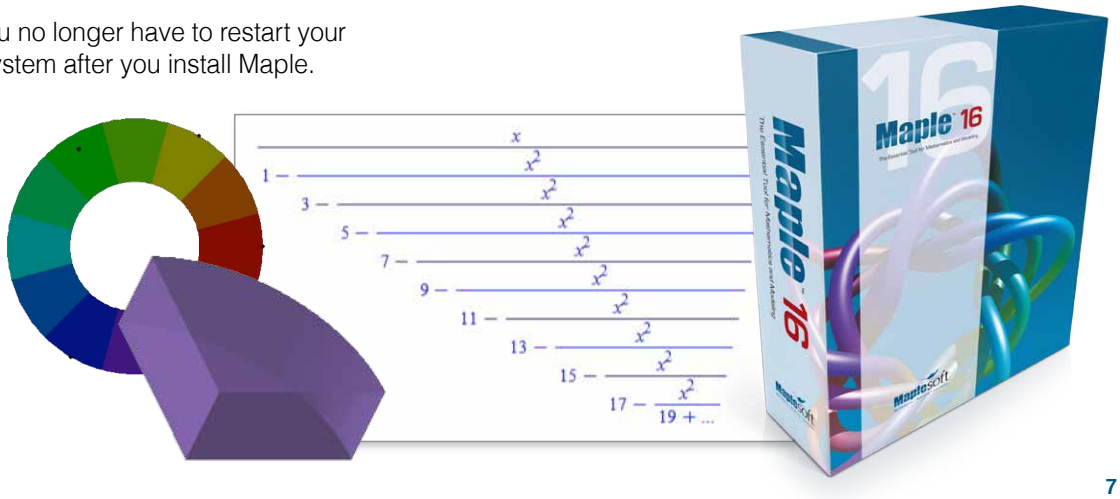
Maple 16 addresses many issues that customers have asked about. These include:

1. **Improved Text Area Components.** Text Area components have new behavior to support single line text entry.
2. **Selecting Subexpressions in 2-D Math.** The ability to easily select, manipulate, and copy pieces of 2-D math output have been improved.
3. **Improved Compiler Installation Process.** On 64-bit Windows, the configure compiler step during installation is now unnecessary.
4. **Undo after Execute.** In Maple 16, you can undo math operations, plot changes, and other operations even after affected portions of the document have been executed.
5. **Improved Printing.** When printing or in print preview, plots and embedded components are now scaled by the same factor as text fonts, so the printed version looks consistent with the original.
6. **Maintains Preference Between Versions.** Maple 16 gives you the option of importing your user preferences from a previous version of Maple, so you can start working right away in an environment already customized to suit you.
7. **Improved Export of 3-D Plots.** When 3-D plots are exported to encapsulated postscript files (EPS format), they are now exported with vector graphics, resulting in scalable, publication-quality plots.
8. **Enhancements to the Directory Management System.** The directory management system in Maple 16 has been unified to ensure that a user does not have to change directories before accessing Maple commands that use the directory management system.
9. **Improved Plotting Messages.** Maple 16 provides more detailed error and warning messages to help users quickly diagnosis and correct mistakes in calls to plot commands.
10. **No more restarts!** You no longer have to restart your Windows operating system after you install Maple.

There's more....

Numerous other improvements have been made to Maple 16, including:

- An updated programming guide that includes a full chapter on object-oriented programming in Maple.
- In addition to PDF versions of the manuals that can be read on e-book readers, Maple 16 manuals are now also available for the iPad®.
- A new ColorTools package with a variety of tools to work with, generate and manipulate colors.
- New prism, sector, and annulus commands in the plottools package that let you easily incorporate those shapes into your visualizations.
- A range of new combinatoric functions, allowing for efficient iteration over combinations and permutations.
- Enhancements to the GraphTheory package, which allow you to compute Delaunay triangulations.
- A number of new functions in the Magma package to test properties of finite magmas.
- Increased flexibility in many Maple commands that means they can accept more data types as arguments. For example, many linear algebra routines which expect a matrix can now also accept arrays and vectors, so you don't need to do the conversion yourself before using the command.
- New data type coercion abilities, which make it easy to write routines that accept similar data types, such as matrices, arrays, and vectors, or lists and sets. Maple handles the conversion automatically, so you do not have to deal with the different data-types in your code.
- New tools to programmatically manipulate compressed gzip files from within Maple.
- Enhancements to RootFinding that allow you to quickly test for the existence of real roots.
- Continued fraction improvements that allow for more flexibility in computing continued fraction approximations.



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