maple 9 Quick Reference Guide

- Maple™ 9 is a powerful problem-solving environment for:
  1. Numerical calculations.
  2. Symbolic computations.
  3. Visualizing math expressions and data.
  4. Single stepping through popular mathematical concepts.
  5. Programming custom math functions.
  6. Communicating with external applications and servers.

- To view the *Introduction to Maple 9* :
  - Select **Introduction** from the **Help** menu

- For information about new and improved features in Maple 9:
  - Select **What's New** from the **Help** menu

- Access online help by:
  1. Selecting **Topic Index** or **Search** from the **Help** menu or, for general information, selecting Using Help.
  2. Selecting the Help icon in the toolbar to open the help system.
  3. Entering **?topic** or **?topic/subtopic** at the Maple prompt (e.g., `?int` or `?LinearAlgebra/Transpose`).

- In Maple 9, data is entered and calculations are performed in a *worksheet* (see `?worksheet`). In a worksheet you can:
  1. *Click and Compute* with your mouse to do math.
  2. Use the Maple 9 versatile *command language*.

Command Language

The Maple command language provides efficient access to all 3,500+ Maple functions. For example, a definite integral is entered at the Maple command prompt (>) as:

```
[> int(sin(x)*cos(x),x=a..b);
```

Maple Symbols

Symbol	Description	Example
;	Statement terminator that displays output	`[> x:=3;` `[> x^2;`
:	Statement terminator that suppresses output	`[> x:=3:` `[> x^2:`
,	Separator used in expression sequences	`[> plot(x^2,x=-1..1);`
:=	Assignment operator	`[> eq1:=5*x^2+7:` `[> solve(eq1,x);`
= <> < > <= >=	Equality and inequality operators	`[> solve(x+1/x>0,x);`
||	Concatenation operator (see also ?cat)	`[> i:=5;` `[> a||i;`

( )	Enclose function parameters or clarify precedence	`[> fn(x);`
		`[> x+y/p;`
		`[> (x+y)/p;`

[ ]	List delimiters (a list is ordered) or indicate subtopics in packages	`[> L:=<1,0,0>; L[2];` `[> plots[arrow](L);`
< >	In conjunction with |, used to construct rtable Matrices and Vectors	`[> A:=<<1,2>|<3,4>>;`
" "	String delimiters	`[> x:="A string";`
` `	Name delimiters (also called backquotes)	`[> `A name` := 1;` `[> `A name`;`
' '	Prevent evaluation (clear variable definitions)	`[> x:=3; x;` `[> x:='x'; x;`

%
%%
%%%
	Previous, 2nd-last, and 3rd-last results (also called ditto perators)	`[> x:=3:`
		`[> y:=2:`
		`[> %; %%%;`

#	Insert a comment	`[> # My comment !!`

\	Continuation character or indicate control characters	`[> 3.1415926535\`
		`89793;`
		`[> printf(`%d %2d \n`,`
		`2, 2^2);`

->	Arrow operator	`[> f:=s -> s^2; f(3);`
@ @@	Composition operators	`[> (sin@cos)(x);` `[> (sin@@2)(x);`
$	Sequence operator (see also ?seq)	`[> diff(x^3, x$2);` `[> $1..10;`

Maple 9 Information

For more information on Maple 9, visit ***www.maplesoft.com***.

For applications describing several new features and benefits in Maple 9, visit ***www.mapleapps.com***.

To learn what Maple can do for you, visit ***www.mapleapps.com/App_Center_Tour/***.

Maple Resources

The Maple Application Center™ (***www.mapleapps.com***) contains over 1,500 applications to view or download. Topics include calculus, linear algebra, physics, and civil engineering.

The Maple Student Center™ (***www.maple4students.com***) provides educational material and Maple resources to assist students. Several tutorials include complete course curricula for calculus, differential equations, and linear algebra.

Frequently Asked Questions (***www.maplesoft.com/support/Faqs/***) provides information on popular topic areas.

Click and Compute

Palettes	Four palettes allow you to easily enter symbols, expressions, Vectors, and Matrices. From the View menu, select Palette.
Context-Sensitive Menus	Right-click the Maple output (command-click in Macintosh®) to display related operations. For example, right-clicking a polynomial displays a menu to integrate, differentiate, simplify, plot, and more. Relevant operations are displayed based on the output selected. Context-sensitive menus are available for expressions, text regions, plot regions, and spreadsheets.
Smart Plots	Right-click appropriate output expressions (command-click in Macintosh) to generate its plot by selecting Plots then 2-D or 3-D Plot from the menu presented. By selecting an expression output or a curve from the Smart Plot region, expressions and curves can be dragged to the plot region.

Common Mathematical Functions & Constants

Mathematical Functions and Constants	Maple Functions and Constants	Example
sum, difference, product, quotient, power	+, -, *, /, ^	`[> q:=x-(1/2)^3;`
square root, n^{th} root	sqrt surd	`[> sqrt(2);` `[> surd(2,3);`
absolute value, |x|	abs	`[> abs(2*x-3);`
binomial coefficient	binomial	`[> binomial(4,2);`
factorial, n!	!	`[> 12!;`
exponential, e^x	exp	`[> exp(x);`

natural logarithm
logarithm base 10
logarithm base b
	ln
	log10
	log[b]
		`[> ln(2);`
		`[> log10(2);`
		`[> log[2](3);`

trigonometric functions (in radians)	sin, cos, tan, csc, sec, cot,	`[> sin(Pi/6);`
inverse trig functions,	arcsin, arccos, arctan, arcsec, arccsc, arccot	`[> arcsin(1/2);`
hyperbolic functions	sinh, cosh, tanh, csch, sech, coth	`[> sinh(3.1+2*I);`
inverse hyperbolic functions	arcsinh, arccosh, arctanh, arcsech, arccsch, arccoth	`[> arcsinh(1.2 + 3.4*I);`
Bessel functions	BesselI, BesselJ, BesselK, BesselY	`[> evalf(BesselJ(0,2));`
computation modulo m	mod, modp, mods	`[> 12 mod 7;` `[> modp(12,7);`

logical operators	and, or, not, xor,
	implies, logical
		`[> if a>0 and b>0 then`
		`print("a>0, b>0");`
		`end if;`

π
e
i
∞
Catalan's number
Euler's constant
	Pi
	exp(1)
	I
	infinity
	Catalan
	gamma
		`[> evalf(Pi);`
		`[> evalf(exp(1));`
		`[> (10+5*I)*(3+I);`
		`[> int(1/x^2, x=1..infinity);`
		`[> evalf(Catalan);`
		`[> evalf(gamma);`

Examples Using Maple's Command Language

1. Solving Equations

The Maple solve command solves equations and systems of equations. Other solvers include: dsolve, fsolve, isolve, msolve, rsolve, and LinearAlgebra[LinearSolve].

```
[> ?solve
[> ?allvalues
```

```
[> solve({y=x^2,y=x+5},{x,y});
[> allvalues(%);
```

2. 2-D and 3-D Plotting

The Maple plots[interactive] routine invokes an interface to several plotting routines and plot options. Alternatively, use the command-line syntax for plotting. Other plotting routines include plots[animate], and plots[display].

```
[> ?plots
[> ?plot,options
[> ?plot3d, options
```

```
[> plots[interactive](sin(x));
[> plot(sin(x)*cos(x), x=0..Pi);
[> plot3d(sin(x)*y, x=0..Pi, y=0..Pi);
```

3. Integration and Differentiation

The Maple int command is used for definite and indefinite integration. For numerical integration use Int (inert form of int) with evalf (floating-point approximation). The Maple diff command returns the derivative with respect to the indicated variable(s).

```
[> ?int
[> ?int,numerical
[> ?diff
```

```
[> int(sin(x),x=0..Pi);
[> int(x/(x^3-1), x);
[> evalf(Int(sin(x)*x, x=0..1));
[> diff(sin(x),x);
```

4. Solving Differential Equations

Maple can solve many ODEs, including initial-value and boundary-value problems, and PDEs.

```
[> ?dsolve
[> ?DEtools
[> ?pdsolve
```

```
[> DE:=D(D(y))(x)+5*D(y)(x)+6*y(x);
[> InitCon:=y(0)=0, D(y)(0)=1;
[> dsolve({DE,InitCon},{y(x)});
```

5. Matrices and Vectors

The LinearAlgebra and VectorCalculus packages provide many commands for working with Matrices and Vectors.

```
[> ?LinearAlgebra
```

```
[> M:=Matrix([[5, x^2],[3/2, x]]);
[> LinearAlgebra:-Determinant(M);
```

6. Writing a Procedure

The Maple procedural programming language can be used for writing simple and complex procedures.

```
[> ?proc
[> ?for
```

```
[> for i from 1 to 5 do i^2;  end do;
```

Common Maple Commands

Command	Description	Example
Mathematics		
alias	Define an abbreviation	`[> alias(J=BesselJ);` `[> J(0,-x);`
allvalues	Find values of RootOf expression	`[> allvalues(2*RootOf(_Z^3-1) - 1);`
assume	Assign properties to a variable	`[> assume(a>0);`
convert	Convert an expression to a different form	`[> convert(9,binary);` `[> convert(tan(x),sincos);`
eval	Evaluate numerically	`[> poly:=x^3+3*x+2;` `[> eval(poly,x=1);`
evalf	Find the floating-point approximation	`[> evalf[500](Pi);`
Im, Re	Find the imaginary or real part	`[> Re(Pi+I*exp(1));`
numer, denom	Find the numerator or denominator	`[> numer(1/x + 1/(x+1));`
RootOf	Representation for roots of equations	`[> RootOf(a*x+b, x);`
simplify	Apply simplification rules	`[> simplify(4^(1/2)+3);`
expand	Expand an expression	`[> expand((x+1)*(x+2));`
value	Evaluate an inert function	`[> F:=Int(sin(x),x);` `[> value(F);`
with	Make package functions available	`[> with(plots);`
Expressions		
anames, unames	Query assigned and unassigned names	`[> a:=b^2:` `[> anames();`
args, nargs	Return arguments and number of arguments for a procedure	`[> for i from 1 to nargs do`
map	Apply procedure to operands	`[> map(x->x^2,x+y);`
op, nops	Return operands and number of operands	`[> u:=[1,4,9]; op(2,u);` `[> nops(u);`
rhs, lhs	Return right- or left-hand side	`[> eqn:=y=a*x^2+b;` `[> rhs(eqn);`
seq	Create a sequence	`[> seq(sin(Pi*i/6), i=1..6);`
type, hastype	Type-checking functions	`[> type(Pi,finite);`
Expressions		
restart	Clear Maple memory	`[> restart;`

Interactive Tutors

1. Precalculus

Study lines, polynomials, linear inequalities, functions and more in this set of interactive tutorials for Precalculus.

```
[> with(Student[Precalculus]);
```

2. Calculus I

Step through differentiation, integration and limit problems or graphically display Newton's Method, the volume of revolution, approximate integration, and more within this set of easy-to-use graphical interfaces.

```
[> with(Student[Calculus1]);
```

3. Linear Algebra

Step through Gaussian elimination or Gauss-Jordan reduction methods, and more in interactive tutors. Several visualization routines display the cross product, linear systems, linear transformation, and more.

```
[> with(Student[LinearAlgebra]);
```

Maple Packages

Maple packages are collections of related functions. Below is a sampling of the 84 Maple packages available to users. For a full listing, see `?index/package`. Package commands can be accessed by either their short form or their long form.

Form	Example
Short	`[> with(LinearAlgebra):` `[> Trace(Matrix([[1,2],[a,b]]));`
Long	`[> LinearAlgebra[Trace](Matrix([[1,2],[a,b]]));`

Package Name	Description
CodeGeneration	Translate Maple code to C, FORTRAN, Java™, MATLAB®, and Visual Basic®
combinat	Combinatorial functions
combstruct	Combinatorial structures
CurveFitting	Functions that support curve-fitting
DEtools	Tools for differential equations
GaussInt	Gaussian integers
geometry	Euclidean geometry
Groebner	Groebner bases
inttrans	Integral transforms
LinearAlgebra	Over 100 functions for constructing, solving, and programming topics in linear algebra
LinearFunctionalSystems	Construct solutions of linear functional systems of equations
ListTools	Tools for manipulating lists
Maplets	Create graphical interfaces to Maple functions
MathML	Import and export Maple expressions as MathML
Matlab	MATLAB link
numapprox	Numerical approximation
PDEtools	Partial differentiation tools
plots	Graphics package
plottools	Basic graphical objects
PolynomialTools	Functions to perform basic manipulations of polynomials
RandomTools	Tools for working with random objects
RationalNormalForms	Construct minimal representation and decomposition of hypergeometric terms
RealDomain	Provides a real number context
ScientificConstants	Values of over 13,000 constants commonly used in chemistry and physics
ScientificErrorAnalysis	Construct quantities with errors and propagate errors through calculations
Spread	Programmatic access to spreadsheet data
stats	Common statistical routines
Student[Calculus1]	Step through differentiation, integration, and limit problems or visualize concepts presented in a first year calculus course
Student[Precalculus]	Tutorials to study lines, polynomials, linear inequalities, and more
Student[LinearAlgebra]	Step through Gaussian elimination and Gauss-Jordan reduction methods or visualize concepts presented in a linear algebra course
Sumtools	Indefinite and definite sums
Units	Convert among 750+ units
VectorCalculus	Perform multivariate and vector calculus operations on objects

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