

Maple Overview

Maple is a powerful Computer Algebra System (CAS). This handout introduces some Maple capabilities, using the system running in the “Worksheet Command Mode”:

Factor an algebraic expression:	<code>factor(expression);</code>
Expand an algebraic expression:	<code>expand(expression);</code>
Evaluate an algebraic expression:	<code>eval(expression, x=a);</code>
Solve an algebraic equation:	<code>solve(equation, x);</code>
Define a function (fcn):	<code>fcn := expression;</code>
Evaluate a function:	<code>eval(fcn, x=a);</code>
Graph (plot) a function:	<code>plot(fcn, x);</code>
To specify axes:	<code>plot(fcn, x=a..b, y=c..d);</code>
Multiple functions:	<code>plot({f1,f2}, x=a..b, y=c..d);</code>
Limit of a function:	<code>limit(fcn, x=a);</code>
Differentiate a function:	<code>diff(fcn, x);</code>
Indefinite Integration:	<code>int(fcn, x);</code>
Definite Integration:	<code>int(fcn, x=a..b);</code>
Define a differential equation:	<code>ode := diff(y(x),x)=expression;</code>
2 nd order equation:	<code>ode := diff(y(x),x,x)=expression;</code>
Solve a differential equation:	<code>dsolve(ode,y(x));</code>
Plot direction field of 1 st o-ode:	<code>DEplot(ode, y(x),x=a..b, y=c..d);</code>
Help for a command (eg dsolve):	<code>?dsolve</code>

Some provisos

Case matters. “ π ” is “Pi” and not “pi” nor “PI”.

Always end a command with “;↵” (semicolon[Enter]).

“2x” SHOULD be typed “2*x”, although “2x” sometimes works.

After typing “*” or “/” or “^”, Maple may reformat it:

 “2*x” to “2·x”; “x^2” to “x²”; “x/2” to horizontal line.

After typing “^” or “/”, hit “→” to “get out of it”.

The exponential function is “exp(x)” and not “e^x” or “e^x”.

Logarithms are $\log(x)=\ln(x)$ and $\log_b(x) = \log[b](x)$.

For $f(x,y)$ or $f(x,y,z)$, “diff(fcn, x);” is the partial derivative.

To start: click on Maple. If not in Worksheet Mode:
 Click File: Close Document. Click File: New: Worksheet Mode.
 The “>” is the command prompt. The “>” is probably red.
 In the following shows the commands are within quotes. Do not type
 the quotes.

“2+2;”	No surprise.
“sin(Pi);”	OK
“sin(pi);”	
“sin(PI);”	Huh? Case matters in Maple.
“expand((x+1)*(x-1));”	No surprise.
“expand((x+1)(x-1));”	Huh? <u>Always type the operation</u>
“factor(x^2 - 1);”	Use “→” to get out of “^”
“factor(x^2 + 1);”	Maple has no **imagination**
“eval(x^3 + 3x + 8, x = 2);”	Oops.
“eval(x^3 + 3*x + 8, x = 2);”	Cool.
“factor(x^3 + 3*x + 8);”	Huh?
“solve(x^3 + 3*x + 8 = 0);”	WOW! What is I? Try evalf.
“eval(sin(x), x=Pi/4);”	
“solve(sin(x) = 1/2);”	

Try some others examples. Let’s move on to functions.
 Define a function:

“f1:=(x^3 - x - 2);”	
“eval(f1, x=2);”	
“solve(f1=0, x);”	
“fred:=sin(x);”	(Or “g1:=” or “f2:=” or ...)
“eval(fred, x=Pi/2);”	
“solve(fred = 1/2, x);”	
“plot(fred, x);”	Nice graph

One need not alias a function

“plot(sin(x), x);”	
“plot(sin(3x),x);”	Oops. Fix it.
“plot({sin(x),sin(3*x)},x=0..4*Pi, y=-2..2);”	Very nice graphs

Define and graph some more functions. Use solve to find X-intercepts.
Let's move on to Calculus.

“limit(sin(x)/x, x=0);”

“limit((x^2 + 2)/x, x=0);”

“limit((x^2 + 3x -10) / (x - 2)),x=2);”

Oops. Fix it.

Try some other limits. Let's do some derivatives (differentiations).

“diff(sin(a*x), x);”

“diff(f1, x);”

“diff(sin(a*x), x=0);”

Does not work. Why not?

“eval(diff(sin(ax), x), x=0);”

OK

“diff(sin(a*x), x,x);”

Second derivatives

“diff(e^(a*x), x,x);”

?

“diff(exp(a*x), x,x);”

Understand?

“Diff(sin(x), x);”

“DIFF(sin(x), x);”

Case really does matter.

Try some other derivatives. Let's do some graphical problems.

Consider the function: $f(x) = \sin^2(x^2) = (\sin(x^2))^2$.

Define f(x) to Maple as f1. Evaluate it at x=1.

What is the equation of the tangent line to f1 at x=1?

Remember? Tangent-line at x=a is: $t(x) = f(a) + f'(a)*(x - a)$.

Define df1=f'(x) and t1=t(x) to Maple.

(Hint: Use eval to define t(x).)

Graph (plot) both f(x) and t(x).

They are tangent.

Do Galilean vs Terminal Velocity of falling bodies.

$$G(t) = -gt + v_0$$

$$TV(t) = -gm/k + (gm/k + v_0)*\exp(-kt/m)$$

$$= -v_\infty + (v_\infty + v_0)*\exp(-kt/m)$$

Define and graph both for a m=85 kg man, $g=9.8m/s^2$, $k=7.9kg/m$, and with $v_\infty = gm/k = 105m/s$. The Galilean model is the tangent line or linear approximation.

Submit your function definitions and joint graph of the above.

Let's do some indefinite integrals.

`"int(x^3, x);"`
`"int(x^3 + 2*x + 7, x);"`
`"int(e^x, x);"`
`"int(a^x, x);"`
`"int(exp(x), x);"`
`"int(1/x, x);"`
`"int(ln(x), x);"`
`"int(log(x), x);"`
`"int(log10(x), x);"`

`"int(sin(x), x);"`
`"int(tan(x));"`
`"int(x*cos(x^2));"`

Try some others. Let's do some definite integrals.

`"int(f1, x=0..Pi);"`
`"int(sin(x), x=0..Pi);"` Yep.
`"int(x^2, x=0..2);"`
`"int(x^2, x=a..b);"` Not only numbers

Let's try some "undoable" ones.

`"int(exp(-x^2), x);"` Huh? erf? Remember error function?
Normal probability distribution or Z-score.

`"int(exp(x^2), x);"` What's up with the imaginary unit?

`"int(sin(x^2), x);"` Fresnel functions from optics

To get Maple help, type "?" followed by the term.

Try: "?FresnelS" or "?erf".

`"erf(2);"`
`"erf(2.0);"`
`"plot(erf(x), x);"`
`"plot(FresnelS(x), x);"`

To work with differential equations:

“with(DEtools);”

Load Maple DE tools

“ode := diff(y(x),x) = x - y(x);”

Must use “y(x)”, not just “y”

“dsolve(ode,y(x));”

Solve. Notice “_C1”.

“DEplot(ode,y(x),x=-9..9,y=-9..9);” Beautiful direction field

“ode := diff(y(x),x) = -2*x*y(x) + 1;”

Must use numbers

“dsolve(ode,y(x));”

“DEplot(ode,y(x),x=-9..9,y=-9..9);”

“ode := diff(y(x),x) = a*y(x) + 1;”

“dsolve(ode,y(x));”

no DEplot

“ode := diff(y(x),x,x) = 3*diff(y(x),x) - 2*y(x) + 1;”

“dsolve(ode,y(x));”

no DEplot

“ode := 4*diff(y(x),x,x) + 3*diff(y(x),x) + 10*y(x) = 5*sin(10x);”

“dsolve(ode,y(x));”

“plot(dsolve(ode,y(x),x));”