

This is an *informal* tour of Maple. Please save your maple worksheet; it will be useful later.

- (1) Find the Help menu and in the Search box type “evalf” for evaluate. Notice the generous number of examples. This Help feature will likely be your way to navigating Maple commands and syntax.
- (2) What is the 8th digit in  $\pi$ ? In Maple lingo  $\pi$  is written “Pi”.
- (3) Find the derivative of  $\cos(ax)$ . The command is “diff( , )” or “ $\frac{d}{dx}f$ ” in the Expressions menu.
- (4) Load the extra plot and vector functions with “with(plots)” and “with(linalg)” Try plotting the function “ $x - x^2$ ”. The command is “plot()”.
- (5) Plot the same function on the interval 0 to 1.5. This is done with “ $x = 0..1.5$ ”.
- (6) Now try plotting “ln cosh  $t$ ” - as we saw in class this is  $y(t)$  for a falling object with drag, in Region III : turbulent air flow - for positive  $t$  less than 3.
- (7) See if you can persuade Maple to plot  $e^{-2t}$ . Take note of any eccentricities you discover!
- (8) Try a contour plot with `plots[contourplot]( $y^2 - 2(\cos(x)) - 4(\sin(x))^2, x = -3..3, y = -1..2$ )`.
- (9) The `solve` command is handy. Use this to answer the following question: How long does it take for a object, launched vertically with initial upward velocity of 15 m/s, to reach a height of 2 m? Use Maple to solve the relation, rather than using the quadratic formula.
- (10) Use Help to determine how to call the expression for the Legendre polynomials  $P_n(x)$ . Plot  $P_2$  from -1 to 1. Take a look at  $P_5$ , too.
- (11) Vector algebra! Let’s find a curl of

$$g := \text{vector} \left( \left[ \frac{xz}{(x^2 + y^2)^{3/2}}, -\frac{yz}{(x^2 + y^2)^{3/2}}, xy \right] \right);$$

Note the way you can define quantities in Maple, with “:=”. You will also need a vector to let Maple know which coordinate is which so enter

$$v := \text{vector} ([x, y, z]);$$

Now take the curl of  $g$ ,  $\nabla \times \vec{g}$ , with `curl(g,v)`; Neat! [Alternately you can load a vector calculus package.]

- (12) Plot the resulting (2D) field with “`fieldplot([place the first two components of your curl here],x=-1..1,y=-1..1,fieldstrength=log)`”. Also try it without the log option. What does this do?
- (13) Enter an ordinary differential equation as `ode := diff(y(x), x, x)+2*y(x)`; Notice the use of  $y(x)$  rather than  $y$ . Find the solution with `dsolve(ode)`. Note Maple assumes you mean “`ode = 0`”. Did Maple get the solution correct?
- (14) Add initial conditions  $y(0) = 1$  and  $\frac{dy}{dx}(0) = 0$ . The derivative has to be entered in Maplesse so it is `D(y)(0)=0` so the initial conditions look like `y(0)=1,D(y)(0)=0`. This `dsolve({ode,y(0)=1,D(y)(0)=0})` command is useful for relatively simple analytic solutions.
- (15) For more complicated ODE’s a numeric solution is useful. To see how this works enter a new SHM differential equation with  $\omega = 4$ . Call it “`ode2`”. Add the initial conditions `ic2 := y(0) = 0, (D(y))(0) = 4` (Note the use of “:=”). Ask Maple to numerically solve with `sol2 := dsolve({ode2, ic2}, numeric, range = 0 .. 4)`. Plot the result with `odeplot(sol2)`. Did Maple succeed?
- (16) The (non-simple) pendulum can be solved numerically. Enter in the equation of motion and the initial conditions for a pendulum with length 1m starting from a horizontal position at

rest. Plot the results. You can use the cursor option on the plot by going to the “Plot” menu and selecting “Probe Info”.

- (17) When numerically integrating differential equations. It is often useful to plot the results in various ways. Here’s a snippet of Maplese to find a log-difference plot (which will be handy later):

```
> test3 := dsolve({x(0) = 0, y(0) = 1, diff(x(t), t, t) = -x(t), diff(y(t), t, t) = -y(t), (D(x))(0) = -1, (D(y))(0) = 0}, numeric);
```

```
> odeplot(test3, [t, log(abs(x(t)-y(t)))], 0 .. 20);
```

Try it out!

- (18) It is often handy to expand an expression in a series. Maple can do with “series”. Try expanding

$$\frac{1}{(1-x)^n}$$

to the fourth order. Use Help to get started.