

# Introduction to Maple

Maple is a very powerful Computer Algebra system that can do many of the calculations that you might encounter in many branches of mathematics, science and engineering. We'll look at some of its capabilities.

We're looking at a Maple worksheet. Worksheets can have text, such as this, as well as Maple input and Maple output. Here is some Maple input (in red).

```
> 2+3*x^4;
```

$$2 + 3 x^4$$

This input was in "Maple notation": there is also "2D Math notation" which looks like this:

```
> 2 + 3 x^4 \int_0^3 t^2 dt
```

$$2 + 27 x^4$$

This may look nice but in my opinion is more trouble than it's worth. Unfortunately, the default is "2D Math notation". You can set the default to "Maple notation": in the menu bar on top click Tools, Options..., Display, set Input Display to "Maple notation", and then click "Apply globally".

Maple has two modes: "Document Mode", which can be used to make fancy-looking documents, and "Worksheet Mode", which is what we'll use. So when you have a choice of Worksheet or Document, choose Worksheet. You can also make Worksheet the default format for new files under Tools, Options, Interface.

When you click on a Maple input region and press Enter, Maple performs whatever command you gave it, prints whatever it will print, and goes on to the next region (or makes a new input region if there's no next one). You can also insert a new input region in the middle of your worksheet by clicking on [> on the tool bar.

```
> 3+5;
```

8

(1)

```
> 1+2;
```

3

Note the ";" at the end of the command. After you press Enter, Maple computes and prints the result and gives you another prompt.

```
> 2 + 4:
```

This time I used ":" instead of ";". This tells Maple to compute the result, but not print it. Usually we'll use ";" since there's no reason not to see the result.

Another difference between this and the last example is that I put in spaces on either side of the "+". These spaces are ignored by Maple, but they are often helpful because they improve readability for humans.

```
> 2 + 3 * 4;
```

14

The multiplication sign in Maple is the asterisk \*. The division sign is /. For powers we use ^.

Maple uses the standard algebraic [precedence rules](#), so this is interpreted as  $2+(3*4)$ , not  $(2+3)*4$ . So Maple can act like a calculator.

> 2^1000;

10715086071862673209484250490600018105614048117055336074437503883703510511249\\  
36122493198378815695858127594672917553146825187145285692314043598457757469\\  
85748039345677748242309854210746050623711418779541821530464749835819412673\\  
98767559165543946077062914571196477686542167660429831652624386837205668069\\  
376

That's something your calculator probably can't do. Maple can handle very large integers.

The "\\" at the end of a line means that the number is continued to the next line.

> 21/39;

7  
13

Maple writes fractions as fractions (automatically reducing them to lowest terms), without resorting to decimal approximations. If you do want to see this as a decimal, you can use the "evalf" command. As with almost every Maple command, the input to "evalf" is enclosed in parentheses.

```
> evalf(7/13);
```

0.5384615385

The default (what Maple does unless otherwise specified) is to use 10 significant digits. This can be changed, using a variable called "Digits". Let's see this number to 25 digits instead of 10.

> Digits := 25;

*Digits* := 25

```
> evalf(7/13);
```

0.5384615384615384615384615

- Maple is case-sensitive. That doesn't mean you can hurt its feelings, it means "Digits" is not the same as "digits" or "DIGITS". Those wouldn't affect the number of digits Maple uses.
  - ":=" is the assignment sign in Maple. It means "assign the value on the right to the variable on the left". This is different from "=" which makes an equation.
  - Once "Digits" has been set, Maple uses this setting every time it computes a decimal result until you change "Digits" again. If you want to change the number of digits for one "evalf" command only, you can specify this as a second input to "evalf". The inputs are separated by a comma.

```
> evalf(7/13, 40);
```

0.5384615384615384615384615384615384615384615385

> Digits;

25

(2)

> Digits := 10;

$> x^2 - 3*x - 4;$

$$x^2 - 3x - 4$$

The "x" here is a symbolic variable. Maple can do algebra as well as arithmetic. Note that the output looks like ordinary typeset mathematics, with exponents as superscripts and omitting the \* for multiplication. Maple can do lots of symbolic calculations. For example, it knows this:

```
> sin(Pi/4);  
                  1  
                  -    √2
```

It doesn't have a symbolic value for the next one, so it just returns unevaluated:

```
> sin(Pi/31);  
                  sin(1/31 π)
```

Again, if you want a numerical value, you can get one with "evalf".

```
> evalf(sin(Pi/31));  
                  0.1011683220
```

Maple can do almost any computational task that might arise in undergraduate mathematics. It doesn't do proofs, but it can be used to help with proofs by exploring what might or might not be true. See the worksheet [courses.mw](#).

## ▼ Maple objects introduced in this lesson:

```
;  
:  
+  
-  
*  
/  
^  
  
evalf  
Digits  
:=  
sin  
Pi
```