

MATHEMATICS 201-105-RE

Linear Algebra

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Maple Introduction

Maple is what is called a computer algebra system. It can do everything the fanciest graphing calculator can do and so much more.

A Maple line is indicated by an input prompt `>` at the left hand margin. A Maple command is entered by typing it on an input line with a semicolon (`;`) at the end and pressing “Enter”.

Basic arithmetic is done as expected, where `*` is used for multiplication, `^` for exponents, and `sqrt` for square roots. If a decimal number is used, then Maple will return a decimal answer to ten figure accuracy.

```
> (2+3)*4-3^2;
```

```
> 2/4;
```

```
> 2.0/4;
```

If only integers are used, then Maple will give an exact answer. To obtain the a numerical answer, we use the command `evalf()`.

```
> evalf(sqrt(2));
```

Maple will give you more accuracy if you tell it how many figures you want.

```
> evalf[100](sqrt(2));
```

Maple has all the standard functions built in. The trigonometric functions are as usual, except that they use radians. The exponential function with base e is called `exp`. Its inverse is `ln`. For other logarithms with base b , use `log[b]`.

```
> cos(Pi);
```

```
> log[2](8);
```

You can give names to expressions using the `:=` symbol.

```
> a:=Pi/4;
```

```
> 3*a;
```

```
> sin(a);
```

To erase from memory the names you use we have the `restart` command.

```
> restart;
```

The advantage of Maple is that we can work with algebraic expressions and do a certain number of operations on them such as simplify, factor, expand, etc. Let us look at some examples.

Simplify the expression $\frac{x^2 - x - 6}{x + 2}$.

```
> simplify( (x^2-x-6) / (x+2) );
```

Note: this simplification is only valid when $x \neq -2$, so caution is advised when simplifying.

Factoring the expression $x^2 - 4$:

```
> factor(x^2-4);
```

Expanding $(x+2)^3$:

> **expand((x+2)^3);**

We can also solve equations with the command **solve(equation, variable to solve for)**.

Solving the equation $x^2 - 3 = 0$:

> **solve(x^2-3=0, x);**

If we wish to have decimal answers, then we use the **fsolve** command.

> **fsolve(x^2-3=0, x);**

Functions are defined as follows: **name := x → function**

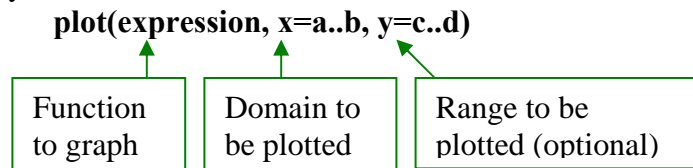
For example, suppose we have the function $f(x) = x + \frac{1}{x}$.

> **f:=x->x+1/x;**

To evaluate a function at a given point, such as at $x = 2$, we have

> **f(2);**

Maple can be of great help to see what the graph of a function looks like. The basic command for plotting graphs is given by



For example, let us sketch the graph of $f(x) = x^5 - 2x + 1$.

> **plot(x^5-2*x+1,x=-5..5);**

Note that the range is rather large, so we can restrict it when needed.

> **plot(x^5-2*x+1,x=-5..5,y=-5..5);**

To graph a relation, we have the command

implicitplot(equation, domain, range, numpoints = n)

↑
Optional, but you may need it to obtain an accurate curve.
By default, $n = 1000$.

from the “plots” package. The first thing to do is to load the package.

> **with(plots):**

Let us plot the circle $x^2 + y^2 = 1$.

> **implicitplot(x^2+y^2=1,x=-3..3,y=-3..3);**

To graph more than one function on a graph, we use the display command from the “plots” package. To have more than one step at a time, we do a SHIFT-RETURN instead of an ordinary RETURN at the end of the line. For example, suppose we want to plot the curve $f(x) = x^2$ along with the line $y = 2x - 1$.

> **with(plots):**

a:=plot(x^2,x=-3..3); ← Note: use a “:” here instead of “;”.

b:=plot(2*x-1,x=-3..3);

display(a,b);