

## Lesson 1

### Numerical Computation and Graphics

#### Initializations

```
> restart;  
with(plots):  
  
>
```

#### 1.1 Numerical Computation

All arithmetic is exact, unless we explicitly ask for a decimal approximation using the **evalf** command.

##### Examples

###### Example 1.1.1

Rational numbers, large integers, trigonometric values and decimal approximations.

```
> n1:=(2/7)^4;  
  
n1 :=  $\frac{16}{2401}$  (2.1.1.1)
```

```
> n2:=evalf(n1);  
  
n2 := 0.006663890046 (2.1.1.2)
```

```
> n3:=73491097^6;  
n3 := 157546362627224319599041649399034062211350126929 (2.1.1.3)
```

```
> n4:=cos(Pi/6);  
  
n4 :=  $\frac{1}{2} \sqrt{3}$  (2.1.1.4)
```

```
> n5:=evalf(n4);  
  
n5 := 0.8660254040 (2.1.1.5)
```

```
>
```

###### Example 1.1.2

Decimal approximations of arbitrary length.

Decimal approximations of arbitrary length can be obtained by specifying the desired number of significant digits as an option in the **evalf** command. The default is ten significant digits.

Here are the first 30 digits of  $\pi$ .

```
> n6:=evalf(Pi, 30);  
n6 := 3.14159265358979323846264338328 (2.1.2.1)
```

## ▼ 1.2 Graphics

Maple contains an extensive array of plotting routines, most of which can be found in the `plots` package which is loaded using the

`with(plots);`

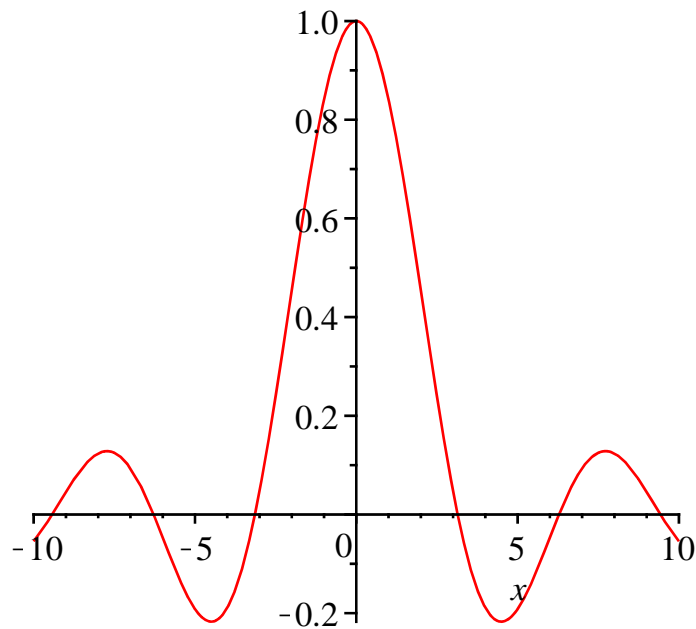
command. Only the basic `plot` routine can be used without using loading the `plots` package.

### ▼ Examples

#### ▼ Example 1.2.1

The `plot` command.

```
> plot(sin(x)/x, x=-10..10);
```



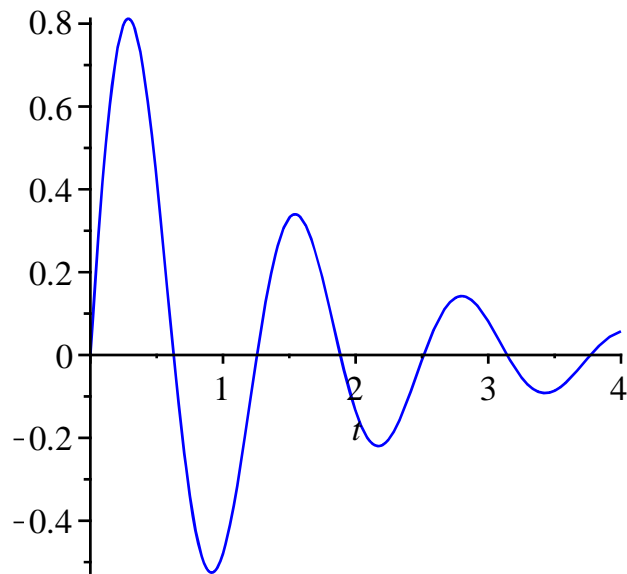
```
>
```

#### ▼ Example 1.2.2

The color option with the `plot` command.

We visualize a damped oscillation and color it blue.

```
> plot(2^(-t)*sin(5*t), t=0..4, color=blue);
```



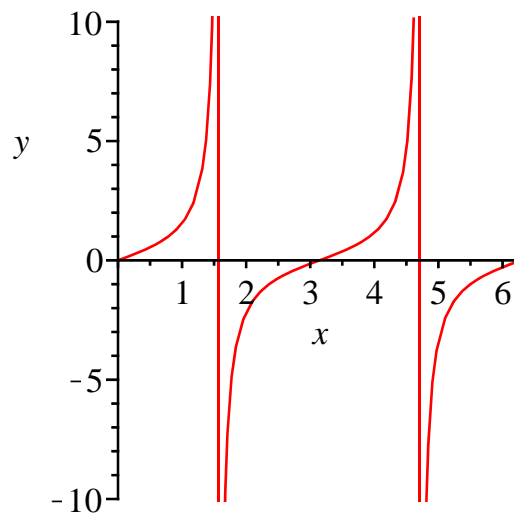
>

### Example 1.2.3

#### Limiting the range of a plot.

Sometimes it is desirable to limit the range of a plot. This feature is particularly useful when vertical asymptotes lie within the domain of the graphic image.

```
> plot(tan(x), x=0..2*Pi, y=-10..10);
```



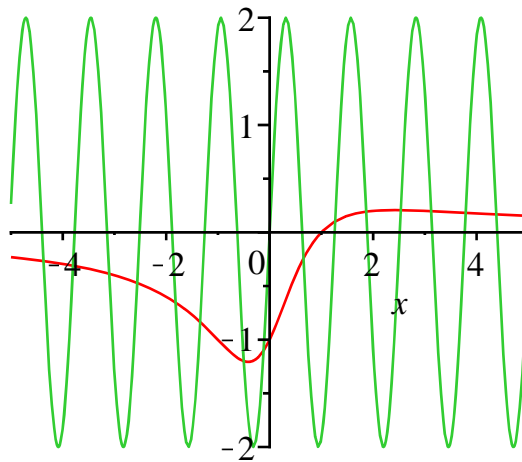
>

### Example 1.2.4

#### Multiple plots in one picture.

We can create multiple plots within one frame by using Maple set notation { ... } or list notation [ ... ].

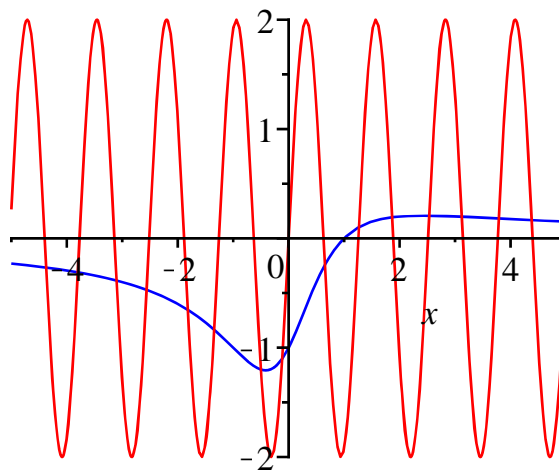
```
> plot({(x-1)/(x^2+1), 2*sin(5*x)}, x=-5..5);
```



>

The advantage of list notation is that it allows for control of the color of individual curves.

```
> plot([(x-1)/(x^2+1), 2*sin(5*x)], x=-5..5, color=[blue,
red]);
```



>

### Example 1.2.3

**The visualization of an implicitly defined curve.**

Plot the curve

$$x y \sin xy = 1$$

Make sure the **plots** package is loaded, then use the **implicitplot** routine. If you plan to use a variety of plot routines in your document, then it is a good idea to include the **with(plots);** command in your initialization section.

```
> with(plots):
```

```
> implicitplot(x*y*sin(x*y)=1, x=-3..3, y=-3..3);
```

