Math 174
Calculus II

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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;
```

$$n1 := \frac{16}{2401} \tag{2.1.1.1}$$

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

$$n2 := 0.006663890046 \tag{2.1.1.2}$$

```
> n3:=73491097^6;
```

$$n3 := 157546362627224319599041649399034062211350126929 \tag{2.1.1.3}$$

```
> n4:=cos(Pi/6);
```

$$n4 := \frac{1}{2}\sqrt{3} \tag{2.1.1.4}$$

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

$$n5 := 0.8660254040 \tag{2.1.1.5}$$

```
>
```

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 π.

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

$$n6 := 3.14159265358979323846264338328 \tag{2.1.2.1}$$

>

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);

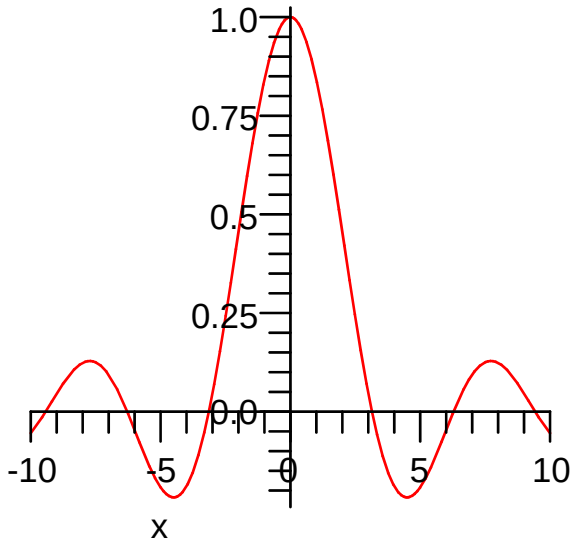
command. Only the basic **plot** routine can be used without using loading the **plots** package.

Examples

Example 1.2.1

The plot command.

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



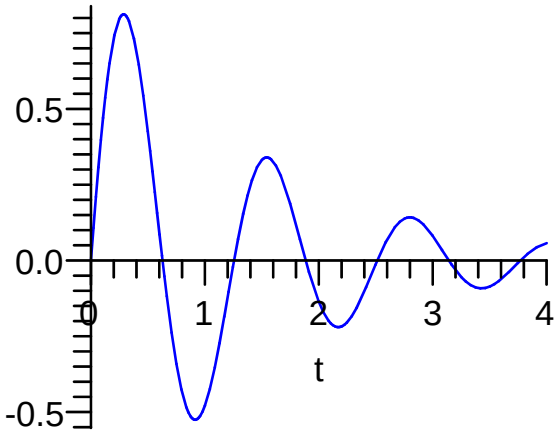
>

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);
```



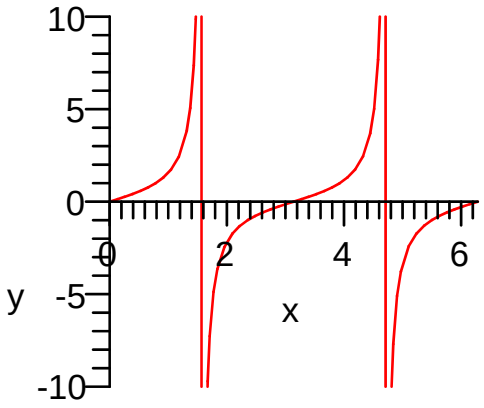
>

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);
```



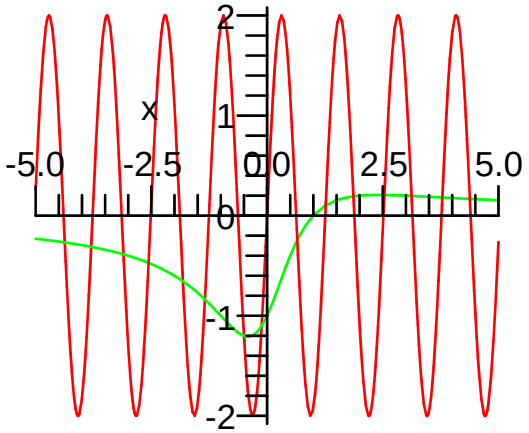
>

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 [**...**].

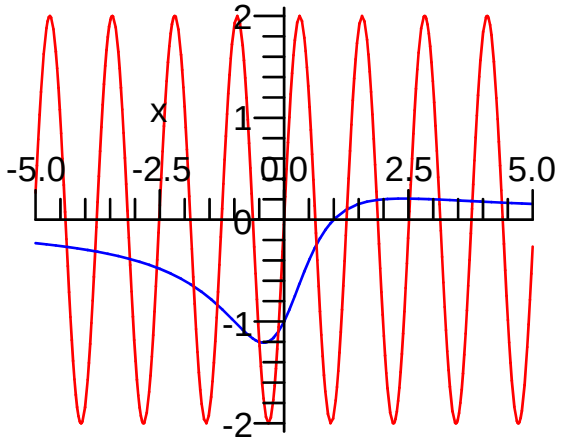
```
> plot({(x-1)/(x^2+1), 2*sin(5*x)}, x=-5..5);
```



>

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

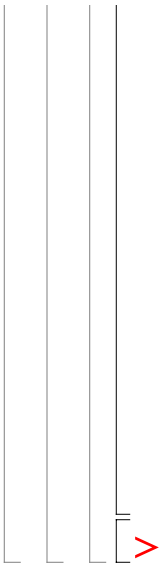
The visualization of an implicitly defined curve.

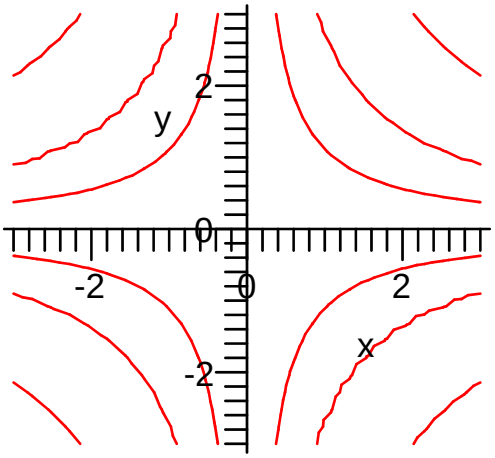
Plot the curve

$$x\,y\,\sin xy = 1$$

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);
```




2
y
0
-2
0
2
x
-2