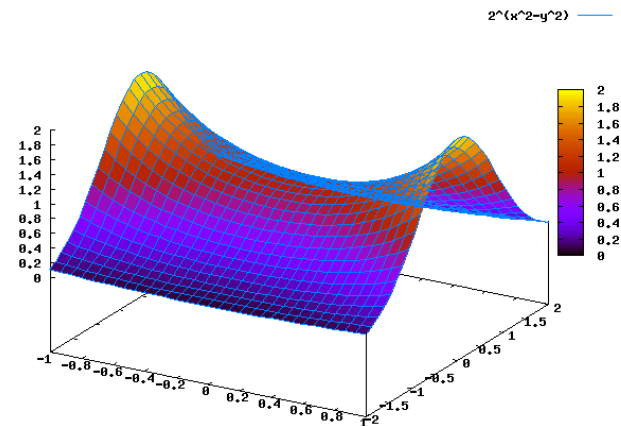
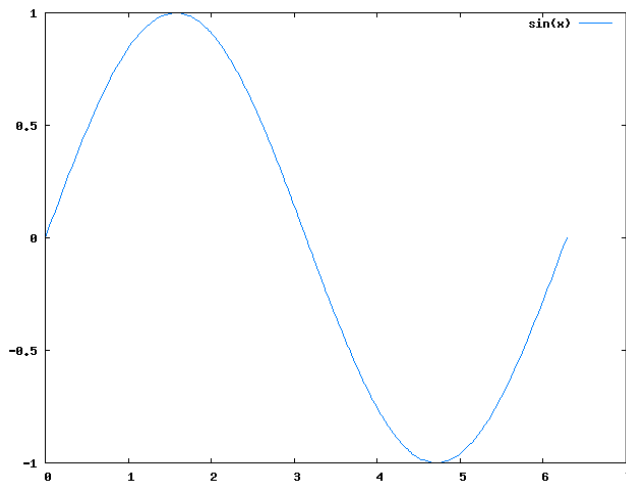




MAXIMA to study maths functions

Maxima is a computer algebra system that manipulate symbolic and numerical expressions, including differentiation, integration, systems of linear equations, and vectors, matrices, and so on. Maxima can plot functions and data in 2D e 3D.





The Maxima source code can be compiled on many systems, including Windows, Linux, and MacOS X.

<http://maxima.sourceforge.net/index.shtml>

You can find Maxima also into the Xplora DVD live bootable.

DVD – Xplora Knoppix, based on the Linux Debian distribution and completely contained on a self booting DVD.

This Knoppix version allow you to work in Linux OS without installing it on your PC.



More information <http://www.xplora.org/shared/data/pdf/xploraknoppix.pdf>



Running Maxima

```
(%i1) ((2*5)^3 - 100)/3 ;  
(%o1) 300
```

```
(%i2) expand((x+y)^2);  
(%o2) y2 + 2 x y + x2
```

```
(%i1) factor (x^3 - 1);  
(%o1) (x - 1) (x2 + x + 1)
```

END each Maxima command with a semicolon ;

END the session with the command (%in) quit();

If you don't want a result showed, you can finish your command with \$ instead of ;.



Function and its zeroes

```
(%i1) f(x):= x^3-4*x^2+3*x$
```

```
(%i2) f(x)=0;
```

```
(%o2) x3 - 4 x2 + 3 x = 0
```

```
(%i3) solve(f(x)=0,x);
```

```
(%o3) [x = 3, x = 1, x = 0]
```

Maxima calculate differential and integral of functions:

```
(%i4) diff (f(x), x);
```

```
(%o4) 3 x2 - 8 x + 3
```

```
(%i5) f1(x):= 3* x^2 - 8* x + 3;
```

```
(%o5) f1(x) := 3 x2 - 8 x + 3
```

```
(%i6) integrate(f1(x),x);
```

```
(%o6) x3 - 4 x2 + 3 x
```

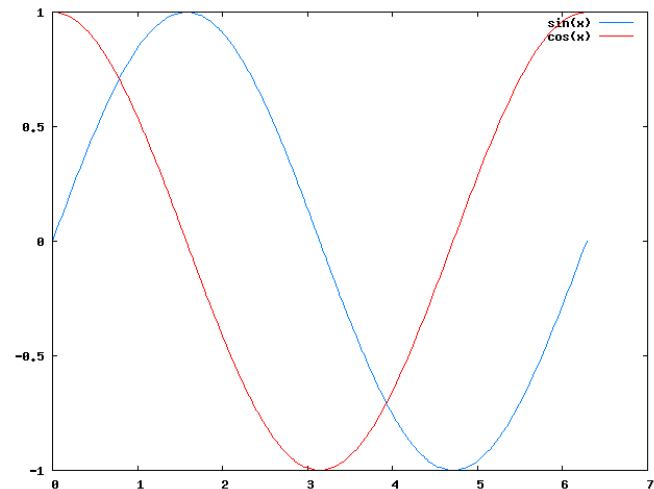
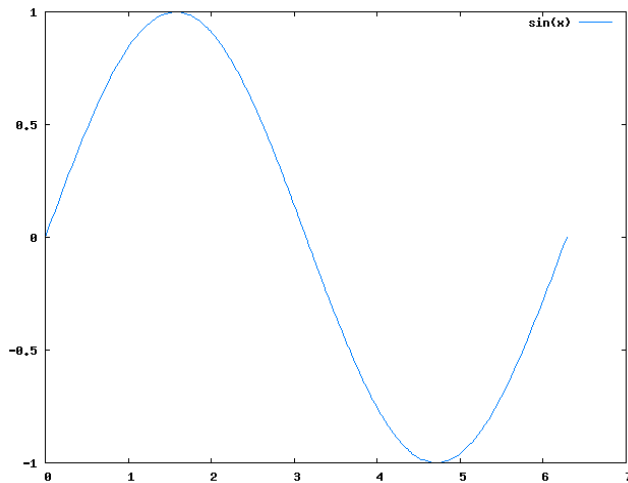


To get graphics of one or more functions

`plot2d ([expr_1, ..., expr_n], x_range, y_range)`

`(%i1) plot2d(sin(x), [x, 0, 2*%pi]);`

`(%i1) plot2d ([sin(x),cos(x)], [x, 0,2*%pi],[y, -1,1]);`





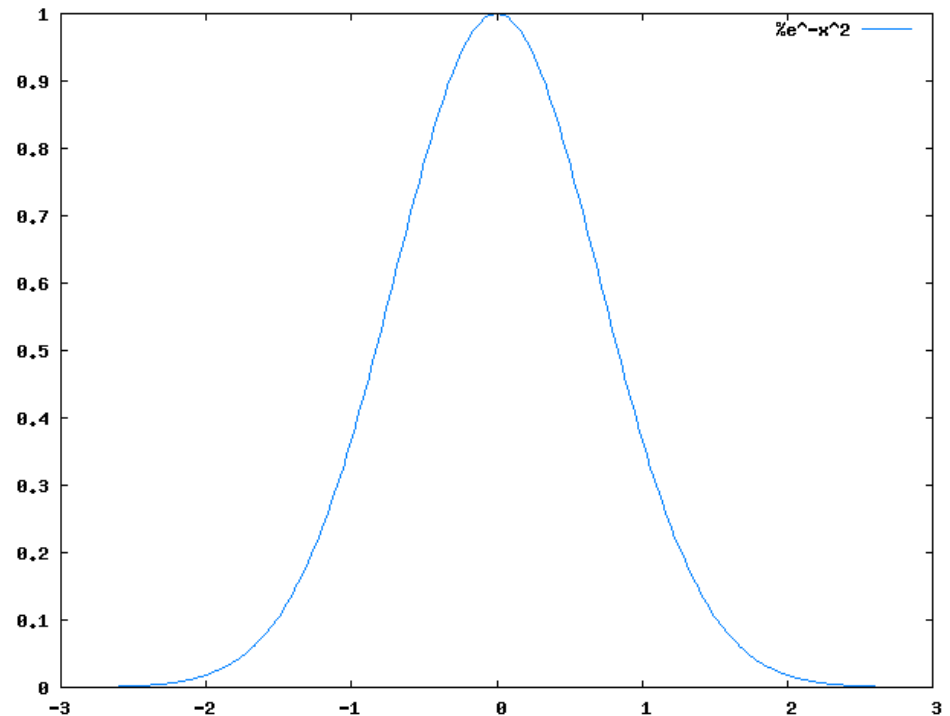
Composition of Functions

```
(%i1) f(x):=-x^2$
```

```
(%i2) g(y):= %e^y$
```

```
(%i3) h(x):=g(f(x))$
```

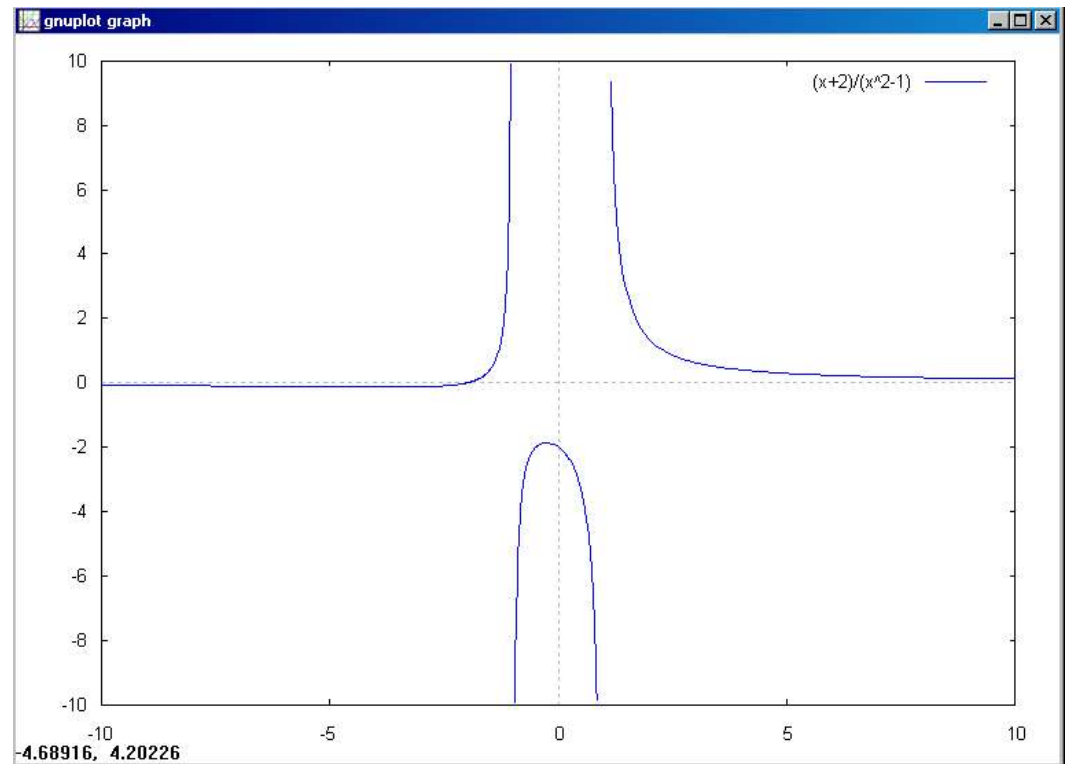
```
(%i4) plot2d(h(x), [x, -3, 3], [x, -5, 5])
```





MAXIMA computes the function limits

```
(%i1) f(x):= (x+2)/(x^2 - 1)$
(%i2) limit (expr, x, val, dir);
(%i3) limit(f(x),x,-1,plus);
      (%o3)      minf
(%i4) limit(f(x),x,-1,minus);
      (%o4)      inf
(%i5) limit(f(x),x,1,plus);
      (%o5)      inf
(%i6) limit(f(x),x,-1,minus);
      (%o6)      inf
(%i7) limit(f(x),x,inf);
      (%o7)      0
```





First Derivative

```
(%i8) diff(f(x),x);
```

$$\frac{1}{x^2 - 1} - \frac{2x(x+2)}{(x^2 - 1)^2}$$

```
(%i9) Deriv1:ratsimp(diff(f(x),x));
```

$$\frac{x^2 + 4x + 1}{x^4 - 2x^2 + 1}$$

```
(%i10) solve (Deriv1=0,x);
```

```
(%o10) [x = - sqrt(3) - 2, x = sqrt(3) - 2]
```

```
%i11) float(%o10);
```

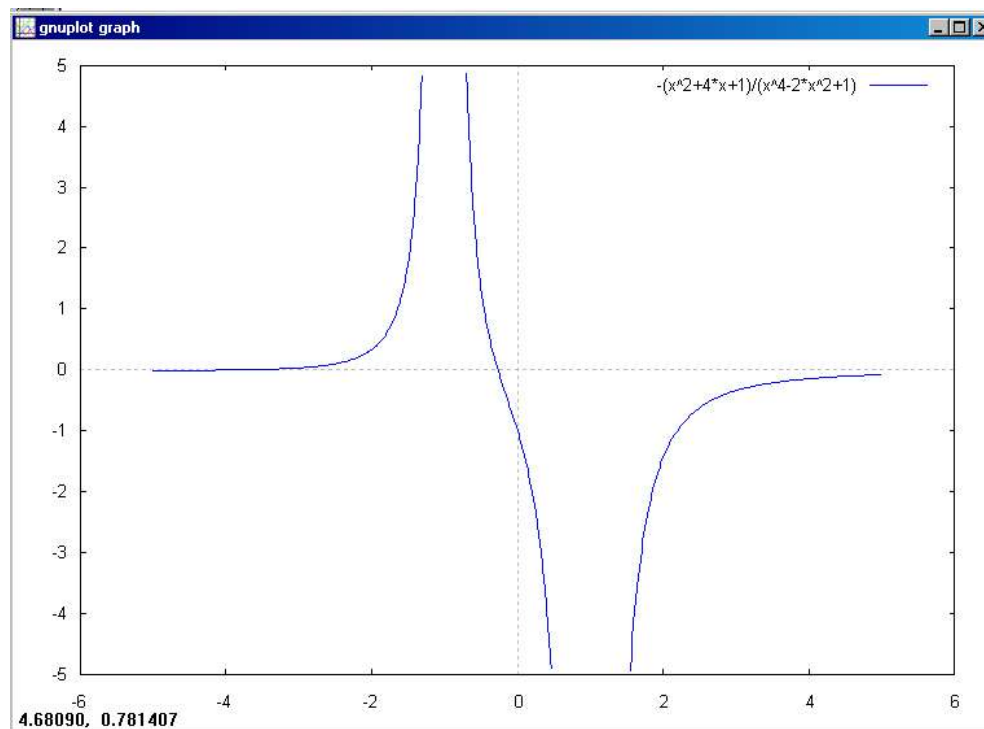
```
(%o11) [x = - 3.732050807568877,  
x = - 0.26794919243112]
```

```
(%i12) ev(f(- 3.732050807568877),float);
```

```
(%o12) - 0.13397459621556
```

```
(%i13) ev(f(- 0.26794919243112),float);
```

```
(%o13) - 1.866025403784439
```





Second Derivative

Second Derivative

```
(%i15) Deriv2:ratsimp(diff(Deriv1,x));
```

```
(%o15) 
$$\frac{2x^3 + 12x^2 + 6x + 4}{x^6 - 3x^4 + 3x^2 - 1}$$

```

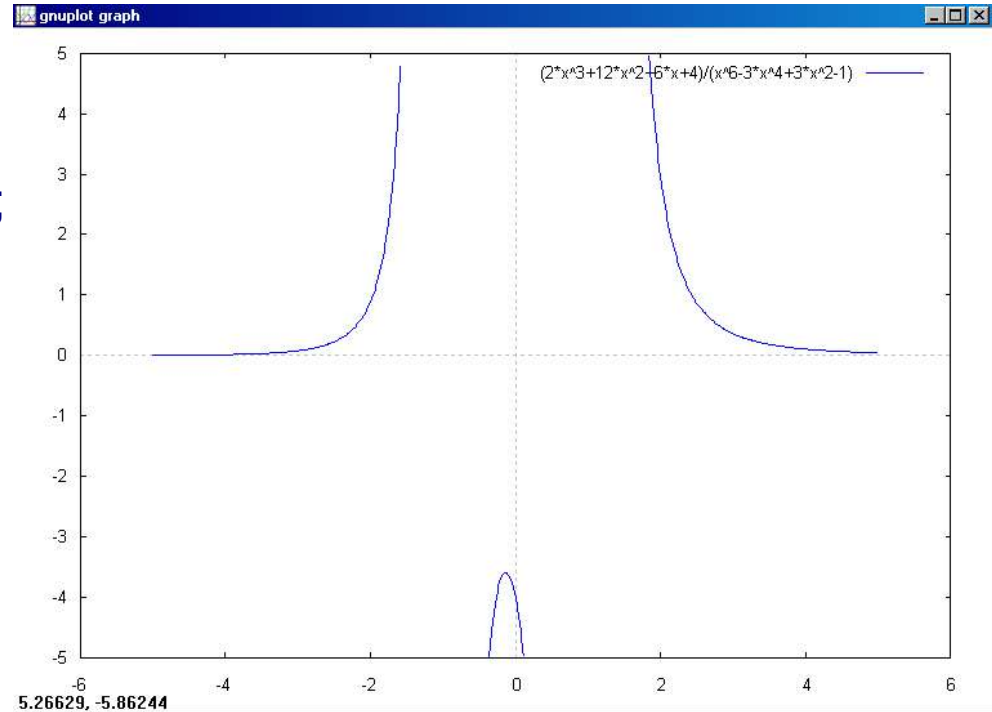
```
(%i16) fpprec:2$
```

```
(%i17) solve (Deriv2=0,x);
```

.....

```
(%i19) float(%o17);
```

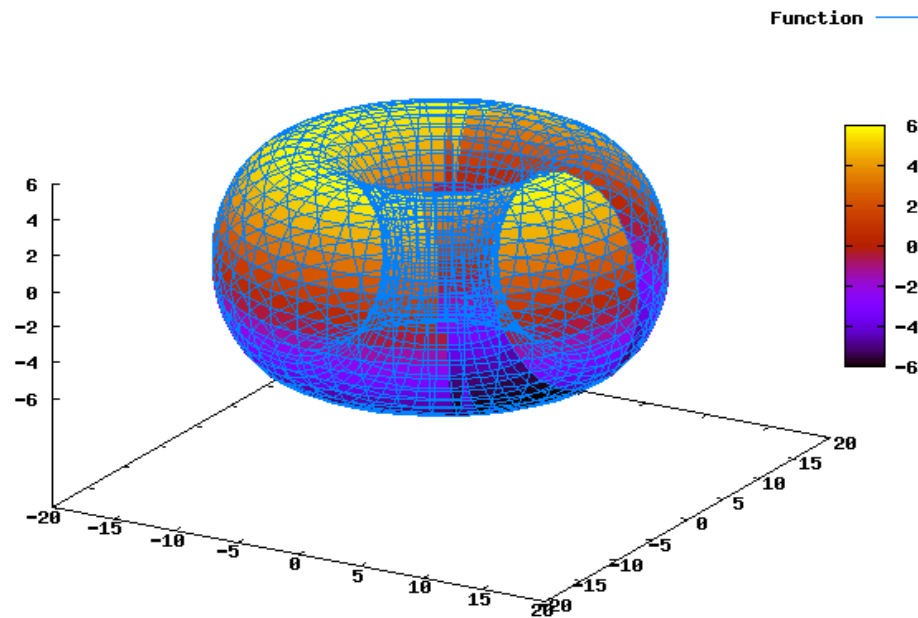
```
(%o19) [x = - 2.1 (0.9 %i - 0.5) - 1.4  
(- 0.9 %i - 0.5) - 2.0, x = - 1.4 (0.9 %i -  
0.5) - 2.1 (- 0.9 %i - 0.5) - 2.0, x = - 5.5]
```





Graphic 3D

```
(%i1) expr_1: cos(y)*(10.0+6*cos(x));(%i2) expr_2: sin(y)*(10.0+6*cos(x));(%i3)
expr_3: -6*sin(x);(%i4) plot3d ([expr_1, expr_2, expr_3],[x, 0, 2*%pi],
[y, 0,2*%pi], ['grid, 40, 40]);
```





Thanks!

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