Einführung in Maple

Grundlegendes

Beenden von Befehlen

```
> 4+1;
```
$$5$$
```
> 4+1:
> 4+1
> ;
```
$$5$$

Zugriff auf berechnete Ergebnisse

```
> 2+3;
```
$$5$$
```
> sqrt(%);
```
$$\sqrt{5}$$
```
> sqrt(%%);
```
$$\sqrt{5}$$
```
> evalf(%);
```
$$2.236067977$$

Variablen

```
> a:=2+3;
```
$$a := 5$$
```
> c:=sqrt(a);
```
$$c := \sqrt{5}$$
```
> evalf(c);
```
$$2.236067977$$
```
> a:=10;
```
$$a := 10$$
```
> c;
```
$$\sqrt{5}$$
```
> a:='a';
```
$$a := a$$
```
> a^2+7;
```
$$a^2+7$$

Elementare Funktionen und Konstanten

```
> Pi;
```
$$\pi$$
```
> pi;
```
$$\pi$$
```
> Pi/pi;
```
$$\frac{\pi}{\pi}$$
```
> evalf(Pi);
```
$$3.141592654$$
```
> evalf(pi);
```
$$\pi$$
```
> cos(Pi);
```
$$-1$$
```
> cos(pi);
```
$$\cos(\pi)$$
```
> I;
```
$$I$$
```
> I^2;
```
$$-1$$
```
> e;
```
$$e$$
```
> ln(e);
```
$$\ln(e)$$
```
> exp(1);
```
$$\mathbf{e}$$
```
> evalf(exp(1));
```
$$2.718281828$$
```
> ln(exp(1));
```
$$1$$
```
> exp(5);
```
$$\mathbf{e}^5$$
```
> exp^5;
```
$$\exp^5$$
```
> evalf(%);
```
$$\exp^5$$

Ausdrücke, Substitutionen, Funktionen

Ausdrücke

```
> f:=1+sqrt(x);
```
$$f := 1+\sqrt{x}$$
```
> f(1);
```
$$1+\sqrt{x(1)}$$
```
> subs(x=1,f);
```
$$2$$
```
> subs(x=5,f);
```
$$1+\sqrt{5}$$
```
> diff(f,x);
```
$$\frac{1}{2\sqrt{x}}$$
```
> x:=5;
```
$$x := 5$$
```
> f;
```
$$1+\sqrt{5}$$
```
> x:=7;
```
$$x := 7$$
```
> f;
```
$$1+\sqrt{7}$$
```
> diff(f,x);
Error, invalid input: diff received 7,
which is not valid for its 2nd argument
> x:='x';
```
$$x := x$$

Substitutionen

```
> subs(x=2,y=3,x^2+y^2);
```
$$13$$
```
> subs({x=2,y=3},x^2+y^2)
  ;
```
$$13$$

Funktionen

```
> g:=x->1+sqrt(x);
```
$$g := x \to 1+\sqrt{x}$$
```
> g(1), g(2), g(3),g(4);
```
$$2, 1+\sqrt{2}, 1+\sqrt{3}, 3$$
```
> diff(g,x);
```
$$0$$
```
> diff(g(x),x);
```
$$\frac{1}{2\sqrt{x}}$$
```
> Mittelwert:=(x,y)->(x+y
  )/2;
```
$$Mittelwert := (x, y) \to \frac{1}{2}x+\frac{1}{2}y$$
```
> Mittelwert(3,5);
```
$$4$$

Listen und Mengen

Listen

```
> l1:=[g(1),g(2),g(3),g(4
  ),g(5)];
```
$$l1 := [2, 1+\sqrt{2}, 1+\sqrt{3}, 3, 1+\sqrt{5}]$$
```
> l1:=[seq(g(i),i=1..5)];
```
$$l1 := [2, 1+\sqrt{2}, 1+\sqrt{3}, 3, 1+\sqrt{5}]$$
```
> l1[3];
```
$$1+\sqrt{3}$$
```
> l1[1..3];
```
$$[2, 1+\sqrt{2}, 1+\sqrt{3}]$$
```
> l1[-1];
```
$$1+\sqrt{5}$$
```
> nops(l1);
```
$$5$$
```
> l3:=[1,2,4,7];
```
$$l3 := [1, 2, 4, 7]$$
```
> f:=x->x^2;
```
$$f := x \to x^2$$
```
> map(f,l3);
```
$$[1, 4, 16, 49]$$
```
> l1;
```
$$[2, 1+\sqrt{2}, 1+\sqrt{3}, 3, 1+\sqrt{5}]$$
```
> map(x->x+1,l1);
```
$$[3, 2+\sqrt{2}, 2+\sqrt{3}, 4, 2+\sqrt{5}]$$

Mengen

```
> m3:={seq(i,i=-2..2)};
```
$$m3 := \{-2, -1, 0, 1, 2\}$$
```
> nops(m3);
```
$$5$$
```
> m3[1..3];
```
$$\{-2, -1, 0\}$$
```
> m4:=map(x->x^2,m3);
```
$$m4 := \{0, 1, 4\}$$
```
> m3 union m4;
```
$$\{-2, -1, 0, 1, 2, 4\}$$
```
> m3 intersect m4;
```
$$\{0, 1\}$$
```
> m3 minus m4;
```
$$\{-2, -1, 2\}$$
```
> m3[];
```
$$-2, -1, 0, 1, 2$$
```
> max(m3);
Error, (in simpl/max) arguments must be
of type algebraic
> max(m3[]);
```
$$2$$

Algebraische Umformungen

Polynome

```
> f:=(X+Y)^10-(X+Y^2)^5;
```
$$f := (X+Y)^{10}-(X+Y^2)^5$$
```
> expand(f);
```
$$X^{10}+10X^9Y+45X^8Y^2+120X^7Y^3$$
$$+210X^6Y^4+252X^5Y^5+210X^4Y^6$$

$$+120\,X^3\,Y^7+45\,X^2\,Y^8+10\,X\,Y^9-X^5$$
$$-5\,X^4\,Y^2-10\,X^3\,Y^4-10\,X^2\,Y^6-5\,X\,Y^8$$

```
> collect(f,X);
```

$$X^{10}+10\,X^9\,Y+45\,X^8\,Y^2+120\,X^7\,Y^3$$
$$+210\,X^6\,Y^4+(252\,Y^5-1)\,X^5$$
$$+(210\,Y^6-5\,Y^2)\,X^4+(-10\,Y^4+120\,Y^7)\,X^3$$
$$+(45\,Y^8-10\,Y^6)\,X^2+(10\,Y^9-5\,Y^8)\,X$$

```
> collect(f,X,factor);
```

$$X^{10}+10\,X^9\,Y+45\,X^8\,Y^2+120\,X^7\,Y^3$$
$$+210\,X^6\,Y^4+(252\,Y^5-1)\,X^5$$
$$+5\,Y^2\,(42\,Y^4-1)\,X^4+10\,Y^4\,(-1+12\,Y^3)\,X^3$$
$$+5\,Y^6\,(9\,Y^2-2)\,X^2+5\,Y^8\,(2\,Y-1)\,X$$

```
> factor(f);
```

$$X\,(X-1+2\,Y)\,(5\,X^3\,Y^2+4\,X^5\,Y+9\,X^4\,Y^2$$
$$+10\,X^3\,Y^3+10\,X^2\,Y^4+6\,X^6\,Y+17\,X^5\,Y^2$$
$$+28\,X^4\,Y^3+30\,X^3\,Y^4+20\,X^2\,Y^5+10\,X\,Y^6$$
$$+8\,X^7\,Y+29\,X^6\,Y^2+62\,X^5\,Y^3+86\,X^4\,Y^4$$
$$+80\,X^3\,Y^5+50\,X^2\,Y^6+20\,X\,Y^7+X^5+X^6$$
$$+X^7+X^8+5\,Y^8+X^4+2\,X^4\,Y)$$

```
> coeff(f,X,5);
```

$$252\,Y^5-1$$

```
> coeff(f,X^5);
```

$$252\,Y^5-1$$

```
> degree(f,X);
```

$$10$$

```
> ldegree(f,X);
```

$$0$$

```
> ldegree(expand(f),X);
```

$$1$$

```
> coeffs(f,X);
Error, invalid arguments to coeffs
```

```
> coeffs(collect(f,X),X);
```

$$10\,Y^9-5\,Y^8,\ 45\,Y^8-10\,Y^6,\ -10\,Y^4+120\,Y^7,$$
$$252\,Y^5-1,\ 210\,Y^4,\ 120\,Y^3,\ 45\,Y^2,\ 10\,Y,\ 1,$$
$$210\,Y^6-5\,Y^2$$

```
> coeffs(collect(f,X),X,t
  );
```

$$10\,Y^9-5\,Y^8,\ 45\,Y^8-10\,Y^6,\ -10\,Y^4+120\,Y^7,$$
$$252\,Y^5-1,\ 210\,Y^4,\ 120\,Y^3,\ 45\,Y^2,\ 10\,Y,\ 1,$$
$$210\,Y^6-5\,Y^2$$

```
> t;
```

$$X,\ X^2,\ X^3,\ X^5,\ X^6,\ X^7,\ X^8,\ X^9,\ X^{10},\ X^4$$

Transzendente Funktionen

```
> sin(x)^2+cos(x)^2;
```

$$\sin(x)^2+\cos(x)^2$$

```
> simplify(%);
```

$$1$$

```
> t2:=ln(27*n);
```

$$t2 := \ln(27\,n)$$

```
> expand(t2);
```

$$3\ln(3)+\ln(n)$$

```
> t3:=ln(2*n-sqrt(2)*n);
```

$$t3 := \ln(2\,n-\sqrt{2}\,n)$$

```
> expand(t3);
```

$$\ln(2\,n-\sqrt{2}\,n)$$

```
> factor(2*n-sqrt(2)*n);
```

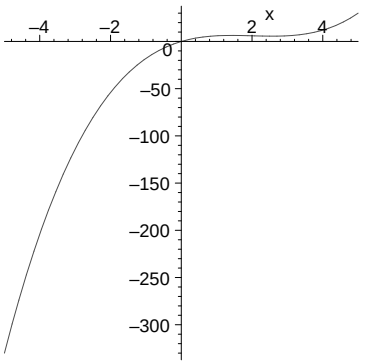
$$-(-2+\sqrt{2})\,n$$

Grafik

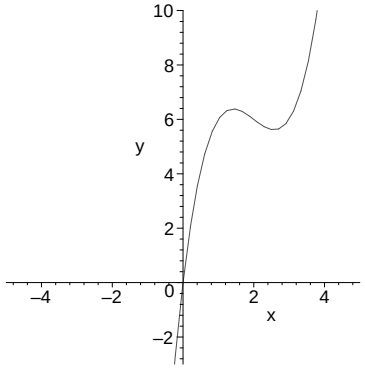
```
> f:=x->x^3-6*x^2+11*x;
```

$$f := x \to x^3-6\,x^2+11\,x$$

```
> plot(f(x),x=-5..5);
```




```
> plot(f(x),x=-5..5,y=-3..1
  0);
```




```
> sol:=solve(f(x)=6);
```

$$sol := 1,\ 2,\ 3$$

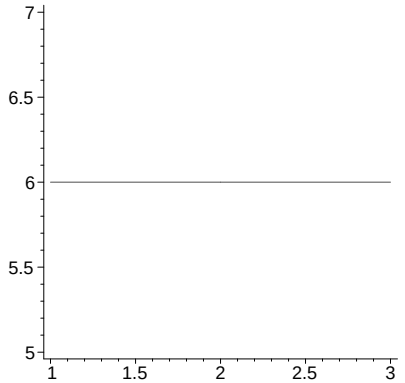
```
> map(f,[sol]);
```

$$[6,\ 6,\ 6]$$

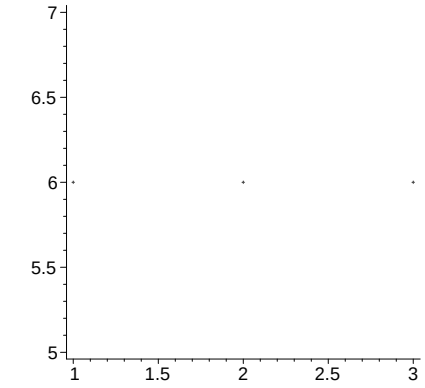
```
> points:=map(x->[x,f(x)],
  [sol]);
```

$$points := [[1,\ 6],\ [2,\ 6],\ [3,\ 6]]$$

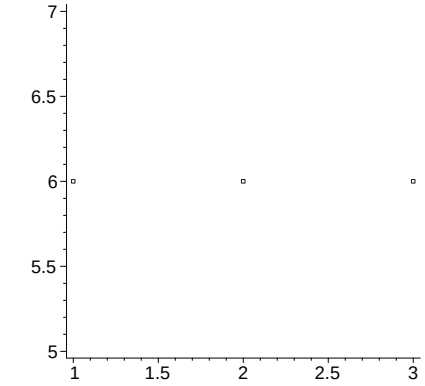
```
> plot(points);
```




```
> plot(points,
  style=POINT);
```




```
> plot(points, style=POINT,
  symbol=BOX, color=blue);
```




```
> plot1:=plot(f(x),x=-5..5,
  y=-3..10);
```

$$plot1 := \text{PLOT}(\text{CURVES}([[-5.,\ -330.],$$
$$[-4.78202845833333346,\ -299.163542194005970]$$
$$,$$
$$[-4.59237258541666638,\ -273.908028346663627]$$
$$,$$
$$[-4.37908472083333322,\ -247.203235644731024]$$
$$,$$
$$[-4.16438304583333351,\ -222.079819971247360]$$
$$,$$
$$[-3.95070181041666668,\ -198.768719511557947]$$
$$,$$

[-3.75259195208333330, -178.613988201814720]
,
[-3.54746066875000032, -159.171868424974748]
,
[-3.33531360208333316, -140.537435786148393]
,
[-3.12384689374999969, -123.396640504104397]
,
[-2.90632739166666632, -107.199023410919992]
,
[-2.71473609583333308, -94.0878900255597728]
,
[-2.49904967499999976, -80.5682302724794113]
,
[-2.28247762499999985, -68.2565115875624286]
,
[-2.07377032499999991, -57.5329114678048867]
,
[-1.88424410208333315, -48.7187148699381609]
,
[-1.65887909166666647, -39.3239849835766790]
,
[-1.46796536666666633, -32.2405042700189455]
,
[-1.24588731874999992, -24.9520819375120020]
,
[-1.04931061666666681, -19.3040797661625376]
, [
-0.833634818749999340, -13.9189970980268604]
, [
-0.628260456249999599, -9.52711366323128139]
, [
-0.413973854166665767, -5.65290300841021498]
, [
-0.217191860416666493, -2.68238973048697459]
, [-0.00493589583333342574,
-0.0544411528262970304],
[0.215538397916667179, 2.10219479567924239]
,
[0.407461918750000152, 3.55357876762049241]
,
[0.614744579166667471, 4.72704366086123340]
,
[0.828887850000000093, 5.56492754077895224]
, [1.03838526250000029, 6.07240679780345172],
[1.24108478125000055, 6.32181624598569503],
[1.46614803750000001, 6.38170526473930088],
[1.66837738333333263, 6.29515289697350512],
[1.88430037500000047, 6.11415082316675118],
[2.07995869791666621, 5.92055250949267275],
[2.29386492500000116, 5.73151224906175117],
[2.49513401458333296, 5.62625189785937874],
[2.70551820625000072, 5.64565767123064877],
[2.91120720833333291, 5.84536683965934589],
[3.12654453124999954, 6.30315604084607806],
[3.33393996666666758, 7.03966725372073832],
[3.54603175416666794, 8.14931527493544117],
[3.75636731458333451, 9.66172049544791101],
[3.94964385000000106, 11.4611691108603502],
[4.17116057083333480, 14.0635562352006591],
[4.36928776666666785, 16.9307672094767128],
[4.58053268125000024, 20.6036187335383545],
[4.78272101875000111, 24.7653801142037295],
[5., 30.]], COLOUR(*RGB*, 1.0, 0., 0.)),
AXESLABELS("x", "y"), VIEW(-5. .. 5., -3. .. 10.)

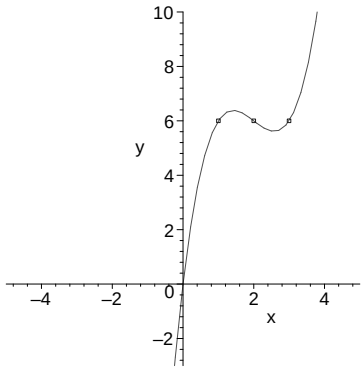
```
> plot2:=plot(points,style=
  POINT, color=blue,
  symbol=BOX):
```

```
> with(plots);
```

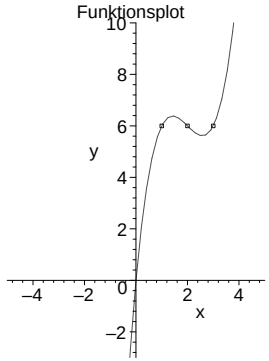
```
Warning, the name changecoords has been
redefined
```

[*animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d, conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, cylinderplot, densityplot, display, display3d, fieldplot, fieldplot3d, gradplot, gradplot3d, graphplot3d, implicitplot, implicitplot3d, inequal, interactive, interactiveparams, listcontplot, listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple, odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra_supported, polyhedraplot, replot, rootlocus, semilogplot, setoptions, setoptions3d, spacecurve, sparsematrixplot, sphereplot, surfdata, textplot, textplot3d, tubeplot*]

```
> display(plot1,plot2);
```



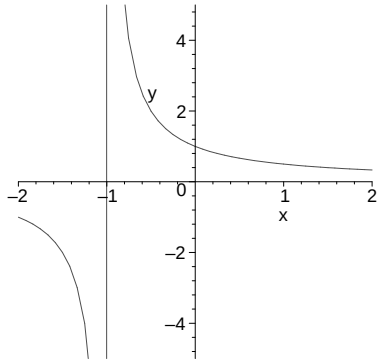

```
> display(plot1, plot2,
  title='Funktionsplot',sca
  ling=CONSTRAINED);
```



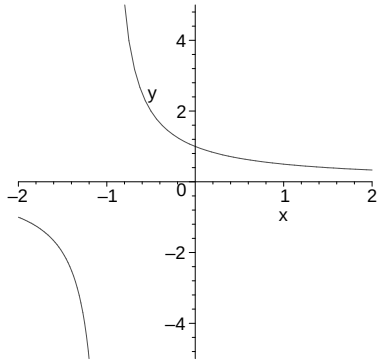

```
> f:=1/(x+1);
```

$$f := \frac{1}{x+1}$$

```
> plot(f,x=-2..2,y=-5..5);
```




```
> plot(f,x=-2..2,y=-5..5,di
  scont=true);
```




```
> discont(f,x);
```

{-1}

Mathematisches

Ableitungen

```
> diff(1+x^2,x);
```

$$2x$$

```
> f:=x->1+x^2;
```

$$f := x \to 1 + x^2$$

```
> diff(f,x);
```

$$0$$

```
> diff(f(x),x);
```

$$2x$$

```
> D(f);
```

$$x \to 2\,x$$

```
> D(f)(x);
```

$$2\,x$$

```
> D(f)(3);
```

$$6$$

```
>
>
```