

# Einführung in *Mathematica*

## Grundlegendes

### Beenden von Befehlen

```
4 + 1
| 5
4 + 1;
```

### Zugriff auf berechnete Ergebnisse

```
2 + 3
| 5
Sqrt[%]
| √5
Sqrt[%%]
| √5
N[%]
| 2.23607
```

### Variable, Zuweisungen

```
a = 2 + 3
| 5
c = Sqrt[a]
| √5
N[c]
| 2.23607
a = 10
| 10
c
| √5
Clear[a, c]
```

### Elementare Funktionen und Konstanten

```
Pi
| π
N[Pi]
| 3.14159
E
| e
N[E]
| 2.71828
I
| i
I^2
| -1
Cos[Pi]
| -1
Sin[Pi]
| 0
Tan[Pi]
| 0
Cot[Pi]
| ComplexInfinity
Exp[Pi] - E^Pi
| 0
```

```
Log[E^2]
| 2
Ln[E^2]
| Ln[e^2]
Log[10, 100]
| 2
```

## Ausdrücke, Regeln, und Funktionen

### Ausdrücke

```
f = 1 + Sqrt[x]
| 1 + √x
f[1]
| (1 + √x)[1]
f /. x → 5
| 1 + √5
```

### Regeln, Substituieren von Werten

```
f /. x → y + 1
| 1 + √(1 + y)
f /. {x → y + 1, y → z + 1}
| 1 + √(1 + y)
f //. x → y + 1
| 1 + √(1 + y)
f //. {x → y + 1, y → z + 1}
| 1 + √(2 + z)
```

### Funktionen

```
Clear[f]
f[x_] = 1 + Sqrt[x]
| 1 + √x
f[1]
| 2
f[5]
| 1 + √5
5 // f
| 1 + √5
Mittelwert[x_, y_] = (x + y) / 2
| (x + y) / 2
Mittelwert[3, 5]
| 4
```

## Listen, Mengen

### Liste

```
li = {a, b, c, d}
| {a, b, c, d}
li[[1]]
| a
li[[3]]
| c
```

```
li[[-1]]
| d
li[{{1, 3}}]
| {a, c}
Map[g, li]
| {g[a], g[b], g[c], g[d]}
?f
```

```
Global`f
f[x_] = 1 + √x
Map[f, li]
| {1 + √a, 1 + √b, 1 + √c, 1 + √d}
Length[li]
| 4
li2 = Table[i, {i, -2, 2}]
| {-2, -1, 0, 1, 2}
Max[li2]
| 2
Table[i, {i, 1, 4}]
| {1, 2, 3, 4}
Range[4]
| {1, 2, 3, 4}
Range[-2, 2]
| {-2, -1, 0, 1, 2}
Range[-3, 3, 2]
| {-3, -1, 1, 3}
```

### Mengen

```
g[x_] = x^2
| x^2
li2
| {-2, -1, 0, 1, 2}
Map[g, li2]
| {4, 1, 0, 1, 4}
Map[#^2 &, li2]
| {4, 1, 0, 1, 4}
qu = Union[%]
| {0, 1, 4}
Intersection[qu, li2]
| {0, 1}
Union[qu, li2]
| {-2, -1, 0, 1, 2, 4}
Complement[qu, li2]
| {4}
```

## Algebraische Umformungen

### Polynome

```
Clear[X]
f = (X + Y)^10 - (X + Y^2)^5
| (X + Y)^10 - (X + Y^2)^5
```

```
Expand[f]
| -X^5 + X^10 + 10 X^9 Y - 5 X^4 Y^2 + 45 X^8 Y^2 +
| 120 X^7 Y^3 - 10 X^3 Y^4 + 210 X^6 Y^4 +
| 252 X^5 Y^5 - 10 X^2 Y^6 + 210 X^4 Y^6 +
| 120 X^3 Y^7 - 5 X Y^8 + 45 X^2 Y^8 + 10 X Y^9
Collect[f, X]
| X^10 + 10 X^9 Y + 45 X^8 Y^2 + 120 X^7 Y^3 +
| 210 X^6 Y^4 + X^5 (-1 + 252 Y^5) +
| X^4 (-5 Y^2 + 210 Y^6) +
| X^3 (-10 Y^4 + 120 Y^7) +
| X^2 (-10 Y^6 + 45 Y^8) + X (-5 Y^8 + 10 Y^9)
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 + 5 X Y^8 (-1 + 2 Y) +
| 5 X^2 Y^6 (-2 + 9 Y^2) +
| 10 X^3 Y^4 (-1 + 12 Y^3) +
| 5 X^4 Y^2 (-1 + 42 Y^4) + X^5 (-1 + 252 Y^5)
Factor[f]
| X (-1 + X + 2 Y)
| (X^4 + X^5 + X^6 + X^7 + X^8 + 2 X^4 Y +
| 4 X^5 Y + 6 X^6 Y + 8 X^7 Y + 5 X^3 Y^2 +
| 9 X^4 Y^2 + 17 X^5 Y^2 + 29 X^6 Y^2 +
| 10 X^3 Y^3 + 28 X^4 Y^3 + 62 X^5 Y^3 +
| 10 X^2 Y^4 + 30 X^3 Y^4 + 86 X^4 Y^4 +
| 20 X^2 Y^5 + 80 X^3 Y^5 + 10 X Y^6 +
| 50 X^2 Y^6 + 20 X Y^7 + 5 Y^8)
Coefficient[f, X, 5]
| -1 + 252 Y^5
Coefficient[f, X^5]
| -1 + 252 Y^5
Exponent[f, X]
| 10
Exponent[f, X, Min]
| 1
Exponent[f, X, h]
| h[1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
```

### Transzendente Funktionen

```
Sin[x]^2 + Cos[x]^2
| Cos[x]^2 + Sin[x]^2
Simplify[%]
| 1
Log[1 + Sqrt[2]] - ArcSinh[1]
| -ArcSinh[1] + Log[1 + √2]
Simplify[%]
| -ArcSinh[1] + Log[1 + √2]
FullSimplify[%]
| 0
Log[27 n]
| Log[27 n]
```

```
Expand[%]
| Log[27 n]
Simplify[%]
| Log[27 n]
FullSimplify[%]
| Log[27 n]
Expand[Log[27 n], Trig → True]
| Log[27 n]
PowerExpand[Log[27 n]]
| Log[27] + Log[n]
PowerExpand[Log[2 n - Sqrt[2] n]]
| Log[2 n - √2 n]
```

?? Plot

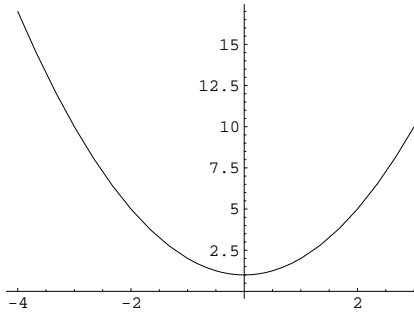
```
Plot[f, {x, xmin, xmax}] generates
a plot of f as a function of
x from xmin to xmax. Plot[{f1,
f2, ... }, {x, xmin, xmax}]
plots several functions fi. Mehr...

Attributes[Plot] = {HoldAll, Protected}

Options[Plot] = {AspectRatio →  $\frac{1}{\text{GoldenRatio}}$ ,
Axes → Automatic, AxesLabel → None,
AxesOrigin → Automatic,
AxesStyle → Automatic,
Background → Automatic,
ColorOutput → Automatic,
Compiled → True,
DefaultColor → Automatic,
DefaultFont → $DefaultFont,
DisplayFunction → $DisplayFunction,
Epilog → {}, FormatType → $FormatType,
Frame → False, FrameLabel → None,
FrameStyle → Automatic,
FrameTicks → Automatic,
GridLines → None,
ImageSize → Automatic, MaxBend → 10.,
PlotDivision → 30., PlotLabel → None,
PlotPoints → 25, PlotRange → Automatic,
PlotRegion → Automatic,
PlotStyle → Automatic,
Prolog → {}, RotateLabel → True,
TextStyle → $TextStyle,
Ticks → Automatic}
```

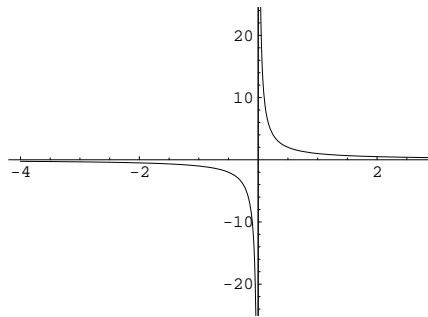
## Plots

```
Plot[1 + x^2, {x, -4, 4}]
```



```
| - Graphics -
```

```
Plot[1/x, {x, -4, 4}]
```



```
| - Graphics -
```

## Mathematisches

### Ableitungen

```
D[1 + x^2, x]
| 2 x
f[x_] = 1 + x^2
Set::write :
Tag Plus in ((X + Y)^10 - (X + Y^2)^5)[x_]
is Protected. Mehr...

| 1 + x^2
Clear[f]
f[x_] = 1 + x^2
| 1 + x^2
D[f, x]
| 0
D[f[x], x]
| 2 x
f'[x]
| 2 x
Clear[f]
```