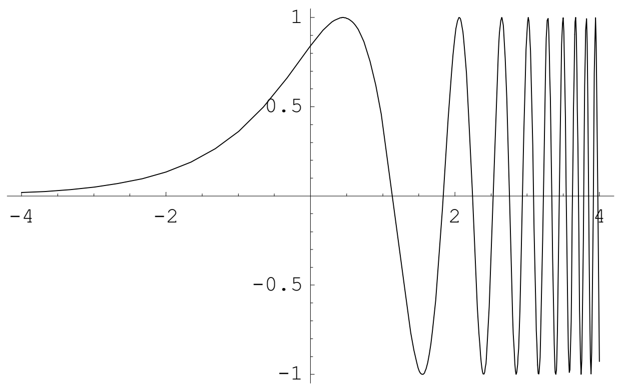
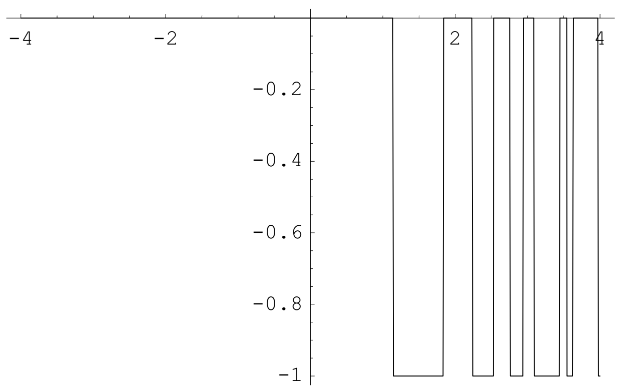
Studiere die Beispiele!

■ 1. Plots ungewohnter Funktionen

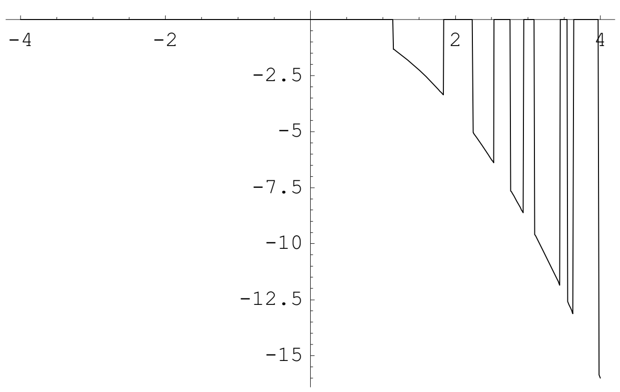
```
f0[x_] := Sin[E^x] ; Plot[f0[x], {x, -4, 4}];
```



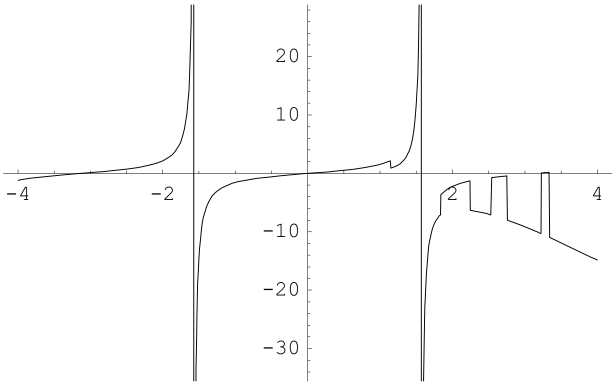

```
f1[x_] := Floor[Sin[E^x]] ; Plot[f1[x], {x, -4, 4}];
```



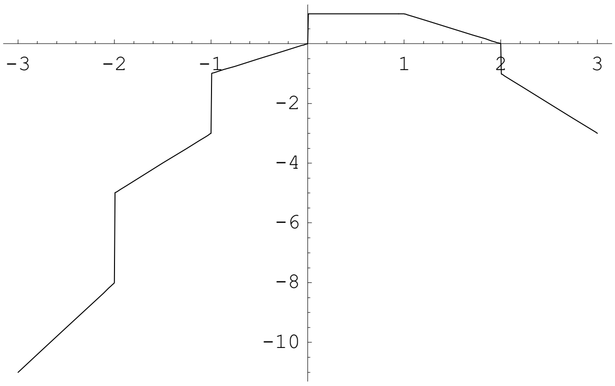

```
f2[x_] := Floor[Sin[E^x]] x^2 ; Plot[f2[x], {x, -4, 4}];
```



```
f3[x_] := Floor[Sin[E^x]] x^2 + Tan[x]; Plot[f3[x], {x, -4, 4}];
```

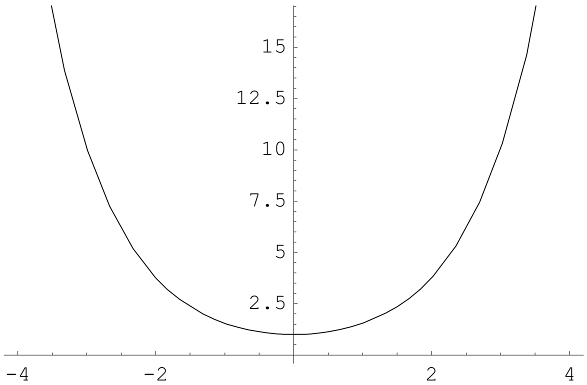



```
Plot[x Floor[1 - x] + Floor[1 + x], {x, -3, 3}];
```



■ 2. Umkehrfunktionen

```
g1[x_] := Cosh[x]; Plot[g1[x], {x, -4, 4}];
```

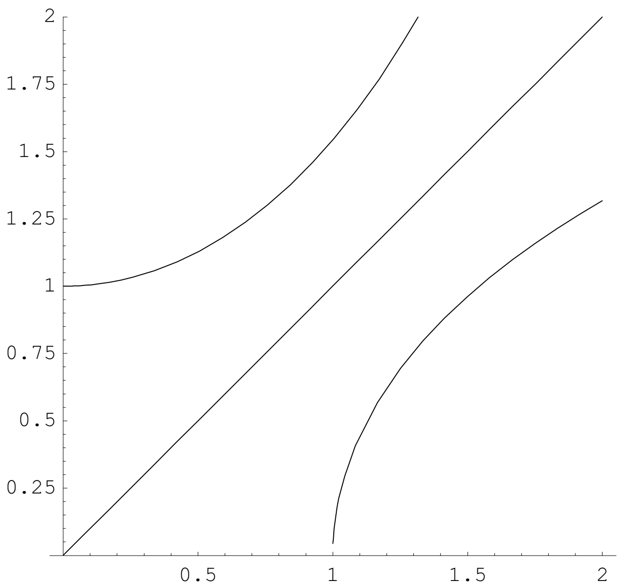


```
Options[Plot]
```

```
{AspectRatio → 1/GoldenRatio, Axes → Automatic, AxesLabel → None,
 AxesOrigin → Automatic, AxesStyle → Automatic, Background → Automatic,
 ColorOutput → Automatic, Compiled → True, DefaultColor → Automatic,
 Epilog → {}, 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,
 Ticks → Automatic, DefaultFont :→ $DefaultFont, DisplayFunction :→ $DisplayFunction,
 FormatType :→ $FormatType, TextStyle :→ $TextStyle}
```

Plot der Funktion und Umkehrfunktion:

```
h1[x_] := ArcCosh[x];
Plot[{g1[x], x, h1[x]}, {x, 0.001, 2}, AspectRatio → Automatic, PlotRange → {0, 2}];
```

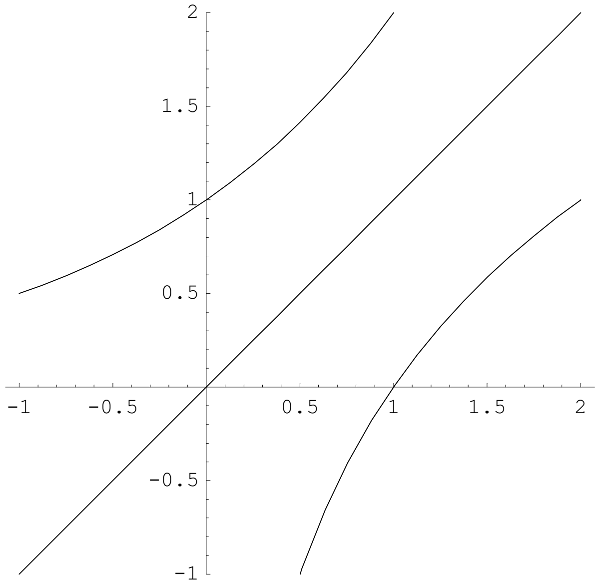



```
?Log
```

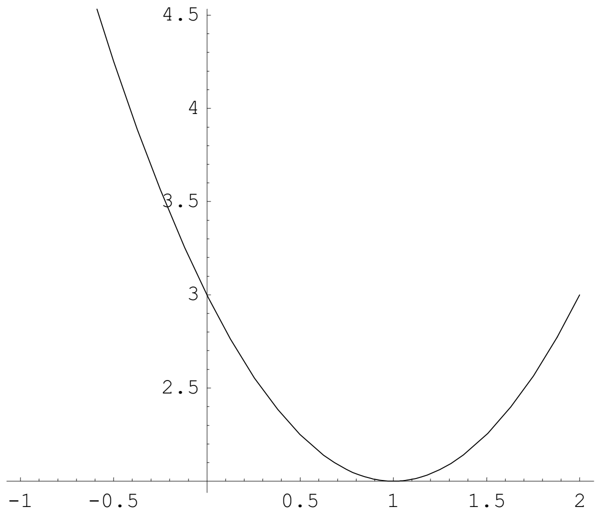
```
Log[z] gives the natural logarithm of z (
  logarithm to base e). Log[b, z] gives the logarithm to base b.
```

Plot der Funktion und Umkehrfunktion:

```
g2[x_] := 2^x;
h2[x_] := Log[2, x];
Plot[{g2[x], x, h2[x]}, {x, -1, 2}, AspectRatio → Automatic, PlotRange → {-1, 2}];
```




```
g3[x_] := x^2 - 2 x + 3;
Plot[{g3[x]}, {x, -1, 2}, AspectRatio → Automatic];
```




```
Solve[g3[x] - 2 == 0, {x}]
```

{{x → 1}, {x → 1}}

===> Minimum in 1

```
Remove[x, y, s]
```

```
Solve[g3[x] == y, {x}]
```

$\{\{x \to 1 - \sqrt{-2 + y}\}, \{x \to 1 + \sqrt{-2 + y}\}\}$

```
s = Solve[g3[x] == y, {x}] // Flatten
```

$\{x \to 1 - \sqrt{-2 + y}, x \to 1 + \sqrt{-2 + y}\}$

```
x = x /. s[[2]]
```

$1+\sqrt{-2+y}$

```
h3[y_] = x /. s ; h3[z]
```

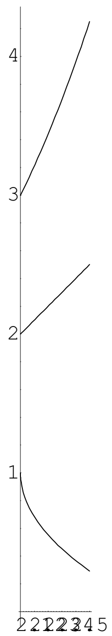
$1-\sqrt{-2+z}$

```
h3[q]
```

$1-\sqrt{-2+q}$

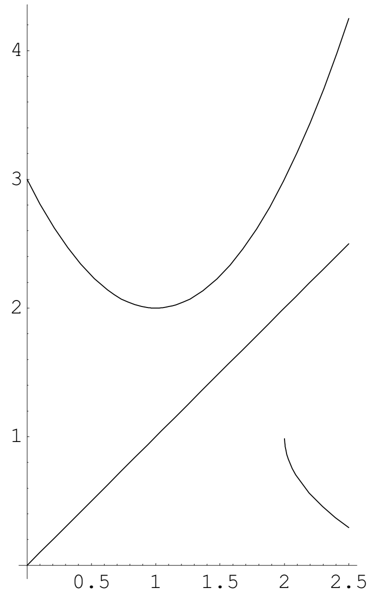
Plot der Funktion und Umkehrfunktion (Skalierung!):

```
p = Plot[{g3[x], x, h3[x]}, {x, 2, 2.5}, AspectRatio → Automatic];
```



Achtung Skalierungen!

```
ShowPlot[{p, Plot[{g3[x], x, h3[x]}, {x, 0, 2.5}, AspectRatio → Automatic];}];
```



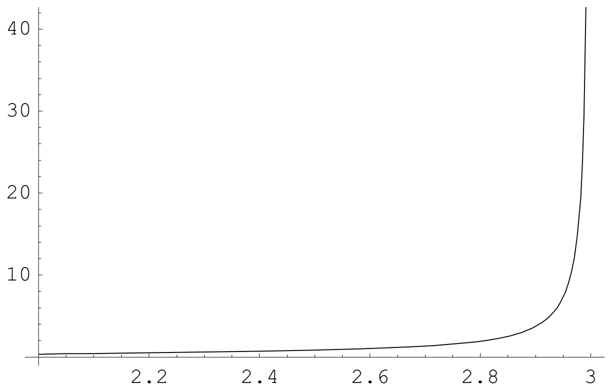

```
h[w_] := (h1[w] - h2[w]) / h3[w];
h[w]
```

$$\frac{\text{ArcCosh}[w] - \frac{\text{Log}[w]}{\text{Log}[2]}}{1 - \sqrt{-2 + w}}$$

Wo ist h[w] definiert?

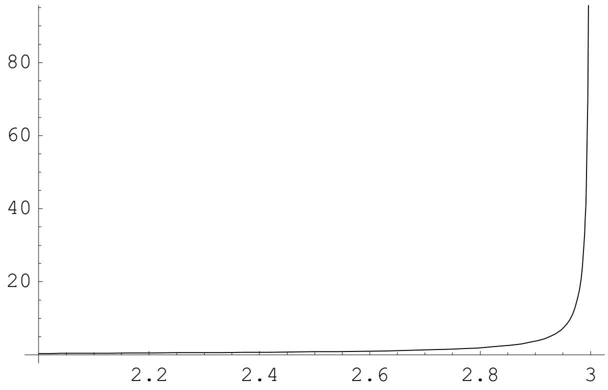
```
Plot[h[w], {w, -1, 3}];
```

```
Plot::plnr : h[w] is not a machine-size real number at w = -1..

Plot::plnr : h[w] is not a machine-size real number at w = -0.837732.

Plot::plnr : h[w] is not a machine-size real number at w = -0.660765.

General::stop : Further output of Plot::plnr will be suppressed during this calculation.
```



Geht nur für w grösser gleich 2. Wieso?

```
Plot[h[w], {w, 2, 3}];
```



■ 3. Asymtote, Pole, Nullstellen, Definitionsbereich, ungefährer Wertebereich

```
Remove[x]
```

```
a[x_] := (x^3 - 2 x^2 + 4 x - 5) / (x^2 + 8 x - 6);
a[x]
```

$$\frac{-5 + 4\,x - 2\,x^2 + x^3}{-6 + 8\,x + x^2}$$

Division:

```
Apart[a[x]]
```

$$-10 + x + \frac{5\,(-13 + 18\,x)}{-6 + 8\,x + x^2}$$

■ Pole:

```
Solve[-6 + 8 x + x^2 == 0, {x}]
```

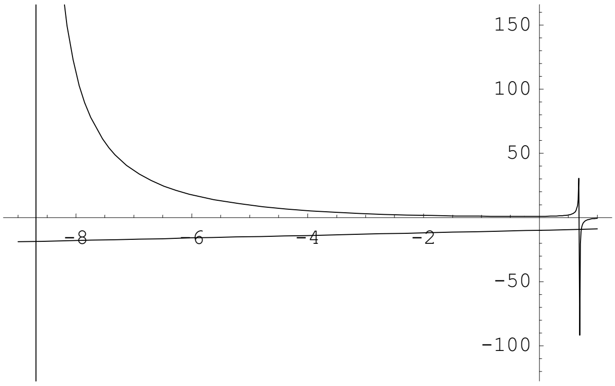
$$\left\{\left\{x \to -4 - \sqrt{22}\right\}, \left\{x \to -4 + \sqrt{22}\right\}\right\}$$

```
Solve[-6 + 8 x + x^2 == 0, {x}] // N
```

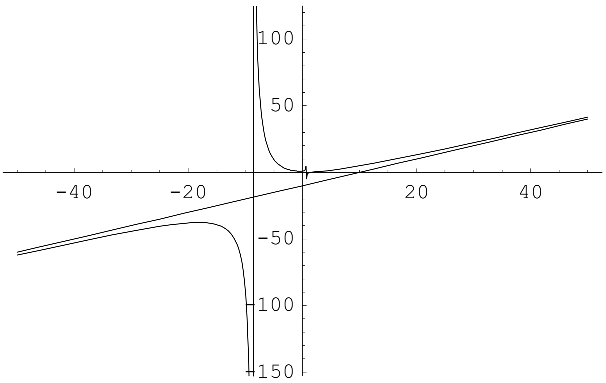
$$\{\{x \to -8.69042\}, \{x \to 0.690416\}\}$$

■ Asymptote:

```
Plot[{-10 + x, a[x]}, {x, -9, 1}];
```




```
Plot[{-10 + x, a[x]}, {x, -50, 50}];
```



■ Nullstellen:

$$\frac{-5+4x-2x^2+x^3}{-6+8x+x^2}$$

$$\texttt{Solve}\left[\frac{-5+4x-2x^2+x^3}{-6+8x+x^2} == 0, \{x\}\right]$$

$$\left\{\left\{x \to \frac{2}{3} - \frac{8}{3}\left(\frac{2}{79+3\sqrt{921}}\right)^{1/3} + \frac{1}{3}\left(\frac{1}{2}\left(79+3\sqrt{921}\right)\right)^{1/3}\right\},\right.$$

$$\left\{x \to \frac{2}{3} + \frac{4}{3}\left(1+i\sqrt{3}\right)\left(\frac{2}{79+3\sqrt{921}}\right)^{1/3} - \frac{1}{6}\left(1-i\sqrt{3}\right)\left(\frac{1}{2}\left(79+3\sqrt{921}\right)\right)^{1/3}\right\},$$

$$\left.\left\{x \to \frac{2}{3} + \frac{4}{3}\left(1-i\sqrt{3}\right)\left(\frac{2}{79+3\sqrt{921}}\right)^{1/3} - \frac{1}{6}\left(1+i\sqrt{3}\right)\left(\frac{1}{2}\left(79+3\sqrt{921}\right)\right)^{1/3}\right\}\right\}$$

$$\texttt{Solve}\left[\frac{-5+4x-2x^2+x^3}{-6+8x+x^2} == 0, \{x\}\right] \texttt{ // N}$$

$\{\{x \to 1.52596\}, \{x \to 0.237021 + 1.79456\, i\}, \{x \to 0.237021 - 1.79456\, i\}\}$

```
Solve[-5 + 4 x - 2 x^2 + x^3 == 0, {x}] // N
```

$\{\{x \to 1.52596\}, \{x \to 0.237021 + 1.79456\, i\}, \{x \to 0.237021 - 1.79456\, i\}\}$

Einzige reelle Nullstelle: Etwa 1.525957480649296

■ Definitionsbereich

Reelle Zahlen ohne $x = -4 - \sqrt{22}$, $x = -4 + \sqrt{22}$

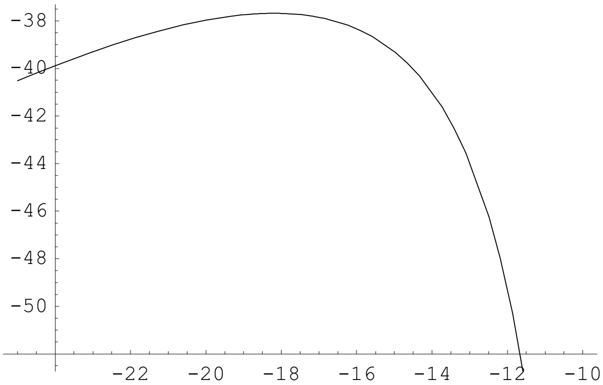
■ Wertebereich

$$\text{Solve}\left[y == \frac{-5 + 4x - 2x^2 + x^3}{-6 + 8x + x^2}, \{x\}\right]$$

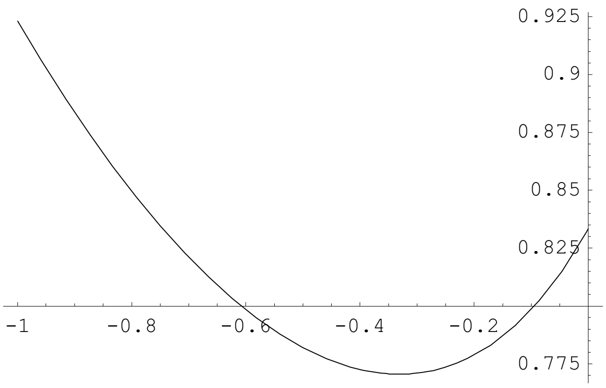
```
{{}}
```

x kann nicht als Funktion von y berechnet werden. Graphisch kommmt man weiter:

```
Plot[a[x], {x, -25, -10}];
```




```
Plot[a[x], {x, -1, 0}];
```



Zwichen ca. y = -38 und y = +0.77 gibt es keine Werte.

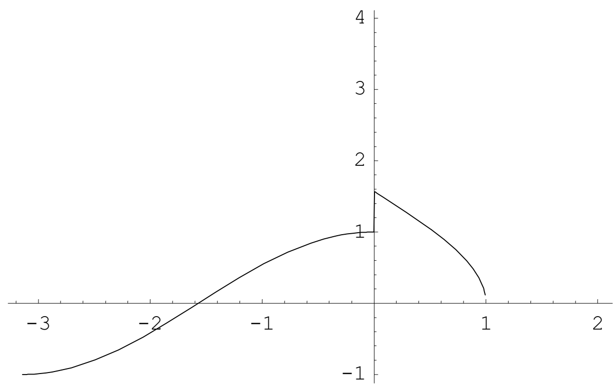
■ 4. Zusammengesetzte Funktionen

```
Remove[u]
```

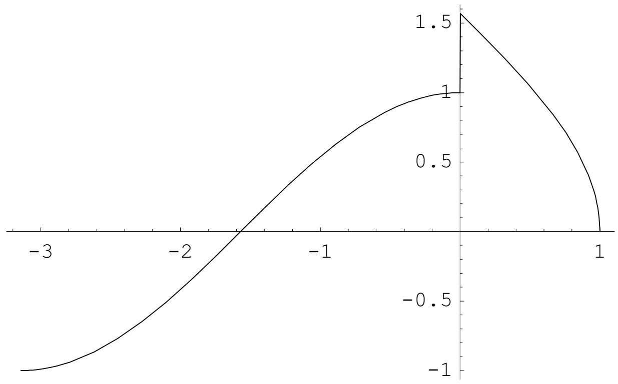
```
u[t_] := ArcCos[t] /; (0 < t && t < Pi / 2);
u[t_] := Cos[t]     /; ( t ≤ 0);
u[t_] := E^t /; (+Pi / 2 <= t);
```

```
Plot[u[x], {x, -Pi, 2}];
```

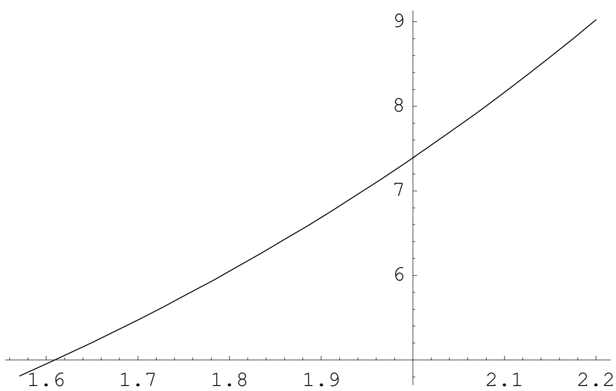
```
Plot::plnr : u[x] is not a machine-size real number at x = 1.1477184121076678`.

Plot::plnr : u[x] is not a machine-size real number at x = 1.0471985871192238`.

Plot::plnr : u[x] is not a machine-size real number at x = 1.0193749626697324`.

General::stop : Further output of Plot::plnr will be suppressed during this calculation.
```



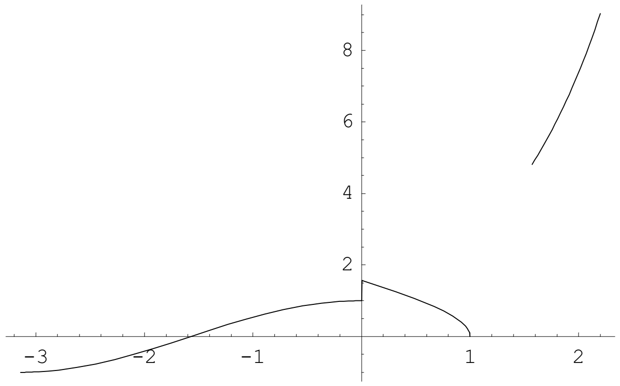

```
p1 = Plot[u[x], {x, -Pi, 1}];
```




```
p2 = Plot[u[x], {x, Pi / 2, 2.2}];
```



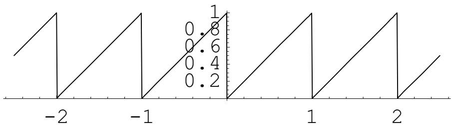
```
Show[p1, p2];
```



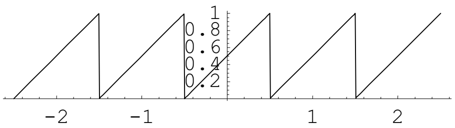
■ 5. Rechtecksfunktion:

```
Remove[f, p]
```

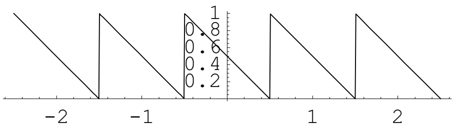
```
f[1, x_] := x - Floor[x];
p[1] = Plot[f[1, x], {x, -2.5, 2.5}, AspectRatio → 1 / 5];
```



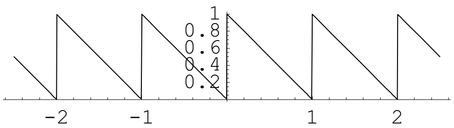

```
f[2, x_] := f[1, x - 0.5];
p[2] = Plot[f[2, x], {x, -2.5, 2.5}, AspectRatio → 1 / 5];
```



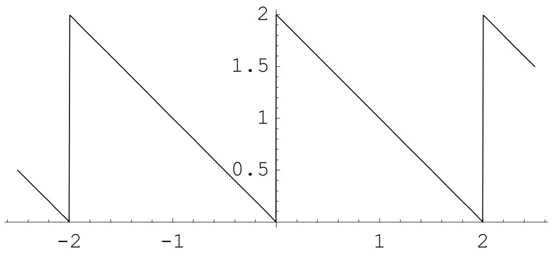

```
f[3, x_] := f[2, -x];
p[3] = Plot[f[3, x], {x, -2.5, 2.5}, AspectRatio → 1 / 5];
```



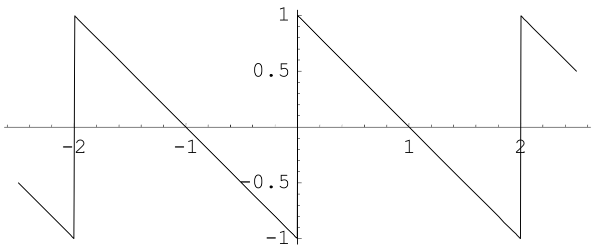

```
f[4, x_] := f[3, x + 0.5];
p[4] = Plot[f[4, x], {x, -2.5, 2.5}, AspectRatio → 1 / 5];
```



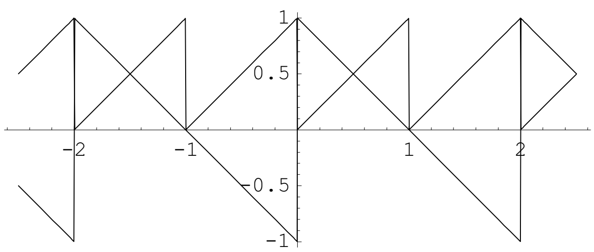
```
f[5, x_] := 2 f[4, 1 / 2 x];
p[5] = Plot[f[5, x], {x, -2.5, 2.5}, AspectRatio → 2 / 5];
```



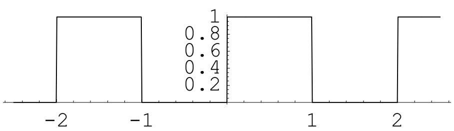
```
f[6, x_] := f[5, x] - 1;
p[6] = Plot[f[6, x], {x, -2.5, 2.5}, AspectRatio → 2 / 5];
```



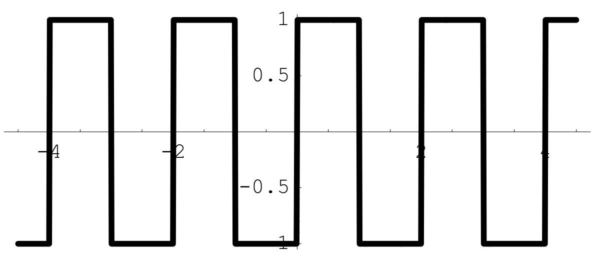
```
Show[p[6], p[1]];
```



```
f[7, x_] := f[1, x] + f[6, x]; p[7] = Plot[f[7, x], {x, -2.5, 2.5}, AspectRatio → 1 / 5];
```



```
f[8, x_] := 2 f[7, x] - 1;
p[8] =
  Plot[f[8, x], {x, -4.5, 4.5}, PlotStyle → Thickness[0.01], AspectRatio → 2 / 5 ];
```



■ 6. Quadratische Ungleichungen

Wo ist $-8 - 5x + 2x^2 \geq 5 + x$?

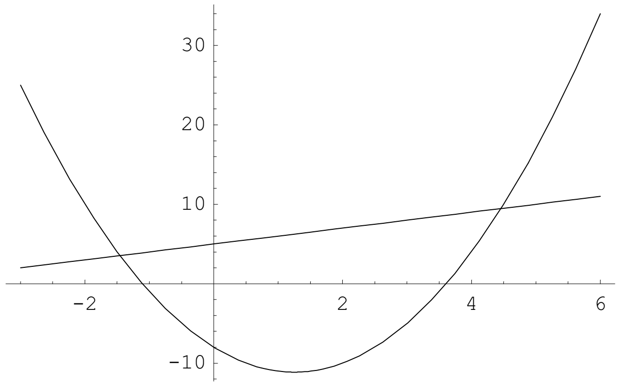
```
Solve[2 x^2 - 5 x - 8 == x + 5, {x}]
```

$\left\{\left\{x \to \frac{1}{2}\left(3 - \sqrt{35}\right)\right\}, \left\{x \to \frac{1}{2}\left(3 + \sqrt{35}\right)\right\}\right\}$

```
Solve[2 x^2 - 5 x - 8 == x + 5, {x}] // N
```

{{x → -1.45804}, {x → 4.45804}}

```
Plot[{2 x^2 - 5 x - 8, x + 5}, {x, -3, 6}];
```




```
2 x^2 - 5 x - 8 >= x + 5 /. x -> 0
```

False

```
2 x^2 - 5 x - 8 >= x + 5 /. x → -2
```

True

```
2 x^2 - 5 x - 8 >= x + 5 /. x → 5
```

True