

# Computergestuetzte Mathematik zur Analysis

## Lektion 1

### Maple rechnet symbolisch

```
> 2/7;
```

$$\frac{2}{7} \quad (1.1)$$

```
> (2/7)^49;
```

$$\frac{562949953421312}{256923577521058878088611477224235621321607} \quad (1.2)$$

```
> 70!;
```

$$119785716699698917960727837216890987364589381425464258575553\backslash \quad (1.3)$$
$$62864628009582789845319680000000000000000$$

```
> 70!/2^70;
```

$$811699589240917094922095887749858461936379573619555344404709\backslash \quad (1.4)$$
$$95723784027099609375/8$$

```
> 2/7; 1/2: 3/2; #Trennzeichen
```

$$\frac{2}{7} \quad (1.5)$$
$$\frac{3}{2}$$

### und numerisch mit beliebiger Praezision

```
> evalf(2/7);
```

$$0.2857142857 \quad (2.1)$$

```
> evalf(2/7, 800); # 800 Stellen
```

$$0.28571428571428571428571428571428571428571428571428571428571428571\backslash \quad (2.2)$$
$$42857142857142857142857142857142857142857142857142857142857142857\backslash$$
$$7142857142857142857142857142857142857142857142857142857142857142\backslash$$
$$8571428571428571428571428571428571428571428571428571428571428571\backslash$$
$$4285714285714285714285714285714285714285714285714285714285714285\backslash$$
$$7142857142857142857142857142857142857142857142857142857142857142\backslash$$
$$8571428571428571428571428571428571428571428571428571428571428571\backslash$$
$$4285714285714285714285714285714285714285714285714285714285714285\backslash$$



$$\text{polynom\_in\_a} := (a - 7)^2 = 0 \quad (3.5)$$

### ⚠ Achtung! Reihenfolge!

```
> restart;
> a := 5; b := 7;
a:=5
b:=7
```

(3.1.1)

```
> f := (a - b)^2;
f:=4
```

(3.1.2)

```
> a := 'a':
> f;
4
```

(3.1.3)

## ▼ Polynome und rationale Funktionen

```
> P:= (x^2 + 2*x +1);
P:= x2 + 2 x + 1
```

(4.1)

```
> Q := x+1;
Q:= x + 1
```

(4.2)

```
> P/Q;

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

```

(4.3)

```
> simplify( ); # Ctrl + L
Error, invalid input: simplify uses a 1st argument, s, which
is missing
```

```
> factor( );
Error, invalid input: factor uses a 1st argument, xFP, which
is missing
```

Vereinfachungen spaeter

## ▼ Konstanten

```
> Pi; gamma; Catalan;
π
γ
Catalan
```

(5.1)

```
> evalf(Catalan);
0.9159655942
```

(5.2)

```
> constants;
false, γ, ∞, true, Catalan, FAIL, π
```

(5.3)

## Elementare Funktionen

$$\text{> Pi;} \quad \pi \quad (6.1)$$

$$\text{> sin(Pi/2);} \quad 1 \quad (6.2)$$

$$\text{> cos(Pi);} \quad -1 \quad (6.3)$$

$$\text{> tan(Pi/2);} \quad \text{Error, (in tan) numeric exception: division by zero}$$

$$\text{> arccot(1);} \quad \frac{1}{4} \pi \quad (6.4)$$

$$\text{> exp(1);} \quad e \quad (6.5)$$

$$\text{> log(exp(1));} \quad 1 \quad (6.6)$$

## Summen

$$\text{> sum(j, j = 0 .. n);} \quad \frac{1}{2} (n+1)^2 - \frac{1}{2} n - \frac{1}{2} \quad (7.1)$$

$$\text{> normal(%);} \quad \frac{1}{2} n^2 + \frac{1}{2} n \quad (7.2)$$

$$\text{> sum(j^2, j = 0 .. n);} \quad \frac{1}{3} (n+1)^3 - \frac{1}{2} (n+1)^2 + \frac{1}{6} n + \frac{1}{6} \quad (7.3)$$

$$\text{> normal(%);} \quad \frac{1}{3} n^3 + \frac{1}{2} n^2 + \frac{1}{6} n \quad (7.4)$$

$$\text{> sum(q^j, j = 1 .. n);} \quad \frac{q^{n+1}}{q-1} - \frac{q}{q-1} \quad (7.5)$$

$$\text{> normal(%);} \quad \frac{q^{n+1} - q}{q-1} \quad (7.6)$$

$$\text{> sum(1/j^2, j = 1 .. infinity);}$$

$$\frac{1}{6} \pi^2 \quad (7.7)$$

```
> sum((-1)^(j+1) / j, j = 1 .. infinity);
Error, (in SumTools:-DefiniteSum:-ClosedForm) powering may
produce overflow
```

### ⚠ Achtung !

```
> sum(q^n, n = 0 .. infinity);
```

$$-\frac{1}{q-1} \quad (7.1.1)$$

```
> sum(4^n, n = 0 .. infinity);
```

$$\infty \quad (7.1.2)$$

## ▼ Grenzwerte

```
> a := (9*x^2 - 5)/(x-2)/(x+3);
```

$$a := \frac{9x^2 - 5}{(x-2)(x+3)} \quad (8.1)$$

```
> limit(a, x = infinity);
```

$$9 \quad (8.2)$$

```
> b := n!/n^n*exp(n)/sqrt(n);
```

$$b := \frac{n! e^n}{n^n \sqrt{n}} \quad (8.3)$$

```
> limit(b, n = infinity);
```

$$\sqrt{2} \sqrt{\pi} \quad (8.4)$$

## ▼ Integrale

```
> f := 1/(7+t^2);
```

$$f := \frac{1}{7+t^2} \quad (9.1)$$

```
> int(f, t);
```

$$\frac{1}{7} \sqrt{7} \arctan\left(\frac{1}{7} t \sqrt{7}\right) \quad (9.2)$$

```
> diff(,t);
Error, ``, ` unexpected
> diff((9.2),t); # Insert Label (Referenz einfüegen)
"strg/control L"
```

$$\frac{1}{7 \left(1 + \frac{1}{7} t^2\right)} \quad (9.3)$$

```
> simplify(9.3);
```

$$\frac{1}{7+t^2}$$

(9.4)

```
> int(exp(-x^2), x = -infinity .. infinity);
```

$$\sqrt{\pi}$$

(9.5)

## ▼ Hilfe!

```
[> ?
```