Ciselne obory v Maplu

Cela cisla

```
> 1;
```

1

```
> whattype(%);
```

integer

```
> ?surface
> 4^(4^4);
```

**13407807929942597099574024998205846127479365820\
0592393377723561443721764030073546976801874298\
1669034276900318581864860508537538828119465699\
46433649006084096**

Maple pouziva backslash k tomu, aby ukazal, ze vystup pokracuje na nasledujicim radku.

```
> length(%);
```

155

```
> 123\456\789;
```

123456789

Maximalni cele cislo, s kterym je Maple schopen pracovat (na 32-bitovych systemech)
ma

```
> kernelopts(maxdigits);
```

268435448

platnych cislic.

```
> 2^28-8;
```

268435448

```
> 4*((2^26-1)-1);
```

268435448

```
> 123456789^987654321;
Error, numeric exception: overflow
```

Pro cisla mensi nez 2^30 Maple nevyuziva dynamickeho datoveho vektoru.

```
> number:=10^29-10^14-1;
```

***number* := 99999999999999989999999999999**

Procedury pro praci s celymi cisly:

```
> isprime(%);
```

false

Overuje, zda zadane cislo je prvocislem.

```
> ifactor(number);
```

(61) (223) (97660768252549) (13166701) (5717)

```
> time(ifactor(3!!!));
```

0.026

Rozklad na prvocisla.

```
> nextprime(number);
```

$$99999999999999900000000000157$$

Urcuje nejblizsi vetsi prvocislo.

```
> prevprime(number);
```

$$99999999999999899999999999981$$

Nejblizsi mensi prvocislo.

```
> ithprime(9);
```

$$23$$

Vraci i-te prvocislo.

```
a:=1234: b:=56:
> q:=iquo(a,b);
```

$$q := 22$$

Celociselne deleni.

```
> r:=irem(a,b);
```

$$r := 2$$

Zbytek po celocislenem deleni.

```
> a=q*b+r;
```

$$1234 = 1234$$

```
> testeq(a=q*b+r);
```

$$true$$

Kontrola spravnosti.

```
> igcd(a,b);
```

$$2$$

Nejvetsi spolecny delitel celych cisel.

```
> lcm(21,35,99);
```

$$3465$$

Nejmensi spolecny nasobek cisel 21, 35 a 99.

```
> abs(-3);
```

$$3$$

Urceni absolutni hodnoty.

Racionalni cisla.

Maple automaticky odstranuje (krati) nejvetsiho spolecneho delitele citatele a jmenovatele
a pozaduje, aby byl jmenovatel kladny.

```
> 4/6;
```

$$\frac{2}{3}$$

```
> whattype(%);
```

$$\mathit{fraction}$$

```
> -3/-6;

Error, ‘-‘ unexpected
```

Cisla s pohyblivou desetinou carkou a irracionalni cisla

Maple neprovadi automaticky zjednoduseni. Upravu je nutno vyzadat.

```
> 25^(1/6);
```

$$25^{(1/6)}$$

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

$$5^{(1/3)}$$

```
> evalf(%%);
```

$$1.709975947$$

```
> convert(%%%, ‘float‘);
```

$$1.709975947$$

```
> whattype(%);
```

$$\mathit{float}$$

Zapis cisla 0,000001 ruznymi zpusoby:

```
> 0.1*10^(-5);
```

$$0.1000000000\ 10^{-5}$$

```
> 1E-6;
```

$$0.1\ 10^{-5}$$

```
> Float(1,-6);
```

$$0.1\ 10^{-5}$$

Cislo = mantisa * 10^(exponent)

```
> printf("%.6f", Float(1,-6));
0.000001
> evalf(sqrt(2));
```

1.414213562

Presnost aproximace je urcovano promennou Digits.

```
> Digits;
```

10

```
> Digits:=20;
```

Digits **:= 20**

```
> evalf(sqrt(2));
```

1.4142135623730950488

```
> evalf[150](Pi);
```

**3.14159265358979323846264338327950288419716939\
937510582097494459230781640628620899862803482534211706798214808651328230664709384460955058223172535940813**

```
> evalf(Pi, 150);
```

3.14159265358979323846264338327950288419716939

93751058209749445923078164062862089986280348253

42117067982148086513282306647093844609550582

3172535940813

```
> interface(displayprecision=6):
> evalf(Pi,150);
```

3.14159265358979323846264338327950288419716939

93751058209749445923078164062862089986280348253

42117067982148086513282306647093844609550582

3172535940813

```
> interface(displayprecision=-1):
> ?constants;
> constants;
```

$$false, \gamma, \infty, true, Catalan, FAIL, \pi$$

```
> Pi:=3.14;
Error, attempting to assign to ‘Pi‘ which is
protected
```

```
> ?inifcns;
> protect(’e’);
> macro(e=exp(1)):
> ln(e);
```

$$1$$

```
> 3/2*5;
```

$$\frac{15}{2}$$

```
> 3/2*5.0;
```

7.500000000000000000

Jakmile zadame nejake cislo v pohyblive desetinne carce, Maple pri vypoctu automaticky pouzije aproximativni aritmetiku.

```
> ceil(7.5);
```

8

```
> floor(7.5);
```

7

ceil(x) urci nejmensi cele cislo vetsi nebo rovne x, floor(x) nejvetsi cele cislo mensi nebo rovne x (pro realna x).

```
> round(7.4);round(7.6);round(7.5);
```

7

8

8

```
> trunc(7.4);trunc(-7.4);
```

7

-7

```
> frac(7.5);
```

0.5

frac(x) vraci desetinnou cast cisla x, tj. frac(x)=x-trunc(x).

Pocitani s odmocninami.

```
> (1/2+1/2*sqrt(5))^2;
```

$$\left(\frac{1}{2}+\frac{\sqrt{5}}{2}\right)^2$$

```
> expand(%);
```

$$\frac{3}{2}+\frac{\sqrt{5}}{2}$$

```
> 1/%;
```

$$\frac{1}{\frac{3}{2}+\frac{\sqrt{5}}{2}}$$

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

$$\frac{2}{3+\sqrt{5}}$$

```
> rationalize(%);
```

$$\frac{3}{2}-\frac{\sqrt{5}}{2}$$

```
> (-1-3*Pi-3*Pi^2-Pi^3)^(1/3);
```

$$(-1-3\,\pi-3\,\pi^2-\pi^3)^{(1/3)}$$

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

$$\frac{(\pi+1)\,(1+\sqrt{3}\,I)}{2}$$

```
> convert(%%, surd);
```

$$-(1+3\pi+3\pi^2+\pi^3)^{(1/3)}$$

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

$$-\pi-1$$

```
> (4+2*3^(1/2))^(1/2);
```

$$\sqrt{4+2\sqrt{3}}$$

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

$$\sqrt{3}+1$$

```
> sqrt(25+5*sqrt(5))-sqrt(5+sqrt(5))-2*sqrt
  (5-sqrt(5));
```

$$\sqrt{25+5\sqrt{5}}-\sqrt{5+\sqrt{5}}-2\sqrt{5-\sqrt{5}}$$

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

$$0$$

```
> radnormal(%);
```

$$0$$

```
> 1/(1+sqrt(2));
```

$$\frac{1}{1+\sqrt{2}}$$

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

$$\frac{1}{1+\sqrt{2}}$$

```
> radnormal(%, rationalized);
```

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

```
> restart;
```

Algebraicka cisla:
Koreny ireducibilnich polynomu nad racionalnimi cisly.

Vnitrni reprezentace algebraickych cisel pomoci procedury RootOf, napr. sqrt(2)
je reprezentovana nasledujicim zpusobem:

```
> alpha:=RootOf(z^2-2,z);
```

$$\alpha := \mathrm{RootOf}(\_Z^2-2)$$

Prevod na tvar "odmocniny" provadime pomoci procedury convert.

```
> convert(alpha, 'radical');
```

$$\sqrt{2}$$

Protoze alpha muze byt bud sqrt(2) nebo -sqrt(2), vsechny hodnoty ziskame pomoci prikazu allvalues:

```
> allvalues(alpha);
```

$$\sqrt{2}, -\sqrt{2}$$

Zpetny prevod:

```
> convert(sqrt(2), 'RootOf');
```

$$\mathrm{RootOf}(\_Z^2-2, index=1)$$

```
> simplify(alpha^2);
```

$$2$$

```
> simplify(1/(1+alpha));
```

$$\mathrm{RootOf}(\_Z^2 - 2) - 1$$

```
> alias(beta=RootOf(z^2-2,z)):
> 1/(1+beta)+1/(beta-1); simplify(%);
```

$$\frac{1}{1+\beta} + \frac{1}{\beta - 1}$$

$$2\,\beta$$

```
> convert((-8)^(1/3), 'RootOf');
```

$$1 + \mathrm{RootOf}(\_Z^2 + 3, index = 1)$$

```
> convert(sqrt(3), 'RootOf');
```

$$\mathrm{RootOf}(\_Z^2 - 3, index = 1)$$

```
> convert(%, 'radical');
```

$$\sqrt{3}$$

```
> root[3](2);
```

$$2^{(1/3)}$$

```
> convert(%, 'RootOf');
```

$$\mathrm{RootOf}(\_Z^3 - 2, index = 1)$$

Nekonecno

```
> infinity;
```

$$\infty$$

```
> infinity-123;
```

$$\infty$$

```
> infinity*5;
```

$$\infty$$

Komplexni cisla.

```
> restart;
> Complex(0,1); Complex(2,3);
```

$$I$$

$$2+3\,I$$

```
> (2+3*I)*(4+5*I);
```

$$-7+22\,I$$

```
> whattype(%);
```

$$\mathbf{complex}(\mathit{extended\_numeric})$$

```
> Re(%%), Im(%%), conjugate(%%), abs(%%);
```

$$-7,\ 22,\ -7-22\,I,\ \sqrt{533}$$

```
> 1/%%%;
```

$$\frac{-7}{533} - \frac{22}{533} I$$

```
> sqrt(-8);
```

$$2 I \sqrt{2}$$

```
> restart;
> 1/(2+a-b*I);
```

$$\frac{1}{2 + a - b I}$$

```
> evalc(%);
```

$$\frac{2 + a}{(2 + a)^2 + b^2} + \frac{b I}{(2 + a)^2 + b^2}$$

Provadi zjednoduseni v oboru komplexnich cisel.

```
> abs(%%);
```

$$\frac{1}{|2 + a - b I|}$$

```
> evalc(%);
```

$$\frac{1}{\sqrt{4 + 4 a + a^2 + b^2}}$$

```
> #interface(imaginaryunit=J);
> #Complex(2,3);
>
```