Ciselne obory v Maplu

Cela cisla

```
> 1;
```

$$1$$

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

$$integer$$

```
> ?type,surface
> type(1, integer);
```

$$true$$

intpos	integer i_0	integer i_1	.....	integer i_n

Figure 2.5. Internal representation of a positive integer.

```
> 4^(4^4);
```

$$134078079299425970995740249982058461274793658205923933772356144372176403007354697680187429816690342769003185818648605085375388281194656994643649006084096$$

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

$$123456789$$

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

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

$$155$$

```
>
```

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.

```
> 2^32-1;
```

$$4294967295$$

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

$$number := 99999999999999899999999999999$$

Procedury pro praci s celymi cisly:

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

$$false$$

Overuje, zda zadane cislo je prvocislem.

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

$$(61)\ (223)\ (13166701)\ (97660768252549)\ (5717)$$

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

$$0.031$$

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

$$(2)^{716}\ (3)^{356}\ (5)^{178}\ (7)^{118}\ (11)^{70}\ (13)^{59}\ (17)^{44}\ (19)^{38}\ (23)^{32}\ (29)^{24}\ (31)^{23}\ (37)^{19}\ (41)^{17}$$
$$(43)^{16}\ (47)^{15}\ (53)^{13}\ (59)^{12}\ (61)^{11}\ (67)^{10}\ (71)^{10}\ (73)^{9}\ (79)^{9}\ (83)^{8}\ (89)^{8}\ (97)^{7}\ (101)^{7}$$
$$(103)^{6}\ (107)^{6}\ (109)^{6}\ (113)^{6}\ (127)^{5}\ (131)^{5}\ (137)^{5}\ (139)^{5}\ (149)^{4}\ (151)^{4}\ (157)^{4}\ (163)^{4}$$
$$(167)^{4}\ (173)^{4}\ (179)^{4}\ (181)^{3}\ (191)^{3}\ (193)^{3}\ (197)^{3}\ (199)^{3}\ (211)^{3}\ (223)^{3}\ (227)^{3}\ (229)^{3}$$
$$(233)^{3}\ (239)^{3}\ (241)^{2}\ (251)^{2}\ (257)^{2}\ (263)^{2}\ (269)^{2}\ (271)^{2}\ (277)^{2}\ (281)^{2}\ (283)^{2}\ (293)^{2}$$
$$(307)^{2}\ (311)^{2}\ (313)^{2}\ (317)^{2}\ (331)^{2}\ (337)^{2}\ (347)^{2}\ (349)^{2}\ (353)^{2}\ (359)^{2}\ (367)\ (373)\ (379)$$
$$383)\ (389)\ (397)\ (401)\ (409)\ (419)\ (421)\ (431)\ (433)\ (439)\ (443)\ (449)\ (457)\ (461)\ (463$$
$$467)\ (479)\ (487)\ (491)\ (499)\ (503)\ (509)\ (521)\ (523)\ (541)\ (547)\ (557)\ (563)\ (569)\ (571$$
$$577)\ (587)\ (593)\ (599)\ (601)\ (607)\ (613)\ (617)\ (619)\ (631)\ (641)\ (643)\ (647)\ (653)\ (659$$
$$661)\ (673)\ (677)\ (683)\ (691)\ (701)\ (709)\ (719)$$

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
```

```
>
```

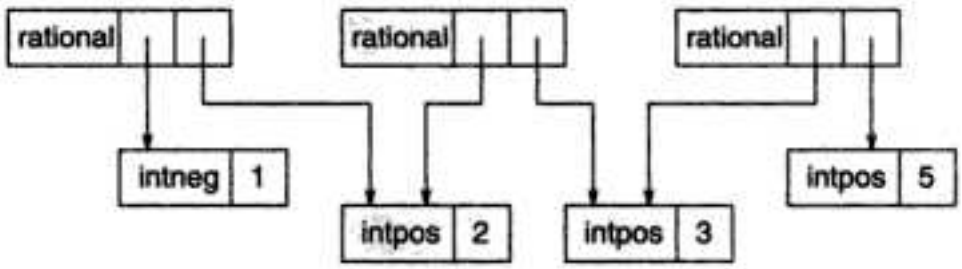

Figure 2.6. Internal representation of the fractions $-\frac{1}{2}$, $\frac{2}{3}$, and $\frac{3}{5}$.

Cisla s pohyblivou desetinou carkou a irracionalni cisla

Maple neprovadi automaticky zjednoduseni. Upravu je nutno vyzadat.

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

$25^{(1/3)}$

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

$5^{(1/3)}$

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

1.709975947

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

1.709975947

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

float

Float(mantissa, exponent)

cislo=mantisa*10^exponent

Zapis cisla 0,000001 ruznymi zpusoby:

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

0.000001

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

0.000001

```
> 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);
```

3.14159265358979323846264338327950288419716939937510582097494459230781628620899862803482534211706798214808651328230664709384460955058223153594081 3

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

3.14159265358979323846264338327950288419716939937510582097494459230781628620899862803482534211706798214808651328230664709384460955058223153594081 3

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

3.14159265358979323846264338327950288419716939937510582097494459230781628620899862803482534211706798214808651328230664709384460955058223153594081 3

Nemeni presnost vypoctu, pouze zpusob zobrazeni.

```
> interface(displayprecision=-1):
```

Vraci puvodni hodnotu (rusi predchozi omezeni).

```
> ?constants;
> constants;
```

false, γ, ∞, *true*, *Catalan*, *FAIL*, π

```
> 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;
```

7.5000000000000000000

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;
```

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

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

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

```
> 1/%;
```

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

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

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

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

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

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

$$0$$

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

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

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

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

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

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

```
> (-8)^(1/3);
```

$$(-8)^{(1/3)}$$

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

$$1 + J\sqrt{3}$$

```
> with(RealDomain);
```

```
Warning, these protected names have been redefined and unprotected: Im, Re, `^`,
arccos, arccosh, arccot, arccoth, arccsc, arccsch, arcsec, arcsech, arcsin, arcsinh,
arctan, arctanh, cos, cosh, cot, coth, csc, csch, eval, exp, expand, limit, ln, log,
sec, sech, signum, simplify, sin, sinh, solve, sqrt, surd, tan, tanh
```

[ℑ, ℜ, ^, arccos, arccosh, arccot, arccoth, arccsc, arccsch, arcsec, arcsech, arcsin, arcsinh, arctan, arctanh, cos, cosh, cot, coth, csc, csch, *eval*, exp, *expand*, *limit*, ln, log, sec, sech, signum, *simplify*, sin, sinh, *solve*, sqrt, surd, tan, tanh]

```
> (-8)^(1/3);
```

$$-2$$

```
> restart;
```

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

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

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

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

```
> use RealDomain in simplify((-1-3*Pi-3*Pi^2-Pi^3)^(1/3)) end use;
```

$$-\pi - 1$$

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');
```

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

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

$$2$$

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

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

```
> 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');
```

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

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

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

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

$$\sqrt{3}$$

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

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

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

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

Nekonecno

```
> infinity;
```

$$\infty$$

```
> infinity-123;
```

$$\infty$$

```
> infinity*5;
```

$$\infty$$

Komplexni cisla.

```
> restart;
```

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

$$J$$

$$2 + 3\,J$$

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

$$-7 + 22\,J$$

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

$$complex(extended\_numeric)$$

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

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

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

$$-\frac{7}{533} - \frac{22}{533}\,J$$

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

$$2\,J\sqrt{2}$$

```
> restart;
```

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

$$\frac{1}{2 + a - J\,b}$$

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

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

Provadi zjednoduseni v oboru komplexnich cisel.

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

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

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

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

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