9.5. `fractions` — Rational numbers

Source code: Lib/fractions.py

The `fractions` module provides support for rational number arithmetic.

A Fraction instance can be constructed from a pair of integers, from another rational number, or from a string.

class `fractions.`**`Fraction`**(*numerator=0*, *denominator=1*)
class `fractions.`**`Fraction`**(*other_fraction*)
class `fractions.`**`Fraction`**(*float*)
class `fractions.`**`Fraction`**(*decimal*)
class `fractions.`**`Fraction`**(*string*)

The first version requires that *numerator* and *denominator* are instances of `numbers.Rational` and returns a new `Fraction` instance with value `numerator/denominator`. If *denominator* is `0`, it raises a `ZeroDivisionError`. The second version requires that *other_fraction* is an instance of `numbers.Rational` and returns a `Fraction` instance with the same value. The next two versions accept either a `float` or a `decimal.Decimal` instance, and return a `Fraction` instance with exactly the same value. Note that due to the usual issues with binary floating-point (see Floating Point Arithmetic: Issues and Limitations), the argument to `Fraction(1.1)` is not exactly equal to 11/10, and so `Fraction(1.1)` does *not* return `Fraction(11, 10)` as one might expect. (But see the documentation for the `limit_denominator()` method below.) The last version of the constructor expects a string or unicode instance. The usual form for this instance is:

```
[sign] numerator ['/' denominator]
```

where the optional `sign` may be either '+' or '-' and `numerator` and `denominator` (if present) are strings of decimal digits. In addition, any string that represents a finite value and is accepted by the `float` constructor is also accepted by the `Fraction` constructor. In either form the input string may also have leading and/or trailing whitespace. Here are some examples:

```
>>> from fractions import Fraction
>>> Fraction(16, -10)
Fraction(-8, 5)
>>> Fraction(123)
Fraction(123, 1)
>>> Fraction()
Fraction(0, 1)
```

```
>>> Fraction('3/7')
Fraction(3, 7)
>>> Fraction(' -3/7 ')
Fraction(-3, 7)
>>> Fraction('1.414213 \t\n')
Fraction(1414213, 1000000)
>>> Fraction('-.125')
Fraction(-1, 8)
>>> Fraction('7e-6')
Fraction(7, 1000000)
>>> Fraction(2.25)
Fraction(9, 4)
>>> Fraction(1.1)
Fraction(2476979795053773, 2251799813685248)
>>> from decimal import Decimal
>>> Fraction(Decimal('1.1'))
Fraction(11, 10)
```

The `Fraction` class inherits from the abstract base class `numbers.Rational`, and implements all of the methods and operations from that class. `Fraction` instances are hashable, and should be treated as immutable. In addition, `Fraction` has the following properties and methods:

Changed in version 3.2: The `Fraction` constructor now accepts `float` and `decimal.Decimal` instances.

numerator

Numerator of the Fraction in lowest term.

denominator

Denominator of the Fraction in lowest term.

from_float(*flt*)

This class method constructs a `Fraction` representing the exact value of *flt*, which must be a `float`. Beware that `Fraction.from_float(0.3)` is not the same value as `Fraction(3, 10)`.

> **Note:** From Python 3.2 onwards, you can also construct a `Fraction` instance directly from a `float`.

from_decimal(*dec*)

This class method constructs a `Fraction` representing the exact value of *dec*, which must be a `decimal.Decimal` instance.

> **Note:** From Python 3.2 onwards, you can also construct a `Fraction` instance directly from a `decimal.Decimal` instance.

limit_denominator(*max_denominator=1000000*)

Finds and returns the closest Fraction to self that has denominator at most max_denominator. This method is useful for finding rational approximations to a given floating-point number:

```
>>> from fractions import Fraction
>>> Fraction('3.1415926535897932').limit_denominator(1000)
Fraction(355, 113)
```

or for recovering a rational number that's represented as a float:

```
>>> from math import pi, cos
>>> Fraction(cos(pi/3))
Fraction(4503599627370497, 9007199254740992)
>>> Fraction(cos(pi/3)).limit_denominator()
Fraction(1, 2)
>>> Fraction(1.1).limit_denominator()
Fraction(11, 10)
```

__floor__()

Returns the greatest `int <= self`. This method can also be accessed through the `math.floor()` function:

```
>>> from math import floor
>>> floor(Fraction(355, 113))
3
```

__ceil__()

Returns the least `int >= self`. This method can also be accessed through the `math.ceil()` function.

__round__()
__round__(*ndigits*)

The first version returns the nearest `int` to `self`, rounding half to even. The second version rounds `self` to the nearest multiple of `Fraction(1, 10**ndigits)` (logically, if `ndigits` is negative), again rounding half toward even. This method can also be accessed through the `round()` function.

`fractions.`**gcd**(*a*, *b*)

Return the greatest common divisor of the integers *a* and *b*. If either *a* or *b* is nonzero, then the absolute value of `gcd(a, b)` is the largest integer that divides both *a* and *b*. `gcd(a,b)` has the same sign as *b* if *b* is nonzero; otherwise it takes the sign of *a*. `gcd(0, 0)` returns `0`.

Deprecated since version 3.5: Use `math.gcd()` instead.

See also:

Module `numbers`
The abstract base classes making up the numeric tower.