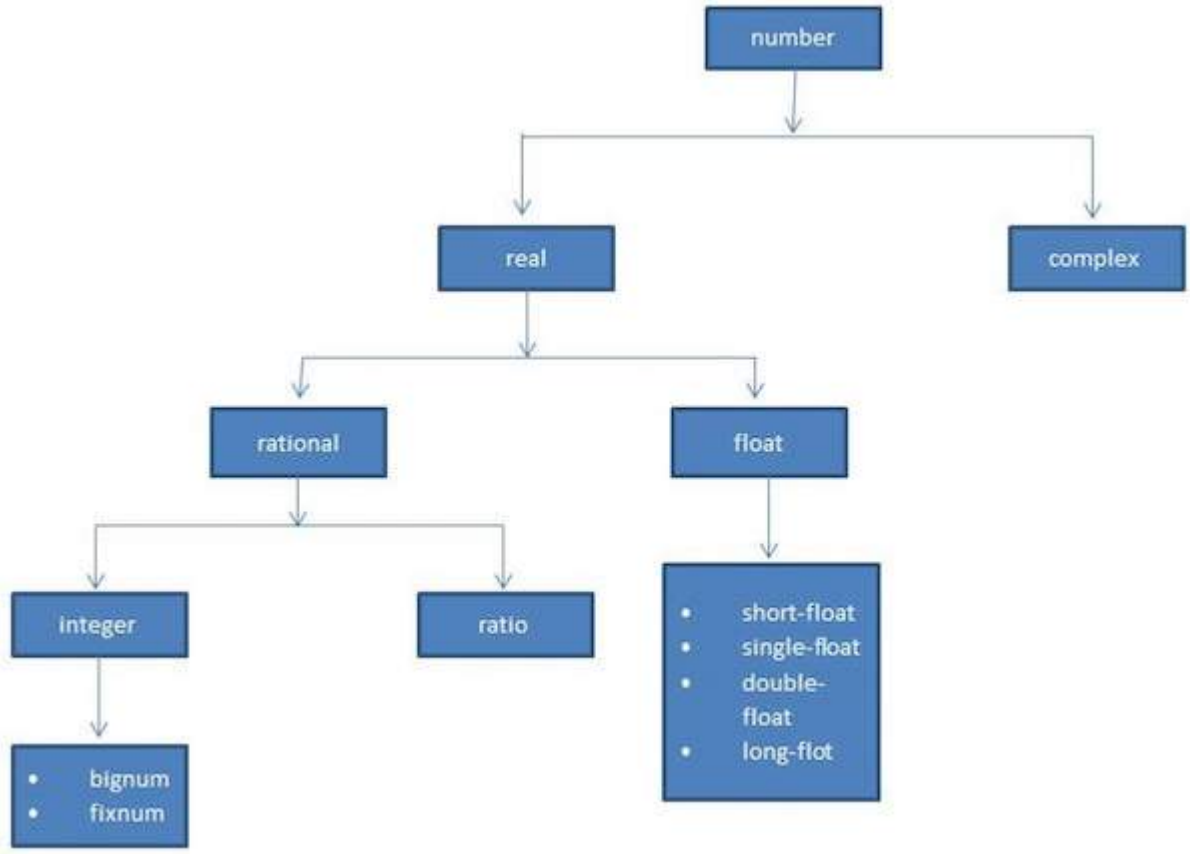
LISP - NUMBERS

Common Lisp defines several kinds of numbers. The **number** data type includes various kinds of numbers supported by LISP.

The number types supported by LISP are:

- Integers
- Ratios
- Floating-point numbers
- Complex numbers

The following diagram shows the number hierarchy and various numeric data types available in LISP:



Various Numeric Types in LISP

The following table describes various number type data available in LISP:

Data type	Description
fixnum	This data type represents integers which are not too large and mostly in the range -215 to 215-1 *itismachine − dependent*
bignum	These are very large numbers with size limited by the amount of memory allocated for LISP, they are not fixnum numbers.
ratio	Represents the ratio of two numbers in the numerator/denominator form. The / function always produce the result in ratios, when its arguments are integers.
float	It represents non-integer numbers. There are four float data types with increasing precision.

complex	It represents complex numbers, which are denoted by #c. The real and imaginary parts could be both either rational or floating point numbers.

Example

Create a new source code file named main.lisp and type the following code in it.

```
(write (/ 1 2))
(terpri)
(write ( + (/ 1 2) (/ 3 4)))
(terpri)
(write ( + #c( 1 2) #c( 3 -4)))
```

When you execute the code, it returns the following result:

```
1/2
5/4
#C(4 -2)
```

Number Functions

The following table describes some commonly used numeric functions:

Function	Description
+, -, *, /	Respective arithmetic operations
sin, cos, tan, acos, asin, atan	Respective trigonometric functions.
sinh, cosh, tanh, acosh, asinh, atanh	Respective hyperbolic functions.
exp	Exponentiation function. Calculates e^x
expt	Exponentiation function, takes base and power both.
sqrt	It calculates the square root of a number.
log	Logarithmic function. It one parameter is given, then it calculates its natural logarithm, otherwise the second parameter is used as base.
conjugate	It calculates the complex conjugate of a number. In case of a real number, it returns the number itself.
abs	It returns the absolute value *ormagnitude* of a number.
gcd	It calculates the greatest common divisor of the given numbers
lcm	It calculates the least common multiple of the given numbers
isqrt	It gives the greatest integer less than or equal to the exact square root of a given natural number.
floor, ceiling, truncate, round	All these functions take two arguments as a number and returns the quotient; **floor** returns the largest integer that is not greater than ratio, **ceiling** chooses the smaller integer that is larger than ratio, **truncate** chooses the integer of the same sign as ratio with the largest absolute value that is less than absolute value of ratio, and **round** chooses an integer that is closest to ratio.

ffloor, fceiling, ftruncate, fround	Does the same as above, but returns the quotient as a floating point number.
mod, rem	Returns the remainder in a division operation.
float	Converts a real number to a floating point number.
rational, rationalize	Converts a real number to rational number.
numerator, denominator	Returns the respective parts of a rational number.
realpart, imagpart	Returns the real and imaginary part of a complex number.

Example

Create a new source code file named main.lisp and type the following code in it.

```
(write (/ 45 78))
(terpri)
(write (floor 45 78))
(terpri)
(write (/ 3456 75))
(terpri)
(write (floor 3456 75))
(terpri)
(write (ceiling 3456 75))
(terpri)
(write (truncate 3456 75))
(terpri)
(write (round 3456 75))
(terpri)
(write (ffloor 3456 75))
(terpri)
(write (fceiling 3456 75))
(terpri)
(write (ftruncate 3456 75))
(terpri)
(write (fround 3456 75))
(terpri)
(write (mod 3456 75))
(terpri)
(setq c (complex 6 7))
(write c)
(terpri)
(write (complex 5 -9))
(terpri)
(write (realpart c))
(terpri)
(write (imagpart c))
```

When you execute the code, it returns the following result:

```
15/26
0
1152/25
46
47
46
46
46.0
47.0
```

```
46.0
46.0
6
#C(6 7)
#C(5 -9)
6
7
```