Built-in Types

The following sections describe the standard types that are built into the interpreter.

The principal built-in types are numerics, sequences, mappings, classes, instances and exceptions.

Some collection classes are mutable. The methods that add, subtract, or rearrange their members in place, and don't return a specific item, never return the collection instance itself but `None`.

Some operations are supported by several object types; in particular, practically all objects can be compared for equality, tested for truth value, and converted to a string (with the `repr()` function or the slightly different `str()` function). The latter function is implicitly used when an object is written by the `print()` function.

Truth Value Testing

Any object can be tested for truth value, for use in an `if` or `while` condition or as operand of the Boolean operations below.

By default, an object is considered true unless its class defines either a `__bool__()` method that returns `False` or a `__len__()` method that returns zero, when called with the object. [1] Here are most of the built-in objects considered false:

- constants defined to be false: `None` and `False`
- zero of any numeric type: `0`, `0.0`, `0j`, `Decimal(0)`, `Fraction(0, 1)`
- empty sequences and collections: `''`, `()`, `[]`, `{}`, `set()`, `range(0)`

Operations and built-in functions that have a Boolean result always return `0` or `False` for false and `1` or `True` for true, unless otherwise stated. (Important exception: the Boolean operations `or` and `and` always return one of their operands.)

Boolean Operations — `and`, `or`, `not`

These are the Boolean operations, ordered by ascending priority:

Operation	Result	Notes
`x or y`	if *x* is true, then *x*, else *y*	(1)
`x and y`	if *x* is false, then *x*, else *y*	(2)
`not x`	if *x* is false, then `True`, else `False`	(3)

Notes:

1. This is a short-circuit operator, so it only evaluates the second argument if the first one is false.
2. This is a short-circuit operator, so it only evaluates the second argument if the first one is true.

Comparisons

There are eight comparison operations in Python. They all have the same priority (which is higher than that of the Boolean operations). Comparisons can be chained arbitrarily; for example, `x < y <= z` is equivalent to `x < y and y <= z`, except that *y* is evaluated only once (but in both cases *z* is not evaluated at all when `x < y` is found to be false).

This table summarizes the comparison operations:

Operation	**Meaning**
`<`	strictly less than
`<=`	less than or equal
`>`	strictly greater than
`>=`	greater than or equal
`==`	equal
`!=`	not equal
`is`	object identity
`is not`	negated object identity

Objects of different types, except different numeric types, never compare equal. The == operator is always defined but for some object types (for example, class objects) is equivalent to `is`. The <, <=, > and >= operators are only defined where they make sense; for example, they raise a `TypeError` exception when one of the arguments is a complex number.

Non-identical instances of a class normally compare as non-equal unless the class defines the `__eq__()` method.

Instances of a class cannot be ordered with respect to other instances of the same class, or other types of object, unless the class defines enough of the methods `__lt__()`, `__le__()`, `__gt__()`, and `__ge__()` (in general, `__lt__()` and `__eq__()` are sufficient, if you want the conventional meanings of the comparison operators).

The behavior of the `is` and `is not` operators cannot be customized; also they can be applied to any two objects and never raise an exception.

Two more operations with the same syntactic priority, `in` and `not in`, are supported by types that are iterable or implement the `__contains__()` method.

Numeric Types — `int`, `float`, `complex`

There are three distinct numeric types: *integers*, *floating-point numbers*, and *complex numbers*. In addition, Booleans are a subtype of integers. Integers have unlimited precision. Floating-point numbers are

Complex numbers have a real and imaginary part, which are each a floating-point number. To extract these parts from a complex number *z*, use `z.real` and `z.imag`. (The standard library includes the additional numeric types `fractions.Fraction`, for rationals, and `decimal.Decimal`, for floating-point numbers with user-definable precision.)

Numbers are created by numeric literals or as the result of built-in functions and operators. Unadorned integer literals (including hex, octal and binary numbers) yield integers. Numeric literals containing a decimal point or an exponent sign yield floating-point numbers. Appending `'j'` or `'J'` to a numeric literal yields an imaginary number (a complex number with a zero real part) which you can add to an integer or float to get a complex number with real and imaginary parts.

Python fully supports mixed arithmetic: when a binary arithmetic operator has operands of different numeric types, the operand with the "narrower" type is widened to that of the other, where integer is narrower than floating point, which is narrower than complex. A comparison between numbers of different types behaves as though the exact values of those numbers were being compared. [2]

The constructors `int()`, `float()`, and `complex()` can be used to produce numbers of a specific type.

All numeric types (except complex) support the following operations (for priorities of the operations, see Operator precedence):

Operation	**Result**	**Notes**	**Full documentation**
`x + y`	sum of *x* and *y*		
`x - y`	difference of *x* and *y*		
`x * y`	product of *x* and *y*		
`x / y`	quotient of *x* and *y*		
`x // y`	floored quotient of *x* and *y*	(1)(2)	
`x % y`	remainder of `x / y`	(2)	
`-x`	*x* negated		
`+x`	*x* unchanged		
`abs(x)`	absolute value or magnitude of *x*		`abs()`
`int(x)`	*x* converted to integer	(3)(6)	`int()`
`float(x)`	*x* converted to floating point	(4)(6)	`float()`
`complex(re, im)`	a complex number with real part *re*, imaginary part *im*. *im* defaults to zero.	(6)	`complex()`
`c.conjugate()`	conjugate of the complex number *c*		
`divmod(x, y)`	the pair `(x // y, x % y)`	(2)	`divmod()`
`pow(x, y)`	*x* to the power *y*	(5)	`pow()`