

The Best* Python Cheat Sheet

Just what you need

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Keywords

and	del	global	nonlocal	type ^❶
as	elif	if	not	while
assert	else	import	or	with
break	except	in	pass	yield
case ^❶	False	is	raise	_ ^❶
class	finally	lambda	return	
continue	for	match ^❶	True	
def	from	None	try	

^❶Soft keywords

Scope

Scope levels:

Builtin	Names pre-assigned in <i>builtins</i> module	Generator expression	Names contained within generator expression
Module (global)	Names defined in current module Code in global scope cannot access local variables	Comprehension	Names contained within comprehension
Enclosing (closure)	Names defined in any enclosing functions	Class	Names shared across all instances
Function (local)	Names defined in current function By default, has read-only access to module and enclosing function names By default, assignment creates a new local name <i>global <name></i> grants read/write access to specified module name <i>nonlocal <name></i> grants read/write access to specified name in closest enclosing function defining that name	Instance	Names contained within a specific instance
		Method	Names contained within a specific instance method

- *globals()* - return *dict* of module scope variables
- *locals()* - return *dict* of local scope variables

```
>>> global_variable = 1
>>> def read_global():
...     print(global_variable)
...     local_variable = "only available in this function"
...     print(local_variable)
>>> read_global()
1

>>> def write_global():
...     global global_variable
...     global_variable = 2
>>> write_global()
>>> print(global_variable)
2

>>> def write_nonlocal():
...     x = 1
...     def nested():
...         nonlocal x
...         x = 2
...     nested()
...     print(x)
>>> write_nonlocal()
2

>>> class C:
...     class_variable = 1
...     def __init__(self):
...         self.instance_variable = 2
...     def method(self):
...         self.instance_variable = 3
...         C.class_variable = 3
...         method_variable = 1
```

Operators

Precedence (high->low)	Description
(...,) [...], {...}, {...:...},	tuple, list, set, dict
s[i] s[i:j] s.attr f(...)	index, slice, attribute, function call
await x	await expression
+x, -x, ~x	unary positive, negative, bitwise NOT
x ** y	power
x * y, x @ y, x / y, x // y, x % y	multiply, maxtrix multiply, divide, floor divide, modulus
x + y, x - y	add, subtract
x << y x >> y	bitwise shift left, right
x & y	bitwise and
x ^ y	bitwise exclusive or
x y	bitwise or
x<y x<=y x>y x>=y x==y x!=y	comparison,
x is y x is not y	identity,
x in s x not in s	membership
not x	boolean negation
x and y	boolean and
x or y	boolean or
if - else	conditional expression
lambda	lambda expression
:=	assignment expression
Assignment	Usually equivalent
a = b	Assign object b to label a
a += b	a = a + b
a -= b	a = a - b
a *= b	a = a * b
a /= b	a = a / b (true division)
a //= b	a = a // b (floor division)
a %= b	a = a % b
a **= b	a = a ** b
a &= b	a = a & b
a = b	a = a b
a ^= b	a = a ^ b
a >>= b	a = a >> b
a <<= b	a = a << b

Splat * operator**Function definition**

```

def f(*args): ...           # f(1, 2, 3)
def f(x, *args): ...        # f(1, 2, 3)
def f(*args, z): ...        # f(1, 2, z=3)

def f(**kwargs): ...        # f(x=1, y=2, z=3)
def f(x, **kwargs): ...     # f(x=1, y=2, z=3) | f(1, y=2, z=3)
def f(*args, **kwargs): ... # f(x=1, y=2, z=3) | f(1, y=2, z=3) | f(1, 2, z=3) | f(1, 2, 3)
def f(x, *args, **kwargs): ... # f(x=1, y=2, z=3) | f(1, y=2, z=3) | f(1, 2, z=3) | f(1, 2, 3)
def f(*args, y, **kwargs): ... # f(x=1, y=2, z=3) | f(1, y=2, z=3)

def f(*, x, y, z): ...       # f(x=1, y=2, z=3)
def f(x, *, y, z): ...       # f(x=1, y=2, z=3) | f(1, y=2, z=3)
def f(x, y, *, z): ...       # f(x=1, y=2, z=3) | f(1, y=2, z=3) | f(1, 2, z=3)

```

Function call

```

args = (1, 2)           # * expands sequence to positional arguments
kwargs = {'x': 3, 'y': 4} # ** expands dictionary to keyword arguments
func(*args, **kwargs)    # is the same as:
func(1, 2, x=3, y=4)

```

Unpacking

```

head, *body = s          # unpack assignment
head, *body, tail = s
*body, tail = s
s = [*it, ...]           # unpack to list
s = (*it, ...)           # unpack to tuple
s = {*it, ...}           # unpack to set
d2 = {**d1, ...}         # unpack to dict

```

Flow control

```

for item in <iterable>:
    ...
[else:
    ...]                  # if loop completes without break

while <condition>:
    ...
[else:
    ...]                  # if loop completes without break

break                    # immediately exit loop
continue                 # skip to next loop iteration
return [value]           # exit function, return value | None
yield [value]            # exit generator, yield value | None
assert <expr>[, message] # if not expr raise AssertionError(message)

```

```

if condition:
    ...
[elif condition:
    ...]*
[else:
    ...]

<expression1> if <condition> else <expression2>

with <expression> [as name]:
    ...

```

Match**3.10+**

```

match <expression>:
    case <pattern> [if <condition>]:
        ...
    case <pattern1> | <pattern2>:      # OR pattern
    case _                             # default case
    ...

```

Match case pattern

1/'abc' /True/None/math.pi	Value pattern, match literal or dotted name
<type>()	Class pattern, match any object of that type
<type>(<name>=<pattern>, ...)	Class pattern, match object with matching attributes
<name>	Capture pattern, match any object, bind to name
_	Wildcard, match any object
<pattern> <pattern> [...]	Or pattern, match any of the patterns
<pattern> as <name>	As pattern, bind match to name
[<pattern>[, ...[, *args]]	Sequence pattern (list tuple) matches sequence with matching items
{<value_pattern>: <pattern>[, ...[, **kws]]}	Mapping pattern matches any dictionary with matching items

- Class patterns **do not** create a new instance of the class
- Patterns can be bracketed to override precedence [| > as > ,]
- Built-in types allow a single positional pattern that is matched against the entire object.
- Names bound in the matching case + names bound in its block are visible after the match statement

Context manager

A *with* statement takes an object with special methods:

- `__enter__()` - locks resources and optionally returns an object
- `__exit__()` - releases resources, handles an exception raised in the block, optionally suppressing it by returning True

```

class MyOpen:
    def __init__(self, filename):
        self.filename = filename
    def __enter__(self):
        self.file = open(self.filename)
        return self.file
    def __exit__(self, exc_type, exception, traceback):
        self.file.close()

>>> with open('test.txt', 'w') as file: ...
...     file.write('Hello World!')
>>> with MyOpen('test.txt') as file: ...
...     print(file.read())
Hello World!

```

Class

Instantiation

```

class C:
    def __init__(self, a):
        self.a = a
    def __repr__(self):
        """Used for repr(c), also for str(c) if __str__ not defined."""
        return f'{self.__class__.__name__}({self.a!r})'
    def __str__(self):
        return str(self.a)

    @classmethod
    def get_class_name(cls): # passed class rather than instance
        return cls.__name__

    @staticmethod
    def static(): # passed nothing
        return 1

# class instantiation does this
obj = cls.__new__(cls, *args, **kwds)
if isinstance(obj, cls):
    obj.__init__(*args, **kwds)

```

Instance property

```

class C:
    @property
    def f(self):
        if not hasattr(self, '_f'):
            return
        return self._f
    @f.setter
    def f(self, value):
        self._f = value

```

Class special methods

Operator	Method
self + other	<code>--add__(self, other)</code>
other + self	<code>--radd__(self, other)</code>
self += other	<code>--iadd__(self, other)</code>
self - other	<code>--sub__(self, other)</code>
other - self	<code>--rsub__(self, other)</code>
self -= other	<code>--isub__(self, other)</code>
self * other	<code>--mul__(self, other)</code>
other * self	<code>--rmul__(self, other)</code>
self *= other	<code>--imul__(self, other)</code>
self @ other	<code>--matmul__(self, other)</code>
other @ self	<code>--rmatmul__(self, other)</code>
self @= other	<code>--imatmul__(self, other)</code>
self / other	<code>--truediv__(self, other)</code>
other / self	<code>--rtruediv__(self, other)</code>
self /= other	<code>--itruediv__(self, other)</code>
self // other	<code>--floordiv__(self, other)</code>
other // self	<code>--rfloordiv__(self, other)</code>
self //= other	<code>--ifloordiv__(self, other)</code>
self % other	<code>--mod__(self, other)</code>
other % self	<code>--rmod__(self, other)</code>
self %= other	<code>--imod__(self, other)</code>
self ** other	<code>--pow__(self, other)</code>
other ** self	<code>--rpow__(self, other)</code>
self **= other	<code>--ipow__(self, other)</code>
self << other	<code>--lshift__(self, other)</code>
other << self	<code>--rlshift__(self, other)</code>
self <<= other	<code>--ilshift__(self, other)</code>
self >> other	<code>--rshift__(self, other)</code>
other >> self	<code>--rrshift__(self, other)</code>
self >>= other	<code>--irshift__(self, other)</code>
self & other	<code>--and__(self, other)</code>
other & self	<code>--rand__(self, other)</code>
self &= other	<code>--iand__(self, other)</code>
self other	<code>--or__(self, other)</code>
other self	<code>--ror__(self, other)</code>
self = other	<code>--ior__(self, other)</code>
self ^ other	<code>--xor__(self, other)</code>
other ^ self	<code>--rxor__(self, other)</code>
self ^= other	<code>--ixor__(self, other)</code>
<code>divmod(self, other)</code>	<code>--divmod__(self, other)</code>
<code>divmod(self, other)</code>	<code>--rdivmod__(self, other)</code>

Operator	Method
-self	<code>__neg__(self)</code>
+self	<code>__pos__(self)</code>
<code>abs(self)</code>	<code>__abs__(self)</code>
~self	<code>__invert__(self)</code> [bitwise]
<code>self == other</code>	<code>__eq__(self)</code> [default 'is', requires <code>__hash__</code>]
<code>self != other</code>	<code>__ne__(self)</code>
<code>self < other</code>	<code>__lt__(self, other)</code>
<code>self <= other</code>	<code>__le__(self, other)</code>
<code>self > other</code>	<code>__gt__(self, other)</code>
<code>self >= other</code>	<code>__ge__(self, other)</code>
<code>item in self</code>	<code>__contains__(self, item)</code>
<code>bool(self)</code>	<code>__bool__(self)</code>
<code>bytes(self)</code>	<code>__bytes__(self)</code>
<code>complex(self)</code>	<code>__complex__(self)</code>
<code>float(self)</code>	<code>__float__(self)</code>
<code>int(self)</code>	<code>__int__(self)</code>
<code>round(self)</code>	<code>__round__(self[, ndigits])</code>
<code>math.ceil(self)</code>	<code>__ceil__(self)</code>
<code>math.floor(self)</code>	<code>__floor__(self)</code>
<code>math.trunc(self)</code>	<code>__trunc__(self)</code>
<code>dir(self)</code>	<code>__dir__(self)</code>
<code>format(self)</code>	<code>__format__(self, format_spec)</code>
<code>hash(self)</code>	<code>__hash__(self)</code>
<code>iter(self)</code>	<code>__iter__(self)</code>
<code>len(self)</code>	<code>__len__(self)</code>
<code>repr(self)</code>	<code>__repr__(self)</code>
<code>reversed(self)</code>	<code>__reversed__(self)</code>
<code>str(self)</code>	<code>__str__(self)</code>
<code>self(*args, **kwargs)</code>	<code>__call__(self, *args, **kwargs)</code>
<code>self[...]</code>	<code>__getitem__(self, key)</code>
<code>self[...] = 1</code>	<code>__setitem__(self, key, value)</code>
<code>del self[...]</code>	<code>__delitem__(self, key)</code>
<code>other[self]</code>	<code>__index__(self)</code>
<code>self.name</code>	<code>__getattr__(self, name)</code> <code>__getattr__(self, name)</code> [if <code>AttributeError</code>]
<code>self.name = 1</code>	<code>__setattr__(self, name, value)</code>
<code>del self.name</code>	<code>__delattr__(self, name)</code>
<code>with self:</code>	<code>__enter__(self)</code> <code>__exit__(self, exc_type, exc_value, traceback)</code>
<code>await self</code>	<code>__await__(self)</code>

Iterator / Iterable

```
def IterableIterator:
    def __iter__(self):
        """Return iterator to make class iterable."""
        return self

    def __next__(self):
        """Implement to be iterable."""
        if at_the_end:
            raise StopIteration
        return next_item

c = IterableIterator()
it = iter(c) # get iterator
next(it)     # get next item
while value := next(it):
    print(value)
```

Generator

```
g = (expression for item in iterable if condition) # generator expression

def gen():
    """Generator function"""
    for i in range(10):
        yield i
g = gen()

next(g)          # next item
list(g)          # list all items
yield from g     # delegate yield to another generator
```

String

Immutable sequence of characters.

<code><substring> in s</code>	True if string contains <i>substring</i>	<code>s.ljust(width, fillchar=' ')</code>	Left justify with <i>fillchar</i>
<code>s.startswith(<prefix>[, start[, end]])</code>	True if string starts with <i>prefix</i> , optionally search bounded substring	<code>s.rjust(width, fillchar=' ')</code>	Right justify with <i>fillchar</i>
<code>s.endswith(<suffix>[, start[, end]])</code>	True if string ends with <i>suffix</i> , optionally search bounded substring	<code>s.center(width, fillchar=' ')</code>	Center with <i>fillchar</i>
<code>s.strip(chars=None)</code>	Strip whitespace from both ends, or passed characters	<code>s.rstrip(chars=None)</code>	Strip whitespace from right end, or passed characters
<code>s.lstrip(chars=None)</code>	Strip whitespace from left end, or passed characters	<code>s.split(sep=None, maxsplit=-1)</code>	Split on whitespace, or <i>sep</i> str at most <i>maxsplit</i> times
<code>s.rstrip(chars=None)</code>	Strip whitespace from right end, or passed characters	<code>s.splitlines(keepend s=False)</code>	Split lines on <code>[\n\r\f\v\x1c-\x1e\x85\u2028\u2029]</code> and <code>\r\n</code>

<code><separator>.join(<strings>)</code>	Join <i>strings</i> with <i>separator</i>	<code>ord(<str>)</code>	Unicode character to integer
<code>s.find(<substring>)</code>	Index of first match or -1	<code>s.isdecimal()</code>	True if [0-9], [o-9] or [᠐-᠙]
<code>s.index(<substring>)</code>	Index of first match or raise <code>ValueError</code>	<code>s.isdigit()</code>	True if <code>isdecimal()</code> or [²³¹...]
<code>s.lower()</code>	To lower case	<code>s.isnumeric()</code>	True if <code>isdigit()</code> or [¼½¾零〇一...]
<code>s.upper()</code>	To upper case	<code>s.isalnum()</code>	True if <code>isnumeric()</code> or [a-zA-Z...]
<code>s.title()</code>	To title case (The Quick Brown Fox)	<code>s.isprintable()</code>	True if <code>isalnum()</code> or [!]
<code>s.capitalize()</code>	Capitalize first letter	<code>s.isspace()</code>	True if [\t\n\r\f\v\x1c-\x1f\x85\xa0...]
<code>s.replace(old, new[, count])</code>	Replace <i>old</i> with <i>new</i> at most <i>count</i> times	<code>head, sep, tail = s.partition(<separator>)</code>	Search for separator from start and split
<code>s.translate(<table>)</code>	Use <code>str.maketrans(<dict>)</code> to generate table	<code>head, sep, tail = s.rpartition(<separator>)</code>	Search for separator from end and split
<code>chr(<int>)</code>	Integer to Unicode character		

String formatting

f-string	Output
<code>f"{6/3}, {'a'+ 'b'}"</code> <code>'{ }, { }'.format(6/3, 'a'+ 'b')</code>	<code>'2, ab'</code>
<code>f'{1:<5}'</code>	<code>'1 '</code>
<code>f'{1:^5}'</code>	<code>' 1 '</code>
<code>f'{1:>5}'</code>	<code>' 1'</code>
<code>f'{1:.<5}'</code>	<code>'1....'</code>
<code>f'{1:.>5}'</code>	<code>'....1'</code>
<code>f'{1:0}'</code>	<code>'1'</code>
<code>f'{1+1=}'</code>	<code>'1+1=2' (= prepends)</code>
<code>f'{v!r}'</code>	<code>repr(v)</code>
<code>f'{today:%d %b %Y}'</code>	<code>'21 Jan 1984'</code>
<code>f'{1.729:.2f}'</code>	<code>'1.73'</code>
<code>f'{1.7:04}'</code>	<code>'01.7'</code>
<code>f'{1.7:4}'</code>	<code>' 1.7'</code>
<code>f"{'abc':.2}"</code>	<code>'ab'</code>
<code>f"{'abc':6.2}"</code>	<code>'ab '</code>
<code>f"{'abc'!r:6}"</code>	<code>""'abc' ""</code>
<code>f'{123456:,}'</code>	<code>'123,456'</code>
<code>f'{123456:_}'</code>	<code>'123_456'</code>
<code>f'{123456:+6}'</code>	<code>' +123'</code>

f-string	Output
<code>f'{123456:=+6}'</code>	<code>'+ 123'</code>
<code>f'{1.234:.2}'</code>	<code>'1.2'</code>
<code>f'{1.234:.2f}'</code>	<code>'1.23'</code>
<code>f'{1.234:.2e}'</code>	<code>'1.230e+00'</code>
<code>f'{1.234:.2%}'</code>	<code>'123.40%'</code>
<code>f'{164:b}'</code>	<code>'10100100'</code>
<code>f'{164:o}'</code>	<code>'244'</code>
<code>f'{164:X}'</code>	<code>'A4'</code>
<code>f'{164:c}'</code>	<code>'ÿ'</code>
<code>f'{1 #comment}'</code>	<code>'1' (v3.12)</code>

Regex

Standard library `re` module provides Python regular expressions.

```
>>> import re
>>> my_re = re.compile(r'name is (?P<name>[A-Za-z]+)')
>>> match = my_re.search('My name is Douglas.')
>>> match.group()
'name is Douglas'
>>> match.group(1)
'Douglas'
>>> match.groupdict()['name']
'Douglas'
```

Regex syntax

.	Any character (newline if DOTALL)		Or
^	Start of string (every line if MULTILINE)	(...)	Group
\$	End of string (every line if MULTILINE)	(?:...)	Non-capturing group
*	0 or more of preceding	(? P<name>...)	Named group
+	1 or more of preceding	(?P=name)	Match text matched by earlier group
?	0 or 1 of preceding	(?=...)	Match next, non-consumptive
*?, +?, ??	Same as *, + and ?, as few as possible	(?!...)	Non-match next, non-consumptive
{m,n}	m to n repetitions	(?<=...)	Match preceding, positive lookahead assertion
{m,n}?	m to n repetitions, as few as possible	(?<!...)	Non-match preceding, negative lookahead assertion
[]	Character set: e.g. '[a-zA-Z]'	(? (group)A B)	Conditional match - A if group previously matched else B
[^]	NOT character set	(? letters)	Set flags for RE ('i', 'L', 'm', 's', 'u', 'x')
\	Escape chars '*?+&\$ ()', introduce special sequences	(?#...)	Comment (ignored)
\\	Literal '\'		

Regex special sequences

<code>\<n></code>	Match by integer group reference starting from 1
<code>\A</code>	Start of string
<code>\b</code>	Word boundary
<code>\B</code>	Not word boundary
<code>\d</code>	Decimal digit
<code>\D</code>	Non-decimal digit

<code>\s</code>	Whitespace [<code>\t\n\r\f\v</code>]
<code>\S</code>	Non-whitespace
<code>\w</code>	Alphanumeric (depends on LOCALE flag)
<code>\W</code>	Non-alphanumeric
<code>\Z</code>	End of string

Regex flags

<code>I</code> or <code>IGNORECASE <=> (?i)</code>	Case insensitive matching
<code>L</code> or <code>LOCALE <=> (?L)</code>	<code>\w</code> , <code>\W</code> , <code>\b</code> , <code>\B</code> depend on current locale
<code>M</code> or <code>MULTILINE <=> (?m)</code>	Match every new line, not only start/end of string

<code>S</code> or <code>DOTALL <=> (?s)</code>	'.' matches ALL chars, including newline
<code>U</code> or <code>UNICODE <=> (?u)</code>	<code>\w</code> , <code>\W</code> , <code>\b</code> , and <code>\B</code> dependent on Unicode database
<code>X</code> or <code>VERBOSE <=> (?x)</code>	Ignores whitespace outside character sets

Regex functions

<code>compile(pattern[, flags=0])</code>	Compiles Regular Expression Object
<code>escape(string)</code>	Escape non-alphanumerics
<code>match(pattern, string[, flags])</code>	Match from start
<code>search(pattern, string[, flags])</code>	Match anywhere
<code>split(pattern, string[, maxsplit=0])</code>	Splits by pattern, keeping splitter if grouped

<code>findall(pattern, string)</code>	Non-overlapping matches as list of groups or tuples (>1)
<code>finditer(pattern, string[, flags])</code>	Iterator over non-overlapping matches
<code>sub(pattern, repl, string[, count=0])</code>	Replace count first leftmost non-overlapping; If repl is function, called with a MatchObj
<code>subn(pattern, repl, string[, count=0])</code>	Like sub(), but returns (newString, numberOfSubsMade)

Regex objects

<code>flags</code>	Flags
<code>groupindex</code>	{group name: group number}
<code>pattern</code>	Pattern
<code>match(string[, pos][, endpos])</code>	Match from start of target[pos:endpos]
<code>search(string[, pos][, endpos])</code>	Match anywhere in target[pos:endpos]

<code>split(string[, maxsplit=0])</code>	See split() function
<code>findall(string[, pos[, endpos]])</code>	See findall() function
<code>finditer(string[, pos[, endpos]])</code>	See finditer() function
<code>sub(repl, string[, count=0])</code>	See sub() function
<code>subn(repl, string[, count=0])</code>	See subn() function

Regex match objects

<code>pos</code>	pos passed to search or match
<code>endpos</code>	endpos passed to search or match

<code>re</code>	RE object
-----------------	-----------

<code>group([g1, g2, ...])</code>	One or more groups of match One arg, result is a string Multiple args, result is tuple If <code>gi</code> is 0, returns the entire matching string If <code>1 <= gi <= 99</code> , returns string matching group (None if no such group) May also be a group name Tuple of match groups Non-participating groups are None String if <code>len(tuple)==1</code>	<code>span(group)</code>	<code>(start(group), end(group));</code> (None, None) if group didn't contribute
<code>start(group)</code> <code>, end(group)</code>	Indices of start & end of group match (None if group exists but didn't contribute)	<code>string</code>	String passed to <code>match()</code> or <code>search()</code>

Numbers / Math

<code>int(<float str bool>)</code> 5	Integer
<code>float(<int str bool>)</code> 5.1, 1.2e-4	Float (inexact, compare with <code>math.isclose(<float>, <float>)</code>)
<code>complex(real=0, imag=0)</code> 3 - 2j, 2.1 + 0.8j	Complex
<code>fractions.Fraction(<numerator>, <denominator>)</code>	Fraction
<code>decimal.Decimal(<str int>)</code>	Decimal (exact, set precision: <code>decimal.getcontext().prec = <int></code>)
<code>bin(<int>)</code> 0b101010 <code>int('101010', 2)</code> <code>int('0b101010', 0)</code>	Binary
<code>hex(<int>)</code> 0x2a <code>int('2a', 16)</code> <code>int('0x2a', 0)</code>	Hex

Functions

<code>pow(<num>, <num>)</code> <code><num> ** <num></code>	Power
<code>abs(<num>)</code>	Absolute
<code>round(<num>[, ±ndigits])</code>	Round

Mathematics

```
from math import (e, pi, inf, nan, isinf, isnan,
                  sin, cos, tan, asin, acos, atan, degrees, radians,
                  log, log10, log2)
```

Statistics

```
from statistics import mean, median, variance, stdev, quantiles, groupby
```

Random

```
>>> from random import random, randint, choice, shuffle, gauss, triangular, seed
>>> random() # float inside [0, 1)
0.42
>>> randint(1, 100) # int inside [<from>, <to>]
42
>>> choice(range(100)) # random item from sequence
42
```

Sequence

Operations on sequence types (List, Tuple, String).

<code>x in s</code>	True if any <code>s[i]==x</code>	<code>s.index(x[, start[, stop]])</code>	Smallest <code>i</code> where <code>s[i]==x</code> , start/stop bounds search
<code>x not in s</code>	True if no <code>s[i]==x</code>	<code>reversed(s)</code>	Iterator on <code>s</code> in reverse order (for string use <code>reversed(list(s))</code>)
<code>s1 + s2</code>	Concatenate <code>s1</code> and <code>s2</code>	<code>sorted(s1, cmp=func, key=getter, reverse=False)</code>	New sorted list
<code>s*n, n*s</code>	Concatenate <code>n</code> copies of <code>s</code>		
<code>s.count(x)</code>	Count of <code>s[i]==x</code>		
<code>len(s)</code>	Number of items		
<code>min(s)</code>	Smallest item		
<code>max(s)</code>	Largest item		

Indexing

Select items from sequence by index or slice.

```
>>> s = [0, 1, 2, 3, 4]
>>> s[0] # 0-based indexing
0
>>> s[-1] # negative indexing from end
4
>>> s[slice(2)] # slice(stop) - index until stop (exclusive)
[0, 1]
>>> s[slice(1, 5, 3)] # slice(start, stop[, step]) - index from start to stop
(exclusive), with optional step size (+|-)
[1, 4]
>>> s[:2] # slices are created implicitly when indexing with ':'
[start:stop:step]
[0, 1]
>>> s[3::-1] # negative steps
[3, 2, 1, 0]
>>> s[1:3]
[1, 2]
>>> s[1:5:2]
[1, 3]
```

- Sequence comparison: values are compared in order until a pair of unequal values is found. The comparison of these two values is then returned. If all values are equal, the shorter sequence is lesser.
- A sortable class should define `__eq__()`, `__lt__()`, `__gt__()`, `__le__()` and `__ge__()` comparison special methods.
- With `functools @total_ordering` decorator a class need only provide `__eq__()` and one other comparison special method.

```

from functools import total_ordering

@total_ordering
class C:
    def __init__(self, a):
        self.a = a
    def __eq__(self, other):
        if isinstance(other, type(self)):
            return self.a == other.a
        return NotImplemented
    def __lt__(self, other):
        if isinstance(other, type(self)):
            return self.a < other.a
        return NotImplemented

```

Tuple

Immutable hashable sequence.

<code>s = (1, 'a', 3.0)</code> <code>s = 1, 'a', 3.0</code>	Create tuple
<code>s = (1,)</code>	Single-item tuple
<code>s = ()</code>	Empty tuple
<code>(1, 2, 3) == (1, 2) + (3,)</code>	Add makes new tuple
<code>(1, 2, 1, 2) == (1, 2) * 2</code>	Multiply makes new tuple

Named tuple

Subclass with named items.

```

>>> from collections import namedtuple
>>> Point = namedtuple('Point', ('x', 'y')) # or namedtuple('Point', 'x y')
>>> p = Point(1, y=2)
Point(x=1, y=2)
>>> p[0]
1
>>> p.y
2

```

List

Mutable non-hashable sequence.

<code>s = [1, 'a', 3.0]</code> <code>s = list(range(3))</code>	Create list	<code>s.extend(it)</code> <code>s[len(s):len(s)] = it</code>	Add elements from iterable to end
<code>s[i] = x</code>	Replace item index i with x	<code>s.insert(i, x)</code> <code>s[i:i] = [x]</code>	Insert item at index i
<code>s[<slice>] = it</code>	Replace slice with iterable	<code>s.remove(x)</code> <code>del s[s.index(x)]</code>	Remove item
<code>del s[<slice>]</code> <code>s[<slice>] = []</code>	Delete slice	<code>y = s.pop([i])</code>	Remove and return last item, or indexed item
<code>s.append(x)</code> <code>s += x</code> <code>s[len(s):len(s)] = [x]</code>	Add element to end	<code>s.reverse()</code>	Reverse in place
		<code>s.sort(cmp=func, key=getter, reverse=False)</code>	Sort in place, default ascending

List comprehension

```
result = [expression for item1 in sequence1 {if condition1}
           {for item2 in sequence2 {if condition2} ... for itemN in sequenceN {if conditionN}}]
```

is equivalent to:

```
result = []
for item1 in sequence1:
    for item2 in sequence2:
        ...
        for itemN in sequenceN:
            if condition1 and condition2 ... and conditionN:
                result.append(expression)
```

Dictionary

Mutable non-hashable key:value pair mapping.

```
dict()           Empty dict
{}
```

```
: dict(<sequence
mapping>)
```

Create from key:value pairs

<code>dict(**kws)</code>	Create from keyword arguments	<code>d.get(key, default=None)</code>	Get value for key, or default
<code>dict(zip(keys, values))</code>	Create from sequences of keys and values	<code>d.setdefault(key, default=None)</code>	Get value for key, add if missing
<code>dict.fromkeys(keys, value=None)</code>	Create from keys, all set to value	<code>d.pop(key)</code>	Remove and return value for key, raise KeyError if missing
<code>d.keys()</code>	Iterable of keys	<code>d.popitem()</code>	Remove and return (key, value) pair (last-in, first-out)
<code>d.values()</code>	Iterable of values		
<code>d.items()</code>	Iterable of (key, value) pairs		

<code>d.clear()</code>	Remove all items	<code>collections.defaultdict(<type>)</code>	dict with default value <code><type>()</code>
<code>d.copy()</code>	Shallow copy	<code>collections.defaultdict(lambda: 42)</code>	e.g. dict with default value 42
		<code>d1.update(d2)</code>	Add/replace key:value pairs from d2 to d1

```
: d3 = d1
```

```
d2
```

```
Merge to new dict, d2 trumps d1
```

```
:
```

```
d3 = {**d1, **d2}
```

```
{k for k, v in d.items() if v==value}
```

Set of keys with given value

Set

Mutable (*set*) and immutable (*frozenset*) sets.

<code>set(iterable=None)</code> {1, 2, 3}	New set from iterable, or empty But {} creates an empty dictionary (sad!)	<code>s.pop()</code>	Remove and return arbitrary element (KeyError if empty)
<code>frozenset(iterable=None)</code>		<code>s.clear()</code>	Remove all elements
<code>len(s)</code>	Cardinality	<code>s1.intersection(s2[, s3...])</code>	New set of shared elements
<code>v in s</code> <code>v not in s</code>	Test membership	<code>s1 & s2</code>	
<code>s1.issubset(s2)</code>	True if s1 is subset of s2	<code>s1.union(s2[, s3...])</code>	New set of all elements
<code>s1.issuperset(s2)</code>	True if s1 is superset of s2	<code>s1 s2</code>	
<code>s.add(v)</code>	Add element	<code>s1.difference(s2[, s3...])</code>	New set of elements unique to s1
<code>s.remove(v)</code>	Remove element (KeyError if not found)	<code>s1 - s2</code>	
<code>s.discard(v)</code>	Remove element if present	<code>s1.symmetric_difference(s2)</code>	New set of unshared elements
		<code>s1 ^ s2</code>	
		<code>s.copy()</code>	Shallow copy
		<code>s.update(it1[, it2...])</code>	Add all values from iterables

Bytes

Immutable sequence of bytes. Mutable version is *bytearray*.

: b'<str>'	Create from ASCII characters
and \x00-\xff	
: bytes(<ints>)	Create from int sequence
: bytes(<str>, 'utf-8')	Create from string
: <str>.encode('utf-8')	
: <int>.to_bytes(length, order, signed=False)	Create from int
(order='big' 'little')	
: bytes.fromhex('<hex>')	Create from hex pairs (can
be separated by whitespace)	
: <int> = <bytes>[<index>]	Return int in range 0 to 255
: <bytes> = <bytes>[<slice>]	Return <i>bytes</i> even if only
one element	
: list(<bytes>)	Return ints in range 0 to
255	
: <bytes_sep>.join(<byte_objs>)	Join <i>byte_objs</i> sequence with
<i>bytes_sep</i> separator	
: str(<bytes>, 'utf-8')	Convert bytes to string
: <bytes>.decode('utf-8')	
: int.from_bytes(bytes, order, signed=False)	Return int from bytes
(order='big' 'little')	
: <bytes>.hex(sep='', bytes_per_sep=2)	Return hex pairs

```
def read_bytes(filename):
    with open(filename, 'rb') as file:
        return file.read()

def write_bytes(filename, bytes_obj):
    with open(filename, 'wb') as file:
        file.write(bytes_obj)
```

Built-in functions

abs()	Absolute value of number	chr()	One character string for unicode ordinal i (0 <= i <= 0x10ffff)
aiter()	Asynchronous iterator for an asynchronous iterable	classmethod()	Transform method into class method
all()	True if all elements of iterable are true (all([]) == True)	compile()	Compile source into code or AST object
any()	True if any element of iterable is true (any([]) == False)	complex()	Complex number with the value real + imag*1j
ascii()	A string with a printable representation of an object	delattr()	Delete the named attribute, if object allows
bin()	Convert integer number to binary string	dict()	Create new dictionary
bool()	Boolean value	dir()	List of names in the local scope
breakpoint()	Drop into debugger at call site	divmod()	Pair of numbers (quotient, remainder)
bytearray()	New array of bytes	enumerate()	Enumerate object as (n, item) pairs
bytes()	New bytes object	eval()	Execute expression
callable()	True if the argument is callable		

<code>exec()</code>	Execute Python code	<code>next()</code>	Next item from iterator
<code>filter()</code>	Make iterator from an iterable, return True	<code>object()</code>	New featureless object
<code>float()</code>	Floating point number from number or string	<code>oct()</code>	Convert integer to octal string
<code>format()</code>	Formatted representation	<code>open()</code>	Open file object
<code>frozenset()</code>	New frozenset object	<code>ord()</code>	Integer representing Unicode code point of character
<code>getattr()</code>	Get value of named attribute of object	<code>pow()</code>	Return base to the power exp.
<code>globals()</code>	Dictionary of current module namespace	<code>print()</code>	Print object to text stream file
<code>hasattr()</code>	True if object has named attribute	<code>property()</code>	Property decorator
<code>hash()</code>	Hash value of object	<code>range()</code>	Generate integer sequence
<code>help()</code>	Built-in help system	<code>repr()</code>	String representation of object for debugging
<code>hex()</code>	Convert integer to lowercase hexadecimal string	<code>reversed()</code>	Reverse iterator
<code>id()</code>	Return unique integer identifier of object	<code>round()</code>	Number rounded to ndigits precision after decimal point
<code>__import__()</code>	Invoked by the import statement	<code>set()</code>	New set object
<code>input(prompt='')</code>	Read string from stdin, with optional prompt	<code>setattr()</code>	Set object attribute value by name
<code>int()</code>	Create integer from number or string	<code>slice()</code>	Slice object representing a set of indices
<code>isinstance()</code>	True if object is instance of given class	<code>sorted()</code>	New sorted list from the items in iterable
<code>issubclass()</code>	True if class is subclass of given class	<code>staticmethod()</code>	Transform method into static method
<code>iter()</code>	Iterator for object	<code>str()</code>	String description of object
<code>len()</code>	Length of object	<code>sum()</code>	Sums items of iterable
<code>list()</code>	Create list	<code>super()</code>	Proxy object that delegates method calls to parent or sibling
<code>locals()</code>	Dictionary of current local symbol table	<code>tuple()</code>	Create a tuple
<code>map()</code>	Apply function to every item of iterable	<code>type()</code>	Type of an object
<code>max()</code>	Largest item in an iterable	<code>vars()</code>	dict attribute for any other object with a dict attribute
<code>memoryview()</code>	Access internal object data via buffer protocol	<code>zip()</code>	Iterate over multiple iterables in parallel
<code>min()</code>	Smallest item in an iterable		

Time

The `datetime` module provides immutable hashable `date`, `time`, `datetime`, and `timedelta` classes.

Time formatting

Code	Output
%a	Day name short (Mon)
%A	Day name full (Monday)
%b	Month name short (Jan)
%B	Month name full (January)
%c	Locale datetime format
%d	Day of month [01,31]
%f	Microsecond [000000,999999]
%H	Hour (24-hour) [00,23]
%I	Hour (12-hour) [01,12]
%j	Day of year [001,366]
%m	Month [01,12]
%M	Minute [00,59]
%p	Locale format for AM/PM
%S	Second [00,61]. Yes, 61!
%U	Week number (Sunday start) [00(partial),53]
%w	Day number [0(Sunday),6]
%W	Week number (Monday start) [00(partial),53]
%x	Locale date format
%X	Locale time format
%y	Year without century [00,99]
%Y	Year with century (2023)
%Z	Time zone (' ' if no TZ)
%z	UTC offset (+HHMM/-HHMM, ' ' if no TZ)
%%	Literal '%'

Exceptions

```

try:
    ...
except [Exception [as e]]:
    ...
except: # catch all
    ...
else: # if no exception
    ...
finally: # always executed
    ...

raise exception [from None] # stop exception chain

try:
    1 / 0
except ZeroDivisionError:
    raise TypeError("Stop chain") from None

```

BaseException	Base class for all exceptions
└ BaseExceptionGroup	Base class for groups of exceptions
└ GeneratorExit	Generator close() raises to terminate iteration
└ KeyboardInterrupt	On user interrupt key (often 'CTRL-C')
└ SystemExit	On sys.exit()
└ Exception	Base class for errors
└ ArithmeticError	Base class for arithmetic errors
└ FloatingPointError	Floating point operation failed
└ OverflowError	Result too large
└ ZeroDivisionError	Argument of division or modulo is 0
└ AssertionError	Assert statement failed
└ AttributeError	Attribute reference or assignment failed
└ BufferError	Buffer operation failed
└ EOFError	input() hit end-of-file without reading data
└ ExceptionGroup	Group of exceptions raised together
└ ImportError	Import statement failed
└ ModuleNotFoundError	Module not able to be found
└ LookupError	Base class for lookup errors
└ IndexError	Index not found in sequence
└ KeyError	Key not found in dictionary
└ MemoryError	Operation ran out of memory
└ NameError	Local or global name not found
└ UnboundLocalError	Local variable value not assigned
└ OSError	System related error
└ BlockingIOError	Non-blocking operation will block
└ ChildProcessError	Operation on child process failed
└ ConnectionError	Base class for connection errors
└ BrokenPipeError	Write to closed pipe or socket
└ ConnectionAbortedError	Connection aborted
└ ConnectionRefusedError	Connection denied by server
└ ConnectionResetError	Connection reset mid-operation
└ FileExistsError	Trying to create a file that already exists
└ FileNotFoundError	File or directory not found
└ InterruptedError	System call interrupted by signal
└ IsADirectoryError	File operation requested on a directory
└ NotADirectoryError	Directory operation requested on a non-directory
└ PermissionError	Operation has insufficient access rights
└ ProcessLookupError	Operation on process that no longer exists
└ TimeoutError	Operation timed out
└ ReferenceError	Weak reference used on garbage collected object
└ RuntimeError	Error detected that doesn't fit other categories
└ NotImplementedError	Operation not yet implemented
└ RecursionError	Maximum recursion depth exceeded
└ StopAsyncIteration	Iterator __anext__() raises to stop iteration
└ StopIteration	Iterator next() raises when no more values
└ SyntaxError	Python syntax error
└ IndentationError	Base class for indentation errors
└ TabError	Inconsistent tabs or spaces
└ SystemError	Recoverable Python interpreter error
└ TypeError	Operation applied to wrong type object
└ ValueError	Operation on right type but wrong value
└ UnicodeError	Unicode encoding/decoding error
└ UnicodeDecodeError	Unicode decoding error
└ UnicodeEncodeError	Unicode encoding error
└ UnicodeTranslateError	Unicode translation error
└ Warning	Base class for warnings
└ BytesWarning	Warnings about bytes and bytearrays
└ DeprecationWarning	Warnings about deprecated features
└ EncodingWarning	Warning about encoding problem
└ FutureWarning	Warnings about future deprecations for end users
└ ImportWarning	Possible error in module imports
└ PendingDeprecationWarning	Warnings about pending feature deprecations
└ ResourceWarning	Warning about resource use
└ RuntimeWarning	Warning about dubious runtime behavior
└ SyntaxWarning	Warning about dubious syntax
└ UnicodeWarning	Warnings related to Unicode
└ UserWarning	Warnings generated by user code

Execution / Environ

```
$ python [-bBdEhiIOqsSuvVWx?] [-c command | -m module-name | script | - ] [args]
$ python --version
Python 3.10.12
$ python --help[-all] # help-all [3.11+]
# Execute code from command line
$ python -c 'print("Hello, world!")'
# Execute __main__.py in directory
$ python <directory>
# Execute module as __main__
$ python -m timeit -s 'setup here' 'benchmarked code here'
# Optimise execution
$ python -O script.py

# Hide warnings
PYTHONWARNINGS="ignore"
# OR
$ python -W ignore foo.py
# OR
import warnings
warnings.filterwarnings("ignore", category=DeprecationWarning)
```

```
if __name__ == '__main__': # run main() if file executed as script
    main()
```

Environment variables

PYTHONHOME	Change location of standard Python libraries	PYTHONOPTIMIZE	Optimise execution (-O)
PYTHONPATH	Augment default search path for module files	PYTHONWARNINGS	Set warning level [default/error/always/module/once/ignore] (-W)
PYTHONSTARTUP	Module to execute before entering interactive prompt	PYTHONPROFILEIMP ORTTIME	Show module import times (-X)

sitecustomize.py / usercustomize.py

Before `__main__` module is executed Python automatically imports:

- `sitecustomize.py` in the system site-packages directory
- `usercustomize.py` in the user site-packages directory

```
# Get user site packages directory
$ python -m site --user-site

# Bypass sitecustomize.py/usercustomize.py hooks
$ python -S script.py
```