
What's New in Python

Release 3.10.0a0

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This article explains the new features in Python 3.10, compared to 3.9.

For full details, see the changelog.

Note: Prerelease users should be aware that this document is currently in draft form. It will be updated substantially as Python 3.10 moves towards release, so it's worth checking back even after reading earlier versions.

1 Summary – Release highlights

2 New Features

- The `int` type has a new method `int.bit_count()`, returning the number of ones in the binary expansion of a given integer, also known as the population count. (Contributed by Niklas Fiekas in [bpo-29882](#).)
- The views returned by `dict.keys()`, `dict.values()` and `dict.items()` now all have a mapping attribute that gives a `types.MappingProxyType` object wrapping the original dictionary. (Contributed by Dennis Sweeney in [bpo-40890](#).)
- **PEP 618:** The `zip()` function now has an optional `strict` flag, used to require that all the iterables have an equal length.

2.1 PEP604: New Type Operator

A new type union operator was introduced which enables the syntax `X | Y`. This provides a cleaner way of expressing ‘either type X or type Y’ instead of using `typing.Union`, especially in type hints (annotations).

In previous versions of Python, to apply a type hint for functions accepting arguments of multiple types, `typing.Union` was used:

```
def square(number: Union[int, float]) -> Union[int, float]:  
    return number ** 2
```

Now, type hints can be written in a more succinct manner:

```
def square(number: int | float) -> int | float:  
    return number ** 2
```

See **PEP 604** for more details.

(Contributed by Maggie Moss and Philippe Prados in [bpo-41428](#).)

3 Other Language Changes

- Builtin and extension functions that take integer arguments no longer accept `Decimals`, `Fractions` and other objects that can be converted to integers only with a loss (e.g. that have the `__int__()` method but do not have the `__index__()` method). (Contributed by Serhiy Storchaka in [bpo-37999](#).)

4 New Modules

- None yet.

5 Improved Modules

5.1 base64

Add `base64.b32hexencode()` and `base64.b32hexdecode()` to support the Base32 Encoding with Extended Hex Alphabet.

5.2 codecs

Add a `codecs.unregister()` function to unregister a codec search function. (Contributed by Hai Shi in [bpo-41842](#).)

5.3 curses

The extended color functions added in ncurses 6.1 will be used transparently by `curses.color_content()`, `curses.init_color()`, `curses.init_pair()`, and `curses.pair_content()`. A new function, `curses.has_extended_color_support()`, indicates whether extended color support is provided by the underlying ncurses library. (Contributed by Jeffrey Kintscher and Hans Petter Jansson in [bpo-36982](#).)

5.4 glob

Added the `root_dir` and `dir_fd` parameters in `glob()` and `iglob()` which allow to specify the root directory for searching. (Contributed by Serhiy Storchaka in [bpo-38144](#).)

5.5 os

Added `os.cpu_count()` support for VxWorks RTOS. (Contributed by Peixing Xin in [bpo-41440](#).)

5.6 py_compile

Added `--quiet` option to command-line interface of `py_compile`. (Contributed by Gregory Schevchenko in [bpo-38731](#).)

5.7 sys

Add `sys.orig_argv` attribute: the list of the original command line arguments passed to the Python executable. (Contributed by Victor Stinner in [bpo-23427](#).)

5.8 types

Reintroduced the `types.EllipsisType`, `types.NoneType` and `types.NotImplementedType` classes, providing a new set of types readily interpretable by type checkers. (Contributed by Bas van Beek in [bpo-41810](#).)

5.9 unittest

Add new method `assertNoLogs()` to complement the existing `assertLogs()`. (Contributed by Kit Yan Choi in [bpo-39385](#).)

5.10 xml

Add a `LexicalHandler` class to the `xml.sax.handler` module. (Contributed by Jonathan Gossage and Zackery Spytz in [bpo-35018](#).)

6 Optimizations

- Constructors `str()`, `bytes()` and `bytearray()` are now faster (around 30–40% for small objects). (Contributed by Serhiy Storchaka in [bpo-41334](#).)
- The `runpy` module now imports fewer modules. The `python3 -m module-name` command startup time is 1.3x faster in average. (Contributed by Victor Stinner in [bpo-41006](#).)

7 Deprecated

8 Removed

- The `ParserBase.error()` method from the private and undocumented `_markupbase` module has been removed. `html.parser.HTMLParser` is the only subclass of `ParserBase` and its `error()` implementation has already been removed in Python 3.5. (Contributed by Berker Peksag in [bpo-31844](#).)

9 Porting to Python 3.10

This section lists previously described changes and other bugfixes that may require changes to your code.

10 Build Changes

- The C99 functions `snprintf()` and `vsnprintf()` are now required to build Python. (Contributed by Victor Stinner in [bpo-36020](#).)
- `sqlite3` requires SQLite 3.7.3 or higher. (Contributed by Sergey Fedoseev and Erlend E. Aasland [bpo-40744](#).)

11 C API Changes

11.1 New Features

- The result of `PyNumber_Index()` now always has exact type `int`. Previously, the result could have been an instance of a subclass of `int`. (Contributed by Serhiy Storchaka in [bpo-40792](#).)
- Add a new `orig_argv` member to the `PyConfig` structure: the list of the original command line arguments passed to the Python executable. (Contributed by Victor Stinner in [bpo-23427](#).)
- The `PyDateTime_DATE_GET_TZINFO()` and `PyDateTime_TIME_GET_TZINFO()` macros have been added for accessing the `tzinfo` attributes of `datetime.datetime` and `datetime.time` objects. (Contributed by Zackery Spytz in [bpo-30155](#).)
- Add a `PyCodec_Unregister()` function to unregister a codec search function. (Contributed by Hai Shi in [bpo-41842](#).)

11.2 Porting to Python 3.10

- The `PY_SSIZE_T_CLEAN` macro must now be defined to use `PyArg_ParseTuple()` and `Py_BuildValue()` formats which use `#`: `es#`, `et#`, `s#`, `u#`, `y#`, `z#`, `U#` and `Z#`. See Parsing arguments and building values and the [PEP 353](#). (Contributed by Victor Stinner in [bpo-40943](#).)
- Since `Py_TYPE()` is changed to the inline static function, `Py_TYPE(obj) = new_type` must be replaced with `Py_SET_TYPE(obj, new_type)`: see `Py_SET_TYPE()` (available since Python 3.9). For backward compatibility, this macro can be used:

```
#if PY_VERSION_HEX < 0x030900A4
# define Py_SET_TYPE(obj, type) ((Py_TYPE(obj) = (type)), (void)0)
#endif
```

(Contributed by Dong-hee Na in [bpo-39573](#).)

- Since `Py_REFCNT()` is changed to the inline static function, `Py_REFCNT(obj) = new_refcnt` must be replaced with `Py_SET_REFCNT(obj, new_refcnt)`: see `Py_SET_REFCNT()` (available since Python 3.9). For backward compatibility, this macro can be used:

```
#if PY_VERSION_HEX < 0x030900A4
# define Py_SET_REFCNT(obj, refcnt) ((Py_REFCNT(obj) = (refcnt)), (void)0)
#endif
```

(Contributed by Victor Stinner in [bpo-39573](#).)

- Since `Py_SIZE()` is changed to the inline static function, `Py_SIZE(obj) = new_size` must be replaced with `Py_SET_SIZE(obj, new_size)`: see `Py_SET_SIZE()` (available since Python 3.9). For backward compatibility, this macro can be used:

```
#if PY_VERSION_HEX < 0x030900A4
# define Py_SET_SIZE(obj, size) ((Py_SIZE(obj) = (size)), (void)0)
#endif
```

(Contributed by Victor Stinner in [bpo-39573](#).)

- Calling `PyDict_GetItem()` without GIL held had been allowed for historical reason. It is no longer allowed. (Contributed by Victor Stinner in [bpo-40839](#).)
- `PyUnicode_FromUnicode(NULL, size)` and `PyUnicode_FromStringAndSize(NULL, size)` raise `DeprecationWarning` now. Use `PyUnicode_New()` to allocate Unicode object without initial data. (Contributed by Inada Naoki in [bpo-36346](#).)

11.3 Deprecated

- The `PyUnicode_InternImmortal()` function is now deprecated and will be removed in Python 3.12: use `PyUnicode_InternInPlace()` instead. (Contributed by Victor Stinner in [bpo-41692](#).)

11.4 Removed

- `PyObject_AsCharBuffer()`, `PyObject_AsReadBuffer()`, `PyObject_CheckReadBuffer()`, and `PyObject_AsWriteBuffer()` are removed. Please migrate to new buffer protocol; `PyObject_GetBuffer()` and `PyBuffer_Release()`. (Contributed by Inada Naoki in [bpo-41103](#).)
- Removed `Py_UNICODE_str*` functions manipulating `Py_UNICODE*` strings. (Contributed by Inada Naoki in [bpo-41123](#).)
 - `Py_UNICODE_strlen`: use `PyUnicode_GetLength()` or `PyUnicode_GET_LENGTH`
 - `Py_UNICODE_strcat`: use `PyUnicode_CopyCharacters()` or `PyUnicode_FromFormat()`
 - `Py_UNICODE_strcpy`, `Py_UNICODE_strncpy`: use `PyUnicode_CopyCharacters()` or `PyUnicode_Substring()`
 - `Py_UNICODE_strcmp`: use `PyUnicode_Compare()`
 - `Py_UNICODE_strncmp`: use `PyUnicode_Tailmatch()`
 - `Py_UNICODE_strchr`, `Py_UNICODE_strrchr`: use `PyUnicode_FindChar()`
- Removed `PyUnicode_GetMax()`. Please migrate to new ([PEP 393](#)) APIs. (Contributed by Inada Naoki in [bpo-41103](#).)
- Removed `PyLong_FromUnicode()`. Please migrate to `PyLong_FromUnicodeObject()`. (Contributed by Inada Naoki in [bpo-41103](#).)
- Removed `PyUnicode_AsUnicodeCopy()`. Please use `PyUnicode_AsUCS4Copy()` or `PyUnicode_AsWideCharString()` (Contributed by Inada Naoki in [bpo-41103](#).)
- Removed `_Py_CheckRecursionLimit` variable: it has been replaced by `ceval.recursion_limit` of the `PyInterpreterState` structure. (Contributed by Victor Stinner in [bpo-41834](#).)

- Removed undocumented macros `Py_ALLOW_RECURSION` and `Py_END_ALLOW_RECURSION` and the `recursion_critical` field of the `PyInterpreterState` structure. (Contributed by Serhiy Storchaka in [bpo-41936](#).)

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Python Enhancement Proposals

PEP 353, [5](#)

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