

# What's New In Python 3.11

**Release:** [|release|](#)  
**Date:** [|today|](#)

This article explains the new features in Python 3.11, compared to 3.10.

For full details, see the [ref`changelog <changelog>`](#).

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 50); [backlink](#)

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## Note

Prerelease users should be aware that this document is currently in draft form. It will be updated substantially as Python 3.11 moves towards release, so it's worth checking back even after reading earlier versions.

## Summary -- Release highlights

- Python 3.11 is up to 10-60% faster than Python 3.10. On average, we measured a 1.22x speedup on the standard benchmark suite. See [Faster CPython](#) for details.

New syntax features:

- [PEP 654](#): Exception Groups and `except*`. (Contributed by Irit Katriel in [:issue:`45292`](#).)

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New typing features:

- [PEP 673](#): `Self` Type. (Contributed by James Hilton-Balfé and Pradeep Kumar in [:issue:`30924`](#).)

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## New Features

### Enhanced error locations in tracebacks

When printing tracebacks, the interpreter will now point to the exact expression that caused the error instead of just the line. For example:

```
Traceback (most recent call last):
  File "distance.py", line 11, in <module>
    print(manhattan_distance(p1, p2))
    ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "distance.py", line 6, in manhattan_distance
    return abs(point_1.x - point_2.x) + abs(point_1.y - point_2.y)
           ^^^^^^^^^
AttributeError: 'NoneType' object has no attribute 'x'
```

Previous versions of the interpreter would point to just the line making it ambiguous which object was `None`. These enhanced errors can also be helpful when dealing with deeply nested dictionary objects and multiple function calls,

```
Traceback (most recent call last):
  File "query.py", line 37, in <module>
    magic_arithmetic('foo')
    ^^^^^^^^^^^^^^^^^^^^^^^
  File "query.py", line 18, in magic_arithmetic
    return add_counts(x) / 25
```

```

^^^^^^^^^^^^^^^^
File "query.py", line 24, in add_counts
    return 25 + query_user(user1) + query_user(user2)
    ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
File "query.py", line 32, in query_user
    return 1 + query_count(db, response['a']['b']['c']['user'], retry=True)
    ~~~~~^~~~~
TypeError: 'NoneType' object is not subscriptable

```

as well as complex arithmetic expressions:

```

Traceback (most recent call last):
  File "calculation.py", line 54, in <module>
    result = (x / y / z) * (a / b / c)
    ~~~~~^~~~
ZeroDivisionError: division by zero

```

See [PEP 657](#) for more details. (Contributed by Pablo Galindo, Batuhan Taskaya and Ammar Askar in [issue:43950](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 133); [backlink](#)

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#### Note

This feature requires storing column positions in code objects which may result in a small increase of disk usage of compiled Python files or interpreter memory usage. To avoid storing the extra information and/or deactivate printing the extra traceback information, the `:option:-X no_debug_ranges` command line flag or the `:envvar:PYTHONNODEBUGRANGES` environment variable can be used.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 137); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 137); [backlink](#)

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#### Column information for code objects

The information used by the enhanced traceback feature is made available as a general API that can be used to correlate bytecode instructions with source code. This information can be retrieved using:

- The `:meth:codeobject.co_positions` method in Python.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 151); [backlink](#)

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- The `:c:func:PyCode_Addr2Location` function in the C-API.

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The `:option:-X no_debug_ranges` option and the environment variable `:envvar:PYTHONNODEBUGRANGES` can be used to disable this feature.

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main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 154); [backlink](#)

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See [PEP 657](#) for more details. (Contributed by Pablo Galindo, Batuhan Taskaya and Ammar Askar in [issue:43950](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 157); [backlink](#)

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## Exceptions can be enriched with a string `__note__`

The `__note__` field was added to `:exc:`BaseException``. It is `None` by default but can be set to a string which is added to the exception's traceback. (Contributed by Irit Katriel in [issue:45607](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 163); [backlink](#)

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## Other Language Changes

- Starred expressions can be used in `:ref`for statements<for>``. (See [issue:46725](#) for more details.)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 170); [backlink](#)

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- Asynchronous comprehensions are now allowed inside comprehensions in asynchronous functions. Outer comprehensions implicitly become asynchronous. (Contributed by Serhiy Storchaka in [issue:33346](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 173); [backlink](#)

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- A `:exc:`TypeError`` is now raised instead of an `:exc:`AttributeError`` in `:meth:`contextlib.ExitStack.enter_context`` and `:meth:`contextlib.AsyncExitStack.enter_async_context`` for objects which do not support the `:term:`context manager`` or `:term:`asynchronous context manager`` protocols correspondingly. (Contributed by Serhiy Storchaka in [issue:44471](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 177); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 177); [backlink](#)

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- A `:exc:`TypeError`` is now raised instead of an `:exc:`AttributeError`` in `:keyword:`with`` and `:keyword:`async with`` statements for objects which do not support the `:term:`context manager`` or `:term:`asynchronous context manager`` protocols correspondingly. (Contributed by Serhiy Storchaka in [issue:`12022`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 184); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 184); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 184); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 184); [backlink](#)

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- Added `meth:`object.__getstate__`` which provides the default implementation of the `__getstate__()` method. `mod:`Copying <copy>`` and `mod:`pickling <pickle>`` instances of subclasses of builtin types `class:`bytearray``, `class:`set``, `class:`frozenset``, `class:`collections.OrderedDict``, `class:`collections.deque``, `class:`weakref.WeakSet``, and `class:`datetime.tzinfo`` now copies and pickles instance attributes implemented as `term:`slots <__slots__>``. (Contributed by Serhiy Storchaka in `issue:`26579``.)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 190); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 190); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 190); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 190); [backlink](#)

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## Other CPython Implementation Changes

- Special methods `meth`complex.__complex__`` and `meth`bytes.__bytes__`` are implemented to support `:class:`typing.SupportsComplex`` and `:class:`typing.SupportsBytes`` protocols. (Contributed by Mark Dickinson and Dong-hee Na in [issue: 24234](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 203); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 203); [backlink](#)

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- `siphash13` is added as a new internal hashing algorithms. It has similar security properties as `siphash24` but it is slightly faster for long inputs. `str`, `bytes`, and some other types now use it as default algorithm for `:func:`hash``. PEP 552 hash-based pyc files now use `siphash13`, too. (Contributed by Inada Naoki in [:issue:`29410`](#).)

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- When an active exception is re-raised by a `:keyword:`raise`` statement with no parameters, the traceback attached to this exception is now always `sys.exc_info()[1].__traceback__`. This means that changes made to the traceback in the current `:keyword:`except`` clause are reflected in the re-raised exception. (Contributed by Irit Katriel in [:issue:`45711`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 213);**  
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[backlink](#)

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- The interpreter state's representation of handled exceptions (a.k.a `exc_info`, or `_PyErr_StackItem`) now has only the `exc_value` field, `exc_type` and `exc_traceback` have been removed as their values can be derived from `exc_value`. (Contributed by Irit Katriel in [:issue:`45711`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 219);**  
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- A new command line option for the Windows installer `AppendPath` has been added. It behaves similar to `PrependPath` but appends the install and scripts directories instead of prepending them. (Contributed by Bastian Neuburger in [:issue:`44934`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 224);**  
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## New Modules

- A new module, `:mod:`tomllib``, was added for parsing TOML. (Contributed by Taneli Hukkinen in [:issue:`40059`](#).)



**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 233); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 233); [backlink](#)

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## Improved Modules

### asyncio

- Add raw datagram socket functions to the event loop: `meth:`~asyncio.AbstractEventLoop.sock_sendto``, `meth:`~asyncio.AbstractEventLoop.sock_recvfrom`` and `meth:`~asyncio.AbstractEventLoop.sock_recvfrom_into``. (Contributed by Alex Grönholm in [issue: 46805](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 243); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 243); [backlink](#)

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### fractions

- Support [PEP 515](#)-style initialization of `class:`~fractions.Fraction`` from string. (Contributed by Sergey B Kirpichev in [issue: 44258](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 252); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 252); [backlink](#)

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- `class:`~fractions.Fraction`` now implements an `__int__` method, so that an `isinstance(some_fraction, typing.SupportsInt)` check passes. (Contributed by Mark Dickinson in [issue: 44547](#).)



**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 255); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 255); [backlink](#)

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## hashlib

- `:func:`hashlib.blake2b`` and `:func:`hashlib.blake2s`` now prefer [libb2](#) over Python's vendored copy. (Contributed by Christian Heimes in [:issue:`47095`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 262); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 262); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 262); [backlink](#)

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- The internal `_sha3` module with SHA3 and SHAKE algorithms now uses *tiny\_sha3* instead of the *Keccak Code Package* to reduce code and binary size. The `:mod:`hashlib`` module prefers optimized SHA3 and SHAKE implementations from OpenSSL. The change affects only installations without OpenSSL support. (Contributed by Christian Heimes in [:issue:`47098`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 266); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 266); [backlink](#)

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## IDLE and idlelib

- Apply syntax highlighting to `.pyi` files. (Contributed by Alex Waygood and Terry Jan Reedy in [:issue:`45447`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 276); [backlink](#)

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## inspect

- Add `:func:`inspect.getmembers_static``: return all members without triggering dynamic lookup via the descriptor protocol. (Contributed by Weipeng Hong in [:issue:`30533`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 281); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 281); [backlink](#)

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- Add `:func:`inspect.ismethodwrapper`` for checking if the type of an object is a `:class:`~types.MethodWrapperType``. (Contributed by Hakan Çelik in [:issue:`29418`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 285); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 285); [backlink](#)

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**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 285); [backlink](#)

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## math

- Add `:func:`math.exp2``: return 2 raised to the power of x. (Contributed by Gideon Mitchell in [:issue:`45917`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 291); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 291); [backlink](#)

Unknown interpreted text role "issue".

- Add `:func:`math.cbrt``: return the cube root of x. (Contributed by Ajith Ramachandran in [:issue:`44357`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 294); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 294); [backlink](#)

Unknown interpreted text role "issue".

- The behaviour of two `:func:`math.pow`` corner cases was changed, for consistency with the IEEE 754 specification. The

operations `math.pow(0.0, -math.inf)` and `math.pow(-0.0, -math.inf)` now return `inf`. Previously they raised `:exc:`ValueError``. (Contributed by Mark Dickinson in [:issue:`44339`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 297); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 297); [backlink](#)

Unknown interpreted text role "exc".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 297); [backlink](#)

Unknown interpreted text role "issue".

- The `:data:`math.nan`` value is now always available. (Contributed by Victor Stinner in [:issue:`46917`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 303); [backlink](#)

Unknown interpreted text role "data".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 303); [backlink](#)

Unknown interpreted text role "issue".

## operator

- A new function `operator.call` has been added, such that `operator.call(obj, *args, **kwargs) == obj(*args, **kwargs)`. (Contributed by Antony Lee in [:issue:`44019`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 310); [backlink](#)

Unknown interpreted text role "issue".

## os

- On Windows, `:func:`os.urandom`` now uses `BCryptGenRandom()`, instead of `CryptGenRandom()` which is deprecated. (Contributed by Dong-hee Na in [:issue:`44611`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 318); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 318); [backlink](#)

Unknown interpreted text role "issue".

## re

- Atomic grouping (`(?>...)`) and possessive quantifiers (`(*, ++, ?+, {m, n}+)`) are now supported in regular expressions.

(Contributed by Jeffrey C. Jacobs and Serhiy Storchaka in [:issue:`433030`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 325); [backlink](#)

Unknown interpreted text role "issue".

## shutil

- Add optional parameter `dir_fd` in `:func:`shutil.rmtree``. (Contributed by Serhiy Storchaka in [:issue:`46245`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 332); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 332); [backlink](#)

Unknown interpreted text role "issue".

## socket

- Add CAN Socket support for NetBSD. (Contributed by Thomas Klausner in [:issue:`30512`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 339); [backlink](#)

Unknown interpreted text role "issue".

## sqlite3

- You can now disable the authorizer by passing `:const:`None`` to `:meth:`~sqlite3.Connection.set_authorizer``. (Contributed by Erlend E. Aasland in [:issue:`44491`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 346); [backlink](#)

Unknown interpreted text role "const".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 346); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 346); [backlink](#)

Unknown interpreted text role "issue".

- Collation name `:meth:`~sqlite3.Connection.create_collation`` can now contain any Unicode character. Collation names with invalid characters now raise `:exc:`UnicodeEncodeError`` instead of `:exc:`sqlite3.ProgrammingError``. (Contributed by Erlend E. Aasland in [:issue:`44688`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 350); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 350); [backlink](#)

Unknown interpreted text role "exc".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 350); [backlink](#)

Unknown interpreted text role "exc".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 350); [backlink](#)

Unknown interpreted text role "issue".

- `:mod:`sqlite3`` exceptions now include the SQLite extended error code as `:attr:`~sqlite3.Error.sqlite_errorcode`` and the SQLite error name as `:attr:`~sqlite3.Error.sqlite_errname``. (Contributed by Aviv Palivoda, Daniel Shahaf, and Erlend E. Aasland in `:issue:`16379`` and `:issue:`24139``.)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 355); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 355); [backlink](#)

Unknown interpreted text role "attr".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 355); [backlink](#)

Unknown interpreted text role "attr".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 355); [backlink](#)

Unknown interpreted text role "issue".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 355); [backlink](#)

Unknown interpreted text role "issue".

- Add `:meth:`~sqlite3.Connection.setlimit`` and `:meth:`~sqlite3.Connection.getlimit`` to `:class:`sqlite3.Connection`` for setting and getting SQLite limits by connection basis. (Contributed by Erlend E. Aasland in `:issue:`45243``.)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 361); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 361); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 361); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 361); [backlink](#)

Unknown interpreted text role "issue".

- `:mod:`sqlite3`` now sets `:attr:`sqlite3.threadsafety`` based on the default threading mode the underlying SQLite library has been compiled with. (Contributed by Erlend E. Aasland in [:issue:`45613`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 366); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 366); [backlink](#)

Unknown interpreted text role "attr".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 366); [backlink](#)

Unknown interpreted text role "issue".

- `:mod:`sqlite3`` C callbacks now use unraisable exceptions if callback tracebacks are enabled. Users can now register an `:func:`unraisable` hook handler` `<sys.unraisablehook>` to improve their debug experience. (Contributed by Erlend E. Aasland in [:issue:`45828`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 370); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 370); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 370); [backlink](#)

Unknown interpreted text role "issue".

- Fetch across rollback no longer raises `:exc:`~sqlite3.InterfaceError``. Instead we leave it to the SQLite library to handle these cases. (Contributed by Erlend E. Aasland in [:issue:`44092`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 376); [backlink](#)

Unknown interpreted text role "exc".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 376); [backlink](#)

Unknown interpreted text role "issue".

- Add `meth:~sqlite3.Connection.serialize`` and `meth:~sqlite3.Connection.deserialize`` to `:class:~sqlite3.Connection`` for serializing and deserializing databases. (Contributed by Erlend E. Aasland in [issue:~41930`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 380); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 380); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 380); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 380); [backlink](#)

Unknown interpreted text role "issue".

## sys

- `:func:~sys.exc_info`` now derives the `type` and `traceback` fields from the `value` (the exception instance), so when an exception is modified while it is being handled, the changes are reflected in the results of subsequent calls to `:func:~exc_info``. (Contributed by Irit Katriel in [issue:~45711`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 389); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 389); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 389); [backlink](#)

Unknown interpreted text role "issue".

- Add `:func:~sys.exception`` which returns the active exception instance (equivalent to `sys.exc_info()[1]`). (Contributed by Irit Katriel in [issue:~46328`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 395); [backlink](#)



Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 395); [backlink](#)

Unknown interpreted text role "issue".

## sysconfig

- Two new `ref: installation schemes <installation_paths>` (`posix_venv`, `nt_venv` and `venv`) were added and are used when Python creates new virtual environments or when it is running from a virtual environment. The first two schemes (`posix_venv` and `nt_venv`) are OS-specific for non-Windows and Windows, the `venv` is essentially an alias to one of them according to the OS Python runs on. This is useful for downstream distributors who modify `func: sysconfig.get_preferred_scheme`. Third party code that creates new virtual environments should use the new `venv` installation scheme to determine the paths, as does `mod: venv`. (Contributed by Miro Hrončok in [issue: 45413](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 403); [backlink](#)

Unknown interpreted text role "ref".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 403); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 403); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 403); [backlink](#)

Unknown interpreted text role "issue".

## threading

- On Unix, if the `sem_clockwait()` function is available in the C library (glibc 2.30 and newer), the `meth: threading.Lock.acquire` method now uses the monotonic clock (`data: time.CLOCK_MONOTONIC`) for the timeout, rather than using the system clock (`data: time.CLOCK_REALTIME`), to not be affected by system clock changes. (Contributed by Victor Stinner in [issue: 41710](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 420); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 420); [backlink](#)

Unknown interpreted text role "data".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 420); [backlink](#)

Unknown interpreted text role "data".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 420); [backlink](#)

Unknown interpreted text role "issue".

## time

- On Unix, `:func:`time.sleep`` now uses the `clock_nanosleep()` or `nanosleep()` function, if available, which has a resolution of 1 nanosecond ( $10^{-9}$  seconds), rather than using `select()` which has a resolution of 1 microsecond ( $10^{-6}$  seconds). (Contributed by Benjamin Szöke and Victor Stinner in [:issue:`21302`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 431); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 431); [backlink](#)

Unknown interpreted text role "issue".

- On Windows 8.1 and newer, `:func:`time.sleep`` now uses a waitable timer based on [high-resolution timers](#) which has a resolution of 100 nanoseconds ( $10^{-7}$  seconds). Previously, it had a resolution of 1 millisecond ( $10^{-3}$  seconds). (Contributed by Benjamin Szöke, Dong-hee Na, Eryk Sun and Victor Stinner in [:issue:`21302`](#) and [:issue:`45429`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 437); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 437); [backlink](#)

Unknown interpreted text role "issue".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 437); [backlink](#)

Unknown interpreted text role "issue".

## unicodedata

- The Unicode database has been updated to version 14.0.0. ([:issue:`45190`](#)).

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 448); [backlink](#)

Unknown interpreted text role "issue".

## venv

- When new Python virtual environments are created, the `venv` `ref`sysconfig installation scheme <installation_paths>`` is used to determine the paths inside the environment. When Python runs in a virtual environment, the same installation scheme is the default. That means that downstream distributors can change the default sysconfig install scheme without changing behavior of virtual environments. Third party code that also creates new virtual environments should do the same. (Contributed by Miro Hrončok in [:issue:`45413`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-

**resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 454);**  
[backlink](#)

Unknown interpreted text role "ref".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 454);**  
[backlink](#)

Unknown interpreted text role "issue".

## zipfile

- Added support for specifying member name encoding for reading metadata in the zipfile's directory and file headers. (Contributed by Stephen J. Turnbull and Serhiy Storchaka in [:issue:`28080`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 467);**  
[backlink](#)

Unknown interpreted text role "issue".

## fcntl

- On FreeBSD, the `:attr:`F_DUP2FD`` and `:attr:`F_DUP2FD_CLOEXEC`` flags respectively are supported, the former equals to `dup2` usage while the latter set the `FD_CLOEXEC` flag in addition.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 474);**  
[backlink](#)

Unknown interpreted text role "attr".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 474);**  
[backlink](#)

Unknown interpreted text role "attr".

## Optimizations

- Compiler now optimizes simple C-style formatting with literal format containing only format codes `%s`, `%r` and `%a` and makes it as fast as corresponding f-string expression. (Contributed by Serhiy Storchaka in [:issue:`28307`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 482);**  
[backlink](#)

Unknown interpreted text role "issue".

- "Zero-cost" exceptions are implemented. The cost of `try` statements is almost eliminated when no exception is raised. (Contributed by Mark Shannon in [:issue:`40222`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 487);**  
[backlink](#)

Unknown interpreted text role "issue".

- Pure ASCII strings are now normalized in constant time by `:func:`unicodedata.normalize``. (Contributed by Dong-hee Na in [:issue:`44987`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 491);**  
[backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 491); [backlink](#)

Unknown interpreted text role "issue".

- `mod:math` functions `func:~math.comb` and `func:~math.perm` are now up to 10 times or more faster for large arguments (the speed up is larger for larger  $k$ ). (Contributed by Serhiy Storchaka in [issue:37295](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 494); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 494); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 494); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 494); [backlink](#)

Unknown interpreted text role "issue".

- Dict don't store hash value when all inserted keys are Unicode objects. This reduces dict size. For example, `sys.getsizeof(dict.fromkeys("abcdefg"))` becomes 272 bytes from 352 bytes on 64bit platform. (Contributed by Inada Naoki in [issue:46845](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 499); [backlink](#)

Unknown interpreted text role "issue".

## Faster CPython

CPython 3.11 is on average [1.22x faster](#) than CPython 3.10 when measured with the [pyperformance](#) benchmark suite, and compiled with GCC on Ubuntu Linux. Depending on your workload, the speedup could be up to 10-60% faster.

This project focuses on two major areas in Python: faster startup and faster runtime. Other optimizations not under this project are listed in [Optimizations](#).

### Faster Startup

#### Frozen imports / Static code objects

Python caches bytecode in the `ref: __pycache__ <tot-pycache>` directory to speed up module loading.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 523); [backlink](#)

Unknown interpreted text role "ref".

Previously in 3.10, Python module execution looked like this:

Read `__pycache__` -> Unmarshal -> Heap allocated code object -> Evaluate

In Python 3.11, the core modules essential for Python startup are "frozen". This means that their code objects (and bytecode) are statically allocated by the interpreter. This reduces the steps in module execution process to this:

Statically allocated code object -> Evaluate

Interpreter startup is now 10-15% faster in Python 3.11. This has a big impact for short-running programs using Python.

(Contributed by Eric Snow, Guido van Rossum and Kumar Aditya in numerous issues.)

## Faster Runtime

### Cheaper, lazy Python frames

Python frames are created whenever Python calls a Python function. This frame holds execution information. The following are new frame optimizations:

- Streamlined the frame creation process.
- Avoided memory allocation by generously re-using frame space on the C stack.
- Streamlined the internal frame struct to contain only essential information. Frames previously held extra debugging and memory management information.

Old-style frame objects are now created only when required by debuggers. For most user code, no frame objects are created at all. As a result, nearly all Python functions calls have sped up significantly. We measured a 3-7% speedup in pyperformance.

(Contributed by Mark Shannon in [issue:44590](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11 .rst, line 564); [backlink](#)

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### Inlined Python function calls

During a Python function call, Python will call an evaluating C function to interpret that function's code. This effectively limits pure Python recursion to what's safe for the C stack.

In 3.11, when CPython detects Python code calling another Python function, it sets up a new frame, and "jumps" to the new code inside the new frame. This avoids calling the C interpreting function altogether.

Most Python function calls now consume no C stack space. This speeds up most of such calls. In simple recursive functions like fibonacci or factorial, a 1.7x speedup was observed. This also means recursive functions can recurse significantly deeper (if the user increases the recursion limit). We measured a 1-3% improvement in pyperformance.

(Contributed by Pablo Galindo and Mark Shannon in [issue:45256](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11 .rst, line 584); [backlink](#)

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## PEP 659: Specializing Adaptive Interpreter

[PEP 659](#) is one of the key parts of the faster CPython project. The general idea is that while Python is a dynamic language, most code has regions where objects and types rarely change. This concept is known as *type stability*.

At runtime, Python will try to look for common patterns and type stability in the executing code. Python will then replace the current operation with a more specialized one. This specialized operation uses fast paths available only to those use cases/types, which generally outperform their generic counterparts. This also brings in another concept called *inline caching*, where Python caches the results of expensive operations directly in the bytecode.

The specifier will also combine certain common instruction pairs into one superinstruction. This reduces the overhead during execution.

Python will only specialize when it sees code that is "hot" (executed multiple times). This prevents Python from wasting time for run-once code. Python can also de-specialize when code is too dynamic or when the use changes. Specialization is attempted periodically, and specialization attempts are not too expensive. This allows specialization to adapt to new circumstances.

(PEP written by Mark Shannon, with ideas inspired by Stefan Brunthaler. See [PEP 659](#) for more information.)

Operation	Form	Specialization	Operation speedup (up to)	Contributor(s)
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Operation	Form	Specialization	Operation speedup (up to)	Contributor(s)
Binary operations	<code>x+x; x*x; x-x;</code>	Binary add, multiply and subtract for common types such as <code>int</code> , <code>float</code> , and <code>str</code> take custom fast paths for their underlying types.	10%	Mark Shannon, Dong-hee Na, Brandt Bucher, Dennis Sweeney
Subscript	<code>a[i]</code>	Subscripting container types such as <code>list</code> , <code>tuple</code> and <code>dict</code> directly index the underlying data structures. Subscripting custom <code>__getitem__</code> is also inlined similar to <a href="#">ref: 'inline-calls'</a> . <div> <b>System Message: ERROR/3</b>  (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 629); <a href="#">backlink</a>  Unknown interpreted text role "ref". </div>	10-25%	Irit Katriel, Mark Shannon
Store subscript	<code>a[i] = z</code>	Similar to subscripting specialization above.	10-25%	Dennis Sweeney
Calls	<code>f(arg) C(arg)</code>	Calls to common builtin (C) functions and types such as <code>len</code> and <code>str</code> directly call their underlying C version. This avoids going through the internal calling convention.	20%	Mark Shannon, Ken Jin
Load global variable	<code>print len</code>	The object's index in the globals/builtins namespace is cached. Loading globals and builtins require zero namespace lookups.	<a href="#">[1]</a>	Mark Shannon
Load attribute	<code>o.attr</code>	Similar to loading global variables. The attribute's index inside the class/object's namespace is cached. In most cases, attribute loading will require zero namespace lookups.	<a href="#">[2]</a>	Mark Shannon
Load methods for call	<code>o.meth()</code>	The actual address of the method is cached. Method loading now has no namespace lookups -- even for classes with long inheritance chains.	10-20%	Ken Jin, Mark Shannon
Store attribute	<code>o.attr = z</code>	Similar to load attribute optimization.	2% in pyperformance	Mark Shannon
Unpack Sequence	<code>*seq</code>	Specialized for common containers such as <code>list</code> and <code>tuple</code> . Avoids internal calling convention.	8%	Brandt Bucher

[\[1\]](#) A similar optimization already existed since Python 3.8. 3.11 specializes for more forms and reduces some overhead.

[\[2\]](#) A similar optimization already existed since Python 3.10. 3.11 specializes for more forms. Furthermore, all attribute loads should be sped up by [:issue:45947](#).

**System Message: ERROR/3** (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 663); [backlink](#)

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## Misc

- Objects now require less memory due to lazily created object namespaces. Their namespace dictionaries now also share keys more freely. (Contributed Mark Shannon in [:issue:45340](#) and [:issue:40116](#).)

**System Message: ERROR/3** (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 671); [backlink](#)

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**System Message: ERROR/3** (D: \onboarding-resources\sample-onboarding-

**resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 671);**  
[backlink](#)

Unknown interpreted text role "issue".

- A more concise representation of exceptions in the interpreter reduced the time required for catching an exception by about 10%. (Contributed by Irit Katriel in [:issue:`45711`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 675);**  
[backlink](#)

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## FAQ

Q: How should I write my code to utilize these speedups?

A: You don't have to change your code. Write Pythonic code that follows common best practices. The Faster CPython project optimizes for common code patterns we observe.

Q: Will CPython 3.11 use more memory?

A: Maybe not. We don't expect memory use to exceed 20% more than 3.10. This is offset by memory optimizations for frame objects and object dictionaries as mentioned above.

Q: I don't see any speedups in my workload. Why?

A: Certain code won't have noticeable benefits. If your code spends most of its time on I/O operations, or already does most of its computation in a C extension library like numpy, there won't be significant speedup. This project currently benefits pure-Python workloads the most.

Furthermore, the pyperformance figures are a geometric mean. Even within the pyperformance benchmarks, certain benchmarks have slowed down slightly, while others have sped up by nearly 2x!

Q: Is there a JIT compiler?

A: No. We're still exploring other optimizations.

## About

Faster CPython explores optimizations for [:term:`CPython`](#). The main team is funded by Microsoft to work on this full-time. Pablo Galindo Salgado is also funded by Bloomberg LP to work on the project part-time. Finally, many contributors are volunteers from the community.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 716);** [backlink](#)

Unknown interpreted text role "term".

## CPython bytecode changes

- Replaced all numeric `BINARY_*` and `INPLACE_*` instructions with a single `:opcode:`BINARY_OP`` implementation.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 725);**  
[backlink](#)

Unknown interpreted text role "opcode".

- Replaced the three call instructions: `:opcode:`CALL_FUNCTION``, `:opcode:`CALL_FUNCTION_KW`` and `:opcode:`CALL_METHOD`` with `:opcode:`PUSH_NULL``, `:opcode:`PRECALL``, `:opcode:`CALL``, and `:opcode:`KW_NAMES``. This decouples the argument shifting for methods from the handling of keyword arguments and



allows better specialization of calls.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 728);  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 728);  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 728);  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 728);  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 728);  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 728);  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 728);  
[backlink](#)

Unknown interpreted text role "opcode".

- Removed `COPY_DICT_WITHOUT_KEYS` and `GEN_START`.
- `:opcode:'MATCH_CLASS'` and `:opcode:'MATCH_KEYS'` no longer push an additional boolean value indicating whether the match succeeded or failed. Instead, they indicate failure with `:const:'None'` (where a tuple of extracted values would otherwise be).

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 737);  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 737);  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 737);  
[backlink](#)

Unknown interpreted text role "const".

- Replace several stack manipulation instructions (`DUP_TOP`, `DUP_TOP_TWO`, `ROT_TWO`, `ROT_THREE`, `ROT_FOUR`, and `ROT_N`) with new `:opcode:'COPY'` and `:opcode:'SWAP'` instructions.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 742);**  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 742);**  
[backlink](#)

Unknown interpreted text role "opcode".

- Add `:opcode:'POP_JUMP_IF_NOT_NONE'` and `:opcode:'POP_JUMP_IF_NONE'` opcodes to speed up conditional jumps.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 746);**  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 746);**  
[backlink](#)

Unknown interpreted text role "opcode".

- Replaced `:opcode:'JUMP_IF_NOT_EXC_MATCH'` by `:opcode:'CHECK_EXC_MATCH'` which performs the check but does not jump.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 749);**  
[backlink](#)

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**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 749);**  
[backlink](#)

Unknown interpreted text role "opcode".

- Replaced `:opcode:'JUMP_IF_NOT_EG_MATCH'` by `:opcode:'CHECK_EG_MATCH'` which performs the check but does not jump.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 752);**  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 752);**  
[backlink](#)

Unknown interpreted text role "opcode".

- Replaced `:opcode:'JUMP_ABSOLUTE'` by the relative `:opcode:'JUMP_BACKWARD'`.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 755);**  
[backlink](#)

Unknown interpreted text role "opcode".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 755);**  
[backlink](#)

Unknown interpreted text role "opcode".

- Added `:opcode:`JUMP_BACKWARD_NO_INTERRUPT``, which is used in certain loops where it is undesirable to handle interrupts.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 757);**  
[backlink](#)

Unknown interpreted text role "opcode".

## Deprecated

- The `:mod:`lib2to3`` package and `2to3` tool are now deprecated and may not be able to parse Python 3.10 or newer. See the [PEP 617](#) (New PEG parser for CPython). (Contributed by Victor Stinner in [:issue:`40360`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 762);**  
[backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 762);**  
[backlink](#)

Unknown interpreted text role "issue".

- Undocumented modules `sre_compile`, `sre_constants` and `sre_parse` are now deprecated. (Contributed by Serhiy Storchaka in [:issue:`47152`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 766);**  
[backlink](#)

Unknown interpreted text role "issue".

- `:class:`webbrowser.MacOSX`` is deprecated and will be removed in Python 3.13. It is untested and undocumented and also not used by `webbrowser` itself. (Contributed by Dong-hee Na in [:issue:`42255`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 770);**  
[backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 770);**  
[backlink](#)

Unknown interpreted text role "issue".

- The behavior of returning a value from a `:class:`~unittest.TestCase`` and `:class:`~unittest.IsolatedAsyncioTestCase`` test methods (other than the default `None` value), is now deprecated.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 774); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 774); [backlink](#)

Unknown interpreted text role "class".

- Deprecated the following `:mod:`unittest`` functions, scheduled for removal in Python 3.13:

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 778); [backlink](#)

Unknown interpreted text role "mod".

- `:func:`unittest.findTestCases``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 781); [backlink](#)

Unknown interpreted text role "func".

- `:func:`unittest.makeSuite``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 782); [backlink](#)

Unknown interpreted text role "func".

- `:func:`unittest.getTestCaseNames``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 783); [backlink](#)

Unknown interpreted text role "func".

Use `:class:`~unittest.TestLoader`` method instead:

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 785); [backlink](#)

Unknown interpreted text role "class".

- `:meth:`unittest.TestLoader.loadTestsFromModule``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 787); [backlink](#)

Unknown interpreted text role "meth".

- `:meth:`unittest.TestLoader.loadTestsFromTestCase``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 788); [backlink](#)

Unknown interpreted text role "meth".

- `meth:unittest.TestLoader.getTestCaseNames``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 789); [backlink](#)

Unknown interpreted text role "meth".

(Contributed by Erlend E. Aasland in [issue:5846`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 791); [backlink](#)

Unknown interpreted text role "issue".

- The `meth:turtle.RawTurtle.settiltangle`` is deprecated since Python 3.1, it now emits a deprecation warning and will be removed in Python 3.13. Use `meth:turtle.RawTurtle.tiltangle`` instead (it was earlier incorrectly marked as deprecated, its docstring is now corrected). (Contributed by Hugo van Kemenade in [issue:45837`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 793); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 793); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 793); [backlink](#)

Unknown interpreted text role "issue".

- The delegation of `func:int`` to `meth:__trunc__`` is now deprecated. Calling `int(a)` when `type(a)` implements `meth:__trunc__`` but not `meth:__int__`` or `meth:__index__`` now raises a `exc:DeprecationWarning``. (Contributed by Zackery Spytz in [issue:44977`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 799); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 799); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 799); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 799);

[backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 799);**  
[backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 799);**  
[backlink](#)

Unknown interpreted text role "exc".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 799);**  
[backlink](#)

Unknown interpreted text role "issue".

- The following have been deprecated in `mod:configparser` since Python 3.2. Their deprecation warnings have now been updated to note they will be removed in Python 3.12:

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 804);**  
[backlink](#)

Unknown interpreted text role "mod".

- the `:class:configparser.SafeConfigParser` class

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 808);** [backlink](#)

Unknown interpreted text role "class".

- the `:attr:configparser.ParsingError.filename` property

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 809);** [backlink](#)

Unknown interpreted text role "attr".

- the `:meth:configparser.ParsingError.readfp` method

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 810);** [backlink](#)

Unknown interpreted text role "meth".

(Contributed by Hugo van Kemenade in `issue:45173`.)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 812);**  
[backlink](#)

Unknown interpreted text role "issue".

- `:class:configparser.LegacyInterpolation` has been deprecated in the docstring since Python 3.2. It now emits a `:exc:DeprecationWarning` and will be removed in Python 3.13. Use `:class:configparser.BasicInterpolation` or `:class:configparser.ExtendedInterpolation` instead. (Contributed by Hugo van Kemenade in `issue:46607`.)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 814); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 814); [backlink](#)

Unknown interpreted text role "exc".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 814); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 814); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 814); [backlink](#)

Unknown interpreted text role "issue".

- The `:func:`locale.getdefaultlocale`` function is deprecated and will be removed in Python 3.13. Use `:func:`locale.setlocale``, `:func:`locale.getpreferredencoding(False)`` <`locale.getpreferredencoding``> and `:func:`locale.getlocale`` functions instead. (Contributed by Victor Stinner in [:issue:`46659`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 820); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 820); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 820); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 820); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 820); [backlink](#)

Unknown interpreted text role "issue".



- The `mod:'asynchat'`, `mod:'asyncore'` and `mod:'smtpd'` modules have been deprecated since at least Python 3.6. Their documentation and deprecation warnings have now been updated to note they will be removed in Python 3.12 (PEP 594). (Contributed by Hugo van Kemenade in [issue: 47022](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 826); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 826); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 826); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 826); [backlink](#)

Unknown interpreted text role "issue".

- PEP 594 led to the deprecations of the following modules which are slated for removal in Python 3.13:
  - `mod:'aifc'`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 835); [backlink](#)

Unknown interpreted text role "mod".

- `mod:'audioop'`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 836); [backlink](#)

Unknown interpreted text role "mod".

(Contributed by Brett Cannon in [issue: 47061](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 838); [backlink](#)

Unknown interpreted text role "issue".

## Removed

- `class:'smtpd.MailmanProxy'` is now removed as it is unusable without an external module, `mailman`. (Contributed by Donghee Na in [issue: 35800](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 844); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 844);**  
[backlink](#)

Unknown interpreted text role "issue".

- The `binhex` module, deprecated in Python 3.9, is now removed. The following `:mod:`binascii`` functions, deprecated in Python 3.9, are now also removed:

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 847);**  
[backlink](#)

Unknown interpreted text role "mod".

- `a2b_hqx()`, `b2a_hqx()`;
- `rlecode_hqx()`, `rledecode_hqx()`.

The `:func:`binascii.crc_hqx`` function remains available.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 854);**  
[backlink](#)

Unknown interpreted text role "func".

(Contributed by Victor Stinner in [:issue:`45085`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 856);**  
[backlink](#)

Unknown interpreted text role "issue".

- The distutils `bdist_msi` command, deprecated in Python 3.9, is now removed. Use `bdist_wheel` (wheel packages) instead. (Contributed by Hugo van Kemenade in [:issue:`45124`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 858);**  
[backlink](#)

Unknown interpreted text role "issue".

- Due to significant security concerns, the `reuse_address` parameter of `:meth:`asyncio.loop.create_datagram_endpoint``, disabled in Python 3.9, is now entirely removed. This is because of the behavior of the socket option `SO_REUSEADDR` in UDP. (Contributed by Hugo van Kemenade in [:issue:`45129`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 862);**  
[backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 862);**  
[backlink](#)

Unknown interpreted text role "issue".

- Removed `:meth:`__getitem__`` methods of `:class:`xml.dom.pulldom.DOMEventStream``, `:class:`wsgiref.util.FileWrapper`` and `:class:`fileinput.FileInput``, deprecated since Python 3.9. (Contributed by Hugo van Kemenade in [:issue:`45132`](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 868);**  
[backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 868); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 868); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 868); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 868); [backlink](#)

Unknown interpreted text role "issue".

- The following deprecated functions and methods are removed in the `:mod:`gettext`` module: `:func:`~gettext.lgettext``, `:func:`~gettext.lgettext``, `:func:`~gettext.lgettext`` and `:func:`~gettext.lgettext``.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 873); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 873); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 873); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 873); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 873); [backlink](#)

Unknown interpreted text role "func".

Function `:func:`~gettext.bind_textdomain_codeset``, methods `:meth:`~gettext.NullTranslations.output_charset`` and `:meth:`~gettext.NullTranslations.set_output_charset``, and the `codeset` parameter of functions `:func:`~gettext.translation`` and `:func:`~gettext.install`` are also removed, since they are only used for the `l*gettext()` functions. (Contributed by Dong-hee Na and Serhiy Storchaka in [:issue:`44235`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 877); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 877); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 877); [backlink](#)

Unknown interpreted text role "meth".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 877); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 877); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 877); [backlink](#)

Unknown interpreted text role "issue".

- The `:func:`@asyncio.coroutine <asyncio.coroutine>` .term`decorator`` enabling legacy generator-based coroutines to be compatible with `async/await` code. The function has been deprecated since Python 3.8 and the removal was initially scheduled for Python 3.10. Use `:keyword:`async def`` instead. (Contributed by Illia Volochii in [:issue:`43216`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 885); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 885); [backlink](#)

Unknown interpreted text role "term".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 885); [backlink](#)

Unknown interpreted text role "keyword".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 885); [backlink](#)

Unknown interpreted text role "issue".

- `:class:`asyncio.coroutines.CoroWrapper`` used for wrapping legacy generator-based coroutine objects in the debug mode. (Contributed by Illia Volochii in [:issue:`43216`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 891); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 891); [backlink](#)

Unknown interpreted text role "issue".

- Removed the deprecated `split()` method of `:class:`_tkinter.TkappType``. (Contributed by Erlend E. Aasland in [:issue:`38371`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 895); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 895); [backlink](#)

Unknown interpreted text role "issue".

- Removed from the `:mod:`inspect`` module:

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 898); [backlink](#)

Unknown interpreted text role "mod".

- the `getargspec` function, deprecated since Python 3.0; use `:func:`inspect.signature`` or `:func:`inspect.getfullargspec`` instead.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 900); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 900); [backlink](#)

Unknown interpreted text role "func".

- the `formatargspec` function, deprecated since Python 3.5; use the `:func:`inspect.signature`` function and `:class:`Signature`` object directly.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 903); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 903); [backlink](#)

Unknown interpreted text role "class".

- the undocumented `Signature.from_builtin` and `Signature.from_function` functions, deprecated since Python 3.5; use the `meth: 'Signature.from_callable() <inspect.Signature.from_callable>'` method instead.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 907); [backlink](#)**

Unknown interpreted text role "meth".

(Contributed by Hugo van Kemenade in [issue: 45320](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 912); [backlink](#)**

Unknown interpreted text role "issue".

- Remove namespace package support from unittest discovery. It was introduced in Python 3.4 but has been broken since Python 3.7. (Contributed by Inada Naoki in [issue: 23882](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 914); [backlink](#)**

Unknown interpreted text role "issue".

- Remove `__class_getitem__` method from `class: 'pathlib.PurePath'`, because it was not used and added by mistake in previous versions. (Contributed by Nikita Sobolev in [issue: 46483](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 918); [backlink](#)**

Unknown interpreted text role "class".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 918); [backlink](#)**

Unknown interpreted text role "issue".

- Remove the undocumented private `float.__set_format__()` method, previously known as `float.__setformat__()` in Python 3.7. Its docstring said: "You probably don't want to use this function. It exists mainly to be used in Python's test suite." (Contributed by Victor Stinner in [issue: 46852](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 922); [backlink](#)**

Unknown interpreted text role "issue".

## Porting to Python 3.11

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

### Changes in the Python API

- Prohibited passing non-`class: 'concurrent.futures.ThreadPoolExecutor'` executors to `meth: 'loop.set_default_executor'` following a deprecation in Python 3.8. (Contributed by Illia Volochii in [issue: 43234](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 938); [backlink](#)**

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\cpython-main) (Doc) (whatsnew) 3.11.rst, line 938); *backlink*

Unknown interpreted text role "meth".

Unknown interpreted text role "meth".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 938);**  
*[backlink](#)*

Unknown interpreted text role "issue".

Unknown interpreted text role "issue".

- `:func:'open'`, `:func:'io.open'`, `:func:'codecs.open'` and `:class:'fileinput.FileInput'` no longer accept `'\u'` ("universal newline") in the file mode. This flag was deprecated since Python 3.3. In Python 3, the "universal newline" is used by default when a file is open in text mode. The `:ref:'newline parameter <open-newline-parameter>'` of `:func:'open'` controls how universal newlines works. (Contributed by Victor Stinner in `:issue:'37330'`.)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\cpython-main) (Doc) (whatsnew) 3.11.rst, line 943); *backlink*

Unknown interpreted text role "func".

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\cpython-main) (Doc) (whatsnew) 3.11.rst, line 943); *backlink*

Unknown interpreted text role "func".

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 943); *backlink*

Unknown interpreted text role "func".

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\cpython-main) (Doc) (whatsnew) 3.11.rst, line 943); *backlink*

Unknown interpreted text role "class".

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\cpython-main) (Doc) (whatsnew) 3.11.rst, line 943); *backlink*

Unknown interpreted text role "ref".

Unknown interpreted text role "ref".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 943); *[backlink](#)*

Unknown interpreted text role "func".

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\cpython-main) (Doc) (whatsnew) 3.11.rst, line 943); *backlink*

Unknown interpreted text role "issue".

Unknown interpreted text role "issue".

- The `.mod.pdb` module now reads the `.file.pdbrc` configuration file with the `'utf-8'` encoding. (Contributed by Srinivas Reddy Thatiparthi ([██████████@redhat.com](#)) in [issue`41137`](#).)



**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 951); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 951); [backlink](#)

Unknown interpreted text role "file".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 951); [backlink](#)

Unknown interpreted text role "issue".

- When sorting using tuples as keys, the order of the result may differ from earlier releases if the tuple elements don't define a total ordering (see [ref`expressions-value-comparisons`](#) for information on total ordering). It's generally true that the result of sorting simply isn't well-defined in the absence of a total ordering on list elements.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 955); [backlink](#)

Unknown interpreted text role "ref".

- `:mod:`calendar``: The `:class:`calendar.LocaleTextCalendar`` and `:class:`calendar.LocaleHTMLCalendar`` classes now use `:func:`locale.getlocale``, instead of using `:func:`locale.getdefaultlocale``, if no locale is specified. (Contributed by Victor Stinner in `:issue:`46659``.)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 962); [backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 962); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 962); [backlink](#)

Unknown interpreted text role "class".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 962); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 962); [backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 962);

[backlink](#)

Unknown interpreted text role "issue".

- Global inline flags (e.g. `(?i)`) can now only be used at the start of the regular expressions. Using them not at the start of expression was deprecated since Python 3.6. (Contributed by Serhiy Storchaka in [:issue:47066](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 968);  
[backlink](#)

Unknown interpreted text role "issue".

- `mod:re` module: Fix a few long-standing bugs where, in rare cases, capturing group could get wrong result. So the result may be different than before. (Contributed by Ma Lin in [:issue:35859](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 973);  
[backlink](#)

Unknown interpreted text role "mod".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 973);  
[backlink](#)

Unknown interpreted text role "issue".

- The *population* parameter of `func:random.sample` must be a sequence. Automatic conversion of sets to lists is no longer supported. If the sample size is larger than the population size, a `exc:ValueError` is raised. (Contributed by Raymond Hettinger in [:issue:40465](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 978);  
[backlink](#)

Unknown interpreted text role "func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 978);  
[backlink](#)

Unknown interpreted text role "exc".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 978);  
[backlink](#)

Unknown interpreted text role "issue".

## Build Changes

- Building Python now requires a C11 compiler without optional C11 features. (Contributed by Victor Stinner in [:issue:46656](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 987);  
[backlink](#)

Unknown interpreted text role "issue".

- Building Python now requires support of IEEE 754 floating point numbers. (Contributed by Victor Stinner in [:issue:46917](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 990);  
[backlink](#)

Unknown interpreted text role "issue".

- CPython can now be built with the ThinLTO option via `--with-lto=thin`. (Contributed by Dong-hee Na and Brett Holman in [:issue:'44340'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 993); [backlink](#)

Unknown interpreted text role "issue".

- libpython is no longer linked against libcrypt. (Contributed by Mike Gilbert in [:issue:'45433'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 996); [backlink](#)

Unknown interpreted text role "issue".

- Building Python now requires a C99 `<math.h>` header file providing the following functions: `copysign()`, `hypot()`, `isfinite()`, `isinf()`, `isnan()`, `round()`. (Contributed by Victor Stinner in [:issue:'45440'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 999); [backlink](#)

Unknown interpreted text role "issue".

- Building Python now requires a C99 `<math.h>` header file providing a NAN constant, or the `__builtin_nan()` built-in function. (Contributed by Victor Stinner in [:issue:'46640'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1004); [backlink](#)

Unknown interpreted text role "issue".

- Building Python now requires support for floating point Not-a-Number (NaN): remove the `Py_NO_NAN` macro. (Contributed by Victor Stinner in [:issue:'46656'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1008); [backlink](#)

Unknown interpreted text role "issue".

- Freelists for object structs can now be disabled. A new `program`configure`` option `option:'!--without-freelists`` can be used to disable all freelists except empty tuple singleton. (Contributed by Christian Heimes in [:issue:'45522'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1012); [backlink](#)

Unknown interpreted text role "program".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1012); [backlink](#)

Unknown interpreted text role "option".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1012); [backlink](#)

Unknown interpreted text role "issue".

- Modules/Setup and Modules/makesetup have been improved and tied up. Extension modules can now be built through makesetup. All except some test modules can be linked statically into main binary or library. (Contributed by Brett Cannon and Christian Heimes in [:issue:'45548'](#), [:issue:'45570'](#), [:issue:'45571'](#), and [:issue:'43974'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1017); [backlink](#)

Unknown interpreted text role "issue".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1017); [backlink](#)

Unknown interpreted text role "issue".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1017); [backlink](#)

Unknown interpreted text role "issue".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1017); [backlink](#)

Unknown interpreted text role "issue".

- Build dependencies, compiler flags, and linker flags for most stdlib extension modules are now detected by `program'configure'`. libffi, libns1, libsqlite3, zlib, bzip2, liblzma, libcrypt, Tcl/Tk libs, and uuid flags are detected by pkg-config (when available). (Contributed by Christian Heimes and Erlend Egeberg Aasland in [:issue:'45847'](#), [:issue:'45747'](#), and [:issue:'45763'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1023); [backlink](#)

Unknown interpreted text role "program".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1023); [backlink](#)

Unknown interpreted text role "issue".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1023); [backlink](#)

Unknown interpreted text role "issue".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1023); [backlink](#)

Unknown interpreted text role "issue".

#### Note

Use the environment variables `TCLTK_CFLAGS` and `TCLTK_LIBS` to manually specify the location of Tcl/Tk headers and libraries. The `program'configure'` options `--with-tcltk-includes` and `--with-tcltk-libs` have been removed.

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1031); [backlink](#)**

Unknown interpreted text role "program".

- CPython now has experimental support for cross compiling to WebAssembly platform `wasm32-emscripten`. The effort is inspired by previous work like Pyodide. (Contributed by Christian Heimes and Ethan Smith in [issue:40280](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1036); [backlink](#)**

Unknown interpreted text role "issue".

- CPython will now use 30-bit digits by default for the Python `:class:`int`` implementation. Previously, the default was to use 30-bit digits on platforms with `SIZEOF_VOID_P >= 8`, and 15-bit digits otherwise. It's still possible to explicitly request use of 15-bit digits via either the `--enable-big-digits` option to the configure script or (for Windows) the `PYLONG_BITS_IN_DIGIT` variable in `PC/pyconfig.h`, but this option may be removed at some point in the future. (Contributed by Mark Dickinson in [issue:45569](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1041); [backlink](#)**

Unknown interpreted text role "class".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1041); [backlink](#)**

Unknown interpreted text role "issue".

- The `:mod:`tkinter`` package now requires Tcl/Tk version 8.5.12 or newer. (Contributed by Serhiy Storchaka in [issue:46996](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1050); [backlink](#)**

Unknown interpreted text role "mod".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1050); [backlink](#)**

Unknown interpreted text role "issue".

## C API Changes

- `:cfunc:`PyErr_SetExcInfo()` no longer uses the `type` and `traceback` arguments, the interpreter now derives those values from the exception instance (the `value` argument). The function still steals references of all three arguments. (Contributed by Irit Katriel in [issue:45711](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1057); [backlink](#)**

Unknown interpreted text role "cfunc".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1057); [backlink](#)**

Unknown interpreted text role "issue".

- `c:func:PyErr_GetExcInfo()` now derives the `type` and `traceback` fields of the result from the exception instance (the `value` field). (Contributed by Irit Katriel in [issue:45711](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1063);**  
[backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1063);**  
[backlink](#)

Unknown interpreted text role "issue".

- `c:struct:_frozen` has a new `is_package` field to indicate whether or not the frozen module is a package. Previously, a negative value in the `size` field was the indicator. Now only non-negative values be used for `size`. (Contributed by Kumar Aditya in [issue:46608](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1067);**  
[backlink](#)

Unknown interpreted text role "c:struct".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1067);**  
[backlink](#)

Unknown interpreted text role "issue".

## New Features

- Add a new `c:func:PyType_GetName` function to get type's short name. (Contributed by Hai Shi in [issue:42035](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1076);**  
[backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1076);**  
[backlink](#)

Unknown interpreted text role "issue".

- Add a new `c:func:PyType_GetQualName` function to get type's qualified name. (Contributed by Hai Shi in [issue:42035](#).)

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1079);**  
[backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1079);**  
[backlink](#)

Unknown interpreted text role "issue".

- Add new `c:func:PyThreadState_EnterTracing` and `c:func:PyThreadState_LeaveTracing` functions to the limited C API to suspend and resume tracing and profiling. (Contributed by Victor Stinner in [issue:43760](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1082); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1082); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1082); [backlink](#)

Unknown interpreted text role "issue".

- Added the `:xdata:Py_Version` constant which bears the same value as `:c:macro:PY_VERSION_HEX`. (Contributed by Gabriele N. Tornetta in [issue:43931](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1087); [backlink](#)

Unknown interpreted text role "c:data".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1087); [backlink](#)

Unknown interpreted text role "c:macro".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1087); [backlink](#)

Unknown interpreted text role "issue".

- `:c:type:Py_buffer` and APIs are now part of the limited API and the stable ABI:

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1091); [backlink](#)

Unknown interpreted text role "c:type".

- `:c:func:PyObject_CheckBuffer`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1094); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:PyObject_GetBuffer`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1095); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:PyBuffer_GetPointer`



**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1096); [backlink](#)

Unknown interpreted text role "c:func".

- :c:func:`PyBuffer\_SizeFromFormat`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1097); [backlink](#)

Unknown interpreted text role "c:func".

- :c:func:`PyBuffer\_ToContiguous`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1098); [backlink](#)

Unknown interpreted text role "c:func".

- :c:func:`PyBuffer\_FromContiguous`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1099); [backlink](#)

Unknown interpreted text role "c:func".

- :c:func:`PyBuffer\_CopyData`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1100); [backlink](#)

Unknown interpreted text role "c:func".

- :c:func:`PyBuffer\_IsContiguous`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1101); [backlink](#)

Unknown interpreted text role "c:func".

- :c:func:`PyBuffer\_FillContiguousStrides`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1102); [backlink](#)

Unknown interpreted text role "c:func".

- :c:func:`PyBuffer\_FillInfo`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1103); [backlink](#)

Unknown interpreted text role "c:func".

- :c:func:`PyBuffer\_Release`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-



resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1104); [backlink](#)

Unknown interpreted text role "c:func".

- :c:func:`PyMemoryView\_FromBuffer`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1105); [backlink](#)

Unknown interpreted text role "c:func".

- :c:member:`~PyBufferProcs.bf\_getbuffer` and :c:member:`~PyBufferProcs.bf\_releasebuffer` type slots

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1106); [backlink](#)

Unknown interpreted text role "c:member".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1106); [backlink](#)

Unknown interpreted text role "c:member".

(Contributed by Christian Heimes in :issue:`45459`.)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1109); [backlink](#)

Unknown interpreted text role "issue".

- Added the :c:data:`PyType\_GetModuleByDef` function, used to get the module in which a method was defined, in cases where this information is not available directly (via :c:type:`PyCMethod`). (Contributed by Petr Viktorin in :issue:`46613`.)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1111); [backlink](#)

Unknown interpreted text role "c:data".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1111); [backlink](#)

Unknown interpreted text role "c:type".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1111); [backlink](#)

Unknown interpreted text role "issue".

- Add new functions to pack and unpack C double (serialize and deserialize): :c:func:`PyFloat\_Pack2`, :c:func:`PyFloat\_Pack4`, :c:func:`PyFloat\_Pack8`, :c:func:`PyFloat\_Unpack2`, :c:func:`PyFloat\_Unpack4` and :c:func:`PyFloat\_Unpack8`.

(Contributed by Victor Stinner in :issue:`46906`.)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1116); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1116); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1116); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1116); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1116); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1116); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1116); [backlink](#)

Unknown interpreted text role "issue".

- Add new functions to get frame object attributes: `:c:func:'PyFrame_GetBuiltins'`, `:c:func:'PyFrame_GetGenerator'`, `:c:func:'PyFrame_GetGlobals'`.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1122); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1122); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1122); [backlink](#)

Unknown interpreted text role "c:func".

## Porting to Python 3.11

- The old trashcan macros (`Py_TRASHCAN_SAFE_BEGIN/Py_TRASHCAN_SAFE_END`) are now deprecated. They should be replaced by the new macros `Py_TRASHCAN_BEGIN` and `Py_TRASHCAN_END`.

A `tp_dealloc` function that has the old macros, such as:

```
static void
mytype_dealloc(mytype *p)
```

```

{
    PyObject_GC_UnTrack(p);
    Py_TRASHCAN_SAFE_BEGIN(p);
    ...
    Py_TRASHCAN_SAFE_END
}

```

should migrate to the new macros as follows:

```

static void
mytype_dealloc(mytype *p)
{
    PyObject_GC_UnTrack(p);
    Py_TRASHCAN_BEGIN(p, mytype_dealloc)
    ...
    Py_TRASHCAN_END
}

```

Note that `Py_TRASHCAN_BEGIN` has a second argument which should be the deallocation function it is in.

To support older Python versions in the same codebase, you can define the following macros and use them throughout the code (credit: these were copied from the `mypy` codebase):

```

#if PY_MAJOR_VERSION >= 3 && PY_MINOR_VERSION >= 8
# define CPy_TRASHCAN_BEGIN(op, dealloc) Py_TRASHCAN_BEGIN(op, dealloc)
# define CPy_TRASHCAN_END(op) Py_TRASHCAN_END
#else
# define CPy_TRASHCAN_BEGIN(op, dealloc) Py_TRASHCAN_SAFE_BEGIN(op)
# define CPy_TRASHCAN_END(op) Py_TRASHCAN_SAFE_END(op)
#endif

```

- The `:cfunc:'PyType_Ready'` function now raises an error if a type is defined with the `:const:'Py_TPFLAGS_HAVE_GC'` flag set but has no traverse function (`:cmember:'PyTypeObject.tp_traverse'`). (Contributed by Victor Stinner in [issue: 44263](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1170); [backlink](#)

Unknown interpreted text role "cfunc".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1170); [backlink](#)

Unknown interpreted text role "const".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1170); [backlink](#)

Unknown interpreted text role "cmember".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1170); [backlink](#)

Unknown interpreted text role "issue".

- Heap types with the `:const:'Py_TPFLAGS_IMMUTABLETYPE'` flag can now inherit the [PEP 590](#) vectorcall protocol. Previously, this was only possible for `:ref:static types <static-types>`. (Contributed by Erlend E. Aasland in [issue: 43908](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1175); [backlink](#)

Unknown interpreted text role "const".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1175); [backlink](#)

Unknown interpreted text role "ref".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1175); [backlink](#)

Unknown interpreted text role "issue".

- Since `:cfunc:'Py_TYPE()'` is changed to an inline static function, `Py_TYPE(obj) = new_type` must be replaced with `Py_SET_TYPE(obj, new_type)`: see the `:cfunc:'Py_SET_TYPE()'` function (available since Python 3.9). For backward compatibility, this macro can be used:

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1180); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1180); [backlink](#)

Unknown interpreted text role "c:func".

```
#if PY_VERSION_HEX < 0x030900A4 && !defined(Py_SET_TYPE)
static inline void _Py_SET_TYPE(PyObject *ob, PyTypeObject *type)
{ ob->ob_type = type; }
#define Py_SET_TYPE(ob, type) _Py_SET_TYPE((PyObject*) (ob), type)
#endif
```

(Contributed by Victor Stinner in [:issue:'39573'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1192); [backlink](#)

Unknown interpreted text role "issue".

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

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1194); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1194); [backlink](#)

Unknown interpreted text role "c:func".

```
#if PY_VERSION_HEX < 0x030900A4 && !defined(Py_SET_SIZE)
static inline void _Py_SET_SIZE(PyVarObject *ob, Py_ssize_t size)
{ ob->ob_size = size; }
#define Py_SET_SIZE(ob, size) _Py_SET_SIZE((PyVarObject*) (ob), size)
#endif
```

(Contributed by Victor Stinner in [:issue:'39573'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1206); [backlink](#)

Unknown interpreted text role "issue".

- `<Python.h>` no longer includes the header files `<stdlib.h>`, `<stdio.h>`, `<errno.h>` and `<string.h>` when the

Py\_LIMITED\_API macro is set to 0x030b0000 (Python 3.11) or higher. C extensions should explicitly include the header files after `#include <Python.h>`. (Contributed by Victor Stinner in [issue:45434](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1208); [backlink](#)

Unknown interpreted text role "issue".

- The non-limited API files `cellobject.h`, `classobject.h`, `code.h`, `context.h`, `funcobject.h`, `genobject.h` and `longintrepr.h` have been moved to the `Include/cpython` directory. Moreover, the `eval.h` header file was removed. These files must not be included directly, as they are already included in `Python.h`: `ref: Include Files <api-includes>`. If they have been included directly, consider including `Python.h` instead. (Contributed by Victor Stinner in [issue:35134](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1214); [backlink](#)

Unknown interpreted text role "ref".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1214); [backlink](#)

Unknown interpreted text role "issue".

- The `PyUnicode_CHECK_INTERNEDED` macro has been excluded from the limited C API. It was never usable there, because it used internal structures which are not available in the limited C API. (Contributed by Victor Stinner in [issue:46007](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1222); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1222); [backlink](#)

Unknown interpreted text role "issue".

- The `PyFrameObject` structure members have been removed from the public C API.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1229); [backlink](#)

Unknown interpreted text role "c:type".

While the documentation notes that the `PyFrameObject` fields are subject to change at any time, they have been stable for a long time and were used in several popular extensions.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1232); [backlink](#)

Unknown interpreted text role "c:type".

In Python 3.11, the frame struct was reorganized to allow performance optimizations. Some fields were removed entirely, as they were details of the old implementation.

`PyFrameObject` fields:

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1240);

[backlink](#)

Unknown interpreted text role "c:type".

- `f_back`: use `:c:func:'PyFrame_GetBack'`.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1242); [backlink](#)

Unknown interpreted text role "c:func".

- `f_blockstack`: removed.
- `f_builtins`: use `:c:func:'PyFrame_GetBuiltins'`.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1244); [backlink](#)

Unknown interpreted text role "c:func".

- `f_code`: use `:c:func:'PyFrame_GetCode'`.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1245); [backlink](#)

Unknown interpreted text role "c:func".

- `f_gen`: use `:c:func:'PyFrame_GetGenerator'`.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1246); [backlink](#)

Unknown interpreted text role "c:func".

- `f_globals`: use `:c:func:'PyFrame_GetGlobals'`.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1247); [backlink](#)

Unknown interpreted text role "c:func".

- `f_iblock`: removed.
- `f_lasti`: use `PyObject_GetAttrString((PyObject*)frame, "f_lasti")`. Code using `f_lasti` with `PyCode_Addr2Line()` should use `:c:func:'PyFrame_GetLineNumber'` instead.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1249); [backlink](#)

Unknown interpreted text role "c:func".

- `f_lineno`: use `:c:func:'PyFrame_GetLineNumber'`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1252); [backlink](#)

Unknown interpreted text role "c:func".

- `f_locals`: use `:c:func:'PyFrame_GetLocals'`.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1253); [backlink](#)

Unknown interpreted text role "c:func".

- `f_stackdepth`: removed.
- `f_state`: no public API (renamed to `f_frame.f_state`).
- `f_trace`: no public API.
- `f_trace_lines`: use `PyObject_GetAttrString((PyObject*) frame, "f_trace_lines")`.
- `f_trace_opcodes`: use `PyObject_GetAttrString((PyObject*) frame, "f_trace_opcodes")`.
- `f_localsplus`: no public API (renamed to `f_frame.localsplus`).
- `f_valustack`: removed.

The Python frame object is now created lazily. A side effect is that the `f_back` member must not be accessed directly, since its value is now also computed lazily. The `c:func:'PyFrame_GetBack'` function must be called instead.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1262); [backlink](#)

Unknown interpreted text role "c:func".

Debuggers that accessed the `f_locals` directly *must* call `c:func:'PyFrame_GetLocals'` instead. They no longer need to call `c:func:'PyFrame_FastToLocalsWithError'` or `c:func:'PyFrame_LocalsToFast'`, in fact they should not call those functions. The necessary updating of the frame is now managed by the virtual machine.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1267); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1267); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1267); [backlink](#)

Unknown interpreted text role "c:func".

Code defining `PyFrame_GetCode()` on Python 3.8 and older:

```
#if PY_VERSION_HEX < 0x030900B1
static inline PyCodeObject* PyFrame_GetCode(PyFrameObject *frame)
{
    Py_INCREF(frame->f_code);
    return frame->f_code;
}
#endif
```

Code defining `PyFrame_GetBack()` on Python 3.8 and older:

```
#if PY_VERSION_HEX < 0x030900B1
static inline PyFrameObject* PyFrame_GetBack(PyFrameObject *frame)
{
    Py_XINCRREF(frame->f_back);
    return frame->f_back;
}
#endif
```

Or use the [pythoncapi\\_compat](#) project to get these two functions on older Python versions.

- Changes of the `c:type:'PyThreadState'` structure members:



**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1297); [backlink](#)

Unknown interpreted text role "c:type".

- `frame`: removed, use `:c:func:`PyThreadState_GetFrame`` (function added to Python 3.9 by `:issue:`40429``). Warning: the function returns a `:term:`strong reference``, need to call `:c:func:`Py_XDECREF``.

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1299); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1299); [backlink](#)

Unknown interpreted text role "issue".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1299); [backlink](#)

Unknown interpreted text role "term".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1299); [backlink](#)

Unknown interpreted text role "c:func".

- `tracing`: changed, use `:c:func:`PyThreadState_EnterTracing`` and `:c:func:`PyThreadState_LeaveTracing`` (functions added to Python 3.11 by `:issue:`43760``).

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1303); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1303); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1303); [backlink](#)

Unknown interpreted text role "issue".

- `recursion_depth`: removed, use `(tstate->recursion_limit - tstate->recursion_remaining)` instead.
- `stackcheck_counter`: removed.

Code defining `PyThreadState_GetFrame()` on Python 3.8 and older:

```
#if PY_VERSION_HEX < 0x030900B1
static inline PyFrameObject* PyThreadState_GetFrame(PyThreadState *tstate)
{
    Py_XINCREF(tstate->frame);
    return tstate->frame;
}
#endif
```

Code defining `PyThreadState_EnterTracing()` and `PyThreadState_LeaveTracing()` on Python 3.10 and older:

```
#if PY_VERSION_HEX < 0x030B00A2
static inline void PyThreadState_EnterTracing(PyThreadState *tstate)
{
    tstate->tracing++;
#if PY_VERSION_HEX >= 0x030A00A1
    tstate->cframe->use_tracing = 0;
#else
    tstate->use_tracing = 0;
#endif
}

static inline void PyThreadState_LeaveTracing(PyThreadState *tstate)
{
    int use_tracing = (tstate->c_tracefunc != NULL || tstate->c_profilefunc != NULL);
    tstate->tracing--;
#if PY_VERSION_HEX >= 0x030A00A1
    tstate->cframe->use_tracing = use_tracing;
#else
    tstate->use_tracing = use_tracing;
#endif
}
#endif
```

Or use [the pythoncapi\\_compat project](#) to get these functions on old Python functions.

- Distributors are encouraged to build Python with the optimized Blake2 library [libb2](#).

## Deprecated

- Deprecate the following functions to configure the Python initialization:
  - `:c:func:PySys_AddWarnOptionUnicode``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1359); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:PySys_AddWarnOption``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1360); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:PySys_AddXOption``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1361); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:PySys_HasWarnOptions``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1362); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:Py_SetPath``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1363); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:`Py_SetProgramName``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1364); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:`Py_SetPythonHome``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1365); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:`Py_SetStandardStreamEncoding``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1366); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:`_Py_SetProgramFullPath``

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1367); [backlink](#)

Unknown interpreted text role "c:func".

Use the new `:c:type:`PyConfig`` API of the `:ref:`Python Initialization Configuration <init-config>`` instead (PEP 587). (Contributed by Victor Stinner in [:issue:`44113`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1369); [backlink](#)

Unknown interpreted text role "c:type".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1369); [backlink](#)

Unknown interpreted text role "ref".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1369); [backlink](#)

Unknown interpreted text role "issue".

- Deprecate the `ob_shash` member of the `:c:type:`PyBytesObject``. Use `:c:func:`PyObject_Hash`` instead. (Contributed by Inada Naoki in [:issue:`46864`](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1373); [backlink](#)

Unknown interpreted text role "c:type".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1373); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1373); [backlink](#)

Unknown interpreted text role "issue".

## Removed

- `:c:func:PyFrame_BlockSetup` and `:c:func:PyFrame_BlockPop` have been removed. (Contributed by Mark Shannon in [:issue:40222](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1379); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1379); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1379); [backlink](#)

Unknown interpreted text role "issue".

- Remove the following math macros using the `errno` variable:

- `Py_ADJUST_ERANGE1()`
- `Py_ADJUST_ERANGE2()`
- `Py_OVERFLOWED()`
- `Py_SET_ERANGE_IF_OVERFLOW()`
- `Py_SET_ERRNO_ON_MATH_ERROR()`

(Contributed by Victor Stinner in [:issue:45412](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1391); [backlink](#)

Unknown interpreted text role "issue".

- Remove `Py_UNICODE_COPY()` and `Py_UNICODE_FILL()` macros, deprecated since Python 3.3. Use `PyUnicode_CopyCharacters()` or `memcpy()` (`wchar_t* string`), and `PyUnicode_Fill()` functions instead. (Contributed by Victor Stinner in [:issue:41123](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1393); [backlink](#)

Unknown interpreted text role "issue".

- Remove the `pystrex.h` header file. It only contains private functions. C extensions should only include the main `<Python.h>` header file. (Contributed by Victor Stinner in [:issue:45434](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1398); [backlink](#)

Unknown interpreted text role "issue".

- Remove the `Py_FORCE_DOUBLE()` macro. It was used by the `Py_IS_INFINITY()` macro. (Contributed by Victor Stinner in [:issue:45440](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1402); [backlink](#)

Unknown interpreted text role "issue".

- The following items are no longer available when `:c:macro:Py_LIMITED_API` is defined:

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1406); [backlink](#)

Unknown interpreted text role "c:macro".

- `:c:func:PyMarshal_WriteLongToFile`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1409); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:PyMarshal_WriteObjectToFile`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1410); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:PyMarshal_ReadObjectFromString`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1411); [backlink](#)

Unknown interpreted text role "c:func".

- `:c:func:PyMarshal_WriteObjectToString`

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1412); [backlink](#)

Unknown interpreted text role "c:func".

- the `Py_MARSHAL_VERSION` macro

These are not part of the [:ref:limited API <stable-abi-list>](#).

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1415); [backlink](#)

Unknown interpreted text role "ref".

(Contributed by Victor Stinner in [:issue:45474](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1417); [backlink](#)

Unknown interpreted text role "issue".

- Exclude `:c:func:'PyWeakref_GET_OBJECT'` from the limited C API. It never worked since the `:c:type:'PyWeakReference'` structure is opaque in the limited C API. (Contributed by Victor Stinner in [:issue:'35134'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1419); [backlink](#)

Unknown interpreted text role "c:func".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1419); [backlink](#)

Unknown interpreted text role "c:type".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1419); [backlink](#)

Unknown interpreted text role "issue".

- Remove the `PyHeapType_GET_MEMBERS()` macro. It was exposed in the public C API by mistake, it must only be used by Python internally. Use the `PyTypeObject.tp_members` member instead. (Contributed by Victor Stinner in [:issue:'40170'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1424); [backlink](#)

Unknown interpreted text role "issue".

- Remove the `HAVE_PY_SET_53BIT_PRECISION` macro (moved to the internal C API). (Contributed by Victor Stinner in [:issue:'45412'](#).)

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 1429); [backlink](#)

Unknown interpreted text role "issue".

## Docutils System Messages

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 5); [backlink](#)

Undefined substitution referenced: "release".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\whatsnew\ (cpython-main) (Doc) (whatsnew) 3.11.rst, line 6); [backlink](#)

Undefined substitution referenced: "today".