Installing Python Modules

Release 3.5.8rc2

Guido van Rossum
and the Python development team

October 12, 2019

Python Software Foundation
Email: docs@python.org

CONTENTS

1 Key terms 3

2 Basic usage 5

3 How do I . . . ? 7
- 3.1 . . . install pip in versions of Python prior to Python 3.4? . . . 7
- 3.2 . . . install packages just for the current user? . . . 7
- 3.3 . . . install scientific Python packages? . . . 7
- 3.4 . . . work with multiple versions of Python installed in parallel? . . . 7

4 Common installation issues 9
- 4.1 Installing into the system Python on Linux . . . 9
- 4.2 Installing binary extensions . . . 9

A Glossary 11

B About these documents 23
- B.1 Contributors to the Python Documentation . . . 23

C History and License 25
- C.1 History of the software . . . 25
- C.2 Terms and conditions for accessing or otherwise using Python . . . 26
- C.3 Licenses and Acknowledgements for Incorporated Software . . . 29

D Copyright 41

Index 43

Email distutils-sig@python.org

As a popular open source development project, Python has an active supporting community of contributors and users that also make their software available for other Python developers to use under open source license terms.

This allows Python users to share and collaborate effectively, benefiting from the solutions others have already created to common (and sometimes even rare!) problems, as well as potentially contributing their own solutions to the common pool.

This guide covers the installation part of the process. For a guide to creating and sharing your own Python projects, refer to the distribution guide.

Note: For corporate and other institutional users, be aware that many organisations have their own policies around using and contributing to open source software. Please take such policies into account when making use of the distribution and installation tools provided with Python.

CHAPTER

ONE

KEY TERMS

- pip is the preferred installer program. Starting with Python 3.4, it is included by default with the Python binary installers.
- a virtual environment is a semi-isolated Python environment that allows packages to be installed for use by a particular application, rather than being installed system wide
- pyvenv is the standard tool for creating virtual environments, and has been part of Python since Python 3.3. Starting with Python 3.4, it defaults to installing pip into all created virtual environments
- virtualenv is a third party alternative (and predecessor) to pyvenv. It allows virtual environments to be used on versions of Python prior to 3.4, which either don't provide pyvenv at all, or aren't able to automatically install pip into created environments.
- the Python Packaging Index is a public repository of open source licensed packages made available for use by other Python users
- the Python Packaging Authority are the group of developers and documentation authors responsible for the maintenance and evolution of the standard packaging tools and the associated metadata and file format standards. They maintain a variety of tools, documentation and issue trackers on both GitHub and BitBucket.
- distutils is the original build and distribution system first added to the Python standard library in 1998. While direct use of distutils is being phased out, it still laid the foundation for the current packaging and distribution infrastructure, and it not only remains part of the standard library, but its name lives on in other ways (such as the name of the mailing list used to coordinate Python packaging standards development).

CHAPTER

TWO

BASIC USAGE

The standard packaging tools are all designed to be used from the command line.

The following command will install the latest version of a module and its dependencies from the Python Packaging Index:

```
python -m pip install SomePackage
```

Note: For POSIX users (including Mac OS X and Linux users), the examples in this guide assume the use of a virtual environment.

For Windows users, the examples in this guide assume that the option to adjust the system PATH environment variable was selected when installing Python.

It's also possible to specify an exact or minimum version directly on the command line. When using comparator operators such as >, < or some other special character which get interpreted by shell, the package name and the version should be enclosed within double quotes:

```
python -m pip install SomePackage==1.0.4    # specific version
python -m pip install "SomePackage>=1.0.4"  # minimum version
```

Normally, if a suitable module is already installed, attempting to install it again will have no effect. Upgrading existing modules must be requested explicitly:

```
python -m pip install --upgrade SomePackage
```

More information and resources regarding pip and its capabilities can be found in the Python Packaging User Guide.

pyvenv has its own documentation at scripts-pyvenv. Installing into an active virtual environment uses the commands shown above.

See also:

Python Packaging User Guide: Installing Python Distribution Packages

CHAPTER

THREE

HOW DO I . . . ?

These are quick answers or links for some common tasks.

3.1 . . . install pip in versions of Python prior to Python 3.4?

Python only started bundling pip with Python 3.4. For earlier versions, pip needs to be "bootstrapped" as described in the Python Packaging User Guide.

See also:

Python Packaging User Guide: Requirements for Installing Packages

3.2 . . . install packages just for the current user?

Passing the --user option to python -m pip install will install a package just for the current user, rather than for all users of the system.

3.3 . . . install scientific Python packages?

A number of scientific Python packages have complex binary dependencies, and aren't currently easy to install using pip directly. At this point in time, it will often be easier for users to install these packages by other means rather than attempting to install them with pip.

See also:

Python Packaging User Guide: Installing Scientific Packages

3.4 . . . work with multiple versions of Python installed in parallel?

On Linux, Mac OS X and other POSIX systems, use the versioned Python commands in combination with the -m switch to run the appropriate copy of pip:

```
python2   -m pip install SomePackage  # default Python 2
python2.7 -m pip install SomePackage  # specifically Python 2.7
python3   -m pip install SomePackage  # default Python 3
python3.4 -m pip install SomePackage  # specifically Python 3.4
```

(appropriately versioned pip commands may also be available)

On Windows, use the py Python launcher in combination with the -m switch:

```
py -2   -m pip install SomePackage  # default Python 2
py -2.7 -m pip install SomePackage  # specifically Python 2.7
py -3   -m pip install SomePackage  # default Python 3
py -3.4 -m pip install SomePackage  # specifically Python 3.4
```

CHAPTER

FOUR

COMMON INSTALLATION ISSUES

4.1 Installing into the system Python on Linux

On Linux systems, a Python installation will typically be included as part of the distribution. Installing into this Python installation requires root access to the system, and may interfere with the operation of the system package manager and other components of the system if a component is unexpectedly upgraded using pip.

On such systems, it is often better to use a virtual environment or a per-user installation when installing packages with pip.

4.2 Installing binary extensions

Python has typically relied heavily on source based distribution, with end users being expected to compile extension modules from source as part of the installation process.

With the introduction of support for the binary wheel format, and the ability to publish wheels for at least Windows and Mac OS X through the Python Packaging Index, this problem is expected to diminish over time, as users are more regularly able to install pre-built extensions rather than needing to build them themselves.

Some of the solutions for installing scientific software that is not yet available as pre-built wheel files may also help with obtaining other binary extensions without needing to build them locally.

See also:

Python Packaging User Guide: Binary Extensions

APPENDIX

A

GLOSSARY

>>> The default Python prompt of the interactive shell. Often seen for code examples which can be executed interactively in the interpreter.

... The default Python prompt of the interactive shell when entering code for an indented code block or within a pair of matching left and right delimiters (parentheses, square brackets or curly braces).

2to3 A tool that tries to convert Python 2.x code to Python 3.x code by handling most of the incompatibilities which can be detected by parsing the source and traversing the parse tree.

2to3 is available in the standard library as lib2to3; a standalone entry point is provided as Tools/scripts/2to3. See 2to3-reference.

abstract base class Abstract base classes complement duck-typing by providing a way to define interfaces when other techniques like hasattr() would be clumsy or subtly wrong (for example with magic methods). ABCs introduce virtual subclasses, which are classes that don't inherit from a class but are still recognized by isinstance() and issubclass(); see the abc module documentation. Python comes with many built-in ABCs for data structures (in the collections.abc module), numbers (in the numbers module), streams (in the io module), import finders and loaders (in the importlib.abc module). You can create your own ABCs with the abc module.

argument A value passed to a function (or method) when calling the function. There are two kinds of argument:

- keyword argument: an argument preceded by an identifier (e.g. name=) in a function call or passed as a value in a dictionary preceded by **. For example, 3 and 5 are both keyword arguments in the following calls to complex():

```
complex(real=3, imag=5)
complex(**{'real': 3, 'imag': 5})
```

- positional argument: an argument that is not a keyword argument. Positional arguments can appear at the beginning of an argument list and/or be passed as elements of an iterable preceded by *. For example, 3 and 5 are both positional arguments in the following calls:

```
complex(3, 5)
complex(*(3, 5))
```

Arguments are assigned to the named local variables in a function body. See the calls section for the rules governing this assignment. Syntactically, any expression can be used to represent an argument; the evaluated value is assigned to the local variable.

See also the parameter glossary entry, the FAQ question on the difference between arguments and parameters, and PEP 362.

asynchronous context manager An object which controls the environment seen in an async with statement by defining __aenter__() and __aexit__() methods. Introduced by PEP 492.

asynchronous iterable An object, that can be used in an async for statement. Must return an asynchronous iterator from its __aiter__() method. Introduced by PEP 492.

asynchronous iterator An object that implements __aiter__() and __anext__() methods. __anext__ must return an awaitable object. async for resolves awaitable returned from asynchronous iterator's __anext__() method until it raises StopAsyncIteration exception. Introduced by PEP 492.

attribute A value associated with an object which is referenced by name using dotted expressions. For example, if an object o has an attribute a it would be referenced as o.a.

awaitable An object that can be used in an await expression. Can be a coroutine or an object with an __await__() method. See also PEP 492.

BDFL Benevolent Dictator For Life, a.k.a. Guido van Rossum, Python's creator.

binary file A file object able to read and write bytes-like objects. Examples of binary files are files opened in binary mode (`'rb'`, `'wb'` or `'rb+'`), sys.stdin.buffer, sys.stdout.buffer, and instances of io.BytesIO and gzip.GzipFile.

See also:

A text file reads and writes str objects.

bytes-like object An object that supports the bufferobjects and can export a C-contiguous buffer. This includes all bytes, bytearray, and array.array objects, as well as many common memoryview objects. Bytes-like objects can be used for various operations that work with binary data; these include compression, saving to a binary file, and sending over a socket.

Some operations need the binary data to be mutable. The documentation often refers to these as "read-write bytes-like objects". Example mutable buffer objects include bytearray and a memoryview of a bytearray. Other operations require the binary data to be stored in immutable objects ("read-only bytes-like objects"); examples of these include bytes and a memoryview of a bytes object.

bytecode Python source code is compiled into bytecode, the internal representation of a Python program in the CPython interpreter. The bytecode is also cached in .pyc files so that executing the same file is faster the second time (recompilation from source to bytecode can be avoided). This "intermediate language" is said to run on a virtual machine that executes the machine code corresponding to each bytecode. Do note that bytecodes are not expected to work between different Python virtual machines, nor to be stable between Python releases.

A list of bytecode instructions can be found in the documentation for the dis module.

class A template for creating user-defined objects. Class definitions normally contain method definitions which operate on instances of the class.

coercion The implicit conversion of an instance of one type to another during an operation which involves two arguments of the same type. For example, int(3.15) converts the floating point number to the integer 3, but in 3+4.5, each argument is of a different type (one int, one float), and both must be converted to the same type before they can be added or it will raise a TypeError. Without coercion, all arguments of even compatible types would have to be normalized to the same value by the programmer, e.g., float(3)+4.5 rather than just 3+4.5.

complex number An extension of the familiar real number system in which all numbers are expressed as a sum of a real part and an imaginary part. Imaginary numbers are real multiples of the imaginary unit (the square root of -1), often written i in mathematics or j in engineering. Python has built-in support for complex numbers, which are written with this latter notation; the imaginary part is written with a j suffix, e.g., 3+1j. To get access to complex equivalents of the math module, use cmath. Use of complex numbers is a fairly advanced mathematical feature. If you're not aware of a need for them, it's almost certain you can safely ignore them.

context manager An object which controls the environment seen in a with statement by defining __enter__() and __exit__() methods. See PEP 343.

contiguous A buffer is considered contiguous exactly if it is either C-contiguous or Fortran contiguous. Zero-dimensional buffers are C and Fortran contiguous. In one-dimensional arrays, the items must be laid out in memory next to each other, in order of increasing indexes starting from zero. In multidimensional C-contiguous arrays, the last index varies the fastest when visiting items in order of memory address. However, in Fortran contiguous arrays, the first index varies the fastest.

coroutine Coroutines is a more generalized form of subroutines. Subroutines are entered at one point and exited at another point. Coroutines can be entered, exited, and resumed at many different points. They can be implemented with the async def statement. See also PEP 492.

coroutine function A function which returns a coroutine object. A coroutine function may be defined with the async def statement, and may contain await, async for, and async with keywords. These were introduced by PEP 492.

CPython The canonical implementation of the Python programming language, as distributed on python.org. The term "CPython" is used when necessary to distinguish this implementation from others such as Jython or IronPython.

decorator A function returning another function, usually applied as a function transformation using the @wrapper syntax. Common examples for decorators are classmethod() and staticmethod().

The decorator syntax is merely syntactic sugar, the following two function definitions are semantically equivalent:

```
def f(...):
    ...
f = staticmethod(f)

@staticmethod
def f(...):
    ...
```

The same concept exists for classes, but is less commonly used there. See the documentation for function definitions and class definitions for more about decorators.

descriptor Any object which defines the methods __get__(), __set__(), or __delete__(). When a class attribute is a descriptor, its special binding behavior is triggered upon attribute lookup. Normally, using a.b to get, set or delete an attribute looks up the object named b in the class dictionary for a, but if b is a descriptor, the respective descriptor method gets called. Understanding descriptors is a key to a deep understanding of Python because they are the basis for many features including functions, methods, properties, class methods, static methods, and reference to super classes.

For more information about descriptors' methods, see descriptors.

dictionary An associative array, where arbitrary keys are mapped to values. The keys can be any object with __hash__() and __eq__() methods. Called a hash in Perl.

dictionary view The objects returned from dict.keys(), dict.values(), and dict.items() are called dictionary views. They provide a dynamic view on the dictionary's entries, which means that when the dictionary changes, the view reflects these changes. To force the dictionary view to become a full list use list(dictview). See dict-views.

docstring A string literal which appears as the first expression in a class, function or module. While ignored when the suite is executed, it is recognized by the compiler and put into the __doc__ attribute of the enclosing class, function or module. Since it is available via introspection, it is the canonical place for documentation of the object.

duck-typing A programming style which does not look at an object's type to determine if it has the right interface; instead, the method or attribute is simply called or used ("If it looks like a duck and quacks like a duck, it must be a duck.") By emphasizing interfaces rather than specific types, well-designed code improves its flexibility by allowing polymorphic substitution. Duck-typing avoids tests using type() or isinstance(). (Note, however, that duck-typing can be complemented with abstract base classes.) Instead, it typically employs hasattr() tests or EAFP programming.

EAFP Easier to ask for forgiveness than permission. This common Python coding style assumes the existence of valid keys or attributes and catches exceptions if the assumption proves false. This clean and fast style is characterized by the presence of many try and except statements. The technique contrasts with the LBYL style common to many other languages such as C.

expression A piece of syntax which can be evaluated to some value. In other words, an expression is an accumulation of expression elements like literals, names, attribute access, operators or function calls which all return a value. In contrast to many other languages, not all language constructs are expressions. There are also statements which cannot be used as expressions, such as if. Assignments are also statements, not expressions.

extension module A module written in C or C++, using Python's C API to interact with the core and with user code.

file object An object exposing a file-oriented API (with methods such as read() or write()) to an underlying resource. Depending on the way it was created, a file object can mediate access to a real on-disk file or to another type of storage or communication device (for example standard input/output, in-memory buffers, sockets, pipes, etc.). File objects are also called file-like objects or streams.

There are actually three categories of file objects: raw binary files, buffered binary files and text files. Their interfaces are defined in the io module. The canonical way to create a file object is by using the open() function.

file-like object A synonym for file object.

finder An object that tries to find the loader for a module that is being imported.

Since Python 3.3, there are two types of finder: meta path finders for use with sys.meta_path, and path entry finders for use with sys.path_hooks.

See PEP 302, PEP 420 and PEP 451 for much more detail.

floor division Mathematical division that rounds down to nearest integer. The floor division operator is //. For example, the expression 11 // 4 evaluates to 2 in contrast to the 2.75 returned by float true division. Note that (-11) // 4 is -3 because that is -2.75 rounded downward. See PEP 238.

function A series of statements which returns some value to a caller. It can also be passed zero or more arguments which may be used in the execution of the body. See also parameter, method, and the function section.

function annotation An arbitrary metadata value associated with a function parameter or return value. Its syntax is explained in section function. Annotations may be accessed via the __annotations__ special attribute of a function object.

Python itself does not assign any particular meaning to function annotations. They are intended to be interpreted by third-party libraries or tools. See PEP 3107, which describes some of their potential uses.

__future__ A pseudo-module which programmers can use to enable new language features which are not compatible with the current interpreter.

By importing the __future__ module and evaluating its variables, you can see when a new feature was first added to the language and when it becomes the default:

```
>>> import __future__
>>> __future__.division
_Feature((2, 2, 0, 'alpha', 2), (3, 0, 0, 'alpha', 0), 8192)
```

garbage collection The process of freeing memory when it is not used anymore. Python performs garbage collection via reference counting and a cyclic garbage collector that is able to detect and break reference cycles.

generator A function which returns a generator iterator. It looks like a normal function except that it contains yield expressions for producing a series of values usable in a for-loop or that can be retrieved one at a time with the next() function.

Usually refers to a generator function, but may refer to a generator iterator in some contexts. In cases where the intended meaning isn't clear, using the full terms avoids ambiguity.

generator iterator An object created by a generator function.

Each yield temporarily suspends processing, remembering the location execution state (including local variables and pending try-statements). When the generator iterator resumes, it picks-up where it left-off (in contrast to functions which start fresh on every invocation).

generator expression An expression that returns an iterator. It looks like a normal expression followed by a for expression defining a loop variable, range, and an optional if expression. The combined expression generates values for an enclosing function:

```
>>> sum(i*i for i in range(10))         # sum of squares 0, 1, 4, ... 81
285
```

generic function A function composed of multiple functions implementing the same operation for different types. Which implementation should be used during a call is determined by the dispatch algorithm.

See also the single dispatch glossary entry, the functools.singledispatch() decorator, and PEP 443.

GIL See global interpreter lock.

global interpreter lock The mechanism used by the CPython interpreter to assure that only one thread executes Python bytecode at a time. This simplifies the CPython implementation by making the object model (including critical built-in types such as dict) implicitly safe against concurrent access. Locking the entire interpreter makes it easier for the interpreter to be multi-threaded, at the expense of much of the parallelism afforded by multi-processor machines.

However, some extension modules, either standard or third-party, are designed so as to release the GIL when doing computationally-intensive tasks such as compression or hashing. Also, the GIL is always released when doing I/O.

Past efforts to create a "free-threaded" interpreter (one which locks shared data at a much finer granularity) have not been successful because performance suffered in the common single-processor case. It is believed that overcoming this performance issue would make the implementation much more complicated and therefore costlier to maintain.

hashable An object is hashable if it has a hash value which never changes during its lifetime (it needs a __hash__() method), and can be compared to other objects (it needs an __eq__() method). Hashable objects which compare equal must have the same hash value.

Hashability makes an object usable as a dictionary key and a set member, because these data structures use the hash value internally.

All of Python's immutable built-in objects are hashable; mutable containers (such as lists or dictionaries) are not. Objects which are instances of user-defined classes are hashable by default. They all compare unequal (except with themselves), and their hash value is derived from their id().

IDLE An Integrated Development Environment for Python. IDLE is a basic editor and interpreter environment which ships with the standard distribution of Python.

immutable An object with a fixed value. Immutable objects include numbers, strings and tuples. Such an object cannot be altered. A new object has to be created if a different value has to be stored. They play an important role in places where a constant hash value is needed, for example as a key in a dictionary.

import path A list of locations (or path entries) that are searched by the path based finder for modules to import. During import, this list of locations usually comes from sys.path, but for subpackages it may also come from the parent package's __path__ attribute.

importing The process by which Python code in one module is made available to Python code in another module.

importer An object that both finds and loads a module; both a finder and loader object.

interactive Python has an interactive interpreter which means you can enter statements and expressions at the interpreter prompt, immediately execute them and see their results. Just launch python with no arguments (possibly by selecting it from your computer's main menu). It is a very powerful way to test out new ideas or inspect modules and packages (remember help(x)).

interpreted Python is an interpreted language, as opposed to a compiled one, though the distinction can be blurry because of the presence of the bytecode compiler. This means that source files can be run directly without explicitly creating an executable which is then run. Interpreted languages typically have a shorter development/debug cycle than compiled ones, though their programs generally also run more slowly. See also interactive.

interpreter shutdown When asked to shut down, the Python interpreter enters a special phase where it gradually releases all allocated resources, such as modules and various critical internal structures. It also makes several calls to the garbage collector. This can trigger the execution of code in user-defined destructors or weakref callbacks. Code executed during the shutdown phase can encounter various exceptions as the resources it relies on may not function anymore (common examples are library modules or the warnings machinery).

The main reason for interpreter shutdown is that the __main__ module or the script being run has finished executing.

iterable An object capable of returning its members one at a time. Examples of iterables include all sequence types (such as list, str, and tuple) and some non-sequence types like dict, file objects, and objects of any classes you define with an __iter__() or __getitem__() method. Iterables can be used in a for loop and in many other places where a sequence is needed (zip(), map(), ...). When an iterable object is passed as an argument to the built-in function iter(), it returns an iterator for the object. This iterator is good for one pass over the set of values. When using iterables, it is usually not necessary to call iter() or deal with iterator objects yourself. The for statement does that automatically for you, creating a temporary unnamed variable to hold the iterator for the duration of the loop. See also iterator, sequence, and generator.

iterator An object representing a stream of data. Repeated calls to the iterator's __next__() method (or passing it to the built-in function next()) return successive items in the stream. When no more data are available a StopIteration exception is raised instead. At this point, the iterator object is exhausted and any further calls to its __next__() method just raise StopIteration again. Iterators are required to have an __iter__() method that returns the iterator object itself so every iterator is also iterable and may be used in most places where other iterables are accepted. One notable exception is code which attempts multiple iteration passes. A container object (such as a list) produces a fresh new iterator each time you pass it to the iter() function or use it in a for loop. Attempting this with an iterator will just return the same exhausted iterator object used in the previous iteration pass, making it appear like an empty container.

More information can be found in typeiter.

key function A key function or collation function is a callable that returns a value used for sorting or ordering. For example, locale.strxfrm() is used to produce a sort key that is aware of locale specific sort conventions.

A number of tools in Python accept key functions to control how elements are ordered or grouped. They include min(), max(), sorted(), list.sort(), heapq.merge(), heapq.nsmallest(), heapq.nlargest(), and itertools.groupby().

There are several ways to create a key function. For example. the str.lower() method can serve as a key function for case insensitive sorts. Alternatively, a key function can be built from a lambda expression such as lambda r: (r[0], r[2]). Also, the operator module provides three key function constructors: attrgetter(), itemgetter(), and methodcaller(). See the Sorting HOW TO for examples of how to create and use key functions.

keyword argument See argument.

lambda An anonymous inline function consisting of a single expression which is evaluated when the function is called. The syntax to create a lambda function is lambda [arguments]: expression

LBYL Look before you leap. This coding style explicitly tests for pre-conditions before making calls or lookups. This style contrasts with the EAFP approach and is characterized by the presence of many if statements.

In a multi-threaded environment, the LBYL approach can risk introducing a race condition between "the looking" and "the leaping". For example, the code, if key in mapping: return mapping[key] can fail if another thread removes key from mapping after the test, but before the lookup. This issue can be solved with locks or by using the EAFP approach.

list A built-in Python sequence. Despite its name it is more akin to an array in other languages than to a linked list since access to elements are O(1).

list comprehension A compact way to process all or part of the elements in a sequence and return a list with the results. result = ['{:#04x}'.format(x) for x in range(256) if x % 2 == 0] generates a list of strings containing even hex numbers (0x..) in the range from 0 to 255. The if clause is optional. If omitted, all elements in range(256) are processed.

loader An object that loads a module. It must define a method named load_module(). A loader is typically returned by a finder. See PEP 302 for details and importlib.abc.Loader for an abstract base class.

mapping A container object that supports arbitrary key lookups and implements the methods specified in the Mapping or MutableMapping abstract base classes. Examples include dict, collections.defaultdict, collections.OrderedDict and collections.Counter.

meta path finder A finder returned by a search of sys.meta_path. Meta path finders are related to, but different from path entry finders.

See importlib.abc.MetaPathFinder for the methods that meta path finders implement.

metaclass The class of a class. Class definitions create a class name, a class dictionary, and a list of base classes. The metaclass is responsible for taking those three arguments and creating the class. Most object oriented programming languages provide a default implementation. What makes Python special is that it is possible to create custom metaclasses. Most users never need this tool, but when the need arises, metaclasses can provide powerful, elegant solutions. They have been used for logging attribute access, adding thread-safety, tracking object creation, implementing singletons, and many other tasks.

More information can be found in metaclasses.

method A function which is defined inside a class body. If called as an attribute of an instance of that class, the method will get the instance object as its first argument (which is usually called self). See function and nested scope.

method resolution order Method Resolution Order is the order in which base classes are searched for a member during lookup. See The Python 2.3 Method Resolution Order for details of the algorithm used by the Python interpreter since the 2.3 release.

module An object that serves as an organizational unit of Python code. Modules have a namespace containing arbitrary Python objects. Modules are loaded into Python by the process of importing.

See also package.

module spec A namespace containing the import-related information used to load a module. An instance of importlib.machinery.ModuleSpec.

MRO See method resolution order.

mutable Mutable objects can change their value but keep their id(). See also immutable.

named tuple Any tuple-like class whose indexable elements are also accessible using named attributes (for example, time.localtime() returns a tuple-like object where the year is accessible either with an index such as t[0] or with a named attribute like t.tm_year).

A named tuple can be a built-in type such as time.struct_time, or it can be created with a regular class definition. A full featured named tuple can also be created with the factory function collections.namedtuple(). The latter approach automatically provides extra features such as a self-documenting representation like Employee(name='jones', title='programmer').

namespace The place where a variable is stored. Namespaces are implemented as dictionaries. There are the local, global and built-in namespaces as well as nested namespaces in objects (in methods). Namespaces support modularity by preventing naming conflicts. For instance, the functions builtins.open and os.open() are distinguished by their namespaces. Namespaces also aid readability and maintainability by making it clear which module implements a function. For instance, writing random.seed() or itertools.islice() makes it clear that those functions are implemented by the random and itertools modules, respectively.

namespace package A PEP 420 package which serves only as a container for subpackages. Namespace packages may have no physical representation, and specifically are not like a regular package because they have no __init__.py file.

See also module.

nested scope The ability to refer to a variable in an enclosing definition. For instance, a function defined inside another function can refer to variables in the outer function. Note that nested scopes by default work only for reference and not for assignment. Local variables both read and write in the innermost scope. Likewise, global variables read and write to the global namespace. The nonlocal allows writing to outer scopes.

new-style class Old name for the flavor of classes now used for all class objects. In earlier Python versions, only new-style classes could use Python's newer, versatile features like __slots__, descriptors, properties, __getattribute__(), class methods, and static methods.

object Any data with state (attributes or value) and defined behavior (methods). Also the ultimate base class of any new-style class.

package A Python module which can contain submodules or recursively, subpackages. Technically, a package is a Python module with an __path__ attribute.

See also regular package and namespace package.

parameter A named entity in a function (or method) definition that specifies an argument (or in some cases, arguments) that the function can accept. There are five kinds of parameter:

- positional-or-keyword: specifies an argument that can be passed either positionally or as a keyword argument. This is the default kind of parameter, for example foo and bar in the following:

```
def func(foo, bar=None): ...
```

- positional-only: specifies an argument that can be supplied only by position. Python has no syntax for defining positional-only parameters. However, some built-in functions have positional-only parameters (e.g. abs()).
- keyword-only: specifies an argument that can be supplied only by keyword. Keyword-only parameters can be defined by including a single var-positional parameter or bare * in the parameter list of the function definition before them, for example kw_only1 and kw_only2 in the following:

```
def func(arg, *, kw_only1, kw_only2): ...
```

- var-positional: specifies that an arbitrary sequence of positional arguments can be provided (in addition to any positional arguments already accepted by other parameters). Such a parameter can be defined by prepending the parameter name with *, for example args in the following:

```
def func(*args, **kwargs): ...
```

- var-keyword: specifies that arbitrarily many keyword arguments can be provided (in addition to any keyword arguments already accepted by other parameters). Such a parameter can be defined by prepending the parameter name with **, for example kwargs in the example above.

Parameters can specify both optional and required arguments, as well as default values for some optional arguments.

See also the argument glossary entry, the FAQ question on the difference between arguments and parameters, the inspect.Parameter class, the function section, and PEP 362.

path entry A single location on the import path which the path based finder consults to find modules for importing.

path entry finder A finder returned by a callable on sys.path_hooks (i.e. a path entry hook) which knows how to locate modules given a path entry.

See importlib.abc.PathEntryFinder for the methods that path entry finders implement.

path entry hook A callable on the sys.path_hook list which returns a path entry finder if it knows how to find modules on a specific path entry.

path based finder One of the default meta path finders which searches an import path for modules.

portion A set of files in a single directory (possibly stored in a zip file) that contribute to a namespace package, as defined in PEP 420.

positional argument See argument.

provisional API A provisional API is one which has been deliberately excluded from the standard library's backwards compatibility guarantees. While major changes to such interfaces are not expected, as long as they are marked provisional, backwards incompatible changes (up to and including removal of the interface) may occur if deemed necessary by core developers. Such changes will not be made gratuitously – they will occur only if serious fundamental flaws are uncovered that were missed prior to the inclusion of the API.

Even for provisional APIs, backwards incompatible changes are seen as a "solution of last resort" - every attempt will still be made to find a backwards compatible resolution to any identified problems.

This process allows the standard library to continue to evolve over time, without locking in problematic design errors for extended periods of time. See PEP 411 for more details.

provisional package See provisional API.

Python 3000 Nickname for the Python 3.x release line (coined long ago when the release of version 3 was something in the distant future.) This is also abbreviated "Py3k".

Pythonic An idea or piece of code which closely follows the most common idioms of the Python language, rather than implementing code using concepts common to other languages. For example, a common idiom in Python is to loop over all elements of an iterable using a for statement. Many other languages don't have this type of construct, so people unfamiliar with Python sometimes use a numerical counter instead:

```
for i in range(len(food)):
    print(food[i])
```

As opposed to the cleaner, Pythonic method:

```
for piece in food:
    print(piece)
```

qualified name A dotted name showing the "path" from a module's global scope to a class, function or method defined in that module, as defined in PEP 3155. For top-level functions and classes, the qualified name is the same as the object's name:

```
>>> class C:
...     class D:
...         def meth(self):
...             pass
...
>>> C.__qualname__
'C'
>>> C.D.__qualname__
'C.D'
>>> C.D.meth.__qualname__
'C.D.meth'
```

When used to refer to modules, the fully qualified name means the entire dotted path to the module, including any parent packages, e.g. email.mime.text:

```
>>> import email.mime.text
>>> email.mime.text.__name__
'email.mime.text'
```

reference count The number of references to an object. When the reference count of an object drops to zero, it is deallocated. Reference counting is generally not visible to Python code, but it is a key element of the CPython implementation. The sys module defines a getrefcount() function that programmers can call to return the reference count for a particular object.

regular package A traditional package, such as a directory containing an __init__.py file.

See also namespace package.

__slots__ A declaration inside a class that saves memory by pre-declaring space for instance attributes and eliminating instance dictionaries. Though popular, the technique is somewhat tricky to get right and is best reserved for rare cases where there are large numbers of instances in a memory-critical application.

sequence An iterable which supports efficient element access using integer indices via the __getitem__() special method and defines a __len__() method that returns the length of the sequence. Some built-in sequence types are list, str, tuple, and bytes. Note that dict also supports __getitem__() and __len__(), but is considered a mapping rather than a sequence because the lookups use arbitrary immutable keys rather than integers.

The collections.abc.Sequence abstract base class defines a much richer interface that goes beyond just __getitem__() and __len__(), adding count(), index(), __contains__(), and __reversed__(). Types that implement this expanded interface can be registered explicitly using register().

single dispatch A form of generic function dispatch where the implementation is chosen based on the type of a single argument.

slice An object usually containing a portion of a sequence. A slice is created using the subscript notation, [] with colons between numbers when several are given, such as in variable_name[1:3:5]. The bracket (subscript) notation uses slice objects internally.

special method A method that is called implicitly by Python to execute a certain operation on a type, such as addition. Such methods have names starting and ending with double underscores. Special methods are documented in specialnames.

statement A statement is part of a suite (a "block" of code). A statement is either an expression or one of several constructs with a keyword, such as if, while or for.

struct sequence A tuple with named elements. Struct sequences expose an interface similar to named tuple in that elements can either be accessed either by index or as an attribute. However, they do not have any of the named tuple methods like _make() or _asdict(). Examples of struct sequences include sys.float_info and the return value of os.stat().

text encoding A codec which encodes Unicode strings to bytes.

text file A file object able to read and write str objects. Often, a text file actually accesses a byte-oriented datastream and handles the text encoding automatically. Examples of text files are files opened in text mode ('r' or 'w'), sys.stdin, sys.stdout, and instances of io.StringIO.

See also:

A binary file reads and write bytes objects.

triple-quoted string A string which is bound by three instances of either a quotation mark (") or an apostrophe ('). While they don't provide any functionality not available with single-quoted strings, they are useful for a number of reasons. They allow you to include unescaped single and double quotes within a string and they can span multiple lines without the use of the continuation character, making them especially useful when writing docstrings.

type The type of a Python object determines what kind of object it is; every object has a type. An object's type is accessible as its __class__ attribute or can be retrieved with type(obj).

universal newlines A manner of interpreting text streams in which all of the following are recognized as ending a line: the Unix end-of-line convention '\n', the Windows convention '\r\n', and the old Macintosh convention '\r'. See PEP 278 and PEP 3116, as well as bytes.splitlines() for an additional use.

virtual environment A cooperatively isolated runtime environment that allows Python users and applications to install and upgrade Python distribution packages without interfering with the behaviour of other Python applications running on the same system.

See also scripts-pyvenv.

virtual machine A computer defined entirely in software. Python's virtual machine executes the bytecode emitted by the bytecode compiler.

Zen of Python Listing of Python design principles and philosophies that are helpful in understanding and using the language. The listing can be found by typing "import this" at the interactive prompt.

APPENDIX

B

ABOUT THESE DOCUMENTS

These documents are generated from reStructuredText sources by Sphinx, a document processor specifically written for the Python documentation.

Development of the documentation and its toolchain is an entirely volunteer effort, just like Python itself. If you want to contribute, please take a look at the reporting-bugs page for information on how to do so. New volunteers are always welcome!

Many thanks go to:

- Fred L. Drake, Jr., the creator of the original Python documentation toolset and writer of much of the content;
- the Docutils project for creating reStructuredText and the Docutils suite;
- Fredrik Lundh for his Alternative Python Reference project from which Sphinx got many good ideas.

B.1 Contributors to the Python Documentation

Many people have contributed to the Python language, the Python standard library, and the Python documentation. See Misc/ACKS in the Python source distribution for a partial list of contributors.

It is only with the input and contributions of the Python community that Python has such wonderful documentation – Thank You!

APPENDIX

C

HISTORY AND LICENSE

C.1 History of the software

Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see https://www.cwi.nl/) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see https://www.cnri.reston.va.us/) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations (now Zope Corporation; see http://www.zope.com/). In 2001, the Python Software Foundation (PSF, see https://www.python.org/psf/) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation is a sponsoring member of the PSF.

All Python releases are Open Source (see https://opensource.org/ for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

Release	Derived from	Year	Owner	GPL compatible?
0.9.0 thru 1.2	n/a	1991-1995	CWI	yes
1.3 thru 1.5.2	1.2	1995-1999	CNRI	yes
1.6	1.5.2	2000	CNRI	no
2.0	1.6	2000	BeOpen.com	no
1.6.1	1.6	2001	CNRI	no
2.1	2.0+1.6.1	2001	PSF	no
2.0.1	2.0+1.6.1	2001	PSF	yes
2.1.1	2.1+2.0.1	2001	PSF	yes
2.1.2	2.1.1	2002	PSF	yes
2.1.3	2.1.2	2002	PSF	yes
2.2 and above	2.1.1	2001-now	PSF	yes

Note: GPL-compatible doesn't mean that we're distributing Python under the GPL. All Python licenses, unlike the GPL, let you distribute a modified version without making your changes open source. The GPL-compatible licenses make it possible to combine Python with other software that is released under the GPL; the others don't.

Thanks to the many outside volunteers who have worked under Guido's direction to make these releases possible.

C.2 Terms and conditions for accessing or otherwise using Python

C.2.1 PSF LICENSE AGREEMENT FOR PYTHON 3.5.8rc2

1. This LICENSE AGREEMENT is between the Python Software Foundation ("PSF"), and the Individual or Organization ("Licensee") accessing and otherwise using Python 3.5.8rc2 software in source or binary form and its associated documentation.

2. Subject to the terms and conditions of this License Agreement, PSF hereby grants Licensee a nonexclusive, royalty-free, world-wide license to reproduce, analyze, test, perform and/or display publicly, prepare derivative works, distribute, and otherwise use Python 3.5.8rc2 alone or in any derivative version, provided, however, that PSF's License Agreement and PSF's notice of copyright, i.e., "Copyright © 2001-2019 Python Software Foundation; All Rights Reserved" are retained in Python 3.5.8rc2 alone or in any derivative version prepared by Licensee.

3. In the event Licensee prepares a derivative work that is based on or incorporates Python 3.5.8rc2 or any part thereof, and wants to make the derivative work available to others as provided herein, then Licensee hereby agrees to include in any such work a brief summary of the changes made to Python 3.5.8rc2.

4. PSF is making Python 3.5.8rc2 available to Licensee on an "AS IS" basis.
   PSF MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED. BY WAY OF EXAMPLE, BUT NOT LIMITATION, PSF MAKES NO AND DISCLAIMS ANY␣
   ↪REPRESENTATION OR
   WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR␣
   ↪THAT THE
   USE OF PYTHON 3.5.8rc2 WILL NOT INFRINGE ANY THIRD PARTY RIGHTS.

5. PSF SHALL NOT BE LIABLE TO LICENSEE OR ANY OTHER USERS OF PYTHON 3.5.8rc2
   FOR ANY INCIDENTAL, SPECIAL, OR CONSEQUENTIAL DAMAGES OR LOSS AS A RESULT␣
   ↪OF
   MODIFYING, DISTRIBUTING, OR OTHERWISE USING PYTHON 3.5.8rc2, OR ANY␣
   ↪DERIVATIVE
   THEREOF, EVEN IF ADVISED OF THE POSSIBILITY THEREOF.

6. This License Agreement will automatically terminate upon a material breach of its terms and conditions.

7. Nothing in this License Agreement shall be deemed to create any relationship of agency, partnership, or joint venture between PSF and Licensee. This License Agreement does not grant permission to use PSF trademarks or trade name in a trademark sense to endorse or promote products or services of Licensee, or any third party.

8. By copying, installing or otherwise using Python 3.5.8rc2, Licensee agrees to be bound by the terms and conditions of this License Agreement.

C.2.2 BEOPEN.COM LICENSE AGREEMENT FOR PYTHON 2.0

BEOPEN PYTHON OPEN SOURCE LICENSE AGREEMENT VERSION 1

1. This LICENSE AGREEMENT is between BeOpen.com ("BeOpen"), having an office at
   160 Saratoga Avenue, Santa Clara, CA 95051, and the Individual or Organization
   ("Licensee") accessing and otherwise using this software in source or binary
   form and its associated documentation ("the Software").

2. Subject to the terms and conditions of this BeOpen Python License Agreement,
   BeOpen hereby grants Licensee a non-exclusive, royalty-free, world-wide license
   to reproduce, analyze, test, perform and/or display publicly, prepare derivative
   works, distribute, and otherwise use the Software alone or in any derivative
   version, provided, however, that the BeOpen Python License is retained in the
   Software, alone or in any derivative version prepared by Licensee.

3. BeOpen is making the Software available to Licensee on an "AS IS" basis.
   BEOPEN MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED. BY WAY OF
   EXAMPLE, BUT NOT LIMITATION, BEOPEN MAKES NO AND DISCLAIMS ANY REPRESENTATION
   OR
   WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR THAT THE
   USE OF THE SOFTWARE WILL NOT INFRINGE ANY THIRD PARTY RIGHTS.

4. BEOPEN SHALL NOT BE LIABLE TO LICENSEE OR ANY OTHER USERS OF THE SOFTWARE FOR
   ANY INCIDENTAL, SPECIAL, OR CONSEQUENTIAL DAMAGES OR LOSS AS A RESULT OF USING,
   MODIFYING OR DISTRIBUTING THE SOFTWARE, OR ANY DERIVATIVE THEREOF, EVEN IF
   ADVISED OF THE POSSIBILITY THEREOF.

5. This License Agreement will automatically terminate upon a material breach of
   its terms and conditions.

6. This License Agreement shall be governed by and interpreted in all respects
   by the law of the State of California, excluding conflict of law provisions.
   Nothing in this License Agreement shall be deemed to create any relationship of
   agency, partnership, or joint venture between BeOpen and Licensee. This License
   Agreement does not grant permission to use BeOpen trademarks or trade names in a
   trademark sense to endorse or promote products or services of Licensee, or any
   third party. As an exception, the "BeOpen Python" logos available at
   http://www.pythonlabs.com/logos.html may be used according to the permissions
   granted on that web page.

7. By copying, installing or otherwise using the software, Licensee agrees to be
   bound by the terms and conditions of this License Agreement.

C.2.3 CNRI LICENSE AGREEMENT FOR PYTHON 1.6.1

1. This LICENSE AGREEMENT is between the Corporation for National Research
   Initiatives, having an office at 1895 Preston White Drive, Reston, VA 20191
   ("CNRI"), and the Individual or Organization ("Licensee") accessing and
   otherwise using Python 1.6.1 software in source or binary form and its
   associated documentation.

2. Subject to the terms and conditions of this License Agreement, CNRI hereby
   grants Licensee a nonexclusive, royalty-free, world-wide license to reproduce,
   analyze, test, perform and/or display publicly, prepare derivative works,
   distribute, and otherwise use Python 1.6.1 alone or in any derivative version,
   provided, however, that CNRI's License Agreement and CNRI's notice of copyright,
   i.e., "Copyright © 1995-2001 Corporation for National Research Initiatives; All
   Rights Reserved" are retained in Python 1.6.1 alone or in any derivative version
   prepared by Licensee. Alternately, in lieu of CNRI's License Agreement,

(continues on next page)

(continued from previous page)

Licensee may substitute the following text (omitting the quotes): "Python 1.6.1 is made available subject to the terms and conditions in CNRI's License Agreement. This Agreement together with Python 1.6.1 may be located on the Internet using the following unique, persistent identifier (known as a handle): 1895.22/1013. This Agreement may also be obtained from a proxy server on the Internet using the following URL: http://hdl.handle.net/1895.22/1013."

3. In the event Licensee prepares a derivative work that is based on or incorporates Python 1.6.1 or any part thereof, and wants to make the derivative work available to others as provided herein, then Licensee hereby agrees to include in any such work a brief summary of the changes made to Python 1.6.1.

4. CNRI is making Python 1.6.1 available to Licensee on an "AS IS" basis. CNRI MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED. BY WAY OF EXAMPLE, BUT NOT LIMITATION, CNRI MAKES NO AND DISCLAIMS ANY REPRESENTATION OR WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR THAT THE USE OF PYTHON 1.6.1 WILL NOT INFRINGE ANY THIRD PARTY RIGHTS.

5. CNRI SHALL NOT BE LIABLE TO LICENSEE OR ANY OTHER USERS OF PYTHON 1.6.1 FOR ANY INCIDENTAL, SPECIAL, OR CONSEQUENTIAL DAMAGES OR LOSS AS A RESULT OF MODIFYING, DISTRIBUTING, OR OTHERWISE USING PYTHON 1.6.1, OR ANY DERIVATIVE THEREOF, EVEN IF ADVISED OF THE POSSIBILITY THEREOF.

6. This License Agreement will automatically terminate upon a material breach of its terms and conditions.

7. This License Agreement shall be governed by the federal intellectual property law of the United States, including without limitation the federal copyright law, and, to the extent such U.S. federal law does not apply, by the law of the Commonwealth of Virginia, excluding Virginia's conflict of law provisions. Notwithstanding the foregoing, with regard to derivative works based on Python 1.6.1 that incorporate non-separable material that was previously distributed under the GNU General Public License (GPL), the law of the Commonwealth of Virginia shall govern this License Agreement only as to issues arising under or with respect to Paragraphs 4, 5, and 7 of this License Agreement. Nothing in this License Agreement shall be deemed to create any relationship of agency, partnership, or joint venture between CNRI and Licensee. This License Agreement does not grant permission to use CNRI trademarks or trade name in a trademark sense to endorse or promote products or services of Licensee, or any third party.

8. By clicking on the "ACCEPT" button where indicated, or by copying, installing or otherwise using Python 1.6.1, Licensee agrees to be bound by the terms and conditions of this License Agreement.

C.2.4 CWI LICENSE AGREEMENT FOR PYTHON 0.9.0 THROUGH 1.2

Copyright © 1991 - 1995, Stichting Mathematisch Centrum Amsterdam, The Netherlands. All rights reserved.

Permission to use, copy, modify, and distribute this software and its documentation for any purpose and without fee is hereby granted, provided that the above copyright notice appear in all copies and that both that copyright notice and this permission notice appear in supporting documentation, and that the name of Stichting Mathematisch Centrum or CWI not be used in advertising or publicity pertaining to distribution of the software without specific, written

(continues on next page)

(continued from previous page)

prior permission.

STICHTING MATHEMATISCH CENTRUM DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, IN NO EVENT SHALL STICHTING MATHEMATISCH CENTRUM BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

C.3 Licenses and Acknowledgements for Incorporated Software

This section is an incomplete, but growing list of licenses and acknowledgements for third-party software incorporated in the Python distribution.

C.3.1 Mersenne Twister

The _random module includes code based on a download from http://www.math.sci.hiroshima-u.ac.jp/~m-mat/MT/MT2002/emt19937ar.html. The following are the verbatim comments from the original code:

A C-program for MT19937, with initialization improved 2002/1/26.
Coded by Takuji Nishimura and Makoto Matsumoto.

Before using, initialize the state by using init_genrand(seed)
or init_by_array(init_key, key_length).

Copyright (C) 1997 - 2002, Makoto Matsumoto and Takuji Nishimura,
All rights reserved.

Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions
are met:

1. Redistributions of source code must retain the above copyright
   notice, this list of conditions and the following disclaimer.

2. Redistributions in binary form must reproduce the above copyright
   notice, this list of conditions and the following disclaimer in the
   documentation and/or other materials provided with the distribution.

3. The names of its contributors may not be used to endorse or promote
   products derived from this software without specific prior written
   permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS
"AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT
LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR
A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR
CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL,
EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO,
PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR
PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF
LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING
NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS
SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

(continues on next page)

(continued from previous page)

```
Any feedback is very welcome.
http://www.math.sci.hiroshima-u.ac.jp/~m-mat/MT/emt.html
email: m-mat @ math.sci.hiroshima-u.ac.jp (remove space)
```

C.3.2 Sockets

The socket module uses the functions, getaddrinfo(), and getnameinfo(), which are coded in separate source files from the WIDE Project, http://www.wide.ad.jp/.

```
Copyright (C) 1995, 1996, 1997, and 1998 WIDE Project.
All rights reserved.

Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions
are met:
1. Redistributions of source code must retain the above copyright
   notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright
   notice, this list of conditions and the following disclaimer in the
   documentation and/or other materials provided with the distribution.
3. Neither the name of the project nor the names of its contributors
   may be used to endorse or promote products derived from this software
   without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE PROJECT AND CONTRIBUTORS ``AS IS'' AND
ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
ARE DISCLAIMED.  IN NO EVENT SHALL THE PROJECT OR CONTRIBUTORS BE LIABLE
FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
SUCH DAMAGE.
```

C.3.3 Floating point exception control

The source for the fpectl module includes the following notice:

```
  ---------------------------------------------------------------------
 /                      Copyright (c) 1996.                            \
|         The Regents of the University of California.                  |
|                        All rights reserved.                           |
|                                                                       |
|   Permission to use, copy, modify, and distribute this software for   |
|   any purpose without fee is hereby granted, provided that this en-   |
|   tire notice is included in all copies of any software which is or   |
|   includes  a  copy  or  modification  of  this software and in all   |
|   copies of the supporting documentation for such software.           |
|                                                                       |
|   This  work was produced at the University of California, Lawrence   |
|   Livermore National Laboratory under  contract  no.  W-7405-ENG-48   |
```

(continues on next page)

(continued from previous page)

```
|  between the U.S. Department of Energy and The Regents of the  |
|  University of California for the operation of UC LLNL.        |
|                                                                |
|                          DISCLAIMER                            |
|                                                                |
|  This software was prepared as an account of work sponsored by an  |
|  agency of the United States Government. Neither the United States  |
|  Government nor the University of California nor any of their em-   |
|  ployees, makes any warranty, express or implied, or assumes any    |
|  liability or responsibility for the accuracy, completeness, or     |
|  usefulness of any information, apparatus, product, or process      |
|  disclosed, or represents that its use would not infringe           |
|  privately-owned rights. Reference herein to any specific commer-   |
|  cial products, process, or service by trade name, trademark,       |
|  manufacturer, or otherwise, does not necessarily constitute or     |
|  imply its endorsement, recommendation, or favoring by the United   |
|  States Government or the University of California. The views and    |
|  opinions of authors expressed herein do not necessarily state or   |
|  reflect those of the United States Government or the University    |
|  of California, and shall not be used for advertising or product    |
\  endorsement purposes.                                             /
 ------------------------------------------------------------------------
```

C.3.4 Asynchronous socket services

The asynchat and asyncore modules contain the following notice:

```
Copyright 1996 by Sam Rushing

                        All Rights Reserved

Permission to use, copy, modify, and distribute this software and
its documentation for any purpose and without fee is hereby
granted, provided that the above copyright notice appear in all
copies and that both that copyright notice and this permission
notice appear in supporting documentation, and that the name of Sam
Rushing not be used in advertising or publicity pertaining to
distribution of the software without specific, written prior
permission.

SAM RUSHING DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE,
INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, IN
NO EVENT SHALL SAM RUSHING BE LIABLE FOR ANY SPECIAL, INDIRECT OR
CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS
OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT,
NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN
CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.
```

C.3.5 Cookie management

The http.cookies module contains the following notice:

```
Copyright 2000 by Timothy O'Malley <timo@alum.mit.edu>

                All Rights Reserved
```

(continues on next page)

(continued from previous page)

```
Permission to use, copy, modify, and distribute this software
and its documentation for any purpose and without fee is hereby
granted, provided that the above copyright notice appear in all
copies and that both that copyright notice and this permission
notice appear in supporting documentation, and that the name of
Timothy O'Malley  not be used in advertising or publicity
pertaining to distribution of the software without specific, written
prior permission.

Timothy O'Malley DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS
SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY
AND FITNESS, IN NO EVENT SHALL Timothy O'Malley BE LIABLE FOR
ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES
WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS,
WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS
ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR
PERFORMANCE OF THIS SOFTWARE.
```

C.3.6 Execution tracing

The trace module contains the following notice:

```
portions copyright 2001, Autonomous Zones Industries, Inc., all rights...
err...  reserved and offered to the public under the terms of the
Python 2.2 license.
Author: Zooko O'Whielacronx
http://zooko.com/
mailto:zooko@zooko.com

Copyright 2000, Mojam Media, Inc., all rights reserved.
Author: Skip Montanaro

Copyright 1999, Bioreason, Inc., all rights reserved.
Author: Andrew Dalke

Copyright 1995-1997, Automatrix, Inc., all rights reserved.
Author: Skip Montanaro

Copyright 1991-1995, Stichting Mathematisch Centrum, all rights reserved.


Permission to use, copy, modify, and distribute this Python software and
its associated documentation for any purpose without fee is hereby
granted, provided that the above copyright notice appears in all copies,
and that both that copyright notice and this permission notice appear in
supporting documentation, and that the name of neither Automatrix,
Bioreason or Mojam Media be used in advertising or publicity pertaining to
distribution of the software without specific, written prior permission.
```

C.3.7 UUencode and UUdecode functions

The uu module contains the following notice:

Copyright 1994 by Lance Ellinghouse
Cathedral City, California Republic, United States of America.
All Rights Reserved
Permission to use, copy, modify, and distribute this software and its
documentation for any purpose and without fee is hereby granted,
provided that the above copyright notice appear in all copies and that
both that copyright notice and this permission notice appear in
supporting documentation, and that the name of Lance Ellinghouse
not be used in advertising or publicity pertaining to distribution
of the software without specific, written prior permission.
LANCE ELLINGHOUSE DISCLAIMS ALL WARRANTIES WITH REGARD TO
THIS SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND
FITNESS, IN NO EVENT SHALL LANCE ELLINGHOUSE CENTRUM BE LIABLE
FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES
WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN
ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT
OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

Modified by Jack Jansen, CWI, July 1995:
- Use binascii module to do the actual line-by-line conversion
  between ascii and binary. This results in a 1000-fold speedup. The C
  version is still 5 times faster, though.
- Arguments more compliant with Python standard

C.3.8 XML Remote Procedure Calls

The xmlrpc.client module contains the following notice:

The XML-RPC client interface is

Copyright (c) 1999-2002 by Secret Labs AB
Copyright (c) 1999-2002 by Fredrik Lundh

By obtaining, using, and/or copying this software and/or its
associated documentation, you agree that you have read, understood,
and will comply with the following terms and conditions:

Permission to use, copy, modify, and distribute this software and
its associated documentation for any purpose and without fee is
hereby granted, provided that the above copyright notice appears in
all copies, and that both that copyright notice and this permission
notice appear in supporting documentation, and that the name of
Secret Labs AB or the author not be used in advertising or publicity
pertaining to distribution of the software without specific, written
prior permission.

SECRET LABS AB AND THE AUTHOR DISCLAIMS ALL WARRANTIES WITH REGARD
TO THIS SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANT-
ABILITY AND FITNESS. IN NO EVENT SHALL SECRET LABS AB OR THE AUTHOR
BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY
DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS,
WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS
ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE
OF THIS SOFTWARE.

C.3.9 test_epoll

The test_epoll contains the following notice:

```
Copyright (c) 2001-2006 Twisted Matrix Laboratories.

Permission is hereby granted, free of charge, to any person obtaining
a copy of this software and associated documentation files (the
"Software"), to deal in the Software without restriction, including
without limitation the rights to use, copy, modify, merge, publish,
distribute, sublicense, and/or sell copies of the Software, and to
permit persons to whom the Software is furnished to do so, subject to
the following conditions:

The above copyright notice and this permission notice shall be
included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND,
EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND
NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE
LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION
OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION
WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
```

C.3.10 Select kqueue

The select and contains the following notice for the kqueue interface:

```
Copyright (c) 2000 Doug White, 2006 James Knight, 2007 Christian Heimes
All rights reserved.

Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions
are met:
1. Redistributions of source code must retain the above copyright
   notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright
   notice, this list of conditions and the following disclaimer in the
   documentation and/or other materials provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE AUTHOR AND CONTRIBUTORS ``AS IS'' AND
ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
ARE DISCLAIMED.  IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE
FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
SUCH DAMAGE.
```

C.3.11 SipHash24

The file Python/pyhash.c contains Marek Majkowski' implementation of Dan Bernstein's SipHash24 algorithm. The contains the following note:

```
<MIT License>
Copyright (c) 2013  Marek Majkowski <marek@popcount.org>

Permission is hereby granted, free of charge, to any person obtaining a copy
of this software and associated documentation files (the "Software"), to deal
in the Software without restriction, including without limitation the rights
to use, copy, modify, merge, publish, distribute, sublicense, and/or sell
copies of the Software, and to permit persons to whom the Software is
furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in
all copies or substantial portions of the Software.
</MIT License>

Original location:
  https://github.com/majek/csiphash/

Solution inspired by code from:
  Samuel Neves (supercop/crypto_auth/siphash24/little)
  djb (supercop/crypto_auth/siphash24/little2)
  Jean-Philippe Aumasson (https://131002.net/siphash/siphash24.c)
```

C.3.12 strtod and dtoa

The file Python/dtoa.c, which supplies C functions dtoa and strtod for conversion of C doubles to and from strings, is derived from the file of the same name by David M. Gay, currently available from http://www.netlib.org/fp/. The original file, as retrieved on March 16, 2009, contains the following copyright and licensing notice:

```
/****************************************************************
 *
 * The author of this software is David M. Gay.
 *
 * Copyright (c) 1991, 2000, 2001 by Lucent Technologies.
 *
 * Permission to use, copy, modify, and distribute this software for any
 * purpose without fee is hereby granted, provided that this entire notice
 * is included in all copies of any software which is or includes a copy
 * or modification of this software and in all copies of the supporting
 * documentation for such software.
 *
 * THIS SOFTWARE IS BEING PROVIDED "AS IS", WITHOUT ANY EXPRESS OR IMPLIED
 * WARRANTY.  IN PARTICULAR, NEITHER THE AUTHOR NOR LUCENT MAKES ANY
 * REPRESENTATION OR WARRANTY OF ANY KIND CONCERNING THE MERCHANTABILITY
 * OF THIS SOFTWARE OR ITS FITNESS FOR ANY PARTICULAR PURPOSE.
 *
 ***************************************************************/
```

C.3.13 OpenSSL

The modules hashlib, posix, ssl, crypt use the OpenSSL library for added performance if made available by the operating system. Additionally, the Windows and Mac OS X installers for Python may include a copy of the OpenSSL libraries, so we include a copy of the OpenSSL license here:

```
LICENSE ISSUES
==============
```

(continues on next page)

(continued from previous page)

```
The OpenSSL toolkit stays under a dual license, i.e. both the conditions of
the OpenSSL License and the original SSLeay license apply to the toolkit.
See below for the actual license texts. Actually both licenses are BSD-style
Open Source licenses. In case of any license issues related to OpenSSL
please contact openssl-core@openssl.org.

OpenSSL License
---------------

  /*
↪==========================================================================
  * Copyright (c) 1998-2008 The OpenSSL Project.  All rights reserved.
  *
  * Redistribution and use in source and binary forms, with or without
  * modification, are permitted provided that the following conditions
  * are met:
  *
  * 1. Redistributions of source code must retain the above copyright
  *    notice, this list of conditions and the following disclaimer.
  *
  * 2. Redistributions in binary form must reproduce the above copyright
  *    notice, this list of conditions and the following disclaimer in
  *    the documentation and/or other materials provided with the
  *    distribution.
  *
  * 3. All advertising materials mentioning features or use of this
  *    software must display the following acknowledgment:
  *    "This product includes software developed by the OpenSSL Project
  *    for use in the OpenSSL Toolkit. (http://www.openssl.org/)"
  *
  * 4. The names "OpenSSL Toolkit" and "OpenSSL Project" must not be used to
  *    endorse or promote products derived from this software without
  *    prior written permission. For written permission, please contact
  *    openssl-core@openssl.org.
  *
  * 5. Products derived from this software may not be called "OpenSSL"
  *    nor may "OpenSSL" appear in their names without prior written
  *    permission of the OpenSSL Project.
  *
  * 6. Redistributions of any form whatsoever must retain the following
  *    acknowledgment:
  *    "This product includes software developed by the OpenSSL Project
  *    for use in the OpenSSL Toolkit (http://www.openssl.org/)"
  *
  * THIS SOFTWARE IS PROVIDED BY THE OpenSSL PROJECT ``AS IS'' AND ANY
  * EXPRESSED OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
  * IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR
  * PURPOSE ARE DISCLAIMED.  IN NO EVENT SHALL THE OpenSSL PROJECT OR
  * ITS CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL,
  * SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT
  * NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES;
  * LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
  * HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT,
  * STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE)
  * ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED
```

(continues on next page)

(continued from previous page)

```
   * OF THE POSSIBILITY OF SUCH DAMAGE.
   *
↪==========================================================================
   *
   * This product includes cryptographic software written by Eric Young
   * (eay@cryptsoft.com).  This product includes software written by Tim
   * Hudson (tjh@cryptsoft.com).
   *
   */

Original SSLeay License
-----------------------

  /* Copyright (C) 1995-1998 Eric Young (eay@cryptsoft.com)
   * All rights reserved.
   *
   * This package is an SSL implementation written
   * by Eric Young (eay@cryptsoft.com).
   * The implementation was written so as to conform with Netscapes SSL.
   *
   * This library is free for commercial and non-commercial use as long as
   * the following conditions are aheared to.  The following conditions
   * apply to all code found in this distribution, be it the RC4, RSA,
   * lhash, DES, etc., code; not just the SSL code.  The SSL documentation
   * included with this distribution is covered by the same copyright terms
   * except that the holder is Tim Hudson (tjh@cryptsoft.com).
   *
   * Copyright remains Eric Young's, and as such any Copyright notices in
   * the code are not to be removed.
   * If this package is used in a product, Eric Young should be given attribution
   * as the author of the parts of the library used.
   * This can be in the form of a textual message at program startup or
   * in documentation (online or textual) provided with the package.
   *
   * Redistribution and use in source and binary forms, with or without
   * modification, are permitted provided that the following conditions
   * are met:
   * 1. Redistributions of source code must retain the copyright
   *    notice, this list of conditions and the following disclaimer.
   * 2. Redistributions in binary form must reproduce the above copyright
   *    notice, this list of conditions and the following disclaimer in the
   *    documentation and/or other materials provided with the distribution.
   * 3. All advertising materials mentioning features or use of this software
   *    must display the following acknowledgement:
   *    "This product includes cryptographic software written by
   *     Eric Young (eay@cryptsoft.com)"
   *    The word 'cryptographic' can be left out if the rouines from the library
   *    being used are not cryptographic related :-).
   * 4. If you include any Windows specific code (or a derivative thereof) from
   *    the apps directory (application code) you must include an acknowledgement:
   *    "This product includes software written by Tim Hudson (tjh@cryptsoft.com)"
   *
   * THIS SOFTWARE IS PROVIDED BY ERIC YOUNG ``AS IS'' AND
   * ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
   * IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
   * ARE DISCLAIMED.  IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE
```

(continues on next page)

(continued from previous page)

```
   * FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
   * DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
   * OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
   * HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
   * LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
   * OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
   * SUCH DAMAGE.
   *
   * The licence and distribution terms for any publically available version or
   * derivative of this code cannot be changed.  i.e. this code cannot simply be
   * copied and put under another distribution licence
   * [including the GNU Public Licence.]
   */
```

C.3.14 expat

The pyexpat extension is built using an included copy of the expat sources unless the build is configured --with-system-expat:

```
Copyright (c) 1998, 1999, 2000 Thai Open Source Software Center Ltd
                               and Clark Cooper

Permission is hereby granted, free of charge, to any person obtaining
a copy of this software and associated documentation files (the
"Software"), to deal in the Software without restriction, including
without limitation the rights to use, copy, modify, merge, publish,
distribute, sublicense, and/or sell copies of the Software, and to
permit persons to whom the Software is furnished to do so, subject to
the following conditions:

The above copyright notice and this permission notice shall be included
in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND,
EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT.
IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY
CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT,
TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE
SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
```

C.3.15 libffi

The _ctypes extension is built using an included copy of the libffi sources unless the build is configured --with-system-libffi:

```
Copyright (c) 1996-2008  Red Hat, Inc and others.

Permission is hereby granted, free of charge, to any person obtaining
a copy of this software and associated documentation files (the
``Software''), to deal in the Software without restriction, including
without limitation the rights to use, copy, modify, merge, publish,
distribute, sublicense, and/or sell copies of the Software, and to
permit persons to whom the Software is furnished to do so, subject to
the following conditions:
```

(continues on next page)

(continued from previous page)

```
The above copyright notice and this permission notice shall be included
in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED ``AS IS'', WITHOUT WARRANTY OF ANY KIND,
EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND
NONINFRINGEMENT.  IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT
HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY,
WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM,
OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER
DEALINGS IN THE SOFTWARE.
```

C.3.16 zlib

The zlib extension is built using an included copy of the zlib sources if the zlib version found on the system is too old to be used for the build:

```
Copyright (C) 1995-2011 Jean-loup Gailly and Mark Adler

This software is provided 'as-is', without any express or implied
warranty.  In no event will the authors be held liable for any damages
arising from the use of this software.

Permission is granted to anyone to use this software for any purpose,
including commercial applications, and to alter it and redistribute it
freely, subject to the following restrictions:

1. The origin of this software must not be misrepresented; you must not
   claim that you wrote the original software. If you use this software
   in a product, an acknowledgment in the product documentation would be
   appreciated but is not required.

2. Altered source versions must be plainly marked as such, and must not be
   misrepresented as being the original software.

3. This notice may not be removed or altered from any source distribution.

Jean-loup Gailly        Mark Adler
jloup@gzip.org          madler@alumni.caltech.edu
```

C.3.17 cfuhash

The implementation of the hash table used by the tracemalloc is based on the cfuhash project:

```
Copyright (c) 2005 Don Owens
All rights reserved.

This code is released under the BSD license:

Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions
are met:

  * Redistributions of source code must retain the above copyright
```

(continues on next page)

(continued from previous page)

```
   notice, this list of conditions and the following disclaimer.

 * Redistributions in binary form must reproduce the above
   copyright notice, this list of conditions and the following
   disclaimer in the documentation and/or other materials provided
   with the distribution.

 * Neither the name of the author nor the names of its
   contributors may be used to endorse or promote products derived
   from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS
"AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT
LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS
FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE
COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT,
INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES
(INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR
SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT,
STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE)
ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED
OF THE POSSIBILITY OF SUCH DAMAGE.
```

C.3.18 libmpdec

The _decimal Module is built using an included copy of the libmpdec library unless the build is configured --with-system-libmpdec:

```
Copyright (c) 2008-2016 Stefan Krah. All rights reserved.

Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions
are met:

1. Redistributions of source code must retain the above copyright
   notice, this list of conditions and the following disclaimer.

2. Redistributions in binary form must reproduce the above copyright
   notice, this list of conditions and the following disclaimer in the
   documentation and/or other materials provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE AUTHOR AND CONTRIBUTORS "AS IS" AND
ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
ARE DISCLAIMED.  IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE
FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
SUCH DAMAGE.
```

APPENDIX

D

COPYRIGHT

Python and this documentation is:

Copyright © 2001-2019 Python Software Foundation. All rights reserved.

Copyright © 2000 BeOpen.com. All rights reserved.

Copyright © 1995-2000 Corporation for National Research Initiatives. All rights reserved.

Copyright © 1991-1995 Stichting Mathematisch Centrum. All rights reserved.

See History and License for complete license and permissions information.

INDEX

Symbols

..., 11
__future__, 14
__slots__, 20
>>>, 11
2to3, 11

A

abstract base class, 11
argument, 11
asynchronous context manager, 11
asynchronous iterable, 12
asynchronous iterator, 12
attribute, 12
awaitable, 12

B

BDFL, 12
binary file, 12
bytecode, 12
bytes-like object, 12

C

C-contiguous, 13
class, 12
coercion, 12
complex number, 12
context manager, 13
contiguous, 13
coroutine, 13
coroutine function, 13
CPython, 13

D

decorator, 13
descriptor, 13
dictionary, 13
dictionary view, 13
docstring, 13
duck-typing, 14

E

EAFP, 14
expression, 14
extension module, 14

F

file object, 14
file-like object, 14
finder, 14
floor division, 14
Fortran contiguous, 13
function, 14
function annotation, 14

G

garbage collection, 15
generator, 15, 15
generator expression, 15, 15
generator iterator, 15
generic function, 15
GIL, 15
global interpreter lock, 15

H

hashable, 15

I

IDLE, 16
immutable, 16
import path, 16
importer, 16
importing, 16
interactive, 16
interpreted, 16
interpreter shutdown, 16
iterable, 16
iterator, 16

K

key function, 17
keyword argument, 17

L

lambda, 17

LBYL, 17
list, 17
list comprehension, 17
loader, 17

M

mapping, 17
meta path finder, 17
metaclass, 17
method, 17
method resolution order, 18
module, 18
module spec, 18
MRO, 18
mutable, 18

N

named tuple, 18
namespace, 18
namespace package, 18
nested scope, 18
new-style class, 18

O

object, 18

P

package, 18
parameter, 18
path based finder, 19
path entry, 19
path entry finder, 19
path entry hook, 19
portion, 19
positional argument, 19
provisional API, 19
provisional package, 19
Python 3000, 20
Python Enhancement Proposals
    PEP 238, 14
    PEP 278, 21
    PEP 302, 14, 17
    PEP 3107, 14
    PEP 3116, 21
    PEP 3155, 20
    PEP 343, 13
    PEP 362, 11, 19
    PEP 411, 19
    PEP 420, 14, 18, 19
    PEP 443, 15
    PEP 451, 14
    PEP 492, 11–13
Pythonic, 20

Q

qualified name, 20

R

reference count, 20
regular package, 20

S

sequence, 20
single dispatch, 21
slice, 21
special method, 21
statement, 21
struct sequence, 21

T

text encoding, 21
text file, 21
triple-quoted string, 21
type, 21

U

universal newlines, 21

V

virtual environment, 21
virtual machine, 21

Z

Zen of Python, 21