Python Setup and Usage

출시 버전 *3.6.15*

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Contents

도큐멘테이션의 이 부분은 여러 플랫폼에서 파이썬 환경을 설정하고, 인터프리터를 호출하며, 파이썬으로 작업하기 더 쉽게 만드는 것들에 관한 일반적인 정보를 다루는데 할당되었습니다.

CHAPTER 1

Command line and environment

The CPython interpreter scans the command line and the environment for various settings.

CPython implementation detail: Other implementations〉 command line schemes may differ. See implementations for further resources.

1.1 Command line

When invoking Python, you may specify any of these options:

```
python [-bBdEhiIOqsSuvVWx?] [-c command | -m module-name | script | - ] [args]
```

The most common use case is, of course, a simple invocation of a script:

```
python myscript.py
```

1.1.1 Interface options

The interpreter interface resembles that of the UNIX shell, but provides some additional methods of invocation:

- When called with standard input connected to a tty device, it prompts for commands and executes them until an EOF (an end-of-file character, you can produce that with `Ctrl-D` on UNIX or `Ctrl-Z, Enter` on Windows) is read.
- When called with a file name argument or with a file as standard input, it reads and executes a script from that file.
- When called with a directory name argument, it reads and executes an appropriately named script from that directory.
- When called with `-c command`, it executes the Python statement(s) given as *command*. Here *command* may contain multiple statements separated by newlines. Leading whitespace is significant in Python statements!
- When called with `-m module-name`, the given module is located on the Python module path and executed as a script.

In non-interactive mode, the entire input is parsed before it is executed.

An interface option terminates the list of options consumed by the interpreter, all consecutive arguments will end up in `sys.argv` – note that the first element, subscript zero (`sys.argv[0]`), is a string reflecting the program's source.

-c <command>
Execute the Python code in *command*. *command* can be one or more statements separated by newlines, with significant leading whitespace as in normal module code.

If this option is given, the first element of `sys.argv` will be `"-c"` and the current directory will be added to the start of `sys.path` (allowing modules in that directory to be imported as top level modules).

-m <module-name>
Search `sys.path` for the named module and execute its contents as the `__main__` module.

Since the argument is a *module* name, you must not give a file extension (`.py`). The module name should be a valid absolute Python module name, but the implementation may not always enforce this (e.g. it may allow you to use a name that includes a hyphen).

Package names (including namespace packages) are also permitted. When a package name is supplied instead of a normal module, the interpreter will execute <pkg>`.__main__` as the main module. This behaviour is deliberately similar to the handling of directories and zipfiles that are passed to the interpreter as the script argument.

참고: This option cannot be used with built-in modules and extension modules written in C, since they do not have Python module files. However, it can still be used for precompiled modules, even if the original source file is not available.

If this option is given, the first element of `sys.argv` will be the full path to the module file (while the module file is being located, the first element will be set to `"-m"`). As with the *-c* option, the current directory will be added to the start of `sys.path`.

Many standard library modules contain code that is invoked on their execution as a script. An example is the `timeit` module:

```
python -mtimeit -s 'setup here' 'benchmarked code here'
python -mtimeit -h # for details
```

더 보기:

runpy.run_module() Equivalent functionality directly available to Python code

PEP 338 – Executing modules as scripts

버전 3.1에서 변경: Supply the package name to run a `__main__` submodule.

버전 3.4에서 변경: namespace packages are also supported

-
Read commands from standard input (`sys.stdin`). If standard input is a terminal, *-i* is implied.

If this option is given, the first element of `sys.argv` will be `"-"` and the current directory will be added to the start of `sys.path`.

<script>
Execute the Python code contained in *script*, which must be a filesystem path (absolute or relative) referring to either a Python file, a directory containing a `__main__.py` file, or a zipfile containing a `__main__.py` file.

If this option is given, the first element of `sys.argv` will be the script name as given on the command line.

If the script name refers directly to a Python file, the directory containing that file is added to the start of `sys.path`, and the file is executed as the `__main__` module.

If the script name refers to a directory or zipfile, the script name is added to the start of `sys.path` and the `__main__.py` file in that location is executed as the `__main__` module.

더 보기:

`runpy.run_path()` Equivalent functionality directly available to Python code

If no interface option is given, *`-i`* is implied, `sys.argv[0]` is an empty string (`""`) and the current directory will be added to the start of `sys.path`. Also, tab-completion and history editing is automatically enabled, if available on your platform (see rlcompleter-config).

더 보기:

tut-invoking

버전 3.4에서 변경: Automatic enabling of tab-completion and history editing.

1.1.2 Generic options

`-?`
`-h`
`--help`
Print a short description of all command line options.

`-V`
`--version`
Print the Python version number and exit. Example output could be:

```
Python 3.6.0b2+
```

When given twice, print more information about the build, like:

```
Python 3.6.0b2+ (3.6:84a3c5003510+, Oct 26 2016, 02:33:55)
[GCC 6.2.0 20161005]
```

버전 3.6에 추가: The `-VV` option.

1.1.3 Miscellaneous options

`-b`
Issue a warning when comparing `bytes` or `bytearray` with `str` or `bytes` with `int`. Issue an error when the option is given twice (`-bb`).

버전 3.5에서 변경: Affects comparisons of `bytes` with `int`.

`-B`
If given, Python won't try to write `.pyc` files on the import of source modules. See also *`PYTHONDONTWRITEBYTECODE`*.

`-d`
Turn on parser debugging output (for wizards only, depending on compilation options). See also *`PYTHONDEBUG`*.

`-E`
Ignore all `PYTHON*` environment variables, e.g. *`PYTHONPATH`* and *`PYTHONHOME`*, that might be set.

-i

When a script is passed as first argument or the *-c* option is used, enter interactive mode after executing the script or the command, even when `sys.stdin` does not appear to be a terminal. The *PYTHONSTARTUP* file is not read.

This can be useful to inspect global variables or a stack trace when a script raises an exception. See also *PYTHONINSPECT*.

-I

Run Python in isolated mode. This also implies -E and -s. In isolated mode `sys.path` contains neither the script's directory nor the user's site-packages directory. All `PYTHON*` environment variables are ignored, too. Further restrictions may be imposed to prevent the user from injecting malicious code.

버전 3.4에 추가.

-O

Remove assert statements and any code conditional on the value of `__debug__`. Augment the filename for compiled (*bytecode*) files by adding `.opt-1` before the `.pyc` extension (see **PEP 488**). See also *PYTHONOPTIMIZE*.

버전 3.5에서 변경: Modify `.pyc` filenames according to **PEP 488**.

-OO

Do *-O* and also discard docstrings. Augment the filename for compiled (*bytecode*) files by adding `.opt-2` before the `.pyc` extension (see **PEP 488**).

버전 3.5에서 변경: Modify `.pyc` filenames according to **PEP 488**.

-q

Don't display the copyright and version messages even in interactive mode.

버전 3.2에 추가.

-R

Kept for compatibility. On Python 3.3 and greater, hash randomization is turned on by default.

On previous versions of Python, this option turns on hash randomization, so that the `__hash__()` values of str, bytes and datetime are《salted》with an unpredictable random value. Although they remain constant within an individual Python process, they are not predictable between repeated invocations of Python.

Hash randomization is intended to provide protection against a denial-of-service caused by carefully-chosen inputs that exploit the worst case performance of a dict construction, O(n^2) complexity. See http://www.ocert.org/advisories/ocert-2011-003.html for details.

PYTHONHASHSEED allows you to set a fixed value for the hash seed secret.

버전 3.2.3에 추가.

-s

Don't add the `user site-packages directory` to `sys.path`.

더 보기:

PEP 370 – Per user site-packages directory

-S

Disable the import of the module `site` and the site-dependent manipulations of `sys.path` that it entails. Also disable these manipulations if `site` is explicitly imported later (call `site.main()` if you want them to be triggered).

-u

Force the binary layer of the stdout and stderr streams (which is available as their `buffer` attribute) to be unbuffered. The text I/O layer will still be line-buffered if writing to the console, or block-buffered if redirected to a non-interactive file.

See also *PYTHONUNBUFFERED*.

-v

Print a message each time a module is initialized, showing the place (filename or built-in module) from which it is loaded. When given twice (`-vv`), print a message for each file that is checked for when searching for a module. Also provides information on module cleanup at exit. See also *PYTHONVERBOSE*.

-W `arg`

Warning control. Python's warning machinery by default prints warning messages to `sys.stderr`. A typical warning message has the following form:

```
file:line: category: message
```

By default, each warning is printed once for each source line where it occurs. This option controls how often warnings are printed.

Multiple *-W* options may be given; when a warning matches more than one option, the action for the last matching option is performed. Invalid *-W* options are ignored (though, a warning message is printed about invalid options when the first warning is issued).

Warnings can also be controlled from within a Python program using the `warnings` module.

The simplest form of argument is one of the following action strings (or a unique abbreviation):

ignore Ignore all warnings.

default Explicitly request the default behavior (printing each warning once per source line).

all Print a warning each time it occurs (this may generate many messages if a warning is triggered repeatedly for the same source line, such as inside a loop).

module Print each warning only the first time it occurs in each module.

once Print each warning only the first time it occurs in the program.

error Raise an exception instead of printing a warning message.

The full form of argument is:

```
action:message:category:module:line
```

Here, *action* is as explained above but only applies to messages that match the remaining fields. Empty fields match all values; trailing empty fields may be omitted. The *message* field matches the start of the warning message printed; this match is case-insensitive. The *category* field matches the warning category. This must be a class name; the match tests whether the actual warning category of the message is a subclass of the specified warning category. The full class name must be given. The *module* field matches the (fully-qualified) module name; this match is case-sensitive. The *line* field matches the line number, where zero matches all line numbers and is thus equivalent to an omitted line number.

더 보기:

`warnings` – the warnings module

PEP 230 – Warning framework

PYTHONWARNINGS

-x

Skip the first line of the source, allowing use of non-Unix forms of `#!cmd`. This is intended for a DOS specific hack only.

-X

Reserved for various implementation-specific options. CPython currently defines the following possible values:

- `-X faulthandler` to enable `faulthandler`;
- `-X showrefcount` to output the total reference count and number of used memory blocks when the program finishes or after each statement in the interactive interpreter. This only works on debug builds.
- `-X tracemalloc` to start tracing Python memory allocations using the `tracemalloc` module. By default, only the most recent frame is stored in a traceback of a trace. Use `-X tracemalloc=NFRAME` to start tracing with a traceback limit of *NFRAME* frames. See the `tracemalloc.start()` for more information.
- `-X showalloccount` to output the total count of allocated objects for each type when the program finishes. This only works when Python was built with `COUNT_ALLOCS` defined.

It also allows passing arbitrary values and retrieving them through the `sys._xoptions` dictionary.

버전 3.2에서 변경: The *-X* option was added.

버전 3.3에 추가: The `-X faulthandler` option.

버전 3.4에 추가: The `-X showrefcount` and `-X tracemalloc` options.

버전 3.6에 추가: The `-X showalloccount` option.

1.1.4 Options you shouldn't use

-J

Reserved for use by Jython.

1.2 Environment variables

These environment variables influence Python's behavior, they are processed before the command-line switches other than -E or -I. It is customary that command-line switches override environmental variables where there is a conflict.

PYTHONHOME

Change the location of the standard Python libraries. By default, the libraries are searched in *prefix*`/lib/pythonversion` and *exec_prefix*`/lib/pythonversion`, where *prefix* and *exec_prefix* are installation-dependent directories, both defaulting to `/usr/local`.

When *PYTHONHOME* is set to a single directory, its value replaces both *prefix* and *exec_prefix*. To specify different values for these, set *PYTHONHOME* to *prefix*`:`*exec_prefix*.

PYTHONPATH

Augment the default search path for module files. The format is the same as the shell's `PATH`: one or more directory pathnames separated by `os.pathsep` (e.g. colons on Unix or semicolons on Windows). Non-existent directories are silently ignored.

In addition to normal directories, individual *PYTHONPATH* entries may refer to zipfiles containing pure Python modules (in either source or compiled form). Extension modules cannot be imported from zipfiles.

The default search path is installation dependent, but generally begins with *prefix*`/lib/pythonversion` (see *PYTHONHOME* above). It is *always* appended to *PYTHONPATH*.

An additional directory will be inserted in the search path in front of *PYTHONPATH* as described above under *Interface options*. The search path can be manipulated from within a Python program as the variable `sys.path`.

PYTHONSTARTUP

If this is the name of a readable file, the Python commands in that file are executed before the first prompt is displayed in interactive mode. The file is executed in the same namespace where interactive commands are executed

so that objects defined or imported in it can be used without qualification in the interactive session. You can also change the prompts `sys.ps1` and `sys.ps2` and the hook `sys.__interactivehook__` in this file.

PYTHONOPTIMIZE
If this is set to a non-empty string it is equivalent to specifying the *-O* option. If set to an integer, it is equivalent to specifying *-O* multiple times.

PYTHONDEBUG
If this is set to a non-empty string it is equivalent to specifying the *-d* option. If set to an integer, it is equivalent to specifying *-d* multiple times.

PYTHONINSPECT
If this is set to a non-empty string it is equivalent to specifying the *-i* option.

This variable can also be modified by Python code using `os.environ` to force inspect mode on program termination.

PYTHONUNBUFFERED
If this is set to a non-empty string it is equivalent to specifying the *-u* option.

PYTHONVERBOSE
If this is set to a non-empty string it is equivalent to specifying the *-v* option. If set to an integer, it is equivalent to specifying *-v* multiple times.

PYTHONCASEOK
If this is set, Python ignores case in `import` statements. This only works on Windows and OS X.

PYTHONDONTWRITEBYTECODE
If this is set to a non-empty string, Python won't try to write `.pyc` files on the import of source modules. This is equivalent to specifying the *-B* option.

PYTHONHASHSEED
If this variable is not set or set to `random`, a random value is used to seed the hashes of str, bytes and datetime objects.

If *PYTHONHASHSEED* is set to an integer value, it is used as a fixed seed for generating the hash() of the types covered by the hash randomization.

Its purpose is to allow repeatable hashing, such as for selftests for the interpreter itself, or to allow a cluster of python processes to share hash values.

The integer must be a decimal number in the range [0,4294967295]. Specifying the value 0 will disable hash randomization.

버전 3.2.3에 추가.

PYTHONIOENCODING
If this is set before running the interpreter, it overrides the encoding used for stdin/stdout/stderr, in the syntax `encodingname:errorhandler`. Both the `encodingname` and the `:errorhandler` parts are optional and have the same meaning as in `str.encode()`.

For stderr, the `:errorhandler` part is ignored; the handler will always be `'backslashreplace'`.

버전 3.4에서 변경: The `encodingname` part is now optional.

버전 3.6에서 변경: On Windows, the encoding specified by this variable is ignored for interactive console buffers unless *PYTHONLEGACYWINDOWSSTDIO* is also specified. Files and pipes redirected through the standard streams are not affected.

PYTHONNOUSERSITE
If this is set, Python won't add the `user site-packages directory` to `sys.path`.

더 보기:

PEP 370 – Per user site-packages directory

PYTHONUSERBASE

Defines the `user base directory`, which is used to compute the path of the `user site-packages directory` and Distutils installation paths for `python setup.py install --user`.

더 보기:

PEP 370 – Per user site-packages directory

PYTHONEXECUTABLE

If this environment variable is set, `sys.argv[0]` will be set to its value instead of the value got through the C runtime. Only works on Mac OS X.

PYTHONWARNINGS

This is equivalent to the *-W* option. If set to a comma separated string, it is equivalent to specifying *-W* multiple times.

PYTHONFAULTHANDLER

If this environment variable is set to a non-empty string, `faulthandler.enable()` is called at startup: install a handler for `SIGSEGV`, `SIGFPE`, `SIGABRT`, `SIGBUS` and `SIGILL` signals to dump the Python traceback. This is equivalent to *-X* `faulthandler` option.

버전 3.3에 추가.

PYTHONTRACEMALLOC

If this environment variable is set to a non-empty string, start tracing Python memory allocations using the `tracemalloc` module. The value of the variable is the maximum number of frames stored in a traceback of a trace. For example, `PYTHONTRACEMALLOC=1` stores only the most recent frame. See the `tracemalloc.start()` for more information.

버전 3.4에 추가.

PYTHONASYNCIODEBUG

If this environment variable is set to a non-empty string, enable the debug mode of the `asyncio` module.

버전 3.4에 추가.

PYTHONMALLOC

Set the Python memory allocators and/or install debug hooks.

Set the family of memory allocators used by Python:

- `malloc`: use the `malloc()` function of the C library for all domains (`PYMEM_DOMAIN_RAW`, `PYMEM_DOMAIN_MEM`, `PYMEM_DOMAIN_OBJ`).
- `pymalloc`: use the pymalloc allocator for `PYMEM_DOMAIN_MEM` and `PYMEM_DOMAIN_OBJ` domains and use the `malloc()` function for the `PYMEM_DOMAIN_RAW` domain.

Install debug hooks:

- `debug`: install debug hooks on top of the default memory allocator
- `malloc_debug`: same as `malloc` but also install debug hooks
- `pymalloc_debug`: same as `pymalloc` but also install debug hooks

When Python is compiled in release mode, the default is `pymalloc`. When compiled in debug mode, the default is `pymalloc_debug` and the debug hooks are used automatically.

If Python is configured without `pymalloc` support, `pymalloc` and `pymalloc_debug` are not available, the default is `malloc` in release mode and `malloc_debug` in debug mode.

See the `PyMem_SetupDebugHooks()` function for debug hooks on Python memory allocators.

버전 3.6에 추가.

PYTHONMALLOCSTATS
If set to a non-empty string, Python will print statistics of the pymalloc memory allocator every time a new pymalloc object arena is created, and on shutdown.

This variable is ignored if the *PYTHONMALLOC* environment variable is used to force the `malloc()` allocator of the C library, or if Python is configured without `pymalloc` support.

버전 3.6에서 변경: This variable can now also be used on Python compiled in release mode. It now has no effect if set to an empty string.

PYTHONLEGACYWINDOWSFSENCODING
If set to a non-empty string, the default filesystem encoding and errors mode will revert to their pre-3.6 values of 'mbcs' and 'replace', respectively. Otherwise, the new defaults 'utf-8' and 'surrogatepass' are used.

This may also be enabled at runtime with `sys._enablelegacywindowsfsencoding()`.

Availability: Windows

버전 3.6에 추가: See **PEP 529** for more details.

PYTHONLEGACYWINDOWSSTDIO
If set to a non-empty string, does not use the new console reader and writer. This means that Unicode characters will be encoded according to the active console code page, rather than using utf-8.

This variable is ignored if the standard streams are redirected (to files or pipes) rather than referring to console buffers.

Availability: Windows

버전 3.6에 추가.

1.2.1 Debug-mode variables

Setting these variables only has an effect in a debug build of Python, that is, if Python was configured with the `--with-pydebug` build option.

PYTHONTHREADDEBUG
If set, Python will print threading debug info.

PYTHONDUMPREFS
If set, Python will dump objects and reference counts still alive after shutting down the interpreter.

CHAPTER 2

Using Python on Unix platforms

2.1 Getting and installing the latest version of Python

2.1.1 On Linux

Python comes preinstalled on most Linux distributions, and is available as a package on all others. However there are certain features you might want to use that are not available on your distro's package. You can easily compile the latest version of Python from source.

In the event that Python doesn't come preinstalled and isn't in the repositories as well, you can easily make packages for your own distro. Have a look at the following links:

더 보기:

https://www.debian.org/doc/manuals/maint-guide/first.en.html for Debian users

https://en.opensuse.org/Portal:Packaging for OpenSuse users

https://docs.fedoraproject.org/en-US/Fedora_Draft_Documentation/0.1/html/RPM_Guide/ch-creating-rpms.html
for Fedora users

http://www.slackbook.org/html/package-management-making-packages.html for Slackware users

2.1.2 On FreeBSD and OpenBSD

- FreeBSD users, to add the package use:

```
pkg install python3
```

- OpenBSD users, to add the package use:

```
pkg_add -r python

pkg_add ftp://ftp.openbsd.org/pub/OpenBSD/4.2/packages/<insert your architecture␣
↪here>/python-<version>.tgz
```

(다음 페이지에 계속)

(이전 페이지에서 계속)

For example i386 users get the 2.5.1 version of Python using:

```
pkg_add ftp://ftp.openbsd.org/pub/OpenBSD/4.2/packages/i386/python-2.5.1p2.tgz
```

2.1.3 On OpenSolaris

You can get Python from OpenCSW. Various versions of Python are available and can be installed with e.g. `pkgutil -i python27`.

2.2 Building Python

If you want to compile CPython yourself, first thing you should do is get the source. You can download either the latest release's source or just grab a fresh clone. (If you want to contribute patches, you will need a clone.)

The build process consists in the usual

```
./configure
make
make install
```

invocations. Configuration options and caveats for specific Unix platforms are extensively documented in the README.rst file in the root of the Python source tree.

경고: `make install` can overwrite or masquerade the `python3` binary. `make altinstall` is therefore recommended instead of `make install` since it only installs *exec_prefix*`/bin/python`*version*.

2.3 Python-related paths and files

These are subject to difference depending on local installation conventions; `prefix` (`${prefix}`) and `exec_prefix` (`${exec_prefix}`) are installation-dependent and should be interpreted as for GNU software; they may be the same.

For example, on most Linux systems, the default for both is `/usr`.

File/directory	Meaning
exec_prefix`/bin/python3`	Recommended location of the interpreter.
prefix`/lib/python`*version*, *exec_prefix*`/lib/python`*version*	Recommended locations of the directories containing the standard modules.
prefix`/include/python`*version*, *exec_prefix*`/include/python`*version*	Recommended locations of the directories containing the include files needed for developing Python extensions and embedding the interpreter.

2.4 Miscellaneous

To easily use Python scripts on Unix, you need to make them executable, e.g. with

```
$ chmod +x script
```

and put an appropriate Shebang line at the top of the script. A good choice is usually

```
#!/usr/bin/env python3
```

which searches for the Python interpreter in the whole `PATH`. However, some Unices may not have the **`env`** command, so you may need to hardcode `/usr/bin/python3` as the interpreter path.

To use shell commands in your Python scripts, look at the `subprocess` module.

2.5 Editors and IDEs

There are a number of IDEs that support Python programming language. Many editors and IDEs provide syntax highlighting, debugging tools, and **PEP 8** checks.

Please go to Python Editors and Integrated Development Environments for a comprehensive list.

CHAPTER 3

Using Python on Windows

This document aims to give an overview of Windows-specific behaviour you should know about when using Python on Microsoft Windows.

3.1 Installing Python

Unlike most Unix systems and services, Windows does not include a system supported installation of Python. To make Python available, the CPython team has compiled Windows installers (MSI packages) with every release for many years. These installers are primarily intended to add a per-user installation of Python, with the core interpreter and library being used by a single user. The installer is also able to install for all users of a single machine, and a separate ZIP file is available for application-local distributions.

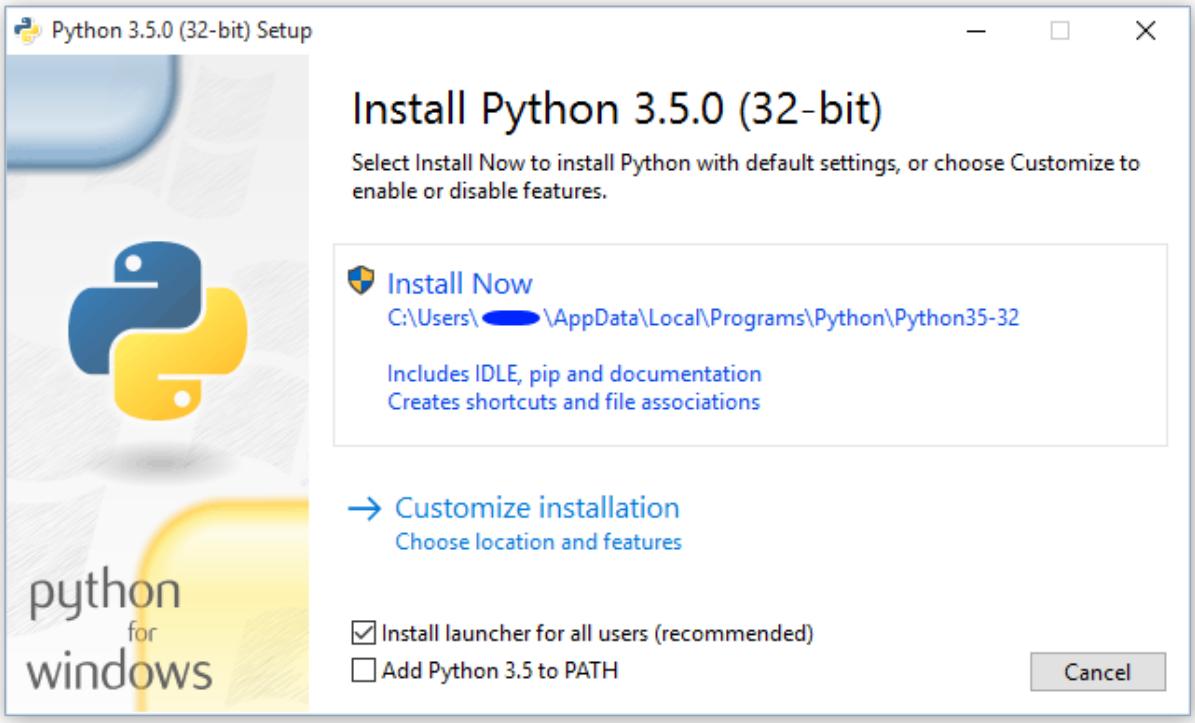
3.1.1 Supported Versions

As specified in **PEP 11**, a Python release only supports a Windows platform while Microsoft considers the platform under extended support. This means that Python 3.6 supports Windows Vista and newer. If you require Windows XP support then please install Python 3.4.

3.1.2 Installation Steps

Four Python 3.6 installers are available for download - two each for the 32-bit and 64-bit versions of the interpreter. The *web installer* is a small initial download, and it will automatically download the required components as necessary. The *offline installer* includes the components necessary for a default installation and only requires an internet connection for optional features. See *Installing Without Downloading* for other ways to avoid downloading during installation.

After starting the installer, one of two options may be selected:



If you select《Install Now》:

- You will *not* need to be an administrator (unless a system update for the C Runtime Library is required or you install the *Python Launcher for Windows* for all users)
- Python will be installed into your user directory
- The *Python Launcher for Windows* will be installed according to the option at the bottom of the first page
- The standard library, test suite, launcher and pip will be installed
- If selected, the install directory will be added to your `PATH`
- Shortcuts will only be visible for the current user

Selecting《Customize installation》will allow you to select the features to install, the installation location and other options or post-install actions. To install debugging symbols or binaries, you will need to use this option.

To perform an all-users installation, you should select《Customize installation》. In this case:

- You may be required to provide administrative credentials or approval
- Python will be installed into the Program Files directory
- The *Python Launcher for Windows* will be installed into the Windows directory
- Optional features may be selected during installation
- The standard library can be pre-compiled to bytecode
- If selected, the install directory will be added to the system `PATH`
- Shortcuts are available for all users

3.1.3 Removing the MAX_PATH Limitation

Windows historically has limited path lengths to 260 characters. This meant that paths longer than this would not resolve and errors would result.

In the latest versions of Windows, this limitation can be expanded to approximately 32,000 characters. Your administrator will need to activate the 《Enable Win32 long paths》 group policy, or set the registry value `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\FileSystem@LongPathsEnabled` to `1`.

This allows the `open()` function, the `os` module and most other path functionality to accept and return paths longer than 260 characters when using strings. (Use of bytes as paths is deprecated on Windows, and this feature is not available when using bytes.)

After changing the above option, no further configuration is required.

버전 3.6에서 변경: Support for long paths was enabled in Python.

3.1.4 Installing Without UI

All of the options available in the installer UI can also be specified from the command line, allowing scripted installers to replicate an installation on many machines without user interaction. These options may also be set without suppressing the UI in order to change some of the defaults.

To completely hide the installer UI and install Python silently, pass the `/quiet` option. To skip past the user interaction but still display progress and errors, pass the `/passive` option. The `/uninstall` option may be passed to immediately begin removing Python - no prompt will be displayed.

All other options are passed as `name=value`, where the value is usually `0` to disable a feature, `1` to enable a feature, or a path. The full list of available options is shown below.

Name	Description	Default
InstallAllUsers	Perform a system-wide installation.	0
TargetDir	The installation directory	Selected based on InstallAllUsers
DefaultAllUsersTargetDir	The default installation directory for all-user installs	`%ProgramFiles%\Python X.Y` or `%ProgramFiles(x86)%\Python X.Y`
DefaultJustForMeTargetDir	The default install directory for just-for-me installs	`%LocalAppData%\Programs\PythonXY` or `%LocalAppData%\Programs\PythonXY-32`
DefaultCustomTargetDir	The default custom install directory displayed in the UI	(empty)
AssociateFiles	Create file associations if the launcher is also installed.	1
CompileAll	Compile all `.py` files to `.pyc`.	0
PrependPath	Add install and Scripts directories to `PATH` and `.PY` to `PATHEXT`	0
Shortcuts	Create shortcuts for the interpreter, documentation and IDLE if installed.	1
Include_doc	Install Python manual	1
Include_debug	Install debug binaries	0
Include_dev	Install developer headers and libraries	1
Include_exe	Install `python.exe` and related files	1
Include_launcher	Install *Python Launcher for Windows*.	1
InstallLauncherAllUsers	Installs *Python Launcher for Windows* for all users.	1
Include_lib	Install standard library and extension modules	1
Include_pip	Install bundled pip and setuptools	1
Include_symbols	Install debugging symbols (*.pdb)	0
Include_tcltk	Install Tcl/Tk support and IDLE	1
Include_test	Install standard library test suite	1
Include_tools	Install utility scripts	1
LauncherOnly	Only installs the launcher. This will override most other options.	0
SimpleInstall	Disable most install UI	0
SimpleInstallDescription	A custom message to display when the simplified install UI is used.	(empty)

For example, to silently install a default, system-wide Python installation, you could use the following command (from an elevated command prompt):

```
python-3.6.0.exe /quiet InstallAllUsers=1 PrependPath=1 Include_test=0
```

To allow users to easily install a personal copy of Python without the test suite, you could provide a shortcut with the following command. This will display a simplified initial page and disallow customization:

```
python-3.6.0.exe InstallAllUsers=0 Include_launcher=0 Include_test=0
    SimpleInstall=1 SimpleInstallDescription="Just for me, no test suite."
```

(Note that omitting the launcher also omits file associations, and is only recommended for per-user installs when there is also a system-wide installation that included the launcher.)

The options listed above can also be provided in a file named `unattend.xml` alongside the executable. This file specifies a list of options and values. When a value is provided as an attribute, it will be converted to a number if possible. Values provided as element text are always left as strings. This example file sets the same options as the previous example:

```
<Options>
    <Option Name="InstallAllUsers" Value="no" />
    <Option Name="Include_launcher" Value="0" />
    <Option Name="Include_test" Value="no" />
    <Option Name="SimpleInstall" Value="yes" />
    <Option Name="SimpleInstallDescription">Just for me, no test suite</Option>
</Options>
```

3.1.5 Installing Without Downloading

As some features of Python are not included in the initial installer download, selecting those features may require an internet connection. To avoid this need, all possible components may be downloaded on-demand to create a complete *layout* that will no longer require an internet connection regardless of the selected features. Note that this download may be bigger than required, but where a large number of installations are going to be performed it is very useful to have a locally cached copy.

Execute the following command from Command Prompt to download all possible required files. Remember to substitute `python-3.6.0.exe` for the actual name of your installer, and to create layouts in their own directories to avoid collisions between files with the same name.

```
python-3.6.0.exe /layout [optional target directory]
```

You may also specify the `/quiet` option to hide the progress display.

3.1.6 Modifying an install

Once Python has been installed, you can add or remove features through the Programs and Features tool that is part of Windows. Select the Python entry and choose 《Uninstall/Change》 to open the installer in maintenance mode.

《Modify》 allows you to add or remove features by modifying the checkboxes - unchanged checkboxes will not install or remove anything. Some options cannot be changed in this mode, such as the install directory; to modify these, you will need to remove and then reinstall Python completely.

《Repair》 will verify all the files that should be installed using the current settings and replace any that have been removed or modified.

《Uninstall》 will remove Python entirely, with the exception of the *Python Launcher for Windows*, which has its own entry in Programs and Features.

3.1.7 Other Platforms

With ongoing development of Python, some platforms that used to be supported earlier are no longer supported (due to the lack of users or developers). Check **PEP 11** for details on all unsupported platforms.

- Windows CE is still supported.
- The Cygwin installer offers to install the Python interpreter as well (cf. Cygwin package source, Maintainer releases)

See Python for Windows for detailed information about platforms with pre-compiled installers.

더 보기:

Python on XP 《7 Minutes to《Hello World!》》 by Richard Dooling, 2006

Installing on Windows in《Dive into Python: Python from novice to pro》by Mark Pilgrim, 2004, ISBN 1-59059-356-1

For Windows users in《Installing Python》in《A Byte of Python》by Swaroop C H, 2003

3.2 Alternative bundles

Besides the standard CPython distribution, there are modified packages including additional functionality. The following is a list of popular versions and their key features:

ActivePython Installer with multi-platform compatibility, documentation, PyWin32

Anaconda Popular scientific modules (such as numpy, scipy and pandas) and the `conda` package manager.

Canopy A《comprehensive Python analysis environment》with editors and other development tools.

WinPython Windows-specific distribution with prebuilt scientific packages and tools for building packages.

Note that these packages may not include the latest versions of Python or other libraries, and are not maintained or supported by the core Python team.

3.3 Configuring Python

To run Python conveniently from a command prompt, you might consider changing some default environment variables in Windows. While the installer provides an option to configure the PATH and PATHEXT variables for you, this is only reliable for a single, system-wide installation. If you regularly use multiple versions of Python, consider using the *Python Launcher for Windows*.

3.3.1 Excursus: Setting environment variables

Windows allows environment variables to be configured permanently at both the User level and the System level, or temporarily in a command prompt.

To temporarily set environment variables, open Command Prompt and use the **set** command:

```
C:\>set PATH=C:\Program Files\Python 3.6;%PATH%
C:\>set PYTHONPATH=%PYTHONPATH%;C:\My_python_lib
C:\>python
```

These changes will apply to any further commands executed in that console, and will be inherited by any applications started from the console.

Including the variable name within percent signs will expand to the existing value, allowing you to add your new value at either the start or the end. Modifying `PATH` by adding the directory containing **`python.exe`** to the start is a common way to ensure the correct version of Python is launched.

To permanently modify the default environment variables, click Start and search for 〈edit environment variables〉, or open System properties, *Advanced system settings* and click the *Environment Variables* button. In this dialog, you can add or modify User and System variables. To change System variables, you need non-restricted access to your machine (i.e. Administrator rights).

참고: Windows will concatenate User variables *after* System variables, which may cause unexpected results when modifying `PATH`.

The *`PYTHONPATH`* variable is used by all versions of Python 2 and Python 3, so you should not permanently configure this variable unless it only includes code that is compatible with all of your installed Python versions.

더 보기:

https://support.microsoft.com/kb/100843 Environment variables in Windows NT

https://technet.microsoft.com/en-us/library/cc754250.aspx The SET command, for temporarily modifying environment variables

https://technet.microsoft.com/en-us/library/cc755104.aspx The SETX command, for permanently modifying environment variables

https://support.microsoft.com/kb/310519 How To Manage Environment Variables in Windows XP

https://www.chem.gla.ac.uk/~louis/software/faq/q1.html Setting Environment variables, Louis J. Farrugia

3.3.2 Finding the Python executable

버전 3.5에서 변경.

Besides using the automatically created start menu entry for the Python interpreter, you might want to start Python in the command prompt. The installer has an option to set that up for you.

On the first page of the installer, an option labelled 《Add Python to PATH》 may be selected to have the installer add the install location into the `PATH`. The location of the `Scripts\` folder is also added. This allows you to type **`python`** to run the interpreter, and **`pip`** for the package installer. Thus, you can also execute your scripts with command line options, see *Command line* documentation.

If you don't enable this option at install time, you can always re-run the installer, select Modify, and enable it. Alternatively, you can manually modify the `PATH` using the directions in *Excursus: Setting environment variables*. You need to set your `PATH` environment variable to include the directory of your Python installation, delimited by a semicolon from other entries. An example variable could look like this (assuming the first two entries already existed):

```
C:\WINDOWS\system32;C:\WINDOWS;C:\Program Files\Python 3.6
```

3.4 Python Launcher for Windows

버전 3.3에 추가.

The Python launcher for Windows is a utility which aids in locating and executing of different Python versions. It allows scripts (or the command-line) to indicate a preference for a specific Python version, and will locate and execute that version.

Unlike the `PATH` variable, the launcher will correctly select the most appropriate version of Python. It will prefer per-user installations over system-wide ones, and orders by language version rather than using the most recently installed version.

3.4.1 Getting started

From the command-line

버전 3.6에서 변경.

System-wide installations of Python 3.3 and later will put the launcher on your `PATH`. The launcher is compatible with all available versions of Python, so it does not matter which version is installed. To check that the launcher is available, execute the following command in Command Prompt:

```
py
```

You should find that the latest version of Python you have installed is started - it can be exited as normal, and any additional command-line arguments specified will be sent directly to Python.

If you have multiple versions of Python installed (e.g., 2.7 and 3.6) you will have noticed that Python 3.6 was started - to launch Python 2.7, try the command:

```
py -2.7
```

If you want the latest version of Python 2.x you have installed, try the command:

```
py -2
```

You should find the latest version of Python 2.x starts.

If you see the following error, you do not have the launcher installed:

```
'py' is not recognized as an internal or external command,
operable program or batch file.
```

Per-user installations of Python do not add the launcher to `PATH` unless the option was selected on installation.

Virtual environments

버전 3.5에 추가.

If the launcher is run with no explicit Python version specification, and a virtual environment (created with the standard library `venv` module or the external `virtualenv` tool) active, the launcher will run the virtual environment's interpreter rather than the global one. To run the global interpreter, either deactivate the virtual environment, or explicitly specify the global Python version.

From a script

Let's create a test Python script - create a file called `hello.py` with the following contents

```
#! python
import sys
sys.stdout.write("hello from Python %s\n" % (sys.version,))
```

From the directory in which hello.py lives, execute the command:

```
py hello.py
```

You should notice the version number of your latest Python 2.x installation is printed. Now try changing the first line to be:

```
#! python3
```

Re-executing the command should now print the latest Python 3.x information. As with the above command-line examples, you can specify a more explicit version qualifier. Assuming you have Python 2.6 installed, try changing the first line to `#! python2.6` and you should find the 2.6 version information printed.

Note that unlike interactive use, a bare《python》will use the latest version of Python 2.x that you have installed. This is for backward compatibility and for compatibility with Unix, where the command `python` typically refers to Python 2.

From file associations

The launcher should have been associated with Python files (i.e. `.py`, `.pyw`, `.pyc` files) when it was installed. This means that when you double-click on one of these files from Windows explorer the launcher will be used, and therefore you can use the same facilities described above to have the script specify the version which should be used.

The key benefit of this is that a single launcher can support multiple Python versions at the same time depending on the contents of the first line.

3.4.2 Shebang Lines

If the first line of a script file starts with `#!`, it is known as a《shebang》line. Linux and other Unix like operating systems have native support for such lines and they are commonly used on such systems to indicate how a script should be executed. This launcher allows the same facilities to be used with Python scripts on Windows and the examples above demonstrate their use.

To allow shebang lines in Python scripts to be portable between Unix and Windows, this launcher supports a number of〈virtual〉commands to specify which interpreter to use. The supported virtual commands are:

- `/usr/bin/env python`
- `/usr/bin/python`
- `/usr/local/bin/python`
- `python`

For example, if the first line of your script starts with

```
#! /usr/bin/python
```

The default Python will be located and used. As many Python scripts written to work on Unix will already have this line, you should find these scripts can be used by the launcher without modification. If you are writing a new script on Windows which you hope will be useful on Unix, you should use one of the shebang lines starting with `/usr`.

Any of the above virtual commands can be suffixed with an explicit version (either just the major version, or the major and minor version) - for example `/usr/bin/python2.7` - which will cause that specific version to be located and used.

The `/usr/bin/env` form of shebang line has one further special property. Before looking for installed Python interpreters, this form will search the executable `PATH` for a Python executable. This corresponds to the behaviour of the Unix `env` program, which performs a `PATH` search.

3.4.3 Arguments in shebang lines

The shebang lines can also specify additional options to be passed to the Python interpreter. For example, if you have a shebang line:

```
#! /usr/bin/python -v
```

Then Python will be started with the `-v` option

3.4.4 Customization

Customization via INI files

Two .ini files will be searched by the launcher - `py.ini` in the current user's 《application data》 directory (i.e. the directory returned by calling the Windows function `SHGetFolderPath` with `CSIDL_LOCAL_APPDATA`) and `py.ini` in the same directory as the launcher. The same .ini files are used for both the 〈console〉 version of the launcher (i.e. py.exe) and for the 〈windows〉 version (i.e. pyw.exe).

Customization specified in the 《application directory》 will have precedence over the one next to the executable, so a user, who may not have write access to the .ini file next to the launcher, can override commands in that global .ini file.

Customizing default Python versions

In some cases, a version qualifier can be included in a command to dictate which version of Python will be used by the command. A version qualifier starts with a major version number and can optionally be followed by a period (〈.〉) and a minor version specifier. If the minor qualifier is specified, it may optionally be followed by 《-32》 to indicate the 32-bit implementation of that version be used.

For example, a shebang line of `#!python` has no version qualifier, while `#!python3` has a version qualifier which specifies only a major version.

If no version qualifiers are found in a command, the environment variable `PY_PYTHON` can be set to specify the default version qualifier - the default value is 《2》. Note this value could specify just a major version (e.g. 《2》) or a major.minor qualifier (e.g. 《2.6》), or even major.minor-32.

If no minor version qualifiers are found, the environment variable `PY_PYTHON{major}` (where `{major}` is the current major version qualifier as determined above) can be set to specify the full version. If no such option is found, the launcher will enumerate the installed Python versions and use the latest minor release found for the major version, which is likely, although not guaranteed, to be the most recently installed version in that family.

On 64-bit Windows with both 32-bit and 64-bit implementations of the same (major.minor) Python version installed, the 64-bit version will always be preferred. This will be true for both 32-bit and 64-bit implementations of the launcher - a 32-bit launcher will prefer to execute a 64-bit Python installation of the specified version if available. This is so the behavior of the launcher can be predicted knowing only what versions are installed on the PC and without regard to the order in which they were installed (i.e., without knowing whether a 32 or 64-bit version of Python and corresponding

launcher was installed last). As noted above, an optional 《-32》 suffix can be used on a version specifier to change this behaviour.

Examples:

- If no relevant options are set, the commands `python` and `python2` will use the latest Python 2.x version installed and the command `python3` will use the latest Python 3.x installed.
- The commands `python3.1` and `python2.7` will not consult any options at all as the versions are fully specified.
- If `PY_PYTHON=3`, the commands `python` and `python3` will both use the latest installed Python 3 version.
- If `PY_PYTHON=3.1-32`, the command `python` will use the 32-bit implementation of 3.1 whereas the command `python3` will use the latest installed Python (PY_PYTHON was not considered at all as a major version was specified.)
- If `PY_PYTHON=3` and `PY_PYTHON3=3.1`, the commands `python` and `python3` will both use specifically 3.1

In addition to environment variables, the same settings can be configured in the .INI file used by the launcher. The section in the INI file is called `[defaults]` and the key name will be the same as the environment variables without the leading `PY_` prefix (and note that the key names in the INI file are case insensitive.) The contents of an environment variable will override things specified in the INI file.

For example:

- Setting `PY_PYTHON=3.1` is equivalent to the INI file containing:

```
[defaults]
python=3.1
```

- Setting `PY_PYTHON=3` and `PY_PYTHON3=3.1` is equivalent to the INI file containing:

```
[defaults]
python=3
python3=3.1
```

3.4.5 Diagnostics

If an environment variable `PYLAUNCH_DEBUG` is set (to any value), the launcher will print diagnostic information to stderr (i.e. to the console). While this information manages to be simultaneously verbose *and* terse, it should allow you to see what versions of Python were located, why a particular version was chosen and the exact command-line used to execute the target Python.

3.5 Finding modules

Python usually stores its library (and thereby your site-packages folder) in the installation directory. So, if you had installed Python to `C:\Python\`, the default library would reside in `C:\Python\Lib\` and third-party modules should be stored in `C:\Python\Lib\site-packages\`.

To completely override `sys.path`, create a `._pth` file with the same name as the DLL (`python36._pth`) or the executable (`python._pth`) and specify one line for each path to add to `sys.path`. The file based on the DLL name overrides the one based on the executable, which allows paths to be restricted for any program loading the runtime if desired.

When the file exists, all registry and environment variables are ignored, isolated mode is enabled, and `site` is not imported unless one line in the file specifies `import site`. Blank paths and lines starting with `#` are ignored. Each path may

be absolute or relative to the location of the file. Import statements other than to `site` are not permitted, and arbitrary code cannot be specified.

Note that `.pth` files (without leading underscore) will be processed normally by the `site` module.

When no `._pth` file is found, this is how `sys.path` is populated on Windows:

- An empty entry is added at the start, which corresponds to the current directory.
- If the environment variable *PYTHONPATH* exists, as described in *Environment variables*, its entries are added next. Note that on Windows, paths in this variable must be separated by semicolons, to distinguish them from the colon used in drive identifiers (`C:\` etc.).
- Additional 《application paths》 can be added in the registry as subkeys of `\SOFTWARE\Python\PythonCore{version}\PythonPath` under both the `HKEY_CURRENT_USER` and `HKEY_LOCAL_MACHINE` hives. Subkeys which have semicolon-delimited path strings as their default value will cause each path to be added to `sys.path`. (Note that all known installers only use HKLM, so HKCU is typically empty.)
- If the environment variable *PYTHONHOME* is set, it is assumed as 《Python Home》. Otherwise, the path of the main Python executable is used to locate a 《landmark file》 (either `Lib\os.py` or `pythonXY.zip`) to deduce the 《Python Home》. If a Python home is found, the relevant sub-directories added to `sys.path` (`Lib`, `plat-win`, etc) are based on that folder. Otherwise, the core Python path is constructed from the PythonPath stored in the registry.
- If the Python Home cannot be located, no *PYTHONPATH* is specified in the environment, and no registry entries can be found, a default path with relative entries is used (e.g. `.\Lib;.\plat-win`, etc).

If a `pyvenv.cfg` file is found alongside the main executable or in the directory one level above the executable, the following variations apply:

- If `home` is an absolute path and *PYTHONHOME* is not set, this path is used instead of the path to the main executable when deducing the home location.

The end result of all this is:

- When running `python.exe`, or any other .exe in the main Python directory (either an installed version, or directly from the PCbuild directory), the core path is deduced, and the core paths in the registry are ignored. Other 《application paths》 in the registry are always read.
- When Python is hosted in another .exe (different directory, embedded via COM, etc), the 《Python Home》 will not be deduced, so the core path from the registry is used. Other 《application paths》 in the registry are always read.
- If Python can't find its home and there are no registry value (frozen .exe, some very strange installation setup) you get a path with some default, but relative, paths.

For those who want to bundle Python into their application or distribution, the following advice will prevent conflicts with other installations:

- Include a `._pth` file alongside your executable containing the directories to include. This will ignore paths listed in the registry and environment variables, and also ignore `site` unless `import site` is listed.
- If you are loading `python3.dll` or `python36.dll` in your own executable, explicitly call `Py_SetPath()` or (at least) `Py_SetProgramName()` before `Py_Initialize()`.
- Clear and/or overwrite *PYTHONPATH* and set *PYTHONHOME* before launching `python.exe` from your application.
- If you cannot use the previous suggestions (for example, you are a distribution that allows people to run `python.exe` directly), ensure that the landmark file (`Lib\os.py`) exists in your install directory. (Note that it will not be detected inside a ZIP file, but a correctly named ZIP file will be detected instead.)

These will ensure that the files in a system-wide installation will not take precedence over the copy of the standard library bundled with your application. Otherwise, your users may experience problems using your application. Note that the first suggestion is the best, as the others may still be susceptible to non-standard paths in the registry and user site-packages.

버전 3.6에서 변경:

- Adds `._pth` file support and removes `applocal` option from `pyvenv.cfg`.
- Adds `pythonXX.zip` as a potential landmark when directly adjacent to the executable.

버전 3.6부터 폐지: Modules specified in the registry under `Modules` (not `PythonPath`) may be imported by `importlib.machinery.WindowsRegistryFinder`. This finder is enabled on Windows in 3.6.0 and earlier, but may need to be explicitly added to `sys.meta_path` in the future.

3.6 Additional modules

Even though Python aims to be portable among all platforms, there are features that are unique to Windows. A couple of modules, both in the standard library and external, and snippets exist to use these features.

The Windows-specific standard modules are documented in mswin-specific-services.

3.6.1 PyWin32

The PyWin32 module by Mark Hammond is a collection of modules for advanced Windows-specific support. This includes utilities for:

- Component Object Model (COM)
- Win32 API calls
- Registry
- Event log
- Microsoft Foundation Classes (MFC) user interfaces

PythonWin is a sample MFC application shipped with PyWin32. It is an embeddable IDE with a built-in debugger.

더 보기:

Win32 How Do I…? by Tim Golden

Python and COM by David and Paul Boddie

3.6.2 cx_Freeze

cx_Freeze is a `distutils` extension (see extending-distutils) which wraps Python scripts into executable Windows programs (`*.exe` files). When you have done this, you can distribute your application without requiring your users to install Python.

3.6.3 WConio

Since Python's advanced terminal handling layer, `curses`, is restricted to Unix-like systems, there is a library exclusive to Windows as well: Windows Console I/O for Python.

WConio is a wrapper for Turbo-C's `CONIO.H`, used to create text user interfaces.

3.7 Compiling Python on Windows

If you want to compile CPython yourself, first thing you should do is get the source. You can download either the latest release's source or just grab a fresh checkout.

The source tree contains a build solution and project files for Microsoft Visual Studio 2015, which is the compiler used to build the official Python releases. These files are in the `PCbuild` directory.

Check `PCbuild/readme.txt` for general information on the build process.

For extension modules, consult building-on-windows.

더 보기:

Python + Windows + distutils + SWIG + gcc MinGW or 《Creating Python extensions in C/C++ with SWIG and compiling them with MinGW gcc under Windows》 or 《Installing Python extension with distutils and without Microsoft Visual C++》 by Sébastien Sauvage, 2003

MingW – Python extensions by Trent Apted et al, 2007

3.8 Embedded Distribution

버전 3.5에 추가.

The embedded distribution is a ZIP file containing a minimal Python environment. It is intended for acting as part of another application, rather than being directly accessed by end-users.

When extracted, the embedded distribution is (almost) fully isolated from the user's system, including environment variables, system registry settings, and installed packages. The standard library is included as pre-compiled and optimized `.pyc` files in a ZIP, and `python3.dll`, `python36.dll`, `python.exe` and `pythonw.exe` are all provided. Tcl/tk (including all dependants, such as Idle), pip and the Python documentation are not included.

참고: The embedded distribution does not include the Microsoft C Runtime and it is the responsibility of the application installer to provide this. The runtime may have already been installed on a user's system previously or automatically via Windows Update, and can be detected by finding `ucrtbase.dll` in the system directory.

Third-party packages should be installed by the application installer alongside the embedded distribution. Using pip to manage dependencies as for a regular Python installation is not supported with this distribution, though with some care it may be possible to include and use pip for automatic updates. In general, third-party packages should be treated as part of the application (《vendoring》) so that the developer can ensure compatibility with newer versions before providing updates to users.

The two recommended use cases for this distribution are described below.

3.8.1 Python Application

An application written in Python does not necessarily require users to be aware of that fact. The embedded distribution may be used in this case to include a private version of Python in an install package. Depending on how transparent it should be (or conversely, how professional it should appear), there are two options.

Using a specialized executable as a launcher requires some coding, but provides the most transparent experience for users. With a customized launcher, there are no obvious indications that the program is running on Python: icons can be customized, company and version information can be specified, and file associations behave properly. In most cases, a custom launcher should simply be able to call `Py_Main` with a hard-coded command line.

The simpler approach is to provide a batch file or generated shortcut that directly calls the `python.exe` or `pythonw.exe` with the required command-line arguments. In this case, the application will appear to be Python and not its actual name, and users may have trouble distinguishing it from other running Python processes or file associations.

With the latter approach, packages should be installed as directories alongside the Python executable to ensure they are available on the path. With the specialized launcher, packages can be located in other locations as there is an opportunity to specify the search path before launching the application.

3.8.2 Embedding Python

Applications written in native code often require some form of scripting language, and the embedded Python distribution can be used for this purpose. In general, the majority of the application is in native code, and some part will either invoke `python.exe` or directly use `python3.dll`. For either case, extracting the embedded distribution to a subdirectory of the application installation is sufficient to provide a loadable Python interpreter.

As with the application use, packages can be installed to any location as there is an opportunity to specify search paths before initializing the interpreter. Otherwise, there is no fundamental differences between using the embedded distribution and a regular installation.

3.9 Other resources

더 보기:

Python Programming On Win32 《Help for Windows Programmers》 by Mark Hammond and Andy Robinson, O'Reilly Media, 2000, ISBN 1-56592-621-8

A Python for Windows Tutorial by Amanda Birmingham, 2004

PEP 397 - Python launcher for Windows The proposal for the launcher to be included in the Python distribution.

CHAPTER 4

Using Python on a Macintosh

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Python on a Macintosh running Mac OS X is in principle very similar to Python on any other Unix platform, but there are a number of additional features such as the IDE and the Package Manager that are worth pointing out.

4.1 Getting and Installing MacPython

Mac OS X 10.8 comes with Python 2.7 pre-installed by Apple. If you wish, you are invited to install the most recent version of Python 3 from the Python website (https://www.python.org). A current 《universal binary》 build of Python, which runs natively on the Mac's new Intel and legacy PPC CPU's, is available there.

What you get after installing is a number of things:

- A `MacPython 3.6` folder in your `Applications` folder. In here you find IDLE, the development environment that is a standard part of official Python distributions; PythonLauncher, which handles double-clicking Python scripts from the Finder; and the 《Build Applet》 tool, which allows you to package Python scripts as standalone applications on your system.
- A framework `/Library/Frameworks/Python.framework`, which includes the Python executable and libraries. The installer adds this location to your shell path. To uninstall MacPython, you can simply remove these three things. A symlink to the Python executable is placed in /usr/local/bin/.

The Apple-provided build of Python is installed in `/System/Library/Frameworks/Python.framework` and `/usr/bin/python`, respectively. You should never modify or delete these, as they are Apple-controlled and are used by Apple- or third-party software. Remember that if you choose to install a newer Python version from python.org, you will have two different but functional Python installations on your computer, so it will be important that your paths and usages are consistent with what you want to do.

IDLE includes a help menu that allows you to access Python documentation. If you are completely new to Python you should start reading the tutorial introduction in that document.

If you are familiar with Python on other Unix platforms you should read the section on running Python scripts from the Unix shell.

4.1.1 How to run a Python script

Your best way to get started with Python on Mac OS X is through the IDLE integrated development environment, see section *The IDE* and use the Help menu when the IDE is running.

If you want to run Python scripts from the Terminal window command line or from the Finder you first need an editor to create your script. Mac OS X comes with a number of standard Unix command line editors, **vim** and **emacs** among them. If you want a more Mac-like editor, **BBEdit** or **TextWrangler** from Bare Bones Software (see http://www.barebones.com/products/bbedit/index.html) are good choices, as is **TextMate** (see https://macromates.com/). Other editors include **Gvim** (http://macvim.org) and **Aquamacs** (http://aquamacs.org/).

To run your script from the Terminal window you must make sure that `/usr/local/bin` is in your shell search path.

To run your script from the Finder you have two options:

- Drag it to **PythonLauncher**
- Select **PythonLauncher** as the default application to open your script (or any .py script) through the finder Info window and double-click it. **PythonLauncher** has various preferences to control how your script is launched. Option-dragging allows you to change these for one invocation, or use its Preferences menu to change things globally.

4.1.2 Running scripts with a GUI

With older versions of Python, there is one Mac OS X quirk that you need to be aware of: programs that talk to the Aqua window manager (in other words, anything that has a GUI) need to be run in a special way. Use **pythonw** instead of **python** to start such scripts.

With Python 3.6, you can use either **python** or **pythonw**.

4.1.3 Configuration

Python on OS X honors all standard Unix environment variables such as *PYTHONPATH*, but setting these variables for programs started from the Finder is non-standard as the Finder does not read your `.profile` or `.cshrc` at startup. You need to create a file `~/.MacOSX/environment.plist`. See Apple's Technical Document QA1067 for details.

For more information on installation Python packages in MacPython, see section *Installing Additional Python Packages*.

4.2 The IDE

MacPython ships with the standard IDLE development environment. A good introduction to using IDLE can be found at https://hkn.eecs.berkeley.edu/~dyoo/python/idle_intro/index.html.

4.3 Installing Additional Python Packages

There are several methods to install additional Python packages:

- Packages can be installed via the standard Python distutils mode (`python setup.py install`).
- Many packages can also be installed via the **setuptools** extension or **pip** wrapper, see https://pip.pypa.io/.

4.4 GUI Programming on the Mac

There are several options for building GUI applications on the Mac with Python.

PyObjC is a Python binding to Apple's Objective-C/Cocoa framework, which is the foundation of most modern Mac development. Information on PyObjC is available from https://pythonhosted.org/pyobjc/.

The standard Python GUI toolkit is `tkinter`, based on the cross-platform Tk toolkit (https://www.tcl.tk). An Aqua-native version of Tk is bundled with OS X by Apple, and the latest version can be downloaded and installed from https://www.activestate.com; it can also be built from source.

wxPython is another popular cross-platform GUI toolkit that runs natively on Mac OS X. Packages and documentation are available from http://www.wxpython.org.

PyQt is another popular cross-platform GUI toolkit that runs natively on Mac OS X. More information can be found at https://riverbankcomputing.com/software/pyqt/intro.

4.5 Distributing Python Applications on the Mac

The《Build Applet》tool that is placed in the MacPython 3.6 folder is fine for packaging small Python scripts on your own machine to run as a standard Mac application. This tool, however, is not robust enough to distribute Python applications to other users.

The standard tool for deploying standalone Python applications on the Mac is **`py2app`**. More information on installing and using py2app can be found at http://undefined.org/python/#py2app.

4.6 Other Resources

The MacPython mailing list is an excellent support resource for Python users and developers on the Mac:

https://www.python.org/community/sigs/current/pythonmac-sig/

Another useful resource is the MacPython wiki:

https://wiki.python.org/moin/MacPython

APPENDIX A

용어집

>>> 대화형 셸의 기본 파이썬 프롬프트. 인터프리터에서 대화형으로 실행될 수 있는 코드 예에서 자주 볼 수 있다.

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

2to3 파이썬 2.x 코드를 파이썬 3.x 코드로 변환하려고 시도하는 도구인데, 소스를 파싱하고 파스 트리를 탐색해서 감지할 수 있는 대부분의 비호환성을 다룬다.

2to3 는 표준 라이브러리에서 `lib2to3` 로 제공된다; 독립적으로 실행할 수 있는 스크립트는 `Tools/scripts/2to3` 로 제공된다. 2to3-reference 를 보세요.

abstract base class (추상 베이스 클래스) 추상 베이스 클래스는 `hasattr()` 같은 다른 테크닉들이 불편하거나 미묘하게 잘못된 (예를 들어, 매직 메서드) 경우, 인터페이스를 정의하는 방법을 제공함으로써 덕 타이핑을 보완한다. ABC는 가상 서브 클래스를 도입하는데, 클래스를 계승하지 않으면서도 `isinstance()` 와 `issubclass()` 에 의해 감지될 수 있는 클래스들이다; `abc` 모듈 도큐멘테이션을 보세요. 파이썬에는 많은 내장 ABC 들이 따라오는데 다음과 같은 것들이 있다: 자료 구조 (`collections.abc` 모듈에서), 숫자 (`numbers` 모듈에서), 스트림 (`io` 모듈에서), 임포트 파인더와 로더 (`importlib.abc` 모듈에서). `abc` 모듈을 사용해서 자신만의 ABC를 만들 수도 있다.

annotation A label associated with a variable, a class attribute or a function parameter or return value, used by convention as a *type hint*.

Annotations of local variables cannot be accessed at runtime, but annotations of global variables, class attributes, and functions are stored in the `__annotations__` special attribute of modules, classes, and functions, respectively.

See *variable annotation*, *function annotation*, **PEP 484** and **PEP 526**, which describe this functionality.

argument (인자) 함수를 호출할 때 함수 (또는 메서드) 로 전달되는 값. 두 종류의 인자가 있다:

- 키워드 인자 *(keyword argument)*: 함수 호출 때 식별자가 앞에 붙은 인자 (예를 들어, `name=`) 또는 `**` 를 앞에 붙인 딕셔너리로 전달되는 인자. 예를 들어, 다음과 같은 `complex()` 호출에서 `3` 과 `5` 는 모두 키워드 인자다:

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

- 위치 인자 *(positional argument)*: 키워드 인자가 아닌 인자. 위치 인자들은 인자 목록의 처음에 나오거나 이터러블 의 앞에 * 를 붙여 전달할 수 있다. 예를 들어, 다음과 같은 호출에서 3 과 5 는 모두 위치 인자다.

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

인자는 함수 바의 이름 붙은 지역 변수에 대입된다. 이 대입에 적용되는 규칙들에 대해서는 calls 섹션을 보세요. 문법적으로, 어떤 표현식이건 인자로 사용될 수 있다; 구해진 값이 지역 변수에 대입된다.

용어집의 파라미터 항목과 FAQ 질문 인자와 파라미터의 차이 와 **PEP 362** 도 보세요.

asynchronous context manager (비동기 컨텍스트 관리자) `__aenter__()` 와 `__aexit__()` 메서드를 정의함으로써 `async with` 문에서 보이는 환경을 제어하는 객체. **PEP 492** 로 도입되었다.

asynchronous generator (비동기 제너레이터) 비동기 제너레이터 이터레이터 를 돌려주는 함수. `async def` 로 정의되는 코루틴 함수처럼 보이는데, `async for` 루프가 사용할 수 있는 일련의 값들을 만드는 `yield` 표현식을 포함한다는 점이 다르다.

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

비동기 제너레이터 함수는 `await` 표현식과, `async for` 문과, `async with` 문을 포함할 수 있다.

asynchronous generator iterator (비동기 제너레이터 이터레이터) 비동기 제너레이터 함수가 만드는 객체.

This is an *asynchronous iterator* which when called using the `__anext__()` method returns an awaitable object which will execute the body of the asynchronous generator function until the next `yield` expression.

Each `yield` temporarily suspends processing, remembering the location execution state (including local variables and pending try-statements). When the *asynchronous generator iterator* effectively resumes with another awaitable returned by `__anext__()`, it picks up where it left off. See **PEP 492** and **PEP 525**.

asynchronous iterable (비동기 이터러블) `async for` 문에서 사용될 수 있는 객체. `__aiter__()` 메서드는 비동기 이터레이터 를 돌려줘야 한다. **PEP 492** 로 도입되었다.

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

attribute (어트리뷰트) 점표현식을 사용하는 이름으로 참조되는 객체와 결합한 값. 예를 들어, 객체 *o* 가 어트리뷰트 *a* 를 가지면, *o.a* 처럼 참조된다.

awaitable (어웨이터블) `await` 표현식에 사용할 수 있는 객체. 코루틴 이나 `__await__()` 메서드를 가진 객체가 될 수 있다. **PEP 492** 를 보세요.

BDFL 자비로운 종신 독재자 (Benevolent Dictator For Life), 즉 Guido van Rossum, 파이썬의 창시자.

binary file (바이너리 파일) 바이트열류 객체들 을 읽고 쓸 수 있는 파일 객체. 바이너리 파일의 예로는 바이너리 모드 (`'rb'`, `'wb'` 또는 `'rb+'`) 로 열린 파일, `sys.stdin.buffer`, `sys.stdout.buffer`, `io.BytesIO` 와 `gzip.GzipFile` 의 인스턴스를 들 수 있다.

`str` 객체를 읽고 쓸 수 있는 파일 객체에 대해서는 텍스트 파일 도 참조하세요.

bytes-like object (바이트열류 객체) bufferobjects 를 지원하고 C-연속 버퍼를 익스포트 할 수 있다. 여러 공통 `memoryview` 객체들은 물론이고 `bytes`, `bytearray`, `array.array` 객체들을 포함한다. 바이트열류 객체들은 바이너리 데이터를 다루는 여러 가지 연산들에 사용될 수 있다; 압축, 바이너리 파일로 저장, 소켓을 통한 전송 같은 것들이 있다.

어떤 연산들은 바이너리 데이터가 가변적일 필요가 있다. 이런 경우에 도큐멘테이션은 종종 《읽고-쓰기 바이트열류 객체》라고 표현한다. 가변 버퍼 객체의 예로는 bytearray 와 bytearray 의 memoryview 가 있다. 다른 연산들은 바이너리 데이터가 불변 객체 (《읽기 전용 바이트열류 객체》) 에 저장되도록 요구한다; 이런 것들의 예로는 bytes 와 bytes 객체의 memoryview 가 있다.

bytecode (바이트 코드) 파이썬 소스 코드는 바이트 코드로 컴파일되는데, CPython 인터프리터에서 파이썬 프로그램의 내부 표현이다. 바이트 코드는 .pyc 파일에 캐시 되어, 같은 파일을 두 번째 실행할 때 더 빨라지게 만든다 (소스에서 바이트 코드로의 재컴파일을 피할 수 있다). 이 《중간 언어》는 각 바이트 코드에 대응하는 기계를 실행하는 가상 기계 에서 실행된다고 말한다. 바이트 코드는 서로 다른 파이썬 가상 기계에서 작동할 것으로 기대하지도, 파이썬 배포 간에 안정적이지도 않다는 것에 주의해야 한다.

바이트 코드 명령어들의 목록은 dis 모듈 도큐멘테이션에 나온다.

class (클래스) 사용자 정의 객체들을 만들기 위한 주형. 클래스 정의는 보통 클래스의 인스턴스를 대상으로 연산하는 메서드 정의들을 포함한다.

class variable A variable defined in a class and intended to be modified only at class level (i.e., not in an instance of the class).

coercion (코어션) 같은 형의 두 인자를 수반하는 연산이 일어나는 동안, 한 형의 인스턴스를 다른 형으로 묵시적으로 변환하는 것. 예를 들어, int(3.15) 는 실수를 정수 3 으로 변환한다. 하지만, 3+4.5 에서, 각 인자는 다른 형이고 (하나는 int, 다른 하나는 float), 둘을 더하기 전에 같은 형으로 변환해야 한다. 그렇지 않으면 TypeError 를 일으킨다. 코어션 없이는, 호환되는 형들조차도 프로그래머가 같은 형으로 정규화해주어야 한다, 예를 들어, 그냥 3+4.5 하는 대신 float(3)+4.5.

complex number (복소수) 익숙한 실수 시스템의 확장인데, 모든 숫자가 실수부와 허수부의 합으로 표현된다. 허수부는 실수에 허수 단위 (-1 의 제곱근)를 곱한 것인데, 종종 수학에서는 i 로, 공학에서는 j 로 표기한다. 파이썬은 후자의 표기법을 쓰는 복소수를 기본 지원한다; 허수부는 j 접미사를 붙여서 표기한다, 예를 들어, 3+1j. math 모듈의 복소수 버전이 필요하면, cmath 를 사용한다. 복소수의 활용은 꽤 수준 높은 수학적 기능이다. 필요하다고 느끼지 못한다면, 거의 확실히 무시해도 좋다.

context manager (컨텍스트 관리자) __enter__() 와 __exit__() 메서드를 정의함으로써 with 문에서 보이는 환경을 제어하는 객체. **PEP 343** 로 도입되었다.

contiguous (연속) 버퍼는 정확히 *C-연속 (C-contiguous)* 이거나 포트란 연속 *(Fortran contiguous)* 일 때 연속이라고 여겨진다. 영차원 버퍼는 C-연속이면서 포트란 연속이다. 일차원 배열에서, 항목들은 서로에 인접하고, 0 에서 시작하는 오름차순 인덱스의 순서대로 메모리에 배치되어야 한다. 다차원 C-연속 배열에서, 메모리 주소의 순서대로 항목들을 방문할 때 마지막 인덱스가 가장 빨리 변한다. 하지만, 포트란 연속 배열에서는, 첫 번째 인덱스가 가장 빨리 변한다.

coroutine (코루틴) 코루틴은 서브루틴의 더 일반화된 형태다. 서브루틴은 한 지점에서 진입하고 다른 지점에서 탈출한다. 코루틴은 여러 다른 지점에서 진입하고, 탈출하고, 재개할 수 있다. 이것들은 async def 문으로 구현할 수 있다. **PEP 492** 를 보세요.

coroutine function (코루틴 함수) 코루틴 객체를 돌려주는 함수. 코루틴 함수는 async def 문으로 정의될 수 있고, await 와 async for 와 async with 키워드를 포함할 수 있다. 이것들은 **PEP 492** 에 의해 도입되었다.

CPython 파이썬 프로그래밍 언어의 규범적인 구현인데, python.org 에서 배포된다. 이 구현을 Jython 이나 IronPython 과 같은 다른 것들과 구별할 필요가 있을 때 용어《CPython》이 사용된다.

decorator (데코레이터) 다른 함수를 돌려주는 함수인데, 보통 @wrapper 문법을 사용한 함수 변환으로 적용된다. 데코레이터의 흔한 예는 classmethod() 과 staticmethod() 다.

데코레이터 문법은 단지 편의 문법일 뿐이다. 다음 두 함수 정의는 의미상으로 동등하다:

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

(다음 페이지에 계속)

(이전 페이지에서 계속)

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

같은 개념이 클래스에도 존재하지만, 덜 자주 쓰인다. 데코레이터에 대한 더 자세한 내용은 함수 정의 와 클래스 정의 의 도큐멘테이션을 보면 된다.

descriptor (디스크립터) 메서드 `__get__()` 이나 `__set__()` 이나 `__delete__()` 를 정의하는 객체. 클래스 어트리뷰트가 디스크립터일 때, 어트리뷰트 조회는 특별한 연결 작용을 일으킨다. 보통, *a.b* 를 읽거나, 쓰거나, 삭제하는데 사용할 때, *a* 의 클래스 딕셔너리에서 *b* 라고 이름 붙여진 객체를 찾는다. 하지만 *b* 가 디스크립터면, 해당하는 디스크립터 메서드가 호출된다. 디스크립터를 이해하는 것은 파이썬에 대한 깊은 이해의 열쇠인데, 함수, 메서드, 프라퍼티, 클래스 메서드, 스태틱 메서드, 슈퍼클래스 참조 등의 많은 기능의 기초를 이루고 있기 때문이다.

디스크립터의 메서드들에 대한 자세한 내용은 descriptors 에 나온다.

dictionary (딕셔너리) 임의의 키를 값에 대응시키는 연관 배열 (associative array). 키는 `__hash__()` 와 `__eq__()` 메서드를 갖는 모든 객체가 될 수 있다. 펄에서 해시라고 부른다.

dictionary view (딕셔너리 뷰) `dict.keys()`, `dict.values()`, `dict.items()` 메서드가 돌려주는 객체들을 딕셔너리 뷰라고 부른다. 이것들은 딕셔너리 항목들에 대한 동적인 뷰를 제공하는데, 딕셔너리가 변경될 때, 뷰가 이 변화를 반영한다는 뜻이다. 딕셔너리 뷰를 완전한 리스트로 바꾸려면 `list(dictview)` 를 사용하면 된다. dict-views 를 보세요.

docstring (독스트링) 클래스, 함수, 모듈에서 첫 번째 표현식으로 나타나는 문자열 리터럴. 스위트가 실행될 때는 무시되지만, 컴파일러에 의해 인지되어 둘러싼 클래스, 함수, 모듈의 `__doc__` 어트리뷰트로 삽입된다. 인트로스팩션을 통해 사용할 수 있으므로, 객체의 도큐멘테이션을 위한 규범적인 장소다.

duck-typing (덕 타이핑) 올바른 인터페이스를 가졌는지 판단하는데 객체의 형을 보지 않는 프로그래밍 스타일; 대신, 단순히 메서드나 어트리뷰트가 호출되거나 사용된다 (《오리처럼 보이고 오리처럼 꽥꽥댄다면, 그것은 오리다.》) 특정한 형 대신에 인터페이스를 강조함으로써, 잘 설계된 코드는 다형적인 치환을 허락함으로써 유연성을 개선할 수 있다. 덕 타이핑은 `type()` 이나 `isinstance()` 을 사용한 검사를 피한다. (하지만, 덕 타이핑이 추상 베이스 클래스 로 보완될 수 있음에 유의해야 한다.) 대신에, `hasattr()` 검사나 *EAFP* 프로그래밍을 쓴다.

EAFP 허락보다는 용서를 구하기가 쉽다 (Easier to ask for forgiveness than permission). 이 흔히 볼 수 있는 파이썬 코딩 스타일은, 올바른 키나 어트리뷰트의 존재를 가정하고, 그 가정이 틀리면 예외를 잡는다. 이 깔끔하고 빠른 스타일은 많은 `try` 와 `except` 문의 존재로 특징지어진다. 이 테크닉은 C와 같은 다른 많은 언어에서 자주 사용되는 *LBYL* 스타일과 대비된다.

expression (표현식) 어떤 값으로 구해질 수 있는 문법적인 조각. 다른 말로 표현하면, 표현식은 리터럴, 이름, 어트리뷰트 액세스, 연산자, 함수들과 같은 값을 돌려주는 표현 요소들을 쌓아 올린 것이다. 다른 많은 언어와 대조적으로, 모든 언어 구성물들이 표현식인 것은 아니다. `if` 처럼, 표현식으로 사용할 수 없는 문장 들이 있다. 대입 또한 문장이고, 표현식이 아니다.

extension module (확장 모듈) C 나 C++ 로 작성된 모듈인데, 파이썬의 C API를 사용해서 핵심이나 사용자 코드와 상호 작용한다.

f-string (f-문자열) `'f'` 나 `'F'` 를 앞에 붙인 문자열 리터럴들을 흔히 《f-문자열》이라고 부르는데, 포맷 문자열 리터럴 의 줄임말이다. **PEP 498** 을 보세요.

file object (파일 객체) 하부 자원에 대해 파일 지향적 API (`read()` 나 `write()` 같은 메서드들) 를 드러내는 객체. 만들어진 방법에 따라, 파일 객체는 실제 디스크 상의 파일이나 다른 저장장치나 통신 장치 (예를 들어, 표준 입출력, 인-메모리 버퍼, 소켓, 파이프, 등등) 에 대한 액세스를 중계할 수 있다. 파일 객체는 파일류 객체 *(file-like objects)* 나 스트림 *(streams)* 이라고도 불린다.

실제로는 세 부류의 파일 객체들이 있다. 날(raw) 바이너리 파일, 버퍼드(buffered) 바이너리 파일, 텍스트 파일. 이들의 인터페이스는 `io` 모듈에서 정의된다. 파일 객체를 만드는 규범적인 방법은 `open()` 함수를 쓰는 것이다.

file-like object (파일류 객체) 파일 객체 의 비슷한 말.

finder (파인더) 임포트될 모듈을 위한 로더 를 찾으려고 시도하는 객체.

파이썬 3.3. 이후로, 두 종류의 파인더가 있다: `sys.meta_path` 와 함께 사용하는 메타 경로 파인더 와 `sys.path_hooks` 과 함께 사용하는 경로 엔트리 파인더.

더 자세한 내용은 **PEP 302**, **PEP 420**, **PEP 451** 에 나온다.

floor division (정수 나눗셈) 가장 가까운 정수로 내림하는 수학적 나눗셈. 정수 나눗셈 연산자는 `//` 다. 예를 들어, 표현식 `11 // 4` 의 값은 `2` 가 되지만, 실수 나눗셈은 `2.75` 를 돌려준다. `(-11) // 4` 가 `-2.75` 를 내림 한 `-3` 이 됨에 유의해야 한다. **PEP 238** 를 보세요.

function (함수) 호출자에게 어떤 값을 돌려주는 일련의 문장들. 없거나 그 이상의 인자 가 전달될 수 있는데, 바디의 실행에 사용될 수 있다. 파라미터 와 메서드 와 function 섹션도 보세요.

function annotation (함수 어노테이션) An *annotation* of a function parameter or return value.

Function annotations are usually used for *type hints*: for example, this function is expected to take two `int` arguments and is also expected to have an `int` return value:

```
def sum_two_numbers(a: int, b: int) -> int:
   return a + b
```

Function annotation syntax is explained in section function.

See *variable annotation* and **PEP 484**, which describe this functionality.

__future__ 프로그래머가 현재 인터프리터와 호환되지 않는 새 언어 기능들을 활성화할 수 있도록 하는 가상 모듈.

`__future__` 모듈을 임포트하고 그 변수들의 값들을 구해서, 새 기능이 언제 처음으로 언어에 추가되었고, 언제부터 그것이 기본이 되는지 볼 수 있다:

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

garbage collection (가비지 수거) 더 사용되지 않는 메모리를 반납하는 절차. 파이썬은 참조 횟수 추적과 참조 순환을 감지하고 끊을 수 있는 순환 가비지 수거기를 통해 가비지 수거를 수행한다. 가비지 수거기는 `gc` 모듈을 사용해서 제어할 수 있다.

generator (제너레이터) 제너레이터 이터레이터 를 돌려주는 함수. 일반 함수처럼 보이는데, 일련의 값들을 만드는 `yield` 표현식을 포함한다는 점이 다르다. 이 값들은 for-루프로 사용하거나 `next()` 함수로 한 번에 하나씩 꺼낼 수 있다.

보통 제너레이터 함수를 가리키지만, 어떤 문맥에서는 제너레이터 이터레이터 를 가리킨다. 의도하는 의미가 명확하지 않은 경우는, 완전한 용어를 써서 모호함을 없앤다.

generator iterator (제너레이터 이터레이터) 제너레이터 함수가 만드는 객체.

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 (제너레이터 표현식) 이터레이터를 돌려주는 표현식. 루프 변수와 범위를 정의하는 `for` 표현식과 생략 가능한 `if` 표현식이 뒤에 붙는 일반 표현식 처럼 보인다. 결합한 표현식은 둘러싼 함수를 위한 값들을 만들어낸다:

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

generic function (제네릭 함수) 같은 연산을 서로 다른 형들에 대해 구현한 여러 함수로 구성된 함수. 호출 때 어떤 구현이 사용될지는 디스패치 알고리즘에 의해 결정된다.

싱글 디스패치 용어집 항목과 `functools.singledispatch()` 데코레이터와 **PEP 443** 도 보세요.

GIL 전역 인터프리터 록 을 보세요.

global interpreter lock (전역 인터프리터 록) 한 번에 오직 하나의 스레드가 파이썬 바이트 코드 를 실행하도록 보장하기 위해 *CPython* 인터프리터가 사용하는 메커니즘. (`dict` 와 같은 중요한 내장형들을 포함하는) 객체 모델이 묵시적으로 동시 액세스에 대해 안전하도록 만들어서 CPython 구현을 단순하게 만든다. 인터프리터 전체를 로킹하는 것은 인터프리터를 다중스레드화하기 쉽게 만드는 대신, 다중 프로세서 기계가 제공하는 병렬성의 많은 부분을 희생한다.

하지만, 어떤 확장 모듈들은, 표준이나 제삼자 모두, 압축이나 해싱 같은 계산 집약적인 작업을 수행할 때는 GIL 을 반납하도록 설계되었다. 또한, I/O를 할 때는 항상 GIL 을 반납한다.

(훨씬 더 미세하게 공유 데이터를 로킹하는) 《스레드에 자유로운(free-threaded)》 인터프리터를 만들고자 하는 과거의 노력은 성공적이지 못했는데, 흔한 단일 프로세서 경우의 성능 저하가 심하기 때문이다. 이 성능 이슈를 극복하는 것은 구현을 훨씬 복잡하게 만들어서 유지 비용이 더 들어갈 것으로 여겨지고 있다.

hashable (해시 가능) 객체가 일생 그 값이 변하지 않는 해시값을 갖고 (`__hash__()` 메서드가 필요하다), 다른 객체와 비교될 수 있으면 (`__eq__()` 메서드가 필요하다), 해시 가능 하다고 한다. 같다고 비교되는 해시 가능한 객체들의 해시값은 같아야 한다.

해시 가능성은 객체를 딕셔너리의 키나 집합의 멤버로 사용할 수 있게 하는데, 이 자료 구조들이 내부적으로 해시값을 사용하기 때문이다.

모든 파이썬의 불변 내장 객체들은 해시 가능하다. (리스트나 딕셔너리 같은) 가변 컨테이너들은 그렇지 않다. 사용자 정의 클래스의 인스턴스 객체들은 기본적으로 해시 가능하다. (자기 자신을 제외하고는) 모두 다르다고 비교되고, 해시값은 `id()` 로 부터 만들어진다.

IDLE 파이썬을 위한 통합 개발 환경 (Integrated Development Environment). IDLE은 파이썬의 표준 배포판에 따라오는 기초적인 편집기와 인터프리터 환경이다.

immutable (불변) 고정된 값을 갖는 객체. 불변 객체는 숫자, 문자열, 튜플을 포함한다. 이런 객체들은 변경될 수 없다. 새 값을 저장하려면 새 객체를 만들어야 한다. 변하지 않는 해시값이 있어야 하는 곳에서 중요한 역할을 한다, 예를 들어, 딕셔너리의 키.

import path (임포트 경로) 경로 기반 파인더 가 임포트할 모듈을 찾기 위해 검색하는 장소들 (또는 경로 엔트리) 의 목록. 임포트하는 동안, 이 장소들의 목록은 보통 `sys.path` 로부터 온다, 하지만 서브 패키지의 경우 부모 패키지의 `__path__` 어트리뷰트로부터 올 수도 있다.

importing (임포팅) 한 모듈의 파이썬 코드가 다른 모듈의 파이썬 코드에서 사용될 수 있도록 하는 절차.

importer (임포터) 모듈을 찾기도 하고 로드 하기도 하는 객체; 동시에 파인더 이자 로더 객체다.

interactive (대화형) 파이썬은 대화형 인터프리터를 갖고 있는데, 인터프리터 프롬프트에서 문장과 표현식을 입력할 수 있고, 즉각 실행된 결과를 볼 수 있다는 뜻이다. 인자 없이 단지 `python` 을 실행하라 (컴퓨터의 주메뉴에서 선택하는 것도 가능할 수 있다). 새 아이디어를 검사하거나 모듈과 패키지를 들여다보는 매우 강력한 방법이다 (`help(x)` 를 기억하세요).

interpreted (인터프리티드) 바이트 코드 컴파일러의 존재 때문에 그 구분이 흐릿해지기는 하지만, 파이썬은 컴파일 언어가 아니라 인터프리터 언어다. 이것은 명시적으로 실행 파일을 만들지 않고도, 소스 파일을 직접 실행할 수 있다는 뜻이다. 그 프로그램이 좀 더 천천히 실행되기는 하지만, 인터프리터 언어는 보통 컴파일 언어보다 짧은 개발/디버깅 주기를 갖는다. 대화형 도 보세요.

interpreter shutdown (인터프리터 종료) 종료하라는 요청을 받을 때, 파이썬 인터프리터는 특별한 시기에 진입하는데, 모듈이나 여러 가지 중요한 내부 구조들과 같은 모든 할당된 자원들을 단계적으로 반납한다. 또한, 가비지 수거기 를 여러 번 호출한다. 사용자 정의 파괴자나 weakref 콜백에 있는 코드들의 실행을 시작시킬 수 있다. 종료 시기 동안 실행되는 코드는 다양한 예외들을 만날 수 있는데, 그것이 의존하는 자원들이 더 기능하지 않을 수 있기 때문이다 (흔한 예는 라이브러리 모듈이나 경고 장치들이다).

인터프리터 종료의 주된 원인은 실행되는 __main__ 모듈이나 스크립트가 실행을 끝내는 것이다.

iterable (이터러블) 멤버들을 한 번에 하나씩 돌려줄 수 있는 객체. 이터러블의 예로는 모든 (list, str, tuple 같은) 시퀀스 형들, dict 같은 몇몇 비시퀀스 형들, 파일 객체들, __iter__() 나 시퀀스 개념을 구현하는 __getitem__() 메서드를 써서 정의한 모든 클래스의 객체들이 있다.

이터러블은 for 루프에 사용될 수 있고, 시퀀스를 필요로 하는 다른 많은 곳 (zip(), map(), …) 에 사용될 수 있다. 이터러블 객체가 내장 함수 iter() 에 인자로 전달되면, 그 객체의 이터레이터를 돌려준다. 이 이터레이터는 값들의 집합을 한 번 거치는 동안 유효하다. 이터러블을 사용할 때, 보통은 iter() 를 호출하거나, 이터레이터 객체를 직접 다룰 필요는 없다. for 문은 이것들을 여러분을 대신해서 자동으로 해주는데, 루프를 도는 동안 이터레이터를 잡아둘 이름 없는 변수를 만든다. 이터레이터, 시퀀스, 제너레이터 도 보세요.

iterator (이터레이터) 데이터의 스트림을 표현하는 객체. 이터레이터의 __next__() 메서드를 반복적으로 호출하면 (또는 내장 함수 next() 로 전달하면) 스트림에 있는 항목들을 차례대로 돌려준다. 더 이상의 데이터가 없을 때는 대신 StopIteration 예외를 일으킨다. 이 지점에서, 이터레이터 객체는 소진되고, 이후의 모든 __next__() 메서드 호출은 StopIteration 예외를 다시 일으키기만 한다. 이터레이터는 이터레이터 객체 자신을 돌려주는 __iter__() 메서드를 가질 것이 요구되기 때문에, 이터레이터는 이터러블이기도 하고 다른 이터러블들을 받아들이는 대부분의 곳에서 사용될 수 있다. 중요한 예외는 여러 번의 이터레이션을 시도하는 코드다. (list 같은) 컨테이너 객체는 iter() 함수로 전달하거나 for 루프에 사용할 때마다 새 이터레이터를 만든다. 이런 것을 이터레이터에 대해서 수행하려고 하면, 지난 이터레이션에 사용된 이미 소진된 이터레이터를 돌려줘서, 빈 컨테이너처럼 보이게 만든다.

typeiter 에 더 자세한 내용이 있다.

key function (키 함수) 키 함수 또는 콜레이션 (collation) 함수는 정렬 (sorting) 이나 배열 (ordering) 에 사용되는 값을 돌려주는 콜러블이다. 예를 들어, locale.strxfrm() 은 로케일 특정 방식을 따르는 정렬 키를 만드는 데 사용된다.

파이썬의 많은 도구가 요소들이 어떻게 순서 지어지고 묶이는지를 제어하기 위해 키 함수를 받아들인다. 이런 것들에는 min(), max(), sorted(), list.sort(), heapq.merge(), heapq.nsmallest(), heapq.nlargest(), itertools.groupby() 이 있다.

키 함수를 만드는 데는 여러 방법이 있다. 예를 들어, str.lower() 메서드는 케이스 구분 없는 정렬을 위한 키 함수로 사용될 수 있다. 대안적으로, 키 함수는 lambda 표현식으로 만들 수도 있는데, 이런 식이다: lambda r: (r[0], r[2]). 또한, operator 모듈은 세 개의 키 함수 생성자를 제공한다: attrgetter(), itemgetter(), methodcaller(). 키 함수를 만들고 사용하는 법에 대한 예로 Sorting HOW TO 를 보세요.

keyword argument (키워드 인자) 인자 를 보세요.

lambda (람다) 호출될 때 값이 구해지는 하나의 표현식 으로 구성된 이름 없는 인라인 함수. 람다 함수를 만드는 문법은 lambda [parameters]: expression 이다.

LBYL 뛰기 전에 보라 (Look before you leap). 이 코딩 스타일은 호출이나 조회를 하기 전에 명시적으로 사전 조건들을 검사한다. 이 스타일은 *EAFP* 접근법과 대비되고, 많은 if 문의 존재로 특징지어진다.

다중 스레드 환경에서, LBYL 접근법은 《보기》와 《뛰기》 간에 경쟁 조건을 만들게 될 위험이 있다. 예를 들어, 코드 if key in mapping: return mapping[key] 는 검사 후에, 하지만 조회 전에, 다른 스레드가 *key* 를 *mapping* 에서 제거하면 실패할 수 있다. 이런 이슈는 록이나 EAFP 접근법을 사용함으로써 해결될 수 있다.

list (리스트) 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 is O(1).

list comprehension (리스트 컴프리헨션) 시퀀스의 요소들 전부 또는 일부를 처리하고 그 결과를 리스트로 돌려주는 간결한 방법. result = ['{:#04x}'.format(x) for x in range(256) if x % 2 == 0] 는 0에서 255 사이에 있는 짝수들의 16진수 (0x..) 들을 포함하는 문자열의 리스트를 만든다. if 절은 생략할 수 있다. 생략하면, range(256) 에 있는 모든 요소가 처리된다.

loader (로더) 모듈을 로드하는 객체. `load_module()` 이라는 이름의 메서드를 정의해야 한다. 로더는 보통 파인더 가 돌려준다. 자세한 내용은 **PEP 302** 를, 추상 베이스 클래스 는 `importlib.abc.Loader` 를 보세요.

mapping (매핑) 임의의 키 조회를 지원하고 `Mapping` 이나 `MutableMapping` 추상 베이스 클래스 에 지정된 메서드들을 구현하는 컨테이너 객체. 예로는 `dict`, `collections.defaultdict`, `collections.OrderedDict`, `collections.Counter` 를 들 수 있다.

meta path finder (메타 경로 파인더) `sys.meta_path` 의 검색이 돌려주는 파인더. 메타 경로 파인더는 경로 엔트리 파인더 와 관련되어 있기는 하지만 다르다.

메타 경로 파인더가 구현하는 메서드들에 대해서는 `importlib.abc.MetaPathFinder` 를 보면 된다.

metaclass (메타 클래스) 클래스의 클래스. 클래스 정의는 클래스 이름, 클래스 딕셔너리, 베이스 클래스들의 목록을 만든다. 메타 클래스는 이 세 인자를 받아서 클래스를 만드는 책임을 진다. 대부분의 객체 지향형 프로그래밍 언어들은 기본 구현을 제공한다. 파이썬을 특별하게 만드는 것은 커스텀 메타 클래스를 만들 수 있다는 것이다. 대부분 사용자에게는 이 도구가 전혀 필요 없지만, 필요가 생길 때, 메타 클래스는 강력하고 우아한 해법을 제공한다. 어트리뷰트 액세스의 로깅(logging), 스레드 안전성의 추가, 객체 생성 추적, 싱글톤 구현과 많은 다른 작업에 사용됐다.

metaclasses 에서 더 자세한 내용을 찾을 수 있다.

method (메서드) 클래스 바디 안에서 정의되는 함수. 그 클래스의 인스턴스의 어트리뷰트로서 호출되면, 그 메서드는 첫 번째 인자 (보통 `self` 라고 불린다) 로 인스턴스 객체를 받는다. 함수 와 중첩된 스코프 를 보세요.

method resolution order (메서드 결정 순서) 메서드 결정 순서는 조회하는 동안 멤버를 검색하는 베이스 클래스들의 순서다. 2.3 릴리스부터 파이썬 인터프리터에 사용된 알고리즘의 상세한 내용은 The Python 2.3 Method Resolution Order 를 보면 된다.

module (모듈) 파이썬 코드의 조직화 단위를 담당하는 객체. 모듈은 임의의 파이썬 객체들을 담는 이름 공간을 갖는다. 모듈은 임포팅 절차에 의해 파이썬으로 로드된다.

패키지 도 보세요.

module spec (모듈 스펙) 모듈을 로드하는데 사용되는 임포트 관련 정보들을 담고 있는 이름 공간. `importlib.machinery.ModuleSpec` 의 인스턴스.

MRO 메서드 결정 순서 를 보세요.

mutable (가변) 가변 객체는 값이 변할 수 있지만 `id()` 는 일정하게 유지한다. 불변 도 보세요.

named tuple (네임드 튜플) 인덱싱할 수 있는 요소들을 이름 붙은 어트리뷰트로도 액세스할 수 있는 모든 튜플류 클래스 (예를 들어, `time.localtime()` 은 *year* 가 `t[0]` 처럼 인덱스로도, `t.tm_year` 처럼 어트리뷰트로도 액세스할 수 있는 튜플류 객체를 돌려준다.)

네임드 튜플은 `time.struct_time` 같은 내장형일 수도, 일반 클래스 정의로 만들 수도 있다. 모든 기능이 구현된 네임드 튜플을 팩토리 함수 `collections.namedtuple()` 로도 만들 수 있다. 마지막 접근법은 `Employee(name='jones', title='programmer')` 와 같은 스스로 문서로 만드는 repr 과 같은 확장 기능도 자동 제공한다.

namespace (이름 공간) 변수가 저장되는 장소. 이름 공간은 딕셔너리로 구현된다. 객체에 중첩된 이름 공간 (메서드 에서) 뿐만 아니라 지역, 전역, 내장 이름 공간이 있다. 이름 공간은 이름 충돌을 방지해서 모듈성을 지원한다. 예를 들어, 함수 `builtins.open` 과 `os.open()` 은 그들의 이름 공간에 의해 구별된다. 또한, 이름 공간은 어떤 모듈이 함수를 구현하는지를 분명하게 만들어서 가독성과 유지 보수성에 도움을 준다. 예를 들어, `random.seed()` 또는 `itertools.islice()` 라고 쓰면 그 함수들이 각각 `random` 과 `itertools` 모듈에 의해 구현되었음이 명확해진다.

namespace package (이름 공간 패키지) 오직 서브 패키지들의 컨테이너로만 기능하는 **PEP 420** 패키지. 이름 공간 패키지는 물리적인 실체가 없을 수도 있고, 특히 `__init__.py` 파일이 없으므로 정규 패키지 와는 다르다.

모듈 도 보세요.

nested scope (중첩된 스코프) 둘러싼 정의에서 변수를 참조하는 능력. 예를 들어, 다른 함수 내부에서 정의된 함수는 바깥 함수에 있는 변수들을 참조할 수 있다. 중첩된 스코프는 기본적으로는 참조만 가능할 뿐, 대입은 되지 않는다는 것에 주의해야 한다. 지역 변수들은 가장 내부의 스코프에서 읽고 쓴다. 마찬가지로, 전역 변수들은 전역 이름 공간에서 읽고 쓴다. `nonlocal` 은 바깥 스코프에 쓰는 것을 허락한다.

new-style class (뉴스타일 클래스) 지금은 모든 클래스 객체에 사용되고 있는 클래스 버전의 예전 이름. 초기의 파이썬 버전에서는, 오직 뉴스타일 클래스만 `__slots__`, 디스크립터, 프라퍼티, `__getattribute__()`, 클래스 메서드, 스태틱 메서드와 같은 파이썬의 새롭고 다양한 기능들을 사용할 수 있었다.

object (객체) 상태 (어트리뷰트나 값) 를 갖고 동작 (메서드) 이 정의된 모든 데이터. 또한, 모든 뉴스타일 클래스의 최종적인 베이스 클래스다.

package (패키지) 서브 모듈들이나, 재귀적으로 서브 패키지들을 포함할 수 있는 파이썬 모듈. 기술적으로, 패키지는 `__path__` 어트리뷰트가 있는 파이썬 모듈이다.

정규 패키지 와 이름 공간 패키지 도 보세요.

parameter (파라미터) 함수 (또는 메서드) 정의에서 함수가 받을 수 있는 인자 (또는 어떤 경우 인자들) 를 지정하는 이름 붙은 엔티티. 다섯 종류의 파라미터가 있다:

- 위치-키워드 *(positional-or-keyword)*: 위치 인자 나 키워드 인자 로 전달될 수 있는 인자를 지정한다. 이것이 기본 형태의 파라미터다, 예를 들어 다음에서 *foo* 와 *bar*:

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

- 위치-전용 *(positional-only)*: 위치로만 제공될 수 있는 인자를 지정한다. 파이썬은 위치-전용 파라미터를 정의하는 문법을 갖고 있지 않다. 하지만, 어떤 매장 함수들은 위치-전용 파라미터를 갖는다 (예를 들어, `abs()`).

- 키워드-전용 *(keyword-only)*: 키워드로만 제공될 수 있는 인자를 지정한다. 키워드-전용 파라미터는 함수 정의의 파라미터 목록에서 앞에 하나의 가변-위치 파라미터나 `*` 를 그대로 포함해서 정의할 수 있다. 예를 들어, 다음에서 *kw_only1* 와 *kw_only2*:

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

- 가변-위치 *(var-positional)*: (다른 파라미터들에 의해서 이미 받아들여진 위치 인자들에 더해) 제공될 수 있는 위치 인자들의 임의의 시퀀스를 지정한다. 이런 파라미터는 파라미터 이름에 `*` 를 앞에 붙여서 정의될 수 있다, 예를 들어 다음에서 *args*:

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

- 가변-키워드 *(var-keyword)*: (다른 파라미터들에 의해서 이미 받아들여진 키워드 인자들에 더해) 제공될 수 있는 임의의 개수 키워드 인자들을 지정한다. 이런 파라미터는 파라미터 이름에 `**` 를 앞에 붙여서 정의될 수 있다, 예를 들어 위의 예 에서 *kwargs*.

파라미터는 선택적 인자들을 위한 기본값뿐만 아니라 선택적이거나 필수 인자들을 지정할 수 있다.

인자 용어집 항목, 인자와 파라미터의 차이 에 나오는 FAQ 질문, `inspect.Parameter` 클래스, function 섹션, **PEP 362** 도 보세요.

path entry (경로 엔트리) 경로 기반 파인더 가 임포트할 모듈들을 찾기 위해 참고하는 임포트 경로 상의 하나의 장소.

path entry finder (경로 엔트리 파인더) `sys.path_hooks` 에 있는 콜러블 (즉, 경로 엔트리 훅) 이 돌려주는 파인더 인데, 주어진 경로 엔트리 로 모듈을 찾는 방법을 알고 있다.

경로 엔트리 파인더들이 구현하는 메서드들은 `importlib.abc.PathEntryFinder` 에 나온다.

path entry hook (경로 엔트리 훅) `sys.path_hook` 리스트에 있는 콜러블인데, 특정 경로 엔트리 에서 모듈을 찾는 법을 알고 있다면 경로 엔트리 파인더 를 돌려준다.

path based finder (경로 기반 파인더) 기본 메타 경로 파인더들 중 하나인데, 임포트 경로 에서 모듈을 찾는다.

path-like object (경로류 객체) 파일 시스템 경로를 나타내는 객체. 경로류 객체는 경로를 나타내는 `str` 나 `bytes` 객체이거나 `os.PathLike` 프로토콜을 구현하는 객체다. `os.PathLike` 프로토콜을 지원하는 객체는 `os.fspath()` 함수를 호출해서 `str` 나 `bytes` 파일 시스템 경로로 변환될 수 있다; 대신 `os.fsdecode()` 와 `os.fsencode()` 는 각각 `str` 나 `bytes` 결과를 보장하는데 사용될 수 있다. **PEP 519** 로 도입되었다.

PEP 파이썬 개선 제안. PEP는 파이썬 커뮤니티에 정보를 제공하거나 파이썬 또는 그 프로세스 또는 환경에 대한 새로운 기능을 설명하는 설계 문서다. PEP는 제안된 기능에 대한 간결한 기술 사양 및 근거를 제공해야 한다.

PEP는 주요 새로운 기능을 제안하고 문제에 대한 커뮤니티 입력을 수집하며 파이썬에 들어간 설계 결정을 문서로 만들기 위한 기본 메커니즘이다. PEP 작성자는 커뮤니티 내에서 합의를 구축하고 반대 의견을 문서화 할 책임이 있다.

PEP 1 참조하세요.

portion (포션) **PEP 420** 에서 정의한 것처럼, 이름 공간 패키지에 이바지하는 하나의 디렉터리에 들어있는 파일들의 집합 (zip 파일에 저장되는 것도 가능하다).

positional argument (위치 인자) 인자 를 보세요.

provisional API (잠정 API) 잠정 API는 표준 라이브러리의 과거 호환성 보장으로부터 신중히 제외된 것이다. 인터페이스의 큰 변화가 예상되지는 않지만, 잠정적이라고 표시되는 한, 코어 개발자들이 필요하다고 생각한다면 과거 호환성이 유지되지 않는 변경이 일어날 수 있다. 그런 변경은 불필요한 방식으로 일어나지는 않을 것이다 — API를 포함하기 전에 놓친 중대하고 근본적인 결함이 발견된 경우에만 일어날 것이다.

잠정 API에서조차도, 과거 호환성이 유지되지 않는 변경은《최후의 수단》으로 여겨진다 - 모든 식별된 문제들에 대해 과거 호환성을 유지하는 해법을 찾으려는 모든 시도가 선행된다.

이 절차는 표준 라이브러리가 오랜 시간 동안 잘못된 설계 오류에 발목 잡히지 않고 발전할 수 있도록 만든다. 더 자세한 내용은 **PEP 411** 를 보면 된다.

provisional package (잠정 패키지) 잠정 *API* 를 보세요.

Python 3000 (파이썬 3000) 파이썬 3.x 배포 라인의 별명 (버전 3의 배포가 먼 미래의 이야기던 시절에 만들어진 이름이다.) 이것을《Py3k》로 줄여 쓰기도 한다.

Pythonic (파이썬다운) 다른 언어들에서 일반적인 개념들을 사용해서 코드를 구현하는 대신, 파이썬 언어에서 가장 자주 사용되는 이디엄들을 가까이 따르는 아이디어나 코드 조작. 예를 들어, 파이썬에서 자주 쓰는 이디엄은 `for` 문을 사용해서 이터러블의 모든 요소로 루핑하는 것이다. 다른 많은 언어에는 이런 종류의 구성물이 없으므로, 파이썬에 익숙하지 않은 사람들은 대신에 숫자 카운터를 사용하기도 한다:

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

더 깔끔한, 파이썬다운 방법은 이렇다:

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

qualified name (정규화된 이름) 모듈의 전역 스코프에서 모듈에 정의된 클래스, 함수, 메서드에 이르는《경로》를 보여주는 점으로 구분된 이름. **PEP 3155** 에서 정의된다. 최상위 함수와 클래스의 경우에, 정규화된 이름은 객체의 이름과 같다:

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

모듈을 가리키는데 사용될 때, 완전히 정규화된 이름 (*fully qualified name*) 은 모든 부모 패키지들을 포함해서 모듈로 가는 점으로 분리된 이름을 의미한다, 예를 들어, `email.mime.text`:

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

reference count (참조 횟수) 객체에 대한 참조의 개수. 객체의 참조 횟수가 0으로 떨어지면, 메모리가 반납된다. 참조 횟수 추적은 일반적으로 파이썬 코드에 노출되지는 않지만, *CPython* 구현의 핵심 요소다. `sys` 모듈은 특정 객체의 참조 횟수를 돌려주는 `getrefcount()` 을 정의한다.

regular package (정규 패키지) `__init__.py` 파일을 포함하는 디렉터리와 같은 전통적인 패키지.

이름 공간 패키지 도 보세요.

__slots__ 클래스 내부의 선언인데, 인스턴스 어트리뷰트들을 위한 공간을 미리 선언하고 인스턴스 딕셔너리를 제거함으로써 메모리를 절감하는 효과를 준다. 인기 있기는 하지만, 이 테크닉은 올바르게 사용하기가 좀 까다로운 편이라서, 메모리에 민감한 응용 프로그램에서 많은 수의 인스턴스가 있는 특별한 경우로 한정하는 것이 좋다.

sequence (시퀀스) `__getitem__()` 특수 메서드를 통해 정수 인덱스를 사용한 빠른 요소 액세스를 지원하고, 시퀀스의 길이를 돌려주는 `__len__()` 메서드를 정의하는 이터러블. 몇몇 내장 시퀀스들을 나열해보면, `list`, `str`, `tuple`, `bytes` 가 있다. `dict` 또한 `__getitem__()` 과 `__len__()` 을 지원하지만, 조회에 정수 대신 임의의 불변 키를 사용하기 때문에 시퀀스가 아니라 매핑으로 취급된다는 것에 주의해야 한다.

`collections.abc.Sequence` 추상 베이스 클래스는 `__getitem__()` 과 `__len__()` 를 넘어서 훨씬 풍부한 인터페이스를 정의하는데, `count()`, `index()`, `__contains__()`, `__reversed__()` 를 추가한다. 이 확장된 인터페이스를 구현한 형을 `register()` 를 사용해서 명시적으로 등록할 수 있다.

single dispatch (싱글 디스패치) 구현이 하나의 인자의 형에 기초해서 결정되는 제네릭 함수 디스패치의 한 형태.

slice (슬라이스) 보통 시퀀스 의 일부를 포함하는 객체. 슬라이스는 서브 스크립트 표기법을 사용해서 만든다. `variable_name[1:3:5]` 처럼, `[]` 안에서 여러 개의 숫자를 콜론으로 분리한다. 꺾쇠괄호 (서브 스크립트) 표기법은 내부적으로 `slice` 객체를 사용한다.

special method (특수 메서드) 파이썬이 형에 어떤 연산을, 덧셈 같은, 실행할 때 묵시적으로 호출되는 메서드. 이런 메서드는 두 개의 밑줄로 시작하고 끝나는 이름을 갖고 있다. 특수 메서드는 specialnames 에 문서로 만들어져 있다.

statement (문장) 문장은 스위트 (코드의 《블록(block)》) 를 구성하는 부분이다. 문장은 표현식 이거나 키워드를 사용하는 여러 가지 구조물 중의 하나다. 가령 `if`, `while`, `for`.

struct sequence (구조체 시퀀스) A tuple with named elements. Struct sequences expose an interface similar to *named tuple* in that elements can 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 (텍스트 인코딩) 유니코드 문자열을 바이트열로 인코딩하는 코덱.

text file (텍스트 파일) `str` 객체를 읽고 쓸 수 있는 파일 객체. 종종, 텍스트 파일은 실제로는 바이트 지향 데이터스트림을 액세스하고 텍스트 인코딩 을 자동 처리한다. 텍스트 파일의 예로는 텍스트 모드 (`'r'` 또는 `'w'`) 로 열린 파일, `sys.stdin`, `sys.stdout`, `io.StringIO` 의 인스턴스를 들 수 있다.

바이트열류 객체 를 읽고 쓸 수 있는 파일 객체에 대해서는 바이너리 파일 도 참조하세요.

triple-quoted string (삼중 따옴표 된 문자열) 따옴표 (《) 나 작은따옴표 (〈) 세 개로 둘러싸인 문자열. 그냥 따옴표 하나로 둘러싸인 문자열에 없는 기능을 제공하지는 않지만, 여러 가지 이유에서 쓸모가 있다. 이스케이프 되지 않은 작은따옴표나 큰따옴표를 문자열 안에 포함할 수 있도록 하고, 연결 문자를 쓰지 않고도 여러 줄에 걸칠 수 있는데, 독스트링을 쓸 때 특히 쓸모 있다.

type (형) 파이썬 객체의 형은 그것이 어떤 종류의 객체인지를 결정한다; 모든 객체는 형이 있다. 객체의 형은 `__class__` 어트리뷰트로 액세스할 수 있거나 `type(obj)` 로 얻을 수 있다.

type alias A synonym for a type, created by assigning the type to an identifier.

Type aliases are useful for simplifying *type hints*. For example:

```
from typing import List, Tuple

def remove_gray_shades(
        colors: List[Tuple[int, int, int]]) -> List[Tuple[int, int, int]]:
    pass
```

could be made more readable like this:

```
from typing import List, Tuple

Color = Tuple[int, int, int]

def remove_gray_shades(colors: List[Color]) -> List[Color]:
    pass
```

See `typing` and **PEP 484**, which describe this functionality.

type hint An *annotation* that specifies the expected type for a variable, a class attribute, or a function parameter or return value.

Type hints are optional and are not enforced by Python but they are useful to static type analysis tools, and aid IDEs with code completion and refactoring.

Type hints of global variables, class attributes, and functions, but not local variables, can be accessed using `typing.get_type_hints()`.

See `typing` and **PEP 484**, which describe this functionality.

universal newlines (유니버설 줄 넘김) 다음과 같은 것들을 모두 줄의 끝으로 인식하는, 텍스트 스트림을 해석하는 태도: 유닉스 개행 문자 관례 `'\n'`, 윈도우즈 관례 `'\r\n'`, 예전의 매킨토시 관례 `'\r'`. 추가적인 사용에 관해서는 `bytes.splitlines()` 뿐만 아니라 **PEP 278** 와 **PEP 3116** 도 보세요.

variable annotation (변수 어노테이션) An *annotation* of a variable or a class attribute.

When annotating a variable or a class attribute, assignment is optional:

```
class C:
    field: 'annotation'
```

Variable annotations are usually used for *type hints*: for example this variable is expected to take `int` values:

```
count: int = 0
```

Variable annotation syntax is explained in section annassign.

See *function annotation*, **PEP 484** and **PEP 526**, which describe this functionality.

virtual environment (가상 환경) 파이썬 사용자와 응용 프로그램이, 같은 시스템에서 실행되는 다른 파이썬 응용 프로그램들의 동작에 영향을 주지 않으면서, 파이썬 배포 패키지들을 설치하거나 업그레이드하는 것을 가능하게 하는, 협력적으로 격리된 실행 환경.

venv 도 보세요.

virtual machine (가상 기계) 소프트웨어만으로 정의된 컴퓨터. 파이썬의 가상 기계는 바이트 코드 컴파일러가 출력하는 바이트 코드 를 실행한다.

Zen of Python (파이썬 젠) 파이썬 디자인 원리와 철학들의 목록인데, 인어를 이해하고 사용하는 데 도움이 된다. 이 목록은 대화형 프롬프트에서 《import this》를 입력하면 보인다.

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 https://www.zope.org/). 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

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```
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).
```

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http://www.math.sci.hiroshima-u.ac.jp/~m-mat/MT/emt.html
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C.3.2 Sockets

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```

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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
```

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```
  version is still 5 times faster, though.
- Arguments more compliant with Python standard
```

C.3.8 XML Remote Procedure Calls

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```
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)
```

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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:

```
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C.3.15 libffi

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```
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```

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:

```
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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:

```
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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`:

```
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