PyInstaller Manual

Version: PyInstaller 2.1.1dev-3607bf4

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based on Gordon McMillan's manual

Contents

Requirements

Windows

- Windows XP or newer.
- PyWin32 Python extensions for Windows is needed for users of Python 2.6 and later.

Mac OS X

- Mac OS X 10.4 (Tiger) or newer (Leopard, Snow Leopard, Lion, Mountain Lion).

Linux

- ldd: Console application to print the shared libraries required by each program or shared library. This typically can by found in the distribution-package *glibc* or *libc-bin*.
- objdump: Console application to display information from object files. This typically can by found in the distribution-package *binutils*.

Solaris

- ldd
- objdump

AIX

- AIX 6.1 or newer. Python executables created using PyInstaller on AIX 6.1 should work on AIX 5.2/5.3.
- ldd
- objdump

FreeBSD

- FreeBSD 9.2 or newer. Tested with FreeBSD 9.2 amd64, with included gcc (version 4.2.1)
- ldd
- objdump

License

PyInstaller is distributed under the GPL License but it has an exception such that you can use it to compile commercial products.

In a nutshell, the license is GPL for the source code with the exception that:

1. You may use PyInstaller to compile commercial applications out of your source code.
2. The resulting binaries generated by PyInstaller from your source code can be shipped with whatever license you want.
3. You may modify PyInstaller for your own needs but changes to the PyInstaller source code fall under the terms of the GPL license. That is, if you distribute your modifications you must distribute them under GPL terms.

For updated information or clarification see our FAQ at the PyInstaller home page.

How To Contribute

PyInstaller is an open-source project that is created and maintained by volunteers. At Pyinstaller.org you find links to the mailing list, IRC channel, and Git repository, and the important How to Contribute link. Contributions to code and documentation are welcome, as well as tested hooks for installing other packages.

Installing *PyInstaller*

Beginning with version 2.1 *PyInstaller* is a Python package and is installed like other Python packages.

Installing Using pip

The recommended method for Windows, Linux, or Mac OS is to use one of the standard package installers such as pip (or the earlier easy_install). When you have installed one of these tools you can download and install *PyInstaller* in one command, for example:

```
pip install pyinstaller
```

and upgrade to a newer version in one command:

```
pip install --upgrade pyinstaller
```

Installing in Windows

For Windows, PyWin32 is a prerequisite. Follow that link and carefully read the instructions; there is a different version of PyWin32 for each version of Python. With this done you can continue to install `pip` using the MS-DOS command line.

However it is particularly easy to use pip-Win, which sets up both pip and virtualenv and makes it simple to install packages and to switch between different Python interpreters. (For more on the uses of virtualenv, see Supporting Multiple Platforms below.)

When pip-Win is working, enter this command in its Command field and click Run:

```
venv -c -i  pyi-env-name
```

This creates a new virtual environment rooted at `C:\Python\pyi-env-name` and makes it the current environment. A new command shell window opens in which you can run commands within this environment. Enter the command

```
pip install PyInstaller
```

Whenever you want to use *PyInstaller*,

- Start pip-Win
- In the Command field enter `venv pyi-env-name`
- Click Run

Then you have a command shell window in which commands execute in that environment.

Installing from the archive

You can also install *PyInstaller* by downloading the compressed archive from PyPI and expanding the archive.

Inside the archive is a script named `setup.py`. Execute `python setup.py install` with administrator privilege to install or upgrade *PyInstaller*.

For platforms other than Windows, Linux and Mac OS, you must build a bootloader program for your platform before installing the Python package.

- `cd` into the distribution folder.
- `cd bootloader`.
- Make a bootloader with: `python ./waf configure build install`.

If this reports an error, read Building the Bootloader below, then ask for technical help. It is of no use to continue the installation without a bootloader. After the bootloader has been created, you can run `python setup.py install` with administrator privileges to complete the installation.

Verifying the installation

On all platforms, the command `pyinstaller` should now exist on the execution path. To verify this, enter the command

```
pyinstaller --version
```

The result should resemble `2.n` for a released version, and `2.1dev-xxxxxx` for a development branch.

If the command is not found, make sure the execution path includes the proper directory:

- Windows: `C:\PythonXY\Scripts` (where *XY* stands for the major and minor Python verysion number, for example `C:\Python27\Scripts` for Python 2.7)
- Linux: `/usr/bin/`
- OS X (using the default Apple-supplied Python) `/usr/local/bin`
- OS X (using Python installed by macports) `/opt/local/bin`

To display the current path in Windows the command is `echo %path%` and in other systems, `echo $PATH`.

Installed commands

The complete installation places these commands on the execution path:

- `pyinstaller` is the main command to build a bundled application. See Using PyInstaller.
- `pyi-makespec` is used to create a spec file. See Using Spec Files.
- `pyi-build` is used to execute a spec file that already exists. See Using Spec Files.
- `pyi-archive_viewer` is used to inspect a bundled application. See Inspecting Archives.
- `pyi-bindepend` is used to display dependencies of an executable. See Inspecting Executables.
- `pyi-grab_version` is used to extract a version resource from a Windows executable. See Capturing Version Data.
- `pyi-make_comserver` is used to build a Windows COM server. See Windows COM Server Support.

If you do not perform the complete installation (`setup.py` or installing via `pip`), these commands will not exist as commands. However you can still execute all the functions documented below by running Python scripts found in the distribution folder. The equivalent of the `pyinstaller` command is *pyinstaller-folder* `/pyinstaller.py`. The other commands are found in *pyinstaller-folder* `/cliutils/` with obvious names (`makespec.py`, etc.)

Overview: What *PyInstaller* Does and How It Does It

This section covers the basic ideas of *PyInstaller*. These ideas apply to all platforms. There are many options, exceptions, and special cases covered under Using PyInstaller. *PyInstaller* reads a Python script written by you. First it analyzes your code to discover every other file your script needs in order to execute. Then it finds, copies, and collects all those other files -- including the active Python interpreter! -- and puts them with your script in a single folder, or optionally in a single executable file.

You distribute this folder or file to other people, and they can execute your program. As far as your users can tell, your app is self-contained; they do not need to install any support packages, or any particular version of Python. They do not need to have Python installed at all.

The output of *PyInstaller* is specific to the active operating system and the active version of Python. To prepare a distribution for a different OS, or for a dfferent version of Python, you run *PyInstaller* on that OS, under that version of Python.

> ***Note***
>
> Don't assume that your 64-bit based Python will generate executables that work on 32-bit systems.

Analysis: Finding the Files Your Program Needs

What does your script need in order to run, besides a Python interpreter? To find out, *PyInstaller* looks at all the `import` statements in your script. It finds those Python modules and looks in them for `import` statements, and so on recursively, until it has a complete list of Python modules your script requires.

PyInstaller understands the "egg" distribution format often used for Python packages. If your script imports a module from an "egg" *PyInstaller* adds the egg and its dependencies to the set of needed files.

PyInstaller also knows about the GUI packages Qt (imported via PyQt or PySide), WxPython, TkInter, Django, and other major packages.

Some Python scripts import modules in ways that *PyInstaller* cannot detect: for example, by using the `__import__()` function with variable data, or manipulating the `sys.path` value at run time. If your script requires files that *PyInstaller* does not know about, you must help it:

- You can give additional files on the *PyInstaller* command line.
- You can give additional import paths on the command line.
- You can edit the `myscript.spec` file that *PyInstaller* writes the first time you run it for your script. In the spec file you can tell *PyInstaller* about code modules that are unique to your script.
- You can write "hook" files that inform *PyInstaller* of hidden imports. If you "hook" imports for a package that other users might also use, you can contribute your hook file to *PyInstaller*.

If your program depends on access to certain data files, you can tell *PyInstaller* to include them in the bundle as well. You do this by modifying the spec file, an advanced topic that is covered under Using Spec Files. In order to locate these files, your program needs to be able to learn its path at run time in a way that works regardless of whether or not it is running from a bundle. This is covered under Accessing Data Files.

Bundling to One Folder

When you apply *PyInstaller* to `myscript.py` the default result is a single folder named `myscript`. This folder contains all the necessary support files, and an executable file also named `myscript` (`myscript.exe` in Windows).

You compress the folder to `myscript.zip` and transmit it to your users. They install the program simply by unzipping it. A user runs your app by opening the folder and launching the `myscript` executable inside it.

A small advantage of one-folder mode is that it is easier to debug a failure in building the app. You can see exactly what files *PyInstaller* collected.

Another small advantage is that when you change your code, as long as it imports *exactly the same set of support files*, you could send out only the updated `myscript` executable. That is typically much smaller than the entire folder. (Of course, if you change the script so that it imports more or different support files, or if the support libraries are upgraded, you must redistribute the whole bundle.)

A small disadvantage of the one-folder format is that the one folder contains a large number of files. Your user must find the `myscript` executable in a long list of names or a big array of icons. Also your user can create a problem by accidentally dragging files out of the folder.

Bundling to One File

An option of *PyInstaller* is to produce a single executable named `myscript` (`myscript.exe` in Windows). All the support files needed to run your program are embedded in the one program file.

The advantage of this is that your users get something they understand, a single executable to launch. One disadvantage is that any related files such as README must be distributed separately. Another is that the single executable is a little slower to start up than the executable in one folder.

> ***Note***
>
> Before bundling your project to one file, make sure it works fine when bundled to one folder. When Things Go Wrong it's *much* easier to find out what actually went wrong if you bundled to one folder.

How the One-Folder Program Works

A bundled program always starts execution in the *PyInstaller* bootloader. This is the heart of the `myscript` executable in the one folder, and of the one-file executable.

The *PyInstaller* bootloader is a binary executable program for the active platform (Windows, Linux, Mac OS X, etc.). When the user launches your program, it is the bootloader that runs. For a one-folder program, the bootloader creates a temporary Python environment such that the Python interpreter will find all imported modules and libraries in the `myscript` folder.

The bootloader starts a copy of the Python interpreter to execute your script. Everything follows normally from there, provided that all the necessary support files were included.

(This is an overview. For more detail, see The Bootstrap Process in Detail below.)

How the One-File Program Works

For a one-file program, the bootloader first creates a temporary folder in the appropriate temp-folder location for this OS. The folder is named `_MEI`*xxxxxx*, where *xxxxxx* is a random number.

The one file contains an embedded archive of all the Python modules used by your script, as well as compressed copies of any non-Python support files (e.g. `.so` files). The bootloader uncompresses the support files and writes copies into the the temporary folder. This can take a little time. That is why a one-file app is a little slower to start than a one-folder app.

After creating the temporary folder, the bootloader proceeds exactly as for the one-folder bundle, in the context of the temporary folder. When the bundled code terminates, it deletes the temporary folder.

(Note that in Linux and related systems, it is possible to mount the `/tmp` folder with a "no-execution" option. That option is not compatible with a *PyInstaller* one-file bundle. It needs to execute code out of `/tmp`.)

Because the program makes a temporary folder with a unique name, you can run multiple copies; they won't interfere with each other. However, running multiple copies is expensive in disk space because nothing is shared.

The `_MEI`*xxxxxx* folder is not removed if the program crashes or is killed (kill -9 on Unix, killed by the Task Manager on Windows, "Force Quit" on Mac OS). Thus if your app crashes frequently, your users will lose disk space to multiple `_MEI`*xxxxxx* temporary folders.

Do *not* give administrator privileges to a one-file executable (setuid root in Unix/Linux, "Run this program as an administrator" property in Windows 7). There is an unlikely but not impossible way in which a malicious attacker could corrupt one of the shared libraries in the temp folder while the bootloader is preparing it. Distribute a privileged program in one-folder mode instead.

Console or not?

By default the bootloader creates a command-line console (a terminal window in Linux and Mac OS, a command window in Windows). It gives this window to the Python interpreter for its standard input and output. Error messages from Python and print statements in your script will appear in the console window. If your script reads from standard input, the user can enter data in the window.

An option for Windows and Mac OS is to tell *PyInstaller* to not provide a console window. The bootloader starts Python with no target for standard output or input. Do this if your script has a graphical interface for user input and can properly report its own diagnostics.

Hiding the Source Code

The bundled app does not include any source code. However, *PyInstaller* bundles compiled Python scripts (`.pyc` files). These could in principle be decompiled to reveal the logic of your code.

If you want to hide your source code more thoroughly, one possible option is to compile some of your modules with Cython. Using Cython you can convert Python modules into C and compile the C to machine language. *PyInstaller* can follow import statements that refer to Cython C object modules and bundle them.

Additionally, Python bytecode can be obfuscated with AES256 by specifying an encryption key on PyInstaller's command line. Please note that it is still very easy to extract the key and get back the original bytecode, but it should prevent most forms of "occasional" tampering.

Using PyInstaller

The syntax of the `pyinstaller` command is:

`pyinstaller` [*options*] *script* [*script* ...] | *specfile*

In the most simple case, set the current directory to the location of your program `myscript.py` and execute:

```
pyinstaller myscript.py
```

PyInstaller analyzes `myscript.py` and:

- Writes `myscript.spec` in the same folder as the script.
- Creates a folder `build` in the same folder as the script if it does not exist.
- Writes some log files and working files in the `build` folder.
- Creates a folder `dist` in the same folder as the script if it does not exist.
- Writes the `myscript` executable folder in the `dist` folder.

In the `dist` folder you find the bundled app you distribute to your users.

Normally you name one script on the command line. If you name more, all are analyzed and included in the output. However, the first script named supplies the name for the spec file and for the executable folder or file. Its code is the first to execute at run-time.

For certain uses you may edit the contents of `myscript.spec` (described under Using Spec Files). After you do this, you name the spec file to *PyInstaller* instead of the script:

```
pyinstaller myscript.spec
```

You may give a path to the script or spec file, for example

`pyinstaller` *options...* `~/myproject/source/myscript.py`

or, on Windows,

```
pyinstaller "C:\Documents and Settings\project\myscript.spec"
```

Options

General Options

`-h, --help`	show this help message and exit
`-v, --version`	Show program version info and exit.
`--distpath=DIR`	Where to put the bundled app (default: /home/hartmut/projekte/software/pyinstaller/doc/source/dist)
`--workpath=WORKPATH`	Where to put all the temporary work files, .log, .pyz and etc. (default: /home/hartmut/projekte/software/pyinstaller/doc/source/build)
`-y, --noconfirm`	Replace output directory (default: SPECPATH/dist/SPECNAME) without asking for confirmation
`--upx-dir=UPX_DIR`	Path to UPX utility (default: search the execution path)
`-a, --ascii`	Do not include unicode encoding support (default: included if available)
`--clean`	Clean PyInstaller cache and remove temporary files before building.
`--log-level=LOGLEVEL`	Amount of detail in build-time console messages (default: INFO, choose one of DEBUG, INFO, WARN, ERROR, CRITICAL)

What to generate

`-F, --onefile`	Create a one-file bundled executable.
`-D, --onedir`	Create a one-folder bundle containing an executable (default)
`--specpath=DIR`	Folder to store the generated spec file (default: current directory)
`-n NAME, --name=NAME`	Name to assign to the bundled app and spec file (default: first script's basename)

What to bundle, where to search

`-p DIR, --paths=DIR`	A path to search for imports (like using PYTHONPATH). Multiple paths are allowed, separated by ':', or use this option multiple times
`--hidden-import=MODULENAME`	Name an import not visible in the code of the script(s). This option can be used multiple times.

`--additional-hooks-dir=HOOKSPATH`	An additional path to search for hooks. This option can be used multiple times.
`--runtime-hook=RUNTIME_HOOKS`	Path to a custom runtime hook file. A runtime hook is code that is bundled with the executable and is executed before any other code or module to set up special features of the runtime environment. This option can be used multiple times.
`--exclude-module=EXCLUDES`	Optional module or package (his Python names,not path names) that will be ignored (as thoughit was not found).This option can be used multiple times.
`--key=KEY`	The key used to encrypt Python bytecode.

How to generate

`-d, --debug`	Tell the bootloader to issue progress messages while initializing and starting the bundled app. Used to diagnose problems with missing imports.
`-s, --strip`	Apply a symbol-table strip to the executable and shared libs (not recommended for Windows)
`--noupx`	Do not use UPX even if it is available (works differently between Windows and *nix)

Windows and Mac OS X specific options

`-c, --console, --nowindowed`	Open a console window for standard i/o (default)
`-w, --windowed, --noconsole`	Windows and Mac OS X: do not provide a console window for standard i/o. On Mac OS X this also triggers building an OS X .app bundle.This option is ignored in *NIX systems.
`-i <FILE.ico or FILE.exe,ID or FILE.icns>, --icon=<FILE.ico or FILE.exe,ID or FILE.icns>`	FILE.ico: apply that icon to a Windows executable. FILE.exe,ID, extract the icon with ID from an exe. FILE.icns: apply the icon to the .app bundle on Mac OS X

Windows specific options

`--version-file=FILE`	add a version resource from FILE to the exe
`-m <FILE or XML>, --manifest=<FILE or XML>`	add manifest FILE or XML to the exe

`-r <FILE[,TYPE[,NAME[,LANGUAGE]]]>, --resource=<FILE[,TYPE[,NAME[,LANGUAGE]]]>`	Add or update a resource of the given type, name and language from FILE to a Windows executable. FILE can be a data file or an exe/dll. For data files, at least TYPE and NAME must be specified. LANGUAGE defaults to 0 or may be specified as wildcard * to update all resources of the given TYPE and NAME. For exe/dll files, all resources from FILE will be added/updated to the final executable if TYPE, NAME and LANGUAGE are omitted or specified as wildcard *.This option can be used multiple times.
`--uac-admin`	Using this option creates a Manifest which will request elevation upon application restart.
`--uac-uiaccess`	Using this option allows an elevated application to work with Remote Desktop.

Mac OS X specific options

`--osx-bundle-identifier=BUNDLE_IDENTIFIER`	Mac OS X .app bundle identifier is used as the default unique program name for code signing purposes. The usual form is a hierarchical name in reverse DNS notation. For example: com.mycompany.department.appname (default: first script's basename)

Building Mac OS X App Bundles

If you specify only `--onefile` under Mac OS X, the output in `dist` is a UNIX executable `myscript`. It can be executed from a Terminal command line. Standard input and output work as normal through the Terminal window.

If you specify `--windowed`, the `dist` folder contains two outputs: the UNIX executable `myscript` and also an OS X application named `myscript.app`.

As you probably know, an application is a special type of folder. The one built by *PyInstaller* contains a folder always named `Contents`. It contains:

- A folder `Frameworks` which is empty.
- A folder `MacOS` that contains a copy of the same `myscript` UNIX executable.
- A folder `Resources` that contains an icon file `icon-windowed.icns`.
- A file `Info.plist` that describes the app.

`Info.plist` is an Info Property List XML file (or "plist"). Its contents tell Mac OS X about your application. You can inspect and edit a plist with the Property List Editor that is part of XCode.

Setting a Custom Icon

The minimal plist provided by *PyInstaller* designates the icon file for the app as the `icon-windowed.icns` file in `Resources`. This is the *PyInstaller* logo in icns format. For now you can apply your own icon after the app is built in several ways:

- Prepare another `.icns` file with your own graphic, save it as `icon-windowed.icns` replacing the default one in `Resources`.

- Prepare an `.icns` file with your own graphic, place it in `Resources` and edit the `Info.plist` to name it.
- Prepare an `.icns` file with your own graphic; open in it Preview.app; select-all and copy; in the Finder, Get Info on your app; click the icon in the info display and paste.

The following programs are capable of creating `.icns` files from JPEG or PNG images:

- GraphicConverter ($$)
- makeicns (MIT License)
- png2icns (GPL)

Setting the Supported Document Types

You can also edit the `Info.plist` file to tell the Mac OS X Launcher what document types your application supports. Refer to the Mac OS developer documentation for these keywords.

Getting the Opened Document Names

When a user double-clicks a document of a type your application supports, or when a user drags a document icon and drops it on your application's icon, Mac OS X launches your application and provides the name(s) of the opened document(s) in the form of an OpenDocument AppleEvent. This AppleEvent is received by the bootloader before your code has started executing.

The bootloader gets the names of opened documents from the OpenDocument event and encodes them into the `argv` string before starting your code. Thus your code can query `sys.argv` to get the names of documents that should be opened at startup.

OpenDocument is the only AppleEvent the bootloader handles. If you want to handle other events, or events that are delivered after the program has launched, you must set up the appropriate handlers.

Shortening the Command

Because of its numerous options, a full `pyinstaller` command can become very long. You will run the same command again and again as you develop your script. You can put the command in a shell script or batch file, using line continuations to make it readable. For example, in Linux:

```
pyinstaller --noconfirm --log-level=WARN \
    --onefile --nowindow \
    --hidden-import=secret1 \
    --hidden-import=secret2 \
    --upx-dir=/usr/local/share/ \
    myscript.spec
```

Or in Windows, use the little-known BAT file line continuation:

```
pyinstaller --noconfirm --log-level=WARN ^
    --onefile --nowindow ^
    --hidden-import=secret1 ^
    --hidden-import=secret2 ^
    --icon-file=..\MLNMFLCN.ICO ^
    myscript.spec
```

Using UPX

UPX is a free utility available for most operating systems. UPX compresses executable files and libraries, making them smaller, sometimes much smaller. UPX is available for most operating systems and can compress a large number of executable file formats. See the UPX home page for downloads, and for the list of supported executable formats. As of May 2013, the only major absence is 64-bit binaries for Windows and Mac OS X. UPX has no effect on these.

A compressed executable program is wrapped in UPX startup code that dynamically decompresses the program when the program is launched. After it has been decompressed, the program runs normally. In the case of a *PyInstaller* one-file executable that has been UPX-compressed, the full execution sequence is:

- The compressed program start up in the UPX decompressor code.
- After decompression, the program executes the *PyInstaller* bootloader, which creates a temporary environment for Python.
- The Python interpreter executes your script.

PyInstaller looks for UPX on the execution path or the path specified with the `--upx-dir` option. If UPX exists, *PyInstaller* applies it to the final executable, unless the `--noupx` option was given. UPX has been used with *PyInstaller* output often, usually with no problems.

Encrypting Python Bytecode

Python bytecode can be encrypted by specifying the '--key' argument on the command line. For this to work, you will need PyCrypto 2.4 (or later) to be installed on the system where the package is built.

Supporting Multiple Platforms

If you distribute your application for only one combination of OS and Python, just install *PyInstaller* like any other package and use it in your normal development setup.

Supporting Multiple Python Environments

When you need to bundle your application within one OS but for different versions of Python and support libraries -- for example, a Python 3 version and a Python 2.7 version; or a supported version that uses Qt4 and a development version that uses Qt5 -- we recommend you use virtualenv. With virtualenv you can maintain different combinations of Python and installed packages, and switch from one combination to another easily.

- Use virtualenv to create as many different development environments as you need, each with its own combination of Python and installed packages.
- Install *PyInstaller* in each environment.
- Use *PyInstaller* to build your application in each environment.

Note that when using virtualenv, the path to the *PyInstaller* commands is:

- Windows: ENV_ROOT\Scripts
- Others: ENV_ROOT/bin

Under Windows, the pip-Win package installs virtualenv and makes it especially easy to set up different environments and switch between them. Under Linux and Mac OS, you switch environments at the command line.

Supporting Multiple Operating Systems

If you need to distribute your application for more than one OS, for example both Windows and Mac OS X, you must install *PyInstaller* on each platform and bundle your app separately on each.

You can do this from a single machine using virtualization. The free virtualBox or the paid VMWare and Parallels allow you to run another complete operating system as a "guest". You set up a virtual machine for each "guest" OS. In it you install Python, the support packages your application needs, and PyInstaller.

The Dropbox system is useful with virtual machines. Install a Dropbox client in each virtual machine, all linked to your Dropbox account. Keep a single copy of your script(s) in a Dropbox folder. Then on any virtual machine you can run *PyInstaller* thus:

```
cd ~/Dropbox/project_folder/src # Linux, Mac -- Windows similar
pyinstaller --workpath=path-to-local-temp-folder  \
            --distpath=path-to-local-dist-folder  \
            ...other options as required...       \
            ./myscript.py
```

Your bundled app is in *path-to-local-dist-folder* on the virtual machine's local disk. After testing it, you can compress the app to a zip file and copy it to the `Public` folder of your Dropbox. Your users can download it from there. (Pro tip: Do not shut down the virtual machine until Dropbox has completely uploaded the .zip to the cloud.)

It is claimed to be possible to cross-develop for Windows under Linux using the free Wine environment. Further details are needed, see How to Contribute.

Using Spec Files

The spec (specification) file tells *PyInstaller* how to process your script. When you name a script (or scripts) to the `pyinstaller` command, the first thing it does is to build a spec file *name*.spec. The spec file encodes the script names and most of the options you give to the `pyinstaller` command.

For many uses of *PyInstaller* you do not need to examine or modify the spec file. Editing the spec file was once a common way to help *PyInstaller* find all the parts of a program, but this is now less common. It is usually enough to give all the needed information (such as hidden imports) as option values to the `pyinstaller` command and let it run.

There are three cases where it may be useful to modify the spec file:

- When you want to bundle data files with the app.
- When you want to add Python run-time options to the executable.
- When you want to create a multiprogram bundle with merged common modules.

These uses are covered in topics below.

You can create a spec file using this command:

`pyi-makespec` *options script* [*script* ...]

The *options* are the same options documented above for the `pyinstaller` command. This command creates the *name*.spec file but does not go on to build the executable.

After you have created a spec file and modified it as necessary, you can build your application from it in either of two ways:

`pyinstaller` *specfile*

or

`pyi-build` *specfile*

The latter executes the part of `pyinstaller` that follows creation of a spec file.

When you create a spec file, many command options are written into the spec file. When you build from a spec file, those options cannot be changed. If they are given on the command line they are ignored and replaced by the options in the spec file. Only the following command-line options have an effect when building from a spec file:

- --upx-dir=
- --distpath=
- --workpath=
- --noconfirm
- --ascii

Spec File Operation

After *PyInstaller* creates a spec file, or opens a spec file when one is given instead of a script, the `pyinstaller` command *executes the spec file as code*. This is important to understand: the spec file contents are the central part of the code executed by *PyInstaller*. Your bundled application is created by the execution of the spec file.

The statements in a spec file create objects from classes that are defined in the *PyInstaller* module `build.py`. Here is an unrealistically simplified spec file for one-folder mode:

```
a = Analysis(['myscript.py'])
pyz = PYZ(a.pure)
exe = EXE(a.scripts, pyz, name="myscript", exclude_binaries=1)
dist = COLLECT(exe, a.binaries, name="dist")
```

If you compare an actual spec file you will find about the same statements, but differently formatted and with more arguments. The statements do the following:

- A new instance of class `Analysis` takes a list of script names as input. The resulting object (here named a) contains three lists, held in object properties named
    - `scripts`: the python scripts named on the command line;
    - `pure`: pure python modules needed by the scripts;
    - `binaries`: non-python modules needed by the scripts.
- An instance of `PYZ` (a `.pyz` archive, described under Inspecting Archives below) is built to contain the modules listed in `a.pure`.
- An instance of `EXE` is built from the analyzed scripts and the `PYZ` archive. This object contains what will be the executable file `myscript`.
- An instance of `COLLECT` creates the output folder.

In one-file mode, there is no call to `COLLECT`, and the `EXE` instance receives all of the scripts, modules and binaries.

In order to read or modify a spec file you must understand some of the classes it uses. However, the class definitions and the exact contents of the spec file might change in future releases. For this reason, the following contains only the most useful and reliable detail. Some further details are under Advanced Topics below; and you can find the complete definition of these classes in the module `build.py`.

TOC Class (Table of Contents)

The `TOC` (Table Of Contents) class is used by all of the target classes. For example, the `scripts` member of an Analysis object is a TOC containing a list of scripts; the `pure` member is a TOC with a list of modules, and so on.

Basically a `TOC` object contains a list of tuples of the form

`(`*name*`,`*path*`,`*typecode*`)`

In fact, it acts as an ordered set of tuples; that is, it contains no duplicates (where uniqueness is based on the *name* element of each tuple). Within this constraint, a TOC preserves the order of tuples added to it.

A TOC behaves like a list object and supports the same methods (appending, indexing, etc). A TOC also supports taking differences and intersections like a set. For these operations a simple list of tuples can be used as one argument. This makes excluding modules quite easy. For example,

```
a.binaries - [('badmodule', None, None)]
```

is an expression that yields a TOC from which any tuple named `badmodule` has been removed.

The right-hand argument to the subtraction operator is a list that contains one tuple in which *name* is `badmodule` and the *path* and *typecode* elements are `None`. (Because set membership is based on the *name* element of a tuple only, it is not necessary to give accurate *path* and *typecode* elements when subtracting.) So, if you modify this line in a one-folder spec file:

```
dist = COLLECT(..., a.binaries - [('badmodule', None, None)], ...)
```

or this line in a one-file spec:

```
exe = EXE(..., a.binaries - [('badmodule', None, None)], ...)
```

you remove `badmodule` from the output executable.

In order to add files to a TOC, you need to know the *typecode* values and their related *path* values. A *typecode* is a one-word string. *PyInstaller* uses a number of *typecode* values internally, but for the normal case you need to know only three:

typecode	description	name	path
'BINARY'	A shared library.	Run-time name.	Full path name in build.
'DATA'	Arbitrary files.	Run-time name.	Full path name in build.
'OPTION'	A Python run-time option.	Option code	ignored.

The Tree Class

The Tree class is a way of creating a TOC that describes some or all of the files within a directory:

`Tree(`*root*`, prefix=`*run-time-folder*`, excludes=`*match*`)`

- The *root* argument is a path string to a directory. It may be absolute or relative to the build directory.
- The *prefix* argument, if given, is a name for a subfolder within the run-time folder to contain the tree files. If you omit *prefix* or give `None`, the tree files will be at the top level of the run-time folder.
- The *excludes* argument, if given, is a list of one or more strings that match files in the *root* that should be omitted from the Tree. An item in the list can be either:
    - a name, which causes files or folders with this basename to be excluded
    - `*.ext`, which causes files with this extension to be excluded

For example:

```
extra_tree = Tree('../src/extras', prefix='extras', excludes=['tmp'])
```

This creates `extra_tree` as a TOC object that lists all files from the relative path `../src/extras`, omitting those that have the basename (or are in a folder named) `tmp`.

Each tuple in this TOC has:

- A *typecode* of `DATA`,
- A *path* consisting of a complete, absolute path to one file in the *root* folder,
- A *name* consisting of the filename of this file, or, if you specify a *prefix*, the *name* is *prefix/filename*.

Adding Files to the Bundle

To add files to the bundle, you insert descriptions of the files into the argument list of the `COLLECT` object for a one-folder bundle, or to the argument list of the `EXE` object for a one-file bundle. You can add files as single TOC-style tuples, or you can add an entire Tree object by name.

To add a single README file at the top level of a one-folder bundle, add a single TOC item describing it to the argument list of COLLECT or EXE:

```
collect = COLLECT(a.binaries +
          [('README', '/my/project/readme', 'DATA')], ...)
```

This appends the README tuple to the `a.binaries` TOC. (You can use a list of one or more tuples in place of a TOC object in most cases).

The COLLECT and EXE classes take a variable-length list of arguments, so it is possible to just append a list of one tuple to the argument list:

```
exe = EXE(a.scripts, a.binaries, ...
          [('README', '/my/project/readme', 'DATA')])
```

To add a folder of files, prepare a Tree for that folder:

```
# Include all spellcheck dictionary files, as a folder named dict
dict_tree = Tree('../../aspell/dict', prefix = 'dict')
```

You could for convenience add single files to that Tree:

```
# add README to the Tree TOC for convenience
dict_tree += [('README', '/my/project/readme', 'DATA')]
```

Then simply mention the Tree at any point in the argument list for COLLECT or EXE:

```
collect = COLLECT(dict_tree, a.binaries,...)
```

The topic Accessing Data Files describes how to find these files at run-time.

Giving Run-time Python Options

You can pass a run-time option to the Python interpreter by adding a tuple to the creation of the EXE object. The *typecode* element of the tuple is `'OPTION'`. The *name* element of the tuple is the option code as it would appear on a python command line. The *path* element is ignored. The options the executables understand are:

Option	Description	Example	Notes
v	Verbose imports	('v', None, 'OPTION')	Same as Python -v ...
u	Unbuffered stdio	('u', None, 'OPTION')	Same as Python -u ...
W spec	Warning option	('W ignore', None, 'OPTION')	Python 2.1+ only.
s	Use site.py	('s', None, 'OPTION')	The opposite of Python's -S flag. Note that site.py must be in the executable's directory to be used.

For example:

```
exe = EXE(a.scripts, pyz,
          [('v', None, 'OPTION'),('W ignore', None, 'OPTION')],
          name="myapp.exe", exclude_binaries=1)
```

In this example, you have inserted a list of two tuples into the EXE call.

Encrypting Python Bytecode

In order to have your bytecode obfuscated, you need to load and initialize a *block cipher* object with a key. You must then pass this object as the `cipher` keyword argument to both the `Analysis` and `PYZ` objects so that the former can pull the required dependencies and generate the key file loaded at bootstrap time, while the latter can use it to encrypt Python modules at build time.

A complete example:

```
from PyInstaller.loader import pyi_crypto

block_cipher = pyi_crypto.PyiBlockCipher(key='test_key')
a = Analysis(['test_onefile_crypto.py'], cipher=block_cipher)
pyz = PYZ(a.pure, cipher=block_cipher)
exe = EXE(pyz,
          a.scripts,
          a.binaries,
          a.zipfiles,
          a.datas,
          name='test_onefile_crypto')
```

Spec File Options For Mac OS X Apps

If you want to create `.app` file, create an instance of `BUNDLE`. You can specify the version number and icon file, add or overwrite default settings in Info.plist. For example, when you use PyQt5, set NSHighResolutionCapable to True to let your app also work in retina screen:

```
exe = EXE(pyz, a.scripts, exclude_binaries=True, name='example',
          debug=False, strip=None, upx=True, console=False )
bundle = BUNDLE(exe, a.binaries, a.zipfiles, a.datas,
               info_plist={
                 'NSHighResolutionCapable': 'True'
               },
               version='0.0.1', icon='example.icns', name='example.app')
```

When Things Go Wrong

Recipes and Examples for Specific Problems

Code examples for some advanced uses and some common problems are available on our Recipe web-page. Some of the recipes there include:

- A more sophisticated way of collecting data files than the one shown above (Adding Files to the Bundle).
- A use of a run-time hook to set the Qt API level.
- A workaround for a multiprocessing constraint under Windows.

and others. Please feel free to contribute more recipes!

Getting the Latest Version

If you have some reason to think you have found a bug in *PyInstaller* you can try downloading the latest development version. This version might have fixes or features that are not yet at PyPI. Links to download the latest stable version and the latest development version are at PyInstaller.org.

If you have Git installed on your development system, you can use it together with pip to install the latest version of *PyInstaller* directly:

```
pip install -e git://github.com/pyinstaller/pyinstaller.git#egg=PyInstaller
```

Finding out What Went Wrong

Build-time Messages

When an `Analysis` step runs, it produces error and warning messages. These display after the command line if the `--log-level` option allows it. Analysis also puts messages in a warnings file named `warn<name>.txt` in the spec file's directory.

An error message appears if Analysis detects an unconditional import and the module it names cannot be found. An unconditional import is one that appears at the top level of the script, so it is certain to be executed.

A warning is given if the module named in an import cannot be found, but the import itself is conditional. An import is conditional when it appears in a function definition or in an `if` statement. There is a reasonable chance that such an import will not be executed, so it will not matter that the module cannot be found.

For example, `os.py` (which is cross-platform) works by figuring out what platform it is on, then importing and rebinding names from the appropriate platform-specific module. If your script imports `os` or `os.path`, the warning file will have lines like:

```
WARNING: no module named dos (conditional import by os)
WARNING: no module named ce (conditional import by os)
WARNING: no module named os2 (conditional import by os)
```

The analysis has detected that the import is within a conditional block (an if statement). You will know that in this system, `os` will never need to import the `os2` module, for example, so that warning can be ignored.

Warnings may also be produced when a class or function is declared in a package (an `__init__.py` module), and the import specifies `package.name`. In this case, the analysis can't tell if name is supposed to refer to a submodule or package.

Warnings are also produced when an `__import__`, `exec` or `eval` statement is encountered. Either `exec` and `eval` could be used to implement a dynamic import, but normally they are used for something else. However, an `__import__` warning should certainly be investigated. It probably represents a place where the script is importing code that *PyInstaller* cannot see.

Problems detected through these messages can be corrected; see Listing Hidden Imports below for how to do it.

Build-Time Python Errors

PyInstaller sometimes terminates by raising a Python exception. In most cases the reason is clear from the exception message, for example "Your system is not supported", or "Pyinstaller requires at least Python 2.4". Others clearly indicate a bug that should be reported.

One of these errors can be puzzling, however: `IOError("Python library not found!")` *PyInstaller* needs to bundle the Python library, which is the main part of the Python interpreter, linked as a dynamic load library. The name and location of this file varies depending on the platform in use. Some Python installations do not include a dynamic Python library by default (a static-linked one may be present but cannot be used). You may need to install a development package of some kind. Or, the library may exist but is not in a folder where *PyInstaller* is searching.

The places where *PyInstaller* looks for the python library are different in different operating systems, but `/lib` and `/usr/lib` are checked in most systems. If you cannot put the python library there, try setting the correct path in the environment variable `LD_LIBRARY_PATH` in Linux or `DYLD_LIBRARY_PATH` in OS X.

Getting Debug Messages

Giving the `--debug` option causes the bundled executable itself to write progress messages when it runs. This can be useful during development of a complex package, or when your app doesn't seem to be starting, or just to learn how the runtime works.

Normally the debug progress messages go to standard output. If the `--windowed` option is used when bundling a Windows app, they are displayed as MessageBoxes. For a `--windowed` Mac OS app they are not displayed.

Remember to bundle without `--debug` for your production version. Users would find the messages annoying.

Getting Python's Verbose Imports

You can also pass a `-v` (verbose imports) flag to the embedded Python interpreter (see Giving Run-time Python Options above). This can be extremely useful. It can be informative even with apps that are apparently working, to make sure that they are getting all imports from the bundle, and not leaking out to the local installed Python.

Python verbose and warning messages always go to standard output and are not visible when the `--windowed` option is used. Remember to not use this in the distributed program.

Helping PyInstaller Find Modules

Extending the Path

If Analysis recognizes that a module is needed, but cannot find that module, it is often because the script is manipulating `sys.path`. The easiest thing to do in this case is to use the `--paths=` option to list all the other places that the script might be searching for imports:

```
pyi-makespec --paths=/path/to/thisdir \
             --paths=/path/to/otherdir myscript.py
```

These paths will be added to the current `sys.path` during analysis.

Listing Hidden Imports

If Analysis thinks it has found all the imports, but the app fails with an import error, the problem is a hidden import; that is, an import that is not visible to the analysis phase.

Hidden imports can occur when the code is using `__import__` or perhaps `exec` or `eval`. You get warnings of these (see Build-time Messages).

Hidden imports can also occur when an extension module uses the Python/C API to do an import. When this occurs, Analysis can detect nothing. There will be no warnings, only a crash at run-time.

To find these hidden imports, set the `-v` flag (Getting Python's Verbose Imports above).

Once you know what they are, you add the needed modules to the bundle using the `--hidden-import=` command option, by editing the spec file, or with a hook file (see Using Hook Files below).

Extending a Package's `__path__`

Python allows a script to extend the search path used for imports through the `__path__` mechanism. Normally, the `__path__` of an imported module has only one entry, the directory in which the `__init__.py` was found. But `__init__.py` is free to extend its `__path__` to include other directories. For example, the `win32com.shell.shell` module actually resolves to `win32com/win32comext/shell/shell.pyd`. This is because `win32com/__init__.py` appends `../win32comext` to its `__path__`.

Because the `__init__.py` of an imported module is not actually executed during analysis, changes it makes to `__path__` are not seen by *PyInstaller*. We fix the problem with the same hook mechanism we use for hidden imports, with some additional logic; see Using Hook Files below.

Note that manipulations of `__path__` hooked in this way apply only to the analysis. That is, at runtime `win32com.shell` is resolved the same way as `win32com.anythingelse`, and `win32com.__path__` knows nothing of `../win32comext`.

Once in a while, that's not enough.

Changing Runtime Behavior

More bizarre situations can be accomodated with runtime hooks. These are small scripts that manipulate the environment before your main script runs, effectively providing additional top-level code to your script.

There are two ways of providing runtime hooks. You can name them with the option `--runtime-hook=`*path-to-script*.

Second, some runtime hooks are provided. At the end of an analysis, the names in the module list produced by the Analysis phase are looked up in `loader/rthooks.dat` in the *PyInstaller* install folder. This text file is the string representation of a Python dictionary. The key is the module name, and the value is a list of hook-script pathnames. If there is a match, those scripts are included in the bundled app and will be called before your main script starts.

Hooks you name with the option are executed in the order given, and before any installed runtime hooks. If you specify `--runtime-hook=file1.py --runtime-hook=file2.py` then the execution order at runtime will be:

1. Code of `file1.py`.
2. Code of `file2.py`.
3. Any hook specified for an included module that is found in `rthooks/rthooks.dat`.
4. Your main script.

Hooks called in this way, while they need to be careful of what they import, are free to do almost anything. One reason to write a run-time hook is to override some functions or variables from some modules. A good example of this is the Django runtime hook (see `loader/rthooks/pyi_rth_django.py` in the *PyInstaller* folder). Django imports some modules dynamically and it is looking for some `.py` files. However `.py` files are not available in the one-file bundle. We need to override the function `django.core.management.find_commands` in a way that will just return a list of values. The runtime hook does this as follows:

```
import django.core.management
def _find_commands(_):
    return """cleanup shell runfcgi runserver""".split()
django.core.management.find_commands = _find_commands
```

Advanced Topics

The Bootstrap Process in Detail

There are many steps that must take place before the bundled script can begin execution. A summary of these steps was given in the Overview (How the One-Folder Program Works and How the One-File Program Works). Here is more detail to help you understand what the bootloader does and how to figure out problems.

Bootloader

The bootloader prepares everything for running Python code. It begins the setup and then returns itself in another process. This approach of using two processes allows a lot of flexibility and is used in all bundles except one-folder mode in Windows. So do not be surprised if you will see your bundled app as two processes in your system task manager.

What happens during execution of bootloader:

A. First process: bootloader starts.

1. If one-file mode, extract bundled files to *temppath*`_MEI`*xxxxxx*
2. Set/unset various environment variables, e.g. override LD_LIBRARY_PATH on Linux or LIBPATH on AIX; unset DYLD_LIBRARY_PATH on OSX.
3. Set up to handle signals for both processes.
4. Run the child process.
5. Wait for the child process to finish.

6. If one-file mode, delete *temppath*`_MEI`*xxxxxx*.

B. Second process: bootloader itself started as a child process.

1. On Windows set the activation context.
2. Load the Python dynamic library. The name of the dynamic library is embedded in the executable file.
3. Initialize Python interpreter: set PYTHONPATH, PYTHONHOME.
4. Run python code.

Running Python code

Running Python code consists of several steps:

1. Run Python initialization code which prepares everything for running the user's main script. The initialization code can use only the Python built-in modules because the general import mechanism is not yet available. It sets up the python import mechanism to load modules from archives embedded in the executable. It also adds the attributes `frozen` and `_MEIPASS` to the `sys` built-in module.
2. Execute run run-time hooks: first those specified by the user, then any standard ones.
3. Install python "egg" files. When a module is part of a zip file (.egg), it has been bundled into the `./eggs` directory. Installing means appending .egg file names to `sys.path`. Python automatically detects whether an item in `sys.path` is a zip file or a directory.
4. Run the main script.

Python imports in a bundled app

PyInstaller embeds compiled python code (`.pyc` files) within the executable. *PyInstaller* injects its code into the normal Python import mechanism. Python allows this; the support is described in PEP 302 "New Import Hooks".

PyInstaller implements the PEP 302 specification for importing built-in modules, importing "frozen" modules (compiled python code bundled with the app) and for C-extensions. The code can be read in `./PyInstaller/loader/pyi_importers.py`.

At runtime the PyInstaller PEP 302 hooks are appended to the variable `sys.meta_path`. When trying to import modules the interpreter will first try PEP 302 hooks in `sys.meta_path` before searching in `sys.path`. As a result, the Python interpreter loads imported python modules from the archive embedded in the bundled executable.

This is the resolution order of import statements in a bundled app:

1. Is it a built-in module? A list of built-in modules is in variable `sys.builtin_module_names`.
2. Is it a module embedded in the executable? Then load it from embedded archive.
3. Is it a C-extension? The app will try to find a file with name *package.subpackage.module*`.pyd` or *package.subpackage.module*`.so`
4. Next examine paths in the `sys.path` (PYTHONPATH). There could be any additional location with python modules or `.egg` filenames.
5. If the module was not found then raise `ImportError`.

Adapting to being "frozen"

You might want to learn at run-time whether the app is running "live" (from source) or "frozen" (bundled). For example, you might have data files that, when running live, are found based on a module's `__file__` attribute. That won't work when the code is bundled.

The *PyInstaller* bootloader adds the name `frozen` to the `sys` module. So the test for "are we bundled?" is:

```
if getattr(sys, 'frozen', False):
        # running in a bundle
```

Accessing Data Files

You can include related files in either type of distribution. Data files and folders of files can be included by editing the spec file; see Adding Files to the Bundle.

The bootloader stores the absolute path to the bundle folder in `sys._MEIPASS`. For a one-folder bundle, this is the path to that folder. For a one-file bundle, this is the path to the `_MEIxxxxxx` temporary folder created by the bootloader (see How the One-File Program Works).

When your application needs access to a data file that is bundled with it, for example a configuration file or an icon image file, you get the path to the file with the following code:

```
import sys
import os
...
if getattr(sys, 'frozen', False):
    # we are running in a |PyInstaller| bundle
    basedir = sys._MEIPASS
else:
    # we are running in a normal Python environment
    basedir = os.path.dirname(os.path.abspath(__file__))
```

This code sets `basedir` to the path to the folder containing your script and any other files or folders bundled with it. When your program was not started by the bootloader, the standard Python variable `__file__` is the full path to the script now executing, and `os.path.dirname()` extracts the path to the folder that contains it. When bundled, `sys._MEIPASS` provides the path to bundle folder.

In the one-folder distribution, bundled data files are in the distribution folder. Your code can make useful changes to files in the folder.

In the one-file mode, bundled data files are packaged into the executable. The bootloader unpacks them into a temporary folder. The `basedir` path discovered by the code above is the path to this temporary folder. Any files your code creates or modifies in that folder are available only while the app is running. When it ends they will be deleted.

Capturing Version Data

`pyi-grab_version` *executable_with_version_resource*

The `pyi-grab_version` command is invoked with the full path name of a Windows executable that has a Version resource. (A Version resource contains a group of data structures, some containing binary integers and some containing strings, that describe the properties of the executable. For details see the Version Information Structures page.)

The command writes text that represents a Version resource in readable form. The version text is written to standard output. You can copy it from the console window or redirect it to a file. Then you can edit the version information to adapt it to your program. This approach is used because version resources are complex. Some elements are optional, others required. When you view the version tab of a Properties dialog, there's no simple relationship between the data displayed and the structure of the resource. Using `pyi-grab_version` you can find an executable that displays the kind of information you want, copy its resource data, and modify it to suit your package.

The version text file is encoded UTF-8 and may contain non-ASCII characters. (Unicode characters are allowed in Version resource string fields.) Be sure to edit and save the text file in UTF-8 unless you are certain it contains only ASCII string values.

The edited version text file can be given with a `--version-file=` option to `pyinstaller` or `pyi-makespec`. The text data is converted to a Version resource and installed in the executable output.

In a Version resource there are two 64-bit binary values, `FileVersion` and `ProductVersion`. In the version text file these are given as four-element tuples, for example:

```
filevers=(2, 0, 4, 0),
prodvers=(2, 0, 4, 0),
```

The elements of each tuple represent 16-bit values from most-significant to least-significant. For example the `FileVersion` value given resolves to `0002000000040000` in hex.

`set_version` *version_text_file executable_file*

The `set_version` utility reads a version text file as written by `pyi-grab_version`, converts it to a Version resource, and installs that resource in the *executable_file* specified.

For advanced uses, examine a version text file. You find it is Python code that creates a `VSVersionInfo` object. The class definition for `VSVersionInfo` is found in `utils/versioninfo.py` in the *PyInstaller* distribution folder. You can write a program that imports that module. In that program you can `eval` the contents of a version info text file to produce a `VSVersionInfo` object. You can use the `.toRaw()` method of that object to produce a Version resource in binary form. Or you can apply the `unicode()` function to the object to reproduce the version text file.

Inspecting Archives

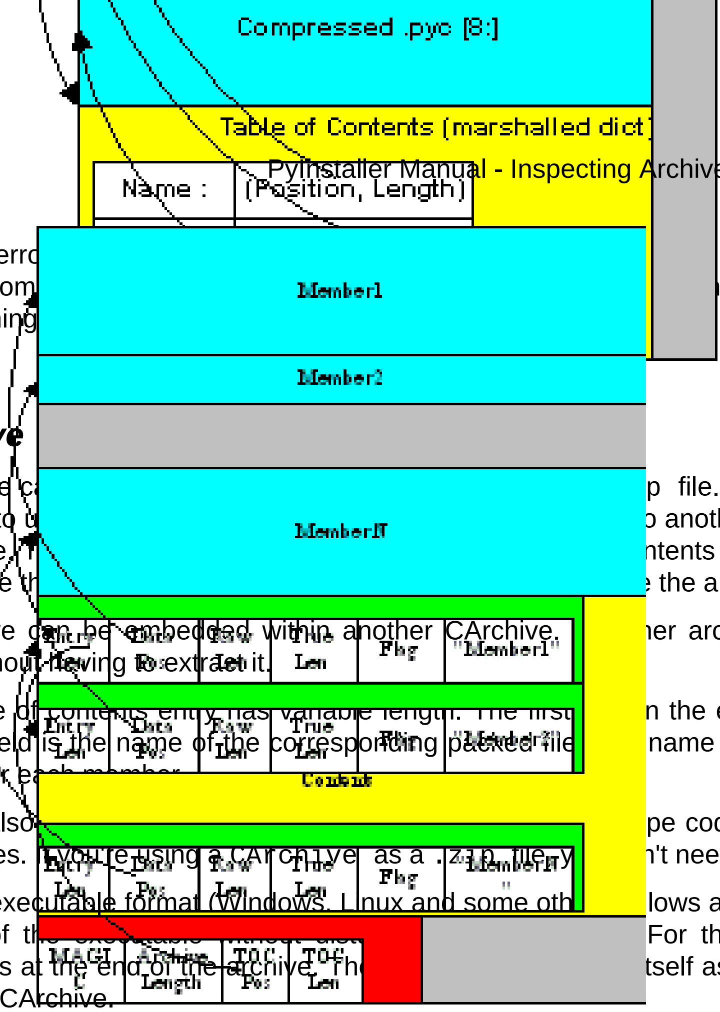
An archive is a file that contains other files, for example a `.tar` file, a `.jar` file, or a `.zip` file. Two kinds of archives are used in *PyInstaller*. One is a ZlibArchive, which allows Python modules to be stored efficiently and, with some import hooks, imported directly. The other, a CArchive, is similar to a `.zip` file, a general way of packing up (and optionally compressing) arbitrary blobs of data. It gets its name from the fact that it can be manipulated easily from C as well as from Python. Both of these derive from a common base class, making it fairly easy to create new kinds of archives.

ZlibArchive

A ZlibArchive contains compressed `.pyc` or `.pyo` files. The `PYZ` class invocation in a spec file creates a ZlibArchive.

The table of contents in a ZlibArchive is a Python dictionary that associates a key, which is a member's name as given in an `import` statement, with a seek position and a length in the ZlibArchive. All parts of a ZlibArchive are stored in the marshalled format and so are platform-independent.

A ZlibArchive is used at run-time to import bundled python modules. Even with maximum compression this works faster than the normal import. Instead of searching `sys.path`, there's a lookup in the dictionary. There are no directory operations and no file to open (the file is already open). There's just a seek, a read and a decompress.



A Python error trace will point to the source file from which the archive entry was created (the `__file__` attribute from the time the .pyc was compiled, captured and saved in the archive). This will not tell your user anything useful, but if they send you a Python error trace, you can make sense of it.

CArchive

A CArchive can contain any kind of file. It's very much like a .zip file. They are easy to create in Python and easy to unpack from C code. A CArchive can be appended to another file, such as an ELF and COFF executable. To allow this, the archive is made with its table of contents at the end of the file, followed only by a cookie that tells where the table of contents starts and where the archive itself starts.

A CArchive can be embedded within another CArchive. An inner archive can be opened and used in place, without having to extract it.

Each table of contents entry has variable length. The first field in the entry gives the length of the entry. The last field is the name of the corresponding packed file. The name is null terminated. Compression is optional for each member.

There is also a type code associated with each member. The type codes are used by the self-extracting executables. If you're using a CArchive as a .zip file, you don't need to worry about the code.

The ELF executable format (Windows, Linux and some others) allows arbitrary data to be concatenated to the end of the executable without disturbing its functionality. For this reason, a CArchive's Table of Contents is at the end of the archive. The executable can open itself as a binary file, seek to the end and 'open' the CArchive.

Using pyi-archive_viewer

Use the `pyi-archive_viewer` command to inspect any type of archive:

`pyi-archive_viewer` *archivefile*

With this command you can examine the contents of any archive built with *PyInstaller* (a `PYZ` or `PKG`), or any executable (`.exe` file or an ELF or COFF binary). The archive can be navigated using these commands:

O *name*

Open the embedded archive *name* (will prompt if omitted). For example when looking in a one-file executable, you can open the `outPYZ.pyz` archive inside it.

U

Go up one level (back to viewing the containing archive).

X *name*

Extract *name* (will prompt if omitted). Prompts for an output filename. If none given, the member is extracted to stdout.

Q

Quit.

The `pyi-archive_viewer` command has these options:

`-h, --help`	Show help.
`-l, --log`	Quick contents log.
`-b, --brief`	Print a python evaluable list of contents filenames.
`-r, --recursive`	Used with -l or -b, applies recursive behaviour.

Inspecting Executables

You can inspect any executable file with `pyi-bindepend`:

`pyi-bindepend` *executable_or_dynamic_library*

The `pyi-bindepend` command analyzes the executable or DLL you name and writes to stdout all its binary dependencies. This is handy to find out which DLLs are required by an executable or by another DLL.

`pyi-bindepend` is used by *PyInstaller* to follow the chain of dependencies of binary extensions during Analysis.

Multipackage Bundles

Some products are made of several different apps, each of which might depend on a common set of third-party libraries, or share code in other ways. When packaging such an product it would be a pity to treat each app in isolation, bundling it with all its dependencies, because that means storing duplicate copies of code and libraries.

You can use the multipackage feature to bundle a set of executable apps so that they share single copies of libraries. Each dependency (a DLL, for example) is packaged only once, in one of the apps. Any other apps in the set that depend on that DLL have an "external reference" to it, telling them to go find that dependency in the executable file of the app that contains it.

This saves disk space because each dependency is stored only once. However, to follow an external reference takes extra time when an app is starting up. Some of the apps in the set will have slightly slower launch times.

The external references between binaries include hard-coded paths to the output directory, and cannot be rearranged. If you use one-folder mode, you must install all the application folders within a single parent directory. If you use one-file mode, you must place all the related applications in the same directory when you install the application.

To build such a set of apps you must code a custom spec file that contains a call to the MERGE Function. This function takes a list of analyzed scripts, finds their common dependencies, and modifies the analyses to minimize the storage cost.

The order of the analysis objects in the argument list matters. The MERGE function packages each dependency into the first script from left to right that needs that dependency. A script that comes later in the list and needs the same file will have an external reference. You might sequence the scripts to place the most-used scripts first in the list.

MERGE Function

A custom spec file for a multipackage bundle contains one call to the MERGE function:

```
MERGE(*args)
```

MERGE is used after the analysis phase and before `EXE` and `COLLECT`. Its variable-length list of arguments consists of a list of tuples, each tuple having three elements:

- The first element is an Analysis object, an instance of class Analysis.
- The second element is the script name (without the `.py` extension).
- The third element is the name for the executable (usually the same as the script).

MERGE examines the Analysis objects to learn the dependencies of each script. It modifies the total list to avoid duplication of libraries and modules. As a result the packages generated will be connected.

Example MERGE spec file

One way to construct a spec file for a multipackage bundle is to first build a spec file for each app in the package. Suppose you have a product that comprises three apps named (because we have no imagination) `foo`, `bar` and `zap`:

```
pyi-makespec options as appropriate... foo.py
pyi-makespec options as appropriate... bar.py
pyi-makespec options as appropriate... zap.py
```

Check for warnings and test the apps individually. Deal with any hidden imports and other problems. When all three work correctly, edit the three files `foo.spec`, `bar.spec` and `zap.spec` and combine them as follows. First copy the Analysis statements from each, changing them to give each Analysis object a unique name:

```
foo_a = Analysis(['foo.py'],
        pathex=['/the/path/to/foo'],
        hiddenimports=[],
        hookspath=None)

bar_a = Analysis(['bar.py'], etc., etc...

zap_a = Analysis(['zap.py'], etc., etc...
```

Now code the call to MERGE to process the three Analysis objects:

```
MERGE( (foo_a, 'foo', 'foo'), (bar_a, 'bar', 'bar'), (zap_a, 'zap', 'zap') )
```

Following this you can copy the `PYZ`, `EXE` and `COLLECT` statements from the original three spec files, substituting the unique names of the Analysis objects where the original spec files have `a.`, for example:

```
foo_pyz = PYZ(foo_a.pure)
foo_exe = EXE(foo_pyz, foo_a.scripts, ... etc.
```

Save the merged spec file as `foobarzap.spec` and then build it:

```
pyi-build foobarzap.spec
```

There are several multipackage examples in the `tests/multipackage` folder of the *PyInstaller* distribution folder.

Remember that a spec file is executable Python. You can use all the Python facilities (`for` and `with` and the members of `sys` and `io`) in creating the Analysis objects and performing the `PYZ`, `EXE` and `COLLECT` statements.

Using Hook Files

In summary, a "hook" file tells *PyInstaller* about hidden imports called by a particular module. The name of the hook file is `hook-<module>.py` where "<module>" is the name of a script or imported module that will be found by Analysis. You should browse through the existing hooks in the `hooks` folder of the *PyInstaller* distribution folder, if only to see the names of the many supported imports.

For example `hook-cPickle.py` is a hook file telling about hidden imports used by the module `cPickle`. When your script has `import cPickle` the Analysis will note it and check for a hook file `hook-cPickle.py`.

Typically a hook module has only one line; in `hook-cPickle.py` it is

```
hiddenimports = ['copy_reg', 'types', 'string']
```

assigning a list of one or more module names to `hiddenimports`. These module names are added to the Analysis list exactly as if the script being analyzed had imported them by name.

When the module that needs these hidden imports is local to your project, store the hook file(s) somewhere near your source file. Then specify their location to the `pyinstaller` or `pyi-makespec` command with the `--additional-hooks-dir=` option. If the hook file(s) are at the same level as the script, the command could be simply

```
pyinstaller --additional-hooks-dir=. myscript.py
```

If you successfully hook a publicly distributed module in this way, please send us the hook file so we can make it available to others.

Hooks in Detail

A hook is a module named `hook-` *fully.qualified.import.name* `.py` in the `hooks` folder of the *PyInstaller* folder (or in a folder specified with `--additional-hooks-dir`).

A hook is executable Python code that should define one or more of the following three global names:

`hiddenimports`

A list of module names (relative or absolute) that the hooked module imports in some opaque way. These names extend the list of imported modules created by scanning the code. Example:

```
hiddenimports = ['_proxy', 'utils', 'defs']
```

A way to simplify adding all submodules of a package is to use:

```
from PyInstaller.hooks.hookutils import collect_submodules
hiddenimports = collect_submodules('package')
```

For an example see `hook-docutils.py` in the hooks folder.

Note: We suggest always using the fully qualified name `PyInstaller.hooks.hookutils` for importing hookutils. This avoids some pitfalls when implementing hooks for sub-modules.

`datas`

A list of globs of files or directories to bundle as datafiles. For each glob, a destination directory is specified.

Example:

```
datas = [
     ('/usr/share/icons/education_*.png', 'icons'),
     ('/usr/share/libsmi/mibs/*', 'mibs'),
     ]
```

This will copy all files matching *education_*.png* into the subdirectory *icons*, and recursively (because of the `*` wildcard) copy the content of */usr/share/libsmi/mibs* into *mibs*.

A way to simplify collecting a folder of files is to use:

```
from hookutils import collect_data_files
datas = collect_data_files('package_name')
```

to collect all package-related data files into a folder *package_name* in the app bundle. For an example see hook-pytz.py in the hooks folder.

`attrs`

A list of (*name* , *value*) pairs (where value is normally meaningless).

This will set the module-attribute *name* to *value* for each pair in the list. The value is usually unimportant because the modules are not executed.

The main purpose is so that ImportTracker will not issue spurious warnings when the rightmost node in a dotted name turns out to be an attribute in a package, instead of a missing submodule. For an example see the hook file `hook-xml.sax.py`.

`def hook(mod):`

Defines a function that takes a `Module` object. It must return a `Module` object, possibly the same one unchanged, or a modified one. A `Module` object is an instance of the class `PyInstaller.depend.modules.Module()` which you can read. If defined, `hook(mod)` is called before *PyInstaller* tests `hiddenimports`, `datas`, or `attrs`. So one use of a `hook(mod)` function would be to test `sys.version` and adjust `hiddenimports` based on that.

This function is supported to handle cases like dynamic modification of a package's `__path__` variable. A static list of names won't suffice because the new entry on `__path__` may well require computation. See `hook-win32com.py` in the hooks folder for an example.

Building the Bootloader

PyInstaller comes with binary bootloaders for most platforms in the `bootloader` folder of the distribution folder. For most cases, these precompiled bootloaders are all you need.

If there is no precompiled bootloader for your platform, or if you want to modify the bootloader source, you need to build the bootloader.

Development tools

On Debian/Ubuntu systems, you can run the following to install everything required:

```
sudo apt-get install build-essential
```

On Fedora/RHEL and derivates, you can run the following:

```
su
yum groupinstall "Development Tools"
```

On Mac OS X you can get gcc by installing Xcode. It is a suite of tools for developing software for Mac OS X. It can be also installed from your Mac OS X Install DVD. It is not necessary to install the version 4 of Xcode.

On Solaris and AIX the bootloader is tested with gcc.

On Windows you can use the Visual Studio C++ compiler (Visual Studio 2008 is recommended). A free version you can download is Visual Studio Express.

Note: There is no connection between the Visual Studio version used to compile the bootloader and the Visual Studio version used to compile Python. The bootloader is a self-contained static executable that imposes no restrictions on the version of Python being used. So you can use any Visual Studio version you have around.

You can download and install or unpack MinGW distribution from one of the following locations:

- MinGW - stable and mature, uses gcc 3.4 as its base
- MinGW-w64 - more recent, uses gcc 4.4 and up.
- TDM-GCC - MinGW and MinGW-w64 installers

Building

On Windows, when using MinGW, it is needed to add `PATH_TO_MINGW\bin` to your system `PATH`. variable. In command prompt before building bootloader run for example:

```
set PATH=C:\MinGW\bin;%PATH%
```

Change to the `bootloader` subdirectory. Run:

```
python ./waf configure build install
```

This will produce

- `./PyInstaller/bootloader/YOUR_OS/run`,
- `./PyInstaller/bootloader/YOUR_OS/run_d`
- `./PyInstaller/bootloader/YOUR_OS/runw` and
- `./PyInstaller/bootloader/YOUR_OS/runw_d`

which are the bootloaders.

On Windows this will produce in the `./PyInstaller/bootloader/YOUR_OS` directory: `run*.exe` (bootloader for regular programs), and `inprocsrvr*.dll` (bootloader for in-process COM servers).

Note: If you have multiple versions of Python, the Python you use to run `waf` is the one whose configuration is used.

Note: On AIX the bootloader builds with gcc and is tested with gcc 4.2.0 on AIX 6.1.

Linux Standard Base (LSB) binary

By default, the bootloaders on Linux are LSB binaries.

LSB is a set of open standards that should increase compatibility among Linux distributions. *PyInstaller* produces a bootloader as an LSB binary in order to increase compatibility for packaged applications among distributions.

Note: LSB version 4.0 is required for successfull building of bootloader.

On Debian- and Ubuntu-based distros, you can install LSB 4.0 tools by adding the following repository to the sources.list file:

```
deb http://ftp.linux-foundation.org/pub/lsb/repositories/debian lsb-4.0 main
```

then after having update the apt repository:

```
sudo apt-get update
```

you can install LSB 4.0:

```
sudo apt-get install lsb lsb-build-cc
```

Most other distributions contain only LSB 3.0 in their software repositories and thus LSB build tools 4.0 must be downloaded by hand. From Linux Foundation download LSB sdk 4.0 for your architecture.

Unpack it by:

```
tar -xvzf lsb-sdk-4.0.3-1.ia32.tar.gz
```

To install it run:

```
cd lsb-sdk
./install.sh
```

After having installed the LSB tools, you can follow the standard building instructions.

NOTE: if for some reason you want to avoid LSB compilation, you can do so by specifying --no-lsb on the waf command line, as follows:

```
python waf configure --no-lsb build install
```

This will also produce `support/loader/YOUR_OS/run`, `support/loader/YOUR_OS/run_d`, `support/loader/YOUR_OS/runw` and `support/loader/YOUR_OS/runw_d`, but they will not be LSB binaries.

Modulefinder Replacement - ImportTracker

The Imptracker package (defined in `depend/imptracker.py` in the *PyInstaller* folder) replaces Modulefinder but is modelled after iu.py. The `modulegraph` package, which is similar, will be supported in a future release.

Imptracker, like Modulefinder, uses `ImportDirectors` and `Owners` to partition the import name space. Except for the fact that these return `Module` instances instead of real module objects, they are identical.

Instead of an `ImportManager`, it has an `ImportTracker` managing things.

ImportTracker

`ImportTracker` can be called in two ways: `analyze_one(name, importername=None)` or `analyze_r(name, importername=None)`. The second method does what modulefinder does - it recursively finds all the module names that importing name would cause to appear in `sys.modules`. The first method is non-recursive. This is useful, because it is the only way of answering the question "Who imports name?" But since it is somewhat unrealistic (very few real imports do not involve recursion), it deserves some explanation.

`analyze_one()`

When a name is imported, there are structural and dynamic effects. The dynamic effects are due to the execution of the top-level code in the module (or modules) that get imported. The structural effects have to do with whether the import is relative or absolute, and whether the name is a dotted name (if there are N dots in the name, then N+1 modules will be imported even without any code running).

The analyze_one method determines the structural effects, and defers the dynamic effects. For example, `analyze_one("B.C", "A")` could return `["B", "B.C"]` or `["A.B", "A.B.C"]` depending on whether the import turns out to be relative or absolute. In addition, ImportTracker's modules dict will have Module instances for them.

Module Classes

There are Module subclasses for builtins, extensions, packages and (normal) modules. Besides the normal module object attributes, they have an attribute imports. For packages and normal modules, imports is a list populated by scanning the code object (and therefor, the names in this list may be relative or absolute names - we don't know until they have been analyzed).

The highly astute will notice that there is a hole in `analyze_one()` here. The first thing that happens when `B.C` is being imported is that `B` is imported and its top-level code executed. That top-level code can do various things so that when the import of `B.C` finally occurs, something completely different happens (from what a structural analysis would predict). But mf can handle this through its hooks mechanism.

code scanning

Like modulefinder, `ImportTracker` scans the byte code of a module, looking for imports. In addition it will pick out a module's `__all__` attribute, if it is built as a list of constant names. This means that if a package declares an `__all__` list as a list of names, ImportTracker will track those names if asked to analyze `package.*`. The code scan also notes the occurance of `__import__`, `exec` and `eval`, and can issue warnings when they are found.

The code scanning also keeps track (as well as it can) of the context of an import. It recognizes when imports are found at the top-level, and when they are found inside definitions (deferred imports). Within that, it also tracks whether the import is inside a condition (conditional imports).

Hooks

In modulefinder, scanning the code takes the place of executing the code object. `ExtensionModules`, of course, don't get scanned, so there needs to be a way of recording any imports they do.

Please read Listing Hidden Imports for more information.

`ImportTracker` goes further and allows a module to be hooked (after it has been scanned, but before analyze_one is done with it).

Warnings

`ImportTracker` has a `getwarnings()` method that returns all the warnings accumulated by the instance, and by the `Module` instances in its modules dict. Generally, it is `ImportTracker` who will accumulate the warnings generated during the structural phase, and `Modules` that will get the warnings generated during the code scan.

Note that by using a hook module, you can silence some particularly tiresome warnings, but not all of them.

Cross Reference

Once a full analysis (that is, an `analyze_r` call) has been done, you can get a cross reference by using `getxref()`. This returns a list of tuples. Each tuple is `(modulename, importers)`, where importers is a list of the (fully qualified) names of the modules importing `modulename`. Both the returned list and the importers list are sorted.

Outdated Features

The following sections document features of *PyInstaller* that are still present in the code but are rarely used and may no longer work.

Windows COM Server Support

Recent rename:

./utils/MakeComServer.py - ./utils/make_comserver.py

and after python setup.py install there will be command 'pyi-make_comserver'

A Windows COM server is a Windows program the uses Microsoft COM (Component Object Model) technology. If you write such a program in Python you can bundle it with *PyInstaller*, but you must prepare a special spec file and name the spec file, not your script, to the pyinstaller command.

To prepare the spec file use the command

`pyi-make_comserver` [*options*] myscript.py

Alternatively you can use the `make_comserver.py` script in the `utils` subdirectory of the *PyInstaller* folder.

This will generate a spec file `myscript.spec` and a new script `drivescript.py`. From this point you build your project using the pyinstaller command, naming the spec file as its input.

pyi-make_comserver assumes that your top level code (registration etc.) is "normal". If it's not, you will have to edit the generated script.

These options are allowed with the pyi-make_comserver command:

`--debug`	Use the debug (verbose) version of the bootloader in the executable.
`--verbose`	Register the COM server(s) with the quiet flag off.
`--ascii`	do not include Unicode support modules.
`--out=output_path`	Generate `drivescript.py` and the spec file in *output_path*.

If you have the win32dbg package installed, you can use it with the generated COM server. In `drivescript.py`, set `debug=1` in the registration line.

Caution: the inprocess COM server support will not work when the client process already has Python loaded. It would be rather tricky to non-obtrusively hook into an already running Python, but the show-stopper is that the Python/C API won't let us find out which interpreter instance to hook into. (If this is important to you, you might experiment with using apartment threading, which seems the best possibility to get this to work). To use a "frozen" COM server from a Python process, you'll have to load it as an exe:

```
o = win32com.client.Dispatch(progid,
                 clsctx=pythoncom.CLSCTX_LOCAL_SERVER)
```

Building Optimized

There are two facets to running optimized: gathering `.pyo`'s, and setting the `Py_OptimizeFlag`. Installer will gather `.pyo`'s if it is run optimized:

```
python -O pyinstaller.py ...
```

The `Py_OptimizeFlag` will be set if you use a `('O','','OPTION')` in one of the `TOCs` building the EXE:

```
exe = EXE(pyz,
          a.scripts + [('O','','OPTION')],
          ...
```

See Using Spec Files for details.

`iu.py`: An *imputil* Replacement

Module `iu` grows out of the pioneering work that Greg Stein did with imputil (actually, it includes some verbatim `imputil` code, but since Greg didn't copyright it, we won't mention it). Both modules can take over Python's builtin import and ease writing of at least certain kinds of import hooks.

`iu` differs from `imputil` in that it:

- is faster
- better emulates the builtin import
- is more manageable

There is an `ImportManager` which provides the replacement for builtin import and hides all the semantic complexities of a Python import request from its delegates.

`ImportManager`

`ImportManager` formalizes the concept of a metapath. This concept implicitly exists in native Python in that builtins and frozen modules are searched before `sys.path`, (on Windows there's also a search of the registry, while on Mac, resources may be searched). This metapath is a list populated with `ImportDirector` instances. There are `ImportDirector` subclasses for builtins, frozen modules, (on Windows) modules found through the registry and a `PathImportDirector` for handling `sys.path`. For a top-level import (that is, not an import of a module in a package), `ImportManager` tries each director on its metapath until one succeeds.

`ImportManager` hides the semantic complexity of an import from the directors. It is up to the `ImportManager` to decide if an import is relative or absolute; to see if the module has already been imported; to keep `sys.modules` up to date; to handle the fromlist and return the correct module object.

`ImportDirector`

An `ImportDirector` just needs to respond to `getmod(name)` by returning a module object or `None`. As you will see, an `ImportDirector` can consider name to be atomic - it has no need to examine name to see if it is dotted.

To see how this works, we need to examine the `PathImportDirector`.

`PathImportDirector`

The `PathImportDirector` subclass manages a list of names, most notably `sys.path`. To do so, it maintains a shadowpath, a dictionary mapping the names on its pathlist (eg, `sys.path`) to their associated `Owners`. (It could do this directly, but the assumption that sys.path is occupied solely by strings seems ineradicable.) `Owners` of the appropriate kind are created as needed (if all your imports are satisfied by the first two elements of `sys.path`, the `PathImportDirector`'s shadowpath will only have two entries).

Owner

An `Owner` is much like an `ImportDirector` but manages a much more concrete piece of turf. For example, a `DirOwner` manages one directory. Since there are no other officially recognized filesystem-like namespaces for importing, that's all that's included in `iu`, but it's easy to imagine `Owner``s for zip files (and I have one for my own ``.pyz` archive format) or even URLs.

As with `ImportDirectors`, an `Owner` just needs to respond to `getmod(name)` by returning a module object or `None`, and it can consider name to be atomic.

So structurally, we have a tree, rooted at the `ImportManager`. At the next level, we have a set of `ImportDirectors`. At least one of those directors, the `PathImportDirector` in charge of `sys.path`, has another level beneath it, consisting of `Owners`. This much of the tree covers the entire top-level import namespace.

The rest of the import namespace is covered by treelets, each rooted in a package module (an `__init__.py`).

Packages

To make this work, `Owners` need to recognize when a module is a package. For a `DirOwner`, this means that name is a subdirectory which contains an `__init__.py`. The `__init__` module is loaded and its `__path__` is initialized with the subdirectory. Then, a `PathImportDirector` is created to manage this `__path__`. Finally the new `PathImportDirector`'s `getmod` is assigned to the package's `__importsub__` function.

When a module within the package is imported, the request is routed (by the `ImportManager`) directly to the package's `__importsub__`. In a hierarchical namespace (like a filesystem), this means that `__importsub__` (which is really the bound getmod method of a `PathImportDirector` instance) needs only the module name, not the package name or the fully qualified name. And that's exactly what it gets. (In a flat namespace - like most archives - it is perfectly easy to route the request back up the package tree to the archive `Owner`, qualifying the name at each step.)

Possibilities

Let's say we want to import from zip files. So, we subclass `Owner`. The `__init__` method should take a filename, and raise a `ValueError` if the file is not an acceptable `.zip` file. (When a new name is encountered on `sys.path` or a package's `__path__`, registered Owners are tried until one accepts the name.) The `getmod` method would check the zip file's contents and return `None` if the name is not found. Otherwise, it would extract the marshalled code object from the zip, create a new module object and perform a bit of initialization (12 lines of code all told for my own archive format, including initializing a package with its `__subimporter__`).

Once the new `Owner` class is registered with `iu`, you can put a zip file on `sys.path`. A package could even put a zip file on its `__path__`.

Compatibility

This code has been tested with the PyXML, mxBase and Win32 packages, covering over a dozen import hacks from manipulations of `__path__` to replacing a module in `sys.modules` with a different one. Emulation of Python's native import is nearly exact, including the names recorded in `sys.modules` and module attributes (packages imported through `iu` have an extra attribute - `__importsub__`).

Performance

In most cases, `iu` is slower than builtin import (by 15 to 20%) but faster than `imputil` (by 15 to 20%). By inserting archives at the front of `sys.path` containing the standard lib and the package being tested, this can be reduced to 5 to 10% slower (or, on my 1.52 box, 10% faster!) than builtin import. A bit more can be shaved off by manipulating the `ImportManager`'s metapath.

Limitations

This module makes no attempt to facilitate policy import hacks. It is easy to implement certain kinds of policies within a particular domain, but fundamentally iu works by dividing up the import namespace into independent domains.

Quite simply, I think cross-domain import hacks are a very bad idea. As author of the original package on which *PyInstaller* is based, McMillan worked with import hacks for many years. Many of them are highly fragile; they often rely on undocumented (maybe even accidental) features of implementation. A cross-domain import hack is not likely to work with PyXML, for example.

That rant aside, you can modify `ImportManger` to implement different policies. For example, a version that implements three import primitives: absolute import, relative import and recursive-relative import. No idea what the Python syntax for those should be, but `__aimport__`, `__rimport__` and `__rrimport__` were easy to implement.

iu Usage

Here's a simple example of using `iu` as a builtin import replacement.

```
>>> import iu
>>> iu.ImportManager().install()
>>>
>>> import DateTime
>>> DateTime.__importsub__
<method PathImportDirector.getmod
  of PathImportDirector instance at 825900>
>>>
```