PyInstaller Manual

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Getting Started

Installing PyInstaller

First, unpack the archive on you path of choice. Installer is **not** a Python package, so it doesn't need to go in site-packages, or have a .pth file. For the purpose of this documentation we will assume /your/path/to/pyinstaller/. You will be using a couple of scripts in the /your/path/to/pyinstaller/ directory, and these will find everything they need from their own location. For convenience, keep the paths to these scripts short (don't install in a deeply nested subdirectory).

PyInstaller is dependant to the version of python you configure it for. In other words, you will need a separate copy of PyInstaller for each Python version you wish to work with *or* you'll need to rerun `Configure.py` every time you switch the Python version).

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Building the bootloaders

Note: Windows users can skip this step, because PyInstaller already ships with binary bootloaders.

On Linux the first thing to do is build the bootloaders (that is, the runtime executables). To do that, you need to have some basic C/C++ development tools and the Python development libraries. On Debian/Ubuntu systems, you can run the following lines to install everything required:

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

Change to the /your/path/to/pyinstaller/ `source/linux` subdirectory. Run:

```
pyinstaller$ cd source/linux
pyinstaller/source/linux$ python Make.py  #[-n|-e]
pyinstaller/source/linux$ make
```

This will produce `support/loader/run` and `support/loader/run_d`, which are the bootloaders.

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

The `-n` and `-e` options set a non-elf or elf flag in your `config.dat`. As of v1.0, the executable will try both strategies, and this flag just sets how you want your executables built. In the elf strategy, the archive is concatenated to the executable. In the non-elf strategy, the executable expects an archive with the same name as itself in the executable's directory. Note that the executable chases down symbolic links before determining it's name and directory, so putting the archive in the same directory as the symbolic link will not work.

> **Bootloader**
>
> The bootloader (also known as *stub* in literature) is the small program which starts up your packaged program. Usually, the archive containing the bytecoded modules of your program is simply attended to it. See Self-extracting executables for more details on the process.

Windows distributions of PyInstaller come with several executables in the `support/loader` directory: `run_*.exe` (bootloader for regular programs), and `inprocsrvr_*.dll` (bootloader for in-process COM servers). To rebuild this, you need to install Scons, and then just run `scons` from the /your/path/to/pyinstaller/ directory.

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Configuring your PyInstaller setup

In the /your/path/to/pyinstaller/ directory, run `Configure.py`. This saves some information into `config.dat` that would otherwise be recomputed every time. It can be rerun at any time if your configuration changes. It must be run before trying to build anything.

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Create a spec file for your project

[For Windows COM server support, see section Windows COM Server Support]

This is the first step to do. The spec file is the description of what you want PyInstaller to do with your program. In the root directory of PyInstaller, there is a simple wizard to create simple spec files that cover all basic usages:

```
python Makespec.py [--onefile] yourprogram.py
```

By deafult, `Makespec.py` generates a spec file that tells PyInstaller to create a distribution directory contains the main executable and the dynamic libraries. The option `--onefile` specifies that you want PyInstaller to build a single file with everything inside.

Elaborating on Makespec.py, this is the supported command line:

```
python Makespec.py [opts] <scriptname> [<scriptname> ...]
```

Where allowed OPTIONS are:

`-F, --onefile`	produce a single file deployment (see below).
`-D, --onedir`	produce a single directory deployment (default).
`-K, --tk`	include TCL/TK in the deployment.
`-a, --ascii`	do not include encodings. The default (on Python versions with unicode support) is now to include all encodings.
`-d, --debug`	use debug (verbose) versions of the executables.
`-w, --windowed, --noconsole`	Use the Windows subsystem executable, which does not open the console when the program is launched. **(Windows only)**
`-c, --nowindowed, --console`	Use the console subsystem executable. This is the default. **(Windows only)**
`-s, --strip`	the executable and all shared libraries will be run through strip. Note that cygwin's strip tends to render normal Win32 dlls unusable.
`-X, --upx`	if you have UPX installed (detected by Configure), this will use it to compress your executable (and, on Windows, your dlls). See note below.
`-o DIR, --out=DIR`	create the spec file in *directory*. If not specified, and the current directory is Installer's root directory, an output subdirectory will be created. Otherwise the current directory is used.
`-p DIR, --paths=DIR`	set base path for import (like using PYTHONPATH). Multiple directories are allowed, separating them with the path separator (';' under Windows, ':' under Linux), or using this option multiple times.
`--icon=<FILE.ICO>`	add *file.ico* to the executable's resources. **(Windows only)**
`--icon=<FILE.EXE,N>`	add the *n*-th incon in *file.exe* to the executable's resources. **(Windows only)**
`-v FILE, --version=FILE`	add verfile as a version resource to the executable. **(Windows only)**
`-n NAME, --name=NAME`	optional *name* to assign to the project (from which the spec file name is generated). If omitted, the basename of the (first) script is used.

[For building with optimization on (like `Python -O`), see section Building Optimized]

For simple projects, the generated spec file will probably be sufficient. For more complex projects, it should be regarded as a template. The spec file is actually Python code, and modifying it should be ease. See Spec Files for details.

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Build your project

```
python Build.py specfile
```

A `buildproject` subdirectory will be created in the specfile's directory. This is a private workspace so that `Build.py` can act like a makefile. Any named targets will appear in the specfile's directory.

The generated files will be placed within the `dist` subdirectory; that's where the files you are interested in will be placed.

In most cases, this will be all you have to do. If not, see When things go wrong and be sure to read the introduction to Spec Files.

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Windows COM Server support

For Windows COM support execute:

```
python MakeCOMServer.py [OPTION] script...
```

This will generate a new script `drivescript.py` and a spec file for the script.

These options are allowed:

`--debug`	Use the verbose version of the executable.
`--verbose`	Register the COM server(s) with the quiet flag off.
`--ascii`	do not include encodings (this is passed through to Makespec).
`--out <dir>`	Generate the driver script and spec file in dir.

Now Build your project on the generated spec file.

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

Warnings: 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 I should 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)
```

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

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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 Build.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 Spec Files for details.

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A Note on using UPX

On both Windows and Linux, UPX can give truly startling compression - the days of fitting something useful on a diskette are not gone forever! Installer has been tested with many UPX versions without problems. Just get it and install it on your PATH, then rerun configure.

For Windows, there is a problem of compatibility between UPX and executables generated by Microsoft Visual Studio .NET 2003 (or the equivalent free toolkit available for download). This is especially worrisome for users of Python 2.4+, where most extensions (and Python itself) are compiled with that compiler. This issue has been fixed in later beta versions of UPX, so you will need at least UPX 1.92 beta. Configure.py will check this for you and complain if you have an older version of UPX and you are using Python 2.4.

For Linux, a bit more discussion is in order. First, UPX is only useful on executables, not shared libs. Installer accounts for that, but to get the full benefit, you might rebuild Python with more things statically linked.

More importantly, when `run` finds that its `sys.argv[0]` does not contain a path, it will use `/proc/pid/exe` to find itself (if it can). This happens, for example, when executed by Apache. If it has been upx-ed, this symbolic link points to the tempfile created by the upx stub and PyInstaller will fail (please see the UPX docs for more information). So for now, at least, you can't use upx for CGI's executed by Apache. Otherwise, you can ignore the warnings in the UPX docs, since what PyInstaller opens is the executable Installer created, not the temporary upx-created executable.

> **UPX and Unix**
>
> Under UNIX, old versions of UPX were not able to expand and execute the executable in memory, and they were extracting it into a temporary file in the filesystem, before spawning it. This is no longer valid under Linux, but the information in this paragraph still needs to be updated.

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How one-file mode works

A `--onefile` works by packing all the shared libs / dlls into the archive attached to the bootloader executable (or next to the executable in a non-elf configuration). When first started, it finds that it needs to extract these files before it can run "for real". That's because locating and loading a shared lib or linked-in dll is a system level action, not user-level. With PyInstaller v1.4 it always uses a temporary directory (`_MEIXXXXX`, where `XXXXX` is a random number to avoid conflicts) in the user's temp directory. It then executes itself again, setting things up so the system will be able to load the shared libs / dlls. When execution is complete, it recursively removes the entire directory it created.

The temporary directory is exported to the program's environment as `os.environ['_MEIPASS2']`. This can be used in case you manually modified the spec file to tell PyInstaller to add additional files (eg: data files) within the executable (see also Accessing Data Files).

This has a number of implications:

- You can run multiple copies - they won't collide.
- Running multiple copies will be rather expensive to the system (nothing is shared).
- On Windows, using Task Manager to kill the parent process will leave the directory behind.
- On *nix, a kill -9 (or crash) will leave the directory behind.
- Otherwise, on both platforms, the directory will be recursively deleted.
- So any files you might create in `os.environ['_MEIPASS2']` will be deleted.
- The executable can be in a protected or read-only directory.

Notes for *nix users: Take notice that if the executable does a setuid root, a determined hacker could possibly (given enough tries) introduce a malicious lookalike of one of the shared libraries during the hole between when the library is extracted into the temporary directory and when it gets loaded by the execvp'd process. So maybe you shouldn't do setuid root programs using `--onefile`. **In fact, we do not recomend the use of --onefile on setuid programs.**

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.egg files and setuptools

setuptools is a distutils extensions which provide many benefits, including the ability to distribute the extension as `eggs`. Together with the nifty easy_install (a tool which automatically locates, downloads and installs Python extensions), `eggs` are becoming more and more widespread as a way for distributing

Python extensions.

`eggs` can be either files or directories. An `egg` directory is basically a standard Python package, with some additional metadata that can be used for advanced setuptools features like entry-points. An `egg` file is simply a ZIP file, and it works as a package as well because Python 2.3+ is able to transparently import modules stored within ZIP files.

PyInstaller supports `eggs` at a good level. In fact:

- It is able to follow dependencies within `eggs` (both files and directories). So if your program imports a package shipped in `egg` format, and this package requires additional libraries, PyInstaller will correctly include everything within the generated executable.
- `egg-files` are fully supported. To let everything works (entry-points, `pkg_resource` library, etc.), PyInstaller either copy the `egg-files` into the distribution directory (in one-dir mode) or packs them as-is within the generated executable and unpack them at startup into the temporary directory (see How one-file mode works).
- `egg-directories` are partially supported. In fact, PyInstaller at build time treat them as regular package. This means that all advanced features requiring `egg` metadatas will not work.

Improved support for `eggs` is planned for a future release of PyInstaller.

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PyInstaller Utilities

ArchiveViewer

```
python ArchiveViewer.py <archivefile>
```

ArchiveViewer lets you examine the contents of any archive build with PyInstaller or executable (PYZ, PKG or exe). Invoke it with the target as the first arg (It has been set up as a Send-To so it shows on the context menu in Explorer). The archive can be navigated using these commands:

O <nm>
: Open the embedded archive <nm> (will prompt if omitted).

U
: Go up one level (go back to viewing the embedding archive).

X <nm>
: Extract nm (will prompt if omitted). Prompts for output filename. If none given, extracted to stdout.

Q
: Quit.

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bindepend

```
python bindepend.py <executable_or_dynamic_library>
```

bindepend will analyze the executable you pass to it, and write to stdout all its binary dependencies. This is handy to find out which DLLs are required by an executable or another DLL. This module is used by PyInstaller itself to follow the chain of dependencies of binary extensions and make sure that all of them get included in the final package.

GrabVersion (Windows)

```
python GrabVersion.py <executable_with_version_resource>
```

GrabVersion outputs text which can be eval'ed by `versionInfo.py` to reproduce a version resource. Invoke it with the full path name of a Windows executable (with a version resource) as the first argument. If you cut & paste (or redirect to a file), you can then edit the version information. The edited text file can be used in a `version = myversion.txt` option on any executable in an PyInstaller spec file.

This was done in this way because version resources are rather strange beasts, and fully understanding them is probably impossible. Some elements are optional, others required, but you could spend unbounded amounts of time figuring this out, because it's not well documented. When you view the version tab on a properties dialog, there's no straightforward relationship between how the data is displayed and the structure of the resource itself. So the easiest thing to do is find an executable that displays the kind of information you want, grab it's resource and edit it. Certainly easier than the Version resource wizard in VC++.

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Analyzing Dependencies

You can interactively track down dependencies, including getting cross-references by using `mf.py`, documented in section mf.py: A modulefinder Replacement

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Spec Files

Introduction

Spec files are in Python syntax. They are evaluated by Build.py. A simplistic spec file might look like this:

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

This creates a single file deployment with all binaries (extension modules and their dependencies) packed into the executable.

A simplistic single directory deployment might look like this:

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

Note that neither of these examples are realistic. Use `Makespec.py` (documented in section Create a spec file for your project) to create your specfile, and tweak it (if necessary) from there.

All of the classes you see above are subclasses of `Build.Target`. A Target acts like a rule in a makefile. It knows enough to cache its last inputs and outputs. If its inputs haven't changed, it can assume its outputs wouldn't change on recomputation. So a spec file acts much like a makefile, only rebuilding as much as needs rebuilding. This means, for example, that if you change an `EXE` from `debug=1` to `debug=0`, the rebuild will be nearly instantaneous.

The high level view is that an `Analysis` takes a list of scripts as input, and generates three "outputs", held in attributes named `scripts`, `pure` and `binaries`. A `PYZ` (a `.pyz` archive) is built from the modules in pure. The `EXE` is built from the `PYZ`, the scripts and, in the case of a single-file deployment, the binaries. In a single-directory deployment, a directory is built containing a slim executable and the binaries.

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TOC Class (Table of Contents)

Before you can do much with a spec file, you need to understand the `TOC` (Table Of Contents) class.

A `TOC` appears to be a list of tuples of the form (name, path, typecode). In fact, it's an ordered set, not a list. A TOC contains no duplicates, where uniqueness is based on name only. Furthermore, within this constraint, a TOC preserves order.

Besides the normal list methods and operations, TOC supports taking differences and intersections (and note that adding or extending is really equivalent to union). Furthermore, the operations can take a real list of tuples on the right hand side. This makes excluding modules quite easy. For a pure Python module:

```
pyz = PYZ(a.pure - [('badmodule', '', '')])
```

or for an extension module in a single-directory deployment:

```
dist = COLLECT(..., a.binaries - [('badmodule', '', '')], ...)
```

or for a single-file deployment:

```
exe = EXE(..., a.binaries - [('badmodule', '', '')], ...)
```

To add files to a TOC, you need to know about the typecodes (or the step using the TOC won't know what to do with the entry).

TYPECODE	DESCRIPTION	NAME	PATH
'EXTENSION'	An extension module.	Python internal name.	Full path name in build.
'PYSOURCE'	A script.	Python internal name.	Full path name in build.
'PYMODULE'	A pure Python module (including __init__ modules).	Python internal name.	Full path name in build.
'PYZ'	A .pyz archive (archive_rt.ZlibArchive).	Runtime name.	Full path name in build.
'PKG'	A pkg archive (carchive4.CArchive).	Runtime name.	Full path name in build.
'BINARY'	A shared library.	Runtime name.	Full path name in build.
'DATA'	Aribitrary files.	Runtime name.	Full path name in build.
'OPTION'	A runtime runtime option (frozen into the executable).	The option.	Unused.

You can force the include of any file in much the same way you do excludes:

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

or even:

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

(that is, you can use a list of tuples in place of a `TOC` in most cases).

There's not much reason to use this technique for `PYSOURCE`, since an `Analysis` takes a list of scripts as input. For `PYMODULEs` and `EXTENSIONs`, the hook mechanism discussed here is better because you won't have to remember how you got it working next time.

This technique is most useful for data files (see the `Tree` class below for a way to build a `TOC` from a directory tree), and for runtime options. The options the run executables understand are:

OPTION	DESCRIPTION	EXAMPLE	NOTES
v	Verbose imports	('v', '', 'OPTION')	Same as Python -v ...
u	Unbuffered stdio	('u', '', 'OPTION')	Same as Python -u ...
W spec	Warning option	('W ignore', '', 'OPTION')	Python 2.1+ only.
s	Use site.py	('s', '', 'OPTION')	The opposite of Python's -S flag. Note that site.py must be in the executable's directory to be used.

Advanced users should note that by using set differences and intersections, it becomes possible to factor out common modules, and deploy a project containing multiple executables with minimal redundancy. You'll need some top level code in each executable to mount the common `PYZ`.

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Target Subclasses

Analysis

```
Analysis(scripts, pathex=None, hookspath=None, excludes=None)
```

scripts
: a list of scripts specified as file names.

pathex
: an optional list of paths to be searched before sys.path.

hookspath
: an optional list of paths used to extend the hooks package.

excludes
: an optional list of module or package names (their Python names, not path names) that will be ignored (as though they were not found).

An Analysis has five outputs, all `TOCs` accessed as attributes of the `Analysis`.

scripts
: The scripts you gave Analysis as input, with any runtime hook scripts prepended.

pure
: The pure Python modules.

binaries
: The extension modules and their dependencies. The secondary dependencies are filtered. On Windows, a long list of MS dlls are excluded. On Linux/Unix, any shared lib in `/lib` or `/usr/lib` is excluded.

datas
: Data-file dependencies. These are data-file that are found to be needed by modules. They can be anything: plugins, font files, etc.

zipfiles
: The zipfiles dependencies (usually `egg-files`).

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PYZ

```
PYZ(toc, name=None, level=9)
```

toc
: a `TOC`, normally an `Analysis.pure`.

name
: A filename for the `.pyz`. Normally not needed, as the generated name will do fine.

level
: The Zlib compression level to use. If 0, the zlib module is not required.

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PKG

Generally, you will not need to create your own `PKGs`, as the `EXE` will do it for you. This is one way to include read-only data in a single-file deployment, however. A single-file deployment including TK support will use this technique.

```
PKG(toc, name=None, cdict=None, exclude_binaries=0)
```

toc
: a `TOC`.

name
: a filename for the `PKG` (optional).

cdict
: a dictionary that specifies compression by typecode. For example, `PYZ` is left uncompressed so that it can be accessed inside the `PKG`. The default uses sensible values. If zlib is not available, no

compression is used.

exclude_binaries
: If 1, EXTENSIONs and BINARYs will be left out of the PKG, and forwarded to its container (usually a COLLECT).

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EXE

```
EXE(*args, **kws)
```

args
: One or more arguments which are either TOCs or Targets.

kws
: Possible keyword arguments:

  console
  : Always 1 on Linux/unix. On Windows, governs whether to use the console executable, or the Windows subsystem executable.

  debug
  : Setting to 1 gives you progress messages from the executable (for a console=0, these will be annoying MessageBoxes).

  name
  : The filename for the executable.

  exclude_binaries
  : Forwarded to the PKG the EXE builds.

  icon
  : Windows NT family only. icon='myicon.ico' to use an icon file, or icon='notepad.exe,0' to grab an icon resource.

  version
  : Windows NT family only. version='myversion.txt'. Use GrabVersion.py to steal a version resource from an executable, and then edit the ouput to create your own. (The syntax of version resources is so arcane that I wouldn't attempt to write one from scratch.)

  append_pkg
  : If True, then append the PKG archive to the EXE. If False, place the PKG archive in a separate file exename.pkg. The default is taken from a flag in config.dat and depends on whether Make.py was given the -n argument when building the loader. The default is True on Windows. On non-ELF platforms where concatenating arbitrary data to an executable does not work, append_pkg must be set to False.

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DLL

On Windows, this provides support for doing in-process COM servers. It is not generalized. However, embedders can follow the same model to build a special purpose DLL so the Python support in their app is hidden. You will need to write your own dll, but thanks to Allan Green for refactoring the C code and making that a managable task.

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COLLECT

```
COLLECT(*args, **kws)
```

args
: One or more arguments which are either TOCs or Targets.

kws
: Possible keyword arguments:

  name
  : The name of the directory to be built.

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Tree

```
Tree(root, prefix=None, excludes=None)
```

root
The root of the tree (on the build system).

prefix
Optional prefix to the names on the target system.

excludes

A list of names to exclude. Two forms are allowed:

name
files with this basename will be excluded (do not include the path).

***.ext**
any file with the given extension will be excluded.

Since a `Tree` is a `TOC`, you can also use the exclude technique described above in the section on `TOCs`.

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When Things Go Wrong

Finding out What Went Wrong

Buildtime Warnings

When an `Analysis` step runs, it produces a warnings file (named `warnproject.txt`) in the spec file's directory. Generally, most of these warnings are harmless. 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. So analyzing `os.py` will produce a set of warnings like:

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

Note that the analysis has detected that the import is within a conditional block (an if statement). The analysis also detects if an import within a function or class, (delayed) or at the top level. A top-level, non-conditional import failure is really a hard error. There's at least a reasonable chance that conditional and / or delayed import will be handled gracefully at runtime.

Ignorable 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 of package.

Warnings are also produced when an `__import__`, `exec` or `eval` statement is encountered. The `__import__` warnings should almost certainly be investigated. Both `exec` and `eval` can be used to implement import hacks, but usually their use is more benign.

Any problem detected here can be handled by hooking the analysis of the module. See [Listing Hidden Imports](#) below for how to do it.

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Getting Debug Messages

Setting `debug=1` on an `EXE` will cause the executable to put out progress messages (for console apps, these go to stdout; for Windows apps, these show as MessageBoxes). This can be useful if you are doing complex packaging, or your app doesn't seem to be starting, or just to learn how the runtime works.

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Getting Python's Verbose Imports

You can also pass a `-v` (verbose imports) flag to the embedded Python. This can be extremely useful. I usually try it even on apparently working apps, just to make sure that I'm always getting my copies of the modules and no import has leaked out to the installed Python.

You set this (like the other runtime options) by feeding a phone `TOC` entry to the `EXE`. The easiest way to do this is to change the `EXE` from:

```
EXE(..., anal.scripts, ....)
```

to:

```
EXE(..., anal.scripts + [('v', '', 'OPTION')], ...)
```

These messages will always go to `stdout`, so you won't see them on Windows if `console=0`.

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Helping Installer Find Modules

Extending the Path

When the analysis phase cannot find needed modules, it may be that the code is manipulating `sys.path`. The easiest thing to do in this case is tell `Analysis` about the new directory through the second arg to the constructor:

```
anal = Analysis(['somedir/myscript.py'],
                ['path/to/thisdir', 'path/to/thatdir'])
```

In this case, the `Analysis` will have a search path:

```
['somedir', 'path/to/thisdir', 'path/to/thatdir'] + sys.path
```

You can do the same when running `Makespec.py`:

```
Makespec.py --paths=path/to/thisdir;path/to/thatdir ...
```

(on *nix, use **:** as the path separator).

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Listing Hidden Imports

Hidden imports are fairly common. These can occur when the code is using `__import__` (or, perhaps `exec` or `eval`), in which case you will see a warning in the `warnproject.txt` file. They can also occur when an extension module uses the Python/C API to do an import, in which case Analysis can't detect anything. You can verify that hidden import is the problem by using Python's verbose imports flag. If the import messages say "module not found", but the `warnproject.txt` file has no "no module named..." message for the same module, then the problem is a hidden import.

Hidden imports are handled by hooking the module (the one doing the hidden imports) at `Analysis` time. Do this by creating a file named `hook-module.py` (where module is the fully-qualified Python name, eg, `hook-xml.dom.py`), and placing it in the `hooks` package under PyInstaller's root directory, (alternatively, you can save it elsewhere, and then use the `hookspath` arg to `Analysis` so your private hooks directory will be searched). Normally, it will have only one line:

Standard hidden imports are already included!

If you are getting w orried w hile reading this paragraph, do not w orry: having hidden imports is the exception, not the norm! And anyw ay, PyInstaller already ships w ith a large set of hooks that take

```
hiddenimports = ['module1', 'module2']
```

care of hidden imports for the most common packages out there. For instance, PIL, PyWin32, PyQt are already taken care of.

When the `Analysis` finds this file, it will proceed exactly as though the module explicitly imported `module1` and `module2`. (Full details on the analysis-time hook mechanism is in the Hooks section).

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

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Extending a Package's `__path__`

Python allows a package to extend the search path used to find modules and sub-packages through the `__path__` mechanism. Normally, a package's `__path__` 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` is not actually run during an analysis, we use the same hook mechanism we use for hidden imports. A static list of names won't do, however, because the new entry on `__path__` may well require computation. So `hook-module.py` should define a method `hook(mod)`. The mod argument is an instance of `mf.Module` which has (more or less) the same attributes as a real module object. The hook function should return a `mf.Module` instance - perhaps a brand new one, but more likely the same one used as an arg, but mutated. See mf.py: A Modulefinder Replacement for details, and hooks/hook-win32com.py for an example.

Note that manipulations of `__path__` hooked in this way apply to the analysis, and only 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 awhile, that's not enough.

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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.

At the tail end of an analysis, the module list is examined for matches in `rthooks.dat`, which is the string representation of a Python dictionary. The key is the module name, and the value is a list of hook-script pathnames.

So putting an entry:

```
'somemodule': ['path/to/somescript.py'],
```

into `rthooks.dat` is almost the same thing as doing this:

```
anal = Analysis(['path/to/somescript.py', 'main.py'], ...
```

except that in using the hook, `path/to/somescript.py` will not be analyzed, (that's not a feature - we just haven't found a sane way fit the recursion into my persistence scheme).

Hooks done in this way, while they need to be careful of what they import, are free to do almost anything. One provided hook sets things up so that win32com can generate modules at runtime (to disk), and the generated modules can be found in the win32com package.

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Adapting to being "frozen"

In most sophisticated apps, it becomes necessary to figure out (at runtime) whether you're running "live" or "frozen". For example, you might have a configuration file that (running "live") you locate based on a module's `__file__` attribute. That won't work once the code is packaged up. You'll probably want to look for it based on `sys.executable` instead.

The bootloaders set `sys.frozen=1` (and, for in-process COM servers, the embedding DLL sets `sys.frozen='dll'`).

For really advanced users, you can access the `iu.ImportManager` as `sys.importManager`. See iu.py for how you might make use of this fact.

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Accessing Data Files

In a `--onedir` distribution, this is easy: pass a list of your data files (in `TOC` format) to the `COLLECT`, and they will show up in the distribution directory tree. The name in the `(name, path, 'DATA')` tuple can be a relative path name. Then, at runtime, you can use code like this to find the file:

```
os.path.join(os.path.dirname(sys.executable), relativename))
```

In a `--onefile` distribution, data files are bundled within the executable and then extracted at runtime into the work directory by the C code (which is also able to reconstruct directory trees). The work directory is best found by `os.environ['_MEIPASS2']`. So, you can access those files through:

```
os.path.join(os.environ["_MEIPASS2], relativename))
```

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MISCELLANEOUS

Pmw -- Python Mega Widgets

Pmw comes with a script named `bundlepmw` in the bin directory. If you follow the instructions in that script, you'll end up with a module named `Pmw.py`. Ensure that Builder finds that module and not the development package.

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Win9xpopen

If you're using popen on Windows and want the code to work on Win9x, you'll need to distribute `win9xpopen.exe` with your app. On older Pythons with Win32all, this would apply to Win32pipe and `win32popenWin9x.exe`. (On yet older Pythons, no form of popen worked on Win9x).

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Self-extracting executables

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 name, seek to the end and 'open' the `CArchive` (see figure 3).

On other platforms, the archive and the executable are separate, but the archive is named `executable.pkg`, and expected to be in the same directory. Other than that, the process is the same.

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One Pass Execution

In a single directory deployment (`--onedir`, which is the default), all of the binaries are already in the file system. In that case, the embedding app:

- opens the archive
- starts Python (on Windows, this is done with dynamic loading so one embedding app binary can be used with any Python version)
- imports all the modules which are at the top level of the archive (basically, bootstraps the import hooks)
- mounts the `ZlibArchive(s)` in the outer archive
- runs all the scripts which are at the top level of the archive
- finalizes Python

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Two Pass Execution

There are a couple situations which require two passes:

- a `--onefile` deployment (on Windows, the files can't be cleaned up afterwards because Python does not call `FreeLibrary`; on other platforms, Python won't find them if they're extracted in the same process that uses them)
- `LD_LIBRARY_PATH` needs to be set to find the binaries (not extension modules, but modules the extensions are linked to).

The first pass:

- opens the archive
- extracts all the binaries in the archive (in PyInstaller v1.4, this is always to a temporary directory).
- sets a magic environment variable
- sets `LD_LIBRARY_PATH` (non-Windows)
- executes itself as a child process (letting the child use his stdin, stdout and stderr)
- waits for the child to exit (on *nix, the child actually replaces the parent)
- cleans up the extracted binaries (so on *nix, this is done by the child)

The child process executes as in One Pass Execution above (the magic environment variable is what tells it that this is pass two).

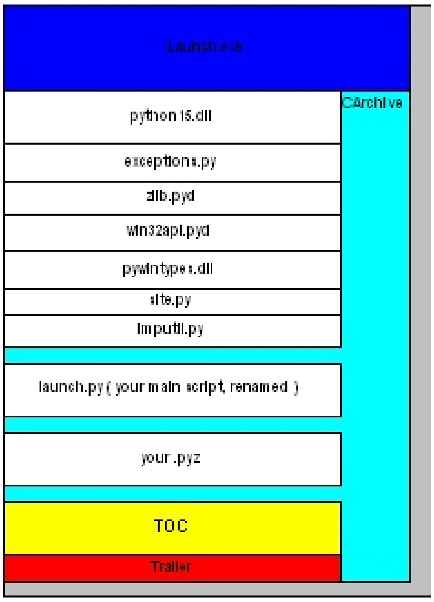

figure 3 - Self Extracting Executable

There are, of course, quite a few differences between the Windows and Unix/Linux versions. The major one is that because all of Python on Windows is in `pythonXX.dll`, and dynamic loading is so simple-minded, that one binary can be use with any version of Python. There's much in common, though, and that C code can be found in source/common/launch.c.

The Unix/Linux build process (which you need to run just once for any version of Python) makes use of the config information in your install (if you installed from RPM, you need the Python-development RPM). It also overrides `getpath.c` since we don't want it hunting around the filesystem to build `sys.path`.

In both cases, while one PyInstaller download can be used with any Python version, you need to have separate installations for each Python version.

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PyInstaller Archives

Archives Introduction

You know what an archive is: a `.tar` file, a `.jar` file, a `.zip` file. Two kinds of archives are used here. One is equivalent to a Java `.jar` file - it allows Python modules to be stored efficiently and, (with some import hooks) imported directly. This is a `ZlibArchive`. The other (a `CArchive`) is equivalent 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.

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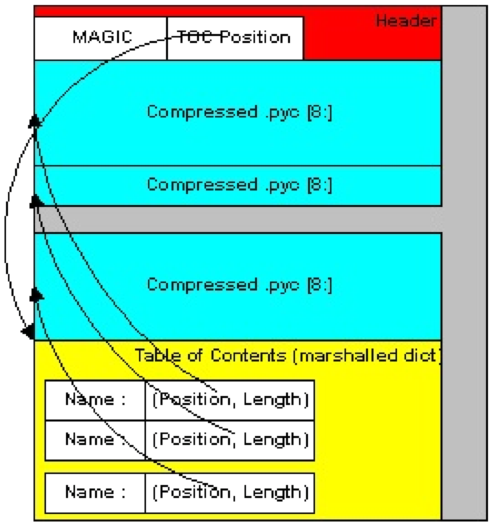
ZlibArchive

A `ZlibArchive` contains compressed `.pyc` (or `.pyo`) files. The Table of Contents is a marshalled dictionary, with the key (the module's name as given in an `import` statement) associated with a seek position and length. Because it is all marshalled Python, `ZlibArchives` are completely cross-platform.

A `ZlibArchive` hooks in with iu.py so that, with a little setup, the archived modules can be imported transparently. Even with compression at level 9, this works out to being faster than the normal import. Instead of searching `sys.path`, there's a lookup in the dictionary. There's no `stat`-ing of the `.py` and `.pyc` and no file opens (the file is already open). There's just a seek, a read and a decompress. A traceback will point to the source file the archive entry was created from (the `__file__` attribute from the time the `.pyc` was compiled). On a user's box with no source installed, this is not terribly useful, but if they send you the traceback, at least you can make sense of it.



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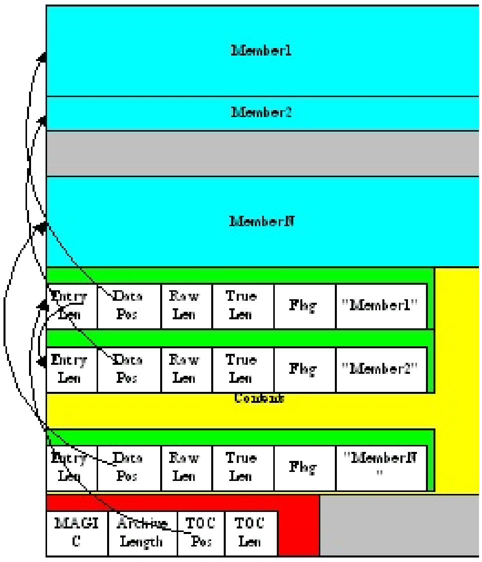
CArchive

A `CArchive` contains whatever you want to stuff into it. It's very much like a `.zip` file. They are easy to create in Python and unpack from C code. `CArchives` can be appended to other files (like ELF and COFF executables, for example). To allow this, they are opened from the end, so the `TOC` for a `CArchive` is at the back, followed only by a cookie that tells you where the `TOC` starts and where the archive itself starts.

`CArchives` can also be embedded within other `CArchives`. The inner archive can be opened in place (without extraction).

Each `TOC` entry is variable length. The first field in the entry tells you the length of the entry. The last field is the name of the corresponding packed file. The name is null terminated. Compression is optional by member.

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



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License

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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 *these* changes to the PyInstaller source code falls under the terms of the GPL license. In other words, any modifications to will *have* to be distributed under GPL.

For updated information or clarification see our [FAQ](#) at [PyInstaller](#) home page: http://pyinstaller.hpcf.upr.edu

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Appendix

`mf.py`: A Modulefinder Replacement

Module `mf` is modelled after `iu`.

It also 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`, `mf` has an `ImportTracker` managing things.

You can stop reading here...

... if you are not interested in technical details. This appendix contains insights of the internal workings of PyInstaller, and you do not need this information unless you plan to work on PyInstaller itself.

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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.

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`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.

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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 it's 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 it's hooks mechanism.

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code scanning

Like modulefinder, `mf` scans the byte code of a module, looking for imports. In addition, `mf` 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're 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).

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Hooks

In modulefinder, scanning the code takes the place of executing the code object. `mf` goes further and allows a module to be hooked (after it has been scanned, but before analyze_one is done with it). A hook is a module named `hook-fullyqualifiedname` in the `hooks` package. These modules should have one or more of the following three global names defined:

`hiddenimports`
: a list of modules names (relative or absolute) that the module imports in some untrackable way.

`attrs`
: a list of `(name, value)` pairs (where value is normally meaningless).

`hook(mod)`
: a function taking a `Module` instance and returning a `Module` instance (so it can modify or replace).

The first hook (`hiddenimports`) extends the list created by scanning the code. `ExtensionModules`, of course, don't get scanned, so this is the only way of recording any imports they do.

The second hook (`attrs`) exists mainly so that ImportTracker won't issue spurious warnings when the rightmost node in a dotted name turns out to be an attribute in a package module, instead of a missing submodule.

The callable hook exists for things like dynamic modification of a package's `__path__` or perverse situations, like `xml.__init__` replacing itself in `sys.modules` with `_xmlplus.__init__`. (It takes nine hook modules to properly trace through PyXML-using code, and I can't believe that it's any easier for the poor programmer using that package). The `hook(mod)` (if it exists) is called before looking at the others - that way it can, for example, test `sys.version` and adjust what's in `hiddenimports`.

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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.

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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.

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Usage

A simple example follows:

```
>>> import mf
>>> a = mf.ImportTracker()
>>> a.analyze_r("os")
['os', 'sys', 'posixpath', 'nt', 'stat', 'string', 'strop',
're', 'pcre', 'ntpath', 'dospath', 'macpath', 'win32api',
'UserDict', 'copy', 'types', 'repr', 'tempfile']
>>> a.analyze_one("os")
['os']
>>> a.modules['string'].imports
[('strop', 0, 0), ('strop.*', 0, 0), ('re', 1, 1)]
>>>
```

The tuples in the imports list are (name, delayed, conditional).

```
>>> for w in a.modules['string'].warnings: print w
...
W: delayed  eval hack detected at line 359
W: delayed  eval hack detected at line 389
W: delayed  eval hack detected at line 418
>>> for w in a.getwarnings(): print w
...
W: no module named pwd (delayed, conditional import by posixpath)
W: no module named dos (conditional import by os)
W: no module named os2 (conditional import by os)
W: no module named posix (conditional import by os)
W: no module named mac (conditional import by os)
W: no module named MACFS (delayed, conditional import by tempfile)
W: no module named macfs (delayed, conditional import by tempfile)
W: top-level conditional exec statment detected at line 47
   - os (C:\Program Files\Python\Lib\os.py)
W: delayed  eval hack detected at line 359
   - string (C:\Program Files\Python\Lib\string.py)
W: delayed  eval hack detected at line 389
   - string (C:\Program Files\Python\Lib\string.py)
W: delayed  eval hack detected at line 418
   - string (C:\Program Files\Python\Lib\string.py)
>>>
```

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`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`: * faster * better emulation of builtin import * more managable

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

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`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 it's metapath until one succeeds.

`ImportManager` hides the semantic complexity of an import from the directors. It's 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.

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`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`.

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`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).

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`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 `Owners` 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`).

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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`) diretly 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.)

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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 pack age with it's `__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__`.

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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__`).

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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.

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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.

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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>
>>>
```

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