5. Creating Built Distributions

A “built distribution” is what you’re probably used to thinking of either as a “binary package” or an “installer” (depending on your background). It’s not necessarily binary, though, because it might contain only Python source code and/or byte-code; and we don’t call it a package, because that word is already spoken for in Python. (And “installer” is a term specific to the world of mainstream desktop systems.)

A built distribution is how you make life as easy as possible for installers of your module distribution: for users of RPM-based Linux systems, it’s a binary RPM; for Windows users, it’s an executable installer; for Debian-based Linux users, it’s a Debian package; and so forth. Obviously, no one person will be able to create built distributions for every platform under the sun, so the Distutils are designed to enable module developers to concentrate on their specialty—writing code and creating source distributions—while an intermediary species called *packagers* springs up to turn source distributions into built distributions for as many platforms as there are packagers.

Of course, the module developer could be his own packager; or the packager could be a volunteer “out there” somewhere who has access to a platform which the original developer does not; or it could be software periodically grabbing new source distributions and turning them into built distributions for as many platforms as the software has access to. Regardless of who they are, a packager uses the setup script and the **bdist** command family to generate built distributions.

As a simple example, if I run the following command in the Distutils source tree:

```
python setup.py bdist
```

then the Distutils builds my module distribution (the Distutils itself in this case), does a “fake” installation (also in the `build` directory), and creates the default type of built distribution for my platform. The default format for built distributions is a “dumb” tar file on Unix, and a simple executable installer on Windows. (That tar file is considered “dumb” because it has to be unpacked in a specific location to work.)

Thus, the above command on a Unix system creates `Distutils-1.0.`*`plat`*`.tar.gz`; unpacking this tarball from the right place installs the Distutils just as though you had downloaded the source distribution and run `python setup.py install`. (The “right place” is either the root of the filesystem or Python’s *`prefix`* directory, depending on the options given to the **bdist_dumb** command; the default is to make dumb distributions relative to *`prefix`*.)

Obviously, for pure Python distributions, this isn't any simpler than just running `python setup.py install`—but for non-pure distributions, which include extensions that would need to be compiled, it can mean the difference between someone being able to use your extensions or not. And creating "smart" built distributions, such as an RPM package or an executable installer for Windows, is far more convenient for users even if your distribution doesn't include any extensions.

The **bdist** command has a `--formats` option, similar to the **sdist** command, which you can use to select the types of built distribution to generate: for example,

```
python setup.py bdist --format=zip
```

would, when run on a Unix system, create `Distutils-1.0.`*`plat`*`.zip`—again, this archive would be unpacked from the root directory to install the Distutils.

The available formats for built distributions are:

Format	Description	Notes
`gztar`	gzipped tar file (`.tar.gz`)	(1)
`bztar`	bzipped tar file (`.tar.bz2`)	
`xztar`	xzipped tar file (`.tar.xz`)	
`ztar`	compressed tar file (`.tar.Z`)	(3)
`tar`	tar file (`.tar`)	
`zip`	zip file (`.zip`)	(2),(4)
`rpm`	RPM	(5)
`pkgtool`	Solaris **pkgtool**	
`sdux`	HP-UX **swinstall**	
`wininst`	self-extracting ZIP file for Windows	(4)
`msi`	Microsoft Installer.	

Changed in version 3.5: Added support for the `xztar` format.

Notes:

1. default on Unix
2. default on Windows
3. requires external **compress** utility.
4. requires either external **zip** utility or `zipfile` module (part of the standard Python library since Python 1.6)
5. requires external **rpm** utility, version 3.0.4 or better (use `rpm --version` to find out which version you have)

You don't have to use the **bdist** command with the `--formats` option; you can also use the command that directly implements the format you're interested in. Some of these **bdist** "sub-commands" actually generate several similar formats; for instance, the **bdist_dumb** command generates all the "dumb" archive formats (`tar`, `gztar`, `bztar`, `xztar`, `ztar`, and `zip`), and **bdist_rpm** generates both binary and source RPMs. The **bdist** sub-commands, and the formats generated by each, are:

Command	Formats
bdist_dumb	tar, gztar, bztar, xztar, ztar, zip
bdist_rpm	rpm, srpm
bdist_wininst	wininst
bdist_msi	msi

The following sections give details on the individual **bdist_*** commands.

5.1. Creating RPM packages

The RPM format is used by many popular Linux distributions, including Red Hat, SuSE, and Mandrake. If one of these (or any of the other RPM-based Linux distributions) is your usual environment, creating RPM packages for other users of that same distribution is trivial. Depending on the complexity of your module distribution and differences between Linux distributions, you may also be able to create RPMs that work on different RPM-based distributions.

The usual way to create an RPM of your module distribution is to run the **bdist_rpm** command:

```
python setup.py bdist_rpm
```

or the **bdist** command with the `--format` option:

```
python setup.py bdist --formats=rpm
```

The former allows you to specify RPM-specific options; the latter allows you to easily specify multiple formats in one run. If you need to do both, you can explicitly specify multiple **bdist_*** commands and their options:

```
python setup.py bdist_rpm --packager="John Doe <jdoe@example.org>" \
                bdist_wininst --target-version="2.0"
```

Creating RPM packages is driven by a `.spec` file, much as using the Distutils is driven by the setup script. To make your life easier, the **bdist_rpm** command normally creates a `.spec` file based on the information you supply in the setup script, on the command line, and in any Distutils configuration files. Various options and sections in the `.spec` file are derived from options in the setup script as follows:

RPM `.spec` file option or section	Distutils setup script option
Name	`name`
Summary (in preamble)	`description`
Version	`version`
Vendor	`author` and `author_email`, or — & `maintainer` and `maintainer_email`
Copyright	`license`
Url	`url`
%description (section)	`long_description`

Additionally, there are many options in `.spec` files that don't have corresponding options in the setup script. Most of these are handled through options to the **bdist_rpm** command as follows:

RPM `.spec` file option or section	bdist_rpm option	default value
Release	`release`	"1"
Group	`group`	"Development/Libraries"
Vendor	`vendor`	(see above)
Packager	`packager`	(none)
Provides	`provides`	(none)
Requires	`requires`	(none)
Conflicts	`conflicts`	(none)
Obsoletes	`obsoletes`	(none)
Distribution	`distribution_name`	(none)
BuildRequires	`build_requires`	(none)
Icon	`icon`	(none)

Obviously, supplying even a few of these options on the command-line would be tedious and error-prone, so it's usually best to put them in the setup configuration file, `setup.cfg`—see section Writing the Setup Configuration File. If you distribute or package many Python module distributions, you might want to put options that apply to all of them in your personal Distutils configuration file (`~/.pydistutils.cfg`). If you want to temporarily disable this file, you can pass the `--no-user-cfg` option to `setup.py`.

There are three steps to building a binary RPM package, all of which are handled automatically by the Distutils:

1. create a `.spec` file, which describes the package (analogous to the Distutils setup script; in fact, much of the information in the setup script winds up in the `.spec` file)
2. create the source RPM
3. create the “binary” RPM (which may or may not contain binary code, depending on whether your module distribution contains Python extensions)

Normally, RPM bundles the last two steps together; when you use the Distutils, all three steps are typically bundled together.

If you wish, you can separate these three steps. You can use the `--spec-only` option to make **bdist_rpm** just create the `.spec` file and exit; in this case, the `.spec` file will be written to the “distribution directory”—normally `dist/`, but customizable with the `--dist-dir` option. (Normally, the `.spec` file winds up deep in the “build tree,” in a temporary directory created by **bdist_rpm**.)

5.2. Creating Windows Installers

Executable installers are the natural format for binary distributions on Windows. They display a nice graphical user interface, display some information about the module distribution to be installed taken from the metadata in the setup script, let the user select a few options, and start or cancel the installation.

Since the metadata is taken from the setup script, creating Windows installers is usually as easy as running:

```
python setup.py bdist_wininst
```

or the **bdist** command with the `--formats` option:

```
python setup.py bdist --formats=wininst
```

If you have a pure module distribution (only containing pure Python modules and packages), the resulting installer will be version independent and have a name like `foo-1.0.win32.exe`. These installers can even be created on Unix platforms or Mac OS X.

If you have a non-pure distribution, the extensions can only be created on a Windows platform, and will be Python version dependent. The installer filename will reflect this and now has the form `foo-1.0.win32-py2.0.exe`. You have to create a separate installer for every Python version you want to support.

The installer will try to compile pure modules into bytecode after installation on the target system in normal and optimizing mode. If you don't want this to happen for some reason, you can run the **bdist_wininst** command with the `--no-target-compile` and/or the `--no-target-optimize` option.

By default the installer will display the cool "Python Powered" logo when it is run, but you can also supply your own 152x261 bitmap which must be a Windows `.bmp` file with the `--bitmap` option.

The installer will also display a large title on the desktop background window when it is run, which is constructed from the name of your distribution and the version number. This can be changed to another text by using the `--title` option.

The installer file will be written to the "distribution directory" — normally `dist/`, but customizable with the `--dist-dir` option.

5.3. Cross-compiling on Windows

Starting with Python 2.6, distutils is capable of cross-compiling between Windows platforms. In practice, this means that with the correct tools installed, you can use a 32bit version of Windows to create 64bit extensions and vice-versa.

To build for an alternate platform, specify the `--plat-name` option to the build command. Valid values are currently 'win32', 'win-amd64' and 'win-ia64'. For example, on a 32bit version of Windows, you could execute:

```
python setup.py build --plat-name=win-amd64
```

to build a 64bit version of your extension. The Windows Installers also support this option, so the command:

```
python setup.py build --plat-name=win-amd64 bdist_wininst
```

would create a 64bit installation executable on your 32bit version of Windows.

To cross-compile, you must download the Python source code and cross-compile Python itself for the platform you are targeting - it is not possible from a binary installation of Python (as the .lib etc file for other platforms are not included.) In practice, this means the user of a 32 bit operating system will need to use Visual Studio 2008 to open the `PCBuild/PCbuild.sln` solution in the Python source tree and build the "x64" configuration of the 'pythoncore' project before cross-compiling extensions is possible.

Note that by default, Visual Studio 2008 does not install 64bit compilers or tools. You may need to reexecute the Visual Studio setup process and select these tools (using Control Panel->[Add/Remove] Programs is a convenient way to check or modify your existing install.)

5.3.1. The Postinstallation script

Starting with Python 2.3, a postinstallation script can be specified with the `--install-script` option. The basename of the script must be specified, and the script filename must also be listed in the scripts argument to the setup function.

This script will be run at installation time on the target system after all the files have been copied, with `argv[1]` set to `-install`, and again at uninstallation time before the files are removed with `argv[1]` set to `-remove`.

The installation script runs embedded in the windows installer, every output (`sys.stdout`, `sys.stderr`) is redirected into a buffer and will be displayed in the GUI after the script has finished.

Some functions especially useful in this context are available as additional built-in functions in the installation script.

`directory_created`(*path*)
`file_created`(*path*)

These functions should be called when a directory or file is created by the postinstall script at installation time. It will register *path* with the uninstaller, so that it will be removed when the distribution is uninstalled. To be safe, directories are only removed if they are empty.

`get_special_folder_path`(*csidl_string*)

This function can be used to retrieve special folder locations on Windows like the Start Menu or the Desktop. It returns the full path to the folder. *csidl_string* must be one of the following strings:

```
"CSIDL_APPDATA"

"CSIDL_COMMON_STARTMENU"
"CSIDL_STARTMENU"

"CSIDL_COMMON_DESKTOPDIRECTORY"
"CSIDL_DESKTOPDIRECTORY"

"CSIDL_COMMON_STARTUP"
"CSIDL_STARTUP"

"CSIDL_COMMON_PROGRAMS"
```

```
"CSIDL_PROGRAMS"

"CSIDL_FONTS"
```

If the folder cannot be retrieved, `OSError` is raised.

Which folders are available depends on the exact Windows version, and probably also the configuration. For details refer to Microsoft's documentation of the `SHGetSpecialFolderPath()` function.

`create_shortcut`(*target*, *description*, *filename*[, *arguments*[, *workdir*[, *iconpath*[, *iconindex*]]]])

This function creates a shortcut. *target* is the path to the program to be started by the shortcut. *description* is the description of the shortcut. *filename* is the title of the shortcut that the user will see. *arguments* specifies the command line arguments, if any. *workdir* is the working directory for the program. *iconpath* is the file containing the icon for the shortcut, and *iconindex* is the index of the icon in the file *iconpath*. Again, for details consult the Microsoft documentation for the `IShellLink` interface.

5.4. Vista User Access Control (UAC)

Starting with Python 2.6, bdist_wininst supports a `--user-access-control` option. The default is 'none' (meaning no UAC handling is done), and other valid values are 'auto' (meaning prompt for UAC elevation if Python was installed for all users) and 'force' (meaning always prompt for elevation).