

Python Packaging and Project Structure

Joseph Hellerstein^{1,3}, Bernease Herman¹, David Beck^{1,2,3},
Sam Gao³

¹eScience Institute

²Chemical Engineering

³Computer Science

April 23, 2019



Agenda

1. Importing in Python
2. Dependency basics
3. Project directory structure for Python projects
4. Packaging Python projects and PyPI



Basic definitions



Basic Definitions

object: Most things in Python, e.g. function, variable, class.

module: A *.py script; carries the name as the file.

built-in module: A “module” that operates like a *.py module, but has been compiled directly into the Python interpreter; often created in C programming language.

namespace: A mapping of unique names to objects.

package: A directory-like concept that can hold multiple Python objects, subpackages under same namespace.



Importing packages



Imports

Order in which Python searches for modules to import:

1. built-in modules in the Python Standard Library (e.g. `math`, `os`)
2. modules or packages in a directory specified by `sys.path`:
 1. If the Python interpreter is run interactively:
 - `sys.path[0]` is the empty string `''`. This tells Python to search the current working directory from which you launched the interpreter, i.e. the output of `pwd` on Unix systems.
 2. If we run a script with `python <script>.py`:
 - `sys.path[0]` is the path to `<script>.py`
 3. directories in the `PYTHONPATH` environment variable
 4. default `sys.path` locations



Imports

There are 4 different syntaxes for writing import statements.

1. `import <package>`
2. `import <module>`
3. `from <package> import <module or subpackage or object>`
4. `from <module> import <object>`

Let `X` be whatever name comes after `import`.

- If `X` is the name of a module or package, then to use objects defined in `X`, you have to write `X.object`.
- If `X` is a variable name, then it can be used directly.
- If `X` is a function name, then it can be invoked with `X()`

Optionally, `as Y` can be added after any `import X` statement: `import X as Y`. The argument to the `import` function can be a single name, or a list of multiple names. Each of these names can be optionally renamed via `as`.



Absolute vs. Relative Imports

Absolute Imports (works in Python 2 and 3):

Import from the top-level Python package. e.g., `import <package>`

Relative Imports:

Import based on your `sys.path` location.

***Explicit* Relative Imports (works in Python 2 and 3):**

Import using `.` and `..` notation.

***Implicit* Relative Imports (only Python 2):**

Python searches down your path to find subpackages or modules you may be referring to. This discouraged and thus, discontinued.



Directory structure



Dependencies



Basic codebase in a Git directory

```
myproject/
```

```
  README.md
```

```
  LICENSE
```

```
myproject/
```

```
  __init__.py
```

```
  core.py
```

```
+submodule/
```

```
-tests/
```

```
  __init__.py
```

```
  test_core.py
```

← This is your git repository,
usually matching the name on
Github



Basic codebase in a Git directory

`myproject/`

← This is your git repository, usually matching the name on Github



Basic codebase in a Git directory

myproject/
 README.md

← Markdown-formatted or plain text file
describing the package.



Basic codebase in a Git directory

```
myproject/  
  README.md  
  LICENSE
```

← Software license specifying how others may use your code.



Basic codebase in a Git directory

```
myproject/
```

```
    README.md
```

```
    LICENSE
```

```
myproject/
```

← The Python package, helpful for
import myproject into separate
namespace.



Basic codebase in a Git directory

```
myproject/
```

```
    README.md
```

```
    LICENSE
```

```
    myproject/
```

```
        __init__.py
```

← This module marks the directory (optional in 3.3+) as a Python package and is run upon import.



Basic codebase in a Git directory

```
myproject/  
  README.md  
  LICENSE  
myproject/  
  __init__.py  
  core.py
```

← Other modules in package containing importable code.



Basic codebase in a Git directory

```
myproject/  
  README.md  
  LICENSE  
myproject/  
  __init__.py  
  core.py  
+ submodule/
```

← Packages can have subpackages (and sub-subpackages, etc.) to any depth. They contain their own `__init__.py` files.



Basic codebase in a Git directory

```
myproject/
```

```
  README.md
```

```
  LICENSE
```

```
  myproject/
```

```
    __init__.py
```

```
    core.py
```

```
  +submodule/
```

```
  -tests/
```

```
    __init__.py
```

```
    test_core.py
```

← Unit tests go into their own submodule.



Packaging and distributing Python projects



GitHub

The screenshot shows a web browser window displaying the GitHub repository page for `uwescience/pulse2percept`. The browser's address bar shows the URL `https://github.com/uwescience/pulse2percept`. The GitHub navigation bar at the top includes a search bar, links for Pull requests, Issues, Marketplace, and Explore. The repository header shows the name `uwescience / pulse2percept`, a 'Watch' button, and a star count of 17. Below the header, a tabbed interface shows 'Code' as the active tab, with other tabs for Issues (9), Pull requests (1), Projects (0), Wiki, Insights, and Settings. The repository description is 'A Python-based simulation framework for bionic vision' with a link to `http://uwescience.github.io/pulse2per...`. Below the description are topic tags: `python`, `neuroscience`, `vision`, `retinal-prosthetics`, and a 'Manage topics' link. A statistics bar shows 481 commits, 2 branches, 6 releases, 1 environment, and 5 contributors. At the bottom, there are buttons for 'Branch: master', 'New pull request', 'Create new file', 'Upload files', and 'Find'. The bottom of the page shows a commit by `ezgirmak` and `mbeyeler` titled 'Allow passing alpha constant to grid class (#86)'.

uwescience/pulse2percept: A F X

GitHub, Inc. [US] | <https://github.com/uwescience/pulse2percept>

Apps People · UWSEDS...

Search or jump to... / Pull requests Issues Marketplace Explore

uwescience / pulse2percept Watch 17

<> Code Issues 9 Pull requests 1 Projects 0 Wiki Insights Settings

A Python-based simulation framework for bionic vision <http://uwescience.github.io/pulse2per...>

python neuroscience vision retinal-prosthetics Manage topics

481 commits 2 branches 6 releases 1 environment 5 contributors

Branch: master New pull request Create new file Upload files Find

ezgirmak and mbeyeler Allow passing alpha constant to grid class (#86) ... Lat

PyPI

The image is a screenshot of a web browser displaying the PyPI project page for 'pulse2percept'. The browser's address bar shows the URL 'https://pypi.org/project/pulse2percept/'. The page has a blue header with the project name 'pulse2percept 0.4.3' in large white text. To the right of the name is a green button with a checkmark and the text 'Latest version'. Below the name is a white box containing the command 'pip install pulse2percept' and a copy icon. To the right of this box, it says 'Last released: May 21, 2018'. Below the blue header is a light gray section with the text 'pulse2percept: A Python-based simulation framework for bionic vision'. The page is divided into two columns. The left column, titled 'Navigation', contains two links: 'Project description' (highlighted with a blue background) and 'Release history'. The right column, titled 'Project description', contains a paragraph of text about the project's purpose and the challenges it addresses.

pulse2percept · PyPI

Python Software Foundation [US] | <https://pypi.org/project/pulse2percept/>

pulse2percept 0.4.3

✓ Latest version

`pip install pulse2percept`

Last released: May 21, 2018

pulse2percept: A Python-based simulation framework for bionic vision

Navigation

- Project description
- Release history

Project description

By 2020 roughly 200 million people will suffer from retinal diseases such as macular degeneration or retinitis pigmentosa. Consequently, a variety of retinal sight restoration procedures are being developed to target these diseases. Electronic prostheses (currently being implanted in patients) directly stimulate remaining retinal cells using electrical

Extending project structure for PyPI

```
myproject/
```

```
    README.md
```

```
    LICENSE
```

```
myproject/
```

```
    __init__.py
```

```
    setup.py
```

```
    requirements.txt
```

```
    MANIFEST.in
```

```
    core.py
```

```
+submodule/
```

```
+tests/
```

← Contains metadata for the package. Often uses `distutils` or `setuptools` standards.

Can contain abstract vital dependencies.



Extending project structure for PyPI

```
myproject/
```

```
    README.md
```

```
    LICENSE
```

```
myproject/
```

```
    __init__.py
```

```
    setup.py
```

```
    requirements.txt
```

```
    MANIFEST.in
```

```
    core.py
```

```
+submodule/
```

```
+tests/
```

← Contains absolute dependencies, especially useful in the application case.

Can generated using:

```
$ pip freeze > requirements.txt
```



Extending project structure in PyPI

```
myproject/  
  README.md  
  LICENSE  
myproject/  
  __init__.py  
  setup.py  
  requirements.txt  
  MANIFEST.in  
  core.py  
+submodule/  
+tests/
```

← Specify data and files that should also be packaged in addition to the Python modules.



Basic setup.py file

```
import setuptools

setuptools.setup(
    name="example-pkg-your-username",
    version="0.0.1",
    author="Example Author",
    author_email="author@example.com",
    description="A small example package",
    install_requires=['docutils>=0.3'],
    long_description=long_description,
    long_description_content_type="text/markdown",
    url="https://github.com/pypa/sampleproject",
    packages=setuptools.find_packages(),
    classifiers=[
        "Programming Language :: Python :: 3",
        "License :: OSI Approved :: MIT License",
        "Operating System :: OS Independent",
    ],
)
```



Submitting your package to PyPI

Update your code and version number. Run your test suites and ensure your code works as intended.

Create your **source**, and if desired, **binary** distribution:

```
$ python setup.py bdist_egg upload [options]  
$ python setup.py bdist_wininst [options]  
$ python setup.py sdist [options]
```

Install `twine` package to submit builds to PyPI.

(Can install using `conda install twine`, `pip install twine`, etc.)

```
$ twine upload dist/*
```

