# Python projects' Best Practices

## Who am I

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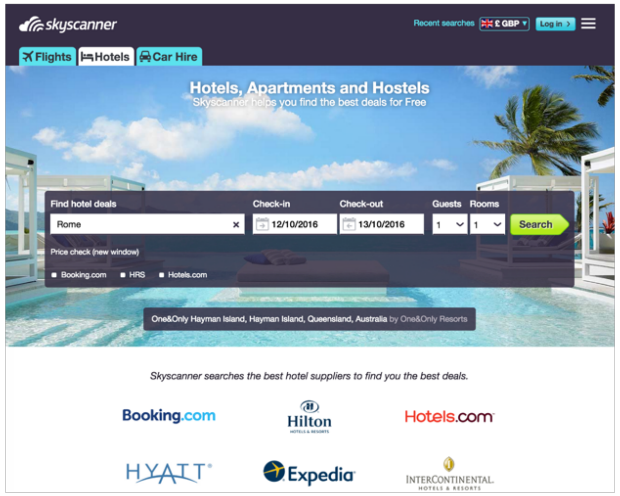
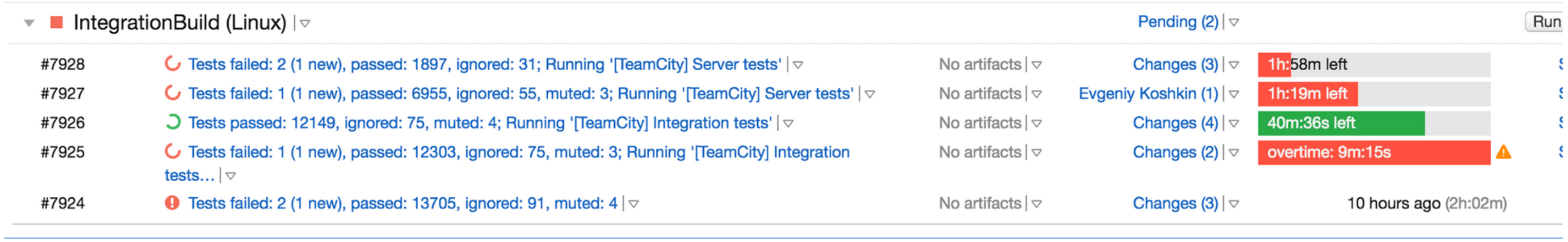
## Motivation

- Started in a mature Python project
- CI & CD already set up





IntegrationBuild (Linux) | Pending (2) | Run

| | | | | |
|---|---|---|---|---|
| #7928 | Tests failed: 2 (1 new), passed: 1897, ignored: 31; Running '[TeamCity] Server tests' | No artifacts | Changes (3) | 1h:58m left |
| #7927 | Tests failed: 1 (1 new), passed: 6955, ignored: 55, muted: 3; Running '[TeamCity] Server tests' | No artifacts | Evgeniy Koshkin (1) | 1h:19m left |
| #7926 | Tests passed: 12149, ignored: 75, muted: 4; Running '[TeamCity] Integration tests' | No artifacts | Changes (4) | 40m:36s left |
| #7925 | Tests failed: 1 (1 new), passed: 12303, ignored: 75, muted: 3; Running '[TeamCity] Integration tests… | No artifacts | Changes (2) | overtime: 9m:15s |
| #7924 | Tests failed: 2 (1 new), passed: 13705, ignored: 91, muted: 4 | No artifacts | Changes (3) | 10 hours ago (2h:02m) |

## Goal

- Help advanced beginners understand project structure

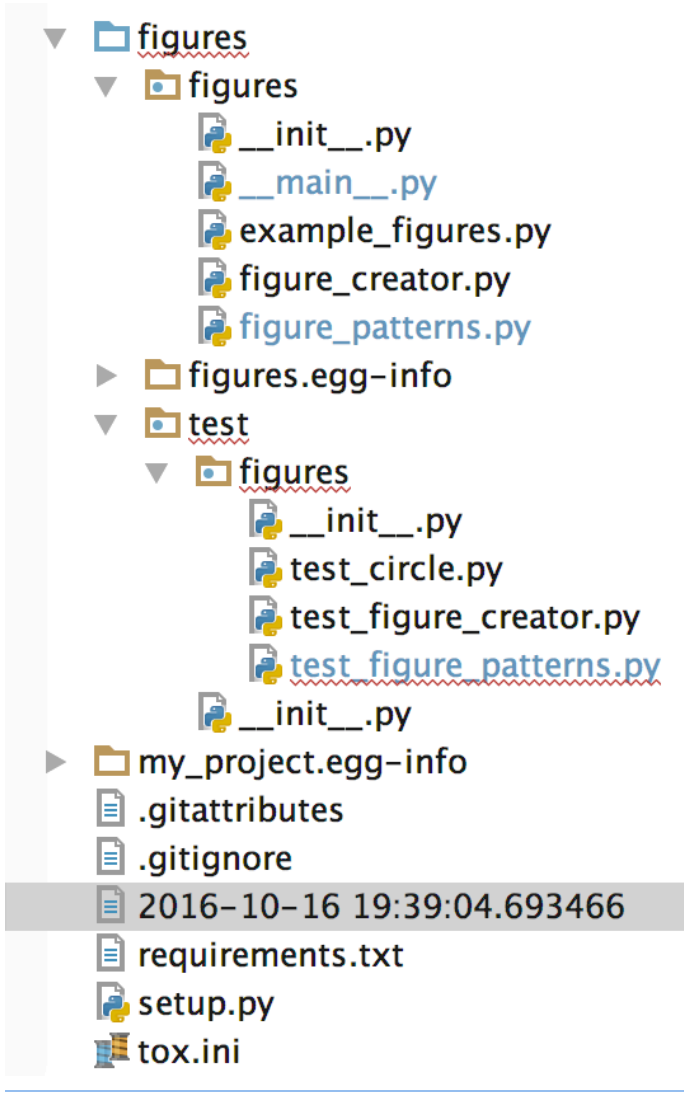
## Best Practices for a Python project

- Project structure
- Modules
- Packages
- PEP8
- Environment setup (virtualenv)
- Testing
- Distributing your project

## Project structure

| project folder | Flask | Requests | boto3 | pandas |
|---|---|---|---|---|
| **docs/** | docs/ | | | |
| **examples** | examples/ | | | |
| **sample/core.py** | flask/ | requests/ | boto3/ | pandas/ |
| **scripts/** | scripts/ | | scripts/ | scripts/ |
| **tests/** | tests/ | tests/ | tests/ | /pandas/tests/ |
| **Makefile** | Makefile | Makefile | Makefile | Makefile |
| **setup.py** | setup.py | setup.py | setup.py | setup.py |
| **requirements.txt** | setup.cfg | requirements.txt | setup.cfg | requirements.txt |
| **tox.ini** | tox.ini | | tox.ini | tox.ini |

## Example project structure: Figures



```
▼ figures
  ▼ figures
      __init__.py
      __main__.py
      example_figures.py
      figure_creator.py
      figure_patterns.py
  ▶ figures.egg-info
  ▼ test
    ▼ figures
        __init__.py
        test_circle.py
        test_figure_creator.py
        test_figure_patterns.py
      __init__.py
▶ my_project.egg-info
  .gitattributes
  .gitignore
  2016-10-16 19:39:04.693466
  requirements.txt
  setup.py
  tox.ini
```

# Modules

- split code in different files for related data and functionality
- lowercase, _separated names for module and function names: create_square

```
def create_square(start, stop):
    print i**2
square(0, 10)
```

- square(0,10) will get run on import!

```
def create_square(start, stop):
    print i**2
if __name__ == '__main__':
    square(0, 10)
```

## What does python do to import a module?

- `Check the module registry` (sys.modules)
- If the module is already imported:
    - Python `uses the existing module` object as is
- Otherwise:
    1. Create a `new, empty module object` (essentially a dictionary)
    2. `Insert` that module object in sys.modules dictionary
    3. `Load the module code` object (if necessary, compile the module first)
    4. `Execute` the module code object in the new module’s namespace (isolated scope)
    5. Top-level statements in modu.py will be executed, including other imports
- It’s fairly cheap to import an already imported module: look the module name up in a dictionary. O(1)

## Importing a module (II)

- **Function and class definitions are stored in the module's dictionary**
    - Available to the caller through the module's namespace
    - The included code is isolated in a module namespace:
        - Generally don't have to worry about the included code having unwanted effects (overriding functions with the same name)

## Packages

```
pack/
pack/__init__.py
pack/modu.py
```

```
python setup.py install
```

Installed into `/dist-packages/`

Don't have to worry about configuring PYTHONPATH to include the source

## Packages (II)

```
sound/__init__.py
sound/effects/__init__.py
sound/effects/echo.py
sound/effects/surround.py
```

```
from sound.effects import surround    import sound.effects.surround as surround
```

- Execute all top-level statements from `__init__.py`
- Execute all top-level statements from surround.py
- Any `public` variable, function, class defined in surround.py is available in sound.effects.surround

# PEP8 (Style Guide for Python code)

Improve the readability of code and make it consistent

- Four spaces (NOT a tab) for each indentation level
- Limit all lines to 80/120 characters
- **Separate:**
  - top level functions and class definitions with 2 blank lines
  - methods inside a class by a single blank line

```python
from figures.figures.figure_patterns import FigurePatterns


class CircleCreator(FigurePatterns, object):

    def __init__(self, name, area=7):
        super(CircleCreator, self).__init__(name)
        self.area = area
```

## PEP8 (II)

- Lowercase, _-separated names for module and function names: `my_module`
- CamelCase to name classes
- '_' prefix: "private" variable/method not to be used outside the module
- blank spaces, CONSTANTS

```python
from figures.figures.figure_patterns import FigurePatterns


class CircleCreator(FigurePatterns, object):

    LINE_WIDTH = 5

    def _compute_area(self):
        return random.random()*10
```

## PEP8 (III)

- imports:
  - standard
  - third-party
  - local library

```
from collections import defaultdict
from requests import
from figures import figure_patterns
```

## Testing: environment setup (virtualenv)

- **Tool to create isolated Python environments**
    - Python packages installed in an isolated location rather than globally.
    - Keep dependencies separated
    - Isolated environments with different python versions

## virtualenv

```
$ virtualenv venv
$ virtualenv -p /usr/bin/python2.7 venv
$ source venv/bin/activate
$ deactivate
$ pip freeze > requirements.txt (list packages and version in venv)
$ pip install -r requirements.txt
```

- Creates:
  - a folder containing the necessary executables to use the packages needed by the Python project
  - a copy of pip to install other packages

## testing: (unittest package)

- Mirror hierarchy:

```
mylib/foo/bar.py
mylib/tests/foo/test_bar.py
```

```python
from unittest import TestCase


class TestFigures(TestCase):

    def setUp(self):
        self.circle = CircleCreator('Circle')

    def tearDown(self):
        self.circle = None

    def test_name_ok(self):
        self.assertEqual(self.circle.get_name(), 'Circle')
```

- assert method provided by unittest

## testing: Fixtures

Resources/initial conditions that a test needs to operate correctly and independently from other tests.

Functions and methods that run before and after a test

```python
from unittest import TestCase


class TestFigures(TestCase):

    def setUp(self):
        self.circle = CircleCreator('Circle')

    def tearDown(self):
        self.circle = None

    def test_name_ok(self):
        self.assertEqual(self.circle.get_name(), 'Circle')
```

## testing: (nose package)

- Provides automatic test discovery
- Loads every file that starts with test_
- Executes all functions within that start with test_
- In maintenance mode for the past several years: use Nose2, py.test

```
$ nosetest
```

test selection:

```
$ path.to.your.module:ClassOfYourTest.test_method
$ path.to.your.module:ClassOfYourTest
$ path.to.your.module
```

## py.test

- Auto-discovery of test modules and functions
- Modular fixtures for managing small or parametrized test resources
- Can run unittest and nose test suites

```
$ py.test tests/
```

## tox

- Clean environment for running unit tests
- Create virtual environment, using pip to install dependencies
- Use setup.py to install package inside virtualenv
- Run tests
- Automate and standardize how tests are run in Python for each environment

```
[tox]
envlist = {py27}

[testenv]
deps =
    -rrequirements.txt

commands =
    nosetests figures/test/
```

## Jargon

- **Built Distribution**
  - A Distribution format containing files and metadata
  - Only need to be moved to the correct location to be installed
- **Source Distribution (or “sdist”)**
  - requires a build step when installed by pip
  - provides metadata and the essential source files needed for pip, or generating a Built Distribution.
  - usually generated with `setup.py sdist`
  - see the bdist_wheel setuptools extension available from the wheel project to create wheels
- **setuptools**
  - Collection of enhancements to the Python distutils, (includes easy_install)
  - Easily build and distribute Python distributions, especially ones that have dependencies on other packages.

## Jargon (II)

- **pip**
  - The PyPA recommended tool for installing Python packages
- **Wheel**
  - A Built Distribution format supported by pip
- **egg**
  - a zip file with different extension
- **setup.cfg**
  - ini file that contains option defaults for setup.py commands.

# setup.py

```python
from setuptools import setup, find_packages

setup(
    name="figures",
    version="1",
    description="figures module to create your own figures",
    packages=packages=['figures'],
    package_dir = {'': 'figures'},
    entry_points={
        'console_scripts': [
            "figures = figures.example_figures:main",
        ],
    },
)
```

- entry points: package.subpackage:function

## setup.py (II)

- **Console scripts**
    - Installs a tiny program in the system path to call a module’s specific function
    - Launchable programs need to be installed inside a directory in the systempath
- **entry points**
    - Part of setuptools
    - Used by other python programs to dynamically discover features that a package provides
    - entry_point_inspector package: lists the entry points available in a package

## setup.py (III)

```
python setup.py install
```

will create a script like this in /bin/:

```
__requires__ = 'figures==1'
import sys
from pkg_resources import load_entry_point

if __name__ == '__main__':
    sys.exit(
        load_entry_point('figures==1', 'console_scripts', 'figure_creator')()
    )
```

- scans the entry points of the figures package
- retrieves the figures key from the console_scripts category

## Requirements for Installing Packages

- pip, setuptools (for advanced installations) and wheel
- distutils for simple package installations
- Create a virtual environment
- pip

```
$ pip install –r requirements.txt
$ pip install ‘botocore=0.6.8’
```

## Wheel

- pre-built distribution format
- **faster installation compared to Source Distributions (sdist)**
  especially if project contains compiled extensions
- zip file with a different extension
- Better caching for testing and continuous integration
- Wheel files do not require installation

## Wheel (II)

- supported by pip
- Offers the bdist_wheel setuptools extension for creating wheel distributions
- Command line utility for creating and installing wheels

```
python setup.py bdist_wheel
```

- creates a .whl file in the /dist/ directory

## References

The Hitchhiker’s Guide to Python: http://docs.python-guide.org/en/latest/

The Hacker's Guide to Python: https://thehackerguidetopython.com

Python Packaging User Guide: https://packaging.python.org/

Writing idiomatic Python: https://jeffknupp.com/

Mouse vs Python: http://www.blog.pythonlibrary.org/

Python for you and me: http://pymbook.readthedocs.io/en/latest/

BogoToBogo: http://www.bogotobogo.com/python

Python testing: http://www.pythontesting.net/

https://blog.ionelmc.ro/presentations/packaging

## <Thank You!>

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