Python-Project-Skeleton

Release 0.2.1

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CONTENTS

| 1 | Python Package Skeleton Template | 1 |
|---|--|--------------|
| | 1.1 Stable version | 1 |
| | 1.2 Latest Build | 1 |
| | 1.3 Motivation | 2 |
| | 1.4 Acknowledgments | 2 |
| | 1.5 Version | 2 |
| 2 | Repository Configuration | 3 |
| | 2.1 Branch organization | 3 |
| | 2.2 Project Layout | 3 |
| | 2.3 CI Platforms | 4 |
| | 2.4 Read the Docs | 12 |
| | 2.5 Badges | 13 |
| | | |
| 3 | Installation | 15 |
| | 3.1 Installation Example | 15 |
| | 3.2 How to use this Template | 15 |
| 4 | Usage | 17 |
| 5 | Contributing | 19 |
| | 5.1 Fork this repository | 19 |
| | 5.2 Install for developers | 19 |
| | 5.3 Branch workflow | 20 |
| | 5.4 Uniformed Tests | 21 |
| | 5.5 Bumpversion | 22 |
| 6 | Course do como estation | 22 |
| 0 | Source documentation 6.1 sampleproject | 23 23 |
| | ···· ································· | 23 |
| | | 23 |
| | 6.3 Libs | 23 |
| 7 | Changelog | 25 |
| | 7.1 0.2.1 (2020-05-31) | 25 |
| | 7.2 0.2.0 (2020-01-31) | 25 |
| | 7.3 0.1.0 (2019-10-03) | 25 |
| 8 | Authors | 27 |
| 9 | Indices and tables | 29 |
| | ALLEAN WARM WONANG | |

| Python Module Index | 31 |
|---------------------|----|
| Indev | 33 |

ONE

PYTHON PACKAGE SKELETON TEMPLATE

This is a **project skeleton template** for a **Python project/library**. The repository intents to implement and explain the latest best practices in team software development, continuous integration and deployment. The repository simulates the implementation of a sampleproject.

You will find in the project's documentation all references that motivated the current configuration as well as detailed explanation on the different configuration files.

I intent to keep this repository up to date to my knowledge and needs. Your feedback and suggestions are highly appreciated, please raise an issue and share your thoughts.

1.1 Stable version

The stable version is hosted at the master branch.

1.2 Latest Build

The latest build is hosted at the latest branch.

1.3 Motivation

Understand and implement in the best practices in software development and deployment for scientific software; actually I think the strategy reviewed here can be applied at many other development contexts.

This repository does NOT intent to be a cookiecutter-like repository. Thought there are many and very well documented cookiecutter templates out there, even for scientific software, I felt that directly using a cookiecutter would lead me nowhere because I would miss the whole understanding of what the cookiecutter is automatizing in the first place. Therefore, building a repository from scratch was the only and best approach to achieve a minimum understanding of best practices and protocols.

1.4 Acknowledgments

The whole repository structure and CI layout has strongly influenced by the discussions provided by ionel in his blog post about *Packaging a python library*. I really recommend reading through that post and the other related posts in his blog. Hence, python-nameless and cookiecutter-pylibrary are two repositories that served as main source of information for the *python-project-skeleton* repository; other sources of information were also important and those are referenced within context.

1.5 Version

v0.2.1

REPOSITORY CONFIGURATION

This page explains how this template repository is organized by detailing the building blocks of the project skeleton.

2.1 Branch organization

Two main branches set the development workflow: the master branch and the latest branch. The latest branch is thought to evolve according to continuous integration practices, and is referred as the *latest* build or version; while, on the other hand, the *master branch* is considered the *stable* or *production* version. Under this configuration the *master* branch receives updates from the *latest* build periodically or when a new version/patch is ready for deployment. Read further about *Branch workflow*.

2.2 Project Layout

The project layout follows the src, tests, docs and devtools folders layout.

2.2.1 The src layout

I have discovered that storing the source library folder under a src directory instead of directly in the project's root is by far the most controversial point out there on the wild Internet. Here I adopted the src-based layout discussed by ionel in his blog post. When reading through the discussed arguments, I found this strategy to have many advantages over the common root directory layout and no added disadvantage.

In detail, though encapsulating the source in a src directory is an uncommon practice in Python projects, adopting this practice avoids unexpected and uncontrolled code imports that could lead to wrong testing operations, as well stated by ionel, see his src-nosrc example. On the same hand, encapsulating the source under a src directory does not create any additional problems that would be avoided by the *standard* layout with source directly on a rootdir-based folder, usually named the same as the package name.

2.2.2 tests

Tests are nicely encapsulated in a tests folder. With this encapsulation, outside the library folder, it is easier to control that tests do not import from relative paths and can only access the library code after library installation (whatever the installation mode is). Also, having tests in a separated folder facilitates the configuration files layout on excluding tests from deployment (MANIFEST.in) and code quality (.codacy.yaml) or coverage (.coveragerc).

2.2.3 docs

All documentation related files are stored in a docs folder. These include files related to the library documentation but also with the development process, such as: AUTHORS, CONTRIBUTING, CHANGELOG, etc.

2.2.4 devtools

The devtools folder hosts the files related to development. Here I used the idea explained by Chodera Lab in their structuring your project guidelines, though for other issues described previously, I do not follow their guides, as explained in context.

2.3 CI Platforms

Here we provide an overview of the implementation strategies for the different continuous integration and quality report platforms. We have adopted a total of seven platforms, two for building and testing, two for code quality control, two for test coverage and one for documentation deployment:

- 1. Building and testing
 - Travis-CI (Linux and OSX)
 - Appveyor (Windows)
- 2. Quality Control
 - Codacy
 - Code Climate
- 3. Test Coverage
 - Codecov
 - Coveralls
- 4. Documentation
 - · Read the Docs

We acknowledge the existence of many other platforms for the same purposes. Though, we have chosen these because they fit the size and scope of the projects to which this template aims at and are those platforms most used within our field of development.

2.3.1 Choosing the CIs

Please note that you do not need to use all these platforms when adapting this template for your project, we do suggest you use at least one for each topic. For example, you do not need to activate Appveyor if you do not intent to deploy/distribute your code for Windows machines. Also, for quality control and test coverage one of the two provided options may suffice, however, having both is free and you can benefit from the different analysis reports the platforms provide.

Note: To **NOT** use a specific CI platform simply do not activate it in their website, remove the configuration file from the root directory of the project, and remove the badge image link from the README.rst file. Continue reading to understand better these concepts.

2.3.2 Activate CI

To activate the different CI platforms for you repository just navigate to their website, login with your GitHub account and activate the repository. The configurations provided in this template should to the rest automatically :-), just start pushing your commits to the server.

2.3.3 Travis-Cl

The configuration for Travis-CI is defined in the .travis.yml file.

Overall, the Travis configuration defines how to execute the different tox environments defined in the tox.ini file.

Find in the .travis.yml file the complete explanation for the implementation proposed, here we mirror the file:

Todo: Configure Travis to run OSX tests.

```
language: python
dist: bionic
# safelist
branches:
 only:
    - master
    - latest
matrix:
  include:
    - name: "Windows Choco 3.8 TOXENV=Check, Radon"
      os: windows
      language: sh
      python: 3.8
      env:
        - TOXENV=check, radon
        - PATH=/c/Python38:/c/Python38/Scripts:$PATH
      before_install:
        - choco install python --version=3.8.1
        - pip3 install --upgrade --user pip
    - name: "Windows Choco 3.7 TOXENV=docs"
      os: windows
```

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2.3. CI Platforms 5

```
language: sh
 python: 3.7
  env:
    - TOXENV=docs
   - PATH=/c/Python37:/c/Python37/Scripts:$PATH
  before_install:
    - choco install python --version=3.7.6
    - pip3 install --upgrade --user pip
- name: "Windows Choco 3.8 TOXENV=py38, codecov, coveralls"
  os: windows
 language: sh
 python: 3.8
  env:
   - TOXENV=py38, codecov, coveralls
   - PATH=/c/Python38:/c/Python38/Scripts:$PATH
 before_install:
   - choco install python --version=3.8.1
    - pip3 install --upgrade --user pip
- name: "Windows Choco 3.7 TOXENV=py37, coveralls"
  os: windows
 language: sh
 python: 3.7
  env:
    - TOXENV=py37, codecov, coveralls
   - PATH=/c/Python37:/c/Python37/Scripts:$PATH
 before install:
    - choco install python --version=3.7.6
    - pip3 install --upgrade --user pip
- name: "Windows Choco 3.6 TOXENV=py36, codecov, coveralls"
  os: windows
 language: sh
 python: 3.6
 env:
   - TOXENV=py36, codecov, coveralls
   - PATH=/c/Python36:/c/Python36/Scripts:$PATH
 before_install:
    - choco install python --version=3.6.8
    - pip3 install --upgrade --user pip
- name: "Linux Python 3.8 TOXENV=check, radon"
  os: linux
 python: 3.8
 env: TOXENV=check, radon
 before_install:
   - python -m pip install --upgrade pip wheel
- name: "Linux Python 3.8 TOXENV=docs"
  os: linux
 python: 3.7
 env: TOXENV=docs
 before install:
    - python -m pip install --upgrade pip wheel
- name: "Linux Python 3.8 TOXENV=py38, codecov, coveralls"
```

(continues on next page)

```
os: linux
     python: 3.8
     env: TOXENV=py38, codecov, coveralls
     before_install:
        - python -m pip install --upgrade pip wheel
   - name: "Linux Python 3.7 TOXENV=py37, codecov, coveralls"
     os: linux
     python: 3.7
     env: TOXENV=py37, codecov, coveralls
     before_install:
       - python -m pip install --upgrade pip wheel
   - name: "Linux Python 3.6 TOXENV=py36, codecov, coveralls"
     os: linux
     python: 3.6
     env: TOXENV=py36, codecov, coveralls
     before_install:
       - python -m pip install --upgrade pip wheel
   - name: "OSX Default Python 3.7 TOXENV=check, radon"
     os: osx
     osx_image: xcode11.3
     language: sh
     env:
       TOXENV=check, radon
     before_install:
       - python3 -m pip install --upgrade pip wheel
   - name: "OSX Default Python 3.7 TOXENV=docs"
     os: osx
     osx_image: xcode11.3
     language: sh
     env: TOXENV=docs
     before install:
       - python3 -m pip install --upgrade pip wheel
   - name: "OSX Conda 3.8 TOXENV=py38, codecov, coveralls"
     os: osx
     osx_image: xcode11.3
     language: sh
     python: "3.8"
     env: TOXENV=py38, codecov, coveralls
     before_install:
       - wget https://repo.continuum.io/miniconda/Miniconda3-4.7.12.1-MacOSX-x86_64.
→sh -O miniconda.sh
       - bash miniconda.sh -b -p $HOME/miniconda
       - source "$HOME/miniconda/etc/profile.d/conda.sh"
       - hash -r
       - conda config --set always_yes yes --set changeps1 no
       - conda update -q conda
       - conda info -a
       - conda create -q -n travenv python=$TRAVIS_PYTHON_VERSION
       - conda activate travenv
   - name: "OSX Default Python 3.7 TOXENV=py37,codecov,coveralls"
     os: osx
```

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2.3. CI Platforms 7

```
osx_image: xcode11.3
      language: sh
      env: TOXENV=py37,codecov,coveralls
      before_install:
        - python3 -m pip install --upgrade pip wheel
    - name: "OSX Brew Python 3.6 TOXENV=py36, codecov, coveralls"
      os: osx
      osx_image: xcode11.3
      language: sh
      env: TOXENV=py36, codecov, coveralls
     before_install:
        # https://stackoverflow.com/questions/51125013/
        - brew unlink python
        - brew uninstall --ignore-dependencies openssl; brew install https://github.
→com/tebelorg/Tump/releases/download/v1.0.0/openssl.rb
        - brew install --ignore-dependencies https://raw.githubusercontent.com/
\rightarrow Homebrew/homebrew-core/f2a764ef944b1080be64bd88dca9a1d80130c558/Formula/python.rb
        - brew info python
        - brew switch python 3.6.5_1
        - python3 -m pip install --upgrade pip wheel
      addons:
        homebrew:
         packages: python
install:
  - pip3 install tox tox-venv
  - tox --version
script:
  - tox -v
after_failure:
  - more .tox/log/* | cat
  - more .tox/*/log/* | cat
notifications:
  email:
   on_success: never
   on_failure: always
```

2.3.4 Appveyor

The configuration for AppVeyor-CI is defined in the .appveyor.yml file.

Contrary to our configuration for *Travis-CI*, with Appveyor, the configuration file simply attempts to build the package and run the unittests battery in the different Python versions.

Find in the .appveyor.yml_ file the complete explanation for the implementation proposed, here we mirror the file:

```
---
environment:
matrix:
- TOXENV: py37
TOXPYTHON: C:\Python37\python.exe
PYTHON_HOME: C:\Python37
```

(continues on next page)

```
PYTHON_VERSION: '3.7'
     PYTHON_ARCH: '32'
    - TOXENV: py37
     TOXPYTHON: C:\Python37-x64\python.exe
      PYTHON_HOME: C:\Python37-x64
     PYTHON_VERSION: '3.7'
     PYTHON_ARCH: '64'
    #- TOXENV: py37-nocov
    # TOXPYTHON: C:\Python37\python.exe
    # PYTHON_HOME: C:\Python37
    # PYTHON_VERSION: '3.7'
    # PYTHON_ARCH: '32'
    #- TOXENV: py37-nocov
    # TOXPYTHON: C:\Python37-x64\python.exe
    # PYTHON HOME: C:\Pvthon37-x64
    # PYTHON_VERSION: '3.7'
    # PYTHON_ARCH: '64'
build: off
init:
 - ps: echo $env:TOXENV
 - ps: ls C:\Python*
install:
   - '%PYTHON_HOME%\python -mpip install --progress-bar=off tox -rdevtools/
→requirements.txt'
   - '%PYTHON_HOME%\Scripts\virtualenv --version'
   - '%PYTHON_HOME%\Scripts\easy_install --version'
   - '%PYTHON_HOME%\Scripts\pip --version'
   - '%PYTHON_HOME%\Scripts\tox --version'
test_script:
    - '%PYTHON_HOME%\Scripts\tox'
```

2.3.5 Codacy

There is not much to configure for *Codacy* in the version we propose in this template. The only setup provided is to exclude the analysis of test scripts, this configuration is provided by the <code>.codacy.yaml</code> file at the root director of the repository. If you wish Codacy to perform quality analysis on your test scripts just remove the file or comment the line. Here we mirror the <code>.codacy.yaml</code> file:

```
---
exclude_paths:
- 'tests/**'
```

2.3. CI Platforms 9

2.3.6 Code Climate

There is not much to configure for Code Climate in the version we propose in this template. The only setup provided is to exclude the analysis of test scripts and other *dev* files Code Climate by default analysis, this configuration is provided by the .codeclimate.yml file at the root director of the repository. If you wish Code Climate to perform quality analysis on your test scripts just remove the file or comment the line.

Code Climate provides a **technical debt** percentage that can be retrieved nicely with a *badge*<*Badges>*

Here we mirror the .codeclimate.yml file:

```
version: "2"
                     # required to adjust maintainability checks
checks:
  argument-count:
     enable: false
  complex-logic:
   confiq:
     threshold: 4
  file-lines:
   config:
     threshold: 2000
  method-complexity:
   confiq:
     threshold: 5
  method-count:
   config:
     threshold: 20
  method-lines:
   config:
     threshold: 25
  nested-control-flow:
   config:
     threshold: 4
  return-statements:
   config:
      threshold: 4
  similar-code:
    config:
      threshold: # language-specific defaults. an override will affect all languages.
  identical-code:
    config:
      threshold: # language-specific defaults. an override will affect all languages.
plugins:
  radon:
   enabled: true
   config:
     threshold: "C"
     python_version: 3
  bandit:
   enabled: true
  sonar-python:
   enabled: true
   config:
      tests_patterns:
        - tests/**
     minimum_critial: major
  editorconfig:
    enabled: false
```

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```
config:
    editorconfig: .editorconfig
exclude_patterns:
    "tests/"
    ".ci/"
    "alphas/"
```

2.3.7 Code coverage

Codecov

Codecov is used very frequently to report test coverage rates the software under development. Activate your repository under Codecov as done for any other CI platform. Additional configurations:

• In general settings change the default branch to the latest branch, if that is your preferred settings.

Coveralls

Coveralls is also included in this template skeleton. Again, activate the coveralls profile by linking your repository to the server (same as with other CI platforms).

The configuration to Coveralls, .coveragerc is the same as of *Codecov*.

Sending coverage reports

Coverage reports are sent to both Codecov and Coveralls servers during the *Travis-tox* -cover environment. .travis.yml configuration handles this and you do not need to worry about nothing else.

The options specific to Codecov report (actually coverage package) are described in .coveragerc file, mirrored bellow, description of the configuration file is provided as comments.

```
[paths]
source =
    src
    */site-packages

[run]
branch = true
source =
    sampleproject
parallel = true

[report]
show_missing = true
precision = 2
omit = *migrations*
exclude_lines =
    if __name__ == .__main__.:
```

The .coveragerc can be expanded to further restraint coverage analysis, for example adding these lines to the exclude tag:

2.3. CI Platforms 11

```
[report]
exclude_lines =
   if self.debug:
   pragma: no cover
   raise NotImplementedError
   if __name__ == .__main__.:
```

2.4 Read the Docs

Activate your project at Read the Docs platform (RdD), their web interface is easy enough to follow without further explanations. If your documentation is building under the *tox workflow* it will build in at Read the Docs.

2.4.1 Docs Requirements

Requirements to build the documentation page are listed in docs/requirements.txt:

```
sphinx>=2.2
sphinx-py3doc-enhanced-theme
sphinx-argparse
CommonMark
mock
```

In this repository we are using Sphinx as documentation builder and the sphinx-py3doc-enhanced-theme as theme, though you can use many different theme flavors, see Sphinx Themes.

2.4.2 Build version

By default, RdD has two main documentation versions (also called builds): the latest and the stable. The *latest* points to the master branch while the *stable* points to the latest GitHub tag. Therefore, every time changes are pushed to the *master branch* a new build in the latest version of the documentation is created, while the stable version is built only when new tags are created.

However, for many projects it is desirable a different setup where the master branch holds the stable version, that is, the code referent to the latest tag, while another branch (usually named *latest* or *develop*) set to the repositories' default, holds the latest development code that has not yet been merged to the master and considered stable. This is the setup of this template repository. Under this setup, it is desirable that the documentation build referent to the *latest* version points to the latest branch, the *stable* doc build will always point to the latest tag. This can be edited in Admin -> Advanced Settings and Default version and Default branch.

2.4.3 Google Analytics

Read the Docs allows straight forward implementation of Google Analytics tracking in the project documentation, just follow their instructions.

2.5 Badges

Badges point to the current status of the different Continuous Integration tools, for example, Travis-CI or Appveyor, but also documentation and code quality reports.

This project has two badge groups, one for the master (stable) branch and other for the latest (develop) branch. By showing information for these two groups the development team can keep track on the improvements (or losses) on code quality or the success of the different building processes.

Each platform provide their own badges, yet you can further tune the badges style by creating your own personalized badge with Shields.io.

You will notice that the badge for Code Climate is missing in the master branch. I could not find yet a straightforward and easy implementation for several branches at Code Climate, so, the badge reports on the main branch set for the repository, in this case the *latest* branch. Also at *Shields.io* there is no shortcut to *branch* for this platform as there is for others.

I observed this same issue for COVERALLS, but then I realize that after the first commit to the master, COVERALLS actually displays nicely the information for both branches.

2.5. Badges 13

THREE

INSTALLATION

In this page you can describe the installation steps required for end-users, use the *Contribution page* to provide the guidelines for developers.

3.1 Installation Example

At the command line:

pip install sampleproject

3.2 How to use this Template

To use this template for your projects use the green button at the main repository page.

FOUR

USAGE

Describe here examples on how to use your software!

To use SampleProject in a project:

import sampleproject

18 Chapter 4. Usage

FIVE

CONTRIBUTING

Here we explain how to contribute to a project that adopted this template. Actually, you can use this same scheme when contributing to this template.

5.1 Fork this repository

Fork this repository before contributing. It is a better practice, possibly even enforced, that only Pull Request from forks are accepted. In my opinion this creates a cleaner representation of the whole contributions to the project.

5.2 Install for developers

First, clone the repository as described in the *section above*.

Create a dedicated Python environment where to develop the project.

If you are using pip follow the official instructions on Installing packages using pip and virtual environments, most likely what you want is:

```
python3 -m venv pyprojskel
source pyprojskel/bin/activate
```

If you are using Anaconda go for:

```
conda create --name pyprojskel python=3.7 conda activate pyprojskel
```

Where pyprojskel is the name you wish to give to the environment dedicated to this project.

Either under *pip* or *conda*, install the package in develop mode, and also *tox*.

```
python setup.py develop
# for pip
pip install tox bumpversion
# for conda
conda install tox bumpversion -c conda-forge
```

Under this configuration the source you edit in the repository git folder is automatically reflected in the development installation.

Continue your implementation following the development guidelines described bellow.

5.3 Branch workflow

The following applies to external contributors, yet main developers can also follow these guidelines.

Branch workflow for development and contribution should follow the Gitflow Workflow guidelines. Please read careful through that guide. Here we highlight the general approach with some tasteful additions such as the --no-ff flag.

5.3.1 Clone your fork

Indeed the first thing to do is to clone your fork, and keep it up to date with the upstream:

```
git clone https://github.com/YOUR-USERNAME/python-project-skeleton.git cd into/cloned/fork-repo git remote add upstream git://github.com/joaomcteixeira/python-project-skeleton.git git fetch upstream git pull upstream latest
```

5.3.2 New feature

To work on a new feature, branch out from the latest branch:

```
git checkout latest
git checkout -b feature_branch
```

Develop the feature and keep regular pushes to your fork with comprehensible commit messages.

5.3.3 Push to latest

To see your development accepted in the main project, you should create a Pull Request to the latest branch following the PULLREQUEST.rst guidelines.

Before submitting a Pull Request, verify your development branch passes all tests as described bellow. If you are developing new code you should also implement new test cases.

If you are an official contributor to this repository, have write permissions, and are sure the new feature branch passes tests, directly merge to the latest branch.

You should bump a patch beforehand.

```
# on your feature_branch
bumpversion patch --no-tag
git push origin feature_branch
git checkout latest
git merge --no-ff feature_branch
git push origin latest
```

The --no-ff option avoids Fast forward merging (1, 2), keeping a record of the branching out/in history.

5.3.4 To official contributors

Release Branches

Create a short lived branch to prepare for the release candidate, in this example release/0.1.0.

```
git checkout latest git checkout -b release/0.1.0
```

Fix the final bugs, does and minor corrections, and finally bump the version.

```
# first commit and push your changes
# then bump
bumpversion patch|minor|major
git push origin release/0.1.0
```

Finally, merge to master AND from master to latest.

```
git checkout master
git merge --no-ff release/0.1.0
git push origin master --tags
git checkout latest
git merge --no-ff master
```

Hotfixes from master

The hotfix strategy is applied when a bug is identified in the production version that can be easily fixed.

```
git checkout master
git checkout -b hotfix_branch
```

Work on the fix...

```
# push yours commits to GitHub beforehand
git push origin hotfix_branch
bumpversion patch
git push origin hotfix_branch --tags
git checkout master
git merge --no-ff hotfix_branch
git push origin master
git checkout latest
git merge --no-ff master
git push origin latest
```

5.4 Uniformed Tests

Thanks to Tox we can have a uniform testing platform where all developers are forced to follow the same rules and, above all, all tests occur in a controlled Python environment.

With *Tox*, the testing setup can be defined in a configuration file, the tox.ini, which contains all the operations that are performed during the test phase. Therefore, to run the unified test suite, developers just need to execute tox, provided tox is installed in the Python environment in use.

5.4. Uniformed Tests 21

```
pip install tox
# or
conda install tox -c conda-forge
```

Todo: Review and consider integrating using tox to setup development envs -> https://tox.readthedocs.io/en/latest/example/devenv.html

One of the greatest advantages of using Tox together with the *src layout*, aside from uniforming the testing routines across developers, is that tests scripts actually perform against an installed source (our package) inside an isolated deployment environment. In order words, tests are performed in an environment simulating a post-deployment state instead of a pre-deploy/development environment. Under this setup, there is no need, in general cases, to deploy test scripts along with the actual source, in my honest opinion - see MANIFEST.in.

Todo: Discuss the need to deploy test scripts.

Before creating a Pull Request from your branch, certify that all the tests pass correctly by running:

```
tox
```

These are exactly the same tests that will be performed in the CI Platforms.

Also, you can run individual environments if you wish to test only specific functionalities, for example:

```
tox -e check # code style and file compatibility
tox -e spell # spell checks documentation
tox -e docs # only builds the documentation
```

5.5 Bumpversion

I found two main version string handlers around: bumpversion and versioneer. I chose *bumpversion* for this repository template. Why? I have no argument against *versioneer* or others, simply I found bumpversion to be so simple, effective and configurable that I could only adopt it. Congratulations to both projects nonetheless.

SIX

SOURCE DOCUMENTATION

6.1 sampleproject

Initial documentation of SampleProject.

6.2 AModule

Main DOCSTRING for amodule.

With several lines.

```
amodule.hello()
    Print 'hello module'.
```

6.3 Libs

General Libraries for the project.

samplemodule that performs sample operations.

Contains:

• sampleclass

```
class sampleproject.libs.samplemodule.SampleClass
    Documentation of the SampleClass.

classmethod false()
    Docstrings should not start with Returns...
```

```
static true()
```

Return True my friend.

Nonetheless, returns False

SEVEN

CHANGELOG

7.1 0.2.1 (2020-05-31)

• updated tox to accepts posargs in pytest and flake8

7.2 0.2.0 (2020-01-31)

- Implemented Travis-CI for Windows, MacOSX and Linux * for Python: 3.6, 3.7 and 3.8 * all previous without using anaconda expect for MacOSX 3.8 * I have nothing against Anaconda;-), on the contrary, I use it everyday.
- Improved tox.ini workflow to my current favorite standards.
- Implemented mock strategy to avoid installing dependencies for documentation generation. * TOXENV docs

7.3 0.1.0 (2019-10-03)

• First release on PyPI.

EIGHT

AUTHORS

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28 Chapter 8. Authors

NINE

INDICES AND TABLES

- genindex
- modindex
- search

PYTHON MODULE INDEX

a amodule, 23 S sampleproject, 23 sampleproject.libs, 23 sampleproject.libs.samplemodule, 23

32 Python Module Index

INDEX

```
Α
amodule
    module, 23
F
\verb|false|()| (sample project. libs. sample module. Sample Class
        class method), 23
Η
hello() (in module amodule), 23
M
module
    amodule, 23
    sampleproject, 23
    sampleproject.libs, 23
    sampleproject.libs.samplemodule, 23
S
SampleClass
                                       samplepro-
                    (class
                               in
        ject.libs.samplemodule), 23
sampleproject
    module, 23
sampleproject.libs
    module, 23
sampleproject.libs.samplemodule
    module, 23
Т
\verb|true|()| (sample project. libs. sample module. Sample Class
        static method), 23
```