

AST1501 - Introduction to Research

Jo Bovy

Documenting your code

Basics of documentation

- Good documentation is essential for allowing people (including yourself!) to use your code
- Should be as complete and up-to-date as possible
- Best if written along-side code development, don't leave writing the documentation to *a later time*
- Document functions/classes/methods *and* have a (brief) guide to using your code

docstrings

Python docstrings

- docstrings: built-in Python feature to document (sub)modules, functions, classes, and methods
- Place to put documentation on your code's *use*, not on its implementation (docstrings are for *users*, not for *developers*)
- Typically, multi-line strings enclosed in `""" """`

Docstring placement

- To be automatically attached to the module, function, class, or method, put docstrings
 - Modules: Right at the beginning of the file
 - Functions: Right after the `def a_function(...): statement`
 - Classes: Right after the `class a_class: statement`
 - Methods: Right after the `def a_method(self,...): statement`
- Then automatically bound to the module/function/class/method's `__doc__` attribute; you can also directly set this attribute!

Module docstring example

As an example, we can write a docstring for the top-level module of the `exampy` package. To do this, we edit the `exampy/__init__.py` file such that it now looks like

```
"""exampy: an example Python package"""  
from .utils import *
```

and the `"""exampy: an example Python package"""` string then becomes the module's docstring. To verify this, open a Python interpreter and do

```
[1]: import exampy  
     ?exampy
```

which shows a message that says something like

```
Type:      module  
String form: <module 'exampy' from '/PATH/TO/exampy/exampy/__init__.py'>  
File:      /PATH/TO/exampy/exampy/__init__.py  
Docstring: exampy: an example Python package
```

and in which you see the docstring that we just defined. You can also verify that it was indeed attached as the module's `__doc__` attribute:

```
[2]: print(exampy.__doc__)  
  
exampy: an example Python package
```

Functions and methods

- *Always* need multi-line docstrings,
 - give overview of what the function/method does
 - List input arguments and keywords
 - List outputs
- For methods, we don't document `self` (because assumed and always the same), so methods are essentially the same as functions
- Follow a consistent style for all the docstrings in your code, e.g., the numpy docstring style

numpy-style docstrings

```
def square(x):  
    """The square of a number  
  
    Parameters  
    -----  
    x: float  
        Number to square  
  
    Returns  
    -----  
    float  
        Square of x  
    """  
    return x**2.
```

The brief description is followed by a *Parameters* section that lists each argument and keyword with the format

```
parameter: type  
    Parameter description
```

Similarly, the return value is described as

```
type  
    Description of return value
```

```
[6]: import exampy.submodule1  
print(exampy.submodule1.cube.__doc__)
```

The cube of a number

Calculates and returns the cube of any floating-point number;
note that, as currently written, the function also works for
arrays of floats, ints, arrays of ints, and more generally,
any number or array of numbers.

Parameters

x: float

Number to cube

Returns

float

Cube of x

Raises

No exceptions are raised.

See Also

exampy.square: Square of a number

exampy.pow: a number raised to an arbitrary power

Notes

Implements the standard cube function

.. math:: f(x) = x^3

History:

2020-03-01: First implementation - Bovy (UofT)

References

.. [1] A. Mathematician, "x to the p-th power: squares, cubes, and their
general form," J. Basic Math., vol. 2, pp. 2-3, 1864.

Ways to document your code

Ways to document your code

- *Always* document code itself functions, classes, etc.
- For more general documentation (installation, dependencies, example use, how-tos):
 - Use the GitHub ReadMe: Markdown is powerful and allows you to easily create a small documentation site —> recommended for all but the biggest/most-shared projects
 - Stand-alone documentation site: sphinx

Using a README

Using a README

- GitHub will render README.md (Markdown) and README.rst (restructuredText)
- Essential sections:
 - Overview
 - Author / contact info
 - Installation
 - Basic usage
 - How to cite

wendy

A one-dimensional gravitational N-body code.

 build  codecov  pypi  launch  binder

Overview

`wendy` solves the one-dimensional gravitational N-body problem to machine precision with an efficient algorithm [$O(\log N)$ / particle-collision]. Alternatively, it can solve the problem with approximate integration, but with exact forces.

Author

Jo Bovy (University of Toronto): `bovy - at - astro - dot - utoronto - dot - ca`

Installation

Install the latest release using

```
pip install wendy
```



or clone/fork/download the repository and install using

```
sudo python setup.py install
```



mwdust

Dust in 3D in the Milky Way

🔄 build passing pypi v1.5.post0 license New BSD DOI 10.3847/0004-637X/818/2/130

Contents

- [Installation](#)
- [Dust Data](#)
- [Usage](#)
- [Supported bandpasses](#)
- [Acknowledging mwdust and its data](#)

🔗 Installation

Install the latest released version using `pip` :

```
pip install mwdust
```

To install the latest development version, clone the repository and do

```
python setup.py install
```

or

```
python setup.py install --user
```


sphinx

What is sphinx?

- Python tool to typeset documentation from a set of reStructuredText files, with a lot of support for documentation tools
- reStructuredText: simple markup language for text documents that can be turned into HTML, LaTeX, ...
- `pip install sphinx`

Getting started with sphinx

- Start a directory `doc/` or `docs/`
- In that directory type `sphinx-quickstart`
- Answer a few questions
 - Name of the package
 - Author
 - Version
 - Separate `build/` and `source/` directories (otherwise have `_build/` in `source/`):
yes, a good idea!
- After this, you have the basic outline of your documentation

```
build/  
source/  
    _static/  
    _templates/  
    conf.py  
    index.rst  
Makefile  
make.bat
```

conf.py

- Configuration file, as a Python script (executed, so can contain Python code)
- Used to set all of the configuration:
 - General: name, author, version, extensions to use, general configuration parameters
 - Configuration parameters for different output types: HTML, LaTeX, ...

Starting conf.py

```
# Configuration file for the Sphinx documentation builder.
#
# This file only contains a selection of the most common options. For a full
# list see the documentation:
# https://www.sphinx-doc.org/en/master/usage/configuration.html

# -- Path setup -----

# If extensions (or modules to document with autodoc) are in another directory,
# add these directories to sys.path here. If the directory is relative to the
# documentation root, use os.path.abspath to make it absolute, like shown here.
#
# import os
# import sys
# sys.path.insert(0, os.path.abspath('.'))

# -- Project information -----

project = 'exampy'
copyright = '2020, Jo Bovy'
author = 'Jo Bovy'

# The full version, including alpha/beta/rc tags
release = '0.1'

# -- General configuration -----

# Add any Sphinx extension module names here, as strings. They can be
# extensions coming with Sphinx (named 'sphinx.ext.*') or your custom
# ones.
extensions = [
]
```

Starting conf.py (continued)

```
# Add any paths that contain templates here, relative to this directory.
templates_path = ['_templates']

# List of patterns, relative to source directory, that match files and
# directories to ignore when looking for source files.
# This pattern also affects html_static_path and html_extra_path.
exclude_patterns = []

# -- Options for HTML output -----

# The theme to use for HTML and HTML Help pages.  See the documentation for
# a list of builtin themes.
#
html_theme = 'alabaster'

# Add any paths that contain custom static files (such as style sheets) here,
# relative to this directory. They are copied after the builtin static files,
# so a file named "default.css" will overwrite the builtin "default.css".
html_static_path = ['_static']
```

Documentation pages

- A set of `.rst` files in reStructuredText format
- `index.rst` contains the main “toctree”, a table of contents
 - Only files listed in this toctree or in toctrees in those files (etc.) are included in the documentation
 - toctree is an example of a *directive*, a way of telling sphinx (and rst) about different elements (e.g., math, images, ...)
- `index.rst` can contain more, but the main toctree is essential

Starting `index.rst`

```
.. exampy documentation master file, created by
   sphinx-quickstart on Sun Mar  1 11:50:01 2020.
   You can adapt this file completely to your liking, but it should at least
   contain the root `toctree` directive.
```

```
Welcome to exampy's documentation!
=====
```

```
.. toctree::
   :maxdepth: 2
   :caption: Contents:
```

```
Indices and tables
=====
```

```
* :ref:`genindex`
* :ref:`modindex`
* :ref:`search`
```

Generating the documentation

- Use the provided Makefile, type make for help

```
make
```

gives

```
Sphinx v2.2.0
```

```
Please use `make target' where target is one of
```

html	to make standalone HTML files
dirhtml	to make HTML files named index.html in directories
singlehtml	to make a single large HTML file
pickle	to make pickle files
json	to make JSON files
htmlhelp	to make HTML files and an HTML help project
qthelp	to make HTML files and a qthelp project
devhelp	to make HTML files and a Devhelp project
epub	to make an epub
latex	to make LaTeX files, you can set PAPER=a4 or PAPER=letter
latexpdf	to make LaTeX and PDF files (default pdflatex)
latexpdfja	to make LaTeX files and run them through platex/dvipdfmx
text	to make text files
man	to make manual pages
texinfo	to make Texinfo files
info	to make Texinfo files and run them through makeinfo
gettext	to make PO message catalogs
changes	to make an overview of all changed/added/deprecated items
xml	to make Docutils-native XML files
pseudoxml	to make pseudoxml-XML files for display purposes
linkcheck	to check all external links for integrity
doctest	to run all doctests embedded in the documentation (if enabled)
coverage	to run coverage check of the documentation (if enabled)

```
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qthelp	to make HTML files and a qthelp project
devhelp	to make HTML files and a Devhelp project
epub	to make an epub
latex	to make LaTeX files, you can set PAPER=a4 or PAPER=letter
latexpdf	to make LaTeX and PDF files (default pdflatex)
latexpdfja	to make LaTeX files and run them through platex/dvipdfmx
text	to make text files
man	to make manual pages
texinfo	to make Texinfo files
info	to make Texinfo files and run them through makeinfo
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devhelp	to make HTML files and a Devhelp project
epub	to make an epub
latex	to make LaTeX files, you can set PAPER=a4 or PAPER=letter
latexpdf	to make LaTeX and PDF files (default pdflatex)
latexpdfja	to make LaTeX files and run them through platex/dvipdfmx
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texinfo	to make Texinfo files
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latexpdf	to make LaTeX and PDF files (default pdflatex)
latexpdfja	to make LaTeX files and run them through platex/dvipdfmx
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Example .rst files

Installation instructions

=====

Dependencies

```exampy``` does not have any dependencies.

## Installation

-----

```exampy``` is currently not yet available on PyPI, but it can be installed by downloading the source code or cloning the GitHub repository and running the standard::

```
python setup.py install
```

command or its usual variants (```python setup.py install --user```, ```python setup.py install --prefix=/PATH/TO/INSTALL/DIRECTORY```, etc.).

For more info, please open an Issue on the GitHub page.

Introduction

=====

``exampy`` is an example Python package that contains some very basic math functions. As an example, we can compute the square of a number as::

```
>>> import exampy
>>> exampy.square(3.)
# 9.
```

Similarly, we can compute the cube of a number, but this functionality is part of the ``exampy.submodule1`` submodule:

.. code-block:: python

```
>>> import exampy.submodule1
>>> exampy.submodule1.cube(3.)
# 27.
```

A general power function ``pow`` is included at the top-level, for example, to get the fourth power of 3, do::

```
>>> exampy.pow(3.,p=4.)
# 81.
```

This concludes the discussion of all of ``exampy``'s basic functionality.

Including docstrings

- sphinx has a built-in extension to grab docstrings from the code and insert them into the documentation (e.g., when creating the API)
- Extension: autodoc (add “sphinx.ext.autodoc” to the extensions list in `conf.py`)
 - Also use `napoleon` for parsing numpy-style docstrings “sphinx.ext.napoleon”
- Three main directives:
 - `.. autofunction:: func`
 - `.. autoclass:: a_class`
 - Also has the `:members:` option to list member methods to include
 - `.. automethod:: a_method`

Example usage

```
API reference
=====

``exampy``
-----

.. autofunction:: exampy.square

.. autofunction:: exampy.pow

.. autoclass:: exampy.PowClass
   :members: __init__

.. automethod:: exampy.PowClass.__call__

``exampy.submodule1``
-----

.. autofunction:: exampy.submodule1.cube
```

exampley

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API reference

exampley

`exampley.square(x)`

The square of a number

Parameters: `x` (*float*) – Number to square
Returns: Square of `x`
Return type: `float`

`exampley.pow(x, p=2.0)`

A number `x` raised to the `p`-th power

Parameters:

- `x` (*float*) – Number to raise to the power `p`
- `p` (*float, optional*) – Power to raise `x` to

Returns: `x^p`
Return type: `float`

`class exampley.PowClass(p=2.0)`

A class to compute the power of a number

`__init__(p=2.0)`

Initialize a `PowClass` instance

Parameters: `p` (*float, optional*) – Power to raise `x` to

`PowClass.__call__(x)`

Evaluate `x^p`

Parameters: `x` (*float*) – Number to raise to the power `p`
Returns: `x^p`
Return type: `float`

exampley.submodule1

`exampley.submodule1.cube(x)`

The cube of a number

Calculates and returns the cube of any floating-point number; note that, as current-

exampy.submodule1

`exampy.submodule1.cube(x)`

The cube of a number

Calculates and returns the cube of any floating-point number; note that, as currently written, the function also works for arrays of floats, ints, arrays of ints, and more generally, any number or array of numbers.

Parameters: `x` (*float*) – Number to cube

Returns: Cube of `x`

Return type: `float`

Raises: No exceptions are raised. –

See also:

`exampy.square()`

Square of a number

`exampy.pow()`

a number raised to an arbitrary power

Notes

Implements the standard cube function

$$f(x) = x^3$$

History:

2020-03-01: First implementation - Bovy (UofT)

References

- 1 A. Mathematician, “x to the p-th power: squares, cubes, and their general form,” J. Basic Math., vol. 2, pp. 2-3, 1864.

Using jupyter notebooks in sphinx documentation

- Easy to write combination of text and code in jupyter notebooks, and to include figures
- Extensions: `nbsphinx` to include jupyter notebooks *as they are* in sphinx documentation
 - `python3 -m pip install nbsphinx`
 - Add “nbsphinx” to the extensions list in `conf.py`
- Then can just add notebook in a toctree!