

Software Engineering Practices



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Topics covered

- GitHub workflow: Repositories & Pull Request
- Code review
- Python packaging
- Testing
- Documentation

What is a software repository?

- A place to keep your work and its history
 - (Future you will thank you!)
- A place to share your work and collaborate with others
- Good things to have:
 - Version control
 - Regular backups

What is

"FINAL".doc

- A place to

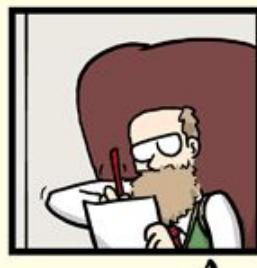


↑ FINAL.doc!



↑ FINAL_rev.2.doc

- A place to

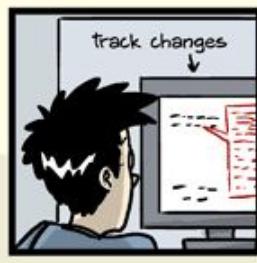


↑ FINAL_rev.6.COMMENTS.doc



↑ FINAL_rev.8.comments5.
CORRECTIONS.doc

- Good thi



↑ FINAL_rev.18.comments7.
corrections9.MORE.30.doc



↑ FINAL_rev.22.comments49.
corrections.10.#@\$%WHYDID
ICOMETOGRAD SCHOOL????.doc

JORGE CHAM © 2012

Hosting services for repositories

GitHub 



GitLab

Atlassian
 **Bitbucket**

 **SOURCEFORGE**

Repositories can be...

- From a pile of short scripts to complex libraries

[astropy / astropy-procedures](#)

Code Issues 32 Pull requests 5 Projects 0 Wiki Insights

Scripts or tools for astropy dev work, and documentation of dev procedures with no other obvious home

261 commits	3 branches	0 releases	12 contributors	BSD-3-Clause	
Branch: master	New pull request	Create new file	Upload files	Find file	Clone or download
bsipocz Merge pull request #99 from bsipocz/adding_manual_packports ... Latest commit 1d8fc1a just now					
documents	More small changes	15 hours ago			
pr_consistency	Clarifying comment for manual backports and adding one more PR to the...	24 seconds ago			
update-affiliated	Cleaning up packages	9 days ago			
visualizations_demographics	Merge pull request #92 from eteq/fix-encode	5 months ago			
.gitignore	Adding all htmls in the PR directory to gitignore	2 years ago			
LICENSE.rst	Add a setup.py for modules/scripts in this repo. This isn't necessari...	4 years ago			
README.md	update the name of the package in readme	8 months ago			
add_to_changelog.py	add option to insert changelog entry	2 years ago			
astropy_grep_affiliated.py	Updated to include the more recently added astropy_grep_affiliated sc...	4 years ago			
astropy_usage.py	Rename variable to something more sensible	7 months ago			
author_lists.py	add last name sorting	3 years ago			
ci_helpers_usage.py	Add script to check ci-helpers usage	7 months ago			

[python / cpython](#)

Code Pull requests 931 Insights

The Python programming language <https://www.python.org/>

102,677 commits 13 branches 369 releases 694 contributors View license

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

ibzyshev and benjaming closes bpo-35171: Fix test_TimeRE_recreation_timezone failure on some... ...	Latest commit f1b9ad3 4 hours ago
azure-pipelines	bpo-34081: Fix wrong example link that was linking to distutils (GH-8248)
github	Add macos-team as a code owner (GH-10045)
Doc	bpo-35099: Improve the doc about IDLE running user code. (#10350)
Grammar	bpo-32117: Allow tuple unpacking in return and yield statements (gh-4509)
Include	bpo-33462: Add __reversed__ to dict and dict views (GH-6827)
Lib	closes bpo-35171: Fix test_TimeRE_recreation_timezone failure on some... 4 hours ago
Mac	bpo-34405: Update to OpenSSL 1.1.0 for macOS installer builds (GH-9166) 2 months ago
Misc	bpo-35099: Improve the doc about IDLE running user code. (#10350) 6 hours ago
Modules	Fix possible crashes in pwdmodule.c. (GH-10331) 13 hours ago
Objects	bpo-33462: Add __reversed__ to dict and dict views (GH-6827) 8 hours ago
PC	bpo-35081: Add pycore_prefix to internal header files (GH-10263) 5 days ago
PCbuild	bpo-35081: And pycore_lifecycle.h and pycore_pathconfig.h (GH-10273) 5 days ago
Parser	bpo-35081: Add _PyThreadState_GET() internal macro (GH-10266) 5 days ago
Programs	bpo-35081: And pycore_lifecycle.h and pycore_pathconfig.h (GH-10273) 5 days ago
Python	bpo-35133: Fix mistakes when concatenate string literals on different... 18 hours ago
Tools	bpo-35133: Fix mistakes when concatenate string literals on different... 18 hours ago
m4	closes bpo-34585: Don't do runtime test to get float byte order. (GH-... 2 months ago
.gitattributes	gitattribute: Mark generated files (GH-7619) 5 months ago

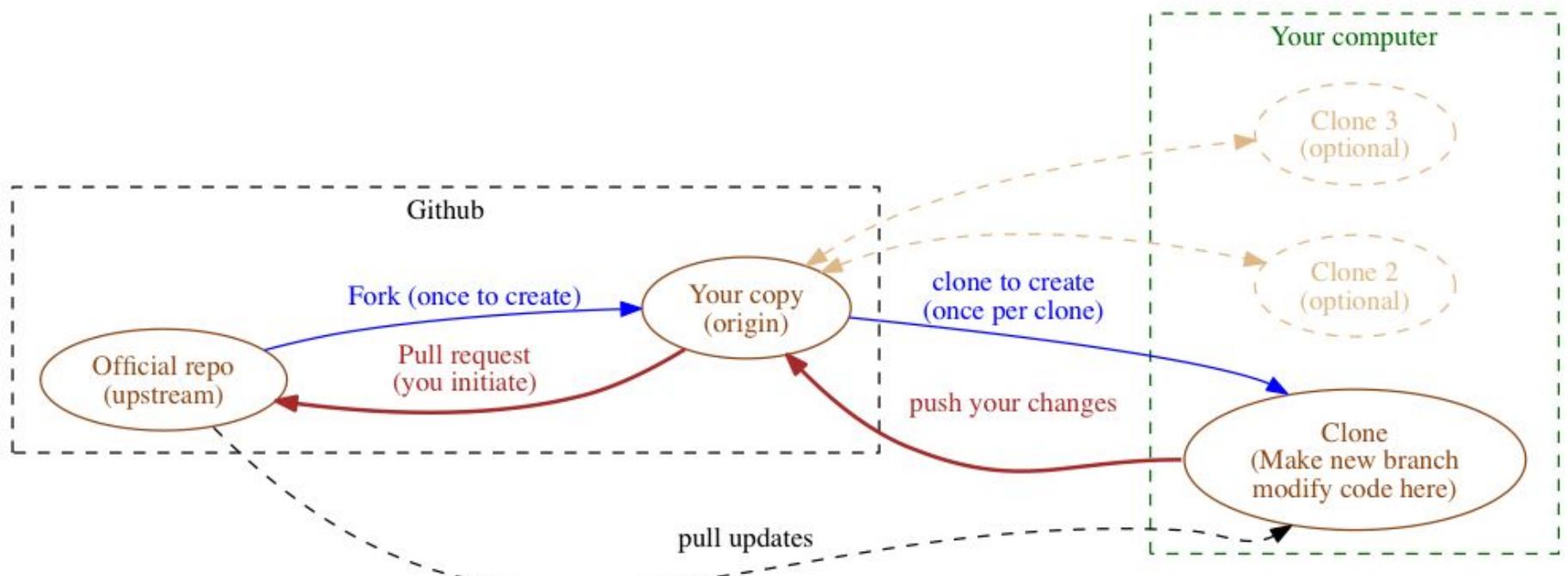
Repositories can be...

- From a pile of short scripts to complex libraries
- Publicly shared or private (Terms and Coditions vary)
 - Educational / not-for-profit options exists

From repository to package

- Make it easily installable by others (makefiles, upload to indexing services e.g. PyPI, conda-forge, etc...)
- Good things to have:
 - Modularity, and well structured overall layout
 - Sensible versioning

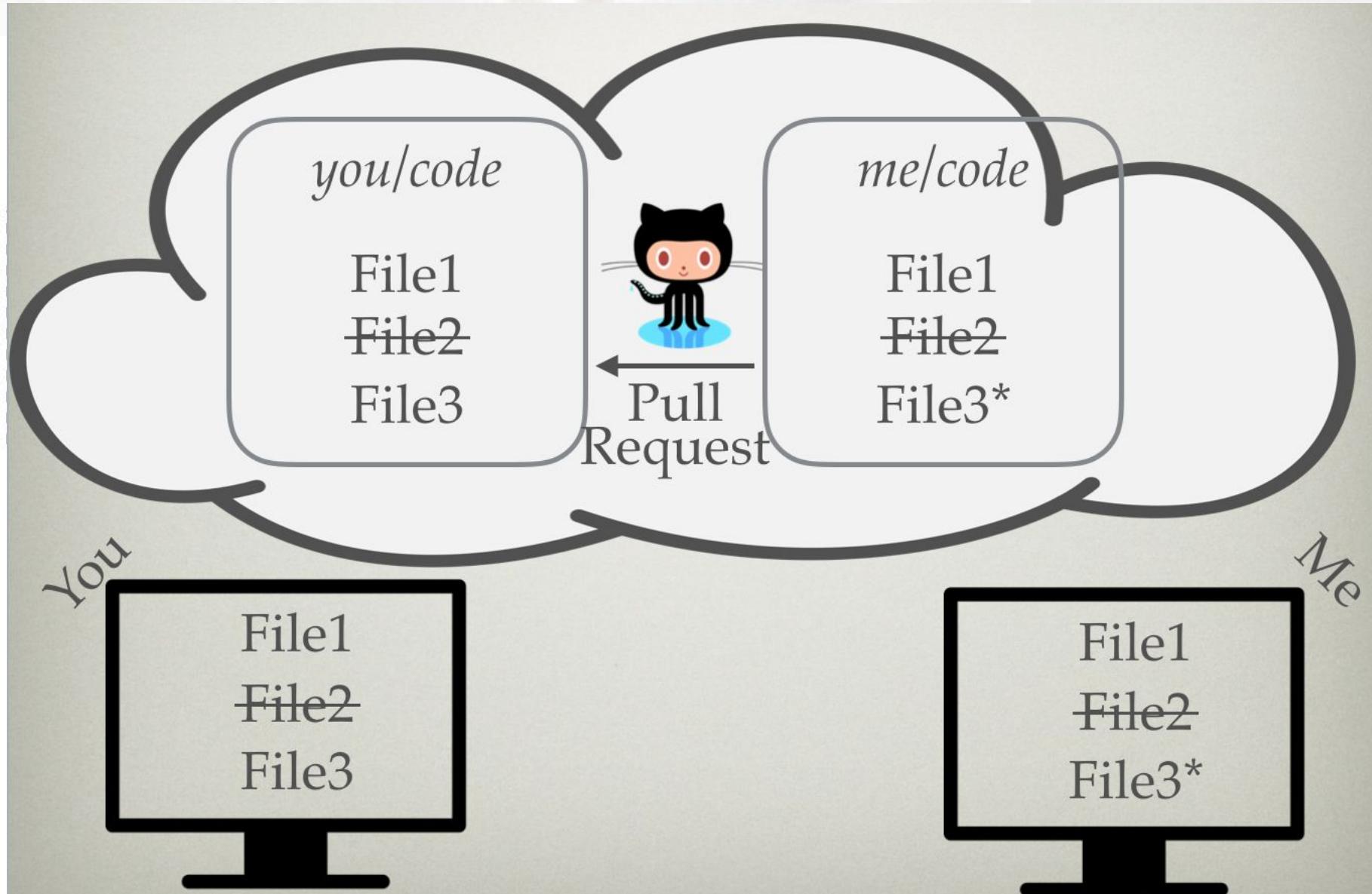
GitHub workflow



By Matt Craig

- Learn and practice your branches:
<https://learngitbranching.js.org/>

GitHub workflow

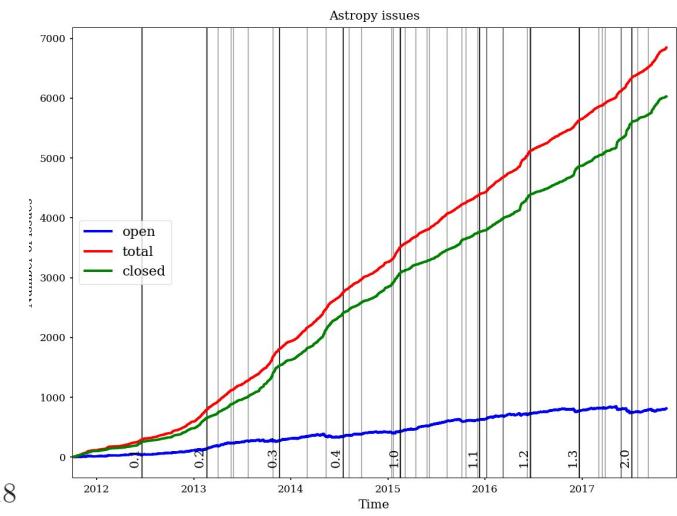
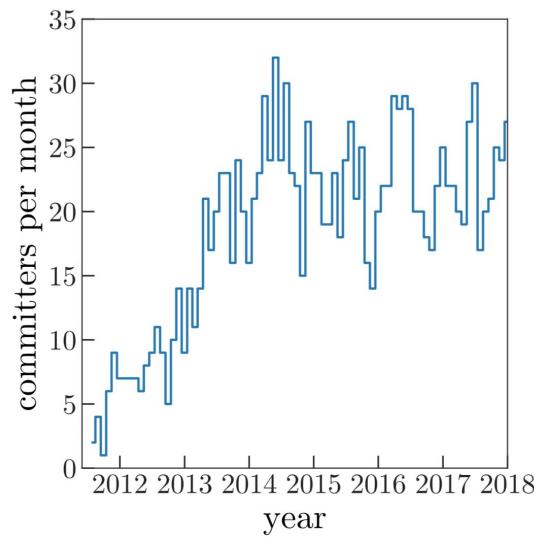
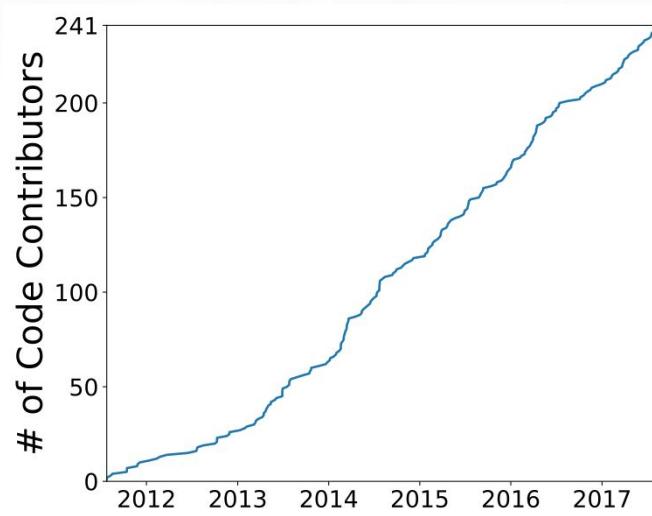


The case of Astropy

The Astropy Project is a **community effort** to develop a common *core package* for Astronomy in Python and foster an **ecosystem of interoperable** packages.

Case study of Astropy

- Key to success: open development
- Community consensus for adding new features
- Well **tested, documented, and stable** code



Case study of Astropy

- Wide variety of contributions, from one liners...

astropy.time.Time bugfix for issue 2123 #2324

Merged astrofrog merged 5 commits into astropy:master from bsipocz:fixing_issue_2123 on Apr 19, 2014

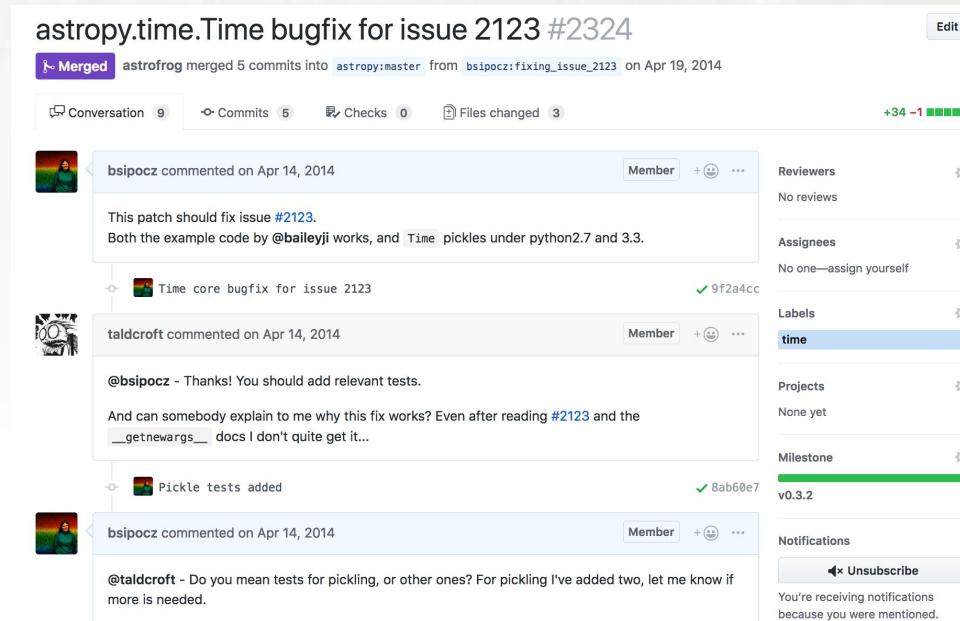
Conversation 9 Commits 5 Checks 0 Files changed 3 +34 -1

bsipocz commented on Apr 14, 2014 Member ...
This patch should fix issue #2123.
Both the example code by @baileyji works, and Time pickles under python2.7 and 3.3.

Time core bugfix for issue 2123 9f2a4cc
taldcroft commented on Apr 14, 2014 Member ...
@bsipocz - Thanks! You should add relevant tests.
And can somebody explain to me why this fix works? Even after reading #2123 and the __getnewargs__ docs I don't quite get it...

Pickle tests added 8ab60e7
bsipocz commented on Apr 14, 2014 Member ...
@taldcroft - Do you mean tests for pickling, or other ones? For pickling I've added two, let me know if more is needed.

Reviewers No reviews
Assignees No one—assign yourself
Labels time
Projects None yet
Milestone v0.3.2
Notifications Unsubscribe
You're receiving notifications because you were mentioned.

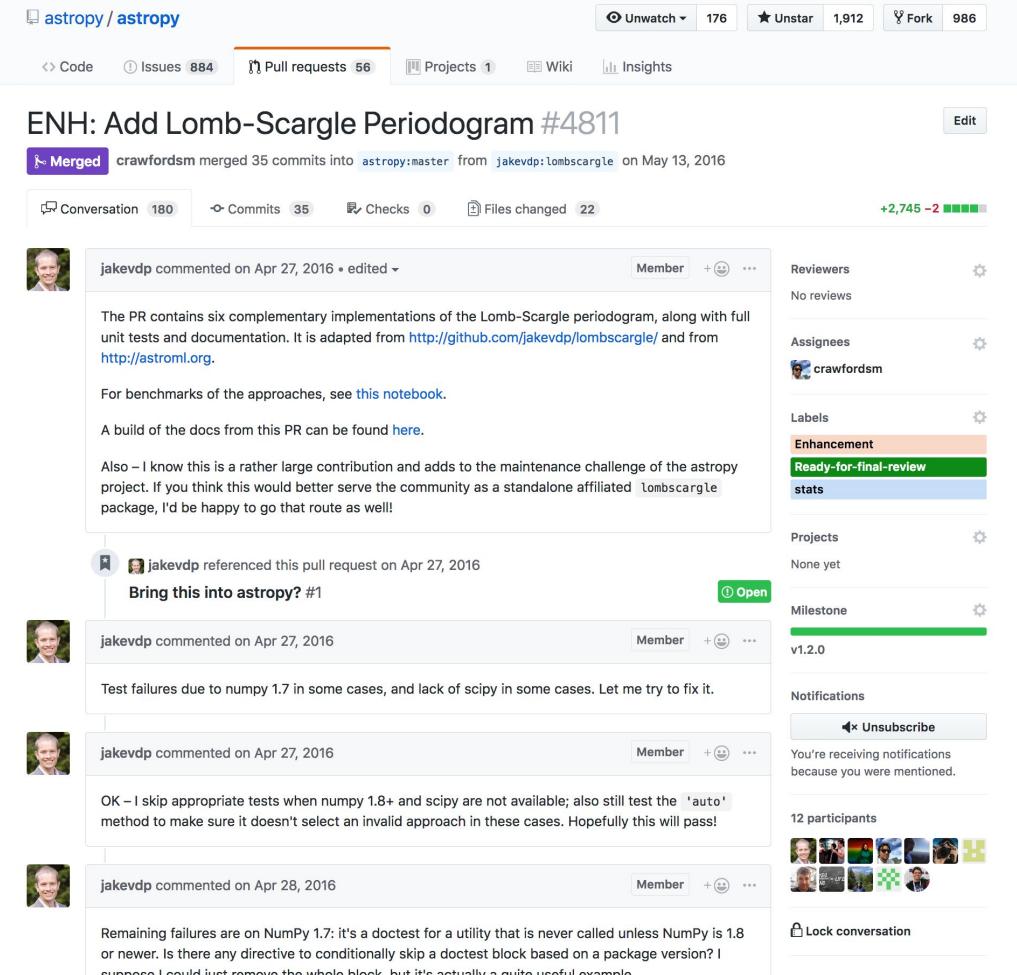


4 astropy/time/core.py

```
@@ -184,8 +184,12 @@ def __new__(cls, val, val2=None, format=None, scale=None,
184     self = val.replicate(format=format, copy=copy)
185     else:
186         self = super(Time, cls).__new__(cls)
187 +
188     return self
189
190 + def __getnewargs__(self):
191     +     return (self._time,
192     +
193     @kwargs_after_scale
194     def __init__(self, val, val2=None, format=None, scale=None,
195                 precision=None, in_subfmt=None, out_subfmt=None,
```

Case study of Astropy

- ...to functionality from established libraries

A screenshot of a GitHub pull request page for the Astropy project. The title is "ENH: Add Lomb-Scargle Periodogram #4811". The status bar shows "Merged" with a merge commit message: "crawfordsm merged 35 commits into astropy:master from jakevdp:lombscargle on May 13, 2016". The pull request has 180 conversations, 35 commits, 0 checks, and 22 files changed. The PR body contains comments from jakevdp explaining the implementation and testing. On the right, there are sections for Reviewers, Assignees, Labels, Projects, Milestone, and Notifications. The Labels section shows "Enhancement" and "Ready-for-final-review" as green buttons.

The PR contains six complementary implementations of the Lomb-Scargle periodogram, along with full unit tests and documentation. It is adapted from <http://github.com/jakevdp/lombscargle/> and from <http://astroml.org/>.

For benchmarks of the approaches, see [this notebook](#).

A build of the docs from this PR can be found [here](#).

Also – I know this is a rather large contribution and adds to the maintenance challenge of the astropy project. If you think this would better serve the community as a standalone affiliated `lombscargle` package, I'd be happy to go that route as well!

jakevdp referenced this pull request on Apr 27, 2016

Bring this into astropy? #1 Open

jakevdp commented on Apr 27, 2016

Test failures due to numpy 1.7 in some cases, and lack of scipy in some cases. Let me try to fix it.

jakevdp commented on Apr 27, 2016

OK – I skip appropriate tests when numpy 1.8+ and scipy are not available; also still test the 'auto' method to make sure it doesn't select an invalid approach in these cases. Hopefully this will pass!

jakevdp commented on Apr 28, 2016

Remaining failures are on NumPy 1.7: it's a doctest for a utility that is never called unless NumPy is 1.8 or newer. Is there any directive to conditionally skip a doctest block based on a package version? I suppose I could just remove the whole block, but it's actually a quite useful example.

Reviewers
No reviews

Assignees
 **crawfordsm**

Labels
Enhancement Ready-for-final-review **stats**

Projects
None yet

Milestone
v1.2.0

Notifications
Unsubscribe
You're receiving notifications because you were mentioned.

12 participants 

Lock conversation

Case study of Astropy

- Code review and cycles of iterations on details

The screenshot shows a GitHub pull request page for the Astropy project. The title of the PR is "ENH: Add Lomb-Scargle Periodogram #4811". The status bar indicates the PR is "Merged" and was merged by "crawfordsm" on May 13, 2016. The PR has 180 conversations, 35 commits, and 22 files changed. A red circle highlights the top navigation bar showing these metrics.

The main body of the PR contains several comments from the author, "jakevdp", discussing the implementation and its integration into the Astropy project. One comment notes test failures due to NumPy 1.7 and suggests fixing them. Another comment discusses skipping tests when NumPy 1.8+ is not available.

On the right side, there are sections for "Reviewers" (none), "Assignees" (crawfordsm), "Labels" (Enhancement, Ready-for-final-review, stats), "Projects" (none yet), "Milestone" (v1.2.0), and "Notifications" (12 participants). A red circle highlights the "Participants" section at the bottom right.

```
astropy / astropy
Unwatch 176 ★ Unstar 1,912 Fork 986
Code Issues 884 Pull requests 56 Projects 1 Wiki Insights
Edit
Merged crawfordsm merged 35 commits into astropy:master from jakevdp:lombscargle on May 13, 2016
Conversation 180 Commits 35 Checks Files changed 22 +2,745 -2
jakevdp commented on Apr 27, 2016 • edited Member ...
The PR contains six complementary implementations of the Lomb-Scargle periodogram, along with full unit tests and documentation. It is adapted from http://github.com/jakevdp/lombscargle/ and from http://astroml.org/.
For benchmarks of the approaches, see this notebook.
A build of the docs from this PR can be found here.
Also – I know this is a rather large contribution and adds to the maintenance challenge of the astropy project. If you think this would better serve the community as a standalone affiliated lombscargle package, I'd be happy to go that route as well!
jakevdp referenced this pull request on Apr 27, 2016
Bring this into astropy? #1
jakevdp commented on Apr 27, 2016 Member ...
Test failures due to numpy 1.7 in some cases, and lack of scipy in some cases. Let me try to fix it.
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Reviewers No reviews
Assignees crawfordsm
Labels Enhancement, Ready-for-final-review, stats
Projects None yet
Milestone v1.2.0
Notifications
Unsubscribe
You're receiving notifications because you were mentioned.
12 participants
```

Case study of Astropy

- Code review and cycles of iterations on details

The screenshot shows a GitHub pull request interface. At the top, a commit history from jakevdp on April 27, 2016, is displayed, showing multiple commits related to Lomb-Scargle implementations and documentation. Below this, a comment from jakevdp on April 29, 2016, stating "Rebased on master". A summary bar indicates "108 hidden items" with a "Load more..." button. The main review section shows a diff in `astropy/stats/lombscargle/implementations/main.py`. mhvk reviewed on May 12, 2016, pointing out a bug in the code logic. The review text reads:

```
91 +     methods = available_methods()
92 +     fast_method_ok = ('fast' in methods)
93 +     prefer_fast = (fast_method_ok and len(frequency) > 200
94 +                     and _is_regular(frequency, assume_regular_frequency))
```

mhvk's note: So `and (assume_regular_frequency or _is_regular(frequency))` (`_is_regular` will not get executed if `assume_regular_frequency` holds, since python short-circuits these expressions).

At the bottom, there is a "Reply..." button.

Case study of Astropy

- Test every commit, require review

The screenshot shows a GitHub pull request interface. At the top, there's a comment from user `saimn` (represented by a blue icon) 19 hours ago:

It would be more generic to handle this case in `Table.replace_column` instead of raising an error. Why not dropping the index there, maybe with a keyword or warning ?

Below it, another comment from user `astrofrog` (represented by a camera icon) 18 hours ago:

@taldcroft - do you have any thoughts on this?

Below the comments, a message encourages pushing to a specific branch:

Add more commits by pushing to the `fix-table-io-time-index` branch on `astrofrog/astropy`.

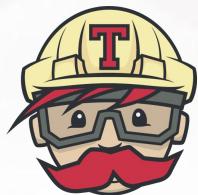
The main body of the interface displays a summary of Continuous Integration (CI) status:

- Review required**: At least 1 approving review is required by reviewers with write access. [Learn more](#).
- All checks have passed**: 11 successful checks
 - ci/circleci: image-tests-mpl222** — Your tests passed on CircleCI! [Details](#)
 - ci/circleci: image-tests-mpi300** — Your tests passed on CircleCI! [Details](#)
 - ci/circleci: image-tests-mpldev** — Your tests passed on CircleCI! [Details](#)
 - continuous-integration/appveyor/pr** — AppVeyor build succeeded [Details](#)
 - continuous-integration/travis-ci/pr** — The Travis CI build passed [Details](#)
- Merging is blocked**: Merging can be performed automatically with 1 approving review.

At the bottom, there are buttons for "Merge pull request" and "You can also open this in GitHub Desktop or view command line instructions."

Case study of Astropy

- Test every commit, require review



A screenshot of a GitHub pull request interface for the `fix-table-io-time-index` branch of the `astrofrog/astropy` repository.

The pull request has two comments:

- saimn commented 19 hours ago: "It would be more generic to handle this case in `Table.replace_column` instead of raising an error. Why not dropping the index there, maybe with a keyword or warning ?"
- astrofrog commented 18 hours ago: "@taldcroft - do you have any thoughts on this?"

Below the comments, a message says: "Add more commits by pushing to the `fix-table-io-time-index` branch on `astrofrog/astropy`".

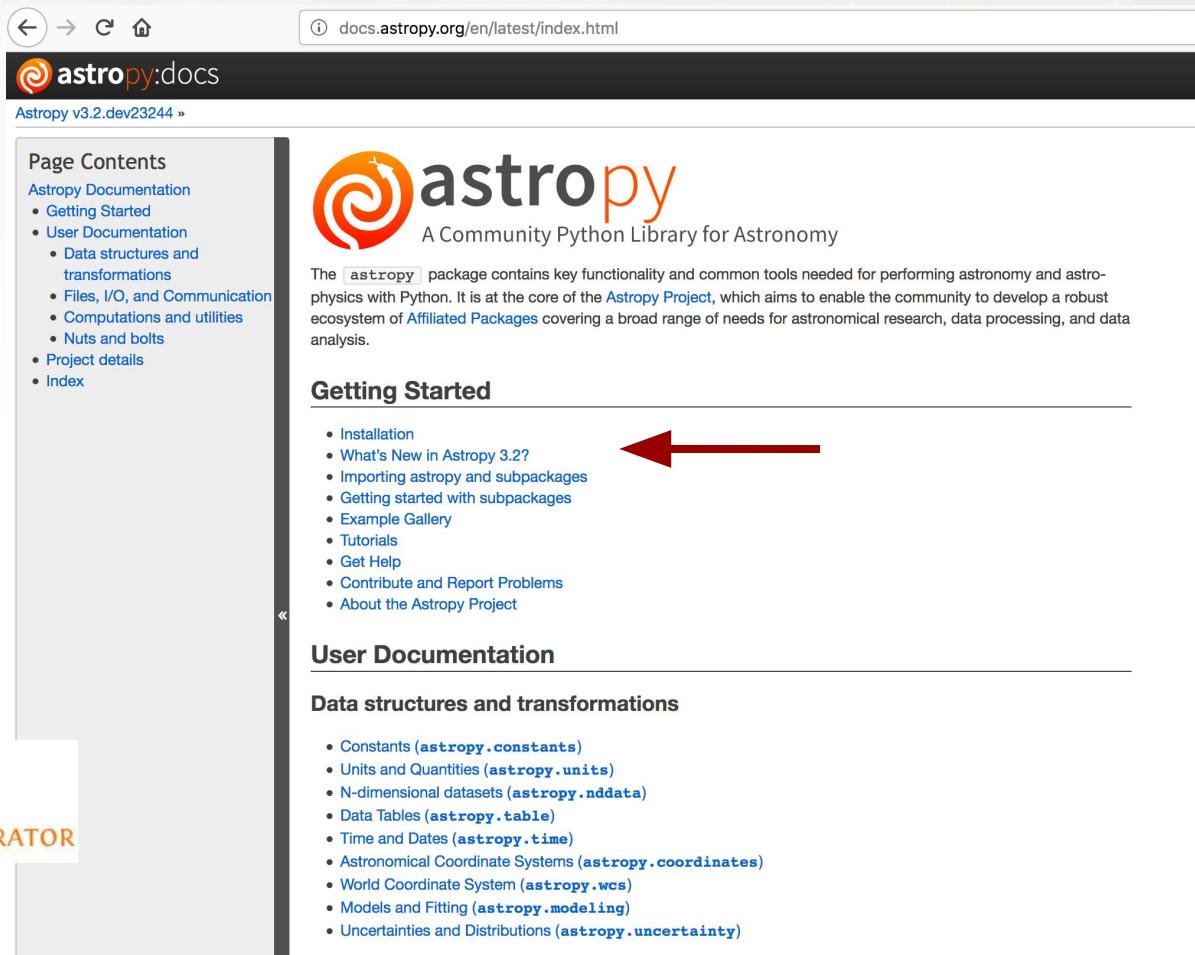
The pull request summary shows the following status:

- Review required**: At least 1 approving review is required by reviewers with write access. [Learn more](#).
- All checks have passed**: 11 successful checks
 - ci/circleci: image-tests-mpl222 — Your tests passed on CircleCI! [Details](#)
 - ci/circleci: image-tests-mpl300 — Your tests passed on CircleCI! [Details](#)
 - ci/circleci: image-tests-mpldev — Your tests passed on CircleCI! [Details](#)
 - continuous-integration/appveyor/pr — AppVeyor build succeeded [Details](#)
 - continuous-integration/travis-ci/pr — The Travis CI build passed [Details](#)
- This branch has no conflicts with the base branch**: Merging can be performed automatically.

At the bottom, there is a button to "Merge pull request" and a note: "You can also [open this in GitHub Desktop](#) or view [command line instructions](#)".

Case study of Astropy

- Write documentation along with code rather than at release time



A screenshot of the Astropy documentation website (docs.astropy.org/en/latest/index.html). The page features the Astropy logo and tagline "A Community Python Library for Astronomy". A red arrow points from the left towards the "Getting Started" section. Another red arrow points from the right towards the "User Documentation" section.

The "Getting Started" section includes links to Installation, What's New in Astropy 3.2?, Importing astropy and subpackages, Getting started with subpackages, Example Gallery, Tutorials, Get Help, Contribute and Report Problems, and About the Astropy Project.

The "User Documentation" section includes a list of data structures and transformations:

- Constants (`astropy.constants`)
- Units and Quantities (`astropy.units`)
- N-dimensional datasets (`astropy.nddata`)
- Data Tables (`astropy.table`)
- Time and Dates (`astropy.time`)
- Astronomical Coordinate Systems (`astropy.coordinates`)
- World Coordinate System (`astropy.wcs`)
- Models and Fitting (`astropy.modeling`)
- Uncertainties and Distributions (`astropy.uncertainty`)



(Python) Packaging

Python packaging jargon

- **Package:** the outer big one, e.g. numpy, astropy, sklearn
E.g. outermost directory with a `__init__.py` file
- **Module:** a part of the namespace, can be from a single file
E.g. `fourier` for the file `fourier.py`
- **Subpackage:** package within a package, e.g `astropy.io.fits`
- **Repository:** everything that is under version control
- **Submodule:** a git repository embedded in another one
E.g. `astropy-helpers` used this way by many packages

A simple package layout

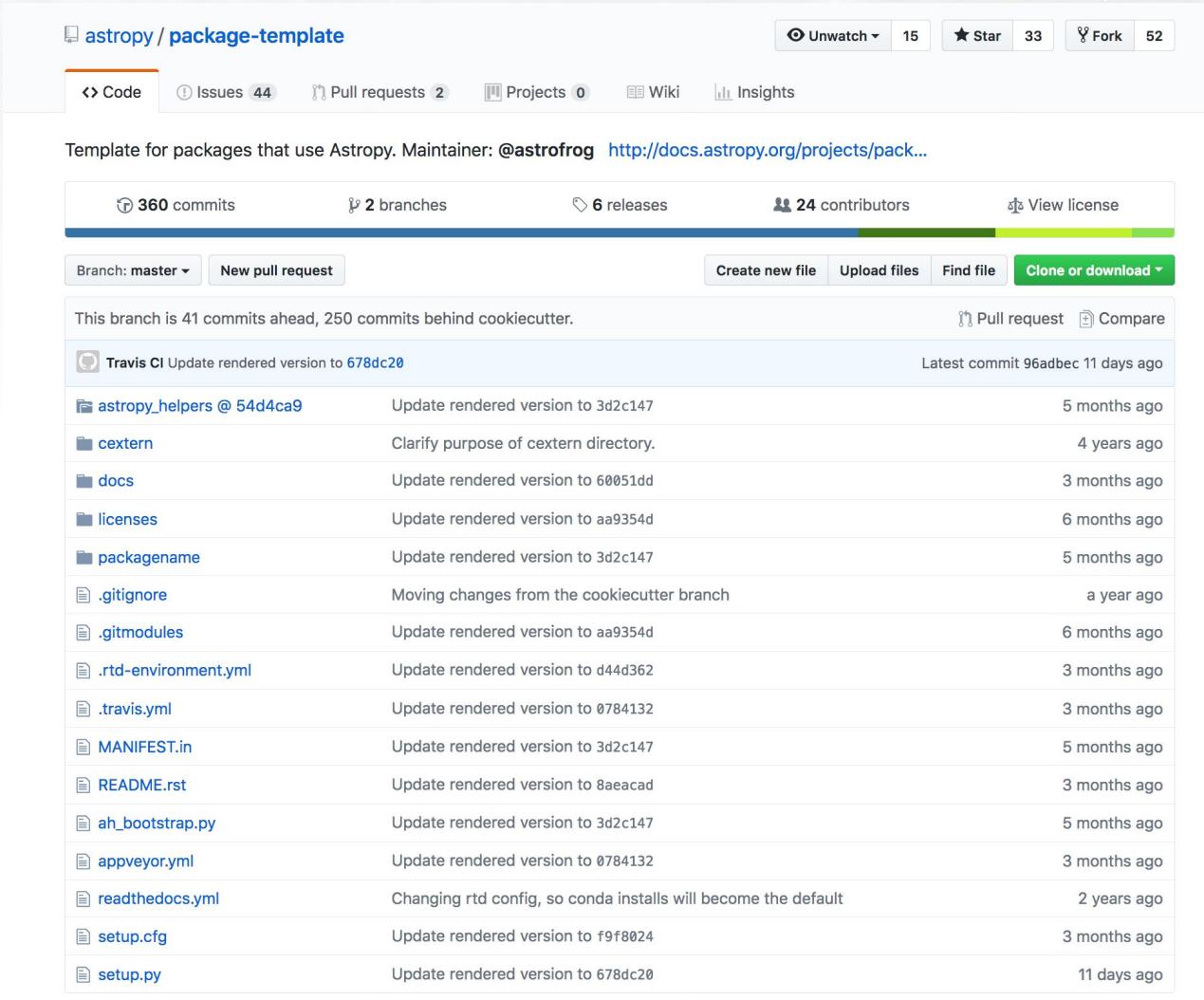
- README
- LICENSE
- setup.py
- packagename/__init__.py
- packagename/moduleone.py
- packagename/modultwo.py
- packagename/tests/
- packagename/subpackage/__init__.py
- packagename/subpackage/modulethree.py



```
>>> import mypackage  
>>> from mypackage import moduleone, modultwo  
>>> import mypackage.subpackage  
>>> from mypackage.subpackage import modulethree
```

Package template

- <http://docs.astropy.org/projects/package-template/>

A screenshot of a GitHub repository page for 'astropy / package-template'. The page shows basic repository statistics: 360 commits, 2 branches, 6 releases, 24 contributors, and a view license button. It also features a 'Clone or download' button. Below these, a message states 'This branch is 41 commits ahead, 250 commits behind cookiecutter.' A list of recent commits is displayed, each with a small icon, the author, the commit message, and the time since the commit. The commits are from various maintainers and include updates to files like .gitignore, .gitmodules, .rtd-environment.yml, .travis.yml, MANIFEST.in, README.rst, ah_bootstrap.py, appveyor.yml, readthedocs.yml, setup.cfg, and setup.py.

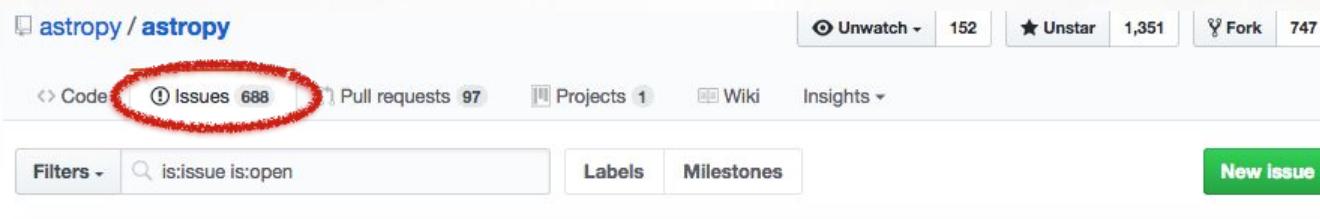
Author	Commit Message	Time Ago
Travis CI	Update rendered version to 678dc20	Latest commit 96adbec 11 days ago
astropy_helpers	Update rendered version to 3d2c147	5 months ago
cextern	Clarify purpose of cextern directory.	4 years ago
docs	Update rendered version to 60051dd	3 months ago
licenses	Update rendered version to aa9354d	6 months ago
packagename	Update rendered version to 3d2c147	5 months ago
.gitignore	Moving changes from the cookiecutter branch	a year ago
.gitmodules	Update rendered version to aa9354d	6 months ago
.rtd-environment.yml	Update rendered version to d44d362	3 months ago
.travis.yml	Update rendered version to 0784132	3 months ago
MANIFEST.in	Update rendered version to 3d2c147	5 months ago
README.rst	Update rendered version to 8aeacad	3 months ago
ah_bootstrap.py	Update rendered version to 3d2c147	5 months ago
appveyor.yml	Update rendered version to 0784132	3 months ago
readthedocs.yml	Changing rtd config, so conda installs will become the default	2 years ago
setup.cfg	Update rendered version to f9f8024	3 months ago
setup.py	Update rendered version to 678dc20	11 days ago

Astropy affiliated packages

- Total: 40 and growing (<http://www.astropy.org/affiliated/>)
- Functionality under development, may become part of core
 - regions: handling regions, including serialization and masking.
 - astropy-healpix: A BSD-licensed HEALPix implementation
- More specialized functionality
 - **astroML**: statistical and machine learning tools for astronomy
 - **photutils**: source detection, photometry and related image-processing
 - **astroquery**: tools for astronomical data access (mainly for open data)
- Packages with incompatible licenses

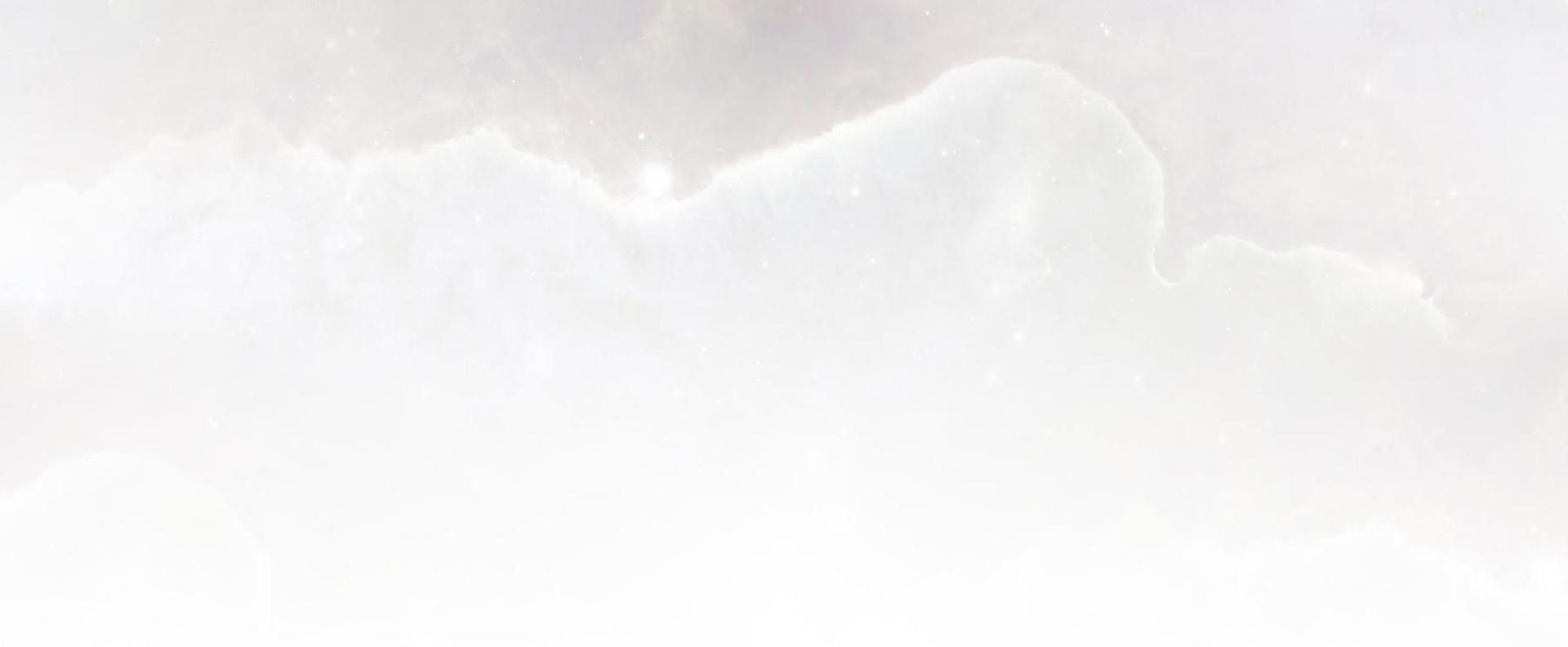
How to contribute to existing libraries

- Look at the contributing guidelines, e.g. “CONTRIBUTING.md” files on GitHub repos, documentation pages.
- Look at the issues page



- Use the labels to navigate and find something to work on, e.g. **Package-novice** and **good first issue** are newcomer friendly.
- Open a PR with the fix. Expect to receive a code review and comment before your fix is merged.

Code Testing and Continuous Integration



Most astronomers in fact DO test.
However they may do them as manual tests
rather than in a formalized, reproducible way.

Why test - How to test

- Does the code run from start to end, do the examples work?
- Result oriented: running on known data, does it produce the expected science out of the whole pipeline
- Want to ensure nothing breaks along the line

What testing is

- Code that runs features with known expected result or behavior
- Known expected result can be e.g. a mathematical relation, trivial case for an algorithm or previously buggy but now fixed behavior.

What testing is

- Code that runs features with known expected result or behavior
- Known expected result can be e.g. a mathematical relation, trivial case for an algorithm or previously buggy but now fixed behavior.

Caveats

- Writing tests takes requires significant human resources, but
- Indispensable especially for collaborative projects where developers are joining and leaving, and no single person is able to oversee all the details

Unit tests

- Lightweight, code is broken up for the smallest sensible pieces
 - Modular code is critical
- Run them early and often
- Make sure the most basic parts work correctly, cover edge cases

Regression tests

- A way to collectively remember the development history of old bugs.

Other types of tests

- Benchmarking
 - Speed
 - Load
- Style
- Security
- Integration
- ...

Example

```
def test_constellations():

    sc = SkyCoord(135*u.deg, 65*u.deg)
    assert sc.get_constellation() == 'Ursa Major'
    assert sc.get_constellation(short_name=True) == 'UMa'

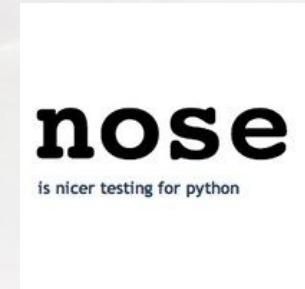
    scs = SkyCoord([135]*2*u.deg, [65]*2*u.deg)
    npt.assert_equal(scs.get_constellation(), ['Ursa Major']*2)
    npt.assert_equal(scs.get_constellation(short_name=True), ['UMa']*2)
```

Code coverage - The illusion of 100% coverage

- 100% coverage:
 - All code was run
 - it doesn't mean all code was tested, all cases may not been covered
 - **But:** Code not covered was certainly not tested
- Passing a test doesn't mean the code is correct
- Incorrect code can pass a tests suite, and correct code can fail
- Tests can be incomplete, tests can be wrong

In practice

- Pytest
Nose
unittest
mock
- Test driven development:
 - write the tests based on the API design
 - test results of algorithms based on extra knowledge
 - from analytic solutions of simple cases
 - test data design (test data are drawn from known distribution)



Continuous integration

- Running tests automatically for all proposed code changes.
- Goal: Catch problems, incompatibility with the existing codebase introduced by new modifications as soon as possible.

Continuous Integration

- Self hosted, e.g.
- Cloud hosted providers, integrated with GitHub:



- Travis CI



- Appveyor



- Azure Pipeline



- CircleCI



- Codecov



Continuous Integration

astropy / astropy  build failing

Current Branches Build History Pull Requests > Build #21243

More options



✓ Pull Request #8077 Fix a bug that caused writing to FITS of Table objects that had index columns to fail

#21243 passed



-o Commit ff35f83 ↗

Ran for 23 min 58 sec

↳ #8077: Fix a bug that caused writing to FITS of Table objects that had index columns to fail ↗

Total time 58 min 25 sec

Branch master ↗

a day ago

 Thomas Robitaille

✓ Initial tests

9 min 15 sec

✓ # 21243.1  Compiler: clang C

PYTHON_VERSION=3.7 CONDA_DEPENDENCIES=\$CONDA_ALL_DEPENDENCIES PIP

9 min 15 sec



✓ # 21243.2  Compiler: gcc C

MAIN_CMD="flake8 astropy --count \$FLAKE8_OPT" SETUP_CMD="

2 min 59 sec



✓ Comprehensive tests

14 min 41 sec

✓ # 21243.3  Compiler: gcc C

PYTHON_VERSION=3.5 NUMPY_VERSION=1.13 INSTALL_CMD='python setup.py bu

7 min 16 sec



✓ # 21243.4  Compiler: gcc C

PYTHON_VERSION=3.5 SETUP_CMD='test --remote-data=astropy --readonly' COND

10 min



✓ # 21243.5  Compiler: gcc C

SETUP_CMD='test --coverage --remote-data=astropy --readonly' CONDA_DEPENDE

14 min 41 sec



✓ # 21243.6  Compiler: gcc C

NUMPY_VERSION=prerelease EVENT_TYPE='push pull_request cron'

2 min 10 sec



✓ # 21243.7  Compiler: gcc C

NUMPY_VERSION=dev SETUP_CMD='test --remote-data' CONDA_DEPENDENCIES=

12 min 4 sec



Continuous Integration

ci-helpers

Current build History Deployments Events Settings

 NEW BUILD  RE-BUILD PR

Pull request #333 - Updating astropy versions to 2.0.9 and 3.0.5

Pinning PYTHON_VERSION to make sure conda doesn't update it

1.0.1056

10 days ago by Brigitte Sipocz

 master → 7b453b76 ←  astropy_305 → 280910fd

Failed 10 days ago in 35 min 34 sec

Jobs

Job name	Tests	Duration
Environment: PYTHON_VERSION=2.7, NUMPY_VERSION=development, CONDA_DEPENDENCIES=scipy glymur, COND...		9 min 54 sec
Environment: PYTHON_VERSION=3.6, NUMPY_VERSION=stable, ASTROPY_VERSION=stable, CONDA_DEPENDENCIE...		3 min 40 sec
Environment: PYTHON_VERSION=2.7, DEBUG=True		1 min 17 sec
Environment: PYTHON_VERSION=3.4, NUMPY_VERSION=1.9		1 min 44 sec
Environment: PYTHON_VERSION=3.5, NUMPY_VERSION=1.13, ASTROPY_VERSION=development		3 min 41 sec
Environment: PYTHON_VERSION=3.5, NUMPY_VERSION=1.13, ASTROPY_VERSION=lts		2 min 14 sec
Environment: PYTHON_VERSION=3.5, CONDA_ENVIRONMENT=conda_environment.yml, TEST_CMD=python -c "impor...		Cancelled
Environment: PYTHON_VERSION=3.6, ASTROPY_VERSION=3.0, SUNPY_VERSION=0.9, PIP_FALLBACK=False, COND...		Cancelled