Archiving and Citing Software

An Introduction for Novices

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future scientific legacy relies on code

Your work will be the foundation on which the next generation must build an improved understanding of how the Universe works

if we don't take care of code we create holes in the scientific record

An example:

Machine Learning

Software is inseparable from "the data"

ML frameworks trade off exact numeric determinism for **performance** and often require remote computing resources

Even if you copy development steps there will be tiny differences in the end results

This is the future (emergent reality) of scientific research

https://petewarden.com/2018/03/19/the-machine-learning-reproducibility-crisis/

Sharing research is challenging in new ways.

This is not a "problem"

We need to acknowledge that changes are needed though

FAIR Code

is good for the future of science

Findable
Accessible
Interoperable
Reusable

Original FAIR Data Principles are helpful with software too.

backup ≠ archive

Backup

- backups are just copies
- can be used to restore an original
- used for operational recoveries (e.g. recover an overwritten file)
- focus is on speed of recovery and integrity

Archive

- archives store a version of a file that's no longer changing, or shouldn't be changing
- searchabilty is more critical in archives
- importance is placed on the ability to scale data integrity and retention over long periods of time
- collection of historical records kept for long-term retention/used for future reference

★ You should not pit backup against archiving ★

(use them together)

Archives have persistent identifiers

DOI

"the backbone of the academic reference and metrics system"

https://guides.github.com/activities/citable-code/

[Citation Needed]

- need for a complete record of the research process
- need to enable software discoverability
- importance of research reproducibility
- **give credit to academic researchers of all levels for the software that they develop**

Native data and software citation are vitally important

```
\software{Astropy \citep{http://dx.doi.org/10.1051/0004-6361/201322068},
          Matplotlib \citep{http://dx.doi.org/10.1109/MCSE.2007.55}}
```

Citation File Format: CITATION.cff

If you want to make your software easily citable, you can put a file called `CITATION.cff` in the root of your repository. This file should provide at least the minimally necessary metadata to cite your software. For example:

```
cff-version: 1.0.3
message: If you use this software, please cite it as below.
authors:
  - family-names: Druskat
    given-names: Stephan
    orcid: https://orcid.org/0000-0003-4925-7248
title: My Research Tool
version: 1.0.4
doi: 10.5281/zenodo.1234
date-released: 2017-12-18
```

★ ★

Solution for most common software citation use cases:

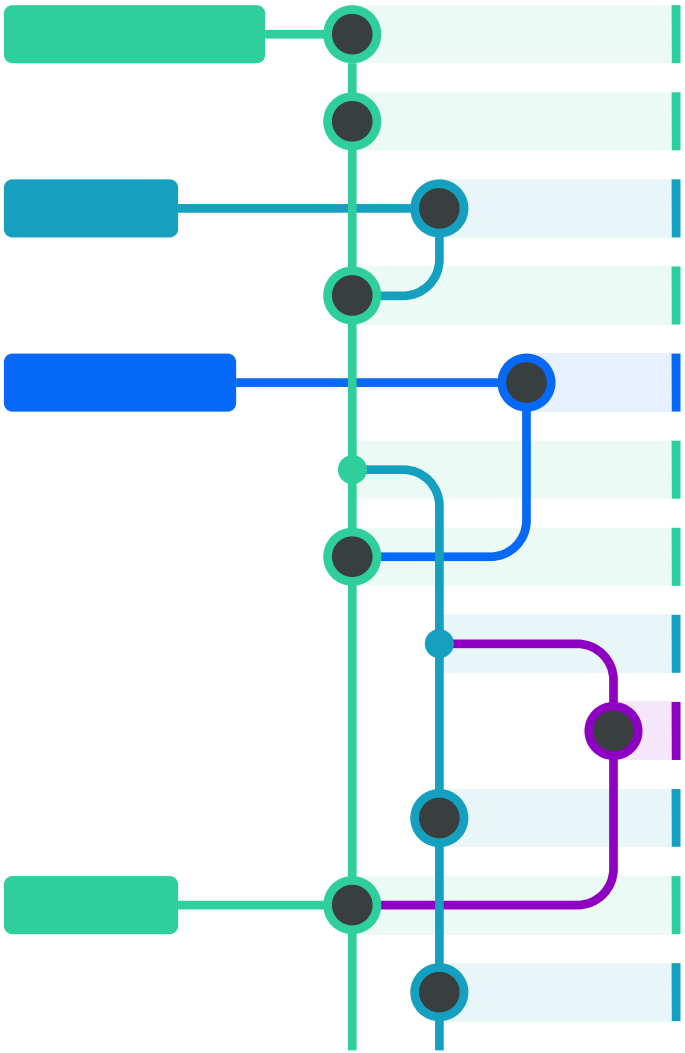
1. *Use software for a paper*
2. *Use software in/with new software*
3. *Store software entry*

Authorship

The astronomy community doesn't agree on how much someone should contribute to a code before that person is considered an author.

- astronomers will cite a paper rather than natively citing code whether or not the code they want to cite is the same version as the code discussed in the paper
  - **May contribute to software paper authors receiving disproportionate credit and current contributors not receiving any**
- Acknowledgement for contributions that might not fit a definition of "authorship"
  - **giving all contributors equal credit as authors may serve to dilute the perceived importance of authoring software**

Versioning



Complicates authorship issues and issues pertaining to dependencies and documentation (metadata)

How do we deal with multiple forks?

How should citations be calculated across different types of digital objects and versions of those objects?

Licenses

Putting things online doesn't make them "open"

Open

(very important)

- Allow software to be freely used, modified, and shared
- **You define how your code can be used**
- Many options

- Apache License 2.0
- BSD 3-Clause "New" or "Revised" license
- BSD 2-Clause "Simplified" or "FreeBSD" license
- GNU General Public License (GPL)
- GNU Library or "Lesser" General Public License (LGPL)
- MIT license
- Mozilla Public License 2.0
- Common Development and Distribution License
- Eclipse Public License

Proprietary

(e.g. IDL, IRAF, MATLAB, etc)

- **Restrictive licenses**
- older versions have no on-going support
- Still determining "fair use" of proprietary research software

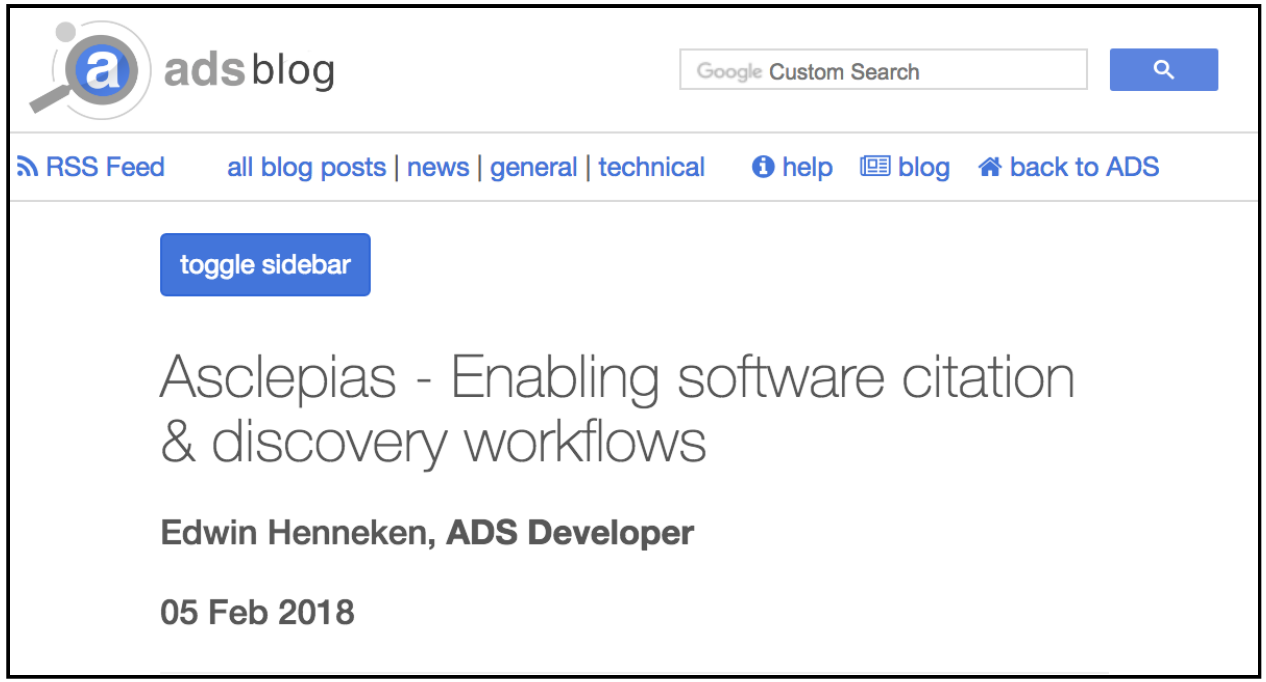
★ **Choose a license that fits your goals and project**

Considerations for how to share code

- Papers
  - Publishers have different citation/publishing policies (e.g. AAS)
- GitHub/Zenodo integration
  - Native software citation
  - **Versioned** DOIs
- Journal of Open Source Software
  - Peer review of code
  - Currently establishing partnership with AAS Publishing
- ASCL
  - Index but no persistent IDs
  - Does not enable native software citation

Ongoing Projects

Asclepias



Gus Muench

Alberto Accomazzi, Sergi Blanco-Cuaresma, Edwin Henneken

Lars Holm Nielsen, Krzysztof Nowak, Alexander Ioannidis

Thomas Robitaille

AAS AMERICAN ASTRONOMICAL SOCIETY

astrophysics data system

zenodo

https://adsabs.github.io/blog/asclepias

Metadata for Software

- **credit** for academic software
  - citation metadata
- **replicate** some analysis
  - versions and dependencies
- discover software you don't already know
  - keywords and descriptions

Zenodo.org is a data archive based at CERN which is popularly used to archive and provide DOIs to academic software from GitHub, as described in the official GitHub guide to Making your code citable.

Property	Zenodo
codeRepository	relatedLink
applicationCategory	communities
author	creators
datePublished	date_published
funder	contributors.Funder
keywords	keywords
license	license
description	description/notes
identifier	id
name	title
affiliation	affiliation
identifier	ORCID
name	name

https://codemeta.github.io/

Software Heritage

THE GREAT LIBRARY OF SOURCE CODE

An essential infrastructure for science

Home / Mission / An essential infrastructure for science

A large part of the technical and scientific **knowledge** that is being developed today **resides in software**. The preservation of this universal body of knowledge has become as essential as preserving research articles and data sets.

As an extremely valuable **service to the research community**, we will search for, collect, organize, preserve and make easily available all the software.

US Research Software Sustainability Institute

http://urssi.us/

Let's do some stuff right now

- License your code **openly**
  - You can add a license to a pre-existing repository
- **Create persistent ID for yourself (ORCiD)**
- Make a DOI for your code **using Zenodo**
  - Create a Zenodo account if you don't already have one
- **Create a CITATION.cff file**
  - Software examples

If you haven't already done so, make a README.md file for your repo

Bouquin, Daina, and Arfon Smith. ‘Software Citation Implementation in Astronomy’, 2018.

https://doi.org/10.25815/3H8N-G736.