SciCodes: Astronomy Research Software and Beyond

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Abstract.

The Astrophysics Source Code Library (ASCL ascl.net), started in 1999, is a free open registry of software used in refereed astronomy research. Over the past few years, it has spearheaded an effort to form a consortium of scientific software registries and repositories. In 2019 and 2020, ASCL contacted editors and maintainers of discipline and institutional software registries and repositories in math, biology, neuroscience, geophysics, remote sensing, and other fields to develop a list of best practices for these research software resources. At the completion of that project, performed as a Task Force for a FORCE11 working group, members decided to form SciCodes as an ongoing consortium. This presentation covered the consortium’s work so far, what it is currently working on, what it hopes to achieve for making scientific research software more discoverable across disciplines, and how the consortium can benefit astronomers.

1. Introduction

The Astrophysics Source Code Library (ASCL ascl.net) is a free online registry for source codes of interest to astronomers and astrophysicists, including solar system astronomers. It registers scientist-written software used in research that has appeared in, or been submitted to, peer-reviewed publications; it can also serve as a repository. The ASCL assigns a unique identifier to its entries, and improves research transparency and reproducibility by making these codes more discoverable for examination.

A broad look at research software shows that codes developed in one discipline may also be useful in another. For example, WND-CHARM (Shamir et al. 2008), first used in X-ray imaging analysis (Shamir et al. 2009), has also been used in galaxy morphology research (Kaminski et al. 2014). emcee (Foreman-Mackey et al. 2013), first written for use in astrophysics and now widely used in the field, has also been used in other disciplines, including materials science (Paulson et al. 2019), Ebola virus research (Liao et al. 2020), and ecology (Mairet & Bayen 2021).

It is not surprising that other disciplines also have registries or repositories for software used in those fields, and that these registries have many of the same goals, concerns, and interests as the ASCL. Among these are software citation and ensuring code authors receive credit for the computational methods that enable research, curation of the records they hold, adopting and adapting practices that support and improve stewardship of the resources themselves, and increased software discoverability both for possible (re)use and to support research by making these methods available.

That these various registries participate in organizations such as the Research Data Alliance (Berman & Crosas 2020) and FORCE11 (Bourne et al. 2012) demonstrates...
that they share a number of interests and goals. In late 2018, the ASCL, as a member of the FORCE11 Software Citation Implementation Working Group,\(^1\) suggested the group form a task force to develop a list of best practices for research software registries. This provided an opportunity for managers and editors of these resources to meet regularly and work toward a common goal. These meetings, a Sloan-funded workshop in November 2019,\(^2\) and subsequent work led to the release of best practices for such resources in late 2020 (Task Force on Best Practices for Software Registries et al. 2020). At the conclusion of that project, the task force’s work done, the participants decided to keep meeting and formed the SciCodes consortium.

2. SciCodes

SciCodes\(^3\) is a consortium of scientific software registries and repositories. The consortium meets monthly, offering two meetings on the same day to enable broad geographic participation. The consortium’s first meeting was in February 2021. In this formative first year, the group was led by three co-chairs, Michael Hucka and Thomas Morrell, both at Caltech, and this author. Participating resources, listed in the Table 1 in the Appendix, were polled on various governance issues, and the group chose, for subsequent years, to have two co-chairs with staggered terms, elected in October and with their terms to start the following January. The group also developed and ranked a list of goals to guide the consortium’s work. Meetings typically offer a short presentation, which is recorded and made available online,\(^4\) and discussion and progress reports on high-priority goals. These goals include:

- Enable searching across multiple software registries
- Speed adoption of CodeMeta (Jones et al. 2017) and CFF (Druskat et al. 2019) standards to improve software citation and discoverability
- Strengthen our resources through implementation of identified best practices
- Keep up with and share advances and ideas
- Discuss challenges and solutions to common issues that arise in managing our resources

3. How SciCodes benefits astronomers

The SciCodes consortium’s work will offer numerous benefits to astronomy. By making scientific software more discoverable across disciplines, SciCodes will enable astronomers in finding useful research software regardless of which discipline it was developed in; further, it will help make astronomy software more discoverable to those in

\(^1\)https://github.com/force11/force11-sciwg

\(^2\)https://ascnet.github.io/SWRegistryWorkshop/

\(^3\)https://scicodes.net

\(^4\)https://scicodes.net/presentations/
other fields. This can improve the efficiency of research, and increase citation of computational methods. SciCodes also works to strengthen each of the participant registries and repositories, making the workings of these resources more transparent to software authors, indexers, and journal data editors, and providing information that reflects on their use of best practices.

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## A. Appendix

Table 1. SciCodes Participating Registries and Repositories

| Resource                                                                 | URL                        |
|--------------------------------------------------------------------------|----------------------------|
| Astrophysics Source Code Library (ASCL)                                  | https://ascl.net            |
| Australian Research Data Commons (ARDC)                                   | https://ardc.edu.au/        |
| Biological General Repository for Interaction Datasets (BioGRID)         | https://thebiogrid.org/     |
| CaltechDATA                                                              | https://data.caltech.edu/   |
| Computational Infrastructure for Geodynamics (CIG)                       | https://geodynamics.org/    |
| DOE CODE                                                                 | https://www.osti.gov/doecode/|
| ELIXIR bio.tools                                                         | https://bio.tools/          |
| HAL                                                                      | https://hal.archives-ouvertes.fr/|
| Harvard Dataverse                                                        | https://dataverse.harvard.edu/|
| Model Integration (MINT)                                                 | http://mint-project.info/   |
| ModelDB                                                                  | https://senselab.med.yale.edu/modeldb/|
| Network for Computational Modeling in Social and Ecological Sciences (CoMSES) | https://www.comses.net/     |
| Oak Ridge National Laboratory Distributed Active Archive Center for Biogeochemical Dynamics (ORNL DAAC) | https://daac.ornl.gov/    |
| Ontosoft                                                                  | http://www.ontosoft.org/    |
| PhysioNet                                                                | https://physionet.org/      |
| Remote Sensing Code Library (RSCL)                                       | https://rscl-grss.org/      |
| SBGrid                                                                   | https://sbgrid.org/         |
| SciCrunch                                                                | https://scicrunch.org/      |
| simTK                                                                    | https://simtk.org/          |
| Software Heritage                                                        | https://www.softwareheritage.org/|
| swMATH                                                                   | https://swmath.org/         |
| Systems Biology Markup Language (SBML)                                   | http://sbml.org/Main_Page   |
| Zenodo                                                                   | https://zenodo.org/         |