

Title: Software and Services Citation Guidelines and Examples

Collaboration Area:

Software and Service Citations Cluster

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Document Description

These guidelines and examples for software and service citation are designed to assist researchers in properly preparing and providing citations for software or services used in support of their research. Software and services citations are included in the reference list of a paper with clear description in the methodology. The Availability Statement should indicate details of how to access the software or service.

Definition

Software: A computer program, in source code or compiled form, that supports scholarly research. Software may be downloaded, compiled, executed and instantiated.

Service: Services provide functions for the creation, access, processing and analysis of data. Services can be web services, provided across the web and following a well-defined machine protocol. In these guidelines software can be a service or web service. Services can be delivered through an implemented software instance that enables users to 'do' something with data. The user does not necessarily directly interact with the code.

Table of Contents

| | |
|------------------------|----------|
| Document Status | 1 |
| Definition | 1 |
| | 1 |

| | |
|---------------------------------|----------|
| Table of Contents | 1 |
| Introduction and Summary | 2 |
| References | 4 |
| Appendix: History | 4 |

Introduction and Summary

The Software and Services Citation Cluster was first formed as a working group under NASA's Earth Science Data Systems Working Group. It originally looked at citations and DOIs for NASA's Earth Science data. The group then evolved its interest to software and services and then moved their participants and objectives to a new ESIP cluster to expand beyond just NASA's scope. The history of the cluster can be found in the appendix. Below you will find the guidelines developed by this cluster on how to cite software and services along with relevant use cases.

Software and services citation is an evolving but increasingly important scientific practice. As data find applicability with the FAIR (Findable, Accessible, Interoperable, Reusable) principles (Wilkinson et al. 2016) so does software. We see several important purposes of citation:

- To aid scientific reproducibility through direct, unambiguous reference to the precise software or service used in a particular study.
- To provide credit for software developers or researchers who spend time in developing software. Citation of software also enables recognition of scholarly effort in disciplines and organisations that want to acknowledge and reward software development.
- To ensure scientific transparency and reasonable accountability of research.
- To aid in tracking the use and reuse of software through reference in scientific literature and within other software.
- To help developers verify how their software is being used.

Nevertheless, software and software services that underpin research are rarely cited in the same way as journal articles or other scholarly resources. There are many reasons for this discrepancy, but part of the problem is that there is a lack of consistent recommendations on how to cite and reference software and on how to actually construct a proper citation.

We need consistent guidelines on how to create citations that support Earth science research.

Various international organizations have been working to develop guidelines for software citation. Examples of these include:

- [FORCE11 Software Citation Principles](#)

- [DataCite Schema 4.1 Documentation](#) (with additions to describe software and examples for software citation)

The ESIP Software and Service Citations cluster has examined these approaches and found that they are generally compatible and useful. For the purposes of Earth, space, and environmental scientific domains, we synthesized both recommendations and domain specific use cases to prepare these guidelines.

In general, software and services should be cited in a similar fashion to data and research publications.

The core required elements of a citation are:

- Author(s) - the people or organizations directly responsible for the intellectual work to develop the software. Author(s) can be a list of individuals or a mission/project/group name.
- Publication Year - when the software is published to a repository or any other publication venues. This is specific to the version being cited.
- Title - the formal title of the software or service.
- Version - the precise version of the software used. Careful version tracking is critical to accurate citation.
- Publisher - the repository where software is held, archived, distributed, released or produced, ideally an institutional or disciplinary repository that provides curation and preservation of software. For example, Climate Data Gateway at NCAR, NASA Earth Exchange, Zenodo, Github (with Zenodo DOI), Figshare, Dataverse, Center for Open Science, Dryad, etc. If the software is self published, according to the American Psychological Association (APA) style, the publisher field is “Author”.
- Locator/Identifier - it should be a persistent identifiers (PID) such as a DOI, Handle or ARK that resolves to a landing page. DOI is considered the best practice for software citation. DOIs are a unique, persistent identifier that can be used to track software citation metrics and to link related research outputs such as journal articles and research data.

DataCite [DOI Citation Formatter](#) is a simple form based system which uses your DOI to allow you to quickly format your citation in hundreds of different styles. Note: this tool was built for publication citation and results from the tool need to be reviewed for compliance with these software and service citation guidelines.

If a persistent identifier doesn't exist, a URL be must used, if there is one.

- Access Date [YYYY-MM-DD] - Ongoing development of software may not always be reflected in release dates and versions. It is important to indicate when software or a service was accessed, especially when no persistent identifier is used. At minimum include year and month.

Software citation format aligning to APA style:

Author. (Publication Year). Title. Version No. Publisher. PID URL. Access Date.

For example:

Xu, C., & Christoffersen, B. (2017). The Functionally-Assembled Terrestrial Ecosystem Simulator. Version 1. Los Alamos National Laboratory (LANL), Los Alamos, NM (United States). <https://doi.org/10.11578/dc.20171025.1962>. Accessed 2018-07-01.

McGibbney, L.J., Reddy, O., Jarif, I., Spahn, N., & Goodman, A. (2018). nasa/podaacpy: Podaacpy v2.2.1. Zenodo. <https://doi.org/10.5281/zenodo.1751973>.

As explained in Locator/Identifier entry, it is desirable to have a DOI as Identifier; the DOI will make it easier for publishers to give proper credit (metrics) to Authors (developers/researchers) and linking the cited software to related resources (e.g. research publications and research data).

In some cases, a software does not have a DOI, but is accessible from a URL. A citation format is suggested as follows:

Author. (Publication Year). Title. Version No. Publisher. PID URL. Access Date.

For example:

Jones E., Oliphant E., & Peterson P., *et al.* (2001). SciPy: Open Source Scientific Tools for Python. Version 1.1.0. Author. <http://www.scipy.org/>. Accessed 2018-07-26.

Giovanni Team. (2018). Giovanni. Ver. 4.28. Goddard Space Flight Center, MD, USA. <https://giovanni.gsfc.nasa.gov/giovanni>. Accessed 2018-08-30.

Some repositories provide a recommended format for citing their software, e.g.

The NCAR Command Language (Version 6.4.0) [Software]. (2017).
Boulder, Colorado: UCAR/NCAR/CISL/TDD. <http://dx.doi.org/10.5065/D6WD3XH5>

The above citation has all mandatory components for a citation. The components can be rearranged to meet publisher's recommended citation format.

References

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DataCite Metadata Working Group. (2017). DataCite Metadata Schema Documentation for the Publication and Citation of Research Data. Version 4.1. DataCite e.V. <https://doi.org/10.5438/0014>.

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Appendix: History

The ESIP Software and Services Citations Cluster has its roots back with NASA's Earth Science Data System Working Group (ESDSWG). The first manifestation was the Data Citations working group, where it investigated how DOIs should be minted and registered for NASA's Earth Science data and recommendations on how to cite the data to its users. Some problems were recognized by that working group, that data citations could not properly address. One is that some data are generated on demand and therefore have no DOI. Another is some users obtain data after a tool provides a service that changes the original value of the data, i.e. averaging, interpolating, etc., therefore citing just the dataset does not fully provide enough information that is needed for provenance and reproducibility. To address these issues, and other concerns, the Software and Services Citations working group was formed. Since this group was supported by NASA, it restricted its scope to what pertained to NASA. The group realized that there are more concerns regarding software citations that were outside of that scope and would require non-NASA participation. Thus the group was reconstituted as a new cluster within ESIP.