

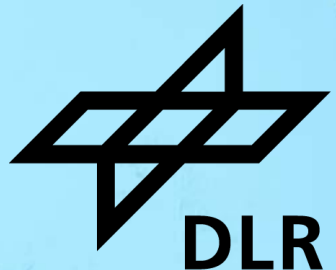
HERMES: FAIR(ER) SOFTWARE PUBLICATION THROUGH RICHER METADATA

Stephan Druskat

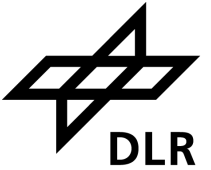
Institute of Software Technology, German Aerospace Center (DLR), Berlin

License [CC-BY-4.0 International](#)

DOI [10.5281/zenodo.14164978](#)

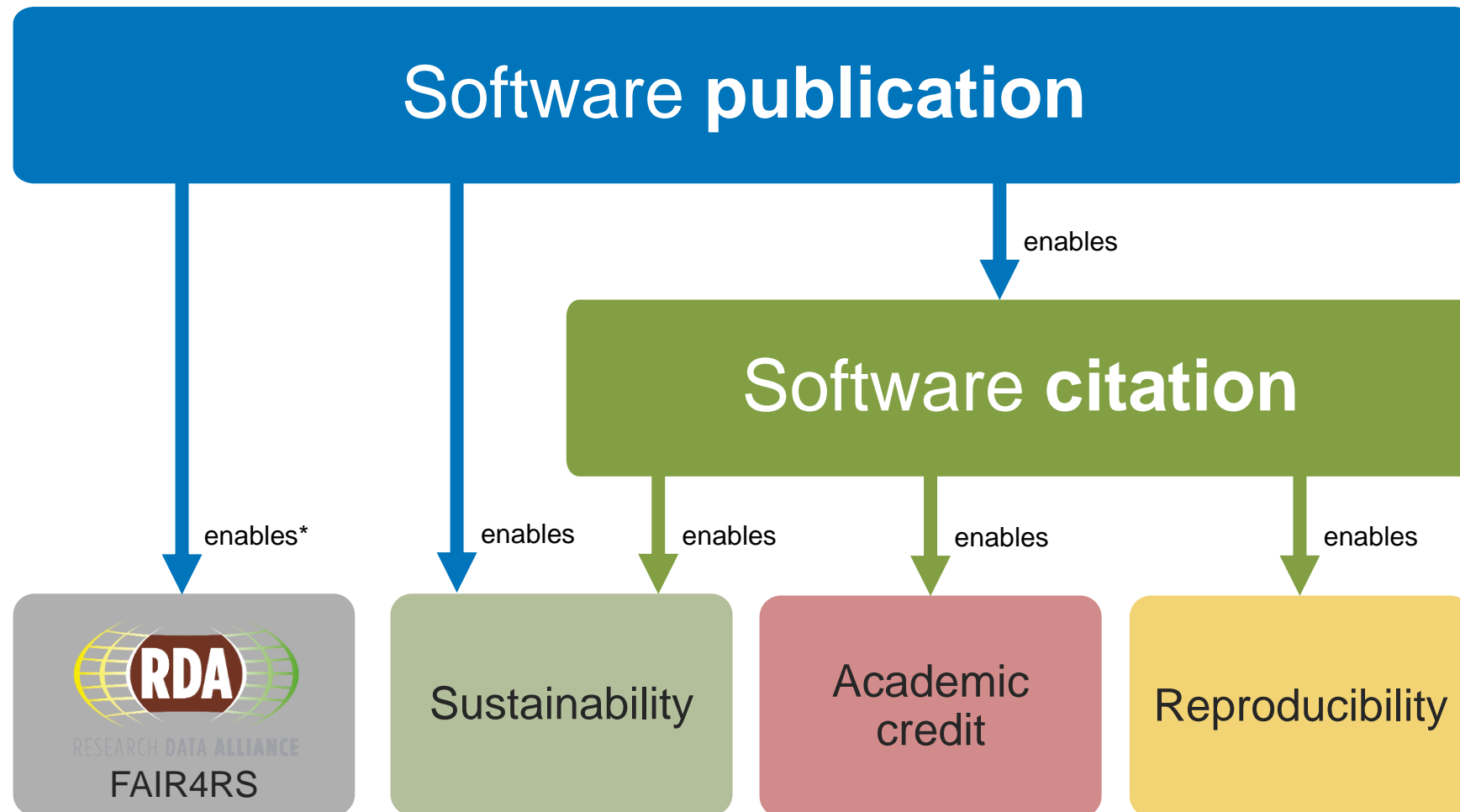


Overview



- Software publication & FAIR research software
- HERMES concept
- HERMES implementation
- Current & future work
- [optional] Example

Software *publication* is important, because research software is important!



Adapted from Druskat et al. (2023)

FAIR for Research Software (FAIR4RS)



- **F:** Software, and its associated metadata, is **easy for both humans and machines to find**.
- **A:** Software, and its metadata, **is retrievable via standardized protocols**.
- **I:** Software **interoperates with other software** by exchanging data and/or metadata, and/or through interaction via application programming interfaces (APIs), described through standards.
- **R:** Software is both usable (**can be executed**) and reusable (**can be understood**, **modified, built upon, or incorporated** into other software).

Chue Hong et al. (2022)

Publication of software with metadata
(Research) Software Engineering

What is software publication?

Publication of metadata and artifacts* for software versions in publication repositories

Persistent identifier for each version

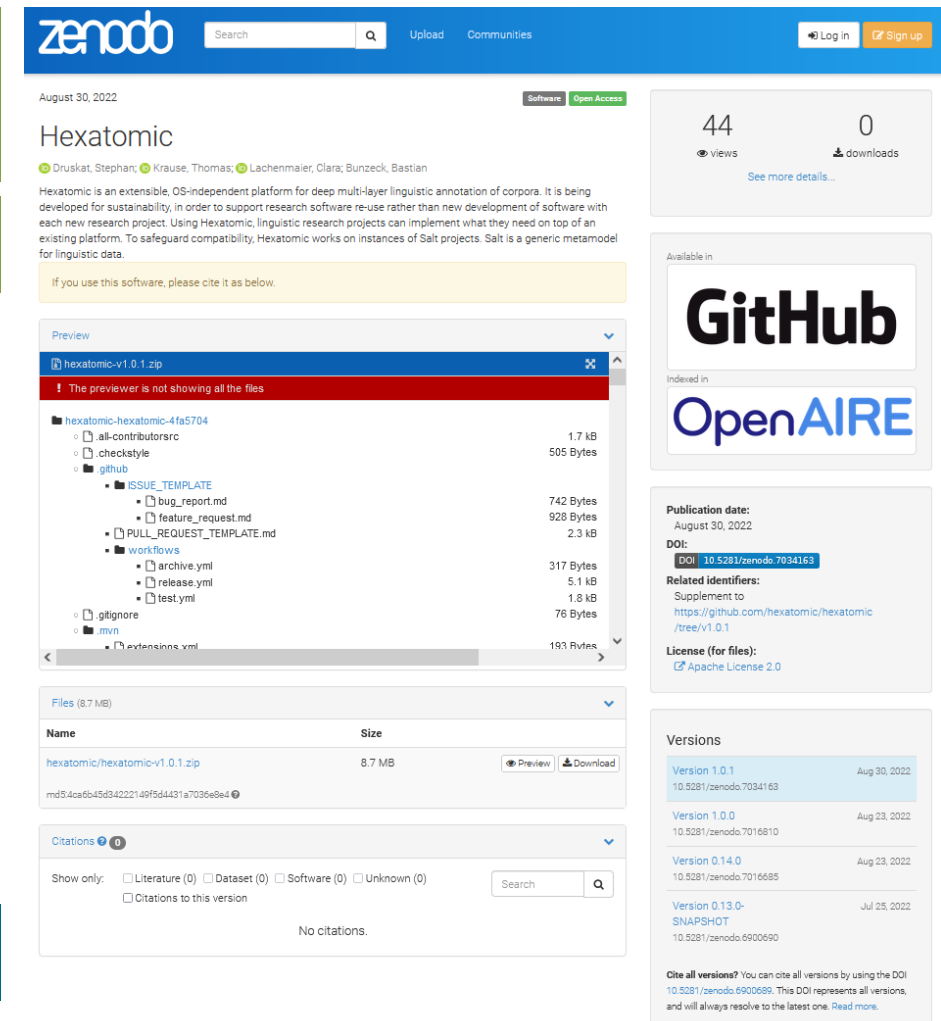
Not software publication:

- Software available on a source code platform (*GitHub, GitLab, etc.*)
- A paper *about* the software

Interim solution:

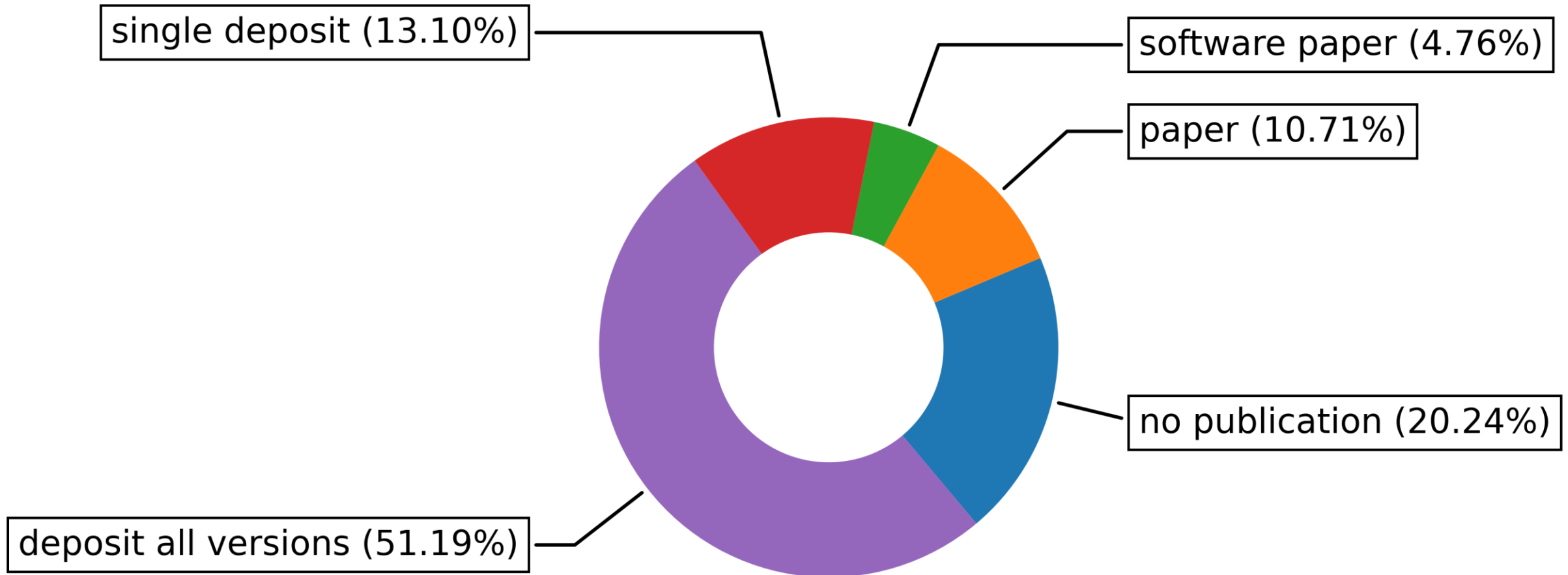
- software journals ([JOSS](#), [JORS](#), etc.)

Challenge: quality assurance



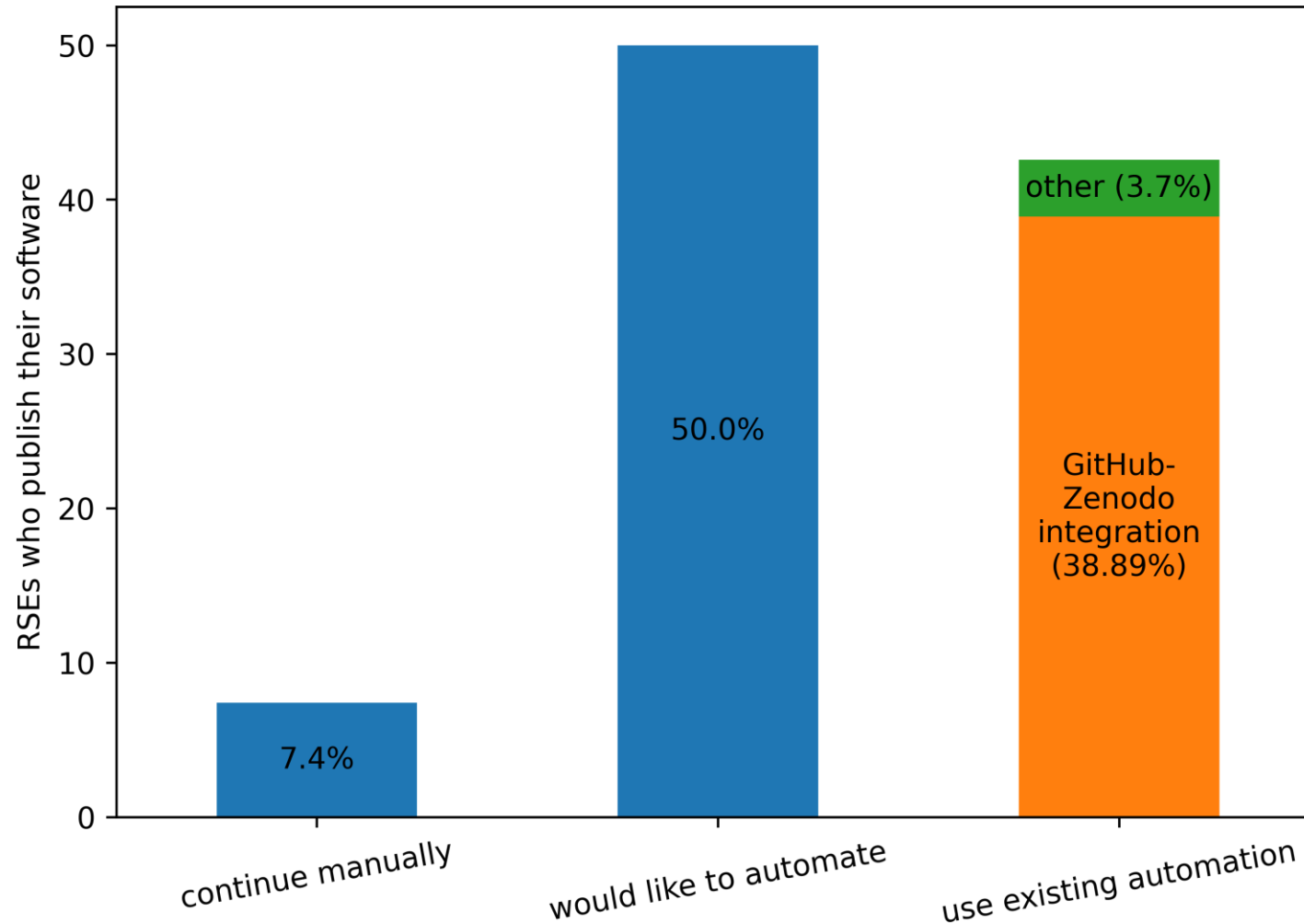
The screenshot shows the Zenodo page for the software 'Hexatomic'. The page includes a search bar, navigation links for 'Upload' and 'Communities', and a 'Log in' / 'Sign up' button. The main content area displays the software title 'Hexatomic', the authors 'Druskat, Stephan; Krause, Thomas; Lachenmaier, Clara; Bunzeck, Bastian', and a brief description. It also shows the publication date 'August 30, 2022', the number of views (44) and downloads (0), and a 'See more details...' link. The software is listed as available in 'GitHub' and indexed in 'OpenAIRE'. The 'Publication date' is 'August 30, 2022', and the 'DOI' is '10.5281/zenodo.7034163'. The 'Related identifiers' section includes a GitHub link. The 'License (for files)' is 'Apache License 2.0'. The 'Versions' section lists several versions: 'Version 1.0.1' (Aug 30, 2022), 'Version 1.0.0' (Aug 23, 2022), 'Version 0.14.0' (Aug 23, 2022), and 'Version 0.13.0-SNAPSHOT' (Jul 25, 2022). A 'Citations' section is also present, showing 'No citations'.

How is software currently published/publicized?



RSE software publication practices, N=84 (Druskat & Theis (submitted))

How do RSEs publish their software?



RSEs' software publication process, N=54 (Druskat & Theis, submitted)

Automated software publication: Zenodo-GitHub integration

DOIs for versions & projects, metadata, persistence

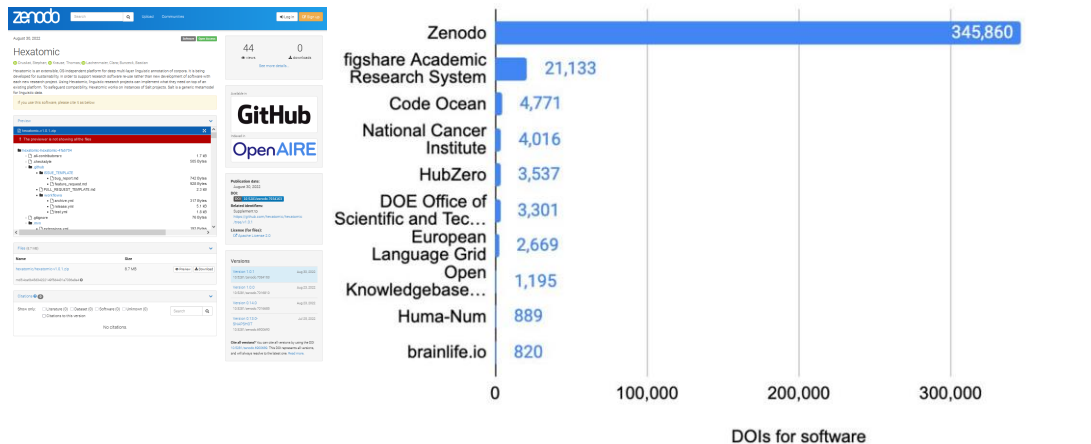
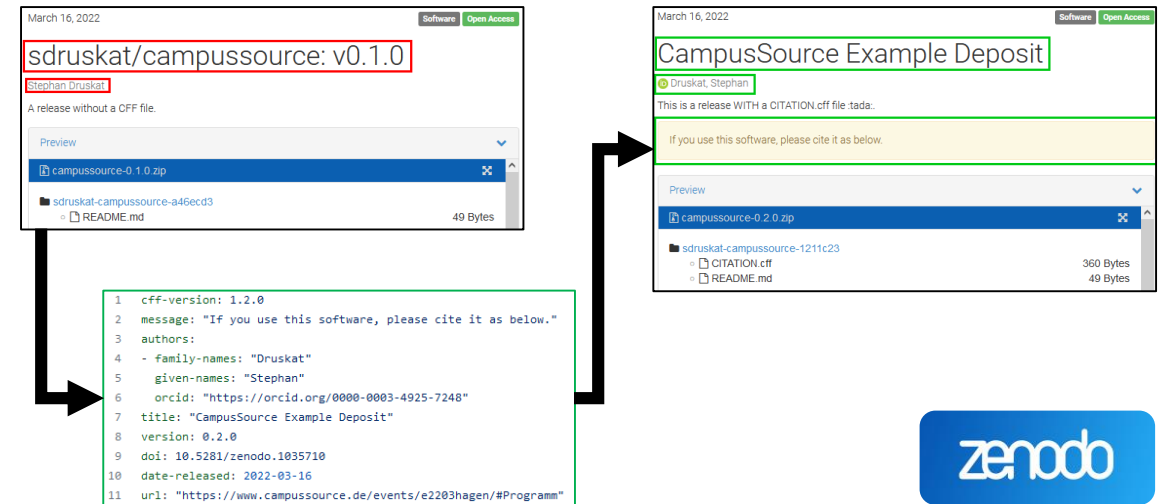


Figure from Mejias (2023).

GitHub-Zenodo integration,
improved metadata via `CITATION.cff`



Left: GitHub release for `sdruskat/campussource: v0.1.0` (March 16, 2022). Metadata is minimal, showing only the release name and a file `campussource-0.1.0.zip`.

Right: GitHub release for `CampusSource Example Deposit` (March 16, 2022). Metadata is enhanced, showing the author `Druskat, Stephan`, a citation instruction, and a `CITATION.cff` file.

```
1 cff-version: 1.2.0
2 message: "If you use this software, please cite it as below."
3 authors:
4 - family-names: "Druskat"
5   given-names: "Stephan"
6   orcid: "https://orcid.org/0000-0003-4925-7248"
7 title: "CampusSource Example Deposit"
8 version: 0.2.0
9 doi: 10.5281/zenodo.1035710
10 date-released: 2022-03-16
11 url: "https://www.campussource.de/events/e2203hagen/#Programm"
```



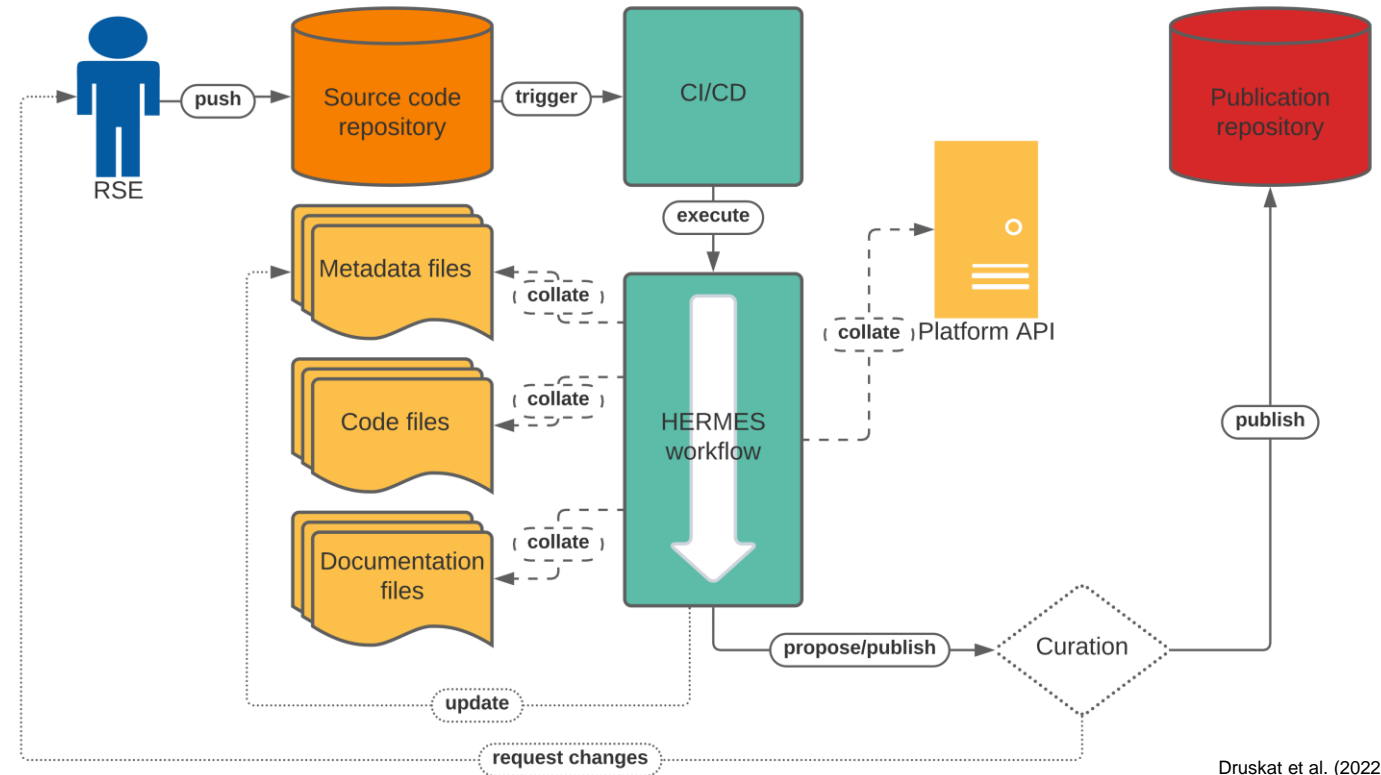
- Most often used by far: [Zenodo](#) (developed & run at CERN), GitHub integration
- Persisted records, persistent identifiers ([DataCite](#) DOIs w/ metadata), landing pages
- Integration only for specific platform combination, insufficient metadata in basic usage

HERMES: Helmholtz Rich Metadata Software Publication

(HMC project ZT-I-PF-3-006, 7/21-12/23, DLR + FZJ + HZDR)



- Automated software publication for all platform combinations
- Use existing metadata to enrich records/improve FAIRness
- Enable:
 - closed source publication,
 - curation & sign-off processes,
 - updating metadata records



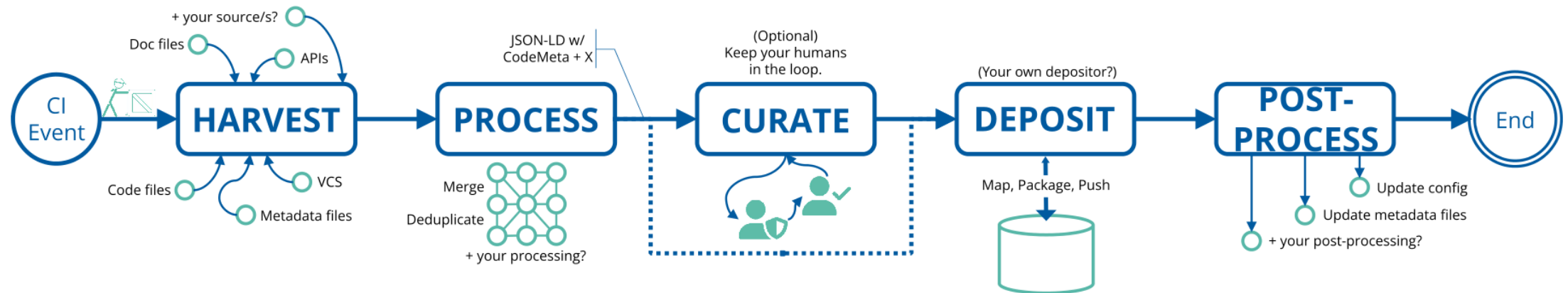
Druskat et al. (2022)

▪ software-metadata.pub



HERMES: Implementation

- Continuous integration workflow: on <event> run `hermes` as configured
- Tutorials for GitHub/GitLab: docs.software-metadata.pub



- `hermes` Python package (Meinel et al. 2024) + CI templates (GitHub, GitLab)
- Plugins via Python Extension Point mechanism for each step
- Details: Kernchen et al. (2024)

HERMES: Use and extensibility



- Dogfooding:
 - <https://github.com/softwarepub/hermes/releases/tag/v0.8.1>
 - <https://zenodo.org/records/13311079>
- User testing at live coding workshop (deRSE24)
- `hermes-plugin-python` (Fritzsche & Meinel 2024) created by high school intern within a few days
- Details: Kernchen et al. (2024)

Published August 13, 2024 | Version 0.8.1

Software Open

hermes

Meinel, Michael¹ ; Druskat, Stephan¹ ; Kelling, Jeffrey² ; Bertuch, Oliver³ ; Knodel, Oliver² ; Pape, David² ; Kernchen, Sophie¹

Show affiliations

hermes

Files

hermes.zip

Files (45.3 kB)

Name	Size	Download all
hermes.zip md5:40a1e0da0e6e7761e1b53091b708914	42.2 kB	
README.md md5:8f06e42aa23604cbcd910f05dccc0f6	3.2 kB	

59 VIEWS 6 DOWNLOADS

Show more details

Versions

Version	Date
Version 0.8.1 10.5281/zenodo.13311079	Aug 13, 2024
Version 0.8.1b1 10.5281/zenodo.13221384	Aug 5, 2024

View all 2 versions

Cite all versions? You can cite all versions by using the DOI 10.5281/zenodo.13221383. This DOI represents all versions, and will always resolve to the latest one. [Read more.](#)

External resources

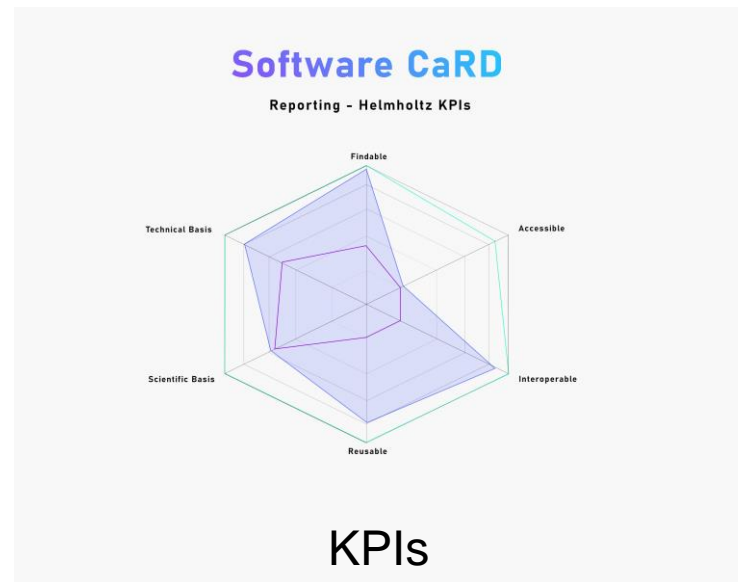
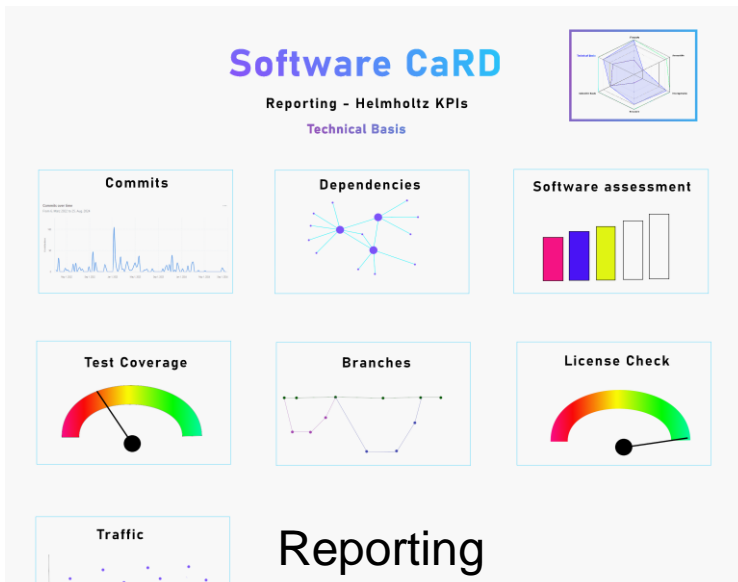
Indexed in

Current work: hermes 1.0.0, Software CaRD



- hermes 1.0.0
- Software Curation and Reporting Dashboard (Software CaRD)
 - Input: Consistent knowledge graph produced by HERMES
 - Compliance checks against configurable policies (KPIs, curation)
 - HMC project (2023 cohort; DLR + HZDR + GFZ + FZJ)

```
{
  "@context": [...],
  "@type": "SoftwareSourceCode",
  "name": "hermes",
  "version": "0.8.1",
  "license": "https://spdx.org/licenses/Apache-2.0",
  "author": [
    {
      "@id": "https://orcid.org/0000-0001-6372-3853",
      "@type": "Person",
      "affiliation": {...},
      "familyName": "Meinel",
      "givenName": "Michael",
      "email": "michael.meinel@dlr.de"
    },
    ...
  ],
  "hasPart": [
    {
      "@type": "CreativeWork",
      "name": "README",
      "encoding": {
        "@type": "TextObject",
        "encodingFormat": "text/markdown",
        "url": "file:///./README.md"
      },
      ...
    },
    ...
  ]
}
```

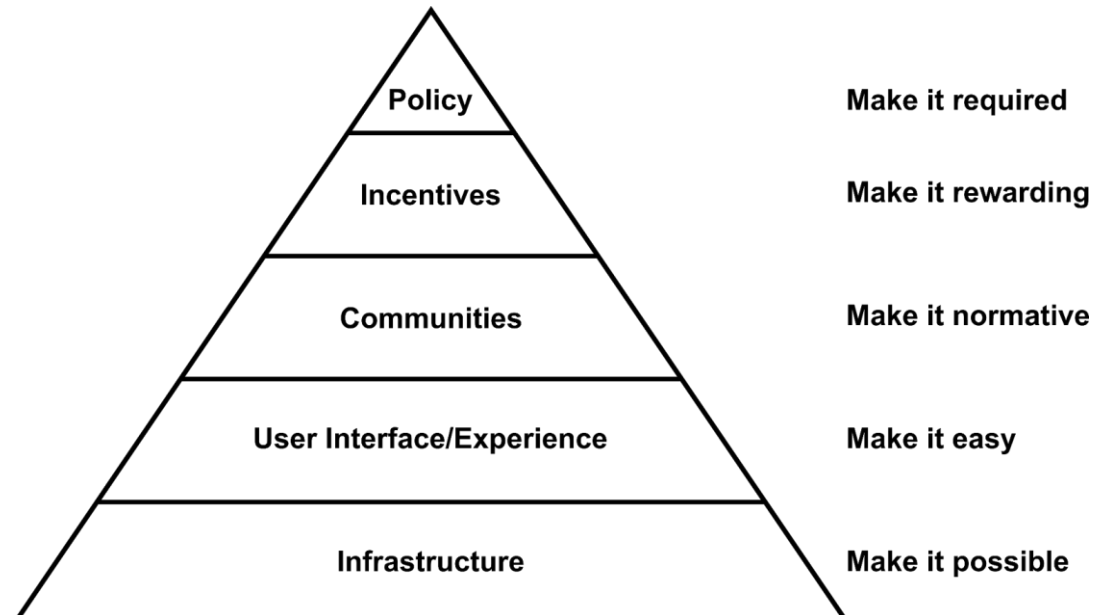


Software CaRD Curation Dashboard

HERMES > Authors > Michael Meinel			
ORCID [id]	0000-0001-6372-3853	Harvester Location	cif CITATION cff edit 2024-09-01T17:34:22
Given name [givenName]	Michael	Harvester Location	cif CITATION cff edit 2024-09-01T17:34:22
Family name [familyName]	Michael	Harvester Location	cif CITATION cff edit 2024-09-01T17:34:22
E-Mail address [email]	michael.meinel@dlr.de	Harvester Location	cif CITATION cff edit 2024-09-01T17:34:22
	led02@me.com	Harvester Location	git 2024-09-01T17:34:22
	michael_meinel@web.de	Harvester Location	orcid 2024-09-01T17:34:22
Affiliation [affiliation]	German Aerospace Center (DLR e.V.)		

Curation

- Rollout of HERMES workflows at two German universities
 - Heterogeneous stakeholders
 - Empirical requirements elicitation & usability optimization
 - New deployment targets: DSpace, MyCoRe
 - Development of targeted capacity building & outreach material



Thanks!



HERMES:

software-metadata.pub, docs.software-metadata.pub
github.com/softwarepub/hermes, github.com/softwarepub/ci-templates
pypi.org/project/hermes/

Me:

Stephan Druskat, stephan.druskat@dlr.de, fosstodon.org/@sdruskat

References:

Druskat, S., Bertuch, O., & Struck, A. (2023). Towards Research Software-ready Libraries. ABI Technik, 43(3), 168-178. doi: [10.1515/abitech-2023-0031](https://doi.org/10.1515/abitech-2023-0031).

Chue Hong, N P., et al. (2022). FAIR Principles for Research Software (FAIR4RS Principles). RDA. doi: [10.15497/RDA00068](https://doi.org/10.15497/RDA00068).

Druskat, S., & Theis, S., (submitted). Challenges in designing research infrastructure software in multi-stakeholder contexts, in 27th International Conference on Human-Computer Interaction, Gothenburg, Sweden, submitted.

Mejias, G., (2023). DOIs for research software: Increasing Visibility, Connectivity, Citability. Zenodo. doi: [10.5281/zenodo.7985199](https://doi.org/10.5281/zenodo.7985199).

Druskat, S., Bertuch, O., Juckeland, G., Knodel, O., & Schlauch, T., (2022). Software publications with rich metadata: State of the art, automated workflows and HERMES concept. arXiv. doi: [10.48550/arXiv.2201.09015](https://doi.org/10.48550/arXiv.2201.09015).

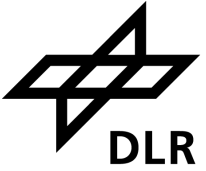
Meinel, M., Druskat, S., Kelling, J., Bertuch, O., Knodel, O., Pape, D., & Kernchen, S. (2024). hermes (v0.8.1). Zenodo. doi: [10.5281/zenodo.13311079](https://doi.org/10.5281/zenodo.13311079).

Kernchen, S., Meinel, M., Druskat, S., Fritzsche, M., Pape, D., & Bertuch, O. (2024). Extending and Applying Automated HERMES Software Publication Workflows. arXiv. doi: [10.48550/arXiv.2410.17614](https://doi.org/10.48550/arXiv.2410.17614).

Fritzsche, M., & Meinel, M. (2024). hermes-plugin-python (0.2.0). Zenodo. doi: [10.5281/zenodo.13168127](https://doi.org/10.5281/zenodo.13168127).

HERMES: Example

github.com/sdruskat/hermes-demo



hermes-demo Public Pin Unwatch 1 Fork 0 Star 0

main 1 Branch 0 Tags Add file Code

sdruskat Initial commit f005271 · 7 minutes ago 1 Commit

README.md Initial commit 7 minutes ago

README

hermes-demo

A repository to demonstrate automated software publishing with hermes

About

A repository to demonstrate automated software publishing with hermes.

[software-metadata.pub](#)

continuous-integration hermes
research-software software-publication
fair4rs

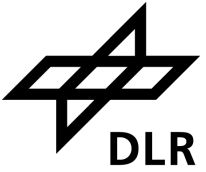
- Readme
- Activity
- 0 stars
- 1 watching
- 0 forks

Releases

No releases published
[Create a new release](#)

HERMES: Example

github.com/sdruskat/hermes-demo



hermes-demo Public

Pin Unwatch 1 Fork 0 Star 0

main 1 Branch 0 Tags

Go to file Add file Code

sdruskat Format README 92f83b8 · 2 minutes ago 4 Commits

.gitignore	Ignore .hermes/ cache folder	6 minutes ago
CITATION.cff	Add citation file	2 minutes ago
README.md	Format README	2 minutes ago

README

hermes-demo

A repository to demonstrate automated software publishing with hermes.

Cite this repository

If you use this software in your work, please cite it using the following metadata. [Learn more about CITATION files.](#)

APA BibTeX

Druskat, S. (2024). HERMES demo (Version v0.

[View citation file](#)

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HERMES: Example

github.com/sdruskat/hermes-demo



The screenshot shows a GitHub repository page for 'sdruskat / hermes-demo'. The navigation bar includes 'Code', 'Issues', 'Pull requests', 'Actions', 'Projects', and 'Wiki'. The current branch is 'main'. A commit by 'sdruskat' is shown with the message 'Add HERMES publication configuration'. The code diff for 'hermes.toml' is displayed, showing 10 lines of code (7 lines of code, 150 bytes).

```
Code Blame 10 lines (7 loc) · 150 Bytes
1   [harvest]
2   sources = [ "cff" ]
3
4   [deposit]
5   target = "invenio_rdm"
6
7   [deposit.invenio_rdm]
8   site_url = "https://sandbox.zenodo.org"
9   access_right = "open"
```

HERMES: Example

github.com/sdruskat/hermes-demo



Applications / New personal access token

Name

HERMES publication

Name of personal access token.

Scopes

deposit:actions
Allow publishing of uploads.

deposit:write
Allow upload (but not publishing).

user:email
Allow access to email address (read-only).

Scopes assign permissions to your personal access token. A personal access token works just like a normal OAuth access token for authentication against the API.

HERMES: Example

github.com/sdruskat/hermes-demo



General

Access

- Collaborators
- Moderation options

Code and automation

- Branches
- Tags
- Rules
- Actions
- Webhooks
- Environments
- Codespaces
- Pages

Security

- Code security
- Deploy keys
- Secrets and variables
 - Actions
 - Codespaces
 - Dependabot

Actions secrets / New secret

Name *

Secret *

<Insert token here>

Add secret

HERMES: Example

github.com/sdruskat/hermes-demo



Actions

- General
- Runners
- Webhooks
- Environments
- Codespaces
- Pages

Security

- Code security
- Deploy keys
- Secrets and variables

Integrations

- GitHub Apps
- Email notifications
- Autolink references

Save

Artifact and log retention

Choose the repository settings for artifacts and logs.

Artifact and log retention

90 days Save

Your organization has set a maximum limit of 90 days. [Learn more about the artifact and log retention policy.](#)

Approval for running fork pull request workflows from contributors

Choose which subset of users will require approval before running workflows on their pull requests. Both the pull request author and the actor of the pull request event triggering the workflow will be checked to determine if approval is required. If approval is required, a user with write access to the repository must [approve the pull request workflow to be run](#).

- Require approval for first-time contributors who are new to GitHub
Only users who are both new on GitHub and who have never had a commit or pull request merged into this repository will require approval to run workflows.
- Require approval for first-time contributors
Only users who have never had a commit or pull request merged into this repository will require approval to run workflows.
- Require approval for all external contributors
All users that are not a member or owner of this repository will require approval to run workflows.

Save

Workflow permissions

Choose the default permissions granted to the GITHUB_TOKEN when running workflows in this repository. You can specify more granular permissions in the workflow using YAML. [Learn more about managing permissions.](#)

- Read and write permissions
Workflows have read and write permissions in the repository for all scopes.
- Read repository contents and packages permissions
Workflows have read permissions in the repository for the contents and packages scopes only.

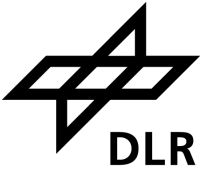
Choose whether GitHub Actions can create pull requests or submit approving pull request reviews.

- Allow GitHub Actions to create and approve pull requests

Save

HERMES: Example

github.com/sdruskat/hermes-demo



ci-templates Public

Edit Pins Unwatch 11 Fork 1 Star 1

main 3 Branches 0 Tags

Go to file Add file Code

poikilotherm Update hermes-ci.yml 71d11c0 · 8 months ago 26 Commits

.github/workflows	added github action to run pre-commit (closes #5)	last year
LICENSES	Add license files	last year
gitlab	Update hermes-ci.yml	8 months ago
.pre-commit-config.yaml	added github action to run pre-commit (closes #5)	last year
README.md	fixed coding style in README.md	last year
TEMPLATE_hermes_github_to_zenodo.yml	Update TEMPLATE_hermes_github_to_zenodo.yml	8 months ago
TEMPLATE_hermes_gitlab_to_zenodo.yml	Fix workflow syntax	last year

README

HERMES continuous integration templates

This repository contains templates for continuous integration systems that can be used to publish software automatically.

About

Continuous integration templates for automatic software publication with HERMES

docs.software-metadata.pub

- Readme
- Activity
- Custom properties
- 1 star
- 11 watching
- 1 fork

Report repository

Contributors 4

- sdruskat Stephan Druskat
- led02 Michael Meinel
- daniel-mohr
- poikilotherm Oliver Bertuch

HERMES: Example

github.com/sdruskat/hermes-demo

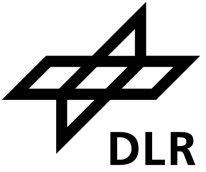


```
hermes-demo$ git status
On branch main
Your branch is up to date with 'origin/main'.

nothing to commit, working tree clean
hermes-demo$ git tag -a v0.1.0 -m "v0.1.0"
hermes-demo$ git push origin tag v0.1.0
Enumerating objects: 1, done.
Counting objects: 100% (1/1), done.
Writing objects: 100% (1/1), 162 bytes | 162.00 KiB/s, done.
Total 1 (delta 0), reused 0 (delta 0), pack-reused 0
To github.com:sdruskat/hermes-demo.git
 * [new tag]          v0.1.0 -> v0.1.0
hermes-demo$
```

HERMES: Example

github.com/sdruskat/hermes-demo



← Software Publication

✓ Copy template and configure to publish on tags #3

🏠 Summary

Jobs

✓ Prepare Metadata for Curation

🕒 Publish Software with Curated Me...

🕒 Cleanup aborted curation branches

Run details

🔄 Usage

📄 Workflow file

Prepare Metadata for Curation

succeeded now in 18s

- > ✓ Set up job
- > ✓ Run actions/checkout@v4
- > ✓ Run actions/setup-python@v5
- > ✓ Run pip install hermes
- > ✓ Run hermes harvest
- > ✓ Run hermes process
- > ✓ Run hermes curate
- > ✓ Run # Cache current branch for PR close job
- > ✓ Run peter-evans/create-pull-request@v5
- > ✓ Post Run actions/setup-python@v5
- > ✓ Post Run actions/checkout@v4
- > ✓ Complete job

HERMES: Example

github.com/sdruskat/hermes-demo



Metadata Curation for Commit 8532d954 #1

[Open](#)

github-actions wants to merge 1 commit into [hermes/curate-8532d954](#) from [hermes/curate-result-8532d954](#)

Conversation 0 Commits 1 Checks 0 Files changed 3

github-actions bot commented 3 minutes ago

Please carefully review the attached metadata.
If you are satisfied with the result, you may merge this PR, which will trigger publication.
(Any temporary branches will be cleaned up.)

[create-pull-request] automated change 20b457b

github-actions bot force-pushed the [hermes/curate-result-8532d954](#) branch from [ce4ed5a](#) to [20b457b](#) 3 minutes ago [Compare](#)

Require approval from specific reviewers before merging
Rulesets ensure specific people approve pull requests before they're merged. [Add rule](#) ✕

✓ This branch has no conflicts with the base branch
Merging can be performed automatically.

[Merge pull request](#)

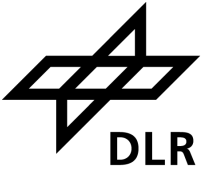
You can also [open this in GitHub Desktop](#) or view [command line instructions](#).

Add a comment

```
0 / 3 files viewed Review in codespace Review changes
Viewed
1 + {
2 +   "@context": [
3 +     "https://doi.org/10.5063/schema/codemeta-2.0",
4 +     {
5 +       "hermes": "https://software-metadata.pub/ns/hermes/"
6 +     }
7 +   ],
8 +   "@type": "SoftwareSourceCode",
9 +   "author": [
10 +    {
11 +      "@id": "https://orcid.org/0000-0003-4925-7248",
12 +      "@type": "Person",
13 +      "affiliation": {
14 +        "@type": "Organization",
15 +        "legalName": "German Aerospace Center (DLR)"
16 +      },
17 +      "familyName": "Druskat",
18 +      "givenName": "Stephan",
19 +      "email": "stephan.druskat@dlr.de"
20 +    }
21 +   ],
22 +   "codeRepository": "https://github.com/sdruskat/hermes-demo",
23 +   "datePublished": "2024-11-14",
24 +   "description": "This is a project to demonstrate automated software
25 +     publication with HERMES CI workflows.",
26 +   "keywords": [
27 +     "HERMES",
28 +     "software publication",
29 +     "demo",
30 +     "Zenodo Sandbox",
31 +     "GitHub",
32 +     "continuous integration"
33 +   ],
34 +   "license": "https://spdx.org/licenses/CC0-1.0",
35 +   "name": "HERMES demo",
36 +   "url": "https://github.com/sdruskat/hermes-demo",
37 +   "version": "v0.1.0"
37 + }
```


HERMES: Example

github.com/sdruskat/hermes-demo



← Software Publication

✓ Metadata Curation for Commit 8532d954 #4

🏠 Summary

Jobs

- 🔄 Prepare Metadata for Curation
- ✓ Publish Software with Curated M...
- 🔄 Cleanup aborted curation branches

Run details

🕒 Usage

📄 Workflow file

Publish Software with Curated Metadata

succeeded now in 24s

- > ✓ Set up job
- > ✓ Run actions/checkout@v3
- > ✓ Run actions/setup-python@v4
- > ✓ Run pip install hermes
- > ✓ Run hermes deposit --initial -O invenio_rdm.auth_token *** --file README.md
- > ✓ Run for BRANCH in \$(git ls-remote origin 'refs/heads/hermes/curate-*' | cut -f2 | cut -d'/' -f3-); do
- > ✓ Post Run actions/setup-python@v4
- > ✓ Post Run actions/checkout@v3
- > ✓ Complete job

HERMES: Example

github.com/sdruskat/hermes-demo



zenodo Search records... Communities My dashboard

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HERMES demo

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