Packaging data with detailed metadata using RO-Crate in FAIR open repositories

Peter Sefton[1], Stian Soiland-Reyes[2]
1: The University of Queensland, Australia; 2: The University of Manchester, UK

Is it FAIR to use all these repositories?

1620 Standards

Terminology Artifact	825
Model/Format	524
Reporting Guideline	229
Identifier Schema	28

VIEW ALL

1944 Databases

Repositories	1000
Knowledgebases	808
Knowledgebase/Repositories	136

VIEW ALL

FAIRsharing.org
standards, databases, policies

https://fairsharing.org/

re3data.org
REGISTRY OF RESEARCH DATA REPOSITORIES

Filter

Reset all

Subjects ⊞

Content Types ⊟

Archived data (504)
Audiovisual data (335)
Configuration data (45)
Databases (473)
Images (1090)
Networkbased data (111)
Plain text (926)
Raw data (979)
Scientific and statistical data formats (1429)
Software applications (368)
Source code (126)
Standard office documents (1262)
Structured graphics (792)
Structured text (735)
other (769)
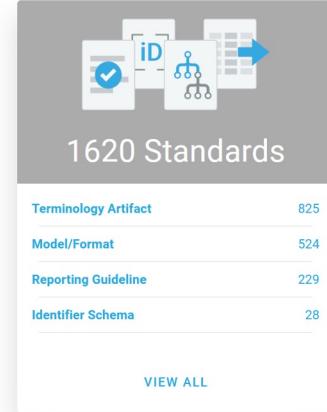
FAIRCOOKBOOK   GITHUB   Search Wizard...

F Findability
EXEMPLAR RECIPES
• Unique, persistent identifiers
• Search engine optimization
LEARN MORE

A Accessibility
EXEMPLAR RECIPES
• Transferring data with SFTP
• Downloading data with Aspera
LEARN MORE

I Interoperability
EXEMPLAR RECIPES
• Selecting terminologies and ontologies
• Creating a metadata profile
LEARN MORE

R Reusability
EXEMPLAR RECIPES
• Data licenses
• Declaring data's permitted uses
LEARN MORE

Infrastructure
LEARN MORE

Assessments
LEARN MORE

Applied Examples
LEARN MORE

Maturity model
LEARN MORE

https://faircookbook.elixir-europe.org/

https://www.re3data.org/

Aims of FAIR Research Objects

Describe and **package** data collections, datasets, software etc. with their **metadata**

Platform-independent object exchange between repositories and services

Support **reproducibility** and **analysis**: link data with codes and workflows
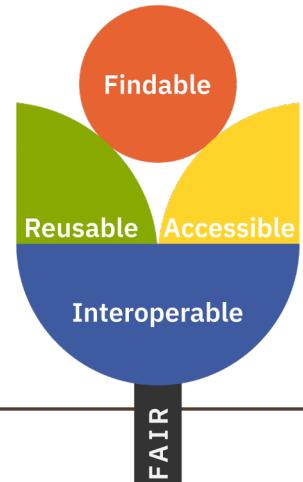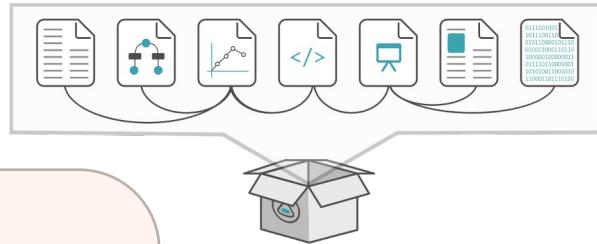
Transfer of **sensitive/large** distributed datasets with persistent identifiers

Aggregate **citations** and **persistent identifiers**

Propagate **provenance** and **existing metadata**
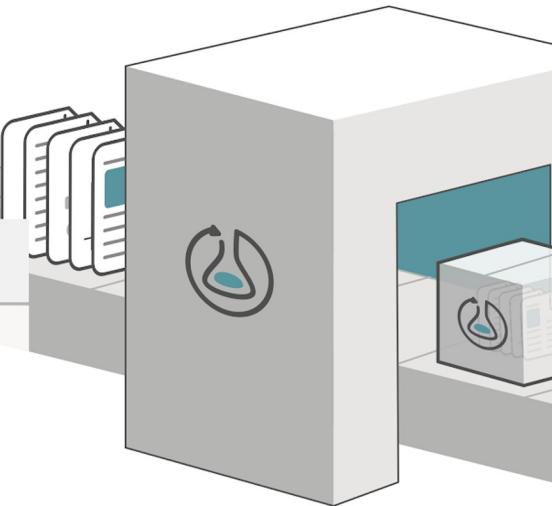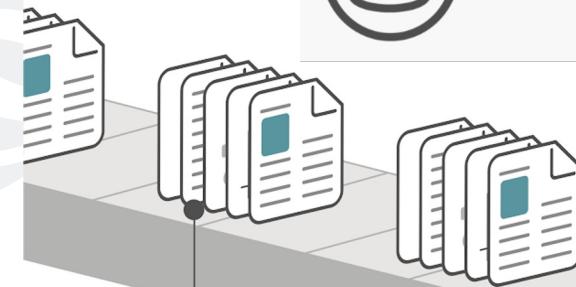
Publish and archive **mixed objects** and references

Reuse existing **standards**, but hide their complexity

research object.org

Findable

Reusable   Accessible

Interoperable

FAIR
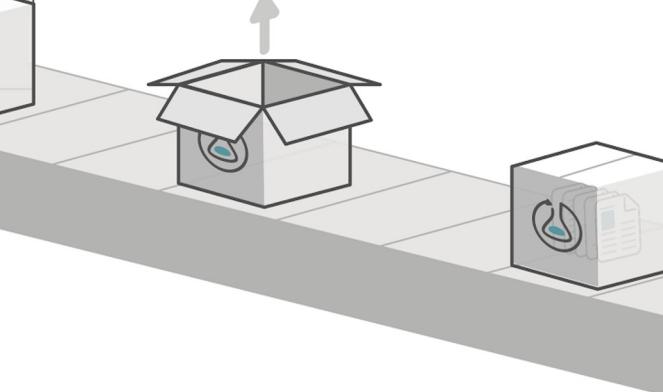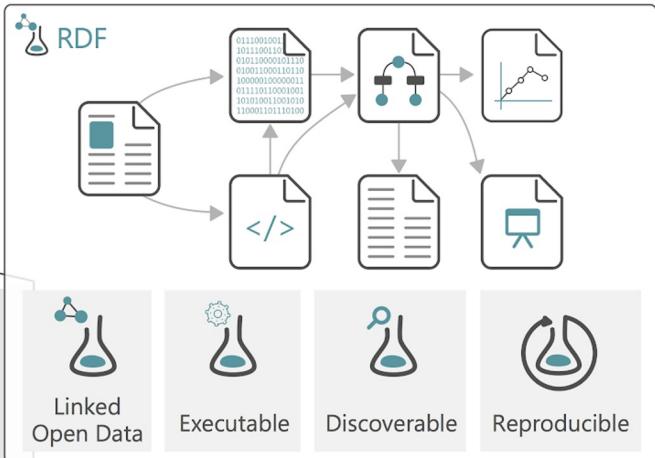
RO-Crate

Search Research Object Crate (RO-Crate)

RO-Crate 1.1 ⌄

Background

Community

Examples

Outreach and Publications

Profiles

RO-Crate In Use ⌄

Specification

Tools

Tutorials

Research Object Crate (RO-Crate)

Permalink: https://w3id.org/ro/crate

News: RO-Crate Metadata specification 1.1 released
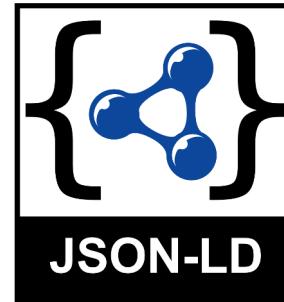
What is RO-Crate?

RO-Crate is a community effort to establish a lightweight approach to packaging research data with their metadata. It is based on schema.org annotations in JSON-LD, and aims to make best-practice in formal metadata description accessible and practical for use in a wider variety of situations, from an individual researcher working with a folder of data, to large data-intensive computational research environments.

Using common formats and vocabularies

.. extending only when needed

Pulse

Contributors

Community

Community Standards

Traffic

Commits

Code frequency

Dependency graph

Network

Forks

People

April 30, 2023 – May 30, 2023

Period: 1 month ▾

Overview

━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ ━━━━ ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ ━━━━━

14 Active pull requests   **11** Active issues
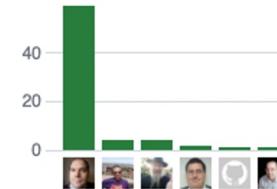
⎇ **13**	⇅ **1**	⊘ **8**	⊙ **3**
Merged pull requests	Open pull request	Closed issues	New issues

Excluding merges, **6 authors** have pushed **60 commits** to master and **71 commits** to all branches. On master, **32 files** have changed and there have been **9,618** additions and **867** deletions.

⎇ **13** Pull requests merged by **6** people

⎇ **update of changelog in progress**
#261 merged last week

⎇ **contentUrl for direct download, add section on Converting to Attached RO-Crate**
#259 merged last week

⎇ **List required properties for entities**
#260 merged last week

⎇ **Specify how cite-as and Signposting should be used**
#255 merged 2 weeks ago

Pyt

Research Object Crate community calls

This is the rolling minutes from the Research Object Crate (*RO-Crate*) telcons. **Feel free** to **join** and **suggest changes** to the agenda or to help **scribe** the minutes of the call!

Regular calls are scheduled on **4th Thursdays** of the month **20:00** UTC.
EOSC-themed calls are also scheduled on **2nd Thursdays** of the month **08:00 UTC**.
(*subject to change, see Upcoming meetings below*)

Note: *We follow UTC and do **not** observe daylight savings,
so double-check when your country changes their clocks!*

Upcoming meetings

- ~~2023-06-08 Cancelled (ELIXIR All Hands)~~
- 2023-06-22 20:00 UTC
- 2023-07-13 08:00 UTC (EOSC-themed)
- 2023-07-27 20:00 UTC
- ~~2023-08-10 Cancelled~~
- ~~2023-08-24 Cancelled~~
- 2023-09-14 08:00 UTC (EOSC-themed)
- 2023-09-28 20:00 UTC
- 2023-10-12 08:00 UTC (EOSC-themed) *Note daylight saving changes*
- 2023-10-26 20:00 UTC *Note daylight saving changes*
- 2023-11-09 08:00 UTC (EOSC-themed) *Note daylight saving changes*
- 2023-11-23 20:00 UTC *Note daylight saving changes*
- 2023-12-14 08:00 UTC (EOSC-themed)
- ~~2023-12-28 Cancelled~~

Tip: Import as Calendar event (ICS) (via Zoom)

ResearchObject.org (RO)

Access Right

☐ Open (96)

File Type

☐ Pdf (83)

☐ Zip (19)

☐ Pptx (16)

☐ Html (12)

☐ Sha256 (3)

☐ Json (2)

☐ Jsonld (2)

☐ Md (2)

☐ Mp4 (2)

☐ Webm (2)

Keywords

☐ Research Object (12)

Found 96 results.

<   1   2   3   4   5   >

Sort by:

Most recent

asc.

June 1, 2023 (v1)   Poster   Open Access

View

Making workflow provenance FAIR across workflow systems with Workflow Run RO-Crate

Simone Leo; Laura Rodríguez-Navas; José M. Fernández; Paul De Geest; Luca Pireddu; Michael R. Crusoe; Daniel Garijo; Iacopo Colonnelli; Raül Sirvent; Stian Soiland-Reyes;

Workflow Run RO-Crate (https://w3id.org/ro/wfrun/), is a set of profiles of RO-Crate (https://doi.org/10.3233/DS-210053) that capture workflow provenance in a lightweight FAIR data package, in order to support traceability, reproducibility and interoperable description of diverse computational

Uploaded on June 2, 2023

May 30, 2023 (v2)   Poster   Open Access

View

Sharing data as machine-actionable objects using RO-Crate, Bioschemas and Signposting

Stian Soiland-Reyes; Simone Leo; Leyla Jael Castro; Peter Sefton; Carole Goble;

RO-Crate (https://doi.org/10.3233/DS-210053) is a lightweight method to package research outputs along with their metadata, based on existing Linked Data standards. Bioschemas (https://bioschemas.org/) provides metadata schemas to add structured metadata to webpages on Life Science, based on schema.

Uploaded on May 31, 2023

1 more version(s) exist for this record

January 23, 2023 (v3)   Presentation   Open Access

View

Sharing research artefacts as FAIR Digital Objects using RO-Crate

Carole Goble; Stian Soiland-Reyes;

WorkflowHub

A registry for describing, sharing and publishing **scientific computational workflows**

WorkflowHub aims to **facilitate discovery and re-use** of workflows in an accessible and interoperable way. This is achieved through extensive use of **open standards** and tools, including CWL, RO-Crate, Bioschemas and GA4GH's TRS API, in accordance with the **FAIR principles**.

WorkflowHub **supports workflows of** *any* **type** in its native repository.

Learn more

Register

Welcome to WorkflowHub

- **Help** is available on about.workflowhub.eu.
- Report any **issues or suggest new features** on GitHub.
- For **comments, questions or feedback**, please use the feedback form.

Want to join the WorkflowHub community?
See our current activities and upcoming meetings here.

Shortcuts

Discover workflows relating to **SARS-CoV-2 / COVID-19**

WfCommons
Looking for WfCommons? Click here

Latest additions

Find content

Original URL: https://workflowhub.eu/workflows/483/ro_crate?ve...=1

There's an HTML page included in the RO-Crate Download that makes the crate human readable

Workflow Inputs

Reference genome | Genome ann...

1_RNA STAR

...rcelref_hist | input_optionslinput_bam

...gTie

...ut_gtf | input_optionslinput_bam

...e merge

guidelguide_sourceref_hist

6_StringTie

input_collection

...ement identifiers | functionModeltool_sourcelnovoisoformslstringtieAnnotation

functionModeltranscriptome | infile | input

8_Search in textfiles

howlfilter_source

9_Filter collection

functionModelsecond_factorltrans_counts | functionModelfirst_factorltrans_counts

10_IsoformSwitchAnalyzeR

Abstract CWL Automatically generated from the Galaxy workflow file: Copy of Genome-wide alternative splicing analysis

Author
Cristóbal Gallardo
License
CC-BY-NC-4.0

Contents

Main Workflow: StringTie workflow
Size: 23236 bytes

APPLIED SCIENCES EARTH OBSERVATION EARTH SCIENCES

Sentinel-1 dataset from LiCSAR over Iceland

Christian Bignami

Contributed by INGV GeoSAR Laboratory
Published by Istituto Nazionale di Geofisica e Vulcanologi...

| Overview | Content | Assessment | Enrichment | Activity |

This RO provides the ADAM collection of the Sentinel-1 dataset over Iceland based on the LiCSAR catalogue.

fb3a8b1f-7...f294808da — Today at

> biblio — Today at
> data — Today at
> metadata — Today at
> raw data — Today at
ro-crate-preview.html — Today at
Screensh....59.08.png — Today at
ro-crate-...tadata.json — Today at

Events
Forks   0
Snapshots   0
Archives   0
Size   3097.19 KB

AGENTS

Elisa Trasatti
Creator

Download

1. RO-Crate ZIP
2. RO-Crate Metadata File (json-ld)
3. RO ZIP (legacy RO model)
4. RO manifest (legacy RO model, text-turtle)
5. PDF

84%

LOCATION:

CONTENT

biblio

RO-Crate Built-in here as well at RO-Hub

Log in   Register

eosc | FAIR-IMPACT
Expanding FAIR solutions across EOSC

About ▾   Coordination mechanisms ▾   FAIR Implementation Framework   EOSC FAIR Champions   Open Calls ▾   News ▾   Events ▾   Outputs and documents ▾

Home /
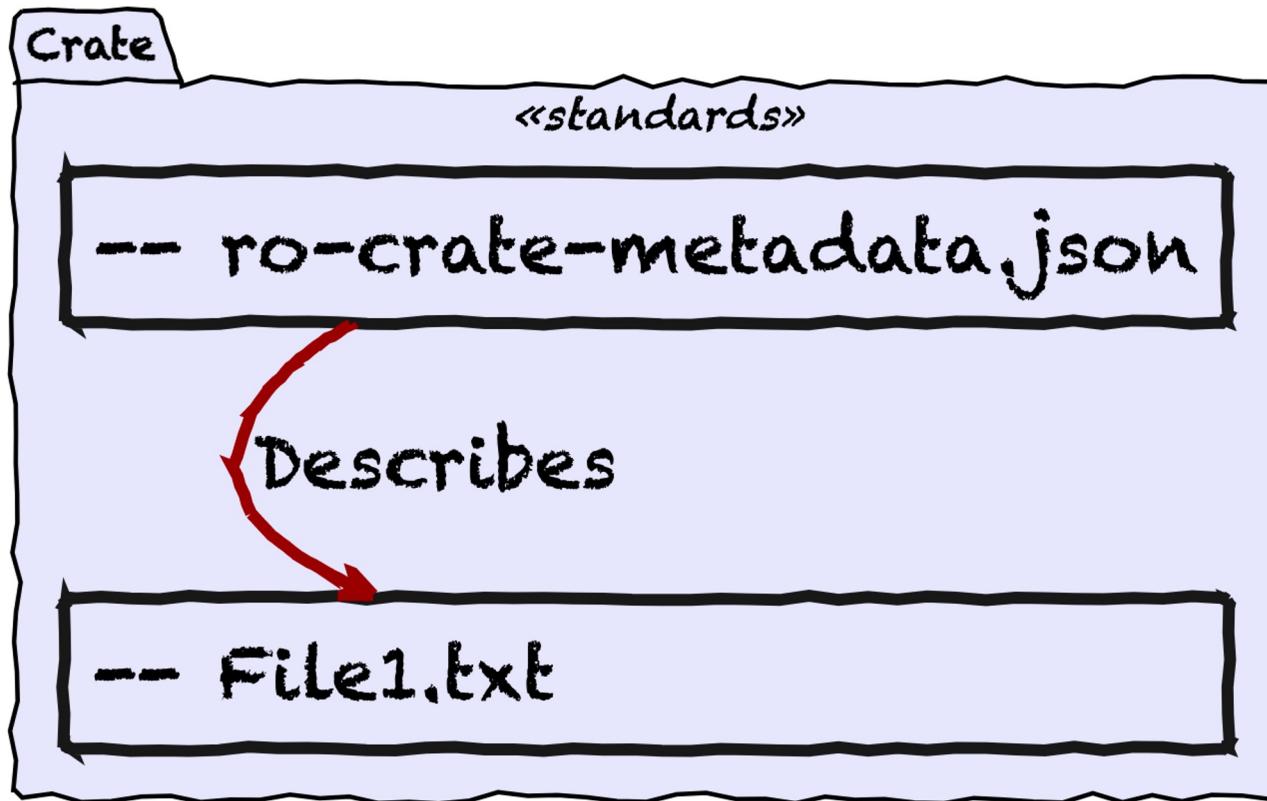
Support offer #2: Enabling FAIR Signposting and RO-Crate for content/metadata discovery and consumption

Context

The findability of a wide range of research objects and their related metadata are central to the FAIR principles. This support action combines two successful approaches (FAIR Signposting and RO-Crate) to help ensure that research objects can be packaged up with structured metadata to support reuse and that these packages can be exposed for improved findability.

FAIR Signposting is a method to expose machine-actionable navigation links that indicate downloadable resources, types and attribution – particularly for scholarly and institutional repositories which use persistent identifiers like DOIs. Signposting makes explicit the links between a typical HTML landing page and the downloadable resources that are available for the research object described by that landing pages, including content resources and machine-readable metadata such as in RDF, although the method is technology-agnostic in terms of metadata formats. It also links to persistent identifiers, both for the research object and its authors. Signposting uses existing standards to achieve this: Web Links (RFC8288) conveyed using a simple HTTP header, HTML <link> elements, and/or Linksets (RFC9264). All link relations used in Signposting are registered in the IANA Link Relations Registry. Signposting client libraries have been

Attached Crate

Crate

«standards»

-- ro-crate-metadata.json

Describes

-- File1.txt

Detached Crate

One payload file RO-Crate package

«standards»

-- ro-crate-metadata.json

Describes
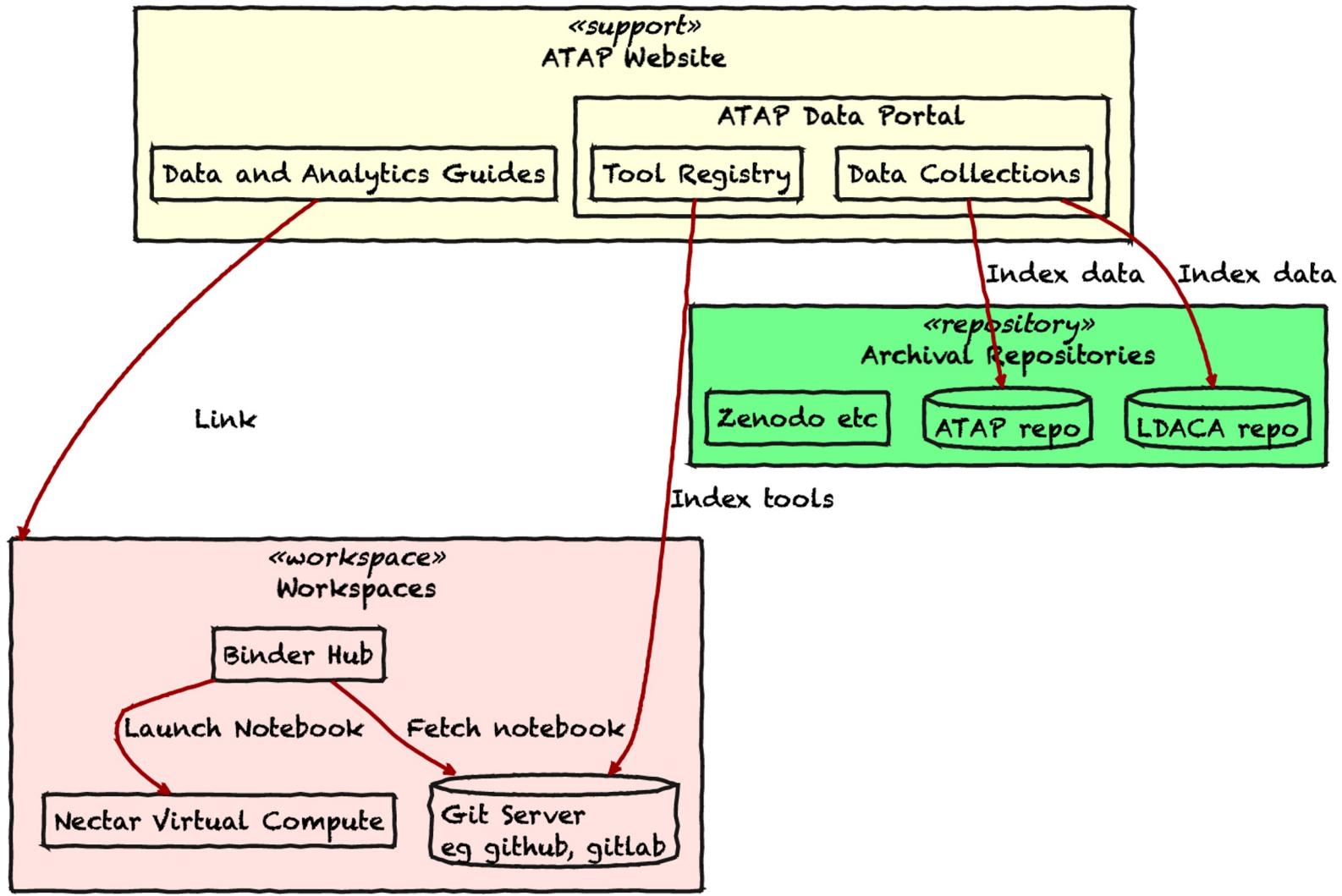
«repository»
Some Repository Service

File1.txt

```
22          },
23          {
24            "@id": "arcp://name,plays/object/WoundsofCivilWar_1594",
25            "@type": [
26              "Dataset",
27              "RepositoryObject"
28            ],
29            "hasPart": {
30              "@id": "http://localhost:8080/stream?
      id=arcp://name,plays/object/WoundsofCivilWar_1594&path=Texts/WoundsofCivilWar_1594.xml"
31            },
32            "hasMember": [
33
34            ],
35            "conformsTo": {
36              "@id": "https://purl.archive.org/language-data-commons/profile#Object"
37            },
38            "memberOf": {
39              "@id": "arcp://name,plays"
40            },
41            "name": "Wounds of Civil War",
42            "W&R_ID": "802",
43            "filename": "WoundsofCivilWar_1594",
44            "author": "\"Lodge Thomas\"",
45            "Company of First Production": "Admiral's (Nottingham's) Men",
46            "Date": "1588",
47            "earliest": "1587",
48            "latest": "1588",
49            "span": "2",
```

References file streams from the API

«support»
ATAP Website

ATAP Data Portal

Data and Analytics Guides

Tool Registry

Data Collections

Index data   Index data

«repository»
Archival Repositories

Zenodo etc

ATAP repo

LDACA repo

Link

Index tools

«workspace»
Workspaces

Binder Hub

Launch Notebook   Fetch notebook

Nectar Virtual Compute

Git Server
eg github, gitlab

Tools

While we're mostly focusing on the RO-Crate specification some tools already exist for working with RO-Crates:

- Describo - interactive desktop application to create, update and export RO-Crates for differen profiles. (~ *RC*)
- Describo Online – Web-based application to create RO-Crates using cloud storage (~ *alpha*)
- ro-crate-excel – Command-line tool to help create RO-Crates from spreadsheets (~ *beta*)
- ro-crate-html – HTML rendering of RO-Crate (~ *beta*)
- ro-crate-preview – GitHub Action for *ro-crate-html*, e.g. publishing crates on GitHub Pages (~ *alpha*)
- ro-crate-js – JavaScript/NodeJS library for RO-Crate rendering as HTML. (~ *beta*)
- ro-crate-ruby – Ruby library to consume/produce RO-Crates (~ *beta*)
- ro-crate-py – Python library to consume/produce RO-Crates (~ *beta*)
- CheckMyCrate – Validation according to Workflow RO-Crate profile (~ *alpha*)
- galaxy2cwl – Wraps Galaxy workflow as Workflow RO-Crate (~ *alpha*)
- ya2ro – Generate RO-Crate and HTML page from YAML template with look-up of DOI/ORCID/GitHub metadata (~ *prototype*)
- arc-to-roc – Generate RO-Crate from an Annotated Research Context (ARC), see DataPlant
- ROCrate_enrichment_service – API-based metadata enrichment service for RO-Crates (~ *prototype*)
- rocrate-to-html – Github Action to publish rocrate objects as Github Pages (~ *alpha*) (see also new_rocrate_to_pages)
- FAIR-Research-Object – evaluate FAIRness of Research Objects through an API (~ *prototype*)
- repo2crate – Generate a Workflow Testing RO-Crate from a "best-practices" workflow repository
- ro-crate-java – Java API for creating and modifying RO-Crate using builder pattern
- ro-crate-benchmarks – Benchmarks for performance testing RO-Crate libraries
- tonkaz – Tool to verify workflow reproducibility, compares RO-Crates of workflow execution results.

- signposting – Python library & CLI tool for resolving PIDs as FAIR Signposting, e.g. DOIs from WorkflowHub to RO-Crate (~ *beta*)
- RO-Crates-and-Excel – generate RO-Crate from Excel file, following the RO-Crates-and-Excel profile.
- rocrate-lang-py – RO Crate Python library to help you load language data from ro-crates (~ *prototype*)
- ROcrate-interface – Initial development in creating an interface between workflow languages and a LivePublication RO-crate specification (~ *prototype*)
- aiida-rocrate – AiiDA plugin that allows exporting (parts) of the provenance graph as Research Object Crates. (~ *planning*)
- RO-Crate-Registry – a Web-based registry of RO-Crates (assumes ZIP on http/https) (~ *prototype*)
- ro-crate-validator-py – a modular RO-Crate validator (~ *alpha*)

See also applications using RO-Crate.

https://www.researchobject.org/ro-crate/tools/

A COrpus of Oz Early English (COOEE)

Name	A COrpus of Oz Early English (COOEE)
Description	Material to be included had to meet with a regional and a temporal criterion. The latter required texts to have been produced between 1788 and 1900 in order to become eligible for COOEE. It was mandatory for a text to have been written in Australia, New Zealand or Norfolk Island. But in a few cases, other localities were allowed. For example, if a person who was a native Australian or who had lived in Australia for a considerable time, wrote a shipboard diary or travelled in other countries. Contains: Letters, published materials in book form, historical texts
Date Published	Not Defined
@id ⓘ	arcp://name,cooee-corpus/corpus/root ⓘ
Author ⓘ	Clemens W. A. Fritz
Citation ⓘ	From English in Australia to Australian English
Temporal Coverage ⓘ	1788-1900
Conforms To ⓘ	https://purl.archive.org/language-data-commons/profile#Collection
Identifier ⓘ	ATAP

Objects in Collection: 1357

- Text 1-001 1788 Phillip, Arthur
- Text 1-002 1788 Phillip, Arthur
- Text 1-003 1788 Phillip, Arthur
- Text 1-004 1788 Phillip, Arthur
- Text 1-005 1788 Phillip, Arthur
- Text 1-006 1788 Phillip, Arthur
- Text 1-007 1788 Phillip, Arthur
- Text 1-008 1788 Phillip, Arthur
- Text 1-009 1788 Bench of Magistrates
- Text 1-010 1788 Fowell, Newton

load more...

Access

Attribution 4.0 International (CC BY 4.0)
Public Metadata ⓘ Indexed ⓘ

Content

Language
   English: 4071
Linguistic Genre
   Private Written: 610
   Public Written: 405
   Government English: 195
   Speech Based: 147
Modality
   WrittenLanguage: 4071
File Formats
   text/plain: 2714

Retrieve Metadata

Download metadata
Open metadata in a new window

Notebooks

cooee notebook

cooee notebook

Description
A sample notebook for the cooee data

@id ⊙	cooee.ipynb ⓘ
Author	Foley, Ben
Conforms To	https://purl.archive.org/language-data-commons/profile#Notebook
Encoding Format ⊙	application/x-ipynb+json
Input	A COrpus of Oz Early English (COOEE) ⓘ

Access

Git Repository
cooee
Notebook Location
https://github.com/Australian-Text-Analytics-Platform/cooee/blob/main/cooee.ipynb

launch binder

Notebook Viewer

```
[1]:  %%capture
      import sys
      !{sys.executable} -m pip install -r requirements.txt
```

```
[2]:  import json                    # json library to read json file formats
      import requests                # Uses the requests library for REST apis
      import os                      # Loads operating system libraries
      from ldaca.ldaca import LDaCA  # Loads the LDaCA ReST api wrapper
      from rocrate_lang.utils import as_list # A handy utility for converting to list
```

```
[3]:  # Specify location where collection is
      LDACA_API = 'https://data.atap.edu.au/api'
      COLLECTION_ID = 'arcp://name,cooee-corpus/corpus/root'
```

☰ **README.md** ✎

Creating an RO-Crate

In its simplest form, an RO-Crate is a directory tree with an `ro-crate-metadata.json` file at the top level that contains metadata about the other files and directories, represented by data entities. These metadata consist both of properties of the data entities themselves and of other, non-digital entities called contextual entities (representing, e.g., a person or an organization).

Suppose Alice and Bob worked on a research task together, which resulted in a manuscript written by both; additionally, Alice prepared a spreadsheet containing the experimental data, which Bob used to generate a diagram. Let's make an RO-Crate to package all this:

```python
from rocrate.rocrate import ROCrate

crate = ROCrate()
paper = crate.add_file("exp/paper.pdf", properties={
    "name": "manuscript",
    "encodingFormat": "application/pdf"
})
table = crate.add_file("exp/results.csv", properties={
    "name": "experimental data",
    "encodingFormat": "text/csv"
})
diagram = crate.add_file("exp/diagram.svg", dest_path="images/figure.svg", prop
```

Crate initialization

The `rocrate init` command explores a directory tree and generates an RO-Crate metadata file (`ro-crate-metadata.json`) listing all files and directories as `File` and `Dataset` entities, respectively.

```
$ rocrate init --help
Usage: rocrate init [OPTIONS]

Options:
  --gen-preview
  -e, --exclude CSV
  -c, --crate-dir PATH
  --help                    Show this message and exit.
```

The command acts on the current directory, unless the `-c` option is specified. The metadata file is added (overwritten if present) to the directory at the top level, turning it into an RO-Crate.

Adding items to the crate

The `rocrate add` command allows to add workflows and other entity types (currently

Usage

Import the `ROCrate` class and create a new empty crate with default configurations:

```
const {ROCrate} = require('ro-crate');
const crate = new ROCrate();
```

The `ROCrate` constructor accepts two optional arguments:

```
const fs = require('fs');

// load existing metadata
const data = JSON.parse(fs.readFileSync('ro-crate-metadata.json', 'utf8'));

// create a crate using the existing data and
// configure the crate to return a property of an Entity as an array and resolve linked entity as n
const crate = new ROCrate(data, { array: true, link: true });
```

To add an Entity to the crate:

```
// A license
const license = {
    '@id': 'https://creativecommons.org/licenses/by/4.0/',
    '@type': 'CreativeWork',
    'description': 'Attribution 4.0 International (CC BY 4.0) ...',
    'name': 'CC BY 4.0'
};
// add the license as an unconnected Entity
crate.addEntity(license);

// add the license to the root dataset
crate.rootDataset.license = {'@id': license['@id']};
// or alternatively, add a new entity directly into a property of other entity :
crate.rootDataset.license = license;
```

Use an entity just like a normal object:

```
let lic = create.getEntity(license['@id']);
console.log(lic.name); // prints 'CC BY 4.0';
// set a property directly
lic.name = 'CC BY 4.0 dummy';
// or with the setProperty method
crate.setProperty(license['@id'], 'name', 'CC BY 4.0 dummy');

console.log(lic.name); // prints 'CC BY 4.0 dummy';
```

@id	@type	name	description	contentSize	dateModified	encodingFormat
LICENSE	File	LICENSE		35149	2023-06-01T13:52:12+10	{"@id":"https://www.natic
README.md	File	README.md		188	2023-06-01T13:52:12+10	{"@id":"https://www.natic
additional-ro-crate-metad	File	additional-ro-crate-metad		95008	2023-06-09T16:05:03+10	{"@id":"https://www.natic
metadata_279_plays_and	File	metadata_279_plays_and		53377	2023-06-01T13:53:21+10	{"@id":"https://www.natic
Texts/1EdwardIV_1599.xr	File	1EdwardIV_1599.xml		532860	2023-06-01T10:19:28+10	{"@id":"https://www.nati
Texts/1FairMaidoftheWes	File	1FairMaidoftheWest_163		392256	2023-06-01T10:19:28+10	{"@id":"https://www.nati
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File ▾

Profile: Language Data Commons top level Collection (corpus)

Selected Directory: corpus-tools-example-plays

🏠 **Root Dataset** / Hugh Craig

@id ℹ️ https://orcid.org/0000-0002-9336-1678

@type ℹ️ Person

＋ Select

Name ℹ️ Hugh Craig

Description ℹ️ ＋ TextArea

Affiliation ℹ️ ＋ Organization

Reverse Links   All Entities

❮ **Dataset** ./

Show all ✕

RO-Crate

RO-Crate on GitHub

RO-Crate 1.1

Background

Community

Examples

Outreach and Publications

Profiles

RO-Crate In Use

Specification

Tools

Tutorials

RO-Crate Community

TABLE OF CONTENTS

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