Handling neuroscientific data with GIN

Present and Future

Michael Sonntag
sonntag@bio.lmu.de

German Neuroinformatics Node
Department Biology II
Ludwig-Maximilians-Universität München

Slides
https://gin.g-node.org/G-Node/PublicResources

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

G-Node German Neuroinf

A brief introduction of the G-Node

http://www.g-node.org

- Funded by BMBF
- Hosted at the Ludwig-Maximilians Universitaet Muenchen
- Bernstein network of Computational Neuroscience
- Associated INCF Node

Thomas Wachtler

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Development of Tools for Efficient Data Management

- Well-defined **data model** for neuroscience data that accounts for all types of recorded data
- Flexible methods for **data annotation** and metadata management that can be adapted to the requirements of the experiment and laboratory
- Format and tools for **integrated organization of data and metadata**, including interfaces for common tools and languages, to facilitate data access, data management, and data analysis
- Development and hosting of **data management infrastructure** for **collaboration** and **data sharing**.

Development of Tools for Efficient Data Management

odML (open metadata Markup Language)

http://www.g-node.org/odml

NIX (Neuroscience Exchange format)

http://www.g-node.org/nix

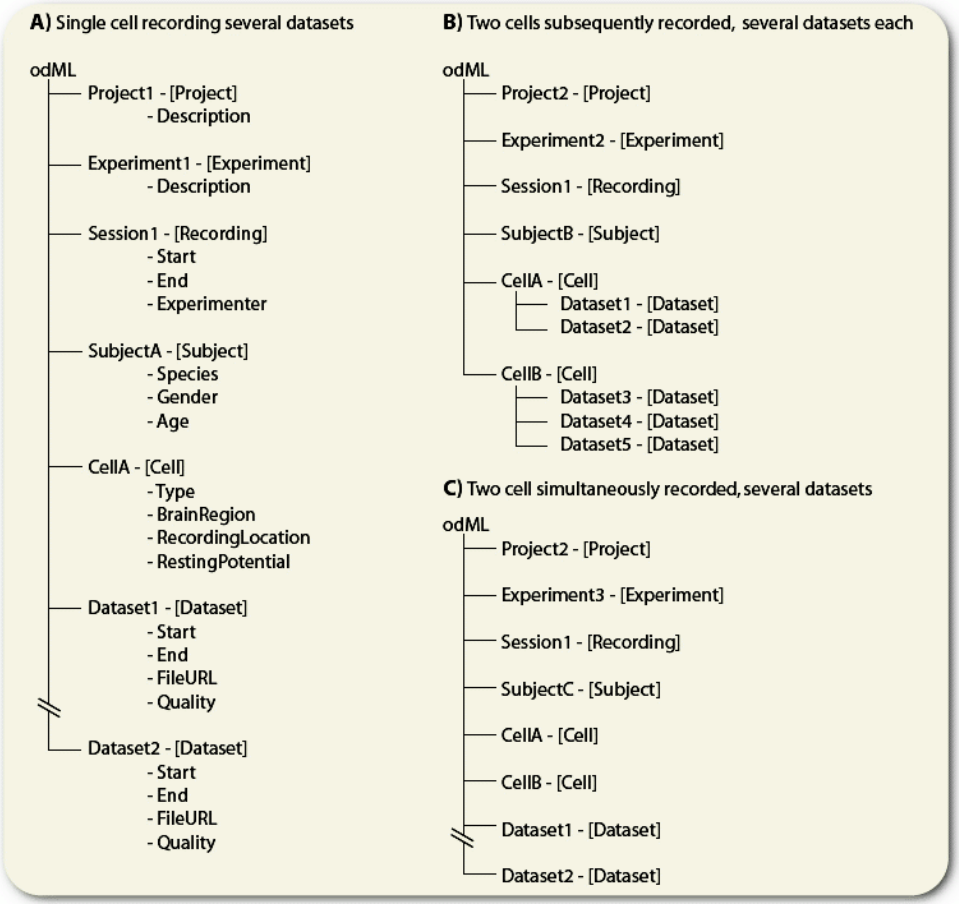
GIN (G-Node Infrastructure services)

https://gin.g-node.org

odML (open metadata Markup Language)

http://www.g-node.org/odml

- format: hierarchical structure of key-value pairs: simple, flexible, inherently extensible ➔ can be adapted to the specifics of the lab or experiment
- can carry **any metadata**
- machine write- and readable, **facilitates automated collection** of metadata in the laboratory
- community-driven standardization through shared terminologies [1]



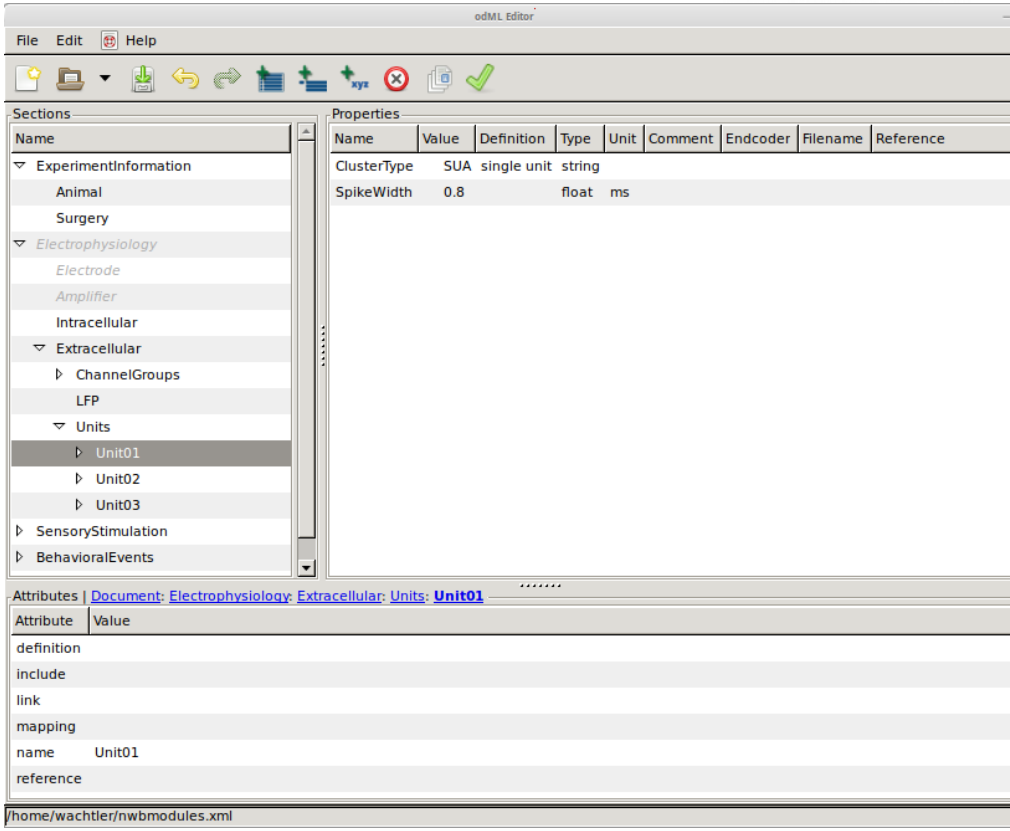
[1] https://github.com/G-Node/odml-terminologies

Grewe et al (2011) Front. Neuroinf. 5:16

odML: Tools

http://www.g-node.org/odml

- Python core library [1]
  enables integration into software tools
- odml-UI editor [2]
- odmltables plugin [3]
  (by INM-6 FZ Jülich)



[1] https://github.com/G-Node/python-odml
[2] https://github.com/G-Node/odml-ui
[3] https://github.com/INM-6/python-odmltables

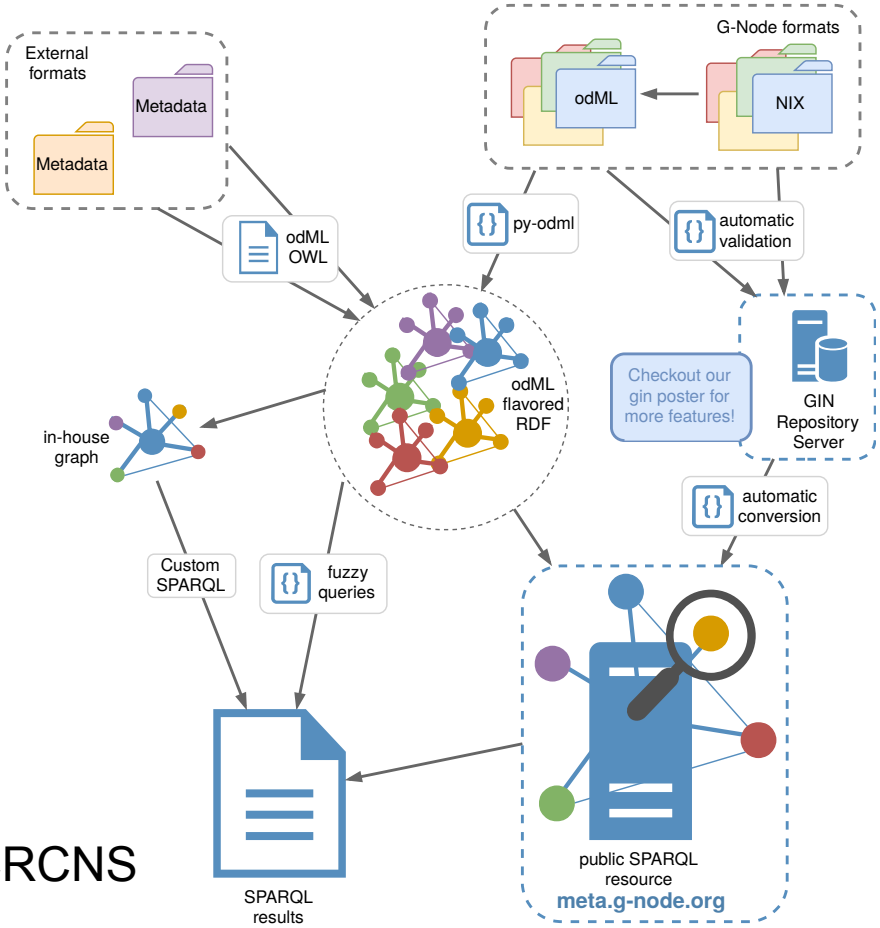
Latest odML format developments

http://www.g-node.org/odml

- streamlined data format (1.3 → 1.4)
- support for YAML and JSON
- export to RDF
- prototype odML flavoured Apache Jena Server
- “fuzzy queries”: experimental abstract SPARQL language

odML flavoured RDF workflow

http://www.g-node.org/odml



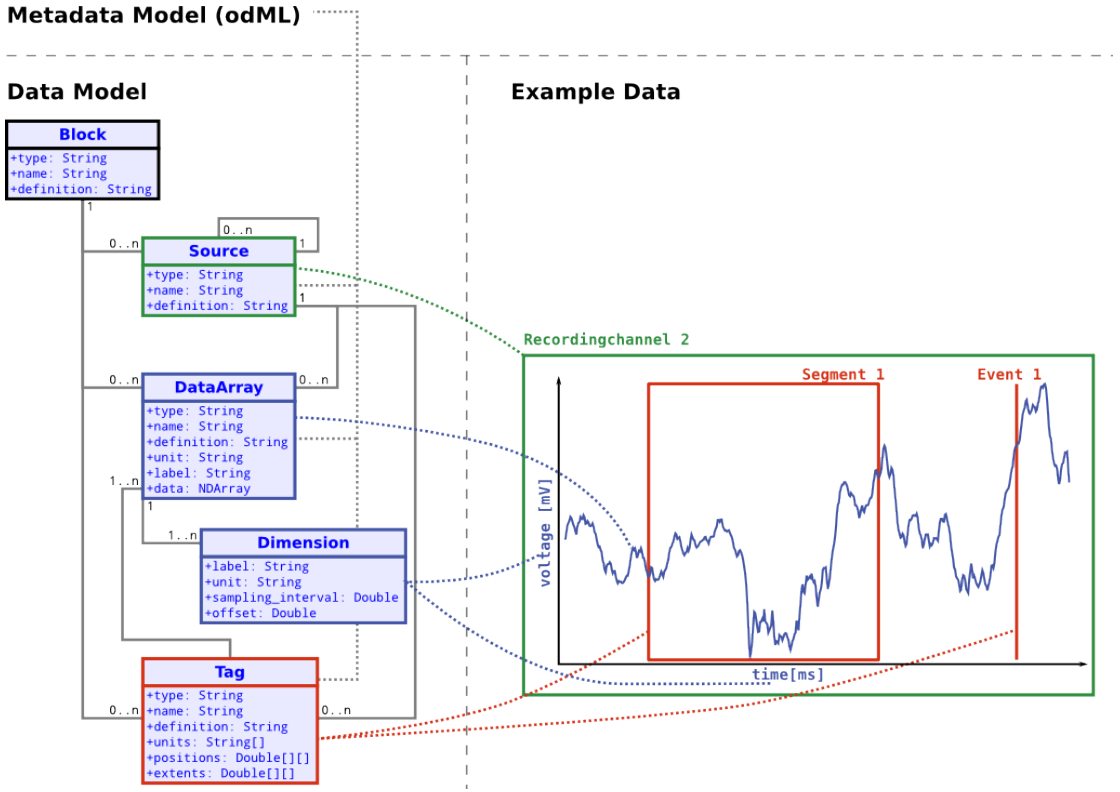
Joint project with the CRCNS

https://crcns.org/

NIX – Format for integration of data and metadata

http://www.g-node.org/nix

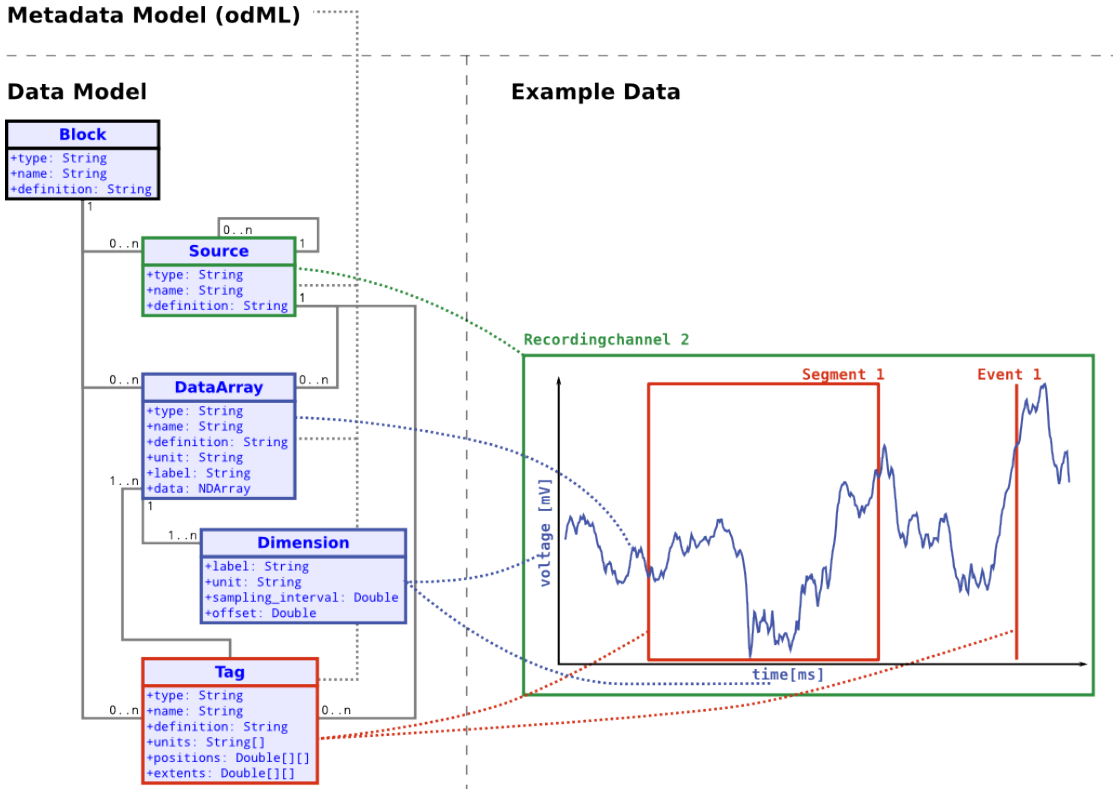
- general data model (derived from **Neo**) to represent recorded data, derived data, relations of data
- flexible data model for metadata (**odML**) for comprehensive annotation of data
- file backend: HDF5 file format
  - structure reflects data model, easy to understand
  - other storage backends possible
- libraries for different languages (C++, Python, Matlab, Java)



NIX – Format for integration of data and metadata

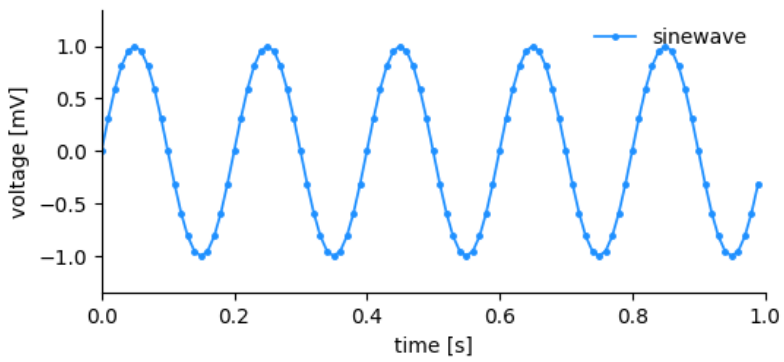
http://www.g-node.org/nix

- storage of n-dimensional data
- definition of regions of interest
- linkage of multiple steps of analysis
- storage of data annotation with data

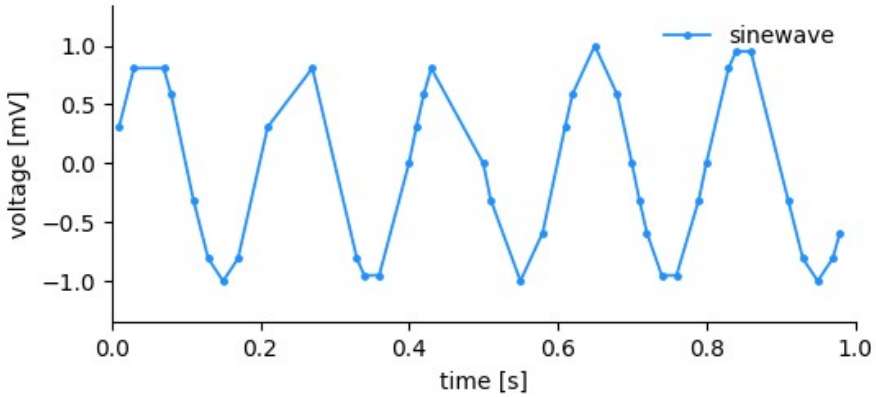


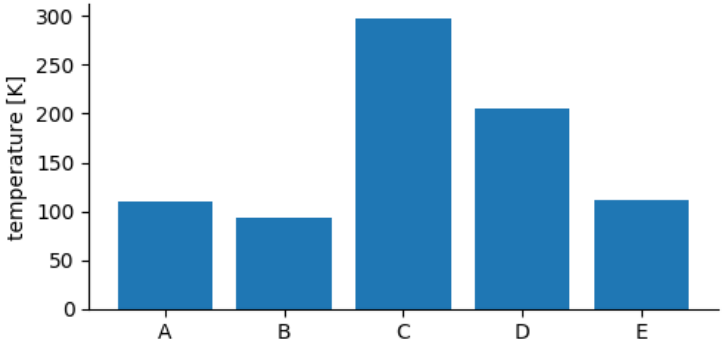
NIX features – Dimensions and tagging

Sampled dimension

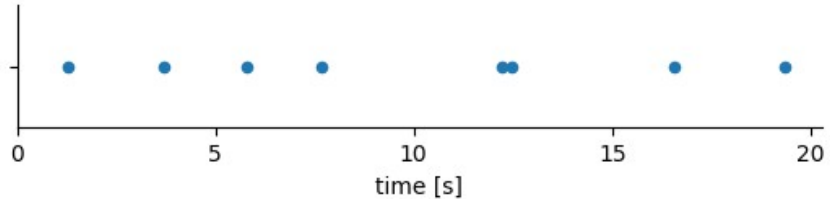


Range dimension





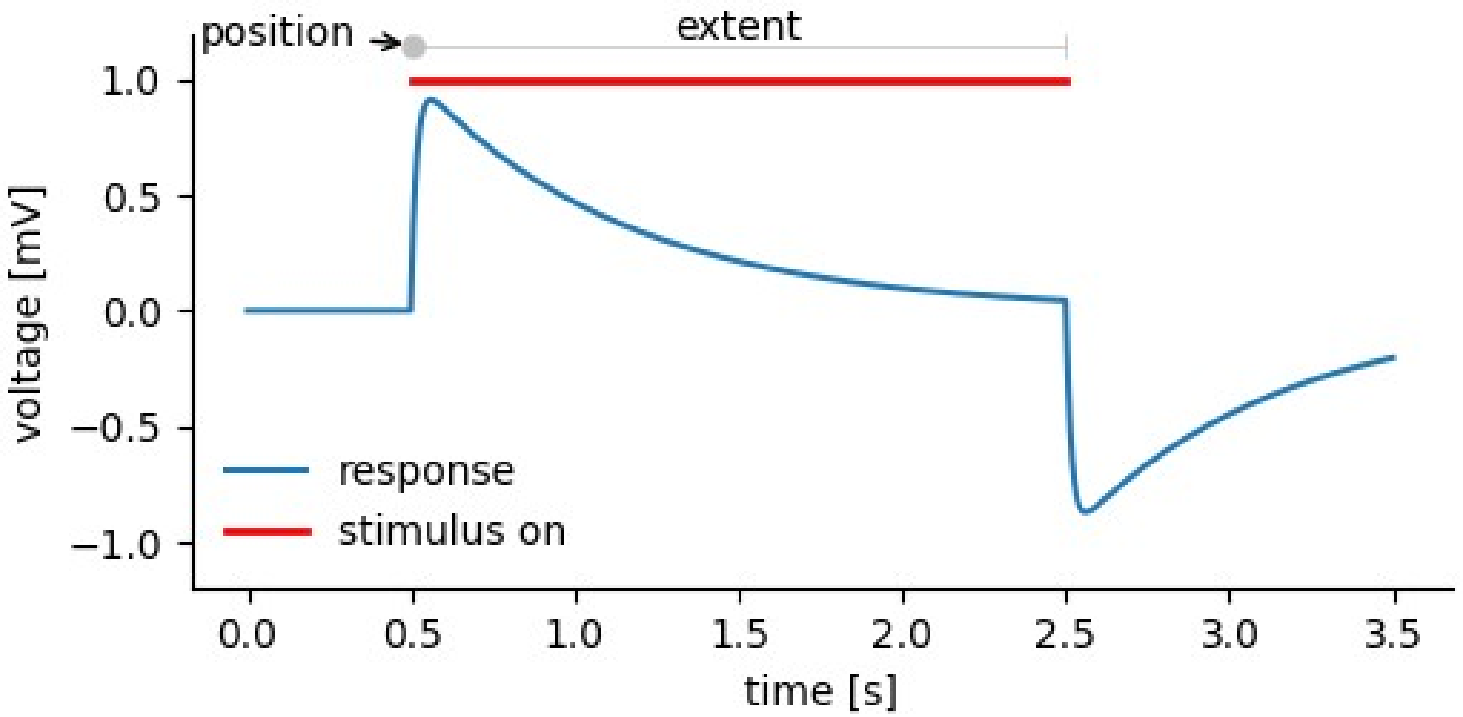
Set dimension



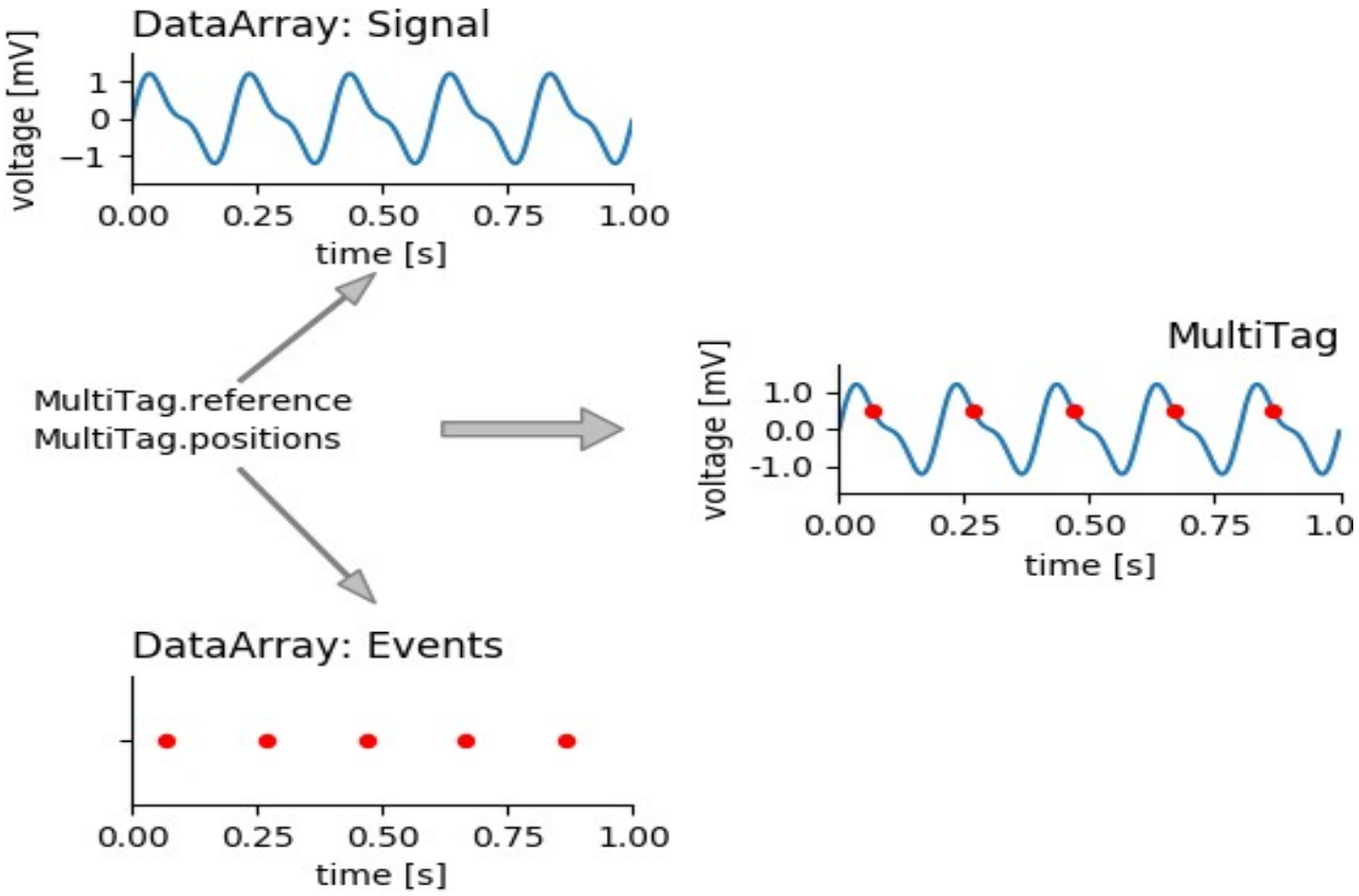
Alias Range dimension

Features automatic SI unit conversion

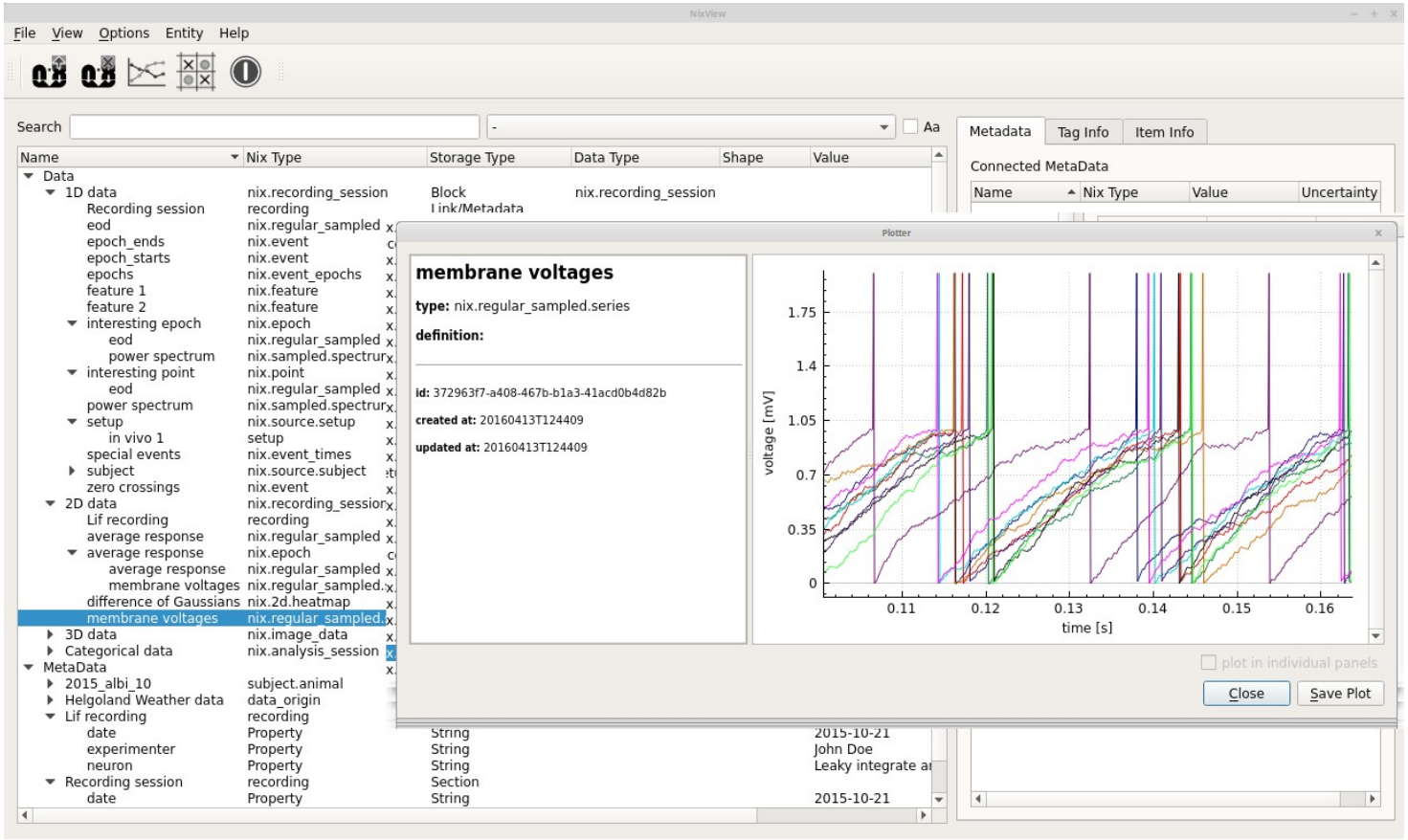
NIX features – Dimensions and tagging



NIX features – Dimensions and tagging



NixView



https://github.com/bendalab/NixView

Latest NIX developments

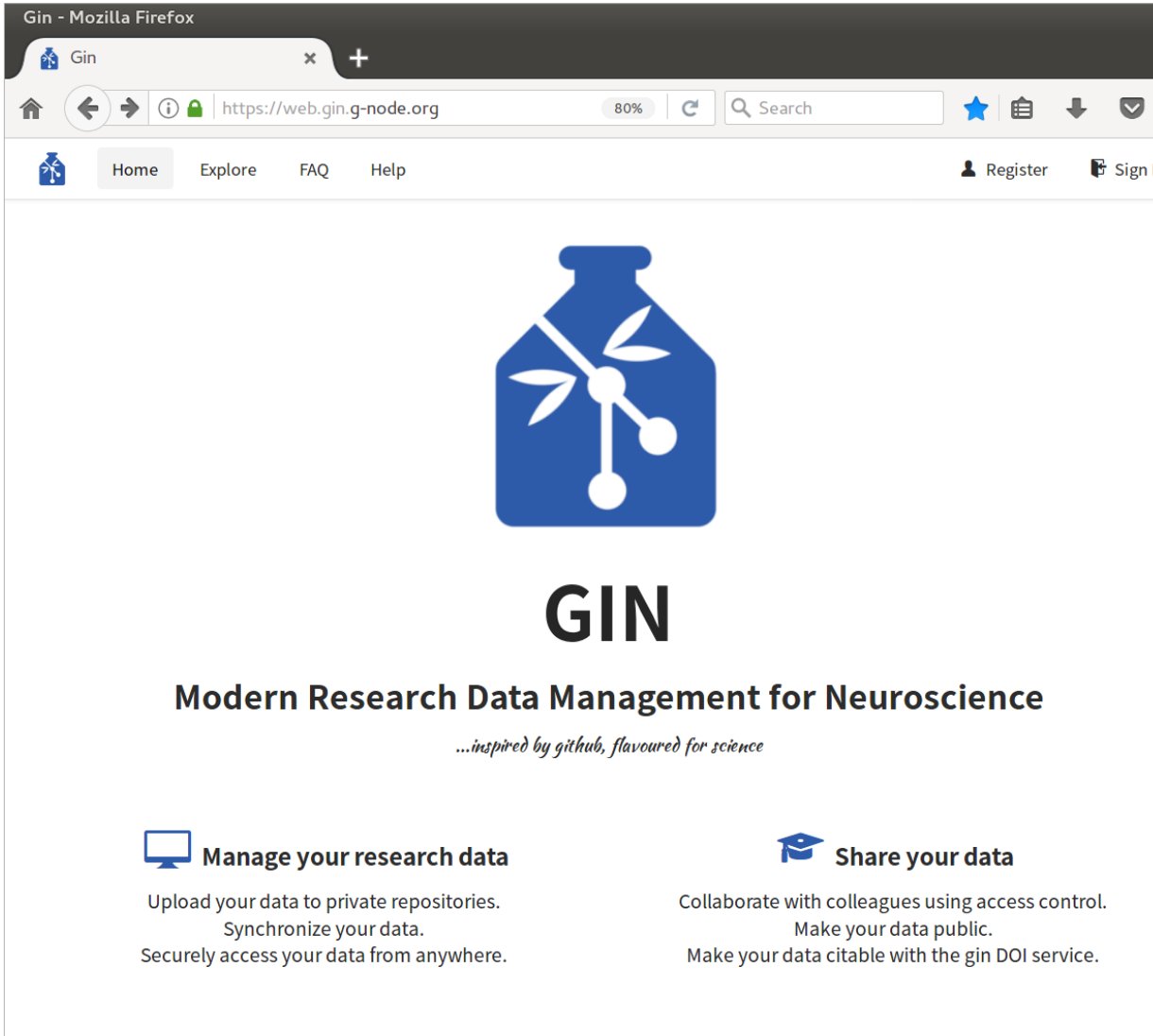
- Pure Python implementation
- Format consolidation NIX ↔ odML
- Suite of tools for conversion [1]
- Visualization tools easy integration into Jupyter notebooks [2]

[1] https://github.com/G-Node/nix-odml-converter
[2] https://github.com/G-Node/nixworks

GIN: Services for Data Organization and Sharing

https://gin.g-node.org

- Versioned management of data repositories (git)
- Distributed data management via file or web browser, or command line client (analysis script integration)
- Secure access and sharing
- Services for search, indexing, and publication (DOI)
- File type plugins
- In house installation
- Extensive usage documentation



GIN: Services for Data Organization and Sharing

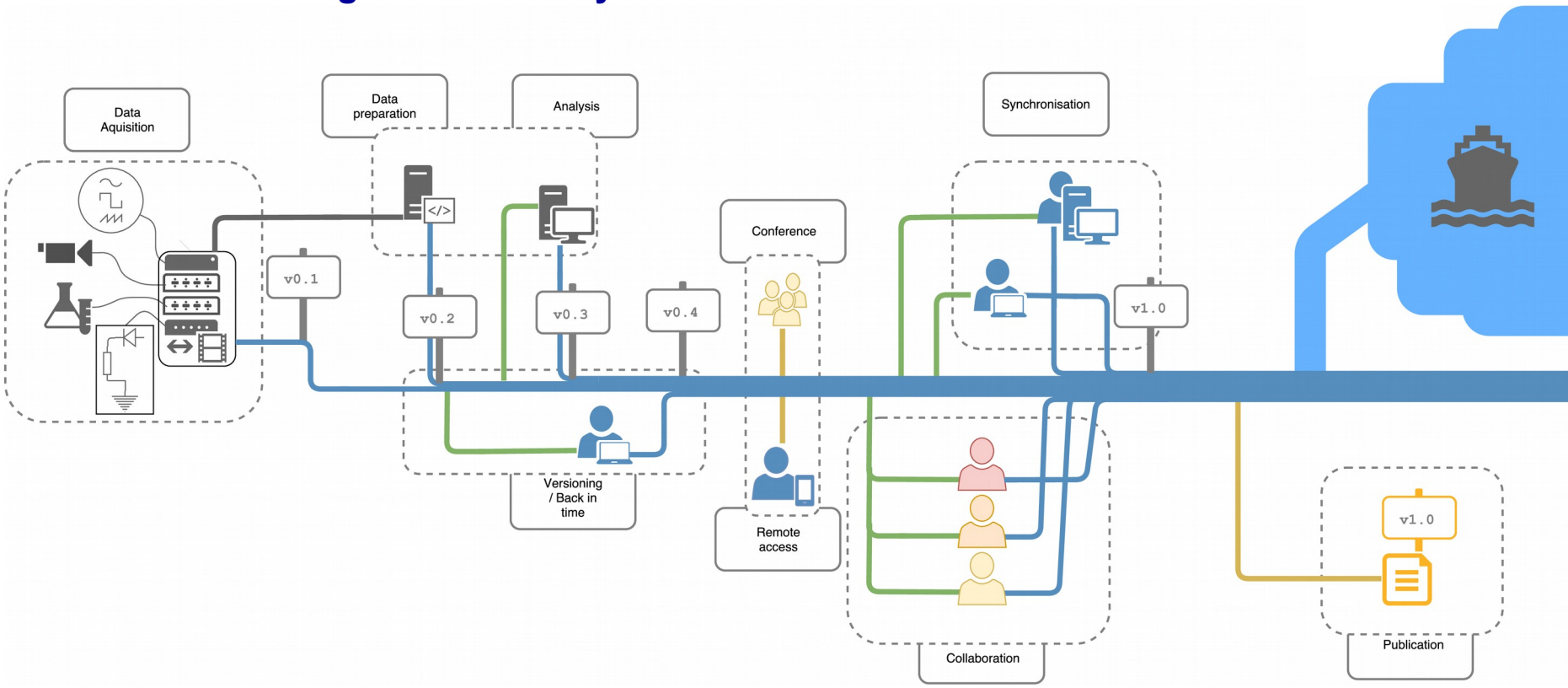
Supporting research data management through the entire data lifecycle

Data Acquisition and Processing

Data Analysis

Data Access and Collaboration

Data Publication



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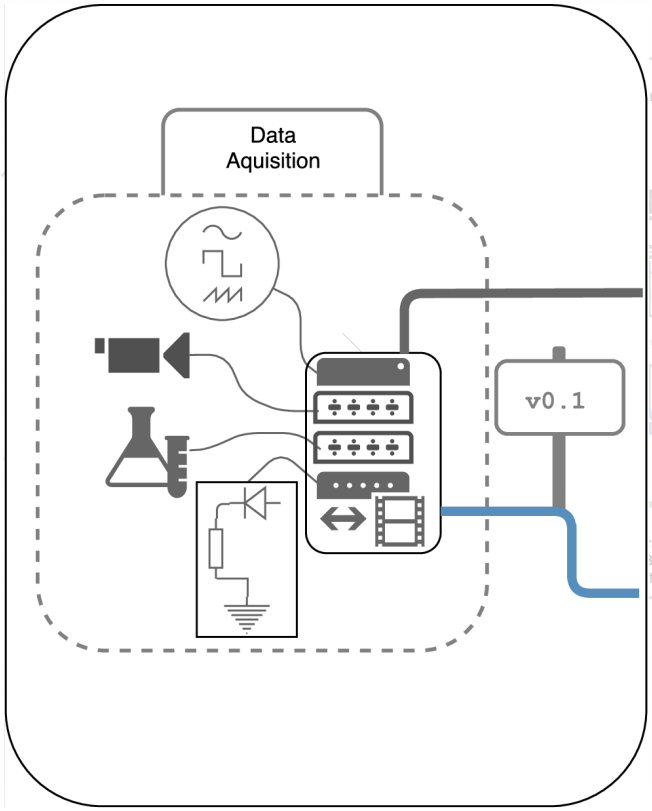
GIN: Services for Data Organization and Sharing

Supporting research data management through the entire data lifecycle

Data Acquisition and Processing

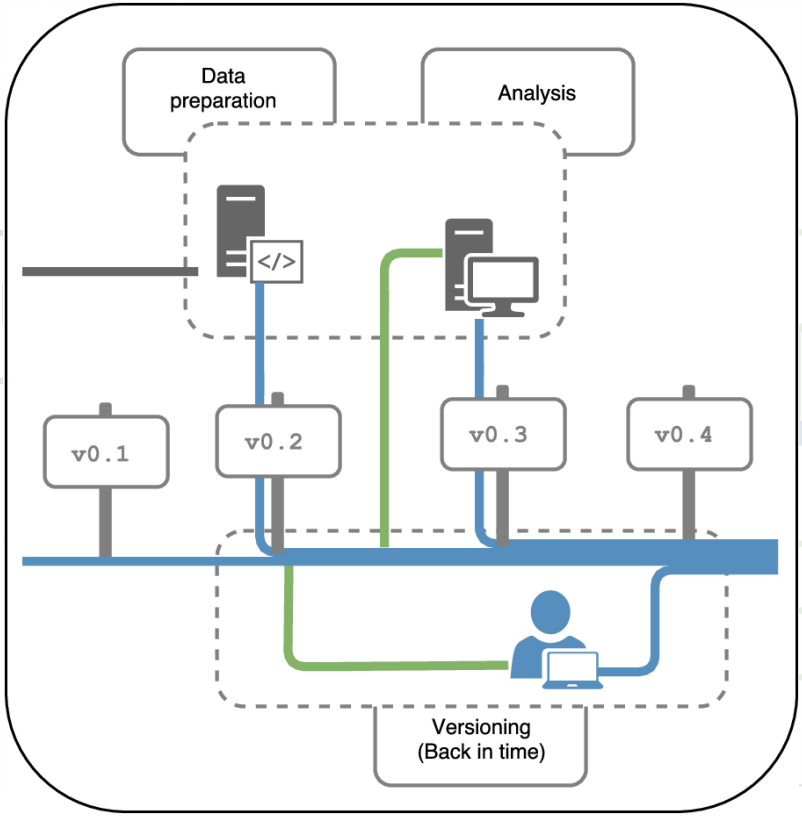


- Versioning of datasets from the beginning
- Keeping track of how dataset evolves
- Immediate access for other lab members
- Manage data with minimal data transfer

GIN: Services for Data Organization and Sharing

Supporting research data management through the entire data lifecycle

Data Analysis



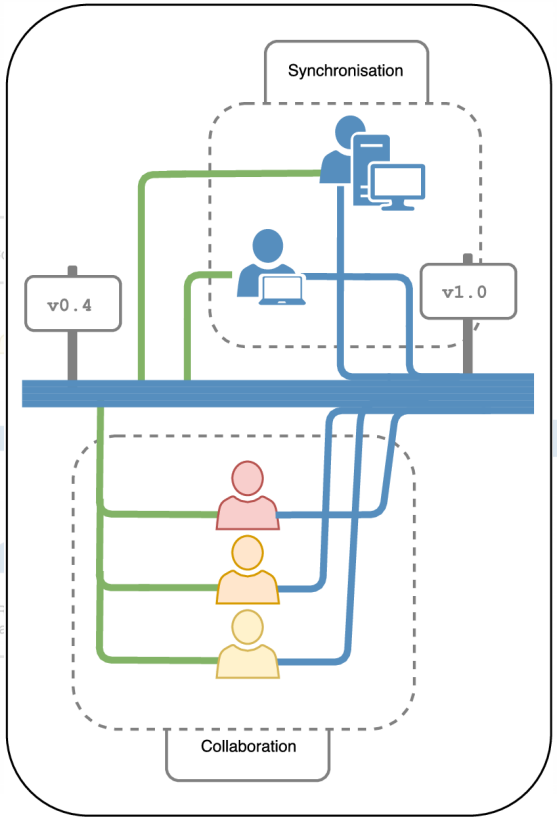
- Versioned analysis workflows
- Working together on data analysis
- Keeping track of who did what
- Reverting changes, Going back in time when necessary

GIN: Services for Data Organization and Sharing

Supporting research data management through the entire data lifecycle

- Accessing your data from outside the lab
- Keeping datasets in sync at diferent places with minimal data duplication
- Working on datasets remotely while transfering data only when needed
- Access for remote collaborators

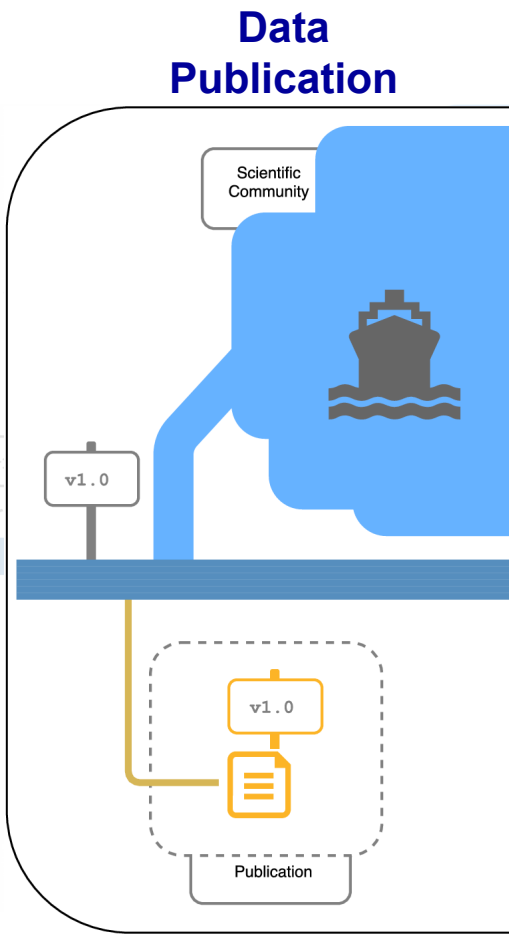
Data Access and Collaboration



GIN: Services for Data Organization and Sharing

Supporting research data management through the entire data lifecycle

- Indexing and data search (gin.g-node.org/explore)
- Making data public with a mouse click
- Dataset publication (supplemental datasets, data publications)
- Citable datasets through Digital Object Identifiers (DOI)



GIN: Services for Data Organization and Sharing

Getting started and Outlook

- Usage documentation at

  https://web.gin.g-node.org/G-Node/Info/wiki/

  https://web.gin.g-node.org/G-Node/Info/wiki/FaqTroubleshooting

- GIN-UI; graphical gin-cli wrapper on Windows
- Web GIN: odML integration
- Web GIN: NIX integration (upcoming)
- GIN microservice: Format validation service (prototype)
  - BIDS, odML, NIX, [your format here]
- GIN microservice: Continuous Integration service (upcoming)

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Get involved

Questions

Emails

dev@g-node.org

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gnode.slack.com

Issues and Feature requests

github.com/G-Node

Data sharing and publication

gin.g-node.org

Slides

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