An introduction to Open Science e Research Data Management

Marco J. Morelli, Center for Omics Sciences, IRCCS Ospedale San Raffaele (Milano)
Valentina Pasquale, Research Organization Directorate, IIT (Genova)
Fondazione Mondino, July 10th 2020
What you will learn today

Setting the context: why Open Science?

The research data lifecycle:

1. *Before:* plan & fund
2. *During:* work with data
3. *After:* preserve & share

Open Science in Neuroscience
Today’s slides

Slides can be found at: https://www.doi.org/10.5281/zenodo.3936442

Special thanks to mentors dr. Elena Giglia, dr.ir. Shalini Kurapati, and the Zenodo community of “Open Science in Italy” for sharing slides & ideas

Where not credited, images are taken from www.unsplash.com

License for these slides is CC BY 4.0.
A little exercise...

Go to www.menti.com and use the code 14 30 93
... here are the results :-)
Scholarly communication: what’s wrong?

Since the 17th century, scholarly communication has taken the form of research letters or articles, having the main function of efficiently communicating science to peers, in addition to get recognition and certification of research validity.

Rosendaal H., Geurts P., Forces and functions in scientific communication: an analysis of their interplay, CRISP 1997
THE EVOLUTION OF ACADEMIA

Publish

Publish or perish

Publish in high impact journals or perish

Publish frequently in high impact journals and maybe you won’t perish

“Surely you were aware when you accepted the position, Professor, that it was publish or perish.”

https://www.deviantart.com/velica/art/Publish-or-Perish-645355248

A new paradigm needed

Goodhart’s law: “When a measure becomes a target, it ceases to be a good measure”.

The main effect is that researchers started to game the system at every level.

https://towardsdatascience.com/unintended-consequences-and-goodharts-law-68d60a94705c
Adapted from E. Giglia, https://doi.org/10.5281/zenodo.3870908
Pressure to publish “positive” results

The only thing that counts in academia is publication of **novel** results in **high impact journals**.

---

**19th century scientist**

I must find the explanation for this phenomenon in order to truly understand Nature...

**21st century academic**

I must get the result that fits my narrative so I can get my paper into Nature..

---

Adapted from S. Kurapati, https://doi.org/10.5281/zenodo.3576440
A reproducibility crisis

Nature’s survey of 1,576 researchers who took a brief online questionnaire on reproducibility in research

Nature 533, 452-454 (26 May 2016), doi: 10.138/533452a
Is that really science?

Selective reporting, poor statistical analysis, methods/code/data unavailable... is that really science?

What is the difference between open science and good science? If research papers are inaccessible, with no code or data, cherry picked results, inability to even attempt to reproduce, is that really even science? Science without openness is more anecdote and faith than science.

Tennant Sept. 2018

Adapted from E. Giglia, https://doi.org/10.5281/zenodo.3519306
Open Science: just Science done right!

Open Science describes an ongoing change in the way research is performed, researchers collaborate, knowledge is shared, and science is organized.

Open Science opens up scientific processes and products from all levels to everyone.

Source: OpenAIRE website

https://www.fosteropenscience.eu/foster#taxonomy
Publishers make coronavirus (COVID-19) content freely available and reusable

More than 30 leading publishers have committed to making all of their COVID-19 and coronavirus-related publications, and the available data supporting them, immediately accessible in PubMed Central (PMC) and other public repositories. This will help to support the ongoing public health emergency response efforts.
Scientists are changing their way of collaborating and sharing research data and findings.

A new era is coming

‘A completely new culture of doing research.’ Coronavirus outbreak changes how scientists communicate

By Kai Kupferschmidt | Feb. 26, 2020, 2:05 PM

Open science takes on the coronavirus pandemic

Data sharing, open-source designs for medical equipment, and hobbyists are all being harnessed to combat COVID-19.

Mark Zastrow
Why only for Covid-19?

Why not for SDGs?

Why not for dementia?

Why not for cancer?
New cases of cancer is 439.2 per 100,000 men and women per year (2011–2015, Source: US National Cancer Institute)

50M people affected in the world (Source: Alzheimer’s Disease International)
"Respondents who first published in the 2000s and 2010s appear to be the most motivated to share their data if it resulted in them being credited as a co-author."

**The State of Open Data 2019**

This year's response cohort included:

- 38% professors
- 41% tenured (with a further 7% on tenure-track)
- 36% had first published a peer reviewed article during the current decade (2010's)
Open Science means transparency, reproducibility, reliability, equity, collaboration and inclusiveness.

Open Science has an enormous transformative potential if you make it yours.

Adapted from E. Giglia, https://doi.org/10.5281/zenodo.3519306
## Benefits for all stakeholders

<table>
<thead>
<tr>
<th>Researchers</th>
<th>Funders</th>
<th>General Public</th>
</tr>
</thead>
</table>
| • greater visibility & reach  
• increased efficiency  
• funding  
• collaboration/networking | • increased visibility & reuse of funded research  
• greater funding impact  
• greater ROI | • faster knowledge transfer  
• increased understanding and expertise  
• promoting engagement in science & research |

<table>
<thead>
<tr>
<th>Organisations/NGOs</th>
<th>National Governments</th>
</tr>
</thead>
</table>
| • enhanced access to research  
• more effective advocacy/lobbying | • evidence-informed policy  
• promoting Human Rights and democracy |

Source: OpenAIRE website
Funding bodies are pushing for Open Science & FAIR data

... and more will follow!

Adapted from Shalini Kurapati, https://doi.org/10.5281/zenodo.3576440
Open Science & FAIR data in Horizon Europe

Key points

“As open as possible, as closed as necessary”.

Mandatory Data Management Plan for FAIR data.

Use of European Open Science Cloud.
What are FAIR data?


Findable
Accessible
Interoperable
Reusable

For humans
And
Machines

Have a look at the Personal Health Train on VIMEO: [https://vimeo.com/143245835](https://vimeo.com/143245835)
We will be moving out of an economy based on fossil fuels, towards a sustainable and a data economy. [...] Every 18 months we double the amount of data we produce. Industrial and commercial data, 85% of which is never used. This is not sustainable. [...] Europe is going to co-create a framework to allow the use of these data. [...] We are creating a European Open Science Cloud now. It is a trusted space for researchers to store their data and to access data from researchers from all other disciplines. [...] Every researcher will be able to better use not only their own data, but also those of others. They will thus come to new insights, new findings and new solutions. [...]
We need 500,000 respected data stewards to operate the European Open Science Cloud

04/05/16 09:08

At the e-IRG workshop in Amsterdam, we had the opportunity to talk to Barend Mons who is chairing the High Level Expert Group on the European Open Science Cloud, an advisory group to the European Commission. To be successful, the European Science Cloud needs a lot of experts to operate it, Barend Mons told us. Data stewards that have a lot of knowledge about managing and maintaining data. Experts who are well respected with a solid career path. Barend Mons also discussed several other findings of the Expert group, whose report will be published very soon.

We are here at the e-IRG workshop in Amsterdam and we are talking with Barend Mons. Welcome. You just had a presentation here, and you were also part of the panel. One of the things that you focused on, was the European Open Science Cloud, because you are chairman of the Expert Group of the European Commission. So can you tell a little bit about the progress? What is the status of the European Science Cloud?
List of desiderata

Data management / data stewardship support in universities
  ○ Budget data management in your grants!

Investments in (national) research data infrastructures
  ○ Germany: https://www.dfg.de/en/research_funding/programmes/nfdi/

University-level data steward education
  ○ France: https://sdm.edu.umontpellier.fr/
  ○ Denmark: https://dighumlab.org/events/data-steward-education/

(National) Open Science policies
  ○ France: https://www.ouvrirlascience.fr/plan-national-pour-la-science-ouverte/
  ○ Netherlands: https://www.openscience.nl/en
Questions?
The research data lifecycle

“Research data management (RDM) concerns the organisation of data, from its entry to the research cycle through to the dissemination and archiving of valuable results. It aims to ensure reliable verification of results, and permits new and innovative research built on existing information.”

Before: plan and fund

or

How I defeated a DMP
What is a Data Management Plan (or DMP)?

It is a written plan detailing how you will manage research data throughout your research project.

If we think of your project as a journey, the DMP is a roadmap that you will use not to get lost in your own data.

As all plans, it is meant to be changed.

The DMP is a living document that will be revised during the project to reflect any change of direction.

It will be useful for all your collaborators.

It is now required by most funding bodies, as well as data sharing.
“Why should I need a DMP?”

Immediate reactions to “sharing” requirements:

• It would take me 5 years to find all my data!
• The PhD/postdoc who had the data left the lab
• Should we write down all protocols?
• Data management is a waste of time
• Nobody will understand my data
• People can just ask me for it when they need it

Adapted from S. Kurapati, https://doi.org/10.5281/zenodo.3576440
Because data are fragile

80% will be lost in 20 years

https://doi.org/10.1016/j.cub.2013.11.014

The Availability of Research Data Declines Rapidly with Article Age

Timothy H. Vines, R. O., Arianne Y.K. Albert, Rose L. Andrew, Jean-Sébastien Moore, Sébastien Renault, Diana J. Remnison

Open Archive • Published: December 19, 2013 • DOI: https://doi.org/10.1016/j.cub.2013.11.014

...THAT’S WHY YOU NEED TO PLAN IN ADVANCE

THE DATA MANAGEMENT PLAN IS NOT JUST AN ADMINISTRATIVE BURDEN

http://www.nature.com/news/scientists-losing-data-at-a-rapid-rate-1.14416

Adapted from Elena Giglia, https://doi.org/10.5281/zenodo.3519305
What should be covered by a DMP?

1. Data summary
2. Documentation & data quality
3. Storage & backup during the research process
4. Legal & ethical requirements
5. Data sharing & long-term preservation
6. Responsibilities & resources

https://www.scienceeurope.org/media/jezkhnoo/se_rdm_practical_guide_final.pdf
Many offices involved

Legal
IT
Finance
Library
Ethics/DPO
Tech Transfer

Who owns the data?
Who owns the IP?
Who is responsible for sharing and preserving the data?
Are the SOPs GDPR-compliant?
Are the informed consents adequate?
<table>
<thead>
<tr>
<th>Dataset name</th>
<th>A descriptive title of your dataset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dataset goal/utility</td>
<td>Define the main purpose: which need will this dataset meet? Which categories of users and/or researchers may use this dataset in the future?</td>
</tr>
<tr>
<td>Data origin</td>
<td>Generated within the project/Already existing</td>
</tr>
<tr>
<td>Type/formats</td>
<td>Indicate data type and formats, with preference for interoperable formats (<a href="https://ukdataservice.ac.uk/recommendedfileformats/">UK Data Service Recommended file formats</a>)</td>
</tr>
<tr>
<td>Expected size</td>
<td>MB / GB / TB ?</td>
</tr>
<tr>
<td>Expected time of delivery</td>
<td>Estimation of when the dataset will be completed</td>
</tr>
</tbody>
</table>
## Documentation, metadata, and data quality

<table>
<thead>
<tr>
<th>Documentation</th>
<th>How will documentation about data collection be captured? e.g. ‘readme’ text files, file headers, code books, or lab notebooks. Which information will be included? e.g. methodology used to collect the data, analytical and procedural information, definitions of variables, units of measurement, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metadata standards</td>
<td>Which metadata standards (for example DDI, DataCite, etc.) will be used? Use community metadata standards where these are in place. Find them at <a href="https://dcc.info/standards">DCC standards webpage</a> or <a href="https://fairsharing.org">FAIRsharing.org</a>.</td>
</tr>
<tr>
<td>Data quality assessment</td>
<td>How will consistency and quality of data collection be controlled and documented?</td>
</tr>
</tbody>
</table>
### Storage & backup strategies
Where will data be stored and backed up during research? How often will backup be performed? Give preference to the use of robust, managed storage with automatic backup, e.g. provided by institutional IT support service.

### Data organization
How will data be organised during the project? e.g. file naming conventions, version control, folder structures, etc. Consistent, well-ordered research data will be easier to find, understand, and re-use.

### Data security & protection
Who will have access to the data during research? How will access be controlled? Consider data protection risks, particularly if your data is sensitive, e.g. personal data, trade secrets.
<table>
<thead>
<tr>
<th>Legal &amp; ethics</th>
</tr>
</thead>
</table>
| **Protection of personal/sensitive data** | Ensure that you are compliant with personal data protection laws (e.g. GDPR)  
› Gain informed consent for preservation and/or sharing of personal data  
› Consider anonymisation for preservation and/or public sharing  
› Consider pseudonymisation/encryption of personal data |
| **Intellectual property rights** | Who will be the owner of the data? Who will have the rights to control access? Make sure to cover these matters for multi-partner projects in the consortium agreement. |
| **Ethical issues** | What ethical issues and codes of conduct are there, and how will they be taken into account? |
# Data sharing & preservation

<table>
<thead>
<tr>
<th>Long-term data sharing</th>
<th>How will data be findable and shared (e.g. trustworthy data repository, indexed in a catalogue, use of a secure data service, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data repository</td>
<td>Specify where the data will be deposited and demonstrate that the data can be curated effectively beyond the lifetime of the grant</td>
</tr>
<tr>
<td>Restrictions on sharing</td>
<td>Are there possible restrictions to data sharing or embargo reasons? Explain any constraint on sharing, such as embargo period or restricted access. Please make sure to justify any potential restriction.</td>
</tr>
<tr>
<td>Data curation</td>
<td>How will data for preservation be selected?</td>
</tr>
<tr>
<td>Licensing</td>
<td>Which licenses will be applied? E.g. <a href="https://creativecommons.org/licenses">CC licenses</a></td>
</tr>
</tbody>
</table>
## Roles and responsibilities

Outline the roles and responsibilities for data management/stewardship activities. For collaborative projects, explain the co-ordination of data management responsibilities across partners: indicate who is responsible for implementing the DMP, and for ensuring it is reviewed and, if necessary, revised.

## Costing

What resources (for example financial and time) will be dedicated to data management? Estimate the costs in terms of personnel (e.g. PM needed to collect and maintain data) and other costs (storage costs, hardware, staff time, costs of preparing data for deposit, and repository charges). Describe how you plan to cover these costs both during and beyond project duration.
DMP templates & mandates

When preparing a grant proposal, check whether you have to anticipate a “data paragraph” at the submission stage (e.g. EU RIA-IA proposal template, Impact - Dissemination & exploitation of results).

European projects in the Open Research Data Pilot (check your grant agreement Art. 29.3) MUST submit a full DMP as a formal deliverable within M6 from project’s start. In some programmes, DMP must be revised in the middle and at the end of the project.

Ask your Projects Office if the funder provides a specific DMP template and about specific data sharing requirements / mandates for your type of project (you can have a look at Sherpa Juliet, searchable database of research funders’ open access policies)
DMP tools

- [DMP Online](https://dmponline.dcc.ac.uk/)
- [Argos](https://argos.openaire.eu/splash/)
- [DSW](https://ds-wizard.org/)
- [Easy.DMP](https://easydmp.eudat.eu/)
- [DMP Tool](https://dmptool.org/)

Online tools helping to fill in predefined templates & producing machine-actionable DMPs
During: work with data

or

How few minutes today can save months next year
The research data lifecycle

“Cold” data

Active data
Active data management

The most creative part of science

Extremely dynamic: it involves many (many many) attempts, changes, analyses

Extremely subjective: demanded to the single researcher, sometimes organised at group level, very rarely at institutional level

Requires a cleaning work once the project is finalised

6 easy tips for active data management
### Tip #1: Folder hierarchy

<table>
<thead>
<tr>
<th>Avoid</th>
<th>Here is one: project/experiment/date</th>
</tr>
</thead>
<tbody>
<tr>
<td>/proj/lastyear/lastversion/temp/notperfect</td>
<td>ERC_cardio/RNAseq_PBMC/20200710</td>
</tr>
<tr>
<td>Choose a simple, <em>consistent</em> way of organising your folders, shared within your group, and stick to it</td>
<td>Contains the results of the experiment RNAseq_PBMC obtained in data <em>July 10th, 2020</em> within the project <em>ERC_cardio</em></td>
</tr>
</tbody>
</table>
## Tip #2: data file naming and versioning

**Avoid!!!**

Choose a simple, consistent way of naming your files and their versions shared within your group, and stick to it.

Here is one:

- **Date_project_description_owner_number.ext**

  - *20200710_PF_wing_MM_05.tif*: image (.tif) taken on July 10th, 2020 (20200710) within the project pattern formation (PF) of a drosophila wing (wing) by Marco Morelli (MM)
### Tip #3: Description of the folder

<table>
<thead>
<tr>
<th>This folder contains 357 files in 24 subfolders and I have a vague idea of what they are</th>
<th>AVOID!!!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each folder should have a few ancillary files or metadata with a short description of the project, the dataset included and the file structure</td>
<td>A very simple, and very effective solution is storing information in a short readme.txt file in the relevant folders</td>
</tr>
</tbody>
</table>
## Tip #4: Is my data personal and/or sensitive?

<table>
<thead>
<tr>
<th>“I will email you an excel table with the patients and their pathologies”</th>
<th>AVOID!!!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only authorised personnel should have access to personal data of living human beings (GDPR).</td>
<td>Pseudonymization (only authorised personnel can trace back the identity of patients)</td>
</tr>
<tr>
<td>Data minimization transfer principle: only the data needed for scientific purpose must be transmitted</td>
<td>Anonymization (nobody can track back the identity of patients*)</td>
</tr>
<tr>
<td></td>
<td>*sometimes this may not be possible</td>
</tr>
</tbody>
</table>
Tip #5: Permissions and backup

<p>| “You can find the data on my computer, the password is 12345678” | AVOID!!! |
| “Oh wait, the hard disk crashed” |  |
| PIs are responsible of the data they manage, including their loss and inappropriate access. |  |
| Where is the data? |  |
| Who can access the folder where the data is deposited? |  |
| Are the data backed up? How often? |  |
| Do they need to be encrypted? |  |</p>
<table>
<thead>
<tr>
<th>Tip #6: Archiving and long-term storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I am ready to submit my paper, where are all the raw data?”</td>
</tr>
<tr>
<td>“Let me think...”</td>
</tr>
<tr>
<td><strong>AVOID!!!</strong></td>
</tr>
<tr>
<td>Tidy up all your zillion attempts and keep only the good one(s)</td>
</tr>
<tr>
<td>How can people access my data and under which conditions?</td>
</tr>
<tr>
<td>Choose a solution that warrants long-term preservation of your data.</td>
</tr>
<tr>
<td>Choose a license by which your data can be re-used</td>
</tr>
</tbody>
</table>
After: preserve and share

or

Reproducibility galore
Real life stories

https://www.youtube.com/watch?v=66oNv_DJuPc
It can make you laugh, but it is very true!
What does the EC require from project grantees on FAIR data?

The EC supports FAIR data not as a standard but as a framework to follow when designing a Data Management Plan. It has produced a set of Guidelines for FAIR data management.

https://www.openaire.eu/how-to-make-your-data-fair
**FINDABLE**

<table>
<thead>
<tr>
<th>To be findable a data object must be <strong>uniquely</strong> and <strong>persistently</strong> identifiable.</th>
<th>Data should not move and have machine-actionable rich metadata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obtain a DOI for the dataset (resolvable, unique, persistent)</td>
<td>Considers also versioning</td>
</tr>
<tr>
<td>The repository must meet some objective requirements</td>
<td>Preferably externally certified</td>
</tr>
</tbody>
</table>
### Accessible

<table>
<thead>
<tr>
<th>Data can always be obtained by humans and machines</th>
<th>Appropriate authorizations may be required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using standard protocols of access</td>
<td>Supports bulk, automatised download or remote analysis</td>
</tr>
<tr>
<td>Describe exact condition of accessibility (NOT: open)</td>
<td>Unauthorized searches are automatically not performed</td>
</tr>
</tbody>
</table>
INTEROPERABLE

Data can be opened without proprietary software

Convert proprietary formats:
doc -> txt
xls -> csv

Metadata should be standardised

Adhering to an international standard (e.g. Dublin Core)

Using a controlled vocabulary/ontology

<table>
<thead>
<tr>
<th>Name</th>
<th>Metadata subtag</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Title</td>
<td>Title</td>
<td>A name given to the resource</td>
</tr>
<tr>
<td>*Creator</td>
<td>Creator</td>
<td>An entity primarily responsible for making the content of the resource</td>
</tr>
<tr>
<td>Subject and keywords</td>
<td>Subject</td>
<td>The topic of the content of the resource</td>
</tr>
<tr>
<td>*Description</td>
<td>Description</td>
<td>An account of the content of the resource</td>
</tr>
<tr>
<td>*Publisher</td>
<td>Publisher</td>
<td>An entity responsible for making the resource available</td>
</tr>
<tr>
<td>Contributor</td>
<td>Contributor</td>
<td>An entity responsible for making contributions to the content of the resource</td>
</tr>
<tr>
<td>*Date</td>
<td>Date</td>
<td>The date that the resource was published or some other important date associated with the resource.</td>
</tr>
<tr>
<td>Resource type</td>
<td>Type</td>
<td>The nature or genre of the content of the resource</td>
</tr>
<tr>
<td>Format</td>
<td>Format</td>
<td>The physical or digital manifestation of the resource</td>
</tr>
<tr>
<td>*Resource identifier</td>
<td>Identifier</td>
<td>An unambiguous reference to the resource within a given context; this is the object identifier or OID</td>
</tr>
<tr>
<td>*Source</td>
<td>Source</td>
<td>A reference to a resource from which the present resource is derived</td>
</tr>
<tr>
<td>*Language</td>
<td>Language</td>
<td>A language of the intellectual content of the resource</td>
</tr>
<tr>
<td>Relation</td>
<td>Relation</td>
<td>A reference to a related resource</td>
</tr>
<tr>
<td>*Coverage</td>
<td>Coverage</td>
<td>The extent or scope of the content of the resource</td>
</tr>
<tr>
<td>Rights management</td>
<td>Rights</td>
<td>Information about rights held in and over the resource</td>
</tr>
</tbody>
</table>

Bainbridge, 2020
<table>
<thead>
<tr>
<th>Humans and machines should be authorised to use data for purposes different from those of the authors’</th>
<th>Choose an appropriate license to distribute the data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data must be easily integrated with external sources</td>
<td>Metadata should be rich and well-described so they can support automatic data integration</td>
</tr>
<tr>
<td>It must be possible to reproduce all the passages from raw to analyzed data</td>
<td>Add methods/codes/SOPs/procedures to metadata</td>
</tr>
</tbody>
</table>
**FAIR summary**

PID: Persistent IDentifier

https://www.go-fair.org/fair-principles/

https://www.force11.org/fairprinciples
How FAIR am I?

Repositories - how to beat down the reproducibility crisis

Where do I put my (open) data?

Some characteristics:
- Long-term preservation
- Versioning
- Embargoed/restricted access option
Licenses (Creative Commons)

“Simple, standardized way to grant copyright permissions by authors to their creative work.”

Combinatorial framework to regulate how content can be copied, distributed, edited, remixed, and built upon

https://creativecommons.org/licenses/
Questions?
Open Neuroscience

or

There’s a whole world out there going open… what about you?
Standards & formats

BIDS is a standard prescribing a formal way to name and organize MRI data and metadata in a file system that simplifies communication and collaboration between users and enables easier data validation and software development through using consistent paths and naming for data files.

https://bids.neuroimaging.io/

Standards and best practices

INCF serves as a standards organization dedicated to open and FAIR neuroscience

The mission of the INCF is to develop, evaluate, and endorse standards and best practices that embrace the principles of Open, FAIR, and Citable neuroscience.

https://www.incf.org/resources/sbps

Data standard for neurophysiology, providing neuroscientists with a common standard to share, archive, use, and build analysis tools for neurophysiology data.

https://www.nwb.org/

Making databases about the brain more usable and accessible for neuroscientists worldwide
Open hardware & software

http://miniscope.org/index.php/Main_Page

https://doi.org/10.3389/fncel.2019.00141

Circuit Investigations With Open-Source Miniaturized Microscopes: Past, Present and Future

Daniel Aharoni* and Tycho M. Hoogland*

https://open-ephys.org/

What does Open Ephys do?

We showcase open-source tools that deserve wider recognition. We focus on tools that foster collaboration, reduce the need for redundant development efforts, and offer similar (or better) performance than their closed-source counterparts at a fraction of the cost.
Collaborative initiatives

International Brain Laboratory

Officially launched on Sept 19th 2017

Experimental & theoretical neuroscientists collaborating to understand brainwide circuits for complex behavior

The International Brain Laboratory will release all data sets within 12 months of collection, or upon acceptance for publication of an associated manuscript, whichever comes first.

https://www.internationalbrainlab.com/

Think Open Rovereto Workshop 2020
July 10-11, 2020

https://ebrains.eu/

Think Open

Data pipelines built by you.

DataJoint Neuro® enables research teams to design scientific databases and computational pipelines by providing support, resources, and services.

Our focus is on neuroscience and AI.

https://event.unitn.it/think-open/

https://djneuro.io/

Modelling the brain, together

Open Source Brain is a resource for sharing and collaboratively developing computational models of neural systems.
Thank you!

or

Will you become an “open” scientist? :-}