ALLEN INSTITUTE *for*
NEURAL DYNAMICS

OPEN SCIENCE at the ALLEN INSTITUTE FOR NEURAL DYNAMICS

11/14/2022

- Mission & data
- Open science and data sharing

Allen Institute for Neural Dynamics - Mission

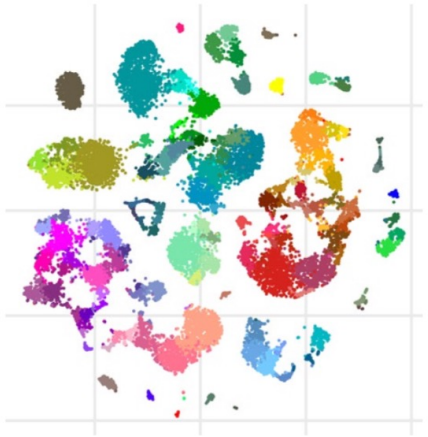
Discover how the brain's neurons produce our emotions, memories and actions.

Answers will be in terms of neural activity in defined neuron types interacting across the whole brain and body.

This requires next-generation neurotechnologies.

Knowledge, data, and tools will be widely shared, to facilitate science elsewhere and to support the development of therapies for brain disorders.

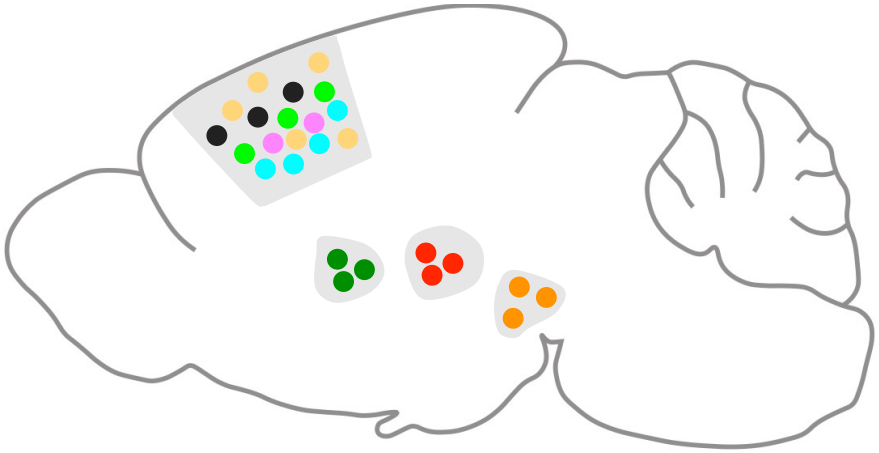
Transcriptomic clusters



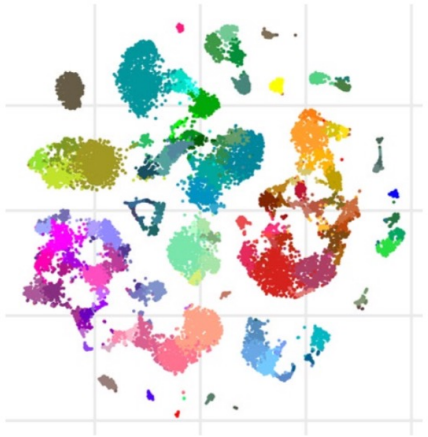
BICCN; AIBS

Cell types

Spatial transcriptomics → map of cell types



Transcriptomic clusters



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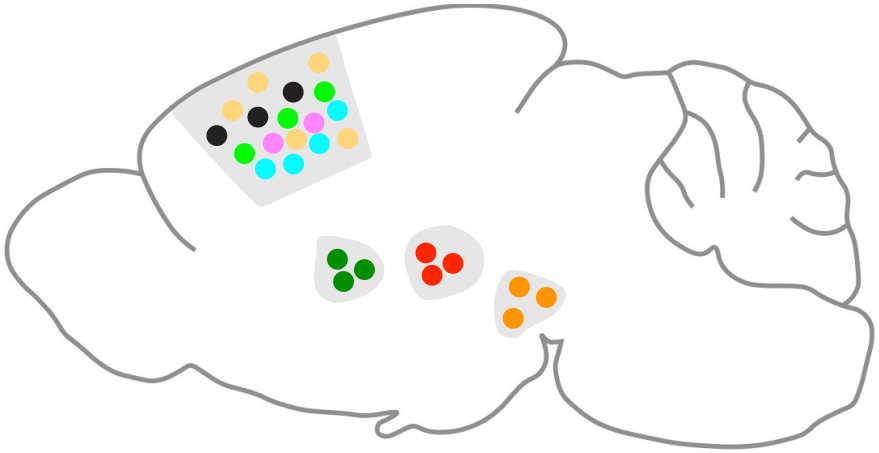
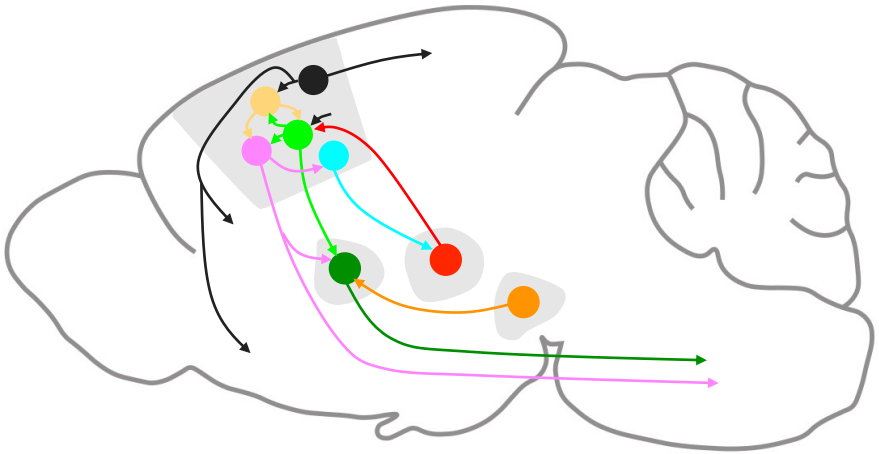


Structure and connectivity → neural circuits



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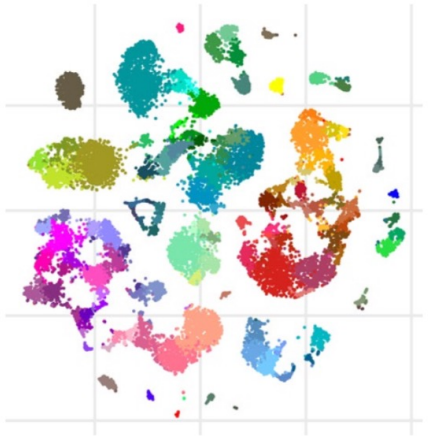

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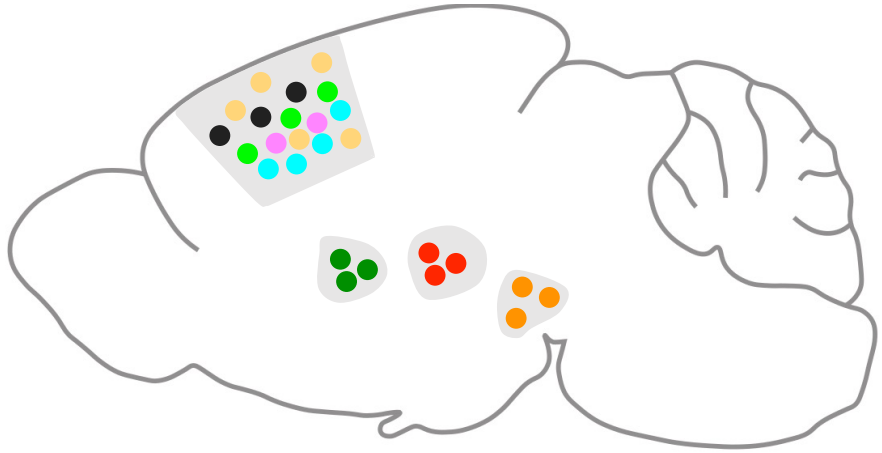
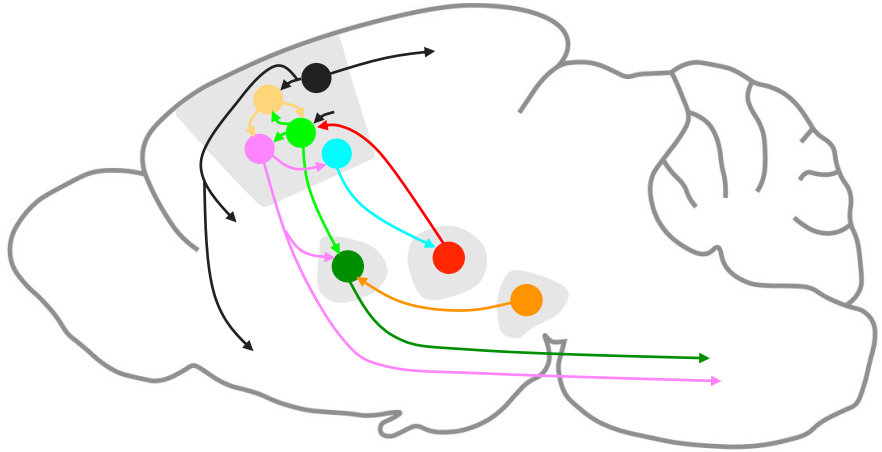


Neural signals → coding of information

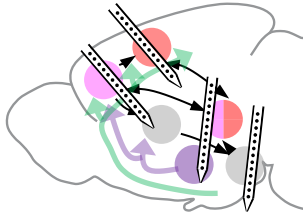
Structure and connectivity → neural circuits



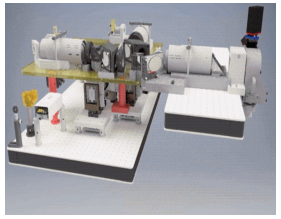
AIND organization: **Groups**

Behavior

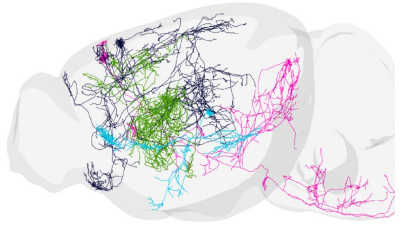
Neural dynamics Ephys



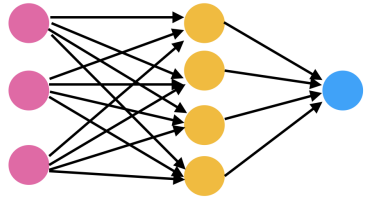
Neural dynamics Ophys



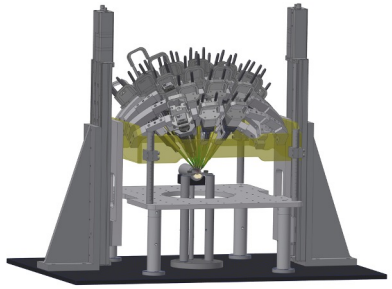
Mapping brain-wide neural circuits



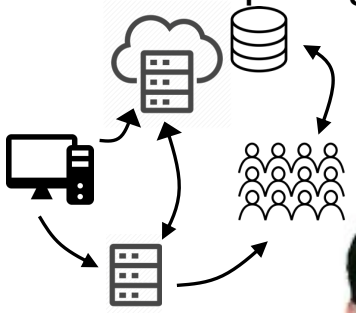
Machine-learning and theory



Instrumentation



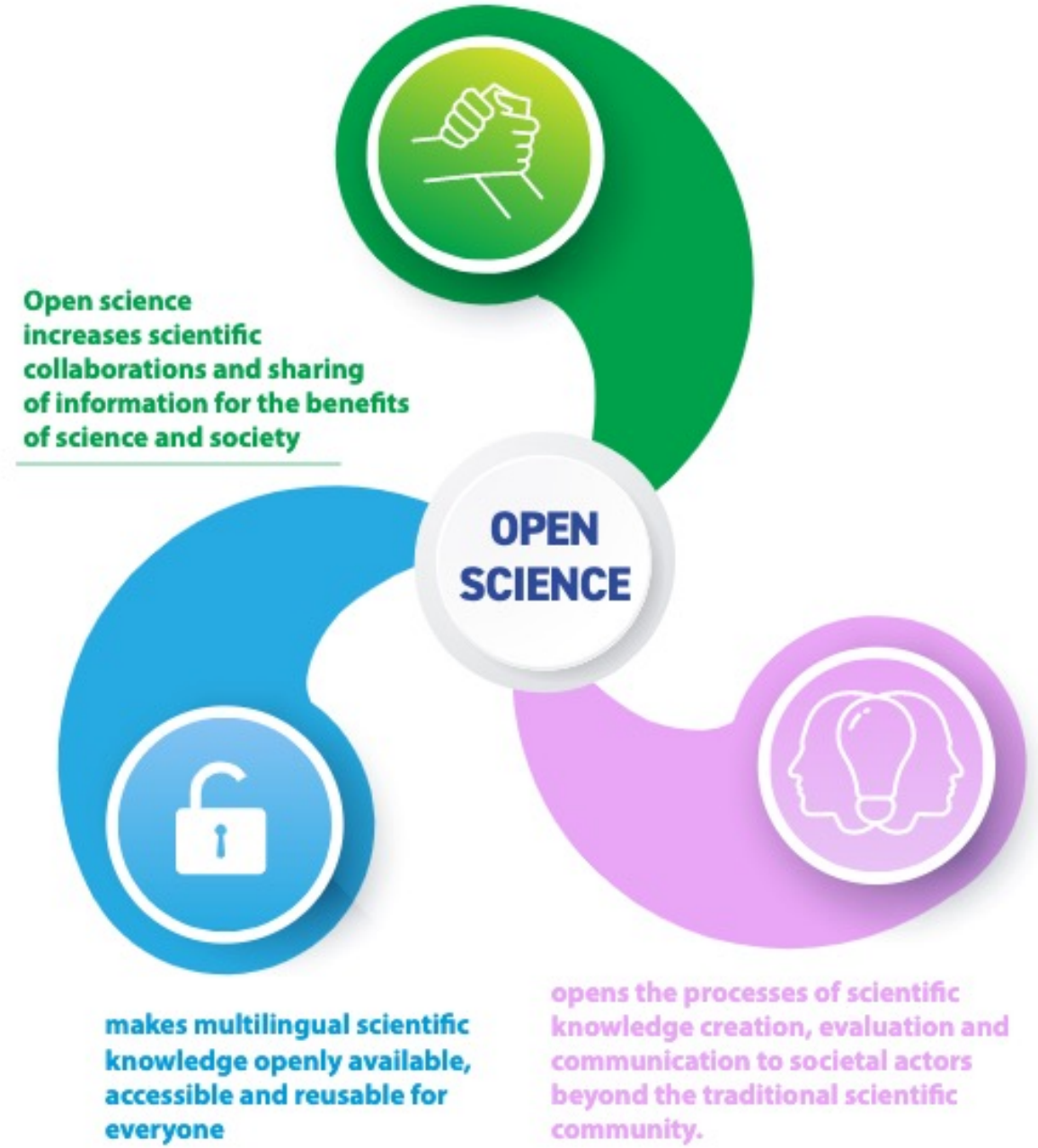
Scientific computing



Project mgt & administration

David Feng

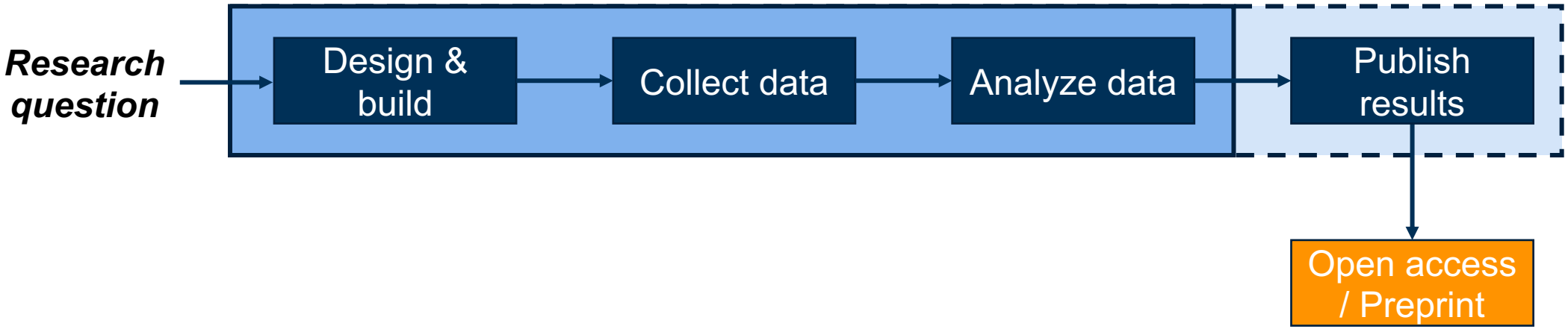
Saskia de Vries



UNESCO Recommendation on Open Science 2021

closed transparent access

closed transparent access



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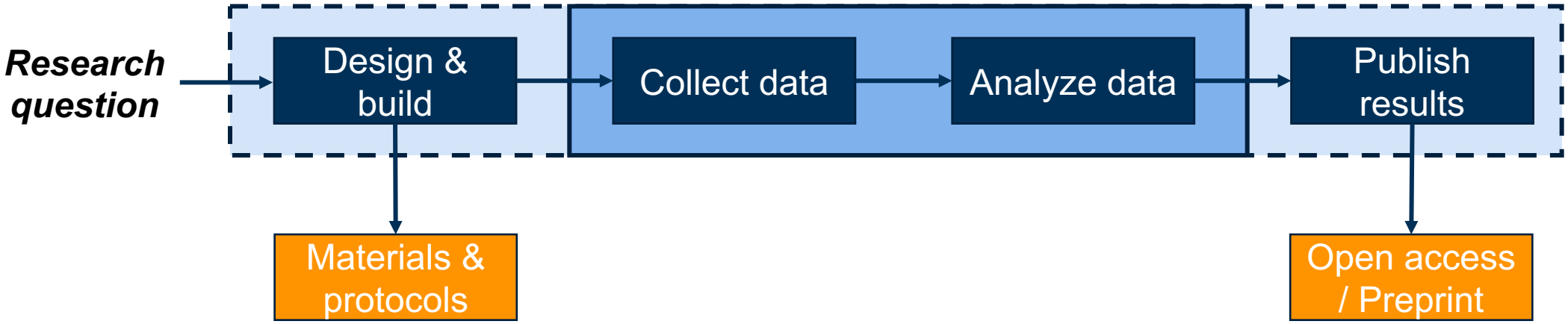

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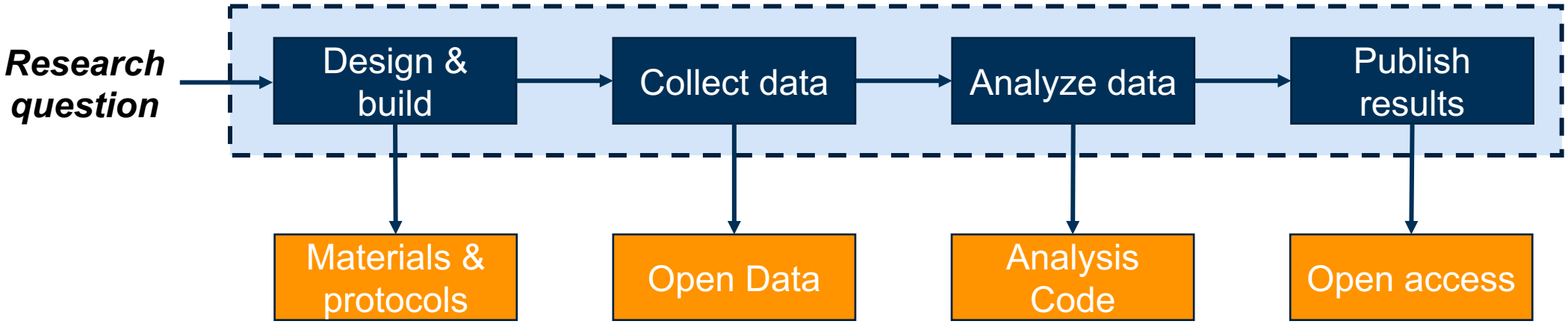
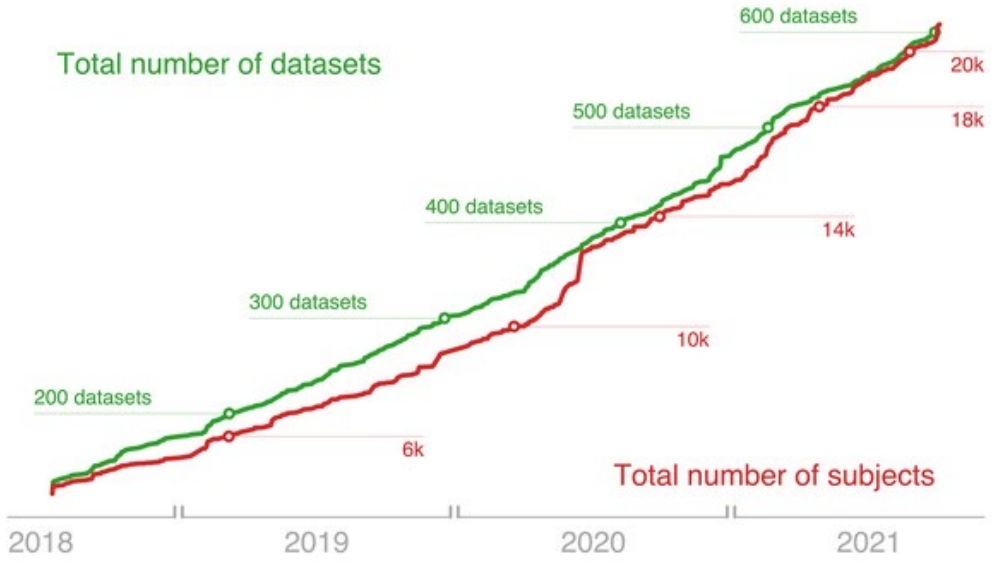


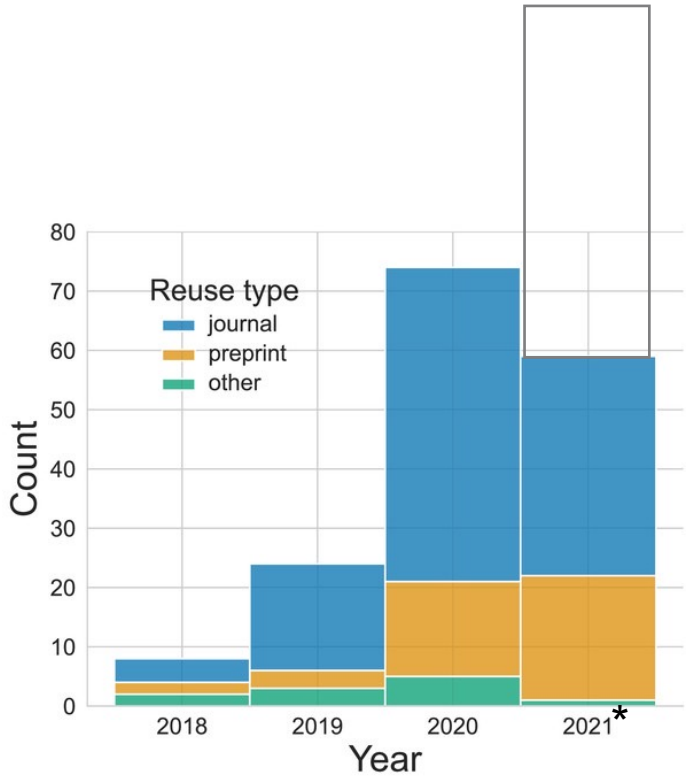
Sharing:
Tools, data, code, research findings

Data re-use in neuroscience: MRI

OpenNeuro datasets



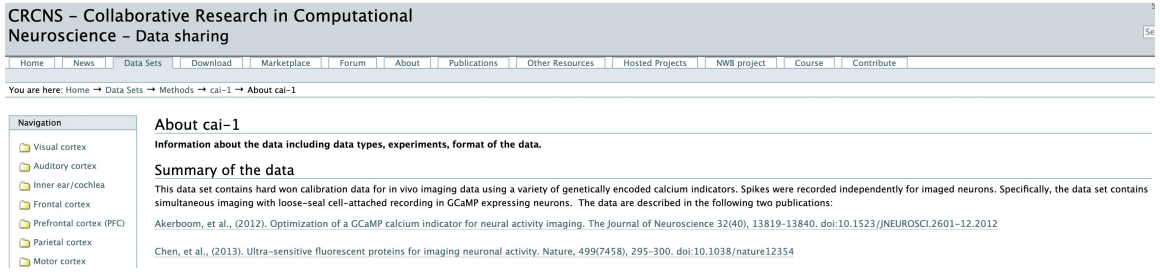
Reuses of OpenNeuro datasets



Markiewiscz *et al.*, 2021

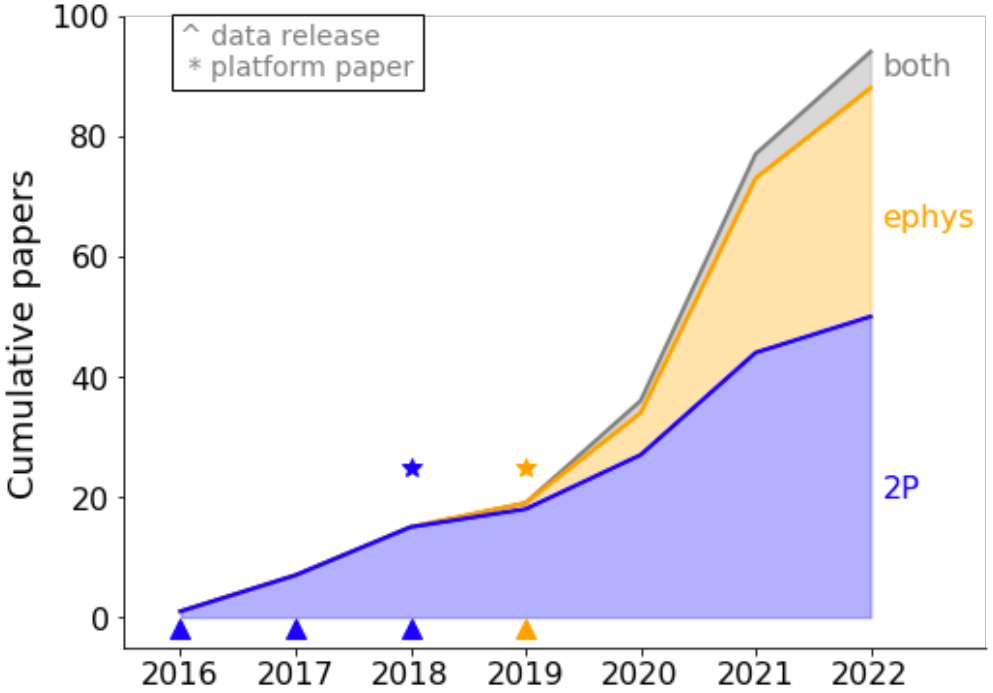
Data re-use: cellular neurophysiology

CRCNS.org

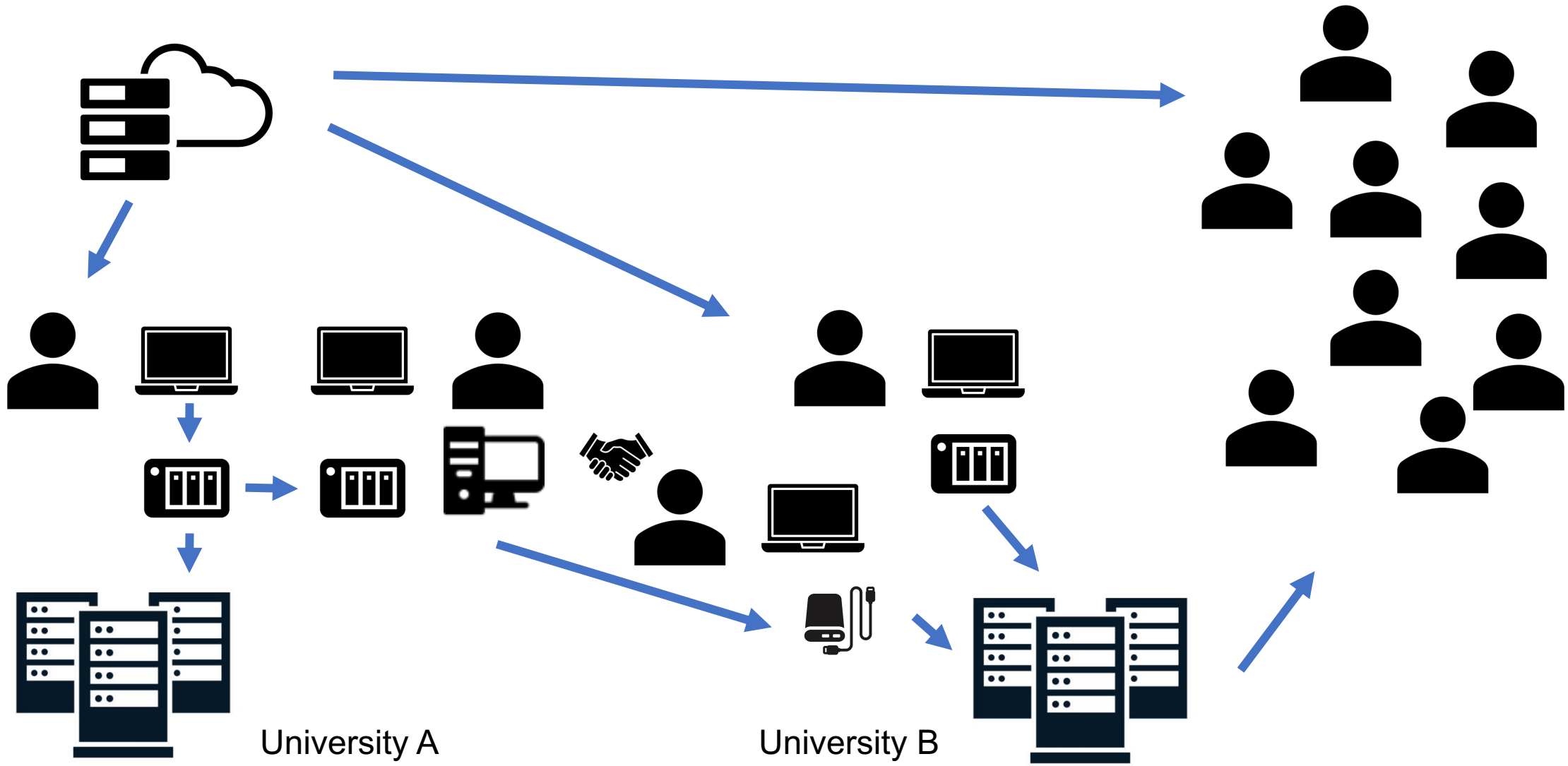


Data reused in dozens of studies focused on the interpretation of calcium imaging data

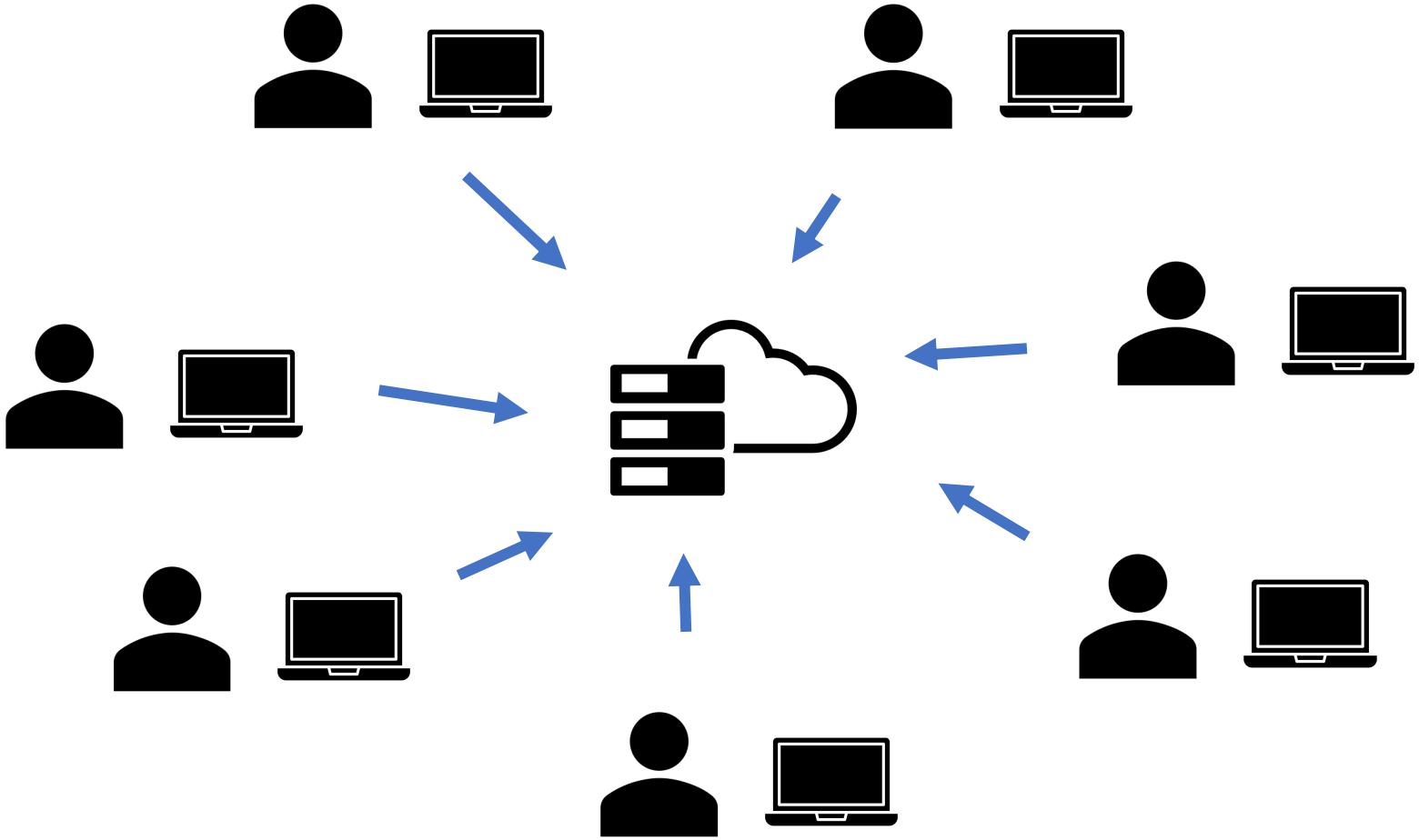
Allen Brain Observatory / DANDI



Moving data is inefficient



Bringing the community to data in the public cloud is more efficient and powerful



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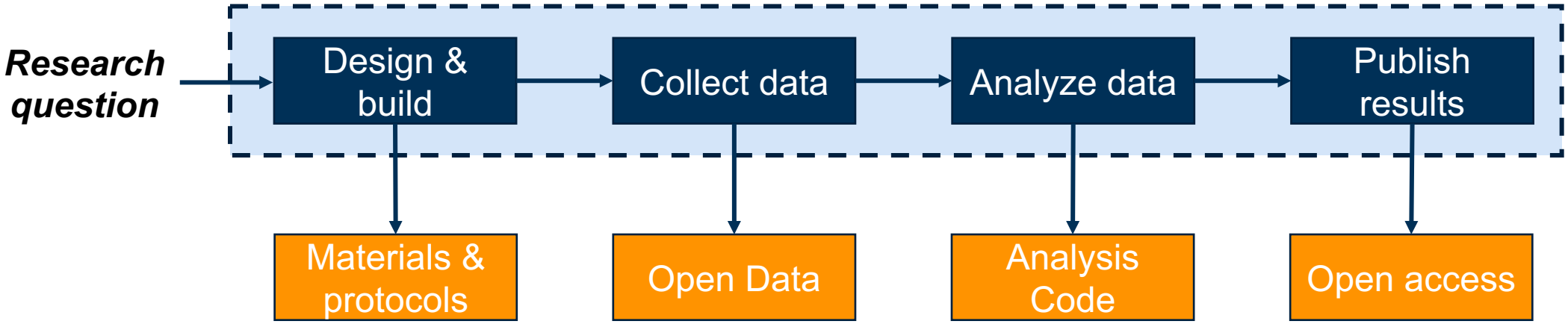

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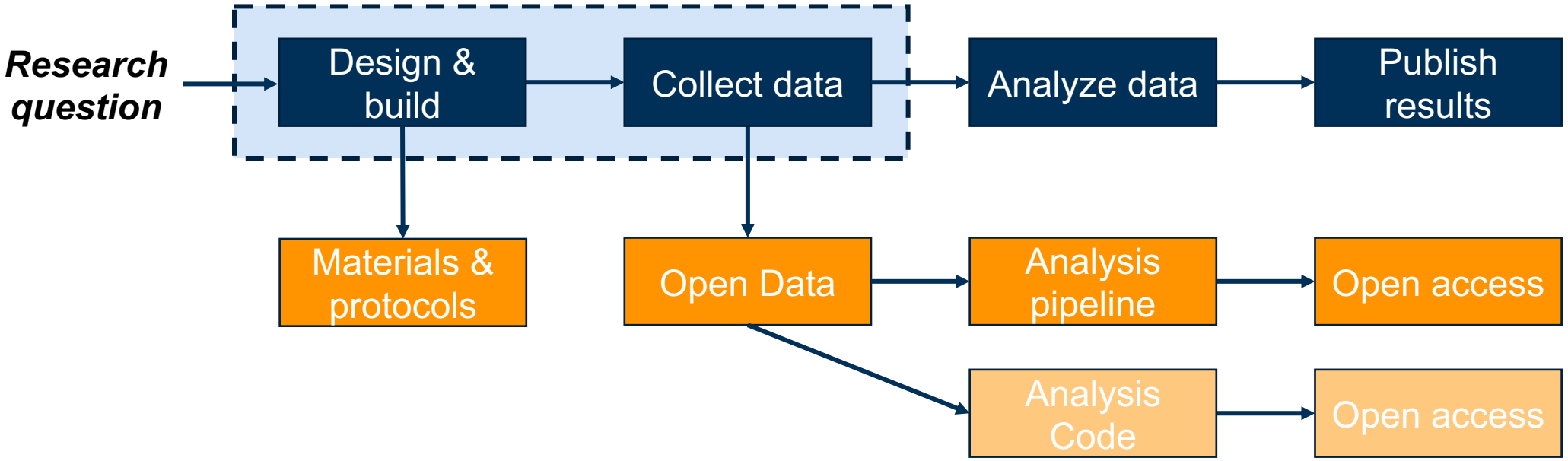

Public cloud data lake architecture

Goals:

- Reproducibility
- Flexibility
- Collaboration
- Dissemination
- Inclusion

Challenges

- Data rate, size (**> 500 TB/w, 2 GB/s**)
- Metadata complexity
- Rate of change (science, tools, standards)
- Cutting edge hardware, software

Approach:

- Minimize on-prem footprint
- Bring scientists to cloud data pipelines
- Accelerate, simplify data ingestion
- All data shareable the day of acquisition
- Use scientist-friendly cloud tools
- If possible buy/use, don't build

Acquisition

SLIMS

- Ephys
- Imaging
- Behavior
- Ophys
- ...more

Manage the labs
electronic lab notebooks
workflow management
separate schemas per lab

Data Transfer

VAST

compress + upload

Data Lake

cloud bucket + CODE OCEAN

- Ecephys_625463_2022-10-06_10-14-25_sorted-Ks2.5 JSON
- Ecephys_625463_2022-09-28_16-34-22_sorted-Ks2.5 JSON
- Ecephys_625464_2022-10-06_11-22-45_sorted-Ks2.5 JSON
- Ecephys_625464_2022-09-29_16-51-32_sorted-Ks2.5 JSON
- Ecephys_625463_2022-09-29_15-26-36_sorted-Ks2.5 JSON
- Ecephys_639379_2022-10-25_15-10-27 JSON
- SmartSPIM_597305_2022-09-27_00-07-58 JSON
- SmartSPIM_623711_2022-10-27_16-48-54 JSON

Self-describing file sets
one per acquisition or analysis
JSON metadata validation
searchable via metadata

Ad-hoc Analysis

CODE OCEAN

Scalable, reproducible
no-code docker, git
elastic, on-demand hardware

Analysis Pipelines

CODE OCEAN + nextflow

Automated, reproducible
results go back into lake
launched on demand

Analysis Views

elasticsearch Amazon DocumentDB

Data Summaries
easy to build (avoid SQL)
updated automatically

On-premises

Cloud

Progress

- **Compression → save $**
- **Upload throughput**
  - Multi-node SLURM jobs
  - 1-2GBps
- **Metadata schema**
  - Inspiration from NWB, DANDI, HCA, BIDS
    - Need more!
  - Database agnostic, versioned

Pain Points

- Poor support for cloud-friendly formats
  - e.g. OME-Zarr, NWB-Zarr
- High-value desktop applications not supported
  - e.g. imagej, napari, phy
- Metadata standardization still very limited
- Cloud archives prefer polished data
- Expectation of free download/compute

Is Open Science Free?

Libre ("free speech") != Gratis ("free beer")

Academia expects both:

1. Download any data locally
2. Run any analysis (maybe on HPC)

Large, hidden, subsidized costs (network, storage, compute, admin)

Cloud pay-as-you-go makes costs very clear

Science must be Libre, but it is never Gratis.

The cloud is a better model, but who pays?

Questions?