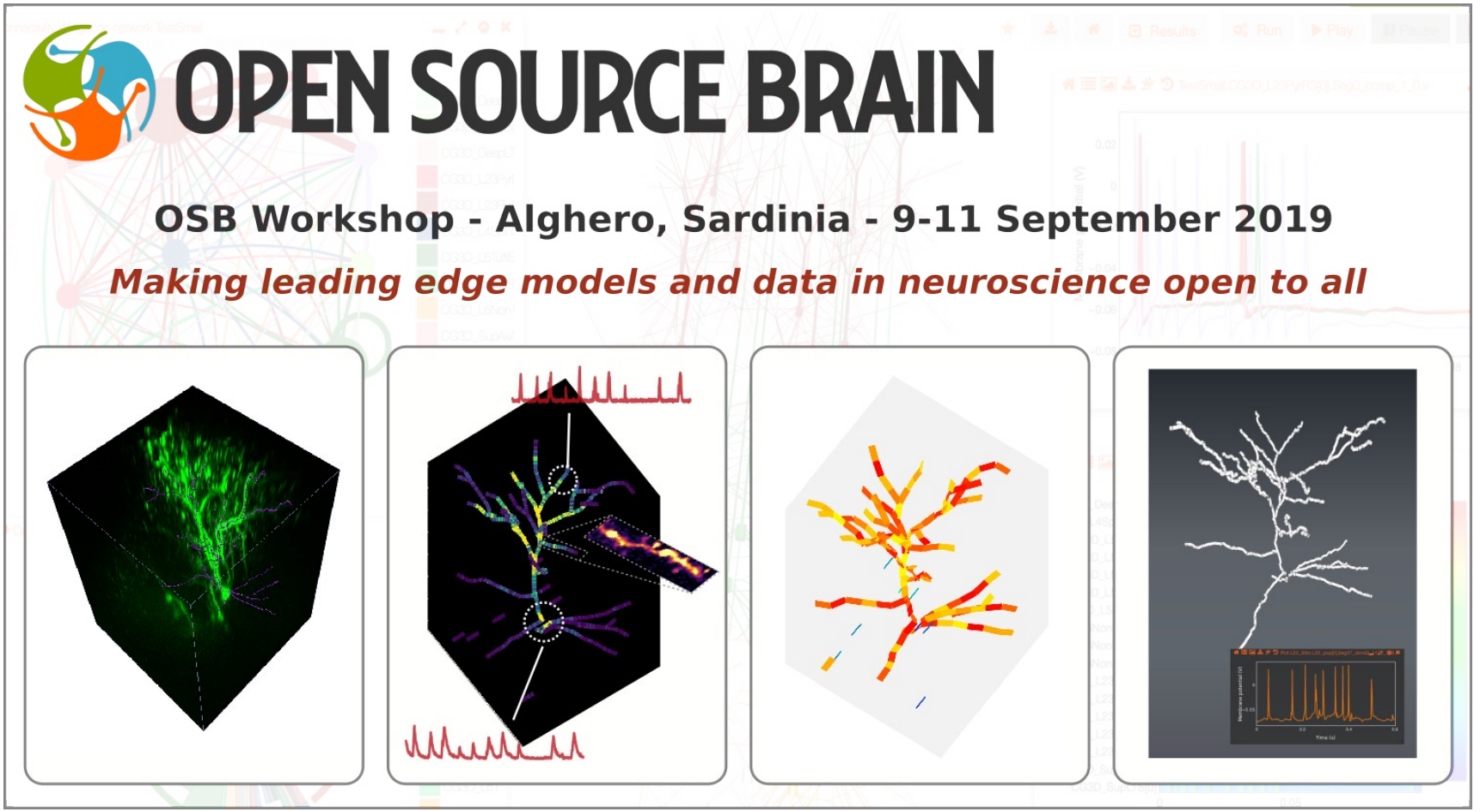
Welcome to the 2019 OSB workshop



OSB Organizers: **Padraig Gleeson**, Matt Earnshaw and Angus Silver
Local Organizer: Sergio Solinas

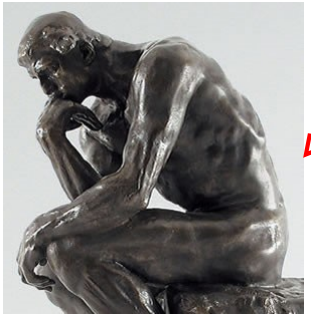
wellcome

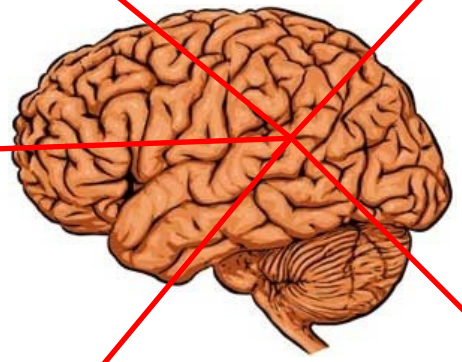
Towards a mechanistic understanding of brain function in health and disease

Sensations

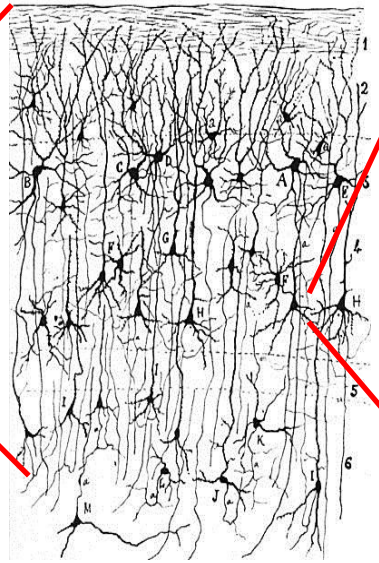
Actions

Cognition

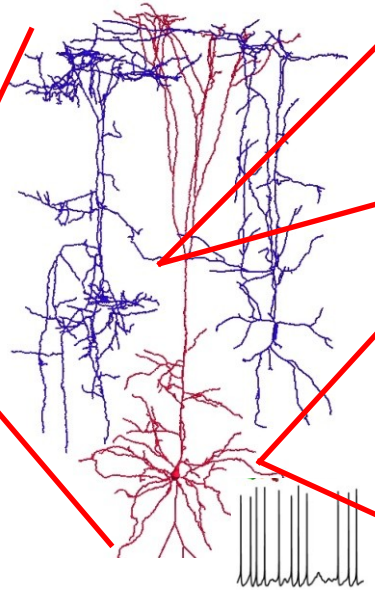




100 billion neurons
100 trillion synapses

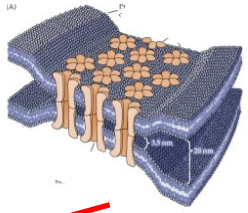


Specialized networks

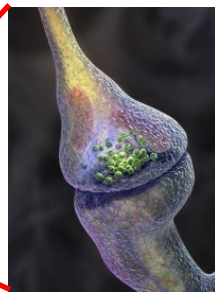


Neuronal classes

Electrical



Chemical



Synaptic types

Why use models in neuroscience?

1) Formalize a hypothesis and test whether it is physically plausible

2) Explore properties that are currently inaccessible to experimental approaches

3) Make predictions that can be tested experimentally

4) Distil the essence of a phenomena and identify general principles

5) Link and consolidate experimental discoveries across multiple scales

Models of brain function span multiple spatial scales

Behaviour

Brain

Network

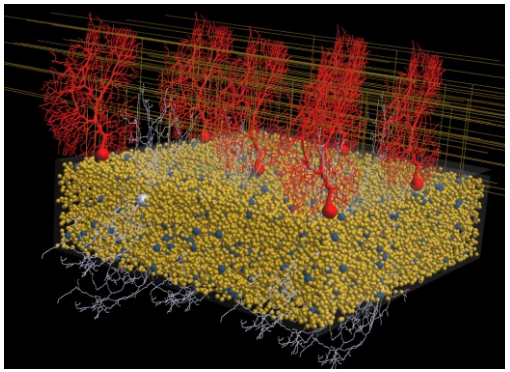
Neuron

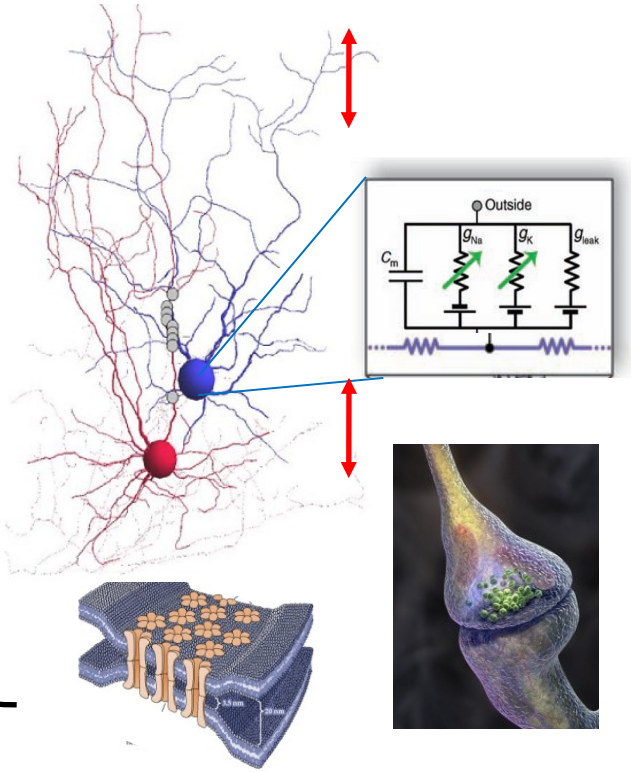
Synapse

Molecular assemblies

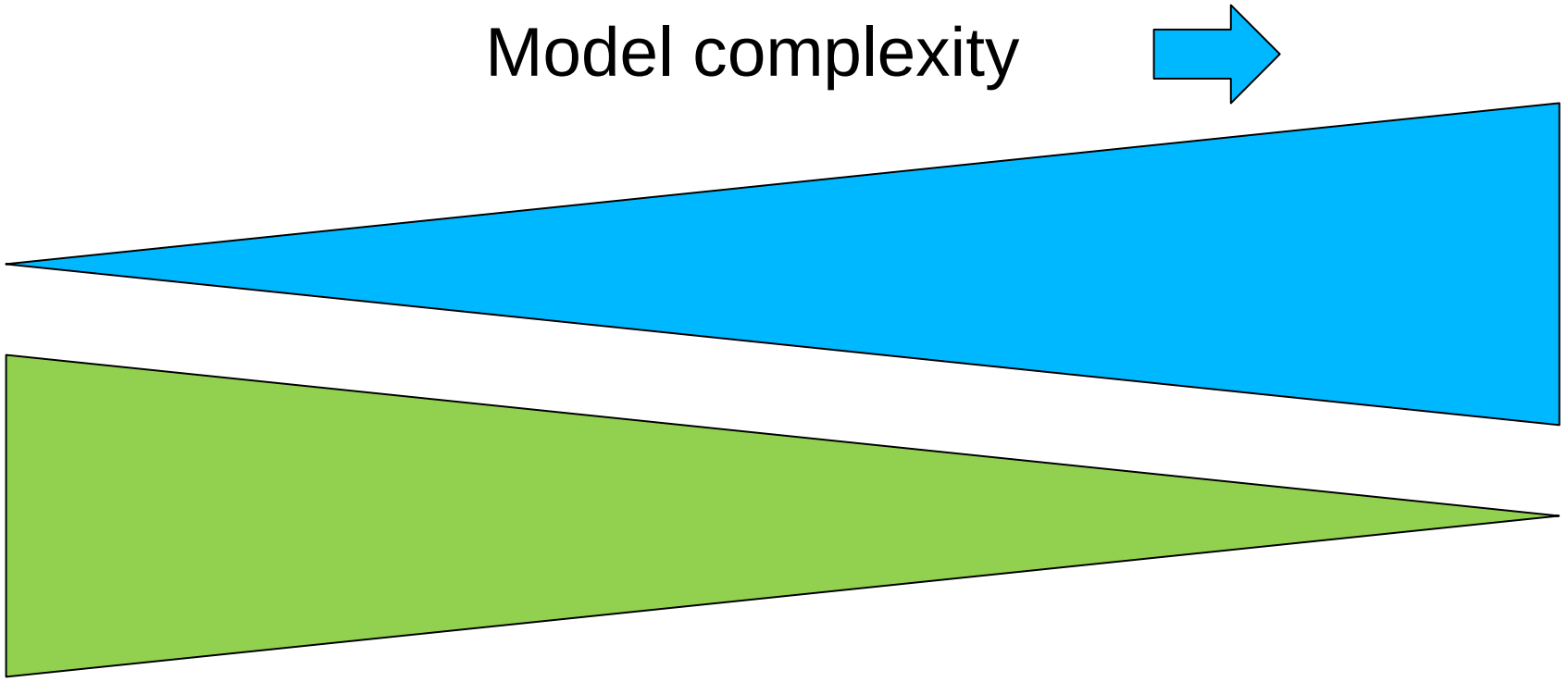
Genes

Biologically detailed multi-scale models of brain function.





A scaling problem



Transparency, accessibility, reproducibility, reuse…..and utility as a scientific tool

Neuroinformatics challenges of modeling complex neural systems

- ***Implementation***: Large size & complex nature of code bases require management and testing to avoid bugs, which can be difficult to identify.

- ***Reproducibility***: In practice it is often difficult to reproduce results reported in papers.

- ***Transparency & Accessibility***: The specialized nature of software and hardware technologies acts as barriers to critical evaluation of model implementation by other scientists.

- ***Reuse***: Models are built to answer specific question and are difficult to modify to address a new scientific question.

Potential neuroinformatics solutions

1. Modular descriptions of model components

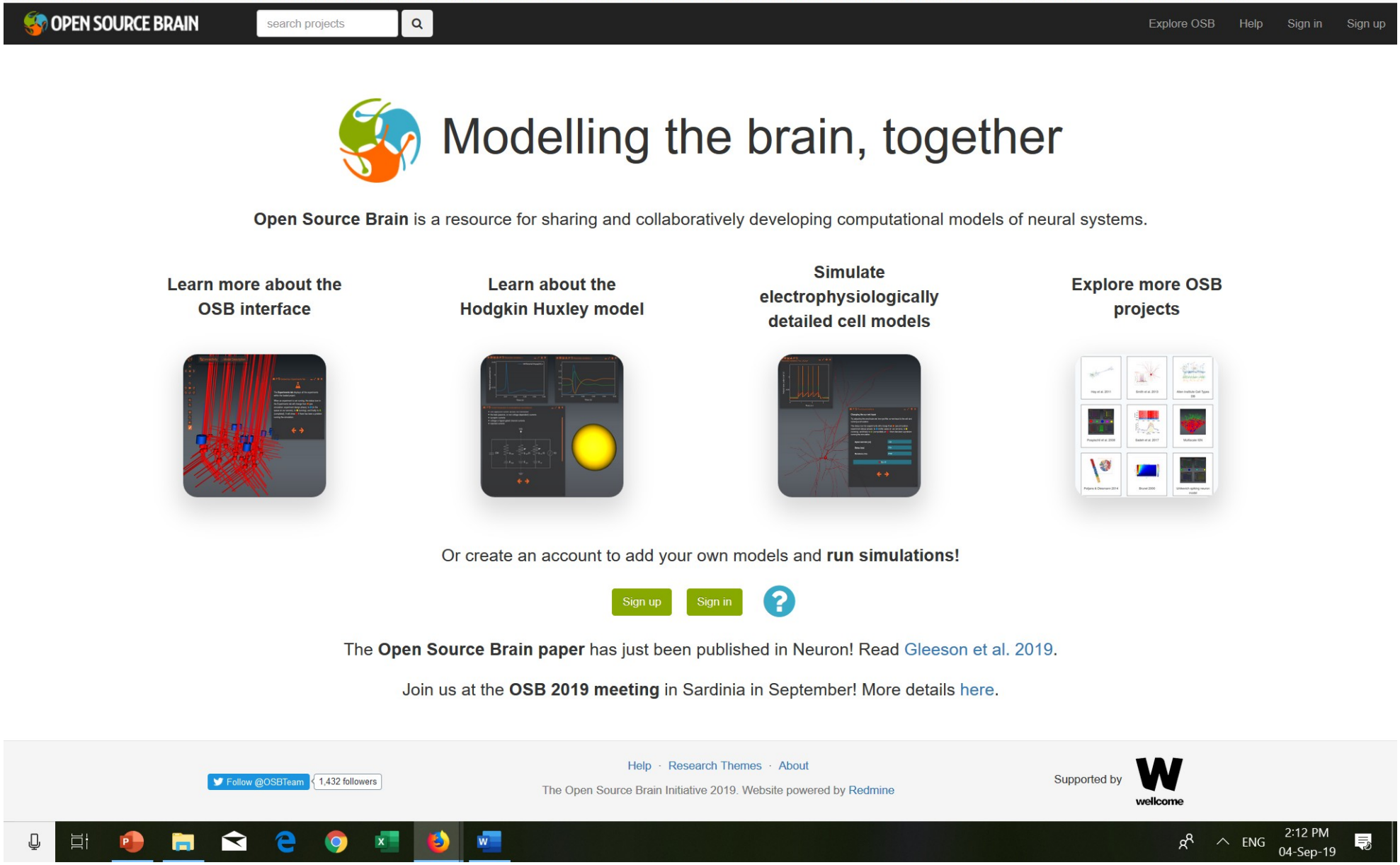
1. Automated testing frameworks

1. Standardized model description languages that contain all necessary information (e.g. NeuroML, pyNN)

1. Automated visualization of model structure and function

1. A framework for deeper collaboration between experimental and computational neuroscience

Open Source Brain: a collaborative resource for visualizing, analyzing, simulating and developing standardized models of neurons and circuits



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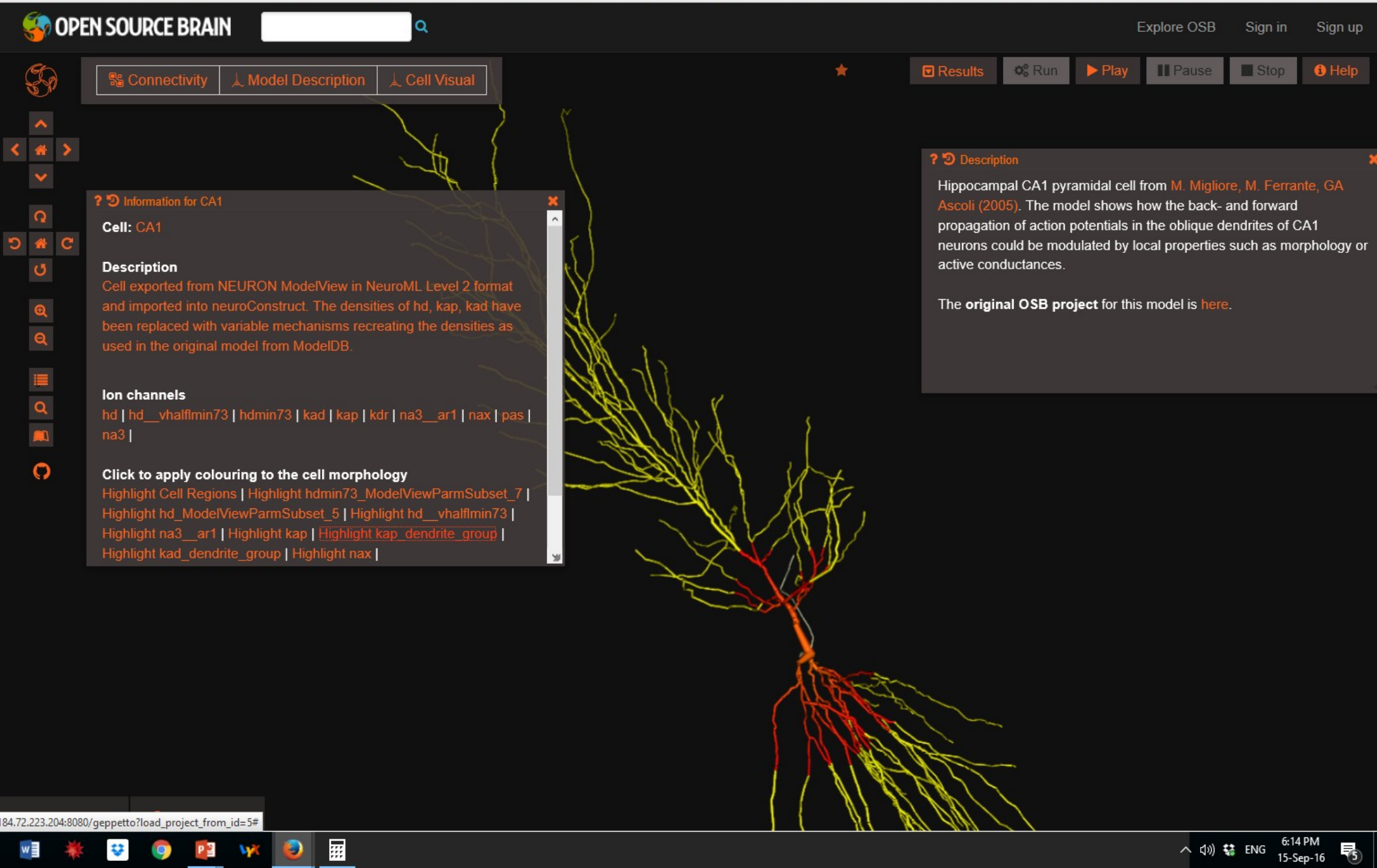

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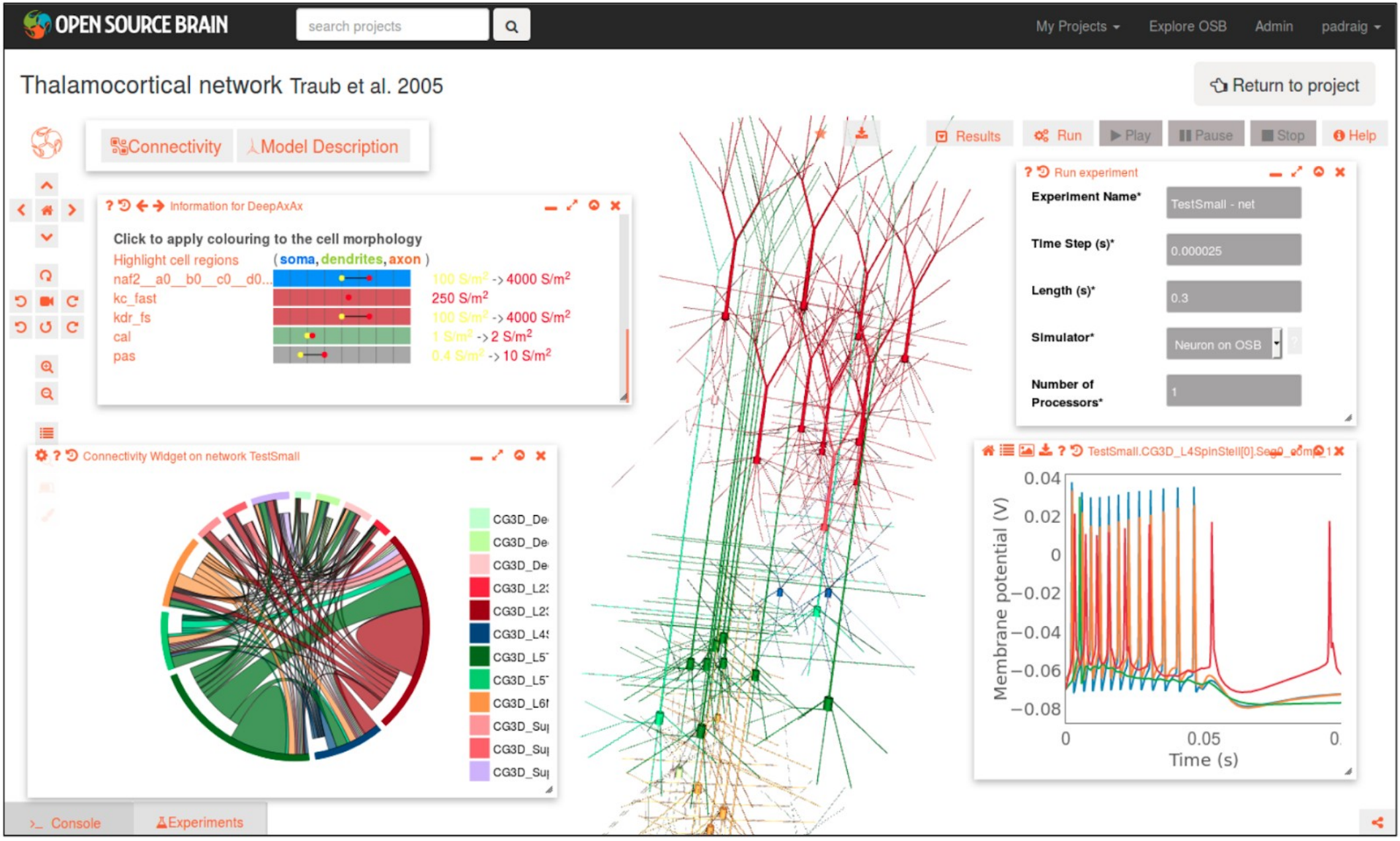
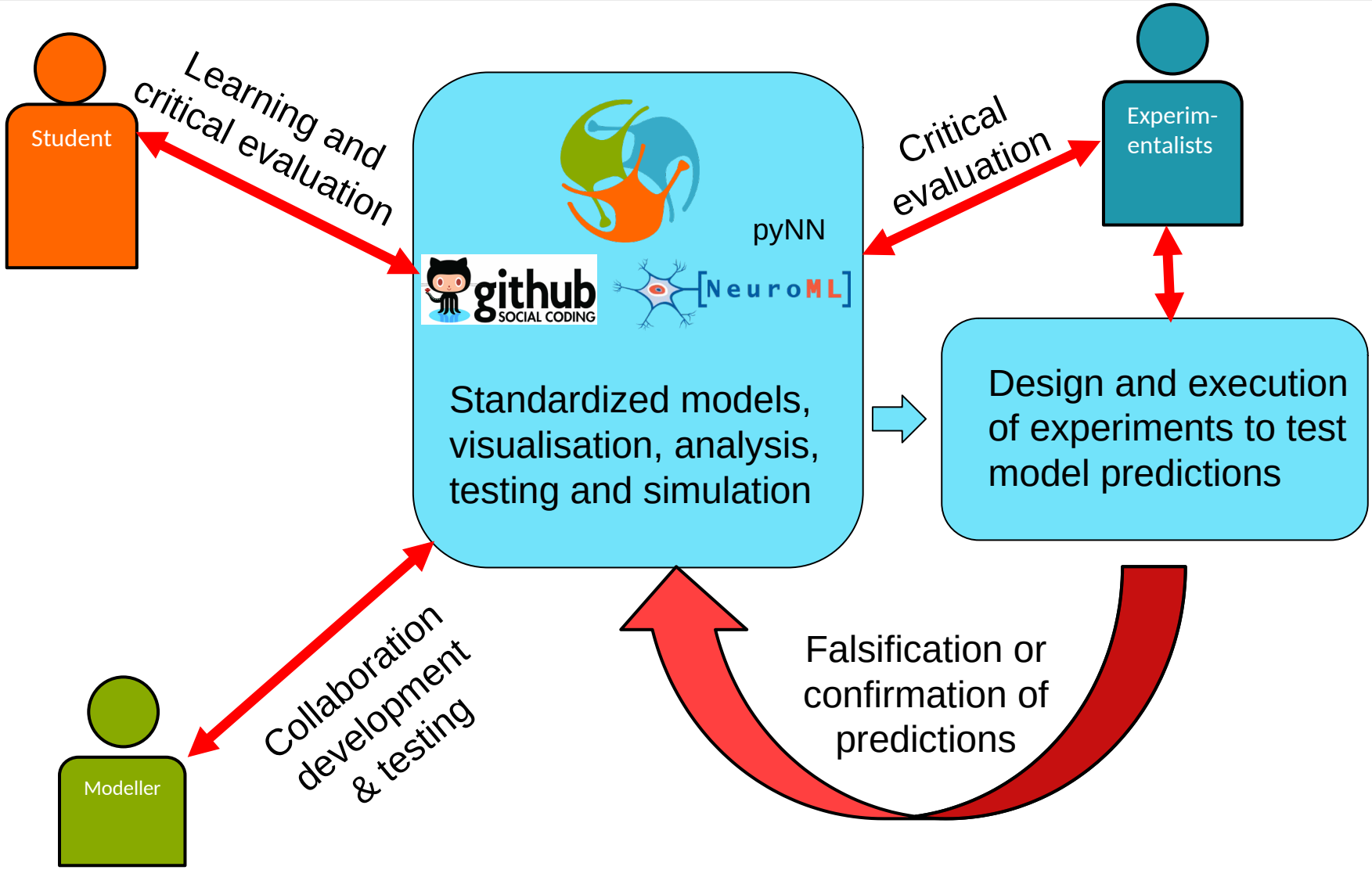
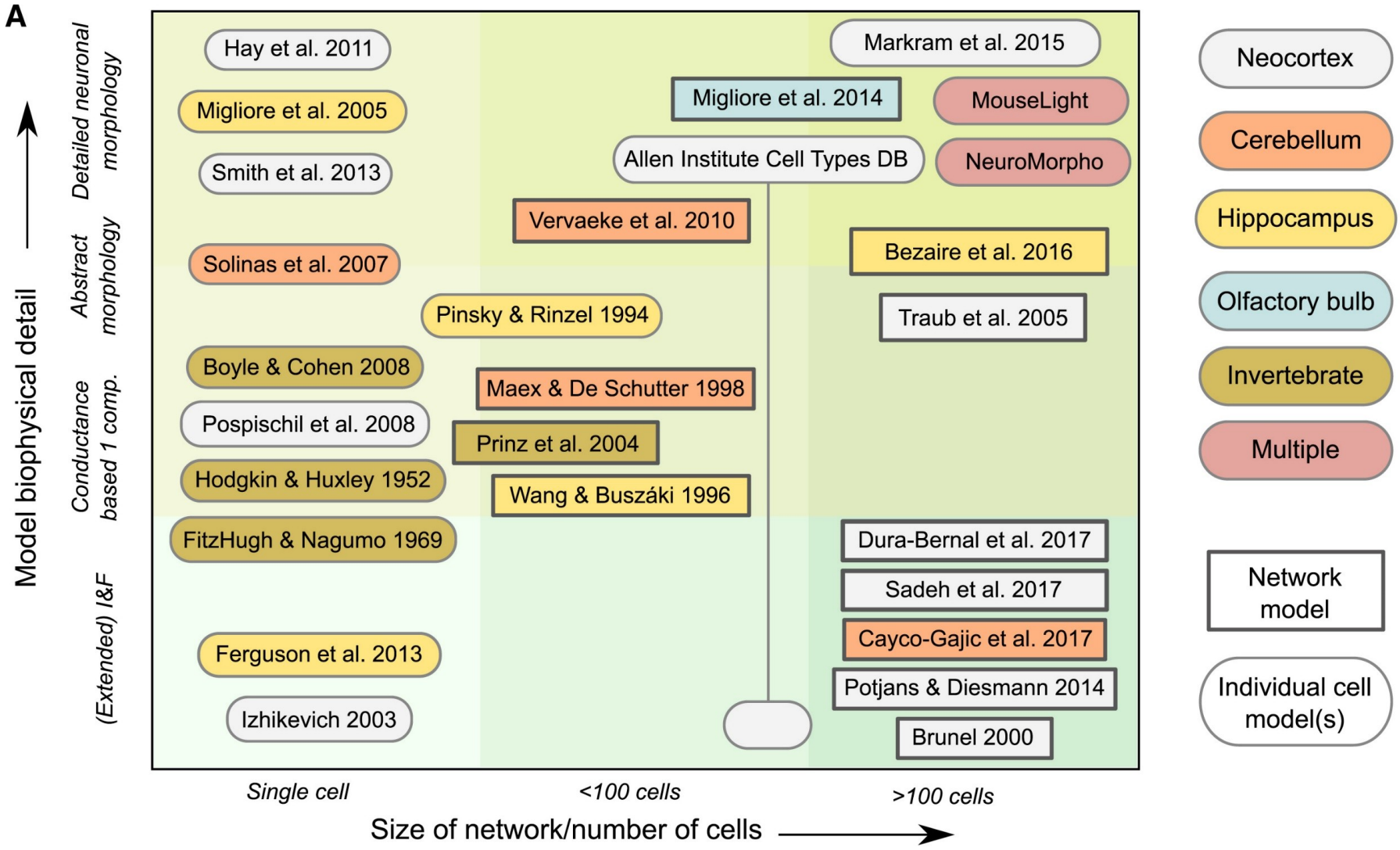


OPEN SOURCE BRAIN NeuroML wellcome trust

Current interactions on OSB and their relation to scientific workflow



OpenSouceBrain.org: where we are now



OpenSouceBrain.org: where we are now

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Neuron
NeuroResource

CellPress

Open Source Brain: A Collaborative Resource for Visualizing, Analyzing, Simulating, and Developing Standardized Models of Neurons and Circuits

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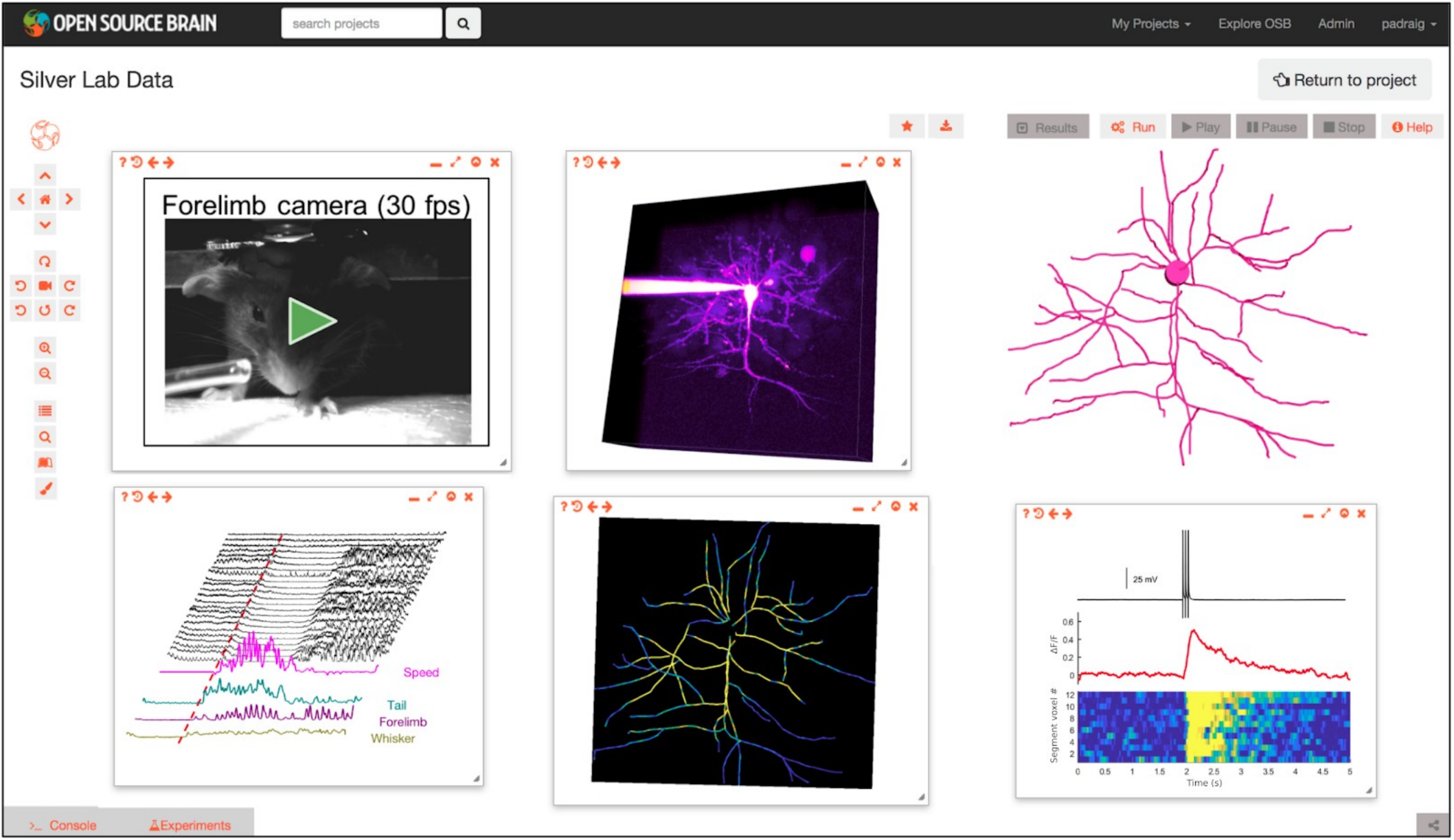
https://doi.org/10.1016/j.neuron.2019.05.019

Future plans: bringing together standardized models and standardized multiscale data on OpenSouceBrain.org



Raw data provides ground truth information for refining and reusing models

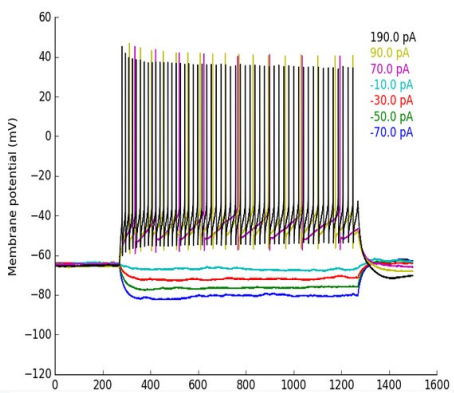
476686112

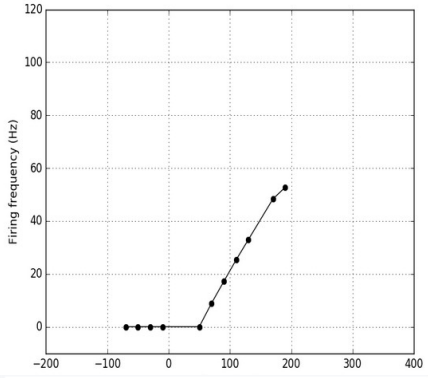
Primary visual area, layer 2/3

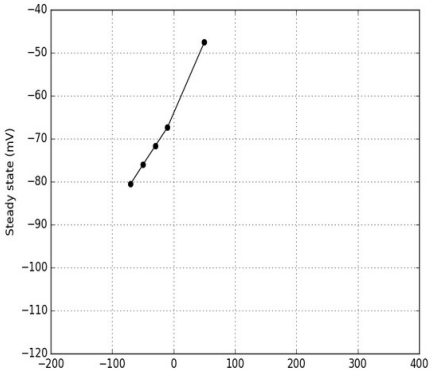
aspiny

Sst-IRES-Cre

Source data

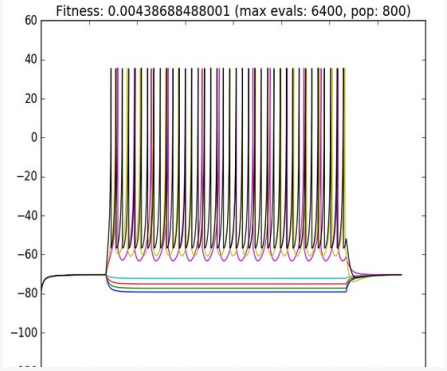


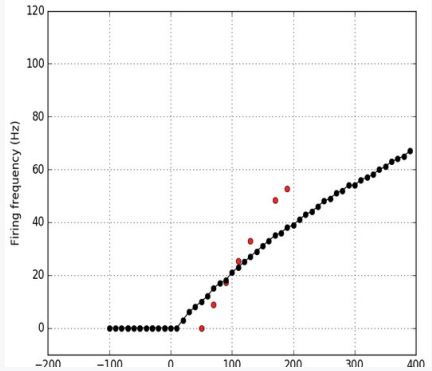


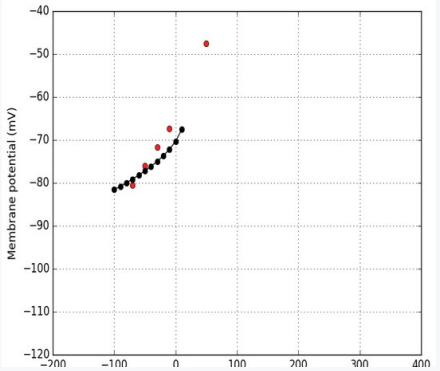


Izhikevich cell model tuned to dataset 476686112

Tuned model

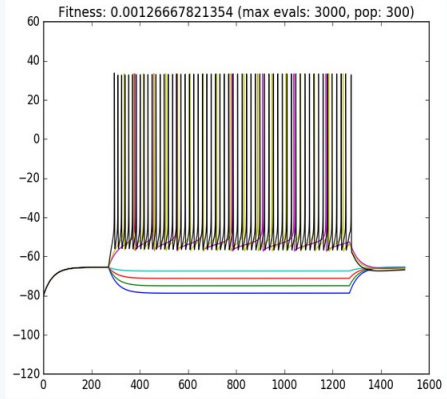


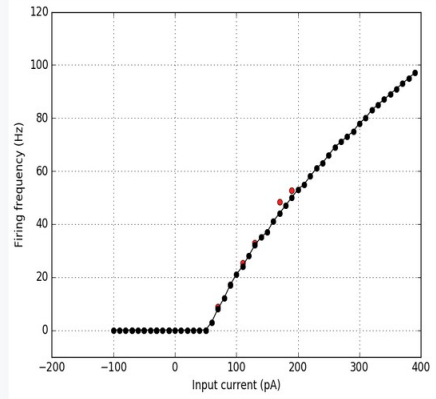


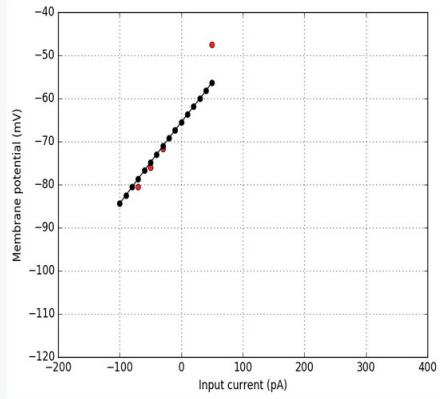


HH2 cell model tuned to dataset 476686112

Tuned model

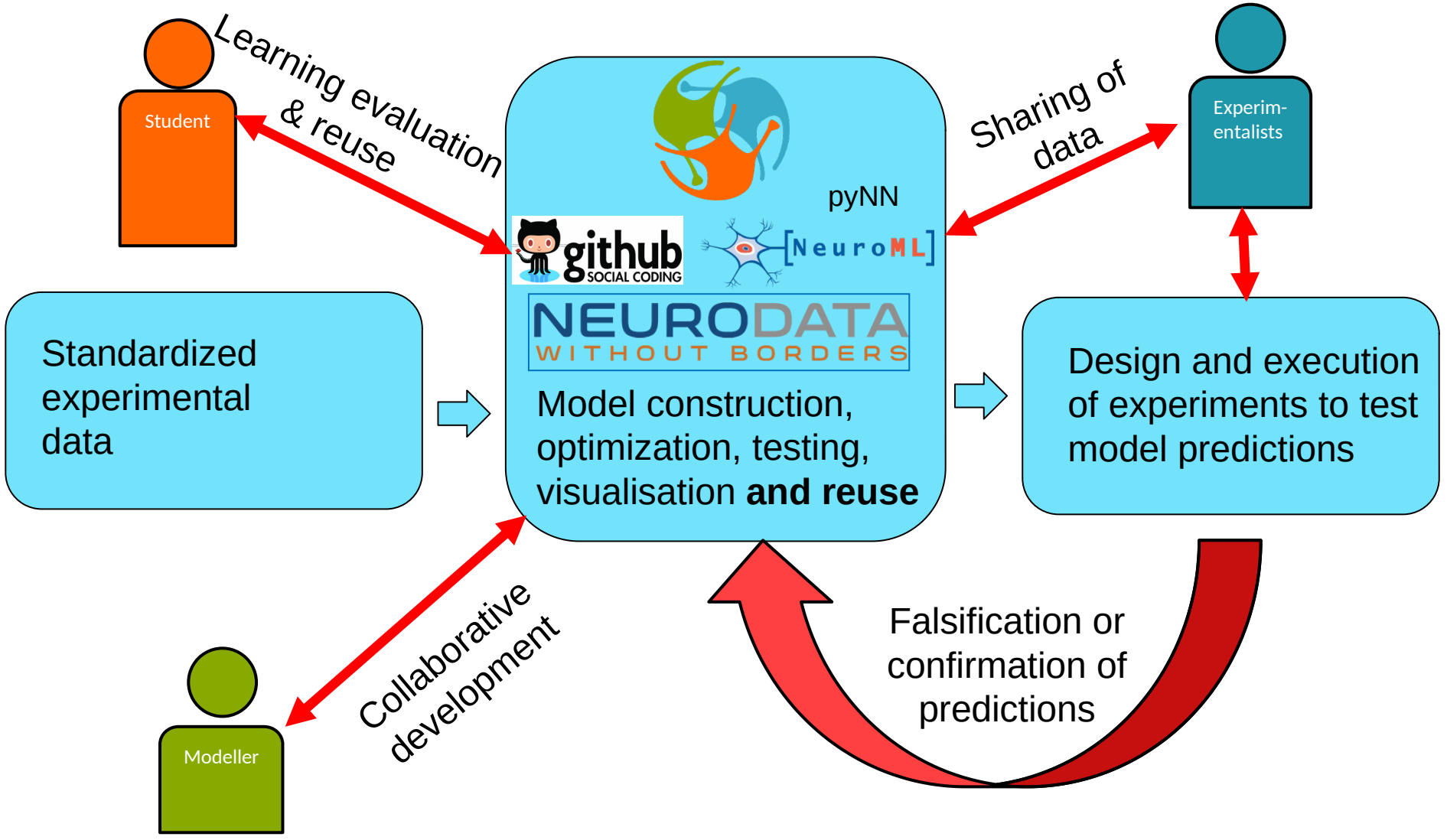






Allen Brain Atlas source data http://celltypes.brain-map.org/mouse/experiment/electrophysiology/476686112

Bringing together standardized data and models on OSB to facilitate reuse



3-day structure of workshop

Day 1: Building and sharing standardised neuronal models

>OSB, HBP, NeuroML, Geppetto, Channelpedia, and models

Day 2: Standardising and sharing experimental neuroscience data

>Imaging, electrophysiology and connectomes data, NeuroSEE, NWB:N and NWB Explorer .

Day 3: Investigating brain function across multiple scales

>Multiscale modelling, analysis of multiscale data and the Allen Brain Initiative,

Discussion sessions

Day 1: How do we make models more accessible and useful to scientists?

> Are the current features of OSB, sufficient for you to switch to using it in your model development and dissemination?
> How can OSB better interact with other initiatives in the field, e.g. HBP/Allen?
> How can we facilitate model conversion to populate OSB more models?
> How can we lower the barrier for building new models and reusing existing components for new scientific questions?
> What are the current limitations of NeuroML and PyNN?

Day 2: How can we make data sharing accessible and useful?

> What are the key challenges in standardizing data so that it can be parsed/reused?
> Are the proposed solutions to data standardization up to handling the size and heterogeneity of neuroscience data (e.g. behavioural analysis, high speed Ca2+ imaging, multi-channel electrophysiology, connectomics, genomics etc.)?
> What are the key challenges in making data available?
> What should be shared? Raw data, analysis, data points in figures?
> Is sharing data worth the (considerable) effort - who will actually use it?

Day 3: How can we create better multiscale models of circuits?

> Are multiscale models of the brain worth the effort?
> What are the benefits of bringing multiscale models and the experimental data used to build and test them together?
> What are the key challenges in linking model structure, optimization and testing to experimental data?
> Do Python notebooks provide the right balance in the trade-off between accessibility and flexibility in model building/ data analysis for OSB infrastructure?

Contribute discussion points on Google Doc

Informal discussion sessions

Pool

Beach

Workshop dinner

Day 1: Building and sharing standardised neuronal models

Morning session

9:00 **Angus Silver** Welcome and Introduction to goals of meeting
9:10 **Padraig Gleeson** Open Source Brain and NeuroML
9:50 **Yann Zerlaut** An overview of the tools for modelling and simulation developed within the Human Brain Project

10:30 - 11:00 Coffee break

11:00 **Sharon Crook** NeuroML-DB: A model sharing platform to promote efficient model selection and reuse
11:30 **Rajnish Ranjan** A kinetic map of the homomeric voltage-gated potassium channel (Kv) family
12:00 **Boris Marin** Converting models to NeuroML

12:30 - 13:30 Lunch

Afternoon session

13:30 **Matteo Cantarelli** Geppetto: an open source platform to build neuroscience applications
14:15 **Ankur Sinha** NeuroFedora: Free software for Open Science
14:45 **Lightning talks** Bence András Lázár, Bettina Kata Kádár, Csaba Kazinczi (University of Szeged)

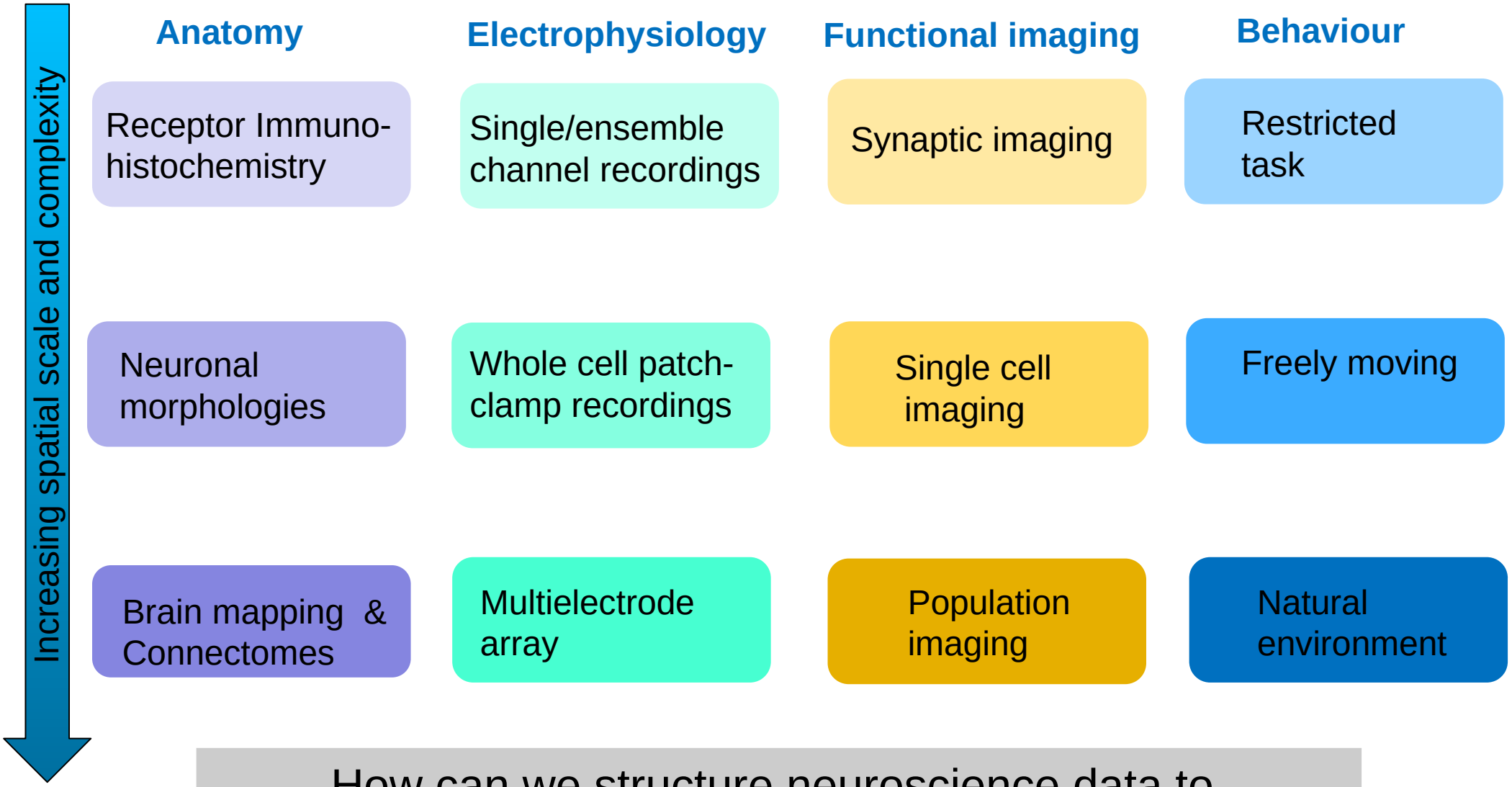
15:00 - 15:30 Coffee break

15:30 - 17:00 **Discussion session:** *How do we make models more accessible and useful to scientists?*

Day 2 – OSB 2019

Standardising and sharing experimental neuroscience data

Experimental neuroscience data is heterogeneous, multiscale and analysis is complex



How can we structure neuroscience data to facilitate reuse?

Day 2: Standardising and sharing experimental neuroscience data

Morning session

9:00 **Angus Silver** Introduction to session
9:05 **Diego Restrepo** Shedding light on the involvement of the cerebellum in associative learning
9:50 **Simon Schultz** NeuroSEE: a pipeline for processing and analysing data from multiphoton fluorescence brain imaging experiments

10:35 - 11:00 Coffee break

11:00 **Jeff Diamond** The Blind Men and the Retina: Community Connectomics Prior to Automated Segmentation
11:45 **Oliver Rübel** NWB:N 2.0: An Ecosystem for Neurophysiology Data Standardization

12:30 - 13:30 Lunch

Afternoon session

13:30 **Matteo Cantarelli & Filippo Ledda** NWB Explorer: visualize and understand neurophysiology data
13:50 **Ian Duguid** Towards a systems level understanding of volitional motor control: approaches and challenges in data acquisition, management & sharing
14:35 **Alex Cayco-Gajic** Population imaging and dimensionality analysis of cerebellar axons

15:05 - 15:30 Coffee break

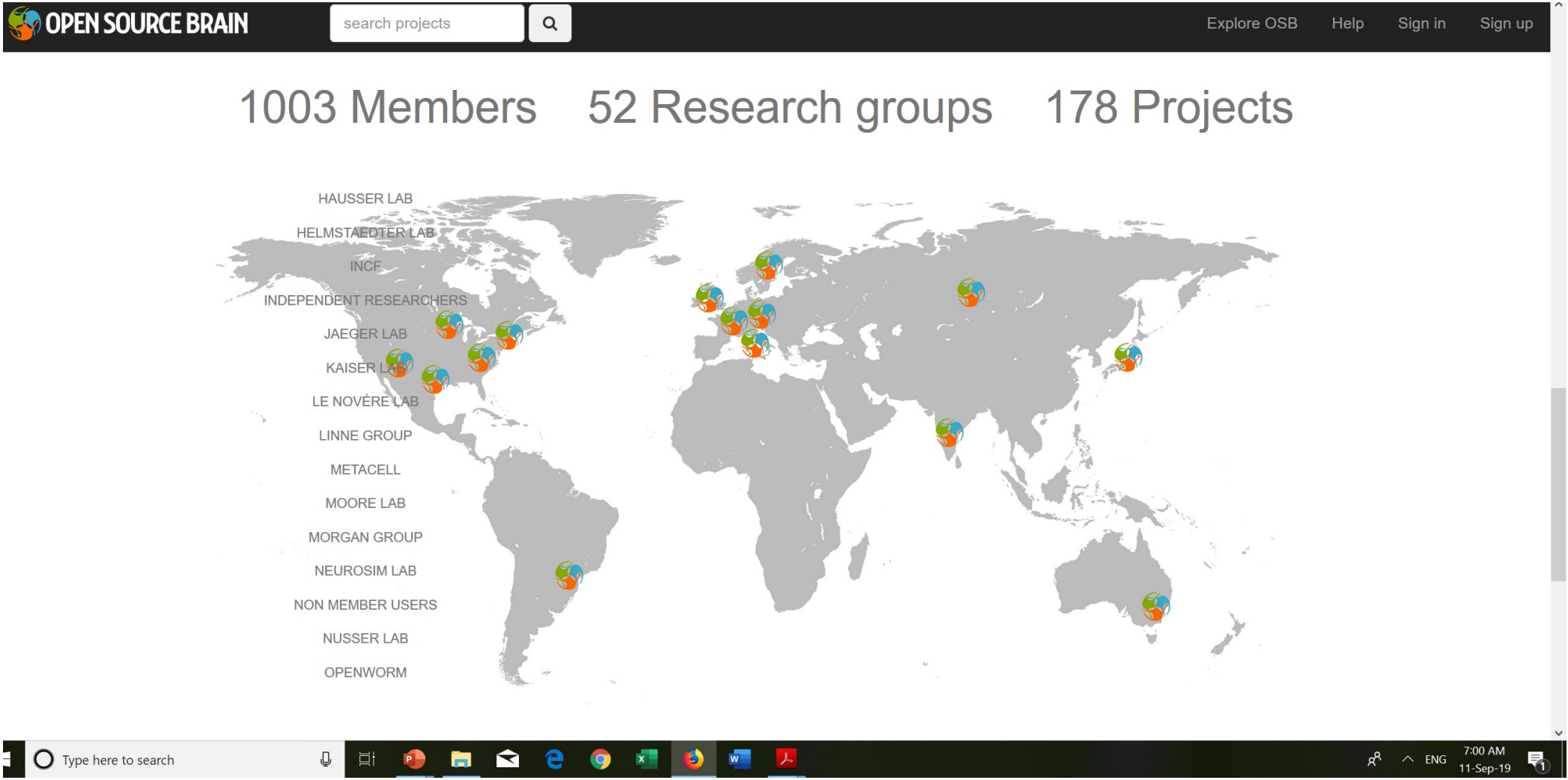
15:30 - 17:00 **Discussion session:** *How can we make data sharing accessible and useful?*

18:00 **Bus to conference dinner** Pedramare restaurant

Day 3 – OSB 2019

Investigating brain function across multiple scales

OSB


OPEN SOURCE BRAIN
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Help
Sign in
Sign up
1003 Members
52 Research groups
178 Projects
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HELMSTAEDTER LAB
INCF
INDEPENDENT RESEARCHERS
JAEGER LAB
KAISER LAB
LE NOVÈRE LAB
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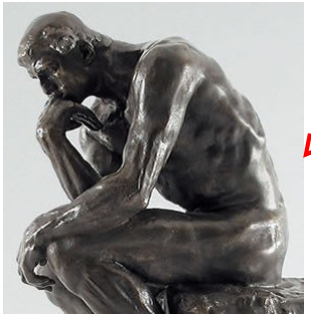
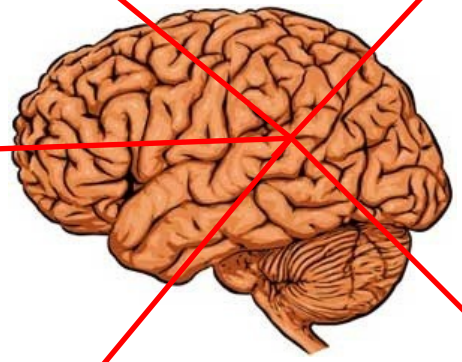
Towards a mechanistic understanding of brain function in health and disease

Sensations

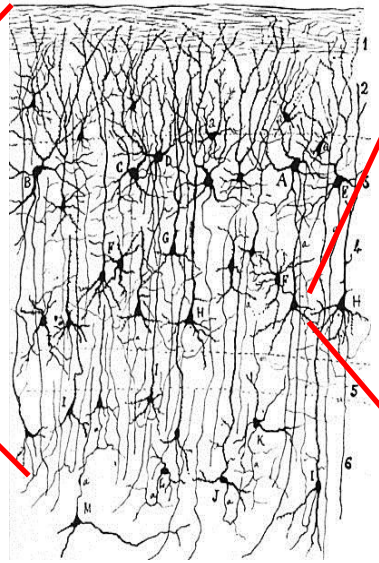
Actions

Cognition

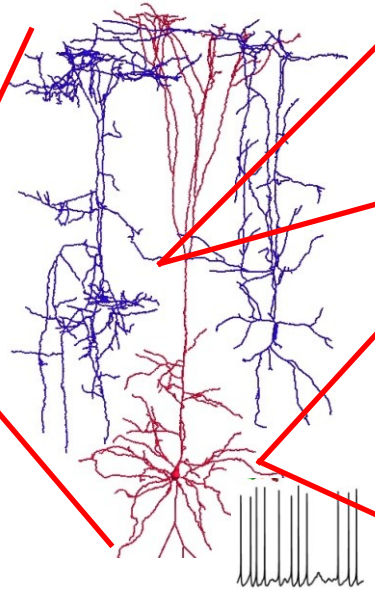




100 billion neurons
100 trillion synapses

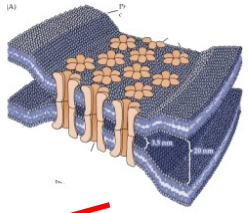


Specialized networks

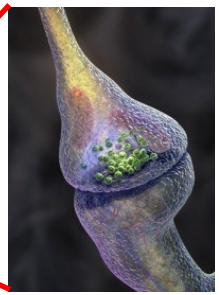


Neuronal classes

Electrical



Chemical



Synaptic types

Models of brain function span multiple spatial scales

Behaviour

Brain

Network

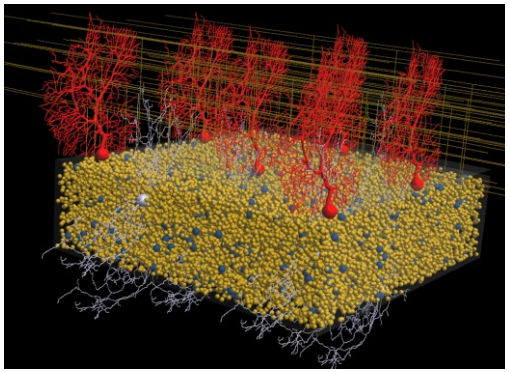
Neuron

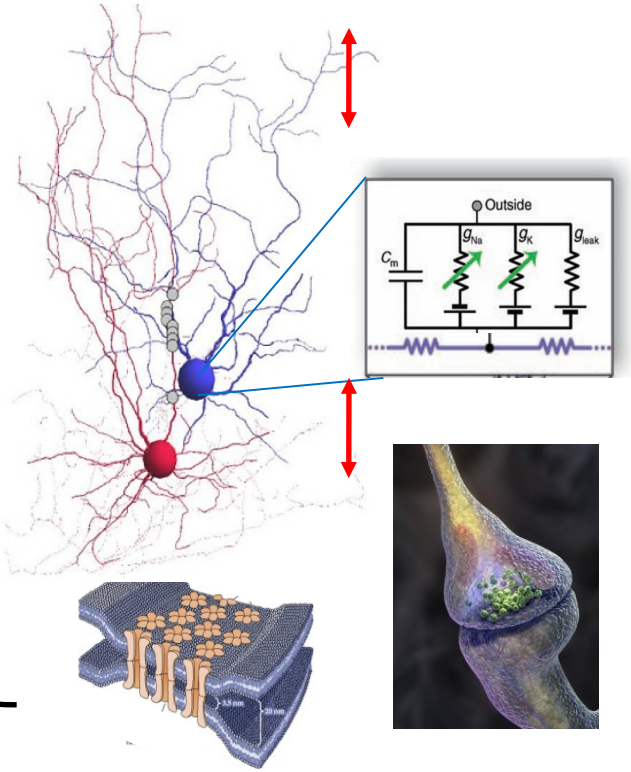
Synapse

Molecular assemblies

Genes

Biologically detailed multi-scale models of brain function.





Day 3: Investigating brain function across multiple scales

Afternoon session

9:00 **Jan Fousek** The Virtual Brain
9:45 **Sacha van Albada** Large-scale spiking neural network modeling of primate cerebral cortex

10:30 - 11:00 Coffee break

11:00 **Yazan Billeh** Large-scale Datasets and Modeling Tools from the Allen Institute for Brain Science
11:45 **Fleur Zeldenrust** Understanding information transfer in the brain: from single cell to network
12:15 **Sergio Solinas** The NeuroAgents ERC project

12:30 - 13:30 Lunch

Afternoon session

13:30 **Oren Amsalem** Cellular mechanisms of auditory surprise in faithful computer replica of cortical microcircuit
14:00 **Harsha Gurnani** Impact of heterogeneity on the dynamics of a NeuroML-based circuit model

14:30 - 15:00 Coffee break

15:00 **Padraig Gleeson** Creating cortical models across scales in NeuroML

15:30 - 17:00 **Discussion session:** How can we create better multiscale models of circuits?

17:30: End of meeting