



NeuroFedora

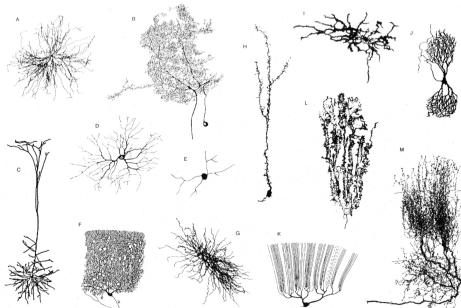
FOSS and Free/Open (neuro) Science

NeuroFedora contributors

1/29

Problem statement: the brain

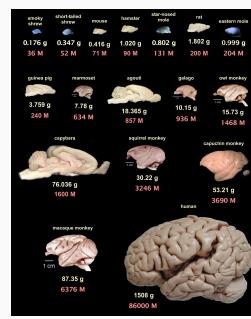
The brain: neurons



Dendrites, Oxford University Press, 2015; Modified from Mel, B.W. Neural Computation, 1994.

2/29

The brain: in numbers: neurons

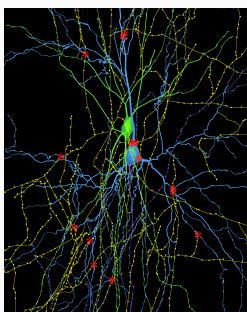


- 86B neurons¹.

¹Suzana Herculano-Houzel. "The human brain in numbers: a linearly scaled-up primate brain". In: *Frontiers in human neuroscience* 3 (2009), p. 31. doi: 10.3389/neuro.09.031.2009

3/29

The brain: in numbers: synapses



- Thousands of connections between neurons (**synapses**)².
- Synapses are also of different types, and serve different functions.
- Synapses underlie learning³.

²Image from The Gao lab, College of Medicine, Drexel University.

³D. O. Hebb. *The organization of behavior: A neuropsychological theory*. 1949

4/29

So, we want to know (among other things)

- how the brain functions (**physiology**),
- how it is structured (**anatomy**),
- about its chemicals (**pharmacology, biochemistry**),
- ...
- how it processes information (**computational**),
- about behaviours, and cognition (**behavioural, cognitive**),
- ...

5/29

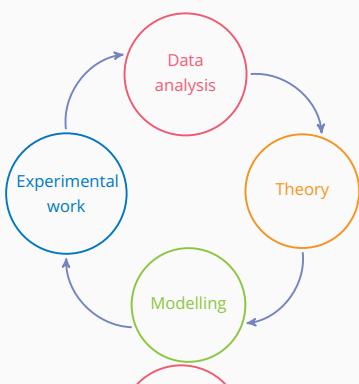
with the aim of applying this knowledge to

- disease prevention and treatment,
- ...
- brain inspired computing,
- ...
- philosophy and consciousness,

6/29

How: research pipeline

General workflow



7/29

Tools of the trade

Experimental:

- EEG, ECoG, intracellular and extracellular single and multi neuron recording,
- CT, DOI, MRI, f-MRI, MEG, PET,

Data analysis:

- Statistics,
- Machine Learning, Big Data, Deep learning,

Theory and modelling:

- Simulators of all kinds,

8/29

Tools of the trade: II

Tools for the dissemination of knowledge⁴:

- visualisation,
- academic writing,
- non academic writing: blogging ... ,
- podcasting,
- video making,
- creating teaching materials,

Collaborative tools and utilities.

⁴also to a non-specialist audience.

9/29

Free/Open (neuro) Science?

A familiar ideal

Free/Open science:

Everyone should have the freedom to **share, study, and modify** scientific material.

FOSS:

Everyone should have the freedom to **share, study, and modify** software⁵.

Free/Open Science implicitly includes, and relies heavily on FOSS.

⁵Free software foundation

10/29

Now,

FOSS is becoming the standard in research⁶.



⁶Open source for neuroscience

11/29

What can we, Fedora, do to help?

Neuroscience community: highly multidisciplinary

- **various specialities:** biologists, mathematicians, physicists, chemists, psychologists, ... ,
- **small proportion of trained software developers,**

12/29

(Anecdotal) notes on development of research software

- often **single developer**, or small development teams,
- limited **access to hardware/resources**,
- limited **code quality**,
- limited **use of established best practices**,
- limited **testing for correctness** (!),
- limited **maintenance**, short-lived projects,
- **complex dependency chains**,
- lack of **documentation and support**,
- lack of **community development know-how**,

13/29

(Anecdotal) notes on users of research software

- **waste time and effort** installing (and reinstalling) their software stacks,
- are **unaware of helpful development tools**,
- rarely run **test suites** (!),
- rarely report **bugs upstream**,
- rarely send **improvements upstream**,

14/29

We, at Fedora, are in a unique position

- we **liaison between upstream and users** already,
- we **follow best practices** in software development,
- we have the **infrastructure**,
- we constantly **work to grow the community**,
- we **learn from one another**—train as we work,
- we **disseminate** information to end-users,

15/29

So, we started NeuroFedora

Primary goal:

- Provide a **ready to use, integrated FOSS platform** for neuroscientists⁷.

Secondary/collateral goals:

- help **improve the standard and maintenance** of tools,
- help users **develop software development skills**,
- **make neuroscience accessible** to non-specialists,
- **make Fedora the go-to distribution for neuroscience**.

⁷ Researchers, academics, hobbyists, anyone!

16/29

In essence,

NeuroFedora is:

- merely leveraging pre-existing community resources to a new domain of software.
- taking the community model of FOSS to neuroscience research,

17/29

NeuroFedora: current metrics

- **less than a year old**⁸,
- **15 active contributors**:
 - 10 package maintainers,
 - 5 designers, newcomers,
 - only 5 from a neuroscience background,
- **software**:
 - 105 packages ready to install⁹.
 - ~160 in queue¹⁰.
- **poster presented at annual Computational Neuroscience Conference (CNS), 2019**¹¹.

⁸in its second iteration

⁹src.fedoraproject.org: Neuro-SIG

¹⁰agure.io: Neuro-SIG: issues

¹¹NeuroFedora blog: poster at CNS*2019

18/29

NeuroFedora: future plans

- make more software available,
 - via modularity,
 - via containers,
- improve documentation, and support,
- increase community,
 - convert research user base into FOSS contributors,
 - convert FOSS contributor base into users,

19/29

NeuroFedora: what you can do

Anything! It's just more of Fedora!

- packaging,
- testing
- containers,
- documentation,
- evangelism,
- marketing,
- design,
-,



20/29

So!

There's so much more to talk about

Mailing list: neuro-sig@lists.fedoraproject.org

IRC: #fedora-neuro

Telegram: t.me/NeuroFedora

Docs: neuro.fedoraproject.org

Blog: neurofedora.github.io

Pagure: [neuro-sig/NeuroFedora](https://pagure.io/neuro-sig/NeuroFedora)

21/29

Fedora ❤ Science

There's more science in Fedora! Come to the HACKATHON!

- [Astronomy SIG](#)
- [Bigdata SIG](#)
- [Machine Learning](#)
- [Electronic Lab](#)
- [Medical](#)
- [Sci-tech](#)

Is your interest not listed? Start your own!

22/29

Myths

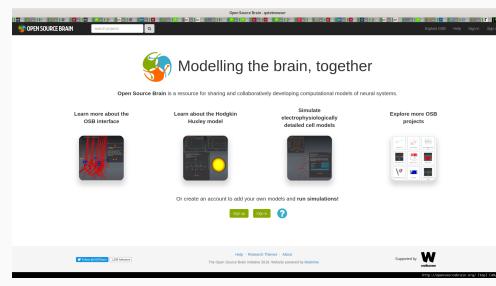
Myth 1

(Neuro) science is all about working on "core research".

Wrong! There is more to (neuro) science!

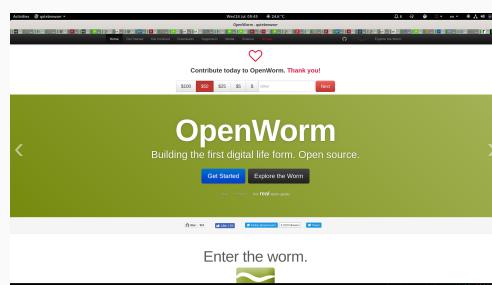
23/29

Myth buster example: Open Source Brain



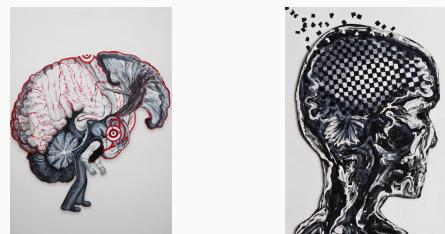
24/29

Myth buster example: OpenWorm



25/29

Myth buster example: Science art



1: Snail: related to Dementia

2: Pieces of the Mind (2014)

¹rebeccalvatts.com, © Rebecca Ivvatts 2019

26/29

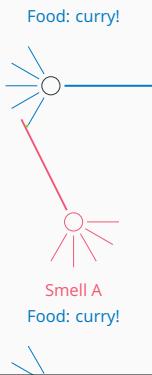
Myth 2

Only researchers can do (neuro) science. It's too hard.

Wrong! Everyone can do (neuro) science!

27/29

Myth buster example: understanding learning



28/29

Myth buster example: an example simulation in NEST

```
# sudo dnf install python3-nest
import pylab
import nest
import nest.voltage_trace

weight = 20.0
delay = 1.0
stim = 1000.0

# create two neurons and a voltmeter
neuron1 = nest.Create("iaf_psc_alpha")
neuron2 = nest.Create("iaf_psc_alpha")
voltmeter = nest.Create("voltmeter")

# give the first neuron a stimulus, connect it to the second one, watch the second spike
nest.SetStatus(neuron1, {"I_e": stim})
nest.Connect(neuron1, neuron2, syn_spec={"weight": weight, "delay": delay})
nest.Connect(voltmeter, neuron2)

nest.Simulate(100.0)

nest.voltage_trace.from_device(voltmeter)
nest.voltage_trace.show()
```

¹nest-simulator.org

29/29