



NeuroFedora

FOSS and Free/Open (neuro) Science

NeuroFedora contributors

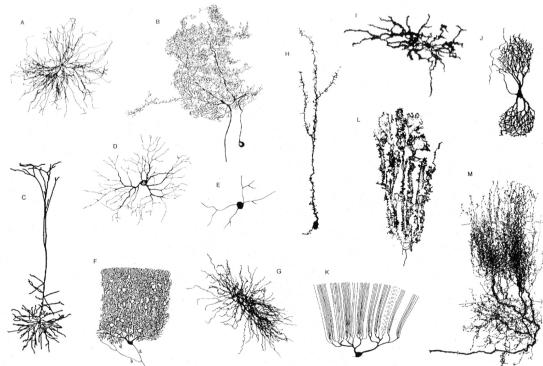
1/29

Notes

Problem statement: the brain

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The brain: neurons

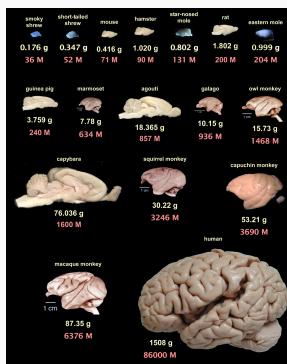


Dendrites, Oxford University Press, 2015; Modified from Mel, B.W. Neural Computation, 1994.

2/29

Notes

The brain: in numbers: neurons



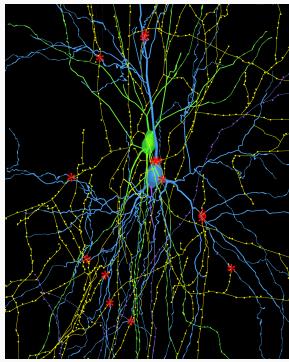
- 86B neurons¹.

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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

Notes

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

Notes

with the aim of applying this knowledge to

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

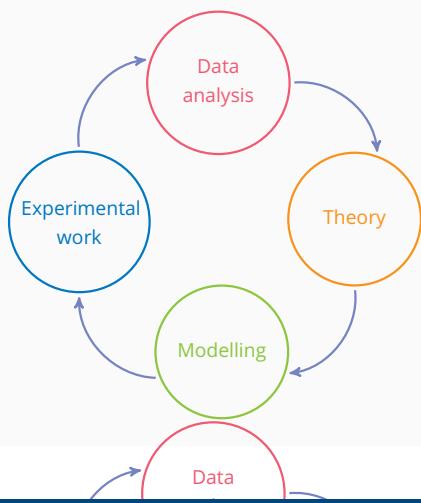
6/29

Notes

How: research pipeline

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General workflow



7/29

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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

Notes

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

Notes

Free/Open (neuro) Science?

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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

Notes

Now,

FOSS is becoming the standard in research⁶.

NEUROVIEW | VOLUME 96, ISSUE 5, P964-965, DECEMBER 06, 2017

A Commitment to Open Source in Neuroscience

Padraig Gleeson • Andrew P. Davison • R. Angus Silver • Giorgio A. Ascoli  

Open Access • DOI: <https://doi.org/10.1016/j.neuron.2017.10.013> •

⁶Open source for neuroscience

11/29

Notes

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

Notes

(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

Notes

(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

Notes

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

Notes

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**.

⁷Researchers, academics, hobbyists, anyone!

16/29

Notes

NeuroFedora is:

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

NeuroFedora: current metrics

- less than a year old⁸,
 - 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), 2019¹¹.

⁸in its second iteration

⁹src.fedoraproject.org: Neuro-SIG

¹⁰ Pagure.io: Neuro-SIG: issues

¹¹NeuroFedora blog: poster at CNS*2019

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,

NeuroFedora: what you can do

Anything! It's just more of Fedora!

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



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So!

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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

Notes

Myths

Myth 1

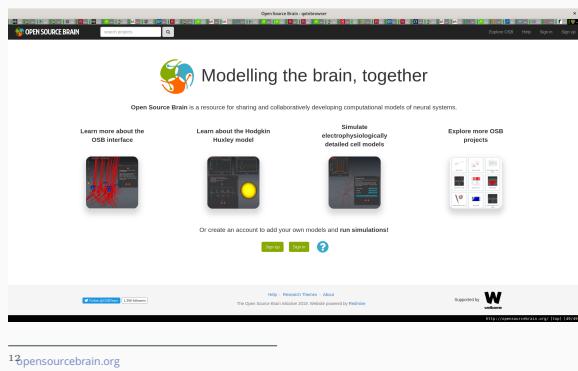
(Neuro) science is all about working on “core research”.

Wrong! There is more to (neuro) science!

23/29

Notes

Myth buster example: Open Source Brain

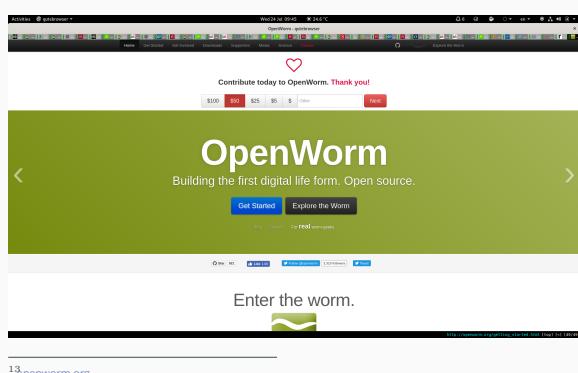


The screenshot shows the homepage of the Open Source Brain website. At the top, there's a navigation bar with links for "Home", "About", "Log In", and "Sign Up". Below the navigation is a main header with the text "Modelling the brain, together" and a globe icon. The page features several cards with different neural models: "Learn more about the OSB interface", "Learn about the Hodgkin-Huxley model", "Simulate electrophysiologically detailed cell models", and "Explore more OSB projects". Below these cards is a section for users to "Or create an account to add your own models and run simulations!" with "Create Account" and "Log In" buttons. At the bottom, there's a footer with links for "Help", "Research Themes", "About", and "Supported by". The URL "12.opensourcebrain.org" is visible at the bottom left.

24/29

Notes

Myth buster example: OpenWorm

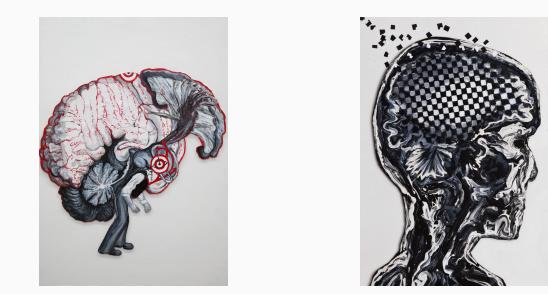


The screenshot shows the homepage of the OpenWorm website. At the top, there's a navigation bar with links for "Home", "About", "Log In", and "Sign Up". Below the navigation is a prominent green banner with the text "OpenWorm" and "Building the first digital life form. Open source." In the center of the banner are two buttons: "Get Started" and "Explore the Worm". Below the banner, there's a large button with the text "Enter the worm." and a small worm icon. The URL "13.openworm.org" is visible at the bottom left.

25/29

Notes

Myth buster example: Science art



1: Snail: related to Dementia

2: Pieces of the Mind (2014)

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Myth 2

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

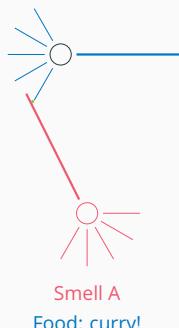
Wrong! Everyone can do (neuro) science!

27/29

Notes

Myth buster example: understanding learning

Food: curry!



28/29

Notes

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)

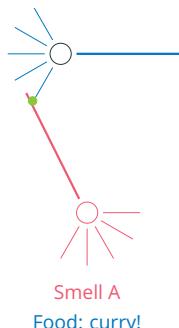
nest.Simulate(100.0)

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

¹⁶nest-simulator.org

29/29

Smell A
Food: curry!



Smell A
Food: curry!



Notes
