



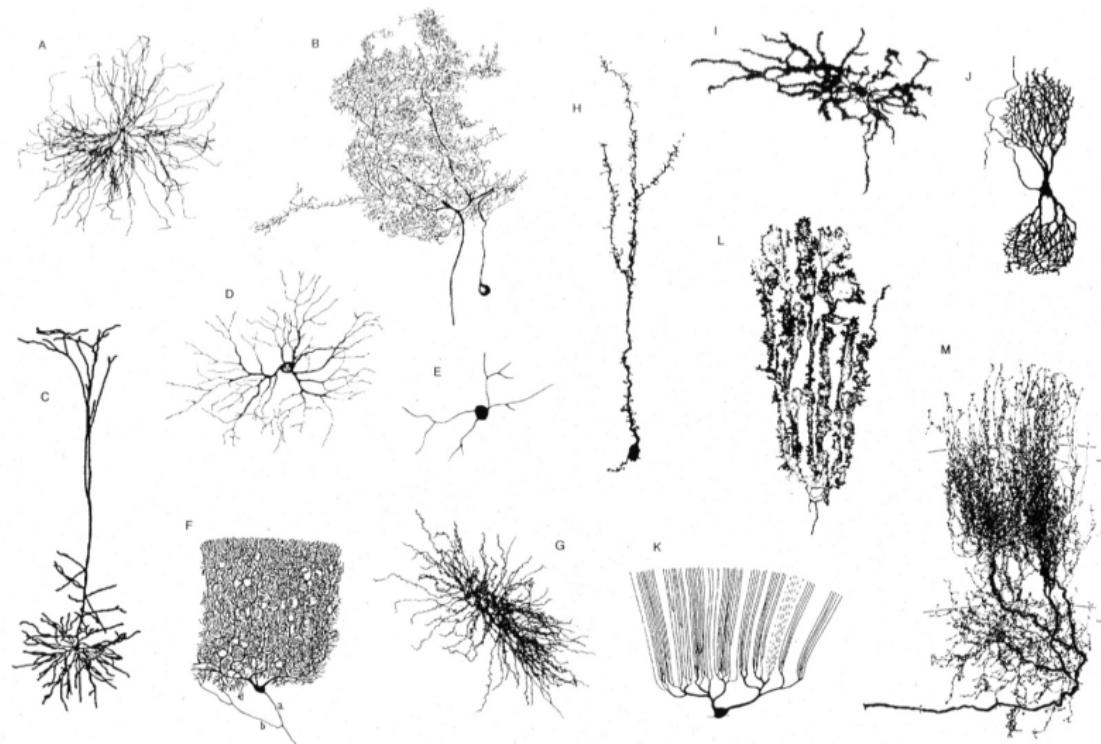
NeuroFedora

FOSS and Free/Open (neuro) Science

NeuroFedora contributors

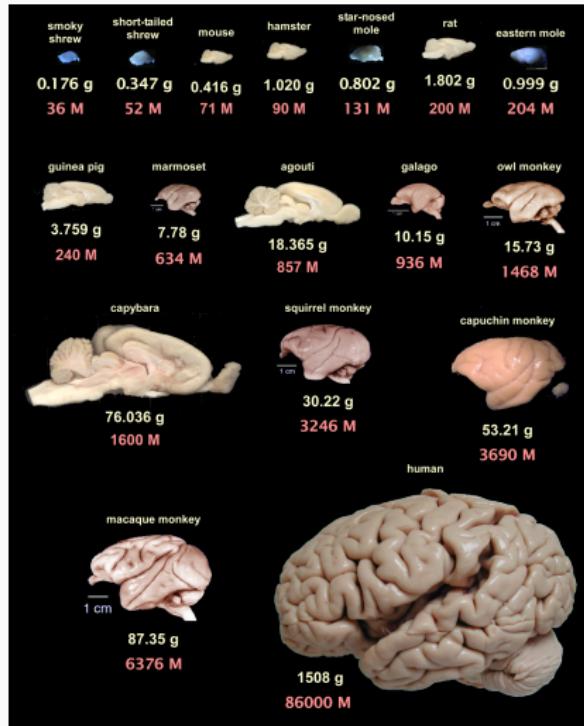
Problem statement: the brain

The brain: neurons



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

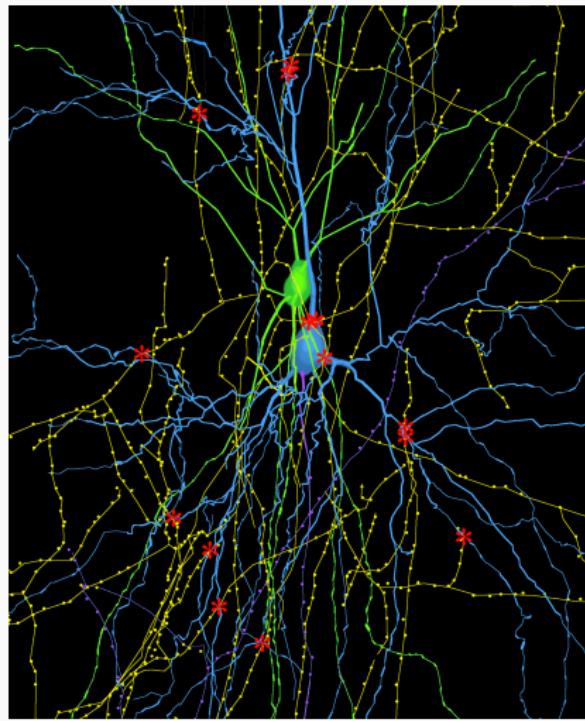
The brain: in numbers: neurons



- 86B neurons¹.

¹ Herculano-Houzel 2009

The brain: in numbers: synapses

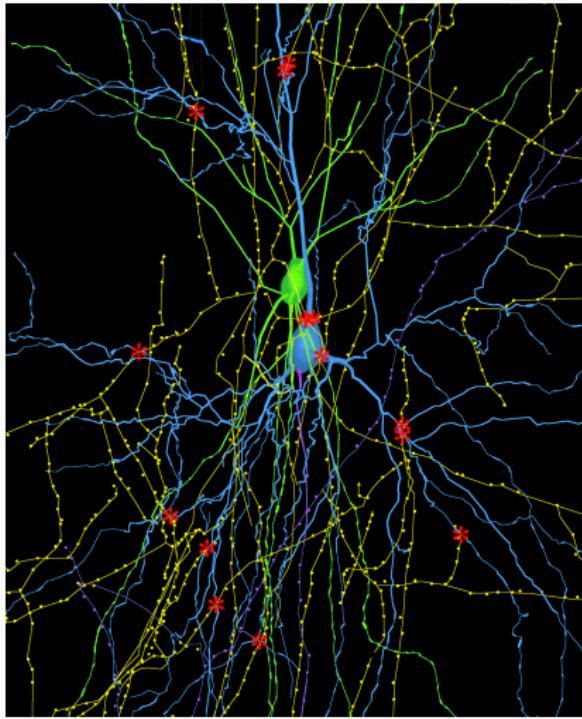


- Thousands of connections between neurons (synapses)².
- Synapses are also of different types, and serve different functions.

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

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

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.

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

with the aim of applying this knowledge to

- disease prevention and treatment,
- ...

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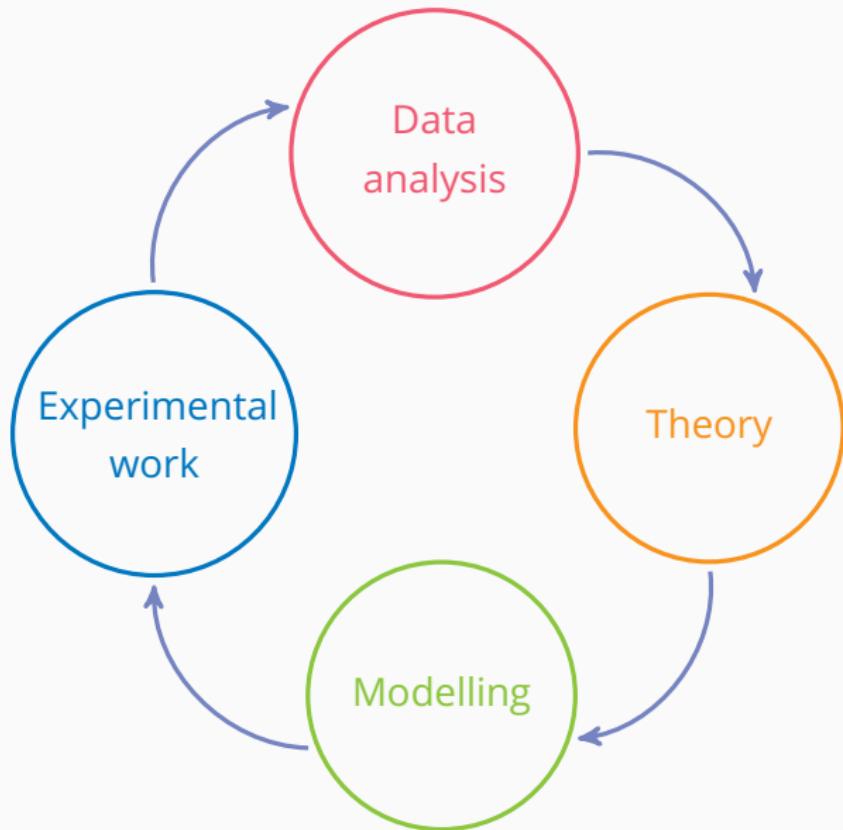
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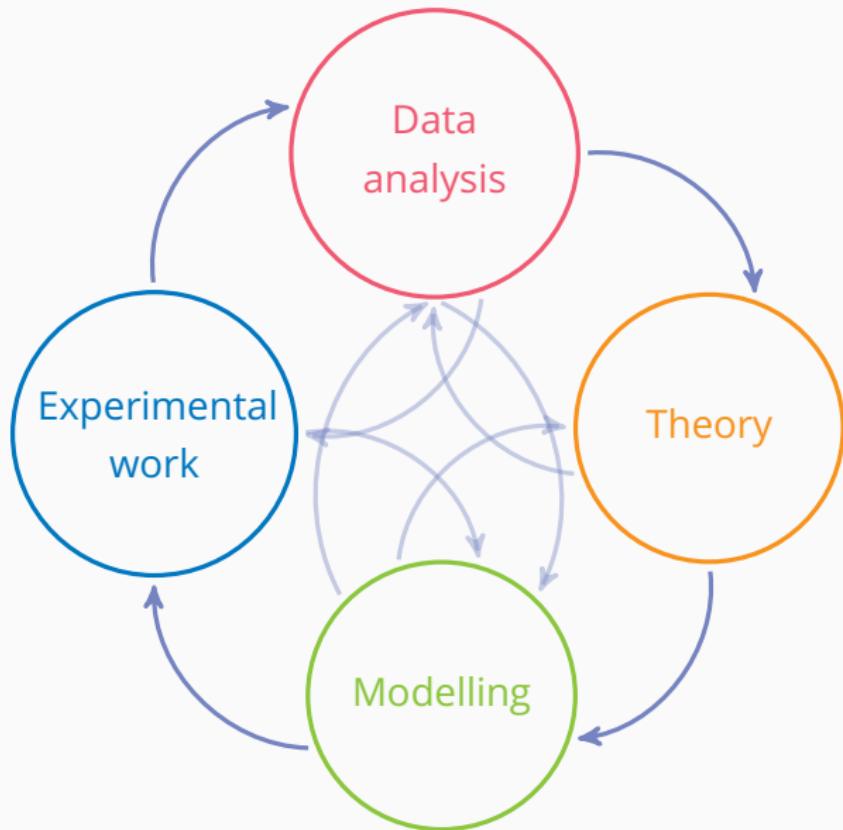
- disease prevention and treatment,
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- brain inspired computing,
- ...
- philosophy and consciousness,

How: research pipeline

General workflow



General workflow



Tools of the trade

Experimental:

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

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Data analysis:

- Statistics,
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Theory and modelling:

- Simulators of all kinds,

Tools of the trade: II

Tools for the dissemination of knowledge⁴:

- visualisation,
- academic writing,
- non academic writing: blogging ... ,
- podcasting,
- video making,
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⁴ also to a non-specialist audience.

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Collaborative tools and utilities.

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Free/Open (neuro) Science?

A familiar ideal

Free/Open science:

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

⁵ Free software foundation

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

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Now,

FOSS is becoming the standard in research⁶.

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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

What can we, Fedora, do to help?

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- various specialities: biologists, mathematicians, physicists, chemists, psychologists, . . . ,

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- small proportion of trained software developers,

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- lack of documentation and support,
- lack of community development know-how,

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- we disseminate information to end-users,

So, we started NeuroFedora

Primary goal:

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

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- make Fedora the go-to distribution for neuroscience.

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NeuroFedora is:

- merely leveraging pre-existing community resources to a new domain of software.

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- 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,

⁸in its second iteration

⁹src.fedoraproject.org: Neuro-SIG

¹⁰[Pagure.io](https://pagure.io): Neuro-SIG: issues

¹¹NeuroFedora blog: poster at CNS*2019

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- 15 active contributors:
 - 10 package maintainers,
 - 5 designers, newcomers,
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NeuroFedora: future plans

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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!

NeuroFedora: what you can do

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



Myths

Myth 1

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

Myth 1

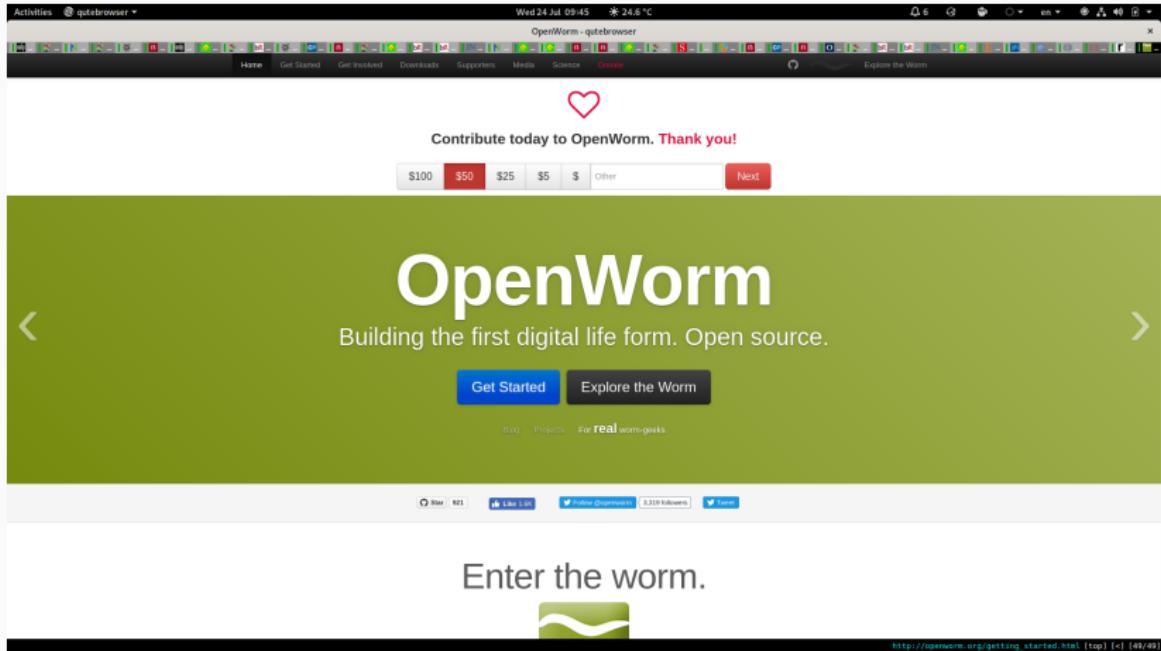
(Neuro) science is all about working on “core research”.

Wrong! There is more to (neuro) science!

Myth buster example: Open Source Brain

The screenshot shows the Open Source Brain website. At the top, there's a navigation bar with a search bar and links for "Explore OSB", "Help", "Sign in", and "Sign up". Below the header, a large logo features a stylized brain and the text "Modelling the brain, together". A sub-headline explains: "Open Source Brain is a resource for sharing and collaboratively developing computational models of neural systems." There are four main sections with buttons: "Learn more about the OSB interface", "Learn about the Hodgkin Huxley model", "Simulate electrophysiologically detailed cell models", and "Explore more OSB projects". Each section has a corresponding image thumbnail. At the bottom, there's a call to action: "Or create an account to add your own models and run simulations!", followed by "Sign in", "Sign up", and a help icon. The footer contains social media links (Facebook, LinkedIn), a "Follow" button, and follower count (1,066 followers). It also includes links for "Help", "Research Themes", and "About", and a note: "The Open Source Brain Initiative 2019. Website powered by Redmine". On the right, it says "Supported by" with the "welcome" logo, and at the bottom right, there's a link: "http://opensourcebrain.org/top [49/49]".

Myth buster example: OpenWorm



Myth buster example: Science art



1: Snail: related to Dementia



2: Pieces of the Mind (2014)

Myth 2

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

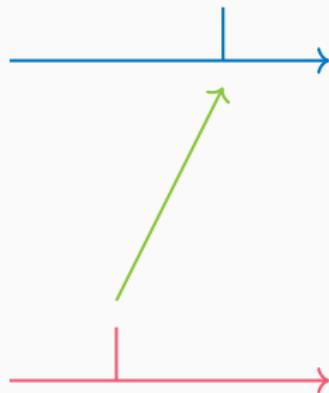
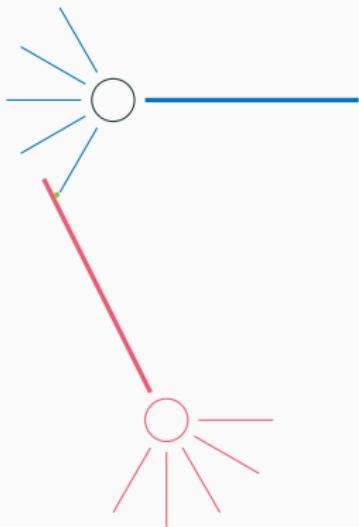
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Wrong! Everyone can do (neuro) science!

Myth buster example: understanding learning

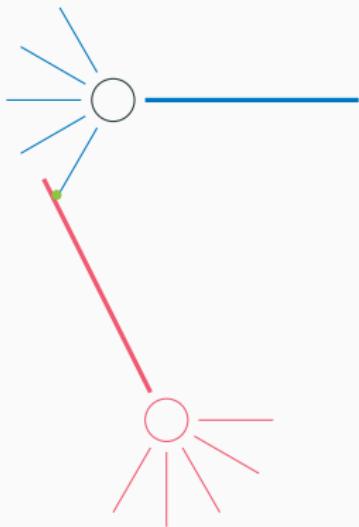
Food: curry!



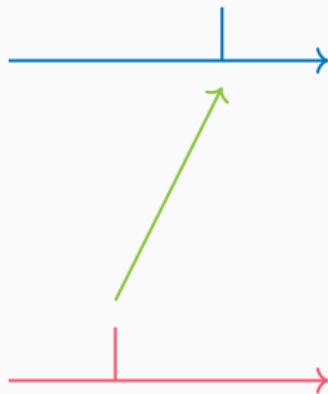
¹⁵Spike-timing dependent plasticity (STDP): underlies learning in the Brain.

Myth buster example: understanding learning

Food: curry!



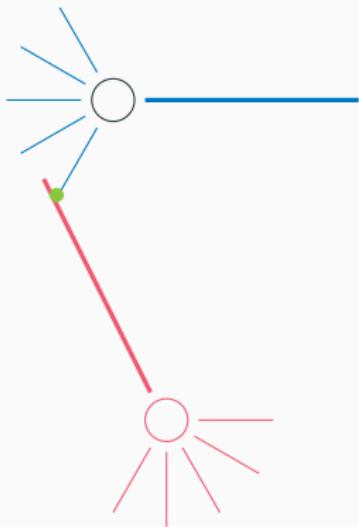
Smell A



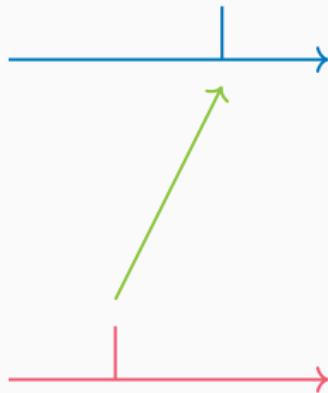
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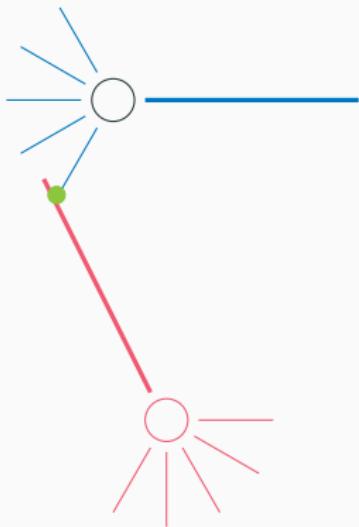
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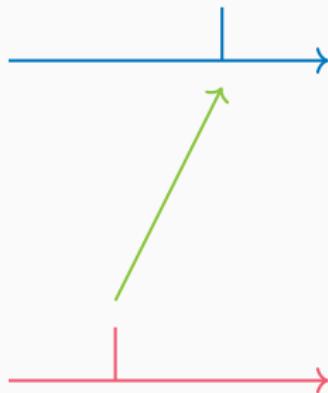
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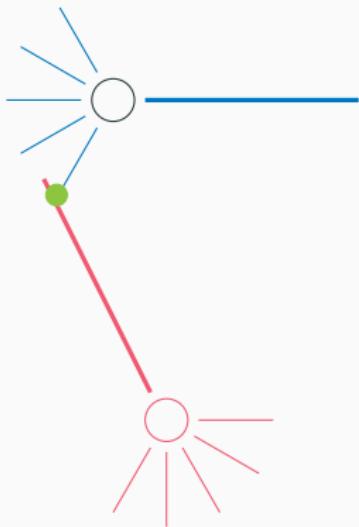
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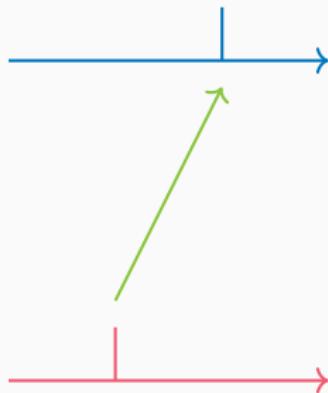
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Myth buster example: understanding learning

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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()
```