



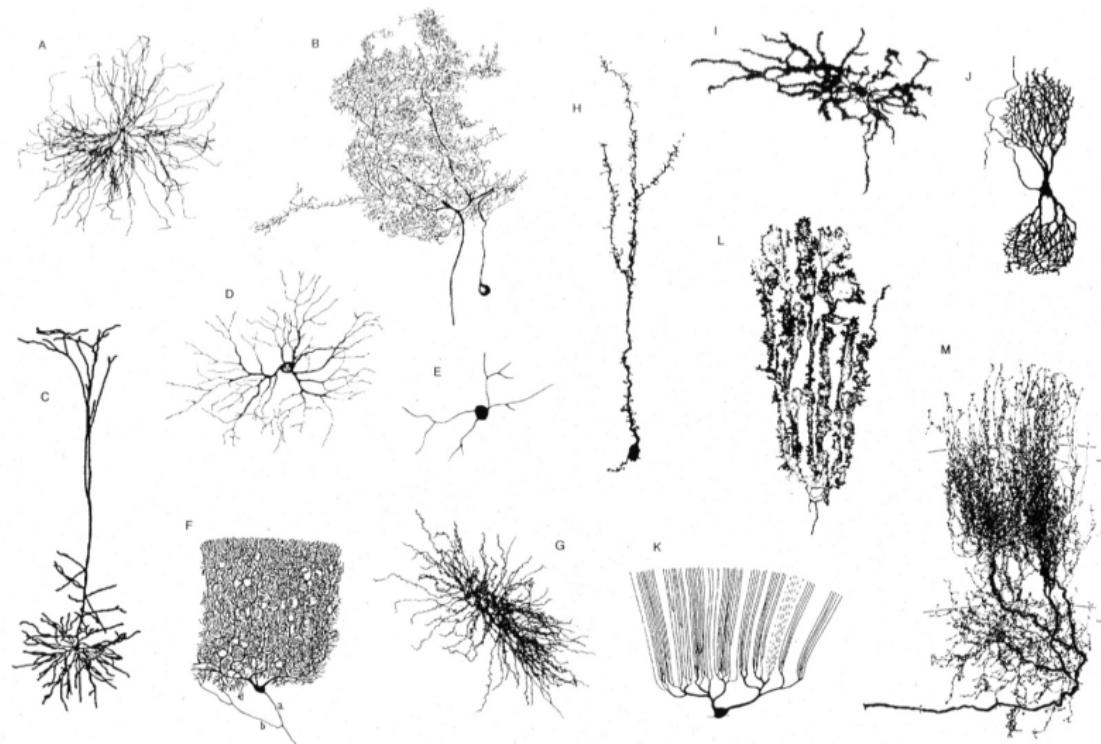
NeuroFedora

FOSS and Free/Open (neuro) Science

NeuroFedora contributors

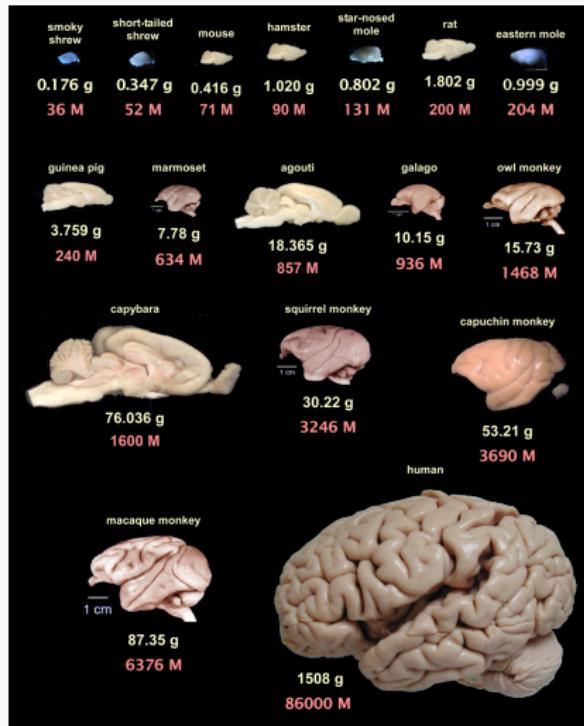
Problem statement: the brain

The brain: neurons



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

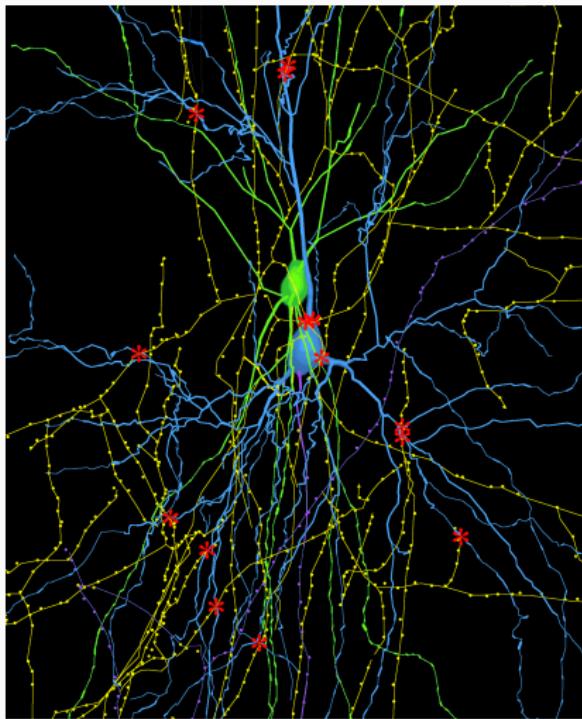
The brain: in numbers: neurons



- 86B neurons¹.

¹ Suzana 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](https://doi.org/10.3389/neuro.09.031.2009)

The brain: in numbers: synapses

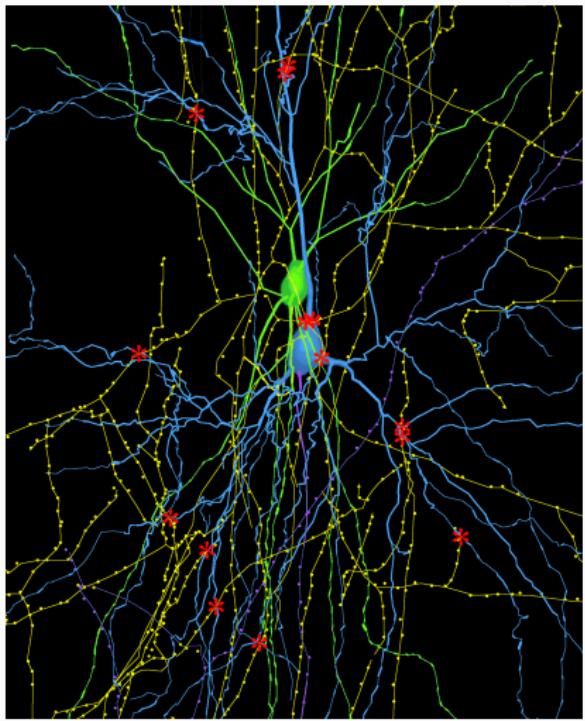


- Thousands of connections between neurons (synapses)².
- Synapses are also of different types, and serve different functions.

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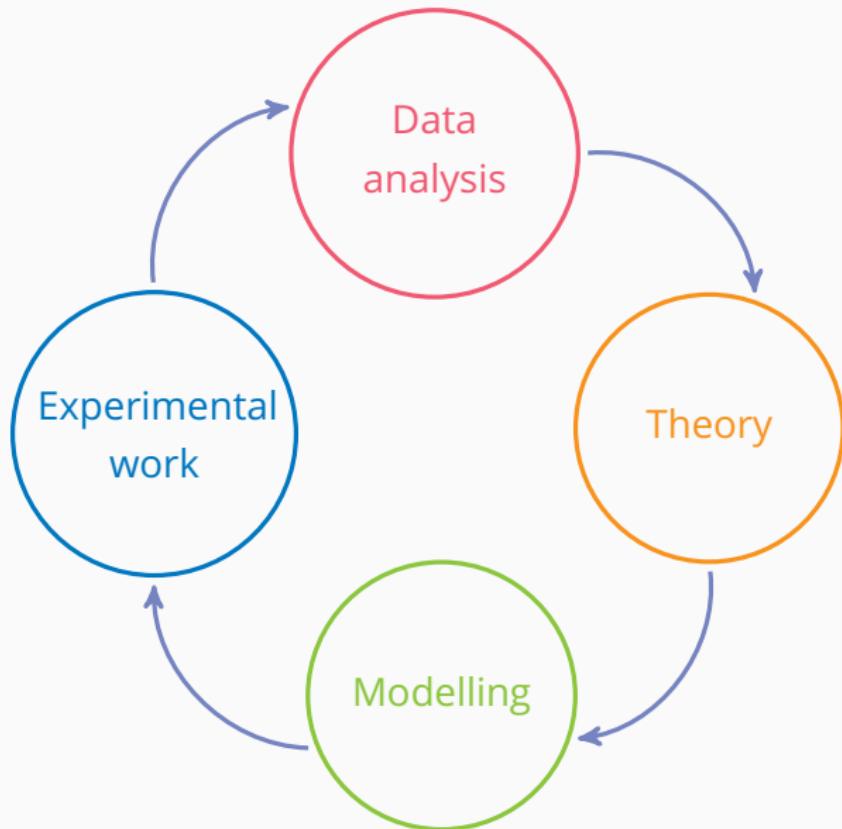
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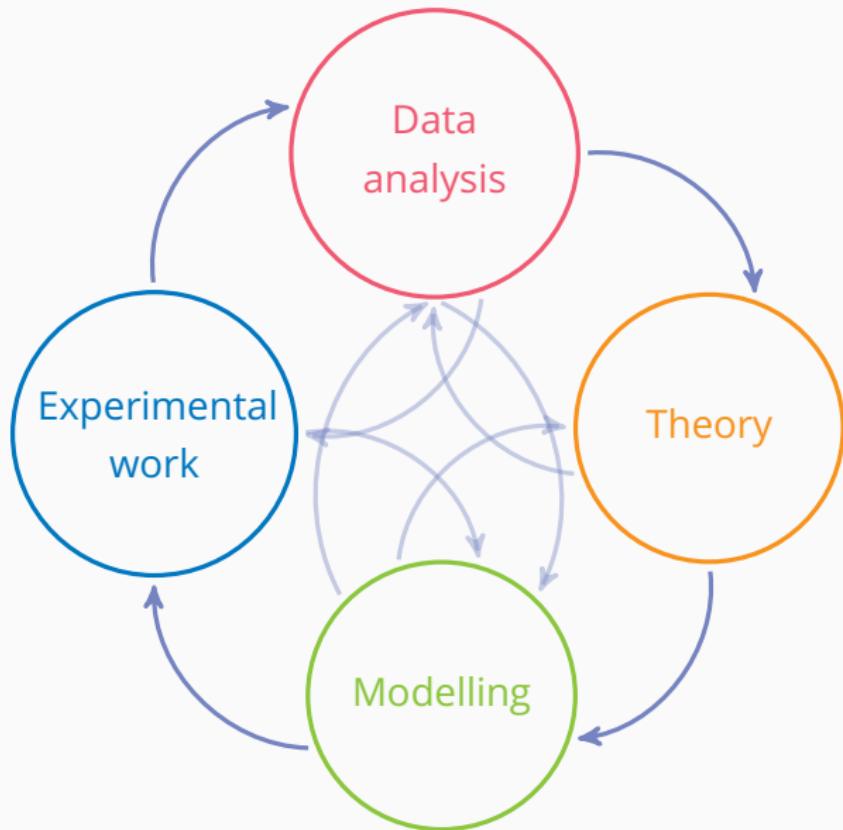
- disease prevention and treatment,
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- brain inspired computing,
- ...
- philosophy and consciousness,

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,
- creating teaching materials,

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.

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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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- 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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- waste time and effort installing (and reinstalling) their software stacks,

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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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In essence,

NeuroFedora is:

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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

NeuroFedora: current metrics

- less than a year old⁸,
- 15 active contributors:
 - 10 package maintainers,
 - 5 designers, newcomers,
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NeuroFedora: future plans

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- 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

Anything! It's just more of Fedora!

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



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)

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

- Astronomy SIG
- Bigdata SIG
- Machine Learning
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- Medical
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Is your interest not listed? Start your own!

Myths

Myth 1

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

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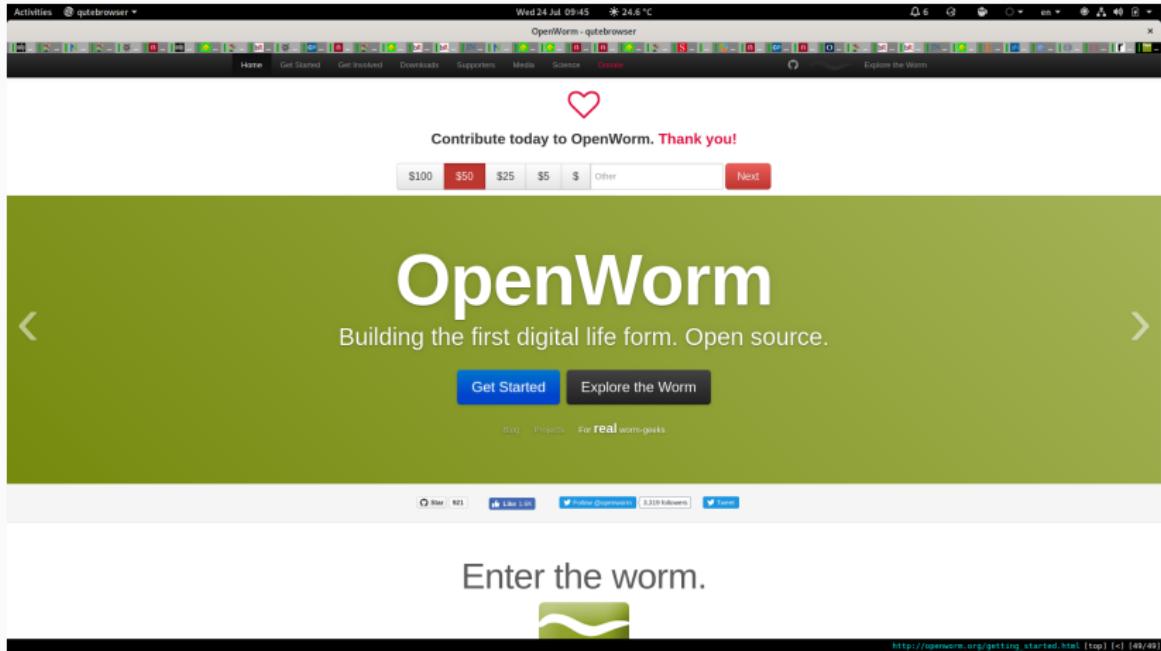
(Neuro) science is all about working on “core research”.

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, there's a logo of a brain and the tagline "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 small thumbnail image. Below these is a call-to-action: "Or create an account to add your own models and run simulations!" with "Sign up" and "Log in" buttons. The footer includes social media links (Facebook, Twitter), a "Follow @OSB_Book" button, and follower count (1,396). It also lists "Help", "Research Themes", and "About". The footer notes "The Open Source Brain Initiative 2019. Website powered by Redmine". On the right, it says "Supported by" with the Wellcome Trust logo and a link to the site's statistics page: "http://opensourcebrain.org/_top [149/49]."

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.

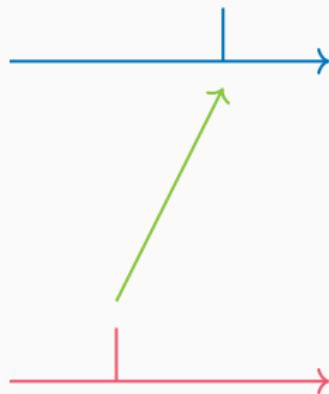
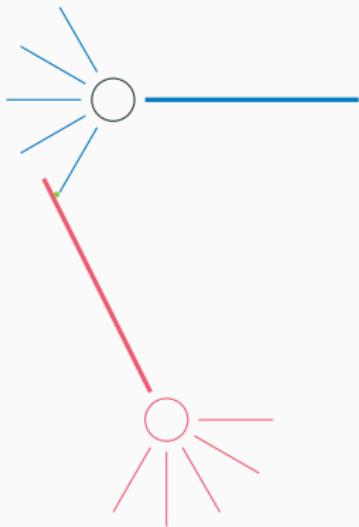
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Wrong! Everyone can do (neuro) science!

Myth buster example: understanding learning

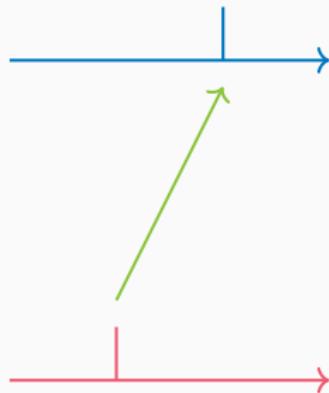
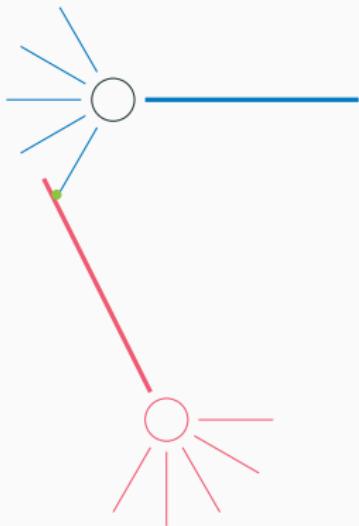
Food: curry!



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

Myth buster example: understanding learning

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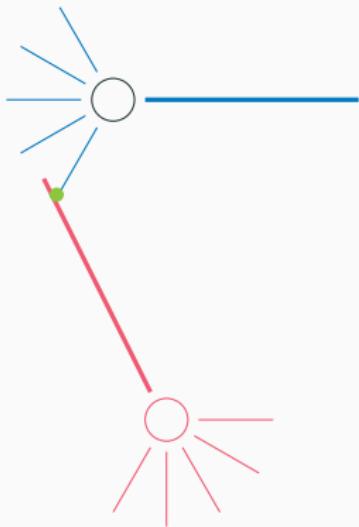


Smell A

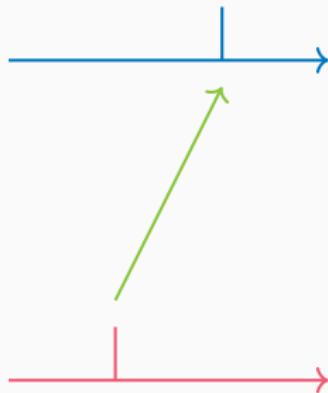
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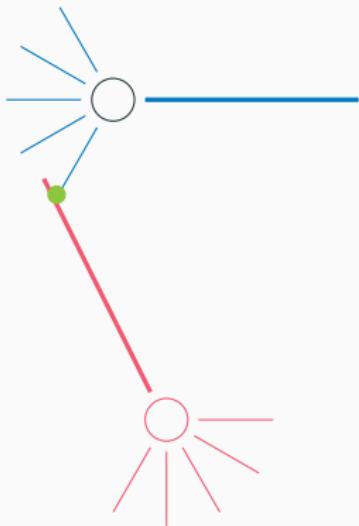
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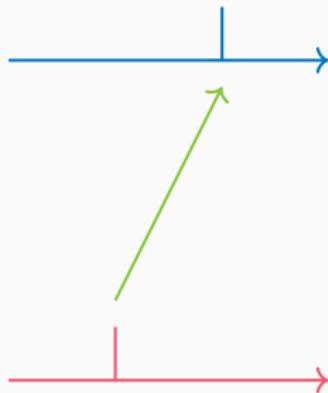
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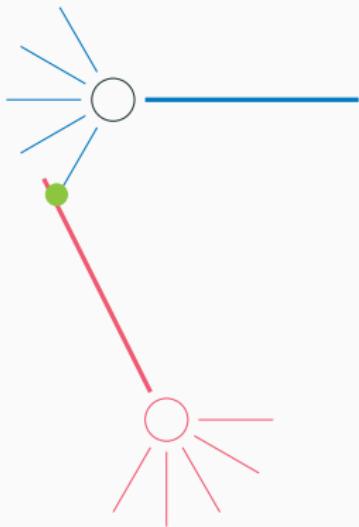
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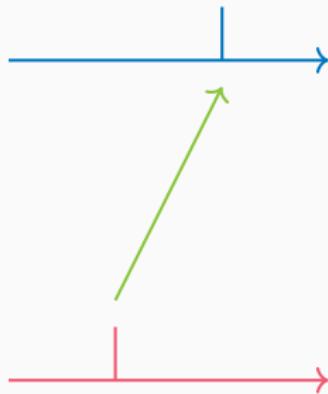
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Myth buster example: understanding learning

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

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()
```