

# ModelDB

<http://modeldb.yale.edu>

ModelDB promotes discoverability and reproducibility of computational neuroscience research by serving as a platform for curated sharing and visualization of published models.

ModelDB Help  
User account  
Login

Register

Find models by

Model name

First author

Each author

Region(circuits)

Find models for

Cell type

Current

Receptor

Gene

Transmitters

Topic

Simulators

Methods

Find models of

Realistic Networks

Neurons

Electrical synapses (gap junctions)

Chemical synapses

Ion channels

Neuroinvasive junctions

## Amyloid beta (IA block) effects on a model CA1 pyramidal cell (Morse et al. 2010)

Download zip file

Auto-launch

Help downloading and running models

Model Information

Model File

Citations

Model Views

Simulation Platform

3D Print

Accession:87284

The model simulations provide evidence oblique dendrites in CA1 pyramidal neurons are susceptible to hyper-excitability by amyloid beta block of the I<sub>A</sub> channel, IA. See paper for details.

Reference:

1. Morse TM, Carnevale NT, Mutalik PG, Migliore M, Shepherd GM (2010) Abnormal excitability of oblique dendrites implicated in early Alzheimer's: a computational study *Front. Neural Circuits* 4:16 [PubMed]

Model Information (Click on a link to find other models with that property)

Model Type: Neuron or other electrically excitable cell;

Brain Region(s)/Organism:

Cell Type(s): Hippocampus CA1 pyramidal cell;

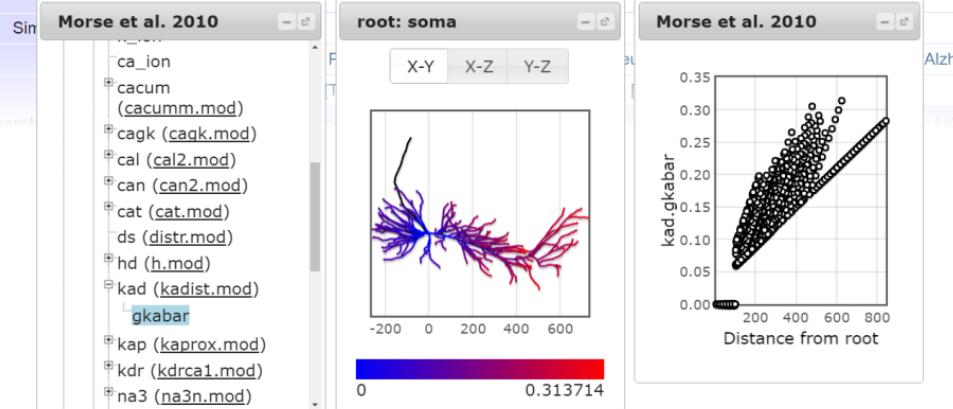
Channel(s): I<sub>Na,t</sub>; I<sub>L</sub> high threshold; I<sub>N</sub>; I<sub>T</sub> low threshold; I<sub>A</sub>; I<sub>K</sub>; I<sub>h</sub>;

Gap Junctions:

Receptor(s):

Gene(s):

Transmitter(s):



```
from neuron import h, rxd
import neuron.rxd.node as node
from matplotlib import pyplot
import time
```

```
h.load_file('stdrun.hoc')
```

```
soma = h.Section()
soma.L = 10
soma.diam = 10
soma.nseg = 11
dend = h.Section()
dend.connect(soma)
dend.L = 50
dend.diam = 2
dend.nseg = 51

def print_nodes():
    print ', '.join(str(v) for v in node._states)

print 'defining rxd'
region = rxd.Region(h.allsec(), nrn_region='i')
ca = rxd.Species(region, name='ca', d=1, charge=2, initial=0.3)
reaction = rxd.Rate(ca, -ca * (1 - ca) * (0.3 - ca))

print 'initializing'
h.initialize()

print 'before:'
print_nodes()
print
```

Morse TM, Carnevale NT, Mutalik PG, Migliore M, Shepherd GM (2010) Abnormal excitability of oblique dendrites implicated in early Alzheimer's: a computational study *Front. Neural Circuits* 4:16 [PubMed]

References and models cited by this paper

Acker CD, White JA (2007) Roles of I(A) and morphology in action potential propagation in CA1 pyramidal cell dendrites. *J Comput Neurosci* 23(2):201-16 [Journal] [PubMed]

- Roles of I(A) and morphology in AP prop. in CA1 pyramidal cell dendrites (Acker and White 2007) [Model]

Anderton BH, Callahan L, Coleman P, Davies P, Flood D, Jicha GA, Ohm T, Weaver C (1998) Dendritic changes in Alzheimer's disease and factors that may underlie these changes. *Prog Neurobiol* 55:595-609 [PubMed]

Andrasfalvy BK, Makara JK, Johnston D, Magee JC (2008) Altered synaptic and non-synaptic properties of CA1 pyramidal cell dendrites in Alzheimer's disease. *J Neurosci* 28:12550-12561 [Journal] [PubMed]

References and models that cite this paper

Culmone V, Migliore M (2012) Progressive effect of beta amyloid peptides accumulation on CA1 pyramidal cell neurons: a model study suggesting possible treatments *Front Comput Neurosci* 6:52 [Journal] [PubMed]

- CA1 pyramidal neurons: effects of Alzheimer (Culmone and Migliore 2012) [Model]

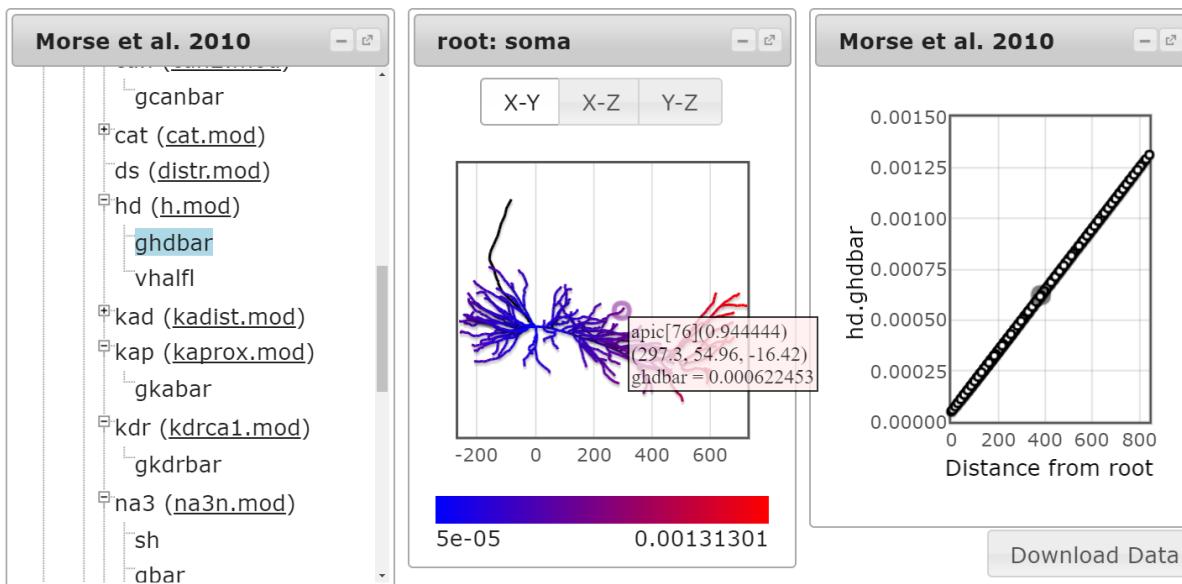
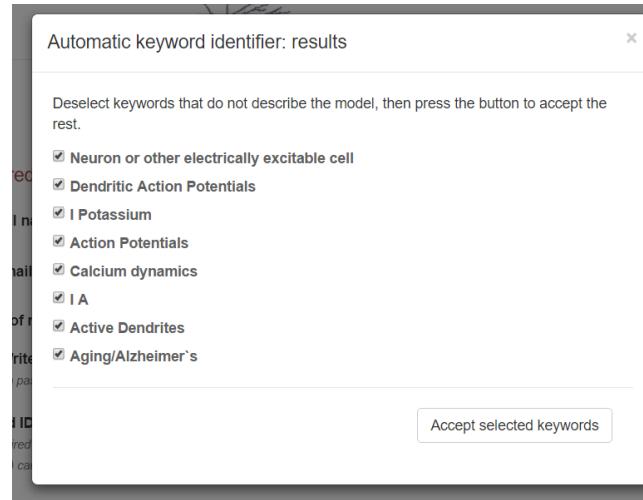
McDougal RA, Morse TM, Hines ML, Shepherd GM (2015) ModelView for ModelDB: online presentation of model structure *Neuroinformatics* 13(4):459-70 [Journal] [PubMed]

- ModelView: online structural analysis of computational models (McDougal et al. 2015) [Model]

Over 1200 models · 76 simulation environments · 178 cell types · 145 topics  
(Alzheimer's, STDP, etc) · 16+ species · 54 ion channels, pumps, etc ·  
24+ mammalian brain regions

# Ongoing ModelDB projects

***Improving quantity and quality of model entries by actively identifying new modelling literature and providing NLP tools to assist entry of descriptive metadata.***



***Model visualization tools make models more accessible by allowing insight into the model structure without reading code.***

Model Information Model File Citations Model Views ▾ 3D Print

Download the displayed file ICGenealogy

/ CA1\_abeta translate readme.html cacumm.mod cagk.mod \* cal2.mod \* can2.mod \* cat.mod \*

```
TITLE CaGK
: Calcium activated K channel.
: Modified from Moczydowski and Latorre (1983)

UNITS {
    (molar) = (1/liter)
}

UNITS {
    (mV) = (millivolt)
    (mA) = (milliamp)
    (mM) = (millimolar)
```

**General data**

- ICG id: 2464
- ModelDB id: 87284
- Reference: Morse TM, Carnevale NT, Matalik PG, Migliore M, Shepherd GM (2010): Abnormal Excitability of Oblique Dendrites Implicated in Early Alzheimer's: A Computational Study.

#### Metadata classes

- Animal Model: rat
- Brain Area: hippocampus, CA1
- Neuron Region: unspecified
- Neuron Type: pyramidal cell
- Runtime Q: Q4 (slow)
- Subtype: not specified

#### Metadata generic

- Age: 7-14 weeks old.
- Authors: M Migliore.
- Comments: Calcium activated k channel, modified from moczydowski and latorre (1983). From hemond et al. (2008), model no. 101629, with no changes (identical mod file). Animal model taken from chen (2005) which is used to constrain model. Channel kinetics from previous study on hippocampal pyramidal neuron (hemond et al. 2008)

Amyloid beta (IA block) effects on a model CA1 pyramidal cell (Morse et al. 2010)

Download zip file Auto-launch

[Help downloading and running models](#)

Model Information Model File Citations Model Views Simulation Platform ▾ 3D Print

Download the displayed file

/ CA1\_abeta translate readme.html cacumm.mod cagk.mod \* cal2.mod \* can2.mod \* cat.mod \* distr.mod \* h.mod ipulse2.mod \* kadist.mod kaprox.mod kdrc1.mod na3n.mod naxn.mod \* zcaquant.mod aBeta.hoc

This is the readme.html file for the model cagk.mod. It contains information about the model's purpose, modifications, and interactions with other models. It also provides instructions for auto-launching the model.

The model code was contributed by Tom Morse. It was created (see paper for details) from earlier models (especially Migliore et al. 2008) and contains modifications and interactions with other models. To recreate figures, auto-launching the model is recommended.

Under unix system: In the expanded command line, type "gnome-terminal -e ./cagk" and run the simulation.

Under Windows system: Compile the model (aBeta.hoc) and run the simulation.

Under MAC OS X: A double click on the "aBeta.hoc" file will open the simulation window.

Other models using cagk.mod:

- A model of unitary responses from A/C and PP synapses in CA3 pyramidal cells (Baker et al. 2010)
- CA1 pyramidal neuron: effects of R213Q and R312W Kv7.2 mutations (Miceli et al. 2013)
- CA3 pyramidal neuron (Saifullina et al. 2010)
- CA3 pyramidal neuron: firing properties (Hemond et al. 2008)
- Neuronal dendrite calcium wave model (Neymotin et al. 2015)

Other models using naxn.mod:

- CA1 pyramidal neuron: effects of R213Q and R312W Kv7.2 mutations (Miceli et al. 2013)
- CA1 pyramidal neuron: functional significance of axonal Kv7 channels (Shah et al. 2008)
- CA1 pyramidal neuron: rebound spiking (Ascoli et al. 2010)
- CA1 pyramidal neuron: schizophrenic behavior (Migliore et al. 2011)
- CA1 pyramidal neuron: signal propagation in oblique dendrites (Migliore et al. 2005)
- CA1 pyramidal neurons: binding properties and the magical number 7 (Migliore et al. 2008)
- CA1 pyramidal neurons: effect of external electric field from power lines (Cavarratta et al. 2014)
- CA1 pyramidal neurons: effects of Alzheimer (Culmone and Migliore 2012)
- CA1 pyramidal neurons: effects of Kv7 (M-) channels on synaptic integration (Shah et al. 2011)
- CA1 pyramidal neurons: effects of a Kv7.2 mutation (Miceli et al. 2009)
- Ca1 pyramidal neuron: reduction model (Marasco et al. 2012)
- Effect of the initial synaptic state on the probability to induce LTP and LTD (Migliore et al. 2015)
- Effects of electric fields on cognitive functions (Migliore et al. 2016)
- Neuronal morphology goes digital ... (Parekh & Ascoli 2013)
- Spine head calcium in a CA1 pyramidal cell model (Graham et al. 2014)

**Better model context through partnerships with external neuroinformatics resources like the Ion Channel Genealogy (above) and through identifying repeated patterns within ModelDB itself (right).**

# Open Source Brain

<http://www.opensourcebrain.org>

The Open Source Brain initiative (OSB) makes computational models of neurons and networks available in open source, standardized formats such as NeuroML and PyNN, encouraging collaborative development. Models and model components can be viewed, analysed and their functional behaviour explored through online simulations in standard web browsers.



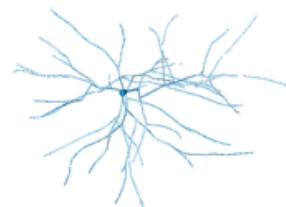
# Modelling the brain, together

**Open Source Brain** is a resource for sharing and collaboratively developing computational models of neural systems.

Try exploring one of these models:



Primary Auditory Cortex  
Network



L23 Cell

...

•

•



Hodgkin-Huxley Neuron



CA1 Pyramidal Cell

Explore OSB to see all the rest, create an account to add your own models and **run simulations!**

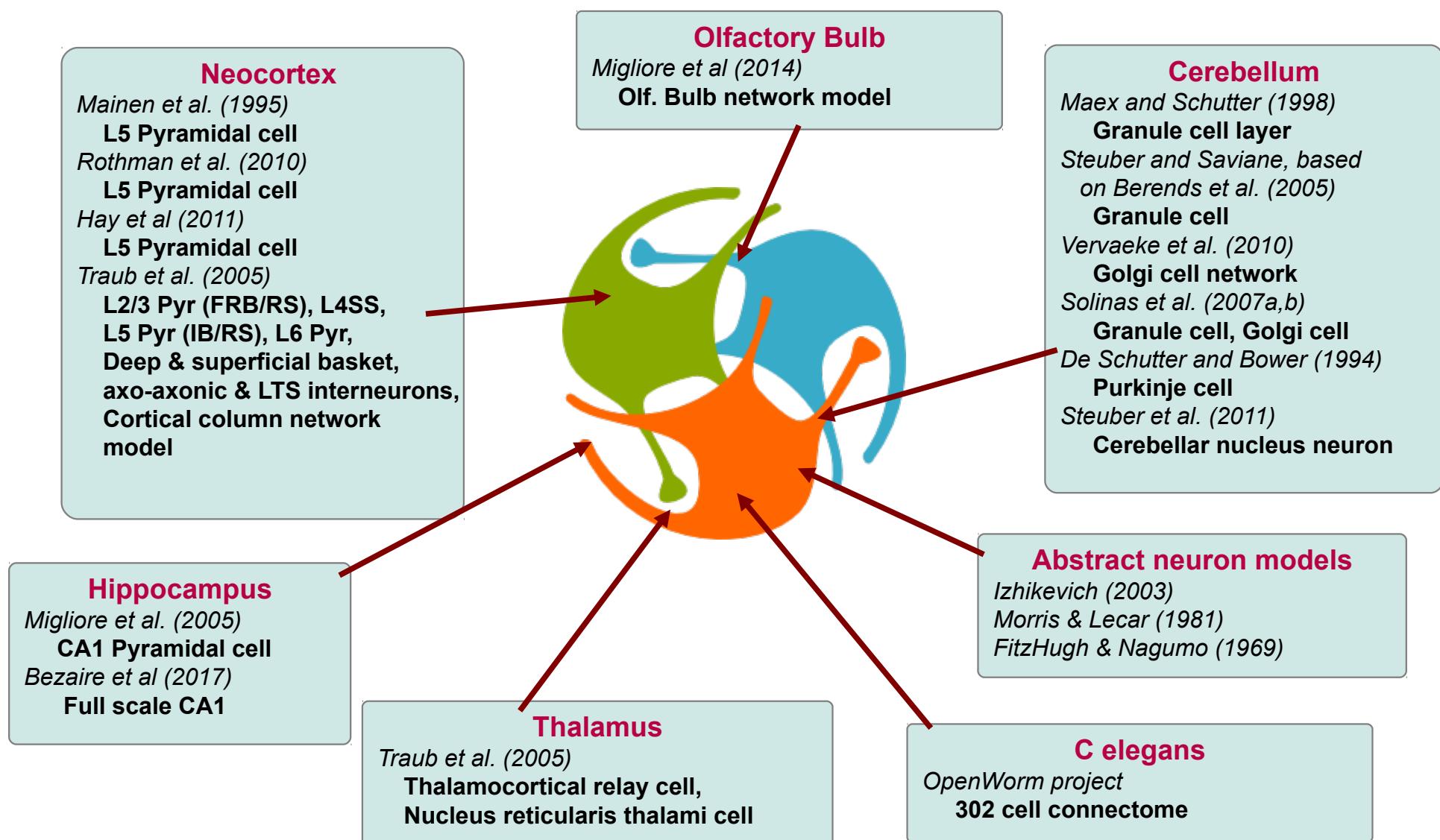
[Explore OSB](#)

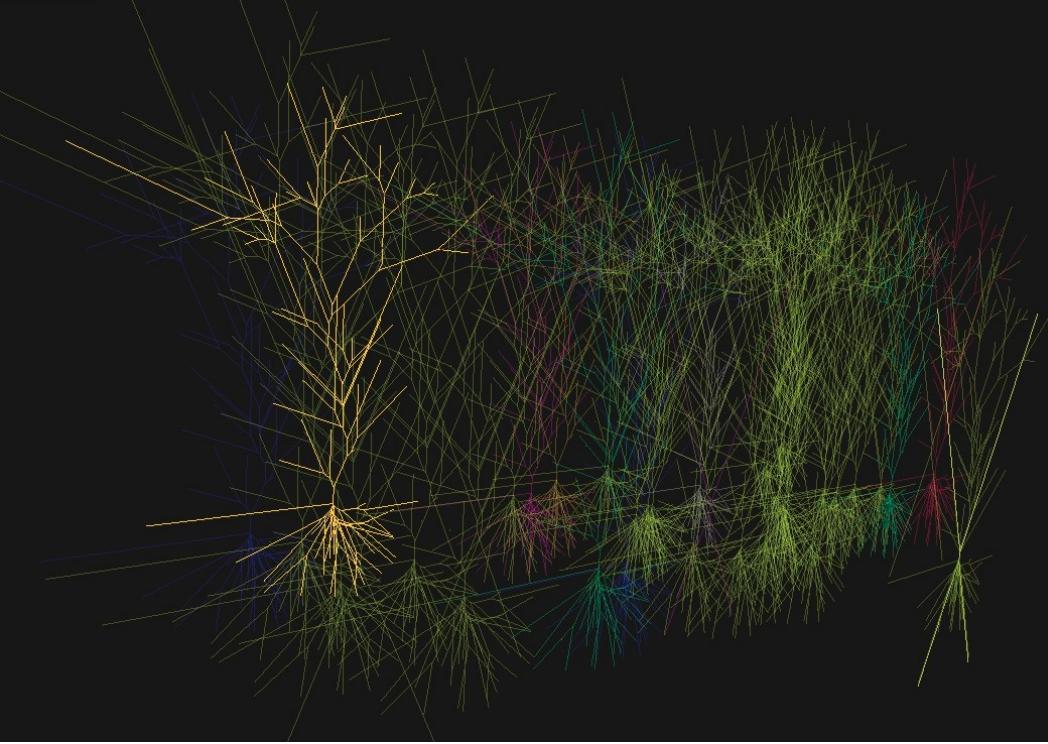
[Sign up](#)

[Sign in](#)



# Models available on OSB





OPEN SOURCE BRAIN Run | Play | Pause | Stop | Help

### 3D Olfactory Bulb Migliore et al. 2014

★ ⌂ Results Run Play Pause Stop Help

Connectivity Model Description Cell Visual

Run experiment

Experiment Name\*: Bulb\_SMC\_240GC - net

Time Step (s)\*: 0.00001

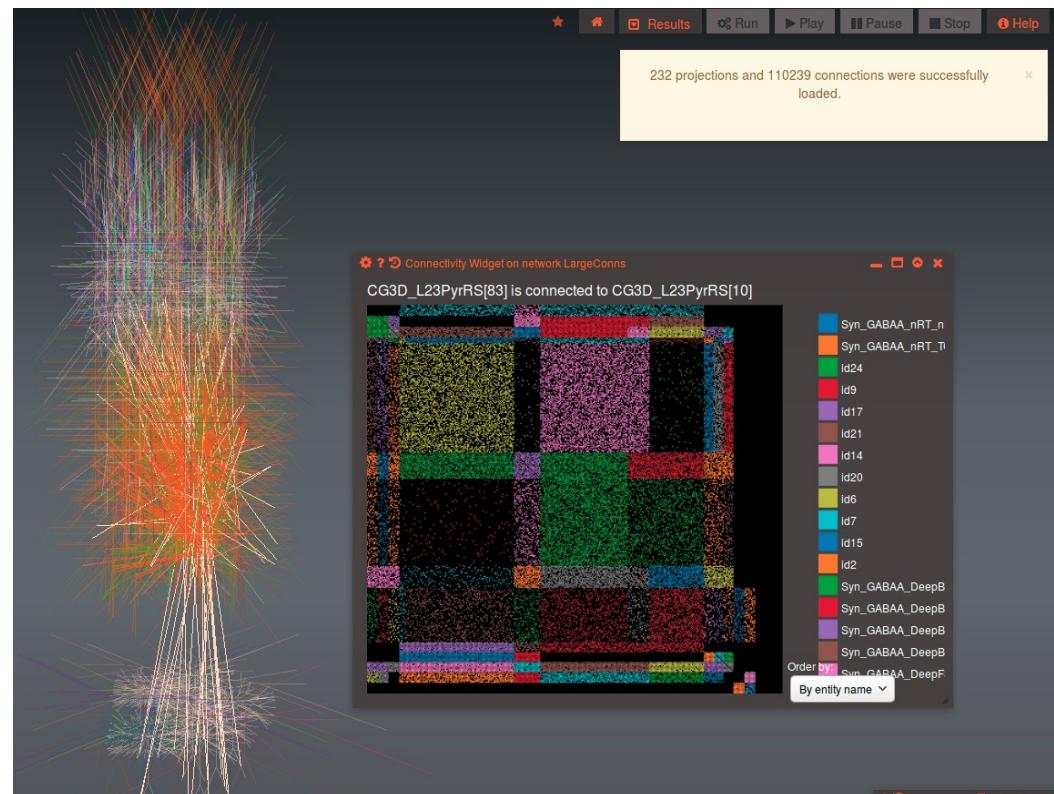
Length (m)\*: 0.3

Simulator\*: Neuron

Number of Processors\*: 1

Submit

Console Experiments



# NeuroML

<http://www.neuroml.org>

NeuroML is a language for expressing models in computational neuroscience in a simulator independent, standardised format. It can express models from integrate and fire cells to complex networks of multicompartmental neurons.

Standardised XML language for computational neuroscience

Version 1.x allowed specification of:

- Detailed neuronal morphologies
- Ion channels
- Synapses
- 3D network structure

30+ simulators/applications/ databases/libraries support NeuroML

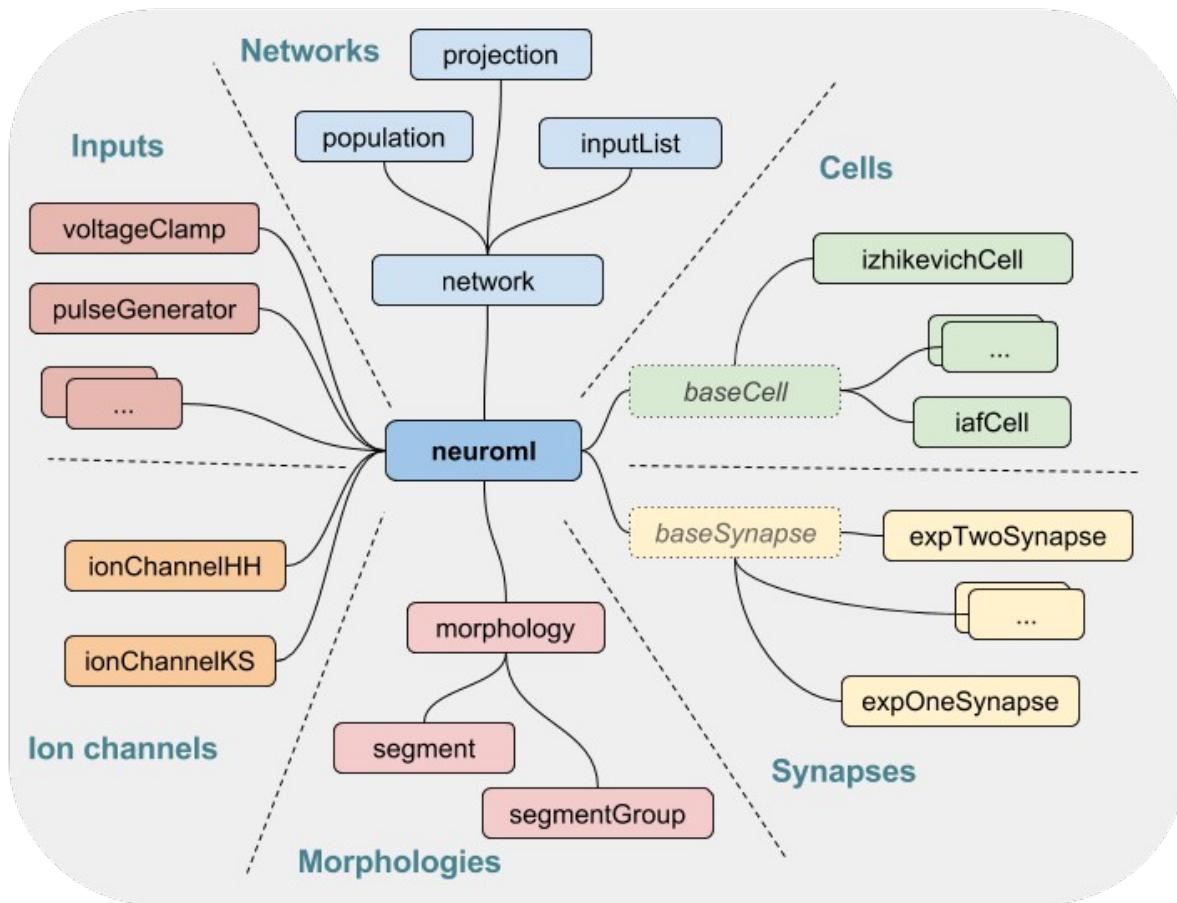
**Simulators**  
NEURON  
GENESIS  
MOOSE  
Brian

**Interoperability**  
PyNN  
neuroConstruct

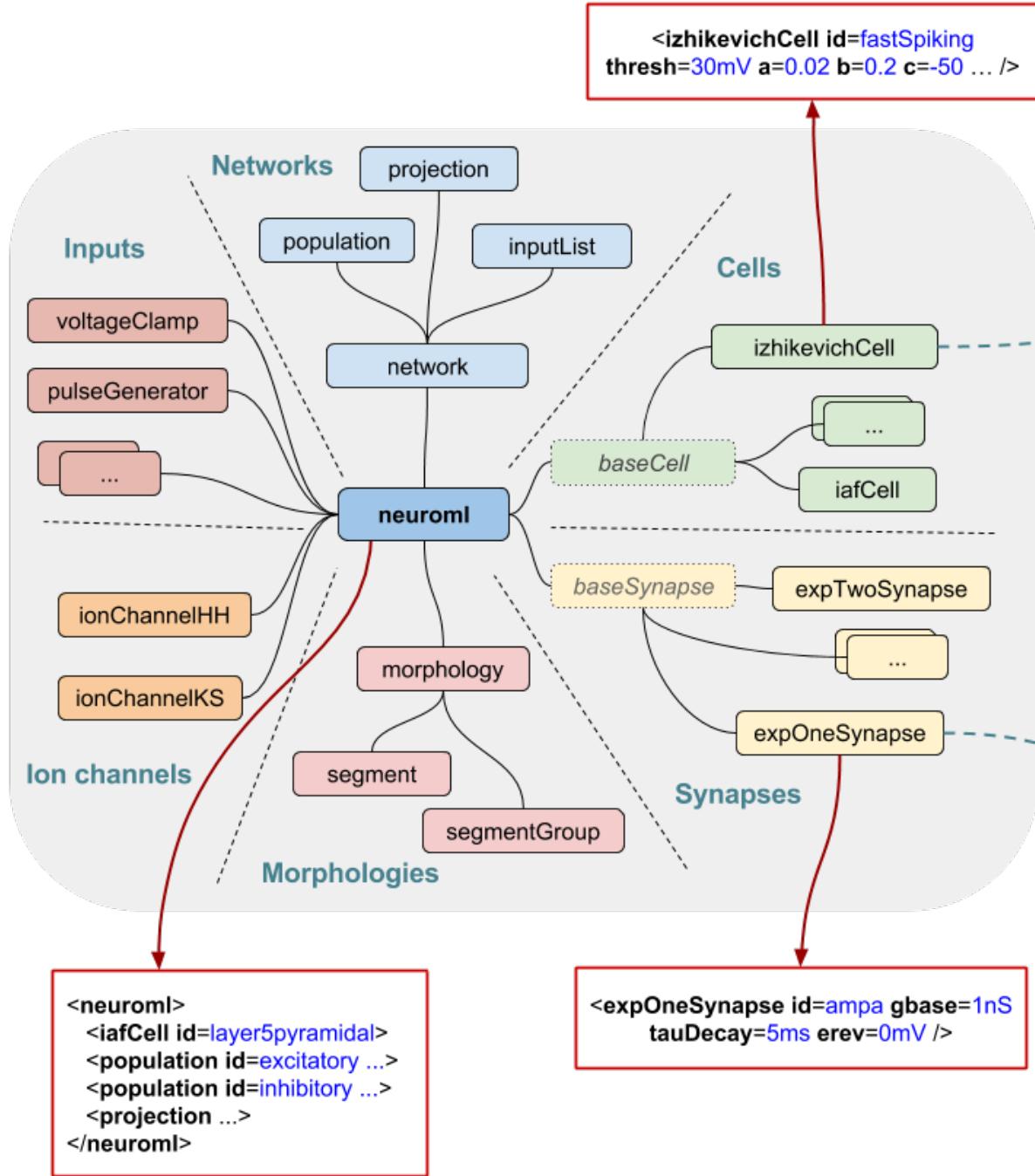
**Initiatives**  
OpenWorm  
Open Source Brain

**Databases**  
Channelpedia  
BBP NMC  
NeuroMorpho  
Allen Institute  
Cell Types DB

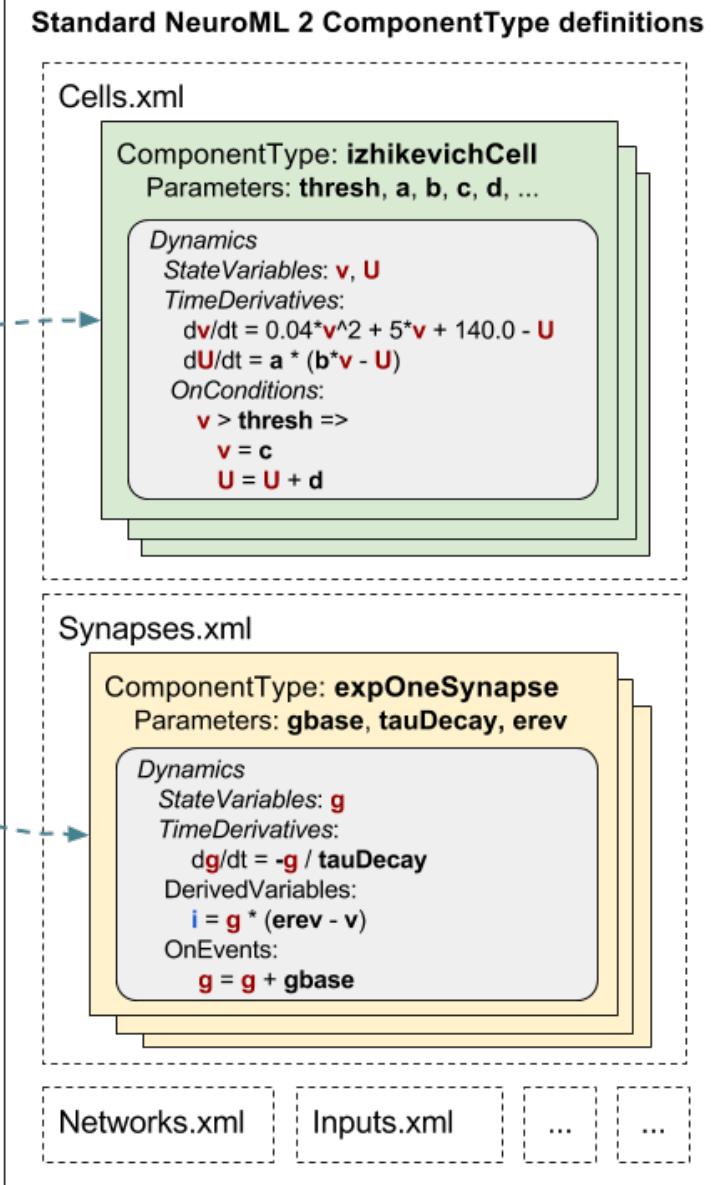
**Morphological analysis/generation**  
Cx3D  
TREES Toolbox  
NeuGen



## NeuroML 2



## LEMS



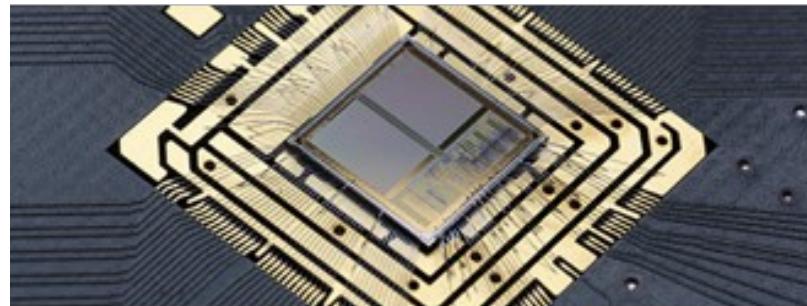
# PyNN

<http://neuralensemble.org/PyNN/>

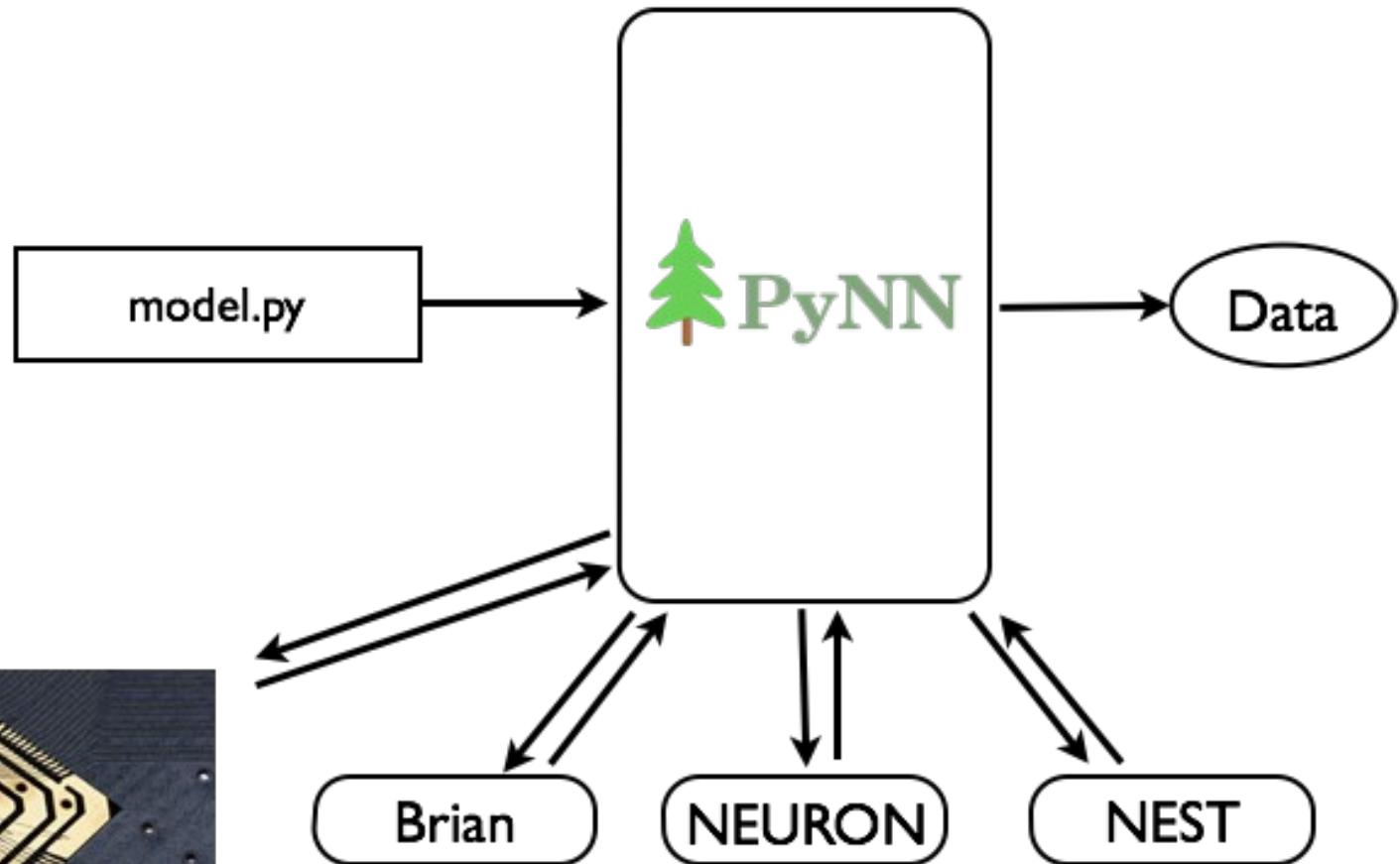
PyNN (pronounced 'pine') is a simulator-independent language for building neuronal network models.

In other words, you can write the code for a model once using the PyNN API and then run it without modification on any simulator that PyNN supports (currently NEURON, NEST, and Brian), and on the SpiNNaker and BrainScaleS neuromorphic hardware systems.

# A common API for neuronal network modelling



neuromorphic hardware





```
import pyNN.nest as simulator
import pyNN.neuron as simulator
import pyNN.brian as simulator
import pyNN.brainscales as simulator
import pyNN.spiNNaker as simulator
```

## **Goals**

facilitate model sharing  
and reuse

simplify validation of  
simulation results

provide a common  
platform on which to build  
other tools

provide a powerful API for  
neuronal network  
modelling

hide complexity of  
parallelization from user

## **Plans**

polishing the rough  
edges → v 1.0 in 2018

multicompartmental  
models with full NeuroML  
support → v 2.0 in 2019

# Gepetto

<http://www.gepetto.org>

Gepetto is a web-based visualisation and simulation platform engineered to explore complex biological systems. In use by a number of neuroinformatics resources including Open Source Brain and Virtual Fly Brain, Gepetto facilitates integration of diverse data and models, and can support different standard formats for both experimental and computational data.

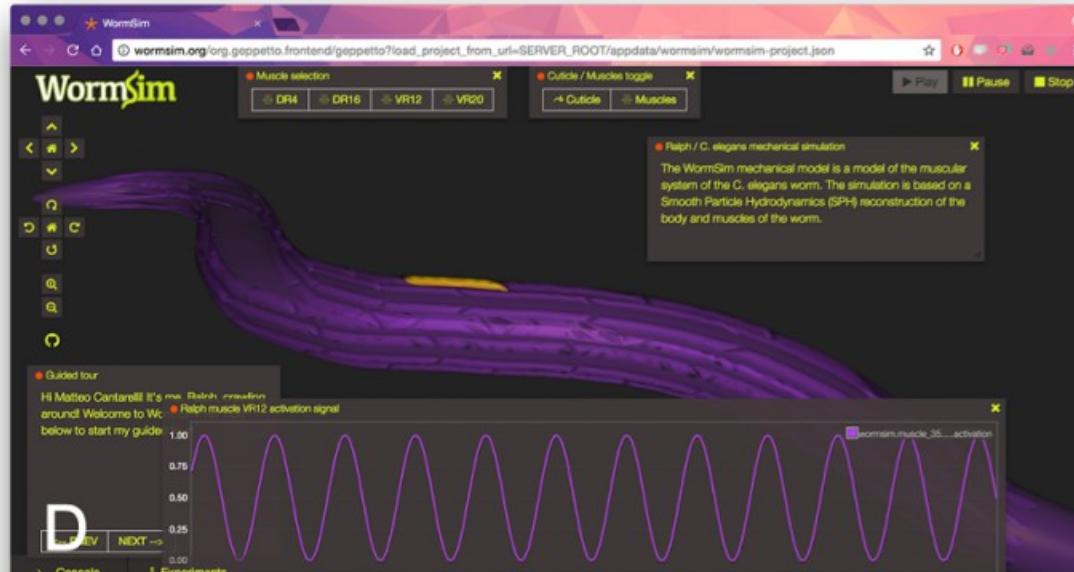
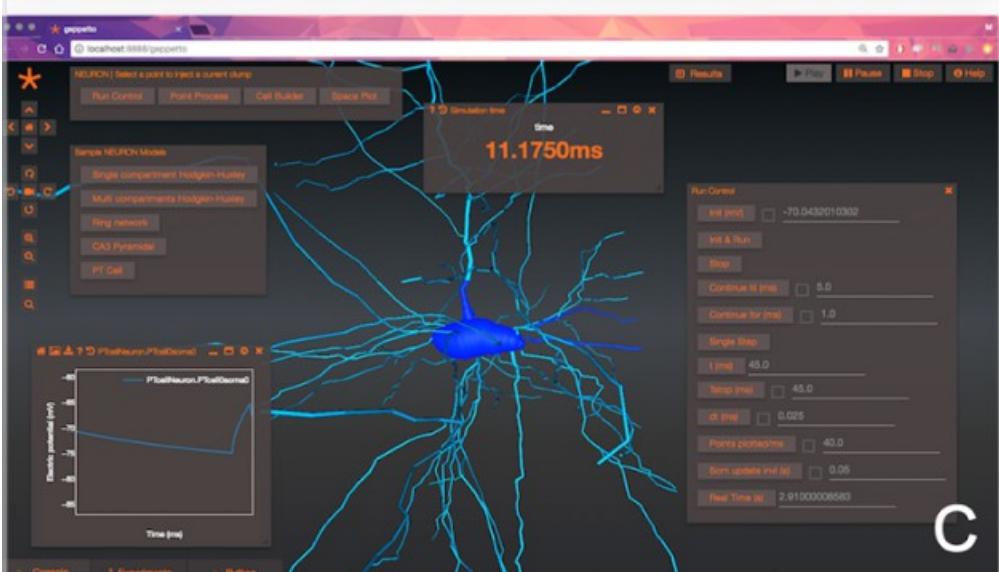
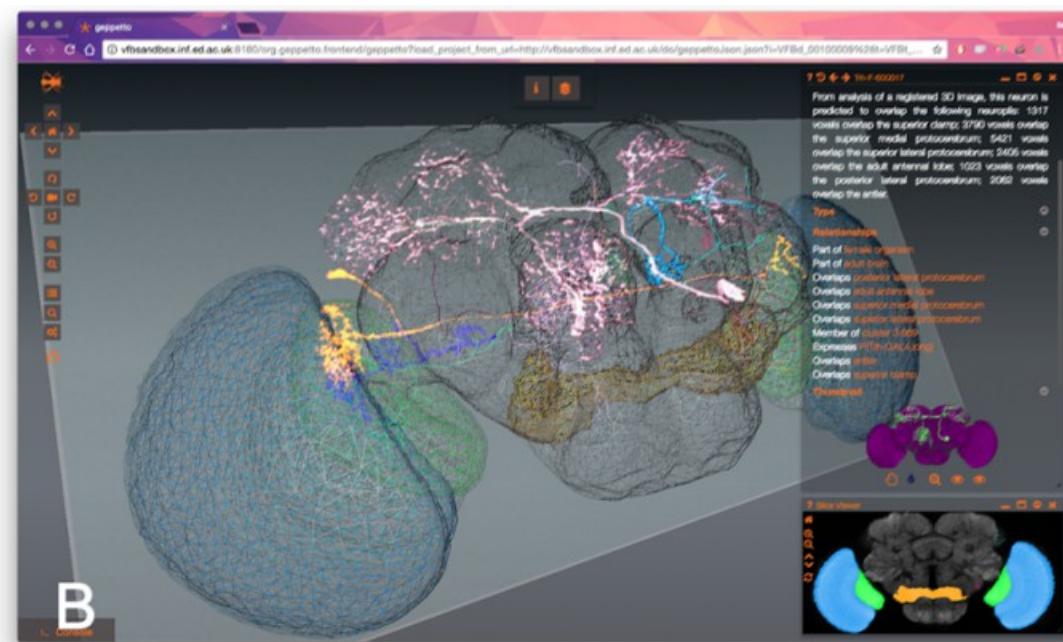
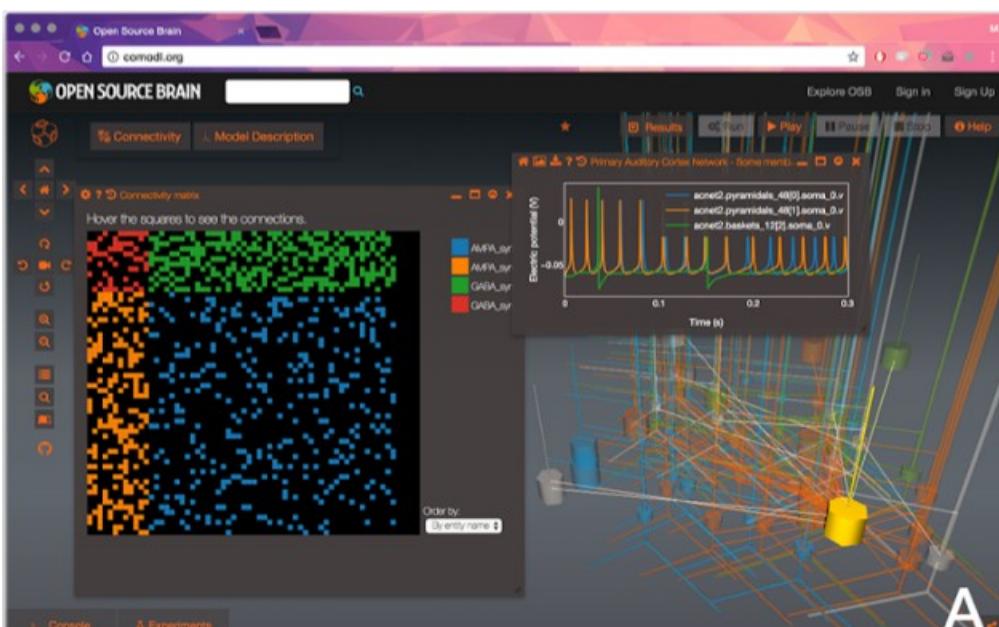


Gepetto is an open source web platform to  
**explore and simulate**  
**neuroscience** models and data  
in a **web** browser

# What can Gepetto do?

- Visualize **neuroscience data** in the browser
  - Computational Neuroscience Models (NeuroML, NEURON)
  - Morphology reconstructions (SWC, OBJ, Collada)
  - Electrophysiology recordings (NWB, HDF5)
  - Medical data (MRI, Electromicroscopy via DICOM, NIFTI, DZI)
- **Record variables, set parameters, an run simulations** from the browser
  - Simulation can run in the same server where Gepetto is running or in a remote one (e.g. San Diego Supercomputer center)
- Connect to Jupyter Notebook
- Seamless **exploration** of data and models in the browser
- Facilitates **reproducibility** of workflows
  - The entire user interface works on top of an API layer. Every user action corresponds to an API command easy to inspect and reproduce.





# GitHub

<http://github.com>

GitHub is a web-based version control repository based on Git and Internet hosting service. It is mostly used for open source code development. It offers all of the distributed version control and source code management functionality of Git as well as adding its own features.

# GitHub



Most widely used open source code development platform

Offers free hosting of Git repositories with:

- Version control
- Issue tracking
- Project/organisation management
- Integration with multiple other platforms, e.g. Travis-CI for continuous integration

Most open source computational neuroscience tools developed here

Example: NEST Simulator...



## nest / nest-simulator

Watch

22

Star

110

Fork

120

Code

Issues 135

Pull requests 18

Projects 2

Wiki

Insights

## The NEST simulator

[nest](#) [neurons](#) [simulation-toolkit](#) [point-neurons](#)

2,843 commits

5 branches

15 releases

52 contributors

GPL-2.0

Branch: [master](#) ▾[New pull request](#)[Create new file](#)[Upload files](#)[Find file](#)[Clone or download](#) ▾

	abigailm committed on GitHub Merge pull request #775 from sdiazpier/issue260	...	Latest commit bbdcd91 2 days ago
	cmake	Removed obsolete file	6 months ago
	conngen	Fixed Vera and formatting issues.	4 months ago
	debian	Initial commit. Based on NEST 2.6.1	2 years ago
	doc	Documentation explaining the use of Python for help generation	a month ago
	examples	fixed more vera complaints	4 months ago
	extras	Merge pull request #668 from gtrensch/bugfix_cppcheck_causes_travis_t...	a month ago
	lib	Merge pull request #729 from heplesser/small-cpp-fixes	2 months ago
	libnestutil	Reverted some third-party files to original version before code-forma...	4 months ago
	librandom	Test travis	2 months ago
	models	Minor changes in wording and line lengths	8 days ago
	nest	Minor changes to fix compiler warnings.	2 months ago
	nestkernel	Merge pull request #775 from sdiazpier/issue260	2 days ago
	precise	Updated strings in set_status and get_status that I missed first time to	2 months ago
	pynest	Fixed typo	9 days ago
	sli	Merge branch 'master' into skipped_sli_tests	2 months ago
	testsuite	Merge pull request #767 from SepehrMN/spin_detector_precision_fix	6 days ago



## Contributors

## Commits

## Code frequency

## Punch card

## Network

## Members

## Dependents

May 10, 2015 – Jul 13, 2017

Contributions: Commits ▾

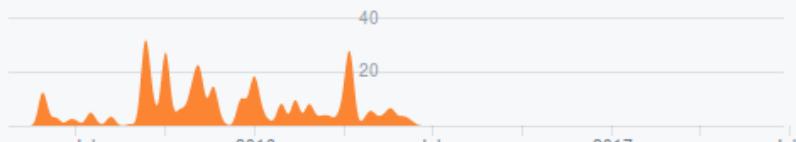
Contributions to master, excluding merge commits



tammoippen

415 commits / 59,381 ++ / 44,941 --

#1



heplesser

340 commits / 35,266 ++ / 31,916 --

#2



steffengraber

151 commits / 405,808 ++ / 397,846 --

#3



jougs

139 commits / 4,683 ++ / 13,045 --

#4



[nest / nest-simulator](#)

Watch ▾

22

Star

110

Fork

120

[Code](#)[Issues 135](#)[Pull requests 18](#)[Projects 2](#)[Wiki](#)[Insights ▾](#)[Filters ▾](#) is:pr is:open[Labels](#)[Milestones](#)[New pull request](#)[18 Open](#) ✓ 372 Closed[Author ▾](#)[Labels ▾](#)[Projects ▾](#)[Milestones ▾](#)[Reviews ▾](#)[Assignee ▾](#)[Sort ▾](#)

### Use absolute path for compile-time NEST\_PREFIX (cf. #749) ✘

#783 opened 3 days ago by muffgaga

26

### Converting some manualtests to tests used by installcheck ✓ C: Infrastructure I: No breaking change

P: PR Created S: Low T: Maintenance

#774 opened 13 days ago by hakonsbm • Approved

### Skip test if NDEBUG is set ✓ C: Infrastructure I: Behavior changes P: Pending S: Low T: Bug

#770 opened 14 days ago by jongu • Approved NEST 2.12.1

4

### Update raster\_plot ✘ C: PyNEST I: No breaking change P: PR Created S: Low T: Enhancement

#765 opened 22 days ago by hcantunc

3

### Enable users to remove gid from filename in recording devices ✓ C: Kernel I: No breaking change

P: PR Created S: Low T: Enhancement

#760 opened 23 days ago by weidel-p • Approved

9

### Add example script for structural plasticity ✓ C: Documentation I: No breaking change P: PR Created

S: Low T: Enhancement

#753 opened 29 days ago by jakobj NEST 2.12.1

66

### Rate neuron framework ✘ C: Kernel I: Internal API P: PR Created S: High T: Enhancement

#745 opened on 6 Jun by janhahne • Changes requested NEST 3.0

### Adding inhomogeneous poisson generator model ✘ C: Model I: No breaking change P: PR Created

S: Low T: Enhancement

#671 opened on 4 Mar by zbarni • Changes requested

29

### New iaf\_exp precise model that guarantees perfect detection of spikes C: Model

I: No breaking change P: PR Created S: Low T: Enhancement

#648 opened on 30 Jan by krishnanj • Changes requested

39

### Aeif psc delta 2 ✘ C: Model I: No breaking change P: PR Created S: Low T: Enhancement

#613 opened on 3 Jan by lepmik • Changes requested

15

# ReScience

<http://rescience.github.io>

**Reproducible Science is good, Replicated Science is Better.**

ReScience is a scientific journal dedicated to the publication of replication in computational sciences.

## **Journal Philosophy**

ReScience is a peer-reviewed journal that targets computational research and encourages the explicit [replication](#) of already published research, promoting new and open-source implementations in order to ensure that the original research is [reproducible](#).

To achieve this goal, the whole publishing chain is radically different from other traditional scientific journals. ReScience lives on [GitHub](#) where each new implementation of a computational study is made available together with comments, explanations and tests. Each submission takes the form of a pull request that is publicly reviewed and tested in order to guarantee that any researcher can re-use it.

If you ever replicated computational results from the literature in your research, ReScience is the perfect place to publish your new implementation.

## **Publishing fees**

None. Zero. Nada. 0\$. 0€.

## **Criteria for Publication**

To be considered for publication in ReScience, any given submission must satisfy the following criteria:

- Replicability
- Rigorous methodology
- Original source code
- Substantial evidence for replication of the original results

Furthermore, you cannot submit the replication of your own research, nor the research of your close collaborators. We believe such restrictions will favor the cross-fertilization of research and the spread of knowledge.

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**ReScience**  
Reproducible science is good. Replicated science is better.