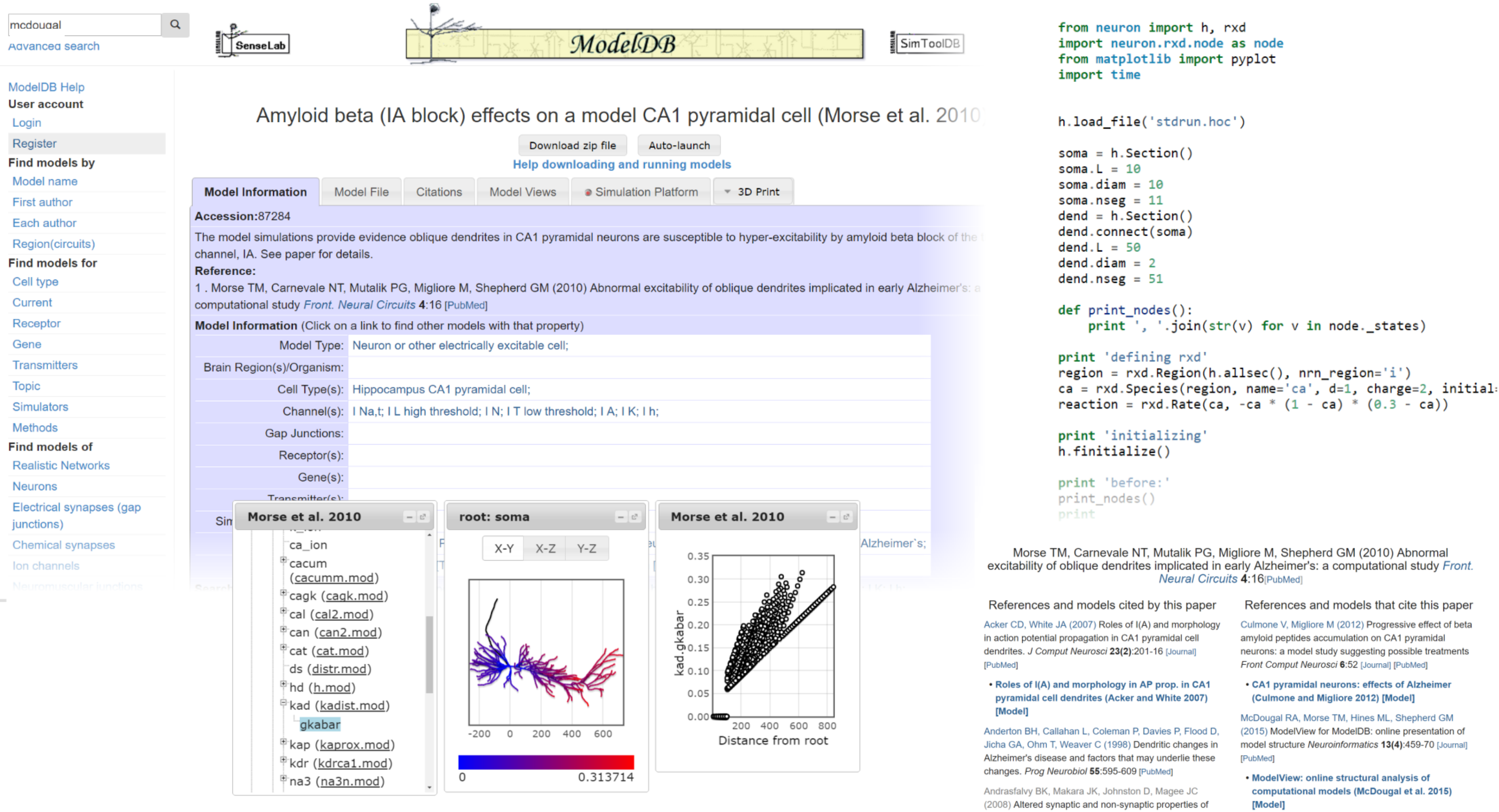
ModelDB

http://modeldb.yale.edu

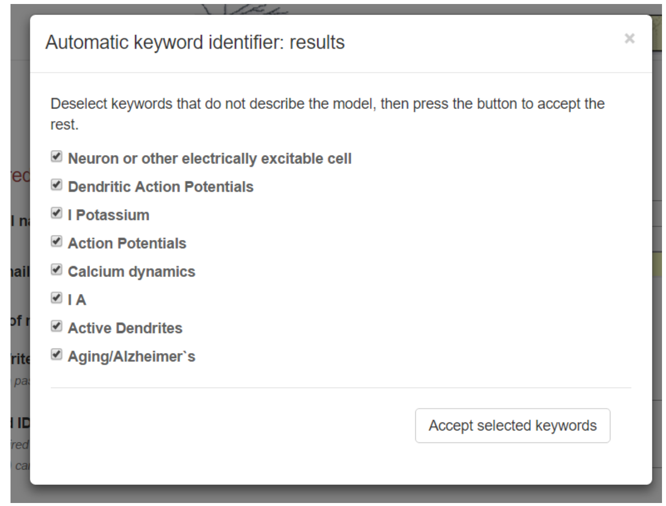
ModelDB promotes discoverability and reproducibility of computational neuroscience research by serving as a platform for curated sharing and visualization of published models.

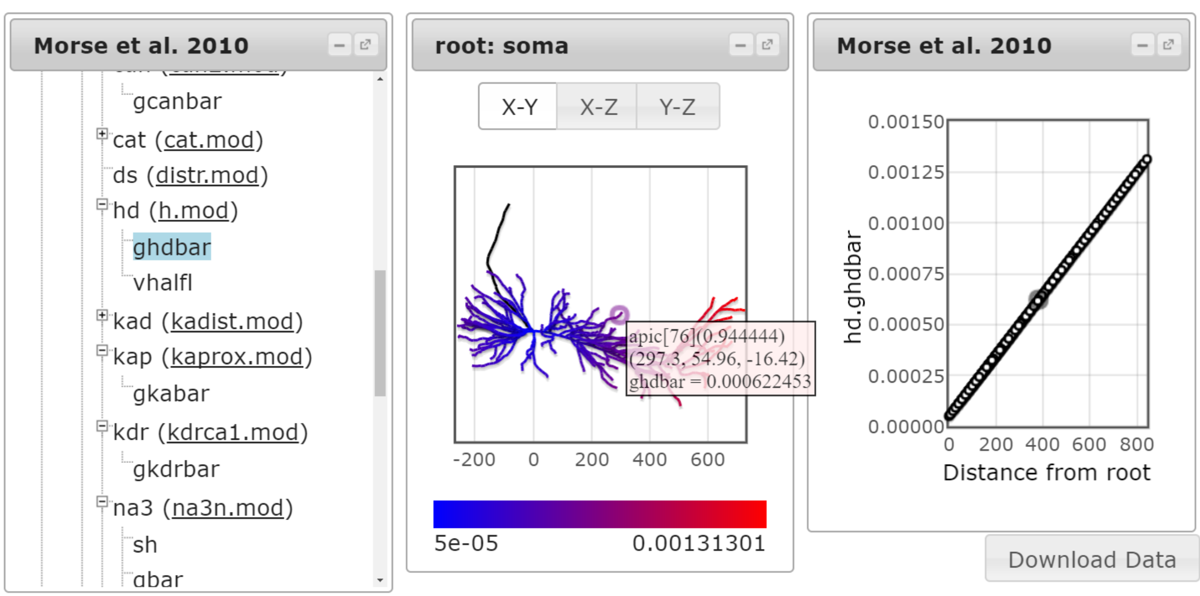


Over 1200 models · 76 simulation environments · 178 cell types · 145 topics (Alzheimer's, STDP, etc) · 16+ species · 54 ion channels, pumps, etc · 24+ mammalian brain regions

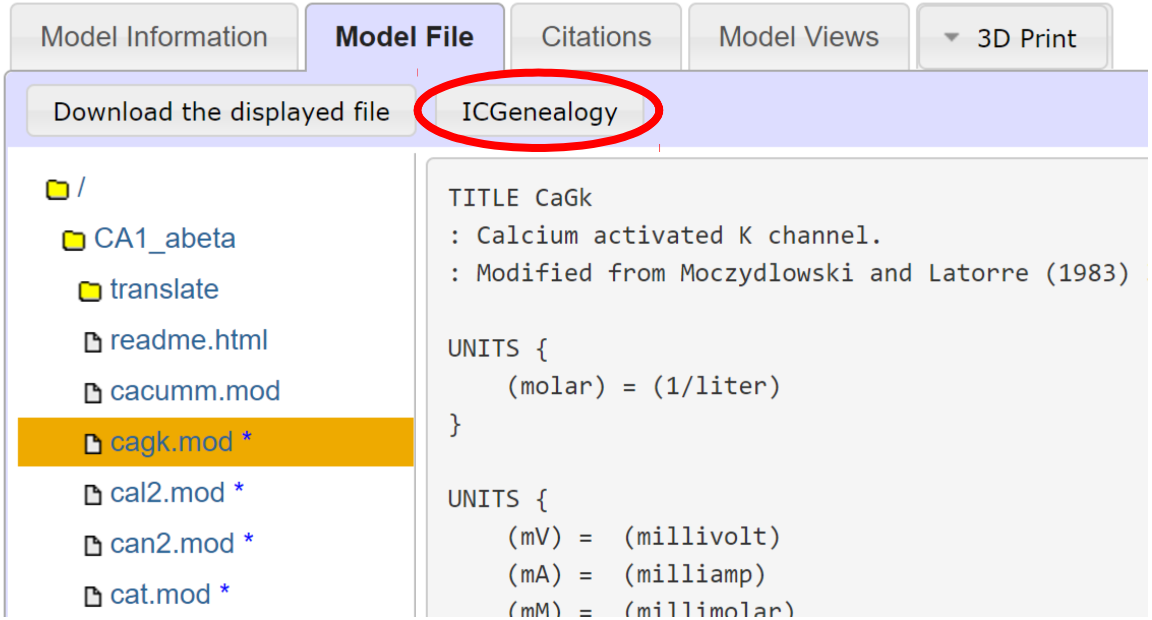
Ongoing ModelDB projects

***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.*



General data

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

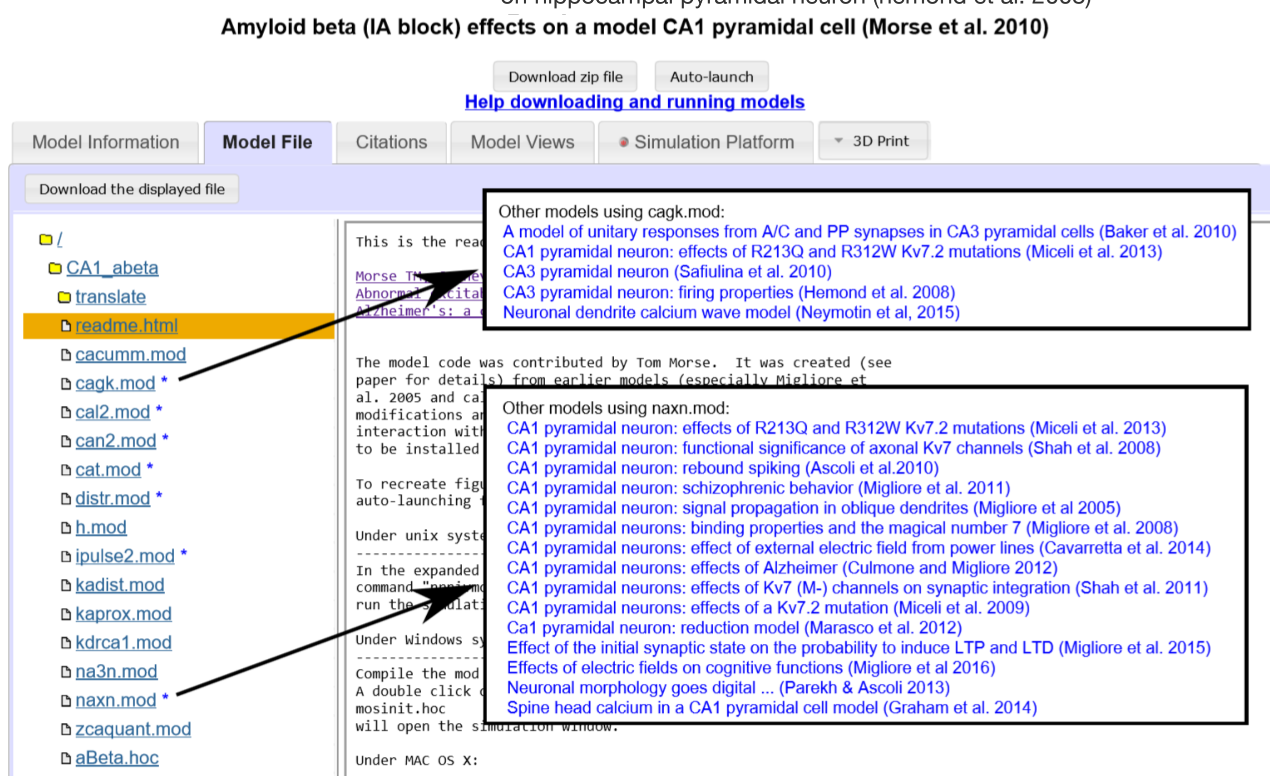
Metadata classes

- **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 moczydlowski 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)

***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

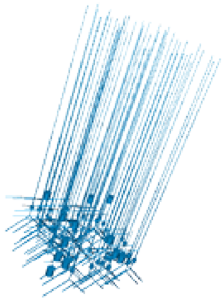
The Open Source Brain initiative (OSB) makes computational models of neurons and networks available in open source, standardized formats such as NeuroML and PyNN, encouraging collaborative development. Models and model components can be viewed, analysed and their functional behaviour explored through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

OPEN SOURCE BRAIN search projects Explore OSB Sign in Sign up

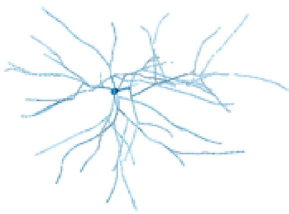
Modelling the brain, together

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

Try exploring one of these models:

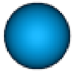


Primary Auditory Cortex Network

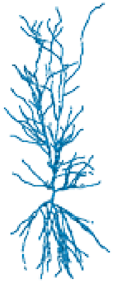


L23 Cell

Izhikevich Spiking Neuron Model



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

Neocortex

Mainen et al. (1995)
  L5 Pyramidal cell
Rothman et al. (2010)
  L5 Pyramidal cell
Hay et al (2011)
  L5 Pyramidal cell
Traub et al. (2005)
  L2/3 Pyr (FRB/RS), L4SS, L5 Pyr (IB/RS), L6 Pyr, Deep & superficial basket, axo-axonic & LTS interneurons, Cortical column network model

Olfactory Bulb

Migliore et al (2014)
  Olf. Bulb network model

Cerebellum

Maex and Schutter (1998)
  Granule cell layer
Steuber and Saviane, based on Berends et al. (2005)
  Granule cell
Vervaeke et al. (2010)
  Golgi cell network
Solinas et al. (2007a,b)
  Granule cell, Golgi cell
De Schutter and Bower (1994)
  Purkinje cell
Steuber et al. (2011)
  Cerebellar nucleus neuron

Hippocampus

Migliore et al. (2005)
  CA1 Pyramidal cell
Bezaire et al (2017)
  Full scale CA1

Thalamus

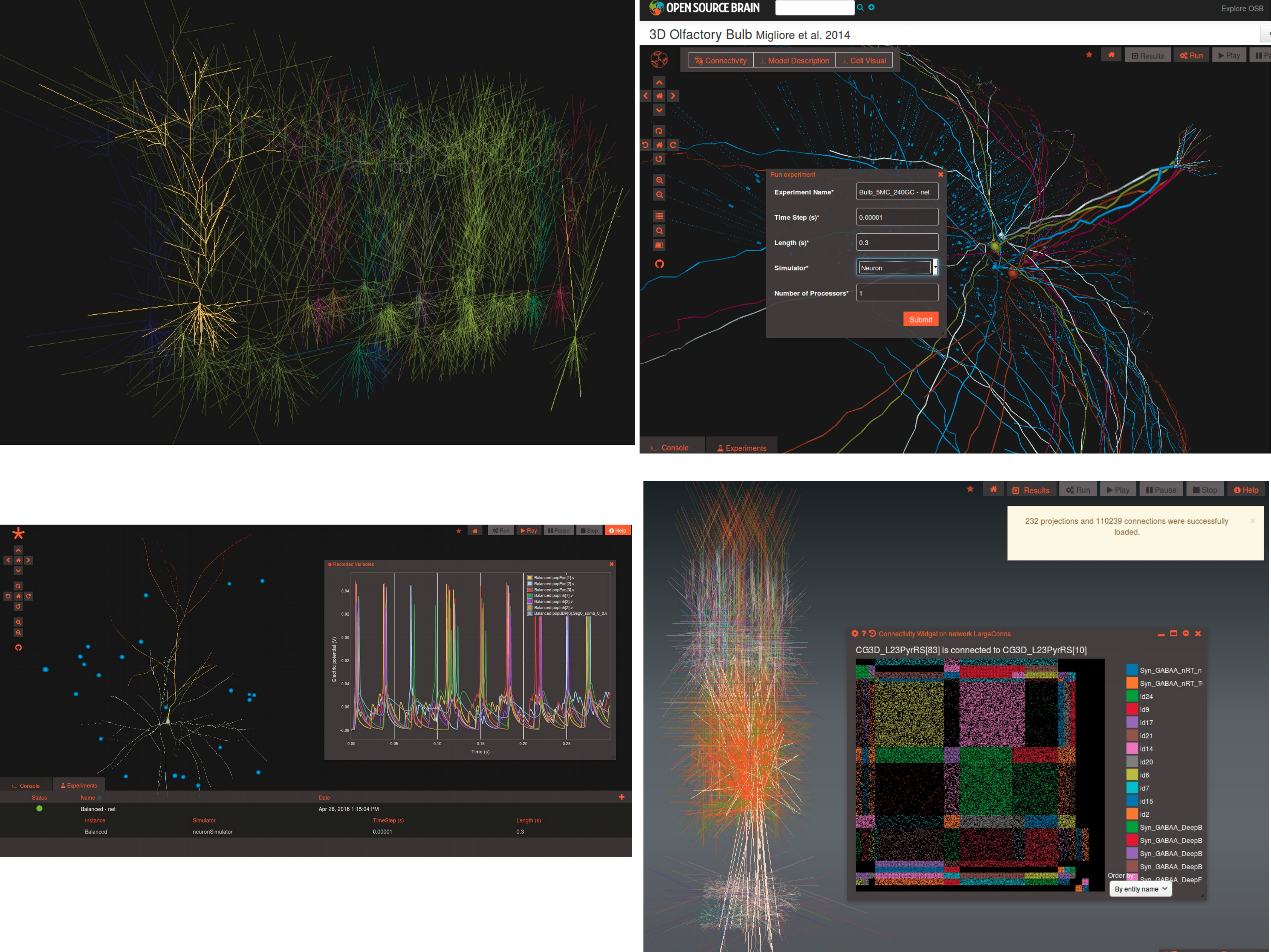
Traub et al. (2005)
  Thalamocortical relay cell, Nucleus reticularis thalami cell

C elegans

OpenWorm project
  302 cell connectome

Abstract neuron models

Izhikevich (2003)
Morris & Lecar (1981)
FitzHugh & Nagumo (1969)



OPEN SOURCE BRAIN
Explore OSB
3D Olfactory Bulb Migliore et al. 2014
Connectivity
Model Description
Cell Visual
Results
Run
Play
Run experiment
Experiment Name*
Bulb_5MC_240GC - net
Time Step (s)*
0.00001
Length (s)*
0.3
Simulator*
Neuron
Number of Processors*
1
Submit
Console
Experiments
Run
Play
Pause
Stop
Help
Recorded Variables
Balanced.popExc[1].v
Balanced.popExc[2].v
Balanced.popExc[3].v
Balanced.popInh[7].v
Balanced.popInh[3].v
Balanced.popInh[2].v
Electric potential (V)
Time (s)
Console
Experiments
Status
Name
Date
Balanced - net
Apr 28, 2016 1:15:04 PM
Instance
Simulator
TimeStep (s)
Length (s)
Balanced
neuronSimulator
0.00001
0.3
Results
Run
Play
Pause
Stop
Help
232 projections and 110239 connections were successfully loaded.
Connectivity Widget on network LargeConns
CG3D_L23PyrRS[83] is connected to CG3D_L23PyrRS[10]
id24
id9
id17
id21
id14
id20
id6
id7
id15
id2
Order by:
By entity name

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

Version 2 in active development
- Greater range of models
- Easier to extend

30+ simulators/applications/databases/libraries support NeuroML

NeuroML

Simulators

NEURON
GENESIS
MOOSE
Brian

Interoperability

PyNN
neuroConstruct

Initiatives

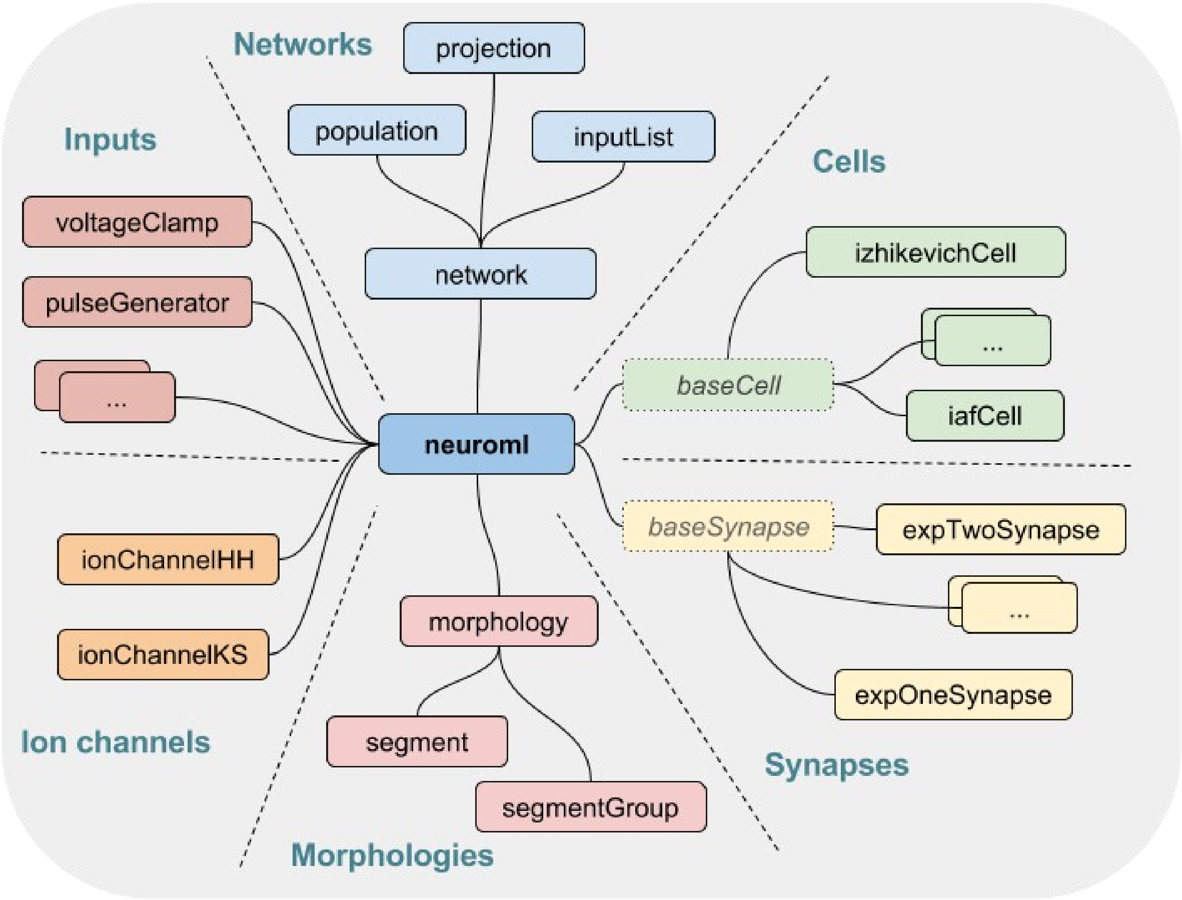
OpenWorm
Open Source Brain

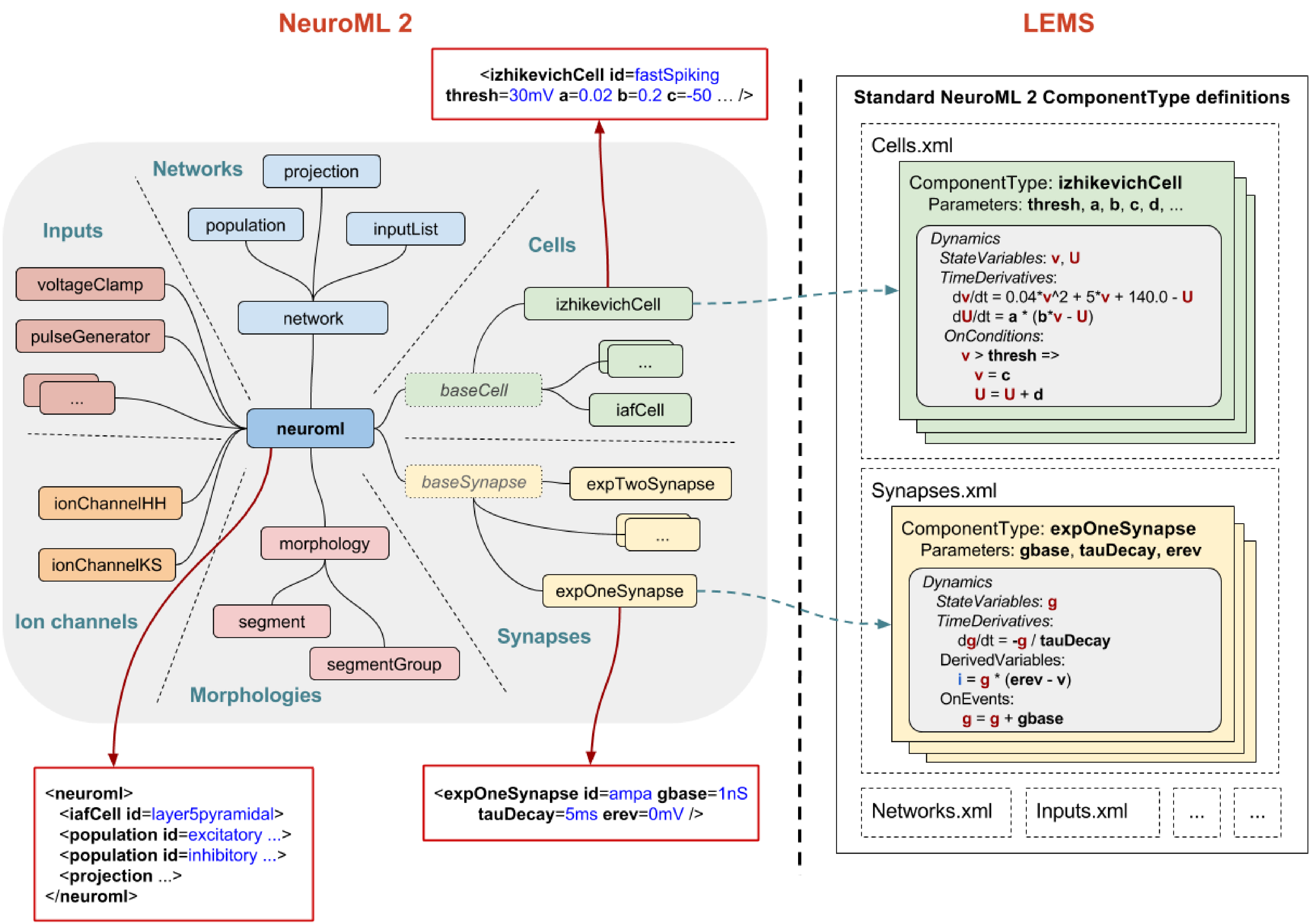
Databases

Channelpedia
BBP NMC
NeuroMorpho
Allen Institute Cell Types DB

Morphological analysis/ generation

Cx3D
TREES Toolbox
NeuGen


Networks
projection
population
inputList
network
Inputs
voltageClamp
pulseGenerator
...
Cells
izhikevichCell
...
baseCell
iafCell
neuroml
baseSynapse
expTwoSynapse
...
expOneSynapse
ionChannelHH
ionChannelKS
morphology
segment
segmentGroup
Ion channels
Morphologies
Synapses



NeuroML 2
LEMS
<izhikevichCell id=fastSpiking
thresh=30mV a=0.02 b=0.2 c=-50 … />
Networks
projection
population
inputList
network
Inputs
voltageClamp
pulseGenerator
...
neuroml
Cells
izhikevichCell
baseCell
...
iafCell
baseSynapse
expTwoSynapse
...
expOneSynapse
ionChannelHH
ionChannelKS
Ion channels
morphology
segment
segmentGroup
Morphologies
Synapses
<neuroml>
<iafCell id=layer5pyramidal>
<population id=excitatory ...>
<population id=inhibitory ...>
<projection ...>
</neuroml>
<expOneSynapse id=ampa gbase=1nS
tauDecay=5ms erev=0mV />
Standard NeuroML 2 ComponentType definitions
Cells.xml
ComponentType: izhikevichCell
Parameters: thresh, a, b, c, d, ...
Dynamics
StateVariables: v, U
TimeDerivatives:
dv/dt = 0.04*v^2 + 5*v + 140.0 - U
dU/dt = a * (b*v - U)
OnConditions:
v > thresh =>
v = c
U = U + d
Synapses.xml
ComponentType: expOneSynapse
Parameters: gbase, tauDecay, erev
Dynamics
StateVariables: g
TimeDerivatives:
dg/dt = -g / tauDecay
DerivedVariables:
i = g * (erev - v)
OnEvents:
g = g + gbase
Networks.xml
Inputs.xml
...
...

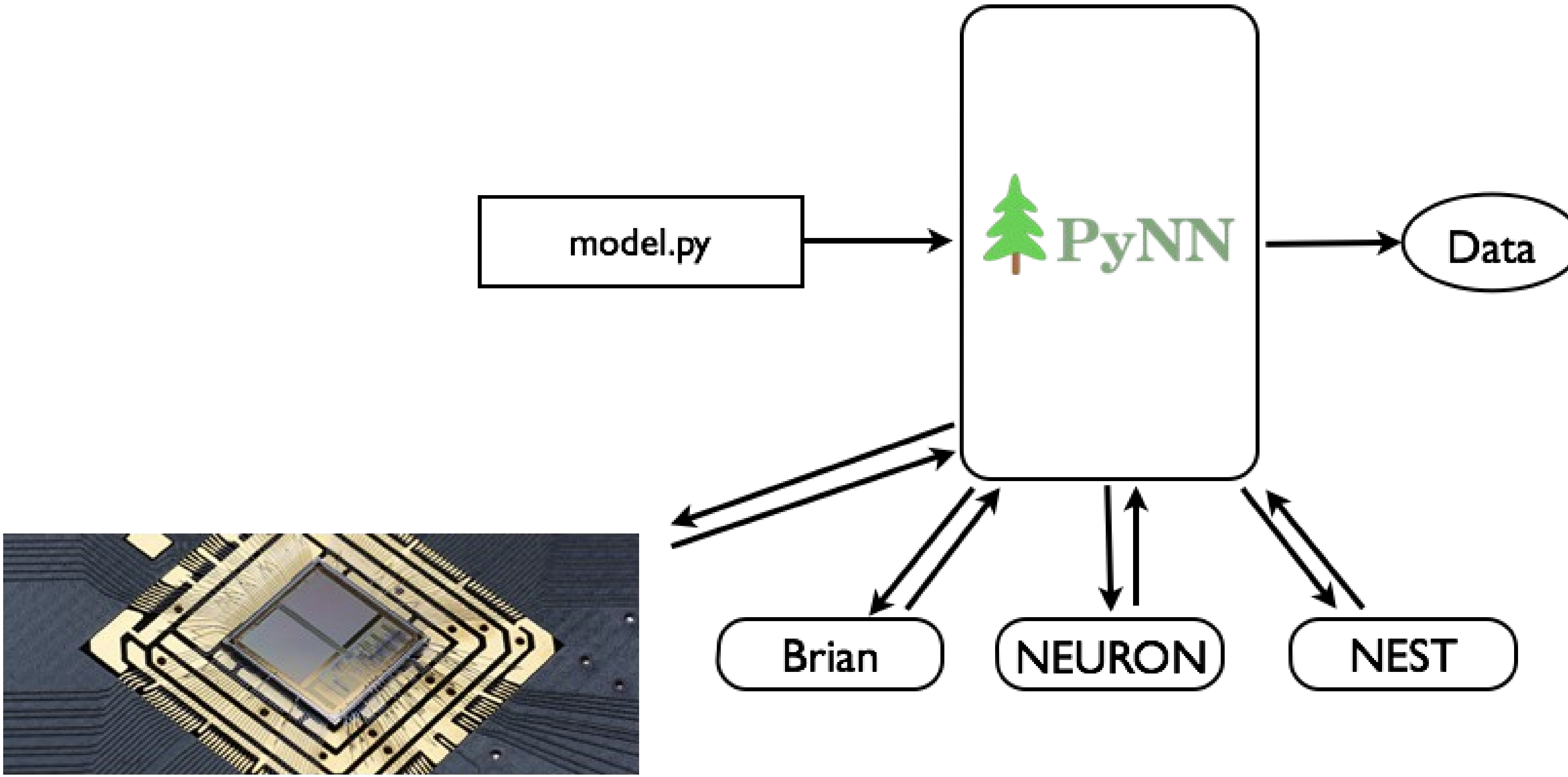
PyNN

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

Geppetto

http://www.geppetto.org

Geppetto 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, Geppetto facilitates integration of diverse data and models, and can support different standard formats for both experimental and computational data.

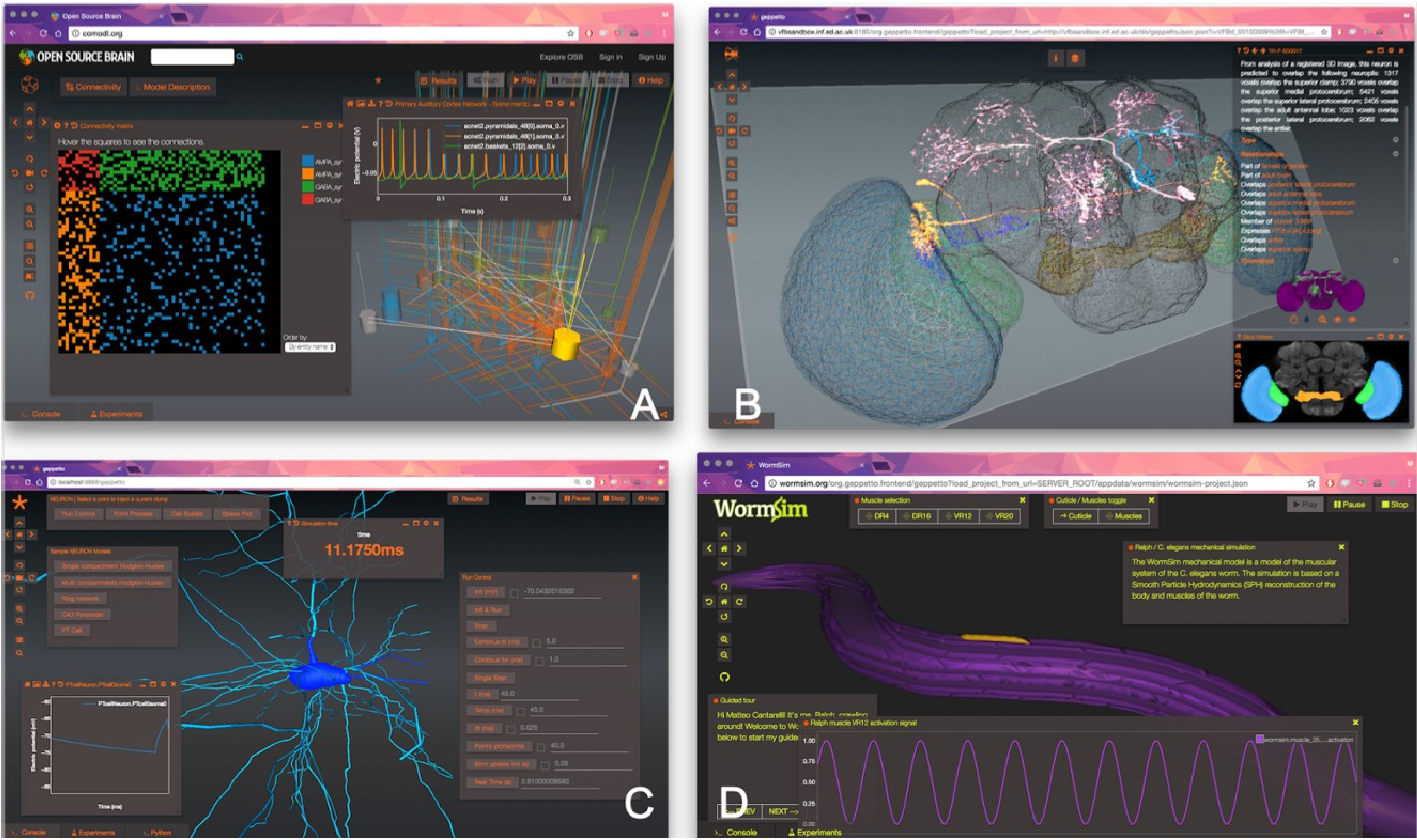
geppetto

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

What can Geppetto do?

- Visualize **neuroscience data** in the browser
    - Computational Neuroscience Models (NeuroML, NEURON)
    - Morphology reconstructions (SWC, OBJ, Collada)
    - Electrophisiology 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 Geppetto 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.

geppetto


A
B
C
D
OPEN SOURCE BRAIN
Explore OSB
Sign in
Sign Up
Connectivity
Model Description
Hover the squares to see the connections.
Time (s)
Time
11.1750ms
WormSim
Muscle selection
DR4
DR16
VR12
VR20
Cuticle / Muscles toggle
Cuticle
Muscles
Play
Pause
Stop
Ralph / C. elegans mechanical simulation
The WormSim mechanical model is a model of the muscular system of the C. elegans worm. The simulation is based on a Smooth Particle Hydrodynamics (SPH) reconstruction of the body and muscles of the worm.
Ralph muscle VR12 activation signal
Console
Experiments

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

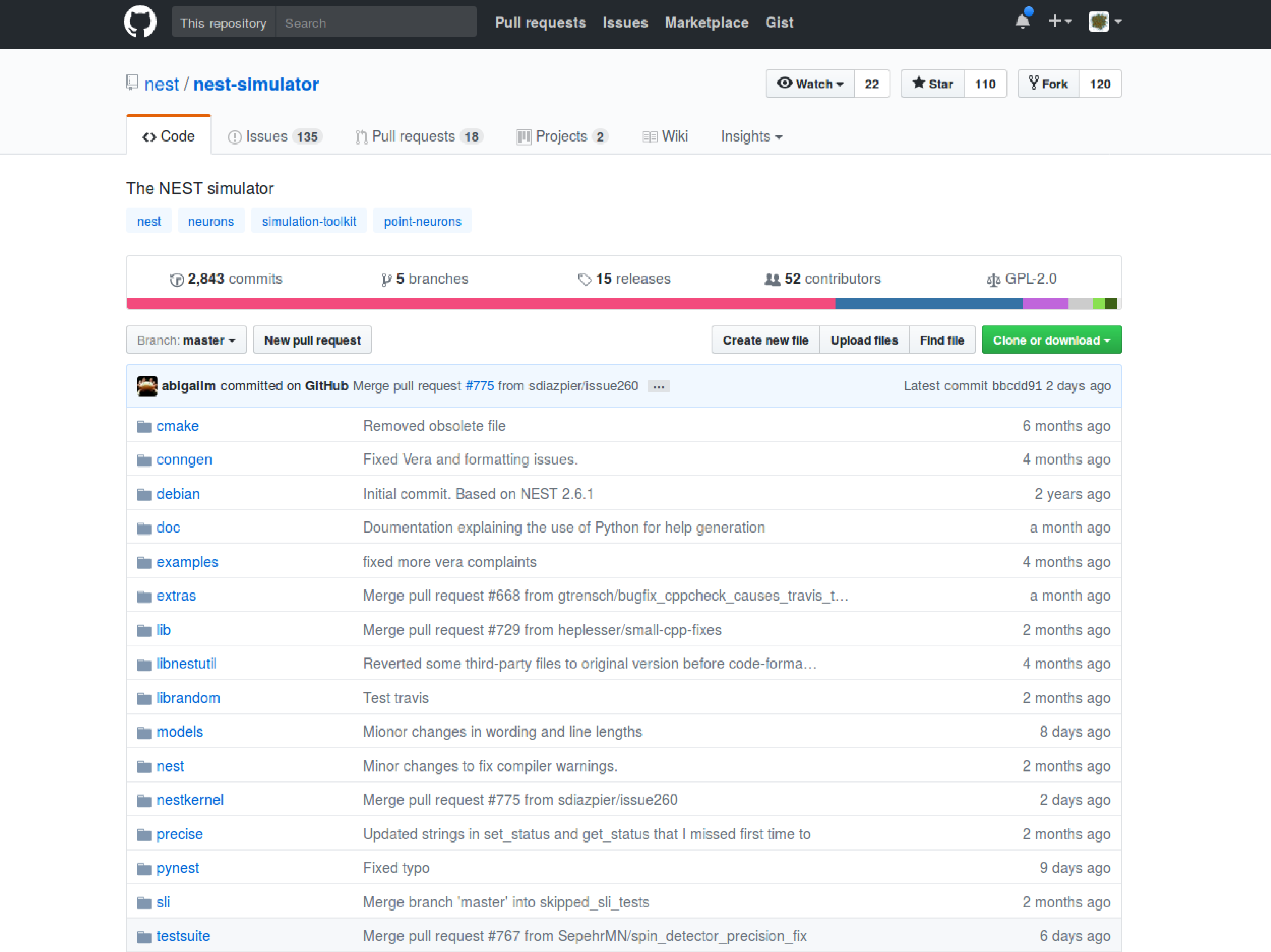
Most widely used open source code development platform

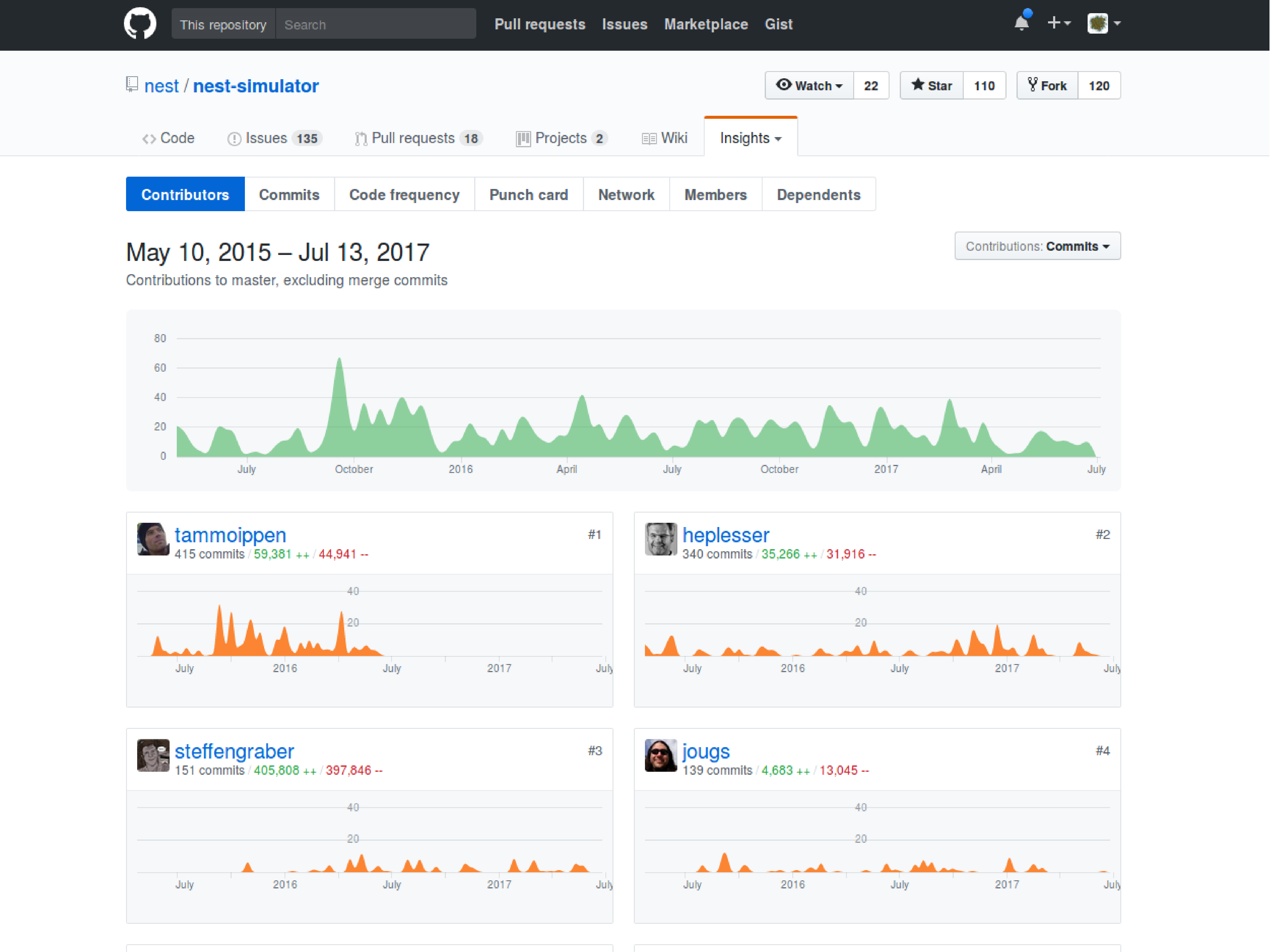
Offers free hosting of Git repositories with:

- 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...


This repository
Search
Pull requests
Issues
Marketplace
Gist
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 bbcdd91 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 Doumentation 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 Mionor 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


This repository
Search
Pull requests
Issues
Marketplace
Gist
nest / nest-simulator
Watch 22
Star 110
Fork 120
Code
Issues 135
Pull requests 18
Projects 2
Wiki
Insights
Contributors
Commits
Code frequency
Punch card
Network
Members
Dependents
May 10, 2015 – Jul 13, 2017
Contributions to master, excluding merge commits
Contributions: Commits
80
60
40
20
0
July
October
2016
April
July
October
2017
April
July
tammoippen
#1
415 commits / 59,381 ++ / 44,941 --
heplesser
#2
340 commits / 35,266 ++ / 31,916 --
steffengraber
#3
151 commits / 405,808 ++ / 397,846 --
jougs
#4
139 commits / 4,683 ++ / 13,045 --
40
20
July
2016
July
2017
July

This repository | Search | Pull requests | Issues | Marketplace | Gist

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

Converting some manualtests to tests used by installcheck ✓ C: Infrastructure | I: No breaking change | P: PR Created | S: Low | T: Maintenance — 26
#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 — 4
#770 opened 14 days ago by jougs • Approved | NEST 2.12.1

Update raster_plot ✗ C: PyNEST | I: No breaking change | P: PR Created | S: Low | T: Enhancement — 3
#765 opened 22 days ago by hcantunc

Enable users to remove gid from filename in recording devices ✓ C: Kernel | I: No breaking change | P: PR Created | S: Low | T: Enhancement — 9
#760 opened 23 days ago by weidel-p • Approved

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

Rate neuron framework ✗ C: Kernel | I: Internal API | P: PR Created | S: High | T: Enhancement — 66
#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 — 29
#671 opened on 4 Mar by zbarni • Changes requested

New iaf_exp precise model that guarantees perfect detection of spikes C: Model | I: No breaking change | P: PR Created | S: Low | T: Enhancement — 39
#648 opened on 30 Jan by krishnanj • Changes requested

Aeif psc delta 2 ✗ C: Model | I: No breaking change | P: PR Created | S: Low | T: Enhancement — 15
#613 opened on 3 Jan by lepmik • Changes requested

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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We redo Science !

ReScience

Reproducible science is good. Replicated science is better.