

Ontology-assisted keyword search for NeuroML models

Justas Birgiolas, MBA

Dr. Sharon Crook | Dr. Suzanne Dietrich

A. Rajadesingan | C. Zhang | S.V. Penchala | V. Addepalli

Arizona State University

Airplanes to Brains

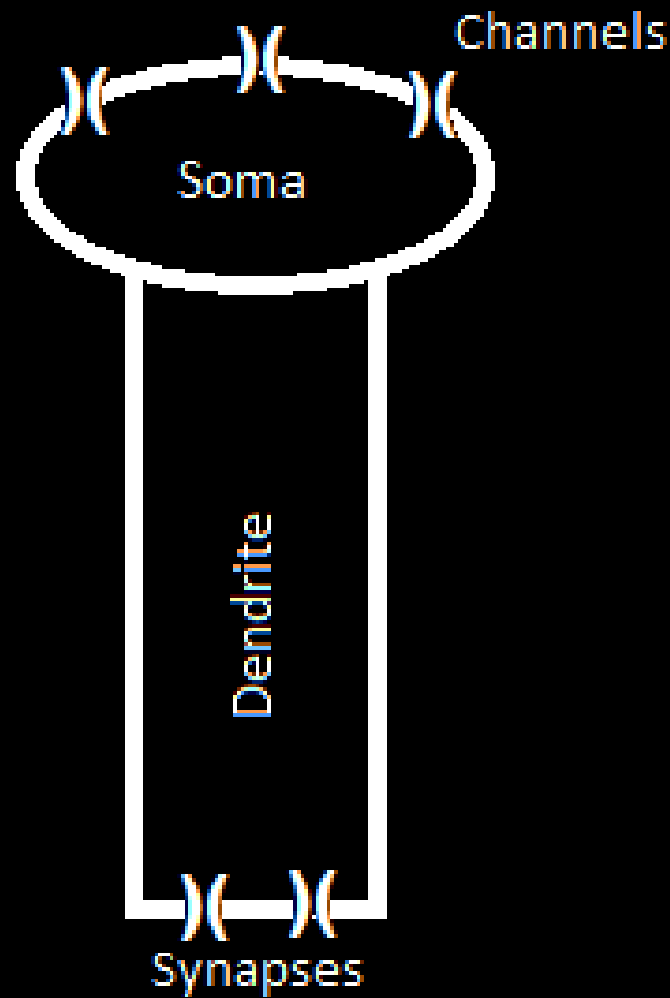


Boeing 787



2.3 million parts

Neuron



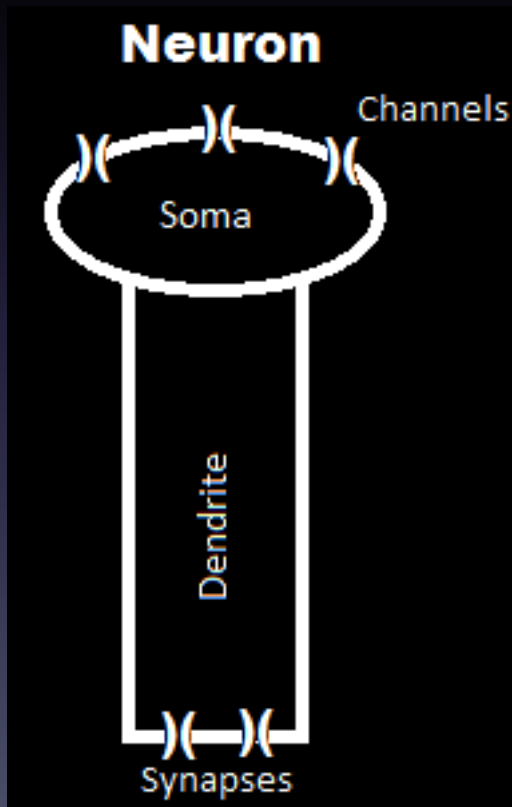
Reusing Models Is Difficult

- Written in a variety of computer languages
 - Translation
 - Extraction
- Duplication of effort
 - Above incentivize re-creation of models
 - Loss to funders and taxpayers



- International collaborative to create modular XML language to describe computational neuroscience models
- Allows description of:
 - Individual neurons + morphology + dynamics
 - Their components
 - Networks composed of neurons

NeuroML facilitates component *re-use*



```
<neuroml>
  <cell>
    <morphology>
      <segment id="0" name="soma">...</segment>
      <segment id="1" name="dend">...</segment>
    </morphology>

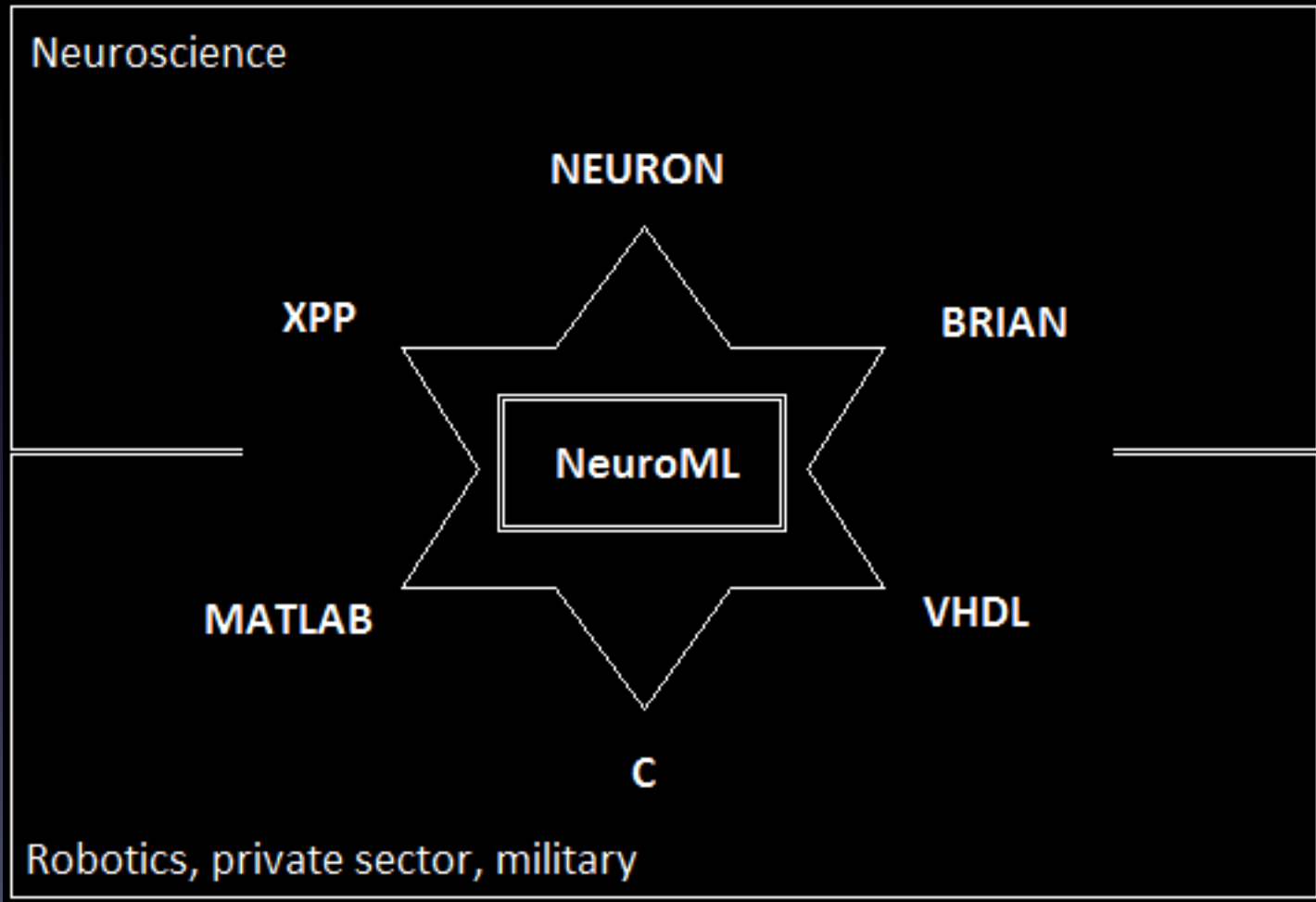
    <biophysicalProperties id="biophys">
      <membraneProperties>

        <channelDensity ion="na">...</channelDensity>
        <channelDensity ion="k">...</channelDensity>

        <spikeThresh value="0 mV"/>
        <specificCapacitance value="3.0 uF_per_cm2"/>
        <initMembPotential value="-60.0 mV"/>

      </membraneProperties>
    </biophysicalProperties>
  </cell>
</neuroml>
```

Automated NeuroML Translation



Challenges of Finding Components

- Searching procedural code is difficult:
 - Lack of knowledge of the language
 - Lack of knowledge of the code structure & conventions
 - Lack of knowledge of model implementation

NeuroML-DB facilitates component *search*

NeuroML-DB.org

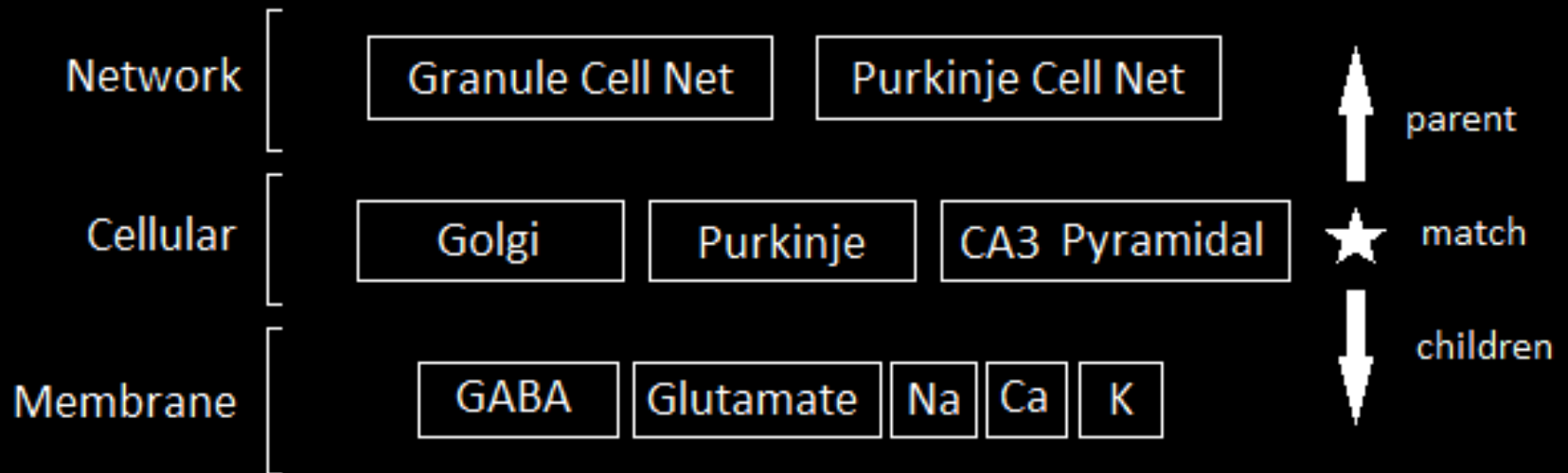
=

Multi-Scale SQL Search of NeuroML

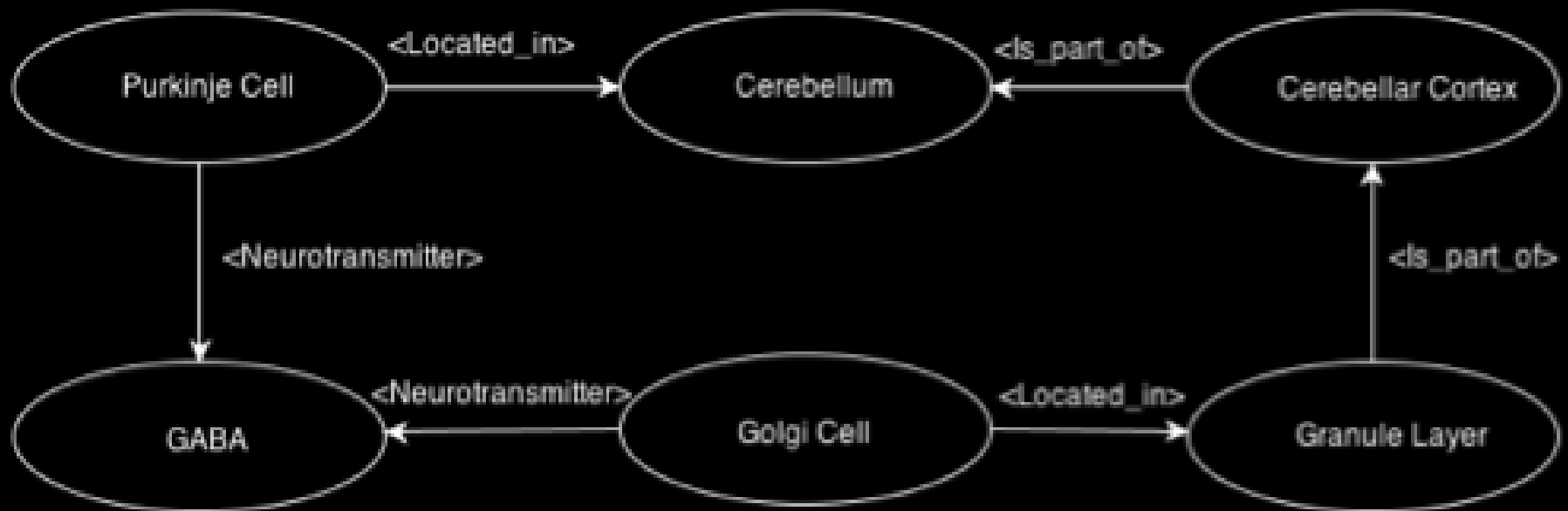
+

SPARQL Graph Search of NeuroLex Ontology

Multi-Scale SQL Search



SPARQL Graph Search



Demo

neuroml-db.org

Search NeuroML Models

Keyword Search Results

[MultiDecaySyn Synapse](#) (NMLSY000100)

[ApicalSyn Synapse](#) (NMLSY000099)

[GapJuncCML Synapse](#) (NMLSY000084)

[NMDA Synapse](#) (NMLSY000083)

[MF_AMPA Synapse](#) (NMLSY000082)

[GABAA Synapse](#) (NMLSY000081)

[AMPA_GranGol Synapse](#) (NMLSY000080)

[Golgi Cell Network - Vervaeke](#) (NMLNT000070)

[Cerebellar Granule Layer Network](#) (NMLNT000001)



[Golgi Cell](#) (NMLCL000085)

Ontology Based Recommendations

[Cerebellar Granule Layer Network](#) (NMLNT000001)

Includes **Cerebellum Golgi cell**

Model Information

Model Id:	NMLCH000037
Model Type:	Channel
Model Name:	CaP_Channel
Authors:	Erik De Schutter James M Bower
Translators:	Padraig Gleeson Arnd Roth David Beeman
Publication:	An active membrane model of the cerebellar Purkinje cell. I. Simulation of current clamps in slice
Neurolex IDs:	Voltage-gated calcium channel, Ca²⁺. CaV
References:	 
Keywords:	None
Associated Cells:	Purkinje Cell
NeuroML Files	DOWNLOAD MODEL FILES

Search NeuroML Models

Keyword Search Results

[NMDA Synapse](#) (NMLSY000083)

[MF_AMPA Synapse](#) (NMLSY000082)

[GABAA Synapse](#) (NMLSY000081)

[AMPA_GranGol Synapse](#) (NMLSY000080)

[Cerebellar Granule Layer Network](#) (NMLNT000001)

Ontology Based Recommendations

[Golgi Cell](#) (NMLCL000004)

Releases **GABA**

[Golgi Cell Network - Vervaeke](#) (NMLNT000070)

Releases **GABA**

[Purkinje Cell](#) (NMLCL000005)

Releases **GABA**

Search NeuroML Models

Keyword Search Results

[MultiDecaySyn Synapse](#) (NMLSY000100)

[ApicalSyn Synapse](#) (NMLSY000099)

[GapJuncCML Synapse](#) (NMLSY000084)

[NMDA Synapse](#) (NMLSY000083)

[MF_AMPA Synapse](#) (NMLSY000082)

[GABAA Synapse](#) (NMLSY000081)

[AMPA_GranGol Synapse](#) (NMLSY000080)

[Golgi Cell Network - Vervaeke](#) (NMLNT000070)

[Cerebellar Granule Layer Network](#) (NMLNT000001)

[Golgi_Cell](#) (NMLCL000085)

Ontology Based Recommendations

[Granule Cell](#) (NMLCL000002)

Located in **Granular layer of cerebellar cortex**

[Golgi Cell](#) (NMLCL000004)

Located in **Granular layer of cerebellar cortex**

[Golgi Cell Network - Vervaeke](#) (NMLNT000070)

Located in **Granular layer of cerebellar cortex**

[Purkinje Cell](#) (NMLCL000005)

Located in **Cerebellum**

Search NeuroML Models

Keyword Search Results

[NMDA Synapse](#) (NMLSY000083)

[MF AMPA Synapse](#) (NMLSY000082)

[GABAA Synapse](#) (NMLSY000081)

[AMPA GranGol Synapse](#) (NMLSY000080)

[Cerebellar Granule Layer Network](#) (NMLNT000001)

[Golgi Cell](#) (NMLCL000004)

[Granule Input Mossy Fiber Cell](#) (NMLCL000003)

[Granule Cell](#) (NMLCL000002)

Ontology Based Recommendations

[Golgi Cell](#) (NMLCL000004)

Located in **Granular layer of cerebellar cortex**

Releases **GABA**

[Golgi Cell Network - Vervaeke](#) (NMLNT000070)

Located in **Granular layer of cerebellar cortex**

Releases **GABA**

[Purkinje Cell](#) (NMLCL000005)

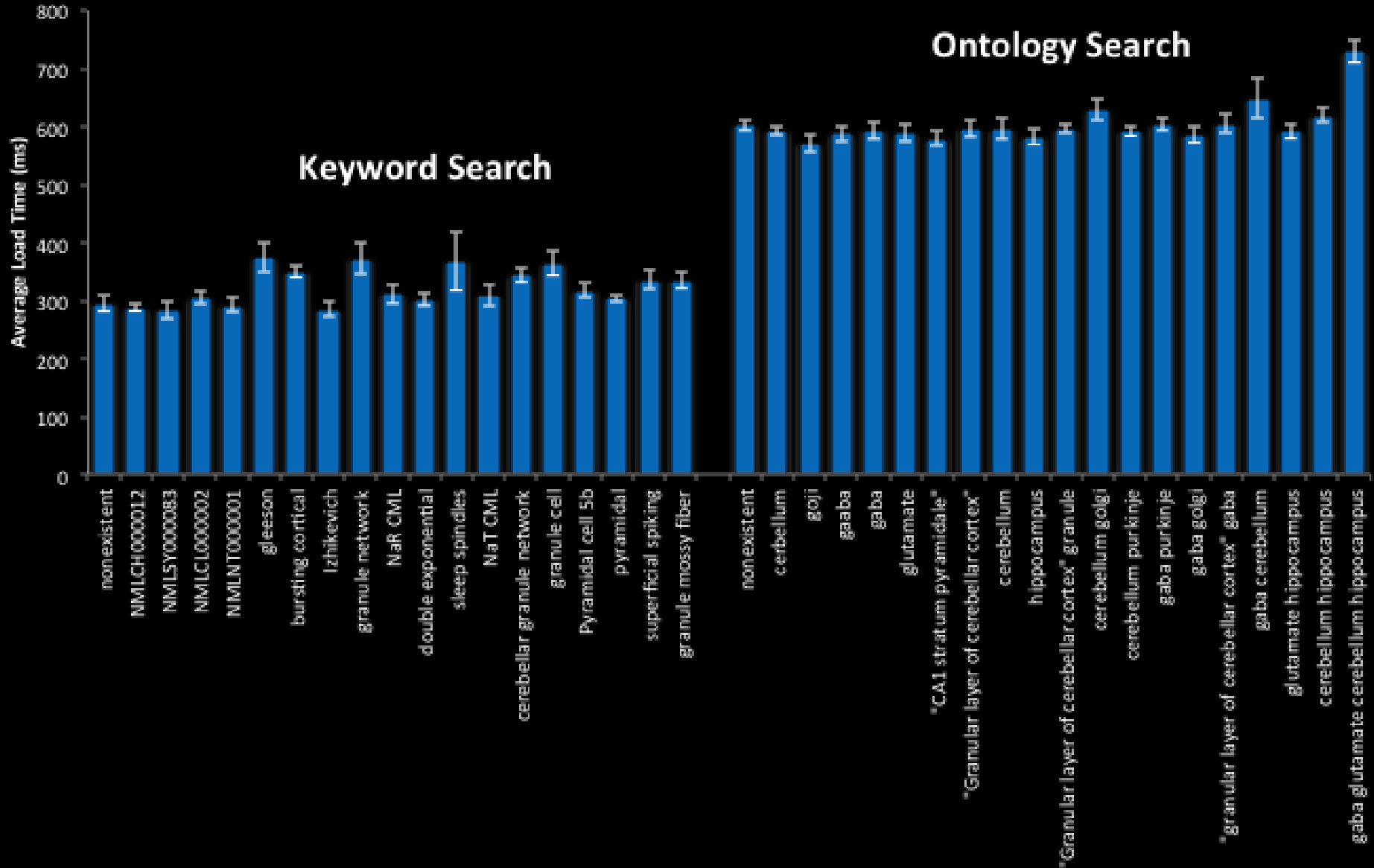
Located in **Cerebellum**

Releases **GABA**

[Granule Cell](#) (NMLCL000002)

Located in **Granular layer of cerebellar cortex**

Implementation Evaluation



The NeuroML Vision

A vibrant desert landscape at sunset. The sky is a mix of orange, yellow, and purple. In the foreground, there are several types of cacti, including tall saguaros and cholla. The middle ground shows more cacti and some low-lying desert shrubs. In the background, there are dark, silhouetted mountains under the setting sun.

Imagine... one day anyone being able to effortlessly assemble cognitive models from pre-made components and networks.

What will they create?
What will *you* create?

Acknowledgements

- Graduate Student Contributions:
 - Ashwin Rajadesingan
 - Chao Zhang
 - Shriharsha Velugoti Penchala
 - Veerasekhar Addepalli
- NeuroLex Collaborators:
 - Maryann Martone
 - Anita Bandrowski
- NeuroML Collaborators:
 - Angus Silver Lab @ UCL
 - Padraig Gleeson
- Funding:
 - National Institute of Biomedical Imaging and Bioengineering (R01EB014640)
 - National Institute of Mental Health (R01MH081905)

Justas Birgiolas, MBA

Dr. Sharon Crook | Dr. Suzanne Dietrich

A. Rajadesingan | C. Zhang | S.V. Penchala | V. Addepalli

Arizona State University