

Brief introduction to NeuroLex

Stephen D. Larson

NeuroML 3rd Annual Workshop

London - 3/31/11

Overview

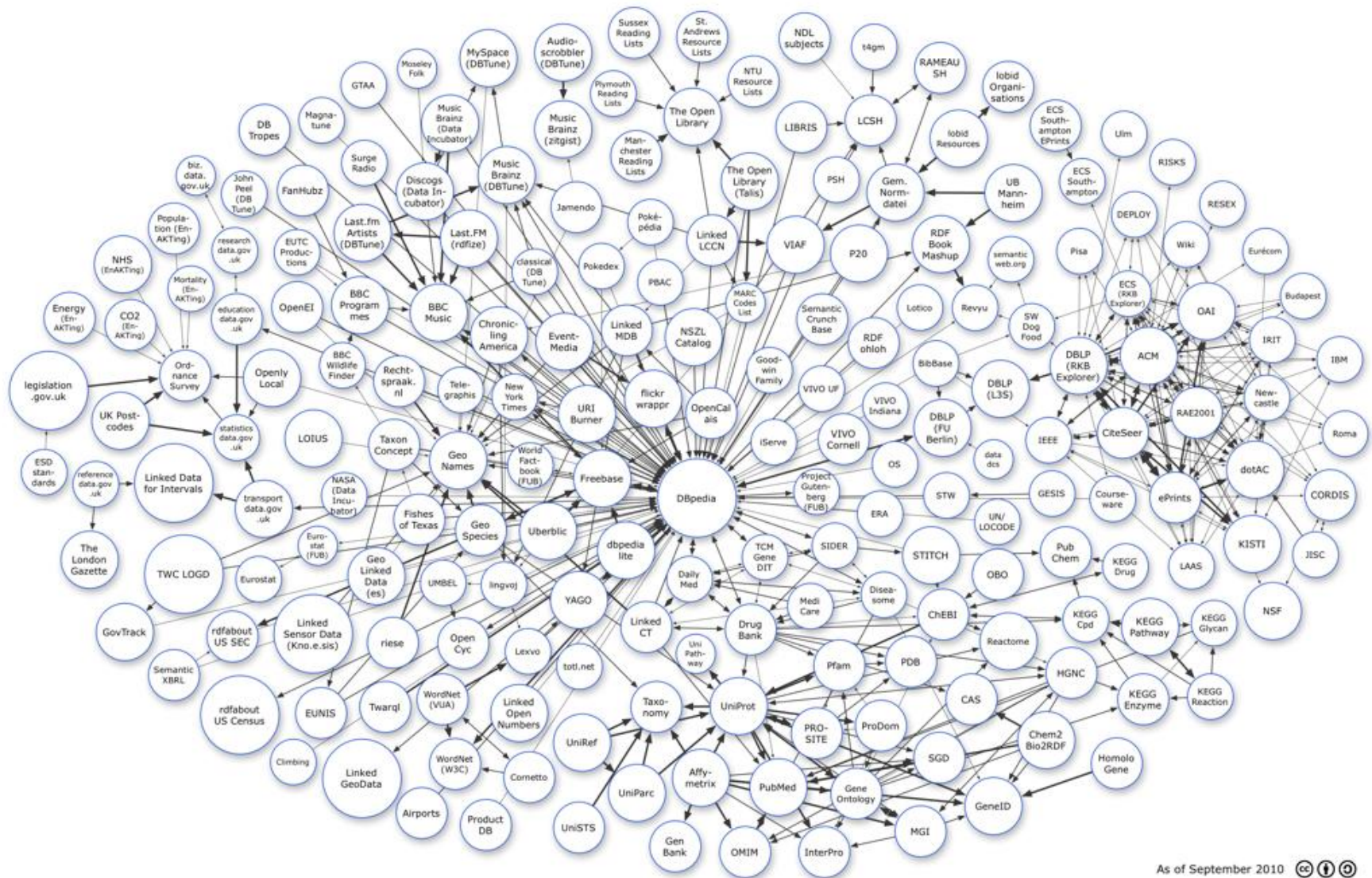
- Brief introduction to linked data
- Value of ontologies for neuroscience
- Neuroscience information framework: Using ontologies to index online neuroscience databases
- NeuroLex.org: Collaborative online management of neuroscience ontologies

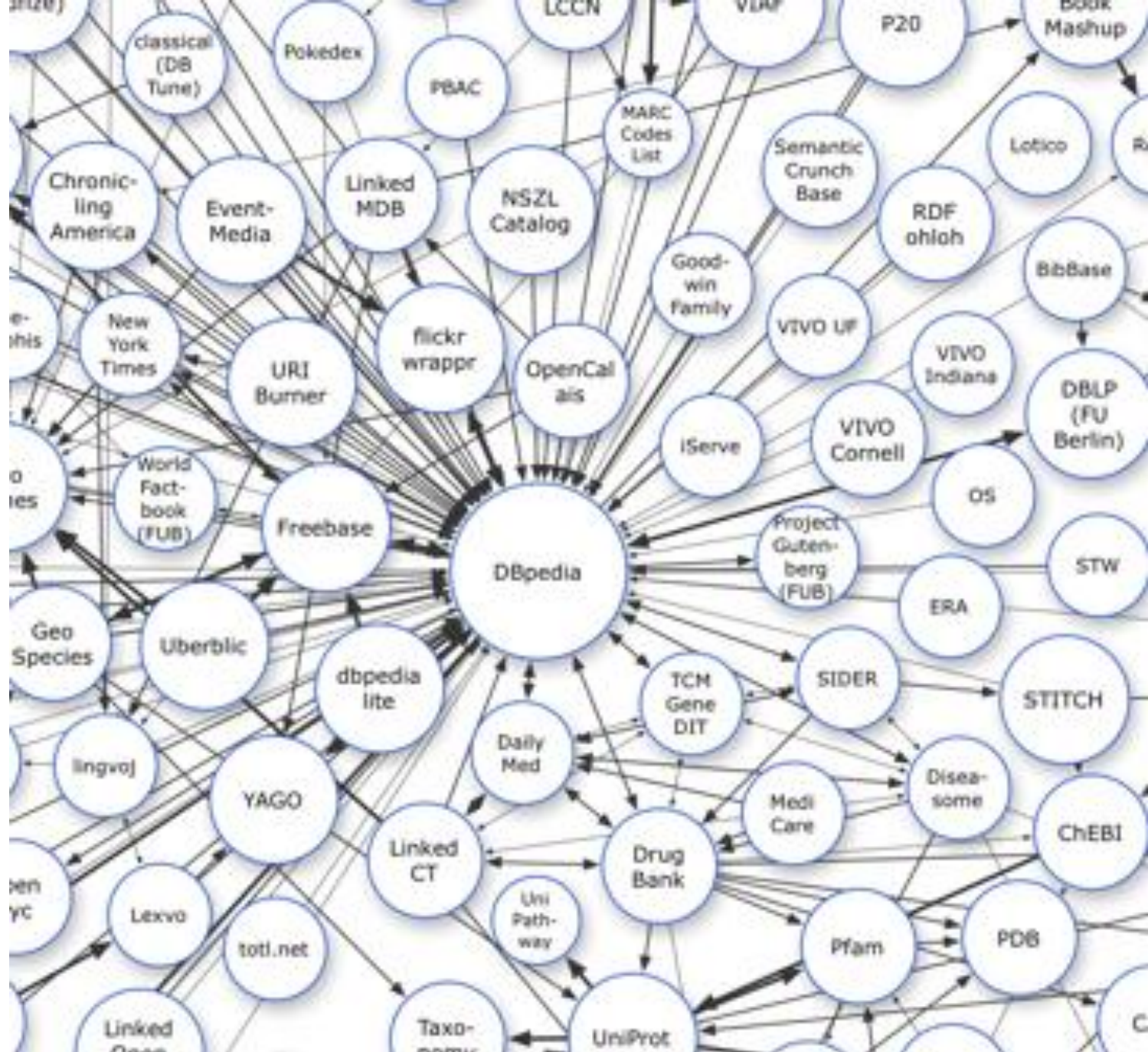
Programmatic resources

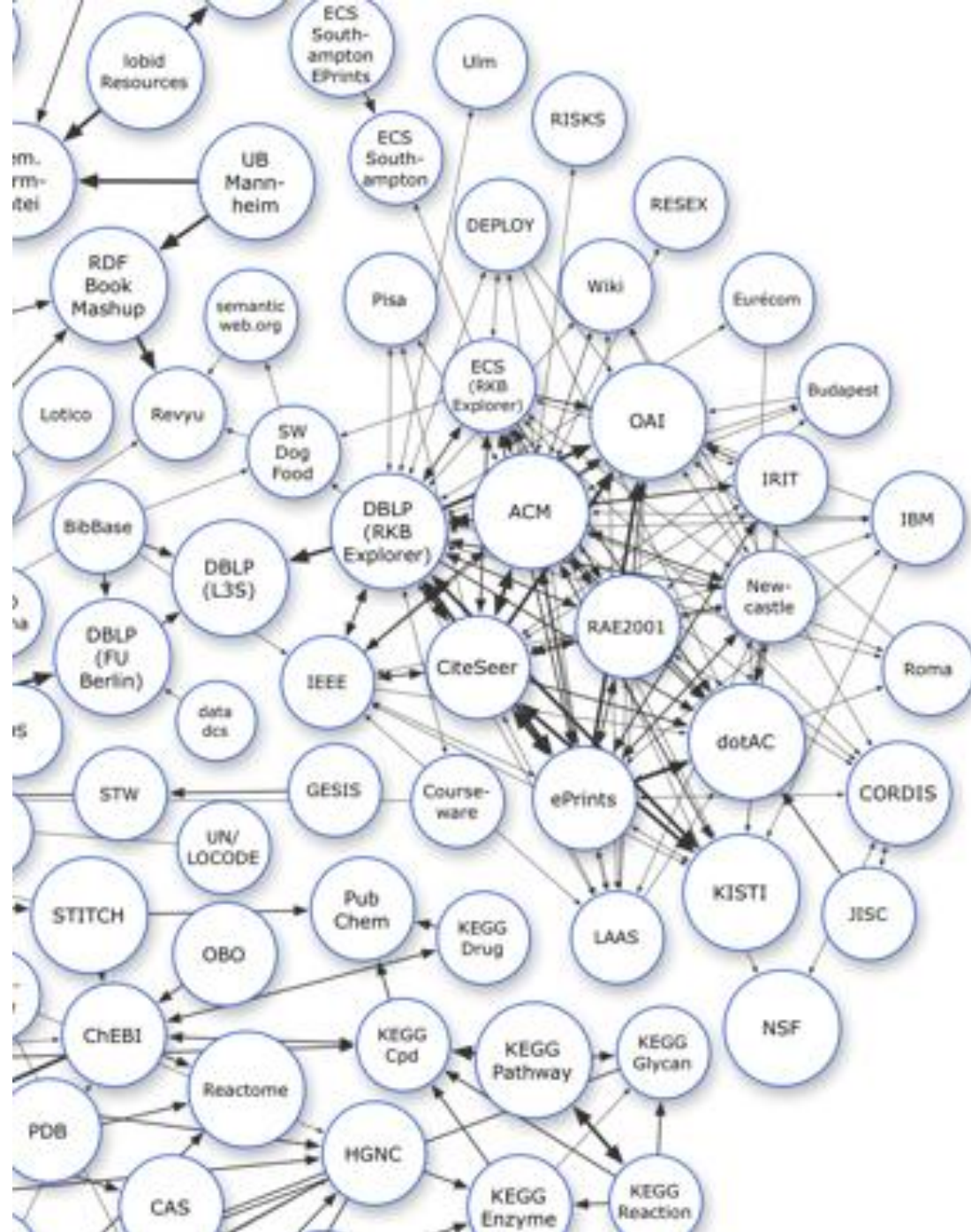
- NIF maintains the NIF vocabularies in different forms for different purposes
 - Neurolex Wiki: Lexicon for community review and comment
 - [http://neurolex.org/wiki/NeuroLex SPARQL endpoint](http://neurolex.org/wiki/NeuroLex_SPARQL_endpoint)
 - NIFSTD: set of modular OWL files normalized under BFO and available for download
 - <http://neuinfo.org/developers/>
 - NCBO Bioportal for visibility and mapping services
 - <http://bioportal.bioontology.org/ontologies/45355>

BRIEF INTRODUCTION TO LINKED DATA

Open Linked Data Graph









WIKIPEDIA
The Free Encyclopedia

Navigation

[Main page](#)
[Contents](#)
[Featured content](#)
[Current events](#)
[Random article](#)

Interaction

[About Wikipedia](#)
[Community portal](#)
[Recent changes](#)
[Contact Wikipedia](#)
[Donate to Wikipedia](#)
[Help](#)

Toolbox

[What links here](#)
[Related changes](#)
[Upload file](#)
[Special pages](#)
[Permanent link](#)
[Cite this page](#)

Print/export

[Create a book](#)
[Download as PDF](#)
[Printable version](#)

Article [Discussion](#)

Read [View source](#)

Germany

From Wikipedia, the free encyclopedia

This article is about the country. For other uses of terms redirecting here, see [Germany \(disambiguation\)](#).



Editing of this article by new or unregistered users is currently disabled. See the [protection policy](#) and [protection log](#) for more details. If you wish to make a change, you can [request an edit](#), [discuss changes on the talk page](#), [request unprotection](#), [log in](#), or [create an account](#).

Germany (ⁱ ⁱ

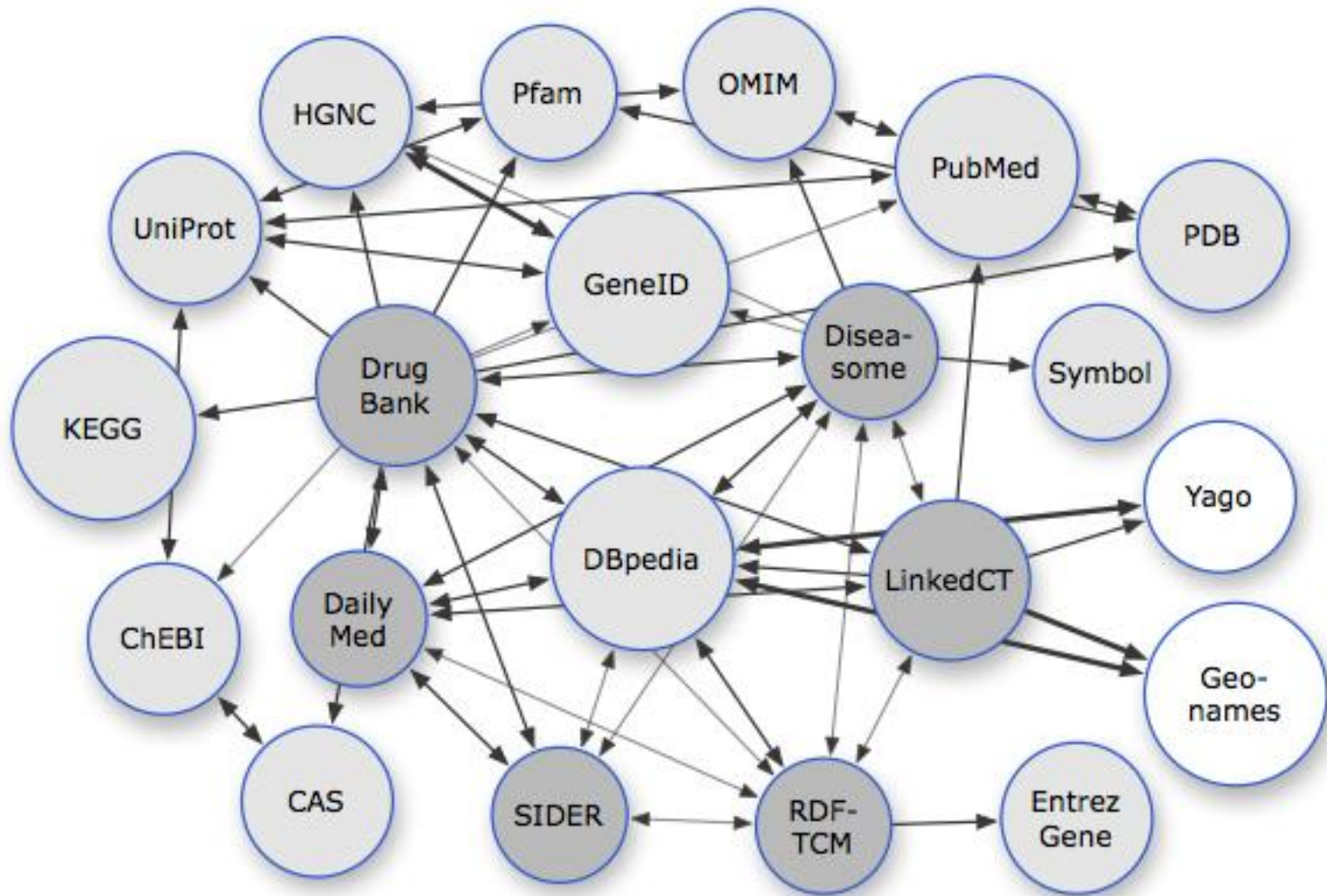
NeuroLex x Inbox (7) -... x PONS Sea... x Tasks x Google C... x Google D... x Research ... x D About: Ge... x

dbpedia.org/page/Germany

GMail Free forum : Whole ... WBC IRC channel Note in Reader Mint.com > Start He... WBC Tasks 42 Mind42.com - The S... Other bookmarks

dbpedia-owl:capital	<ul style="list-style-type: none"> dbpedia:Berlin
dbpedia-owl:demonym	<ul style="list-style-type: none"> German
dbpedia-owl:ethnicGroup	<ul style="list-style-type: none"> dbpedia:Germans
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dbpedia-owl:language	<ul style="list-style-type: none"> dbpedia:German_language
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dbpedia-owl:leaderTitle	<ul style="list-style-type: none"> President Chancellor
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dbpprop:aircraftCode	<ul style="list-style-type: none"> D
dbpprop:altSportCode	<ul style="list-style-type: none"> GER
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dbpprop:cctld	<ul style="list-style-type: none"> .de
dbpprop:commonName	<ul style="list-style-type: none"> Germany
dbpprop:conventionalLongName	<ul style="list-style-type: none"> Federal Republic of Germany
dbpprop:currency	<ul style="list-style-type: none"> Euro
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dbpprop:establishedEvent	<ul style="list-style-type: none"> dbpedia:History_of_Germany dbpedia:Holy_Roman_Empire dbpedia:German_reunification dbpedia:Unification_of_Germany
dbpprop:ethnicGroups	<ul style="list-style-type: none"> 91.5% German, 2.4% Turkish, 6.1% other
dbpprop:euseats	<ul style="list-style-type: none"> 99 (xsd:integer)
dbpprop:footnote	<ul style="list-style-type: none"> Also .eu, shared with other European Union member states. Before 2002: Deutsche Mark .

Biological Linked Data



World Wide Web Consortium's Health Care and Life Sciences Interest Group



The screenshot shows the HCLSIG website interface. At the top right, there is a 'Log in' link. Below it, a navigation bar contains links for 'page', 'discussion', 'view source', and 'history'. The W3C logo is on the left, and the HCLSIG logo is on the right. The main heading is 'Semantic Web for Health Care and Life Sciences Interest Group'. Below this, a dashed box contains links for 'Task Forces', 'Presentations', 'Documents', 'Demonstrations', and 'Participants'. A paragraph describes the mission of the group, mentioning its focus on biological science, translational medicine, and health care, and its reliance on the interoperability of Semantic Web technologies. It also mentions that more information is available on the W3C Web site for the HCLSIG. Below this, there is a section for 'HCLSIG Group Meetings' with a 'Telcon' subsection. The 'Telcon' subsection lists links for 'Next Meeting July 1', 'Past Meetings', and 'Teleconference Guide'. On the left side, there is a 'navigation' section with links for 'Main Page', 'Browse categories', 'Recent changes', and 'Help'. Below that is a 'search' section with a search box and 'Go' and 'Search' buttons. At the bottom left is a 'toolbox' section with links for 'What links here', 'Related changes', 'Special pages', 'Printable version', 'Permanent link', and 'Browse properties'.

W3C[®]

HCLSIG

page discussion view source history

Log in

Semantic Web for Health Care and Life Sciences Interest Group

[Task Forces](#) | [Presentations](#) | [Documents](#) | [Demonstrations](#) | [Participants](#)

The [mission of the Semantic Web for Health Care and Life Sciences Interest Group \(HCLSIG\)](#) is to develop, advocate for, and support the use of Semantic Web technologies for biological science, translational medicine and health care. These domains stand to gain tremendous benefit by adoption of Semantic Web technologies, as they depend on the interoperability of information from many domains and processes for efficient decision support. More information on the group is available on the [W3C Web site for the HCLSIG](#).

HCLSIG Group Meetings

Telcon

- [Next Meeting July 1](#)
- [Past Meetings](#)
- [Teleconference Guide](#)

navigation

- [Main Page](#)
- [Browse categories](#)
- [Recent changes](#)
- [Help](#)







search

Go Search

toolbox

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Browse properties](#)

Working now on a Translational Medicine
Ontology & Knowledge Base!!!

SPARQL endpoint provid...					
www.freebase.com/view/user/bio2rdf/public/sparql					
GMail Free forum : Whole ... WBC IRC channel Note in Reader Mint.com > Start He... WBC Tasks 42 Mind42.com - The S... Other bookmarks					
Name	Image	Date Modified	Number Of Triples	Number Of Topics	Article
GenelD : Database of genes from NCBI RefSeq genomes			172,931,628	4,153,063	Entrez Gene (www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=gene) is NCBI's database for gene-specific information. It does not include all known or predicted genes; instead Entrez Gene focuses on the genomes that have been completely sequenced, that...
UniProt : The Universal Protein Resource			338,602,962	3,334,420	The Swiss-Prot, TrEMBL, and PIR protein database activities have united to form the Universal Protein Resource (UniProt), which provides a central resource on protein sequences and functional annotation with three database components, each...
UniRef : UniProt Non-redundant Reference Databases			242,000,000	11,694,097	The UniProt NREF (UniProt Reference Clusters) database. The two major objectives of UniRef are: (i) to facilitate sequence merging in UniProt, and (ii) to allow faster and...
UniParc : UniProt Archive a non-redundant archive of protein sequences extracted from Swi			490,000,000	16,695,439	UniProt Archive (UniParc) is part of UniProt project. It is a non-redundant archive of protein sequences extracted from public databases UniProtKB/Swiss-Prot, UniProtKB/TrEMBL, PIR-PSD, EMBL, EMBL WGS, Ensembl, IPI, PDB, PIR-PSD, RefSeq, FlyBase, ...
Path : KEGG PATHWAY Database		Mar 21, 2009	84,715,161	89,735	KEGG PATHWAY is a collection of manually drawn pathway maps representing our knowledge on the molecular interaction and reaction networks for: 1. Metabolism Carbohydrate Energy ...
PC : Pathway Commons			27,623,683	485,600	Pathway Commons is a collection of publicly available pathways from multiple organisms. It provides...

Birlex 1204

at neurolex.org

http://rdf.neurolex.org/Birlex_1204

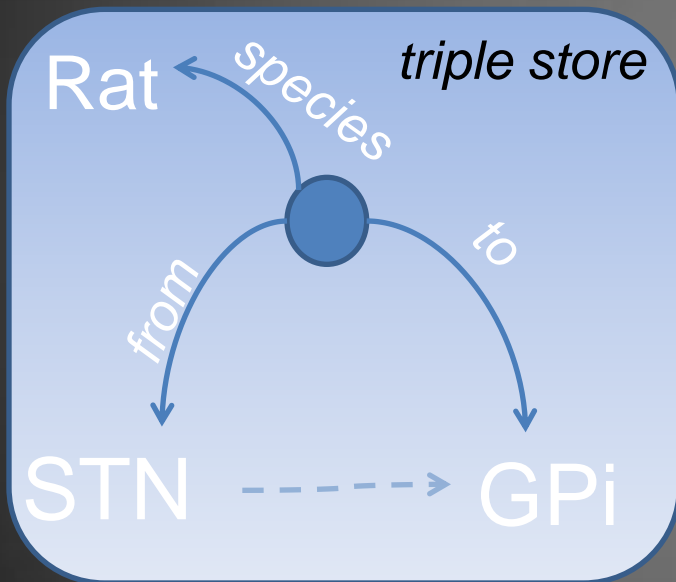
Property	Value
nlxprop:Created	2006-07-15T00:00:00 (xsd:dateTime)
nlxprop:CurationStatus	uncurated (xsd:string)
nlxprop:Has_part	<ul style="list-style-type: none"> nlxcat:CA3_part_of_stratum_lacunosum_moleculare nlxcat:CA3_part_of_stratum_oriens nlxcat:CA3_part_of_stratum_pyramidale_hippocampi nlxcat:CA3_part_of_stratum_radiatum nlxcat:CA3_stratum_lacunosum_moleculare nlxcat:CA3_stratum_lucidum nlxcat:CA3_stratum_oriens nlxcat:CA3_stratum_pyramidale_hippocampi nlxcat:Hippocampus_CA3_oriens_lacunosum_moleculare_neuron
nlxprop:Id	birlex_1204 (xsd:string)
nlxprop:Is_part_of	nlxcat:Hippocampus
nlxprop:Label	CA3 (xsd:string)
nlxprop:ModifiedDate	2010-04-26T00:00:00 (xsd:dateTime)
nlxprop:NeuronamesLink	< http://braininfo.rprc.washington.edu/Scripts/hiercentraldirectory.aspx?ID=167 >
nlxprop:Synonym	<ul style="list-style-type: none"> CA3 field (xsd:string) CA3 field of hippocampus (xsd:string) Regio inferior (xsd:string)
nlxprop:Umlscui	C0694600 (xsd:string)
rdfs:isDefinedBy	wikiurl:Special:ExportRDF/Birlex_1204
rdfs:label	Birlex 1204
swikt:page	wikiurl:Birlex_1204
owl:sameAs	nlxcat:CA3
rdf:type	<ul style="list-style-type: none"> nlxcat:Predominantly_gray_regional_part_of_hippocampal_formation swikt:Subject

This page shows information obtained from the SPARQL endpoint at <http://api.talis.com/stores/neurolex-dev1/services/sparql>.

[As N3](#) | [As RDF/XML](#) | [Browse in Disco](#) | [Browse in Tabulator](#) | [Browse in OpenLink Browser](#)

What is a "triple"?:

1) *subject* + 2) *relation* + 3) *object* = *triple*!



to

GPi



from

STN

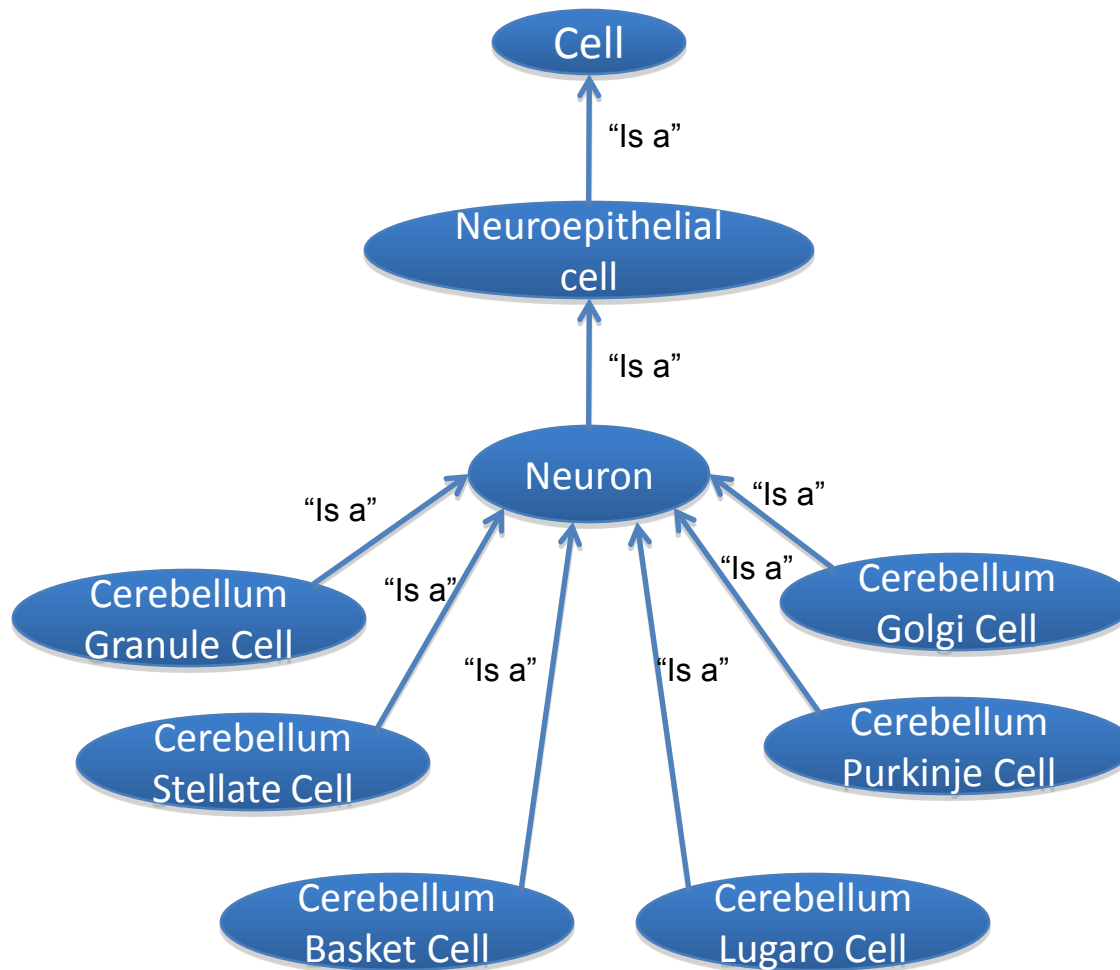


species

Rat

VALUE OF ONTOLOGIES FOR NEUROSCIENCE

Shared ontologies for neuroscience provide a structured way to organize concepts






















- Ontologies provide a formalism for the conceptual bridge between data
- Goal: represent terminological knowledge in a machine analyzable form
 - Taxonomy
 - Relationships
 - Supports reasoning and inference

Value of ontologies for neuroscience

Parts of Cerebellum

Click the + next to "Cerebellum" to see its parts

-   Cerebellum
 -   Posterior lobe of the cerebellum
 -   Flocculonodular lobe
 -   Anterior lobe of the cerebellum
 -   Deep cerebellar nuclear complex
 -   Cerebellar cortex
 -  Climbing fiber
 -   Cerebellar Corticopontine Projection
 -   Cerebellar Pontocerebellar Projection
 -  Cerebellar Serotonergic Afferents
 -  Prepositus Nuclear Complex

Inferred incoming projections for Cerebellum

Receives projections from Central cervical spinocerebellar tract, Cerebellar Serotonergic Afferents, Climbing fiber, Posterior spinocerebellar tract, and Rostral spinocerebellar tract

Neurons in Cerebellum

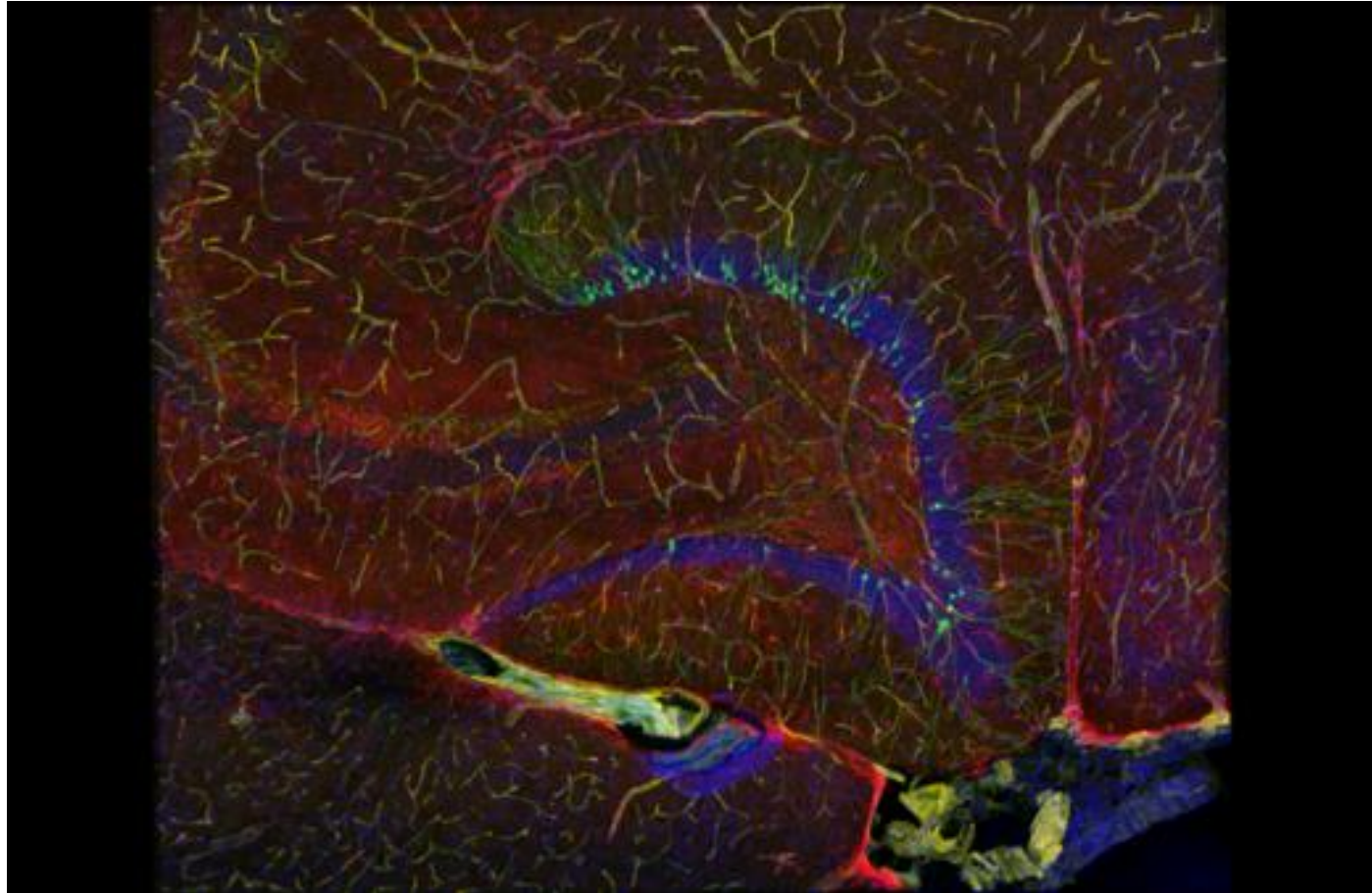
Cerebellum Golgi cell, Cerebellum Lugaro cell, Cerebellum Purkinje cell, Cerebellum basket cell, Cerebellum granule cell, Cerebellum stellate cell, Cerebellum unipolar brush cell, and Golgi II cell are neurons that can be found in Cerebellum or its parts.



Larry Swanson,
University of Southern
California

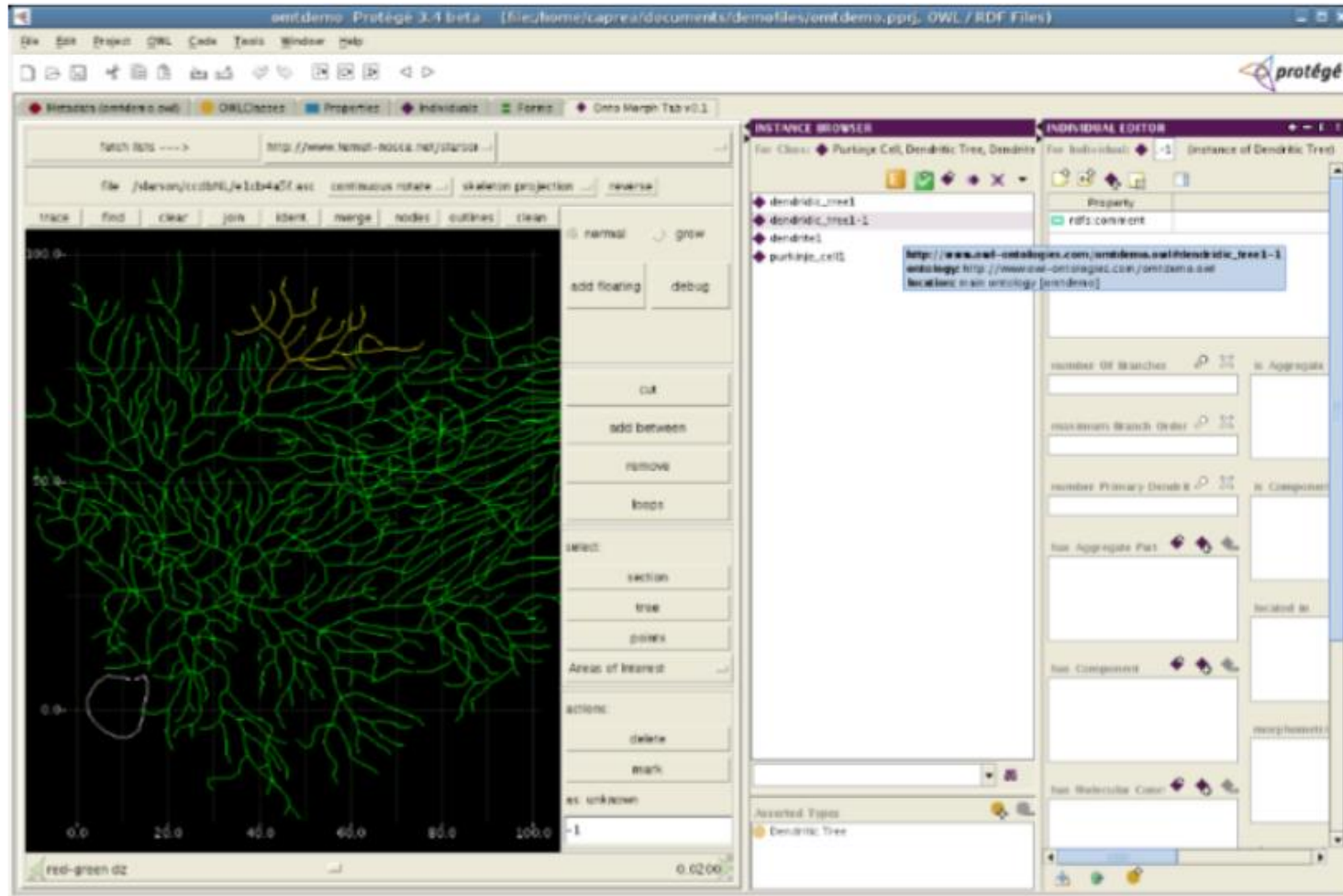
"We need a parts catalog for the brain" – Society for Neuroscience
Keynote lecture,
2009

Confocal image stacks



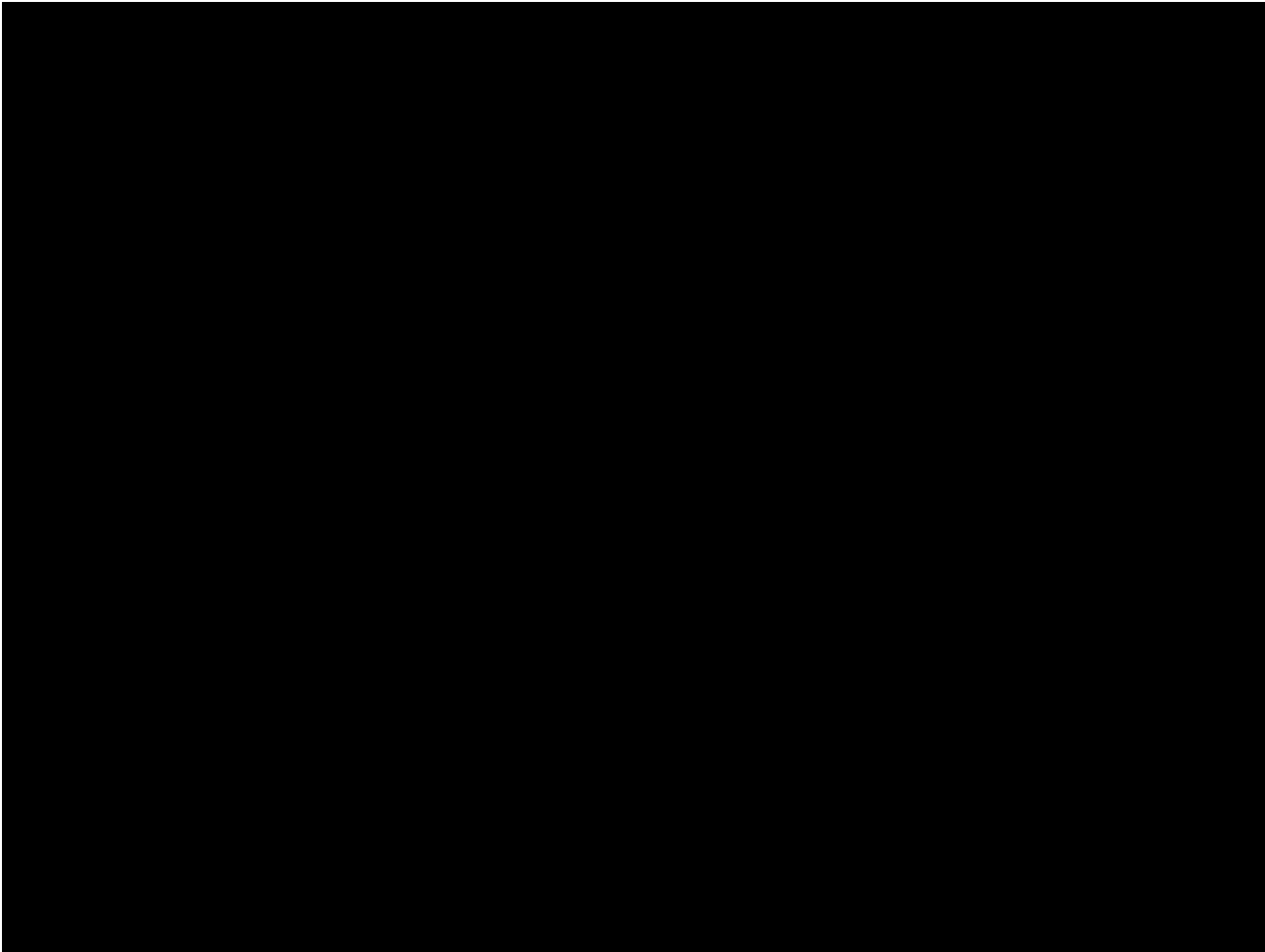
Masako Terada, Eric
Bushong, Fred
Gage, Mark Ellisman
<http://ncmir.ucsd.edu>
Amira

Value of ontologies for neuroscience: structuring data



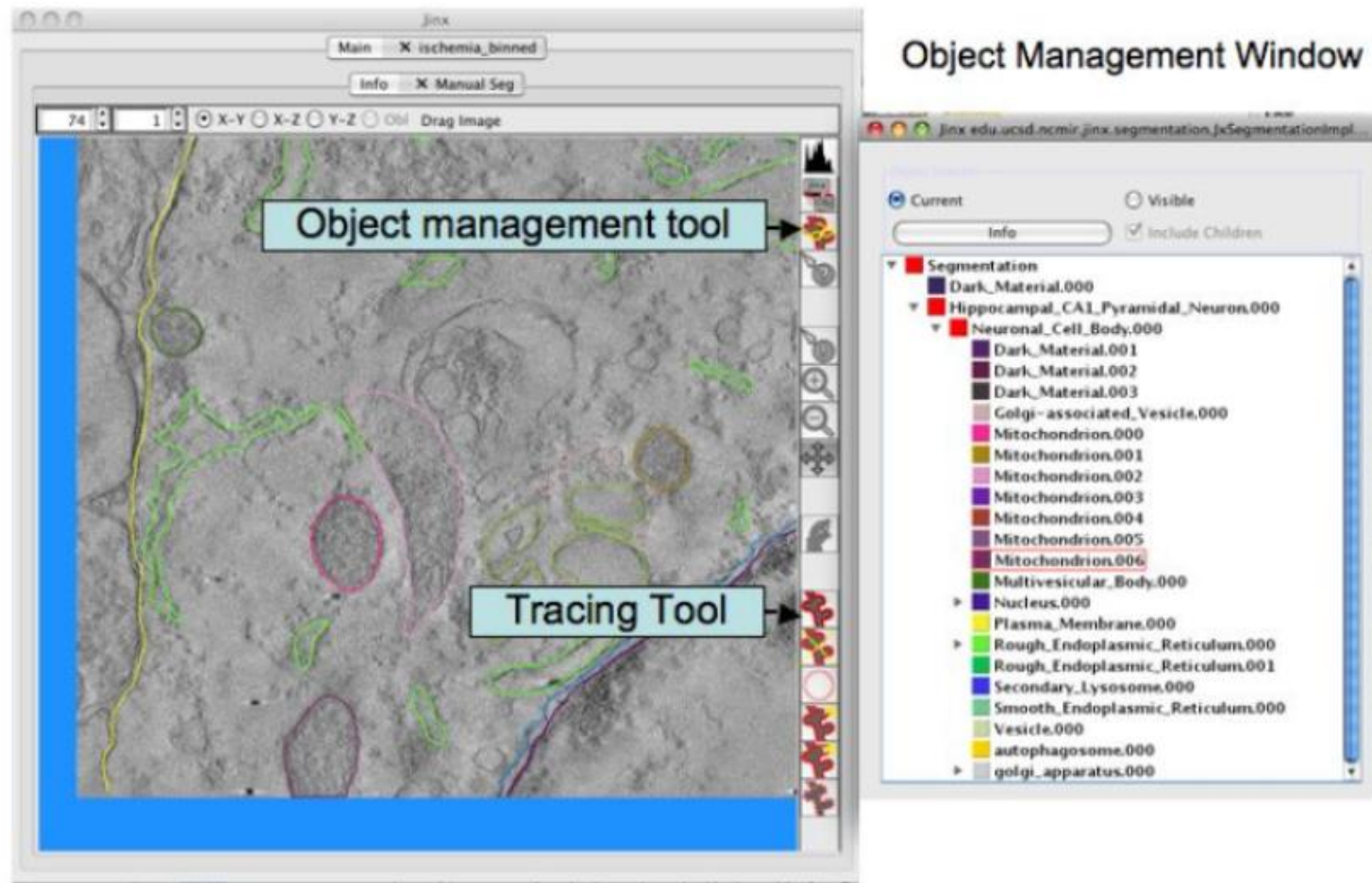
<http://ontomorphtab.googlecode.com>

Electron microscopy



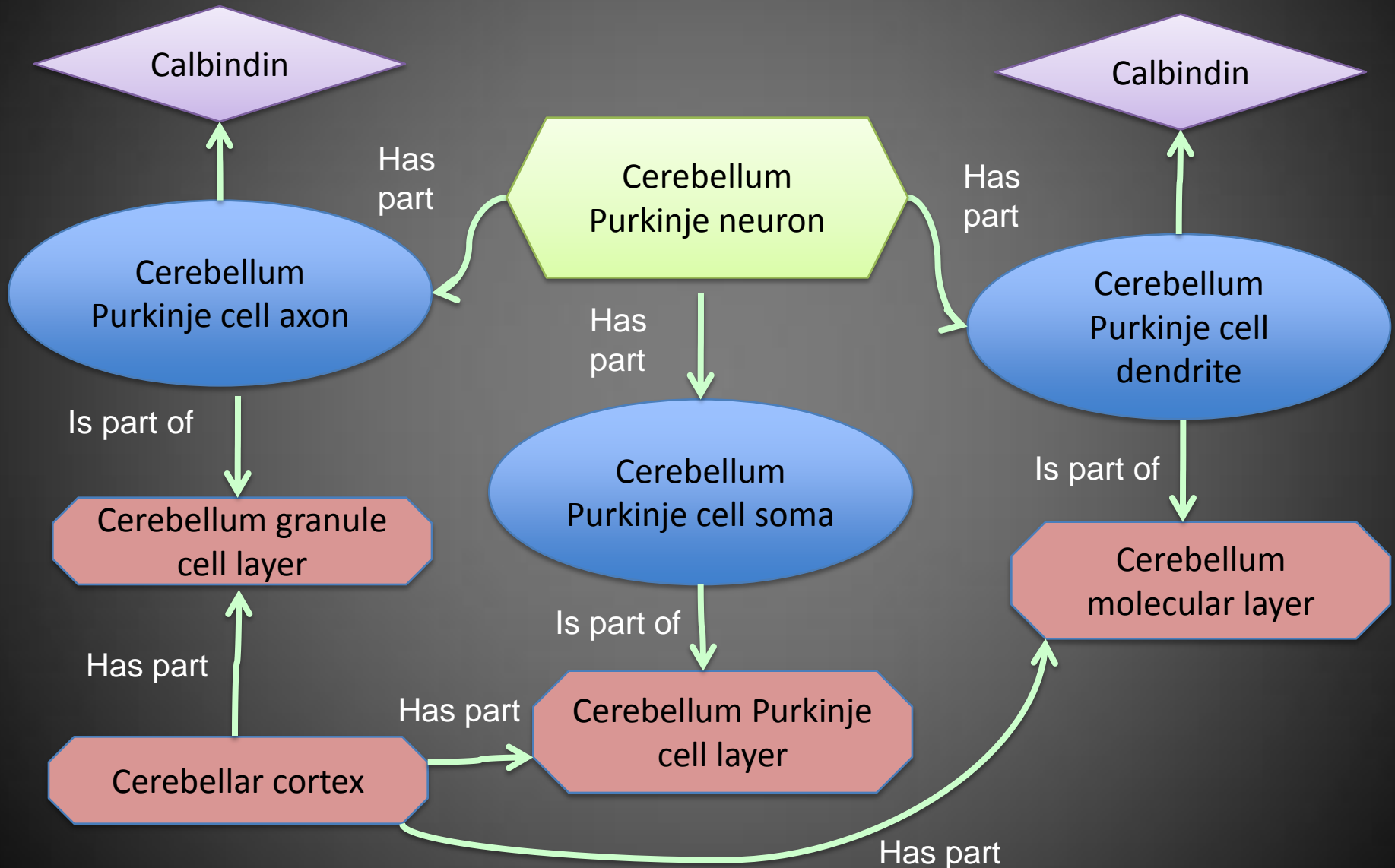
Eric Bushong, Mark
Ellisman
<http://ncmir.ucsd.edu>
Amira

Value of ontologies for neuroscience: structuring data



<http://ncmir.ucsd.edu/downloads/jinx.shtm>

Shared building blocks



NEUROSCIENCE INFORMATION FRAMEWORK: USING ONTOLOGIES TO INDEX ONLINE NEUROSCIENCE DATABASES

NIF in action (<http://neuinfo.org>)

NIF

NEUROSCIENCE INFORMATION FRAMEWORK



▼ ABOUT

- About NIF
- Release Notes 3.1
- People
- Publications
- Presentations
- Brochures
- FAQ

► NIF PRODUCTS

► NIF COMPONENTS

► NIF COMMUNITY

NEUROLEX

REGISTER A RESOURCE

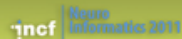
THE NIF FORUM

Ask the NIF Community: Where can I find...?

HELP

4th INCF Congress of
Neuroinformatics

Boston, USA | Sept 4 - 6



Registered with NIF?
Place this icon on your site.



Search for Neuroscience Resources

SEARCH TIPS | WHAT IS THIS? (example searches: cerebellum, "pulvinar nucleus", gene:snca)

Welcome to NIF 3.1

The Neuroscience Information Framework is excited to announce the release of NIF 3.1. With improved search and many added products, NIF 3.1 also boasts a new look and feel on the web. To introduce you to the new website, we have created a [YouTube video](#) and a [Tutorial](#) on the new search interface. You may also wish to view our [release notes](#). As always, we look forward to your [comments](#).

What is NIF?

A dynamic inventory of Web-based neuroscience resources: data, materials, and tools accessible via any computer connected to the Internet. An initiative of the NIH Blueprint for Neuroscience Research, the Neuroscience Information Framework advances neuroscience research by enabling discovery and access to public research data and tools worldwide through an open source, networked environment.



Community News & Events

NIF Data Spotlight: AddGene – What was that plasmid?

March 28th, 2011 07:00 AM

This week's NIF Data Spotlight: AddGene. Visit us each Monday for the NIF Data Spotlight to find a highlight of the database of the ... [read more »](#)

NIFarious Ideas: Science collects data, the Brain improvises

March 11th, 2011 08:00 AM

Twitter

Webinar is TOMORROW Mar 29 11AM PST. Please join us as we explore KEfED, Knowledge Engineering from Experimental Design
<http://bit.ly/eaGeYq> 1 day ago

NIF launches the Monday blog feature: NIF Data Spotlight, a new neuroscience database highlight each Monday

NIF NAVIGATOR

LITERATURE →

- PubMed (19717944)
- Open Access (125650)

DATA TYPE →

- Animals (247941)
- Antibodies (890571)
- Brain Activation Foci (56591)
- Clinical_Trials (95779)
- Connectivity (25443)
- Dataset (358981)
- Disease (669)
- Drugs (51608)
- Grants (2651235)
- Images (598108)
- Microarray (9535440)
- Models (575)
- Pathways (43013)
- People (377)
- Plasmids (10505)
- Software (816)

NERVOUS SYSTEM LEVELS →

- Brain Regions (48887)
- Cellular Level (21847)
- Genes (22544758)
- Molecular Level (103770)
- Multi-Level (2850991)
- Nervous System Function (57890)

NIF REGISTRY (3589) →



NIF searches across multiple sources of information

The NIF Registry catalogs web accessible neuroscience research resources and is searchable by content and resource type. It is sponsored by the NIH Blueprint for Neuroscience Research and is administered by the National Institute of Neurological Disorders and Stroke.

Categories [Show all](#)

- ▶ Educational resources (1)
- ▶ Software resource (4)
- ▶ Service resource (1)
- ▲ Data, Information or knowledge resource (10)
 - ▶ Narrative resource (2)
 - ▶ Portals (5)
 - ▶ Atlas, Bibliography or Portal (5)
 - ▲ Database or Ontology (10)
 - ▶ Database (10)
 - ▶ Data files (2)

Resource Name

- [The Voxelation Map of Gene Expression in a Coronal Section of the Mouse Brain](#)
- [Confocal Microscopy Image Gallery - Rat Brain Tissue Sections](#)
- [Institute of Experimental Medicine of the Hungarian Academy of Sciences: Laboratory of Cerebral Cortex Research](#)
- [Temporal-Lobe: Hippocampal - Parahippocampal Neuroanatomy of the Rat](#)
- [Synapse Web](#)
- [The Mouse Brain Library](#)

Page 1 of 2

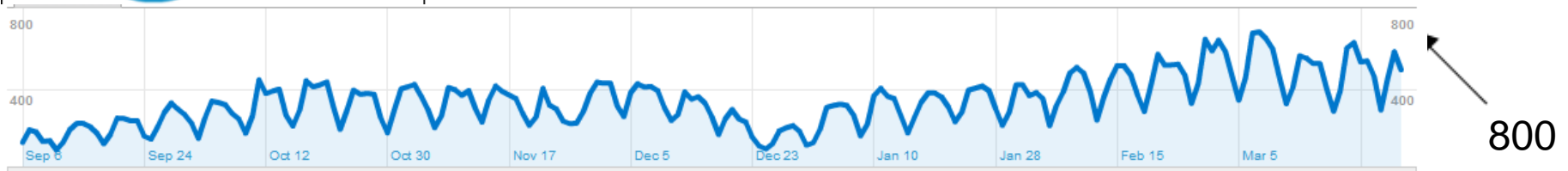
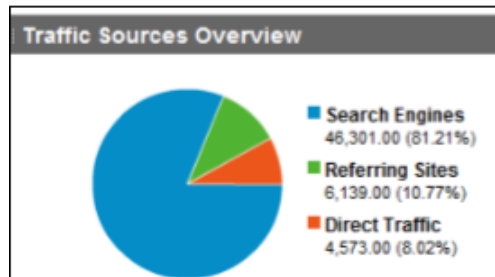
- NIF data federation
 - Independent databases registered with NIF or through web services
- NIF registry: catalog
- NIF Web: custom web index (work in progress)
- NIF literature: neuroscience-centered literature corpus (Textpresso)

**NEUROLEX.ORG: COLLABORATIVE
ONLINE MANAGEMENT OF
NEUROSCIENCE ONTOLOGIES**

An online ontology for neuroscience

- Built using the same open source software that runs Wikipedia
- Extra functionality to create ontologies
- Allows anyone to edit or create new concepts
- 16,000 concepts

NeuroLex.org



NEURO LEX
[ABOUT](#)
[WHAT'S NEW](#)
[FAQS](#)
[NIFSTD ONTOLOGIES](#)
[HOW TO CONTRIBUTE](#)
[CURATION POLICIES](#)
[SUBSCRIBE](#)
[BACK TO NIF HOMEPAGE](#)
[REGISTER A RESOURCE](#)

THE NEUROSCIENCE LEXICON POWERED BY THE NEUROSCIENCE INFORMATION FRAMEWORK

Neurons ▾ **Brain Regions** ▾
Main Page
Page Discussion
History More ▾
Welcome to NeuroLex, the Neuroscience Lexicon.
A dynamic lexicon of 15,993 neuroscience terms supported by [The Neuroscience Information Framework](#)
[About](#) • [What's new](#) • [FAQs](#) • [NIFSTD ontologies](#) • [How to Contribute](#) • [Curation policies](#) • [Subscribe to Neurolex mailing list](#)

Show me a Random Term!
All Categories [A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

HIERARCHIES

- Behavioral Activity
- Behavioral Paradigms
- Brain Regions
- Cells
- Neurons
- Diseases
- Molecules
- Nervous System Function
- Subcellular Parts
- Resource Types
- Qualities

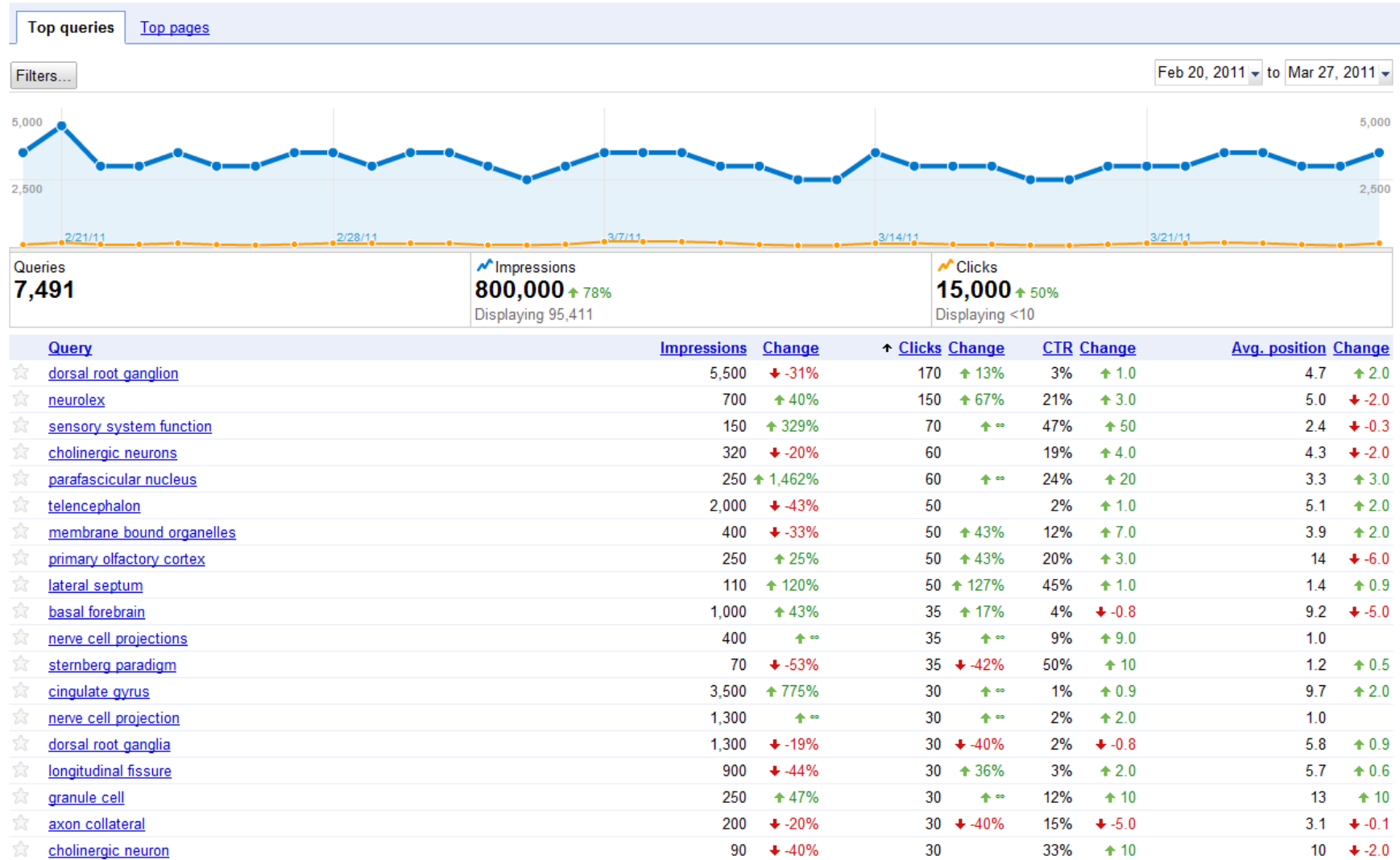
TABLES

- Behavioral Activity
- Brain Regions
- Cell Types
- Diseases
- Molecules
- Nervous System Function
- Neurons
- Neurons by Neurotransmitter
- Organisms
- Resources and Information Entities
- Subcellular Parts
- Qualities

Visitors, September, 2010 to March, 2011

NeuroLex is being found spontaneously online

Search queries



Categories linked through explicit relationships

Category:CA1

Basic		Advanced
Name:	CA1	
Definition:	A cytoarchitectural region of the hippocampus. The pyramidal neurons of CA1 form a subregion of the hippocampus.	
Synonym(s):	CA1 field of hippocampus	
Is part of :	Hippocampus	
Super-category:	Predominantly granular	
Id:	birnlex_1197	
Link to OWLRDF:	Download this content as OWL/RDF	

Parts of CA1

Click the + next to "CA1" to see its parts



CA1

- CA1 stratum lacunosum moleculare
- CA1 stratum radiatum
- CA1 stratum oriens

Neurons in CA1

Hippocampus CA1 IS-I neuron, Hippocampus CA1 IS-II neuron, Hippocampus CA1 IS-III neuron, Hippocampus CA1 LM(R) PP neuron, Hippocampus CA1 basket cell, Hippocampus CA1 neurogliaform cell, Hippocampus CA1 oriens lacunosum moleculare neuron, Hippocampus CA1 stratum oriens neuron, Hippocampus CA1 trilaminar neuron are neurons that can be found in CA1 or its parts.

Category:CA1 stratum oriens

Basic		Advanced
-------	--	----------

Name:	CA1 stratum oriens
Definition:	CA1 part of stratum oriens
Is part of :	CA1
Super-category:	Regional part of stratum oriens
Id:	birnlex_4116
Link to OWLRDF:	Download this content as OWL/RDF

Who makes sure the data is reliable?



NEUROSCIENCE INFORMATION FRAMEWORK



Curators with the NIH-funded Neuroscience Information
Framework and volunteers with the International
Neuroinformatics Coordinating Facility



YOU!!!

Flexibility

- NIF maintains the NIF vocabularies in different forms for different purposes
 - Neurolex Wiki: Lexicon for community review and comment
 - [http://neurolex.org/wiki/NeuroLex SPARQL endpoint](http://neurolex.org/wiki/NeuroLex_SPARQL_endpoint)
 - NIFSTD: set of modular OWL files normalized under BFO and available for download
 - <http://neuinfo.org/developers/>
 - NCBO Bioportal for visibility and mapping services
 - <http://bioportal.bioontology.org/ontologies/45355>