

INCF Tutorial on the OWL version of the CUMBO Ontology

Current version: CUMBO-OWL-0.1

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1. Introduction

The [Common Upper Mammalian Brain Ontology \(CUMBO\)](#) is an effort by the [Representation and Deployment Task Force](#) in the INCF Program of “Ontologies of Neural Structures”. This ontology aims at representing the general and essential terms of brains across the mammals as well as their interconnected structures. The OWL version of the CUMBO ontology is designed to support structured query languages such as SPARQL and possible reasoning tasks. Currently, the OWL version of the CUMBO ontology is with ontological terms from [NeuroLex](#). Alignment to other ontologies (e.g. the Allen Brain Atlas ontology) will be supported soon in the next release. CUMBO is a multi-lingual ontology. Currently, all word terms in CUMBO are available both in English and in Chinese.

2. Sample SPARQL Queries for the CUMBO Ontology:

This section provides several sample SPARQL queries for the OWL version of the CUMBO Ontology. “Sub-Class”, “part-whole”, and many other relations (e.g. Definition) are supported for queries. The OWL version of CUMBO ontology needs to be downloaded, and can be loaded in Protégé, Jena TDB, and many other ontology editors or semantic triple stores.

2.1 Find all “Sub-Class” relation among word terms in CUMBO Ontology:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
SELECT ?subject ?object
WHERE { ?subject rdfs:subClassOf ?object }
```

SPARQL Query output Sample from Protégé:

subject	object
'Motor system'	'Neural system'
Sulcus	'Regional part of nervous system'
Ganglion	'Regional part of nervous system'
'Central nervous system'	'Regional part of nervous system'
Interneuron	Neuron
'Anatomical entity'	'Independent continuant'
'Sensory system'	'Neural system'
'Defined neuron class'	'Defined class'
'Nervous System'	'Body system'
Tract	'Regional part of nervous system'
'Blood brain barrier'	'Supra Cellular Structure'
'Realizable entity'	'Specifically dependent continuant'
Commissure	'Regional part of nervous system'
'regional part of body system'	'Anatomical entity'
'Body system'	'Anatomical entity'
'Defined class'	Thing
Brain	Organ
'Medial-lateral axis'	Neuraxis
Lamina	'Regional part of nervous system'
'Supra Cellular Structure'	'Subcellular entity'
'Dorsal-ventral axis'	Neuraxis
'Neural system'	'Body system'
'Rostral-caudal axis'	Neuraxis
Lemnicus	'Regional part of nervous system'
'Parcellation scheme'	'Realizable entity'

2.2 Find all “partOf” relation among word terms in CUMBO Ontology:

```

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
SELECT ?subject ?object
      WHERE { ?subject <http://www.ia.ac.cn/property/partOf> ?object }
    
```

SPARQL Query sample output from Protégé:

subject	object
Hemisphere	Brain
Bregma	Brain
'Right Cerebellar hemisphere'	'Cerebellar hemisphere'
Parcel	'Gray matter'
'White matter'	Brain
Ganglion	'Peripheral nervous system'
'Left Cerebellar hemisphere'	'Cerebellar hemisphere'
Fascicle	Fasciculus
'Nerve fiber bundle'	Fascicle
'Gray matter'	Brain
Nerve	'Nervous System'
Meninges	Brain
'Right cerebral hemisphere'	'Cerebral hemisphere'
'Spinal cord'	'Central nervous system'
Neuropil	'Nerve fiber bundle'
lobe	Brain
Dendrite	Neuron
'Peripheral nervous system'	'Nervous System'
Circuit	'Neural system'
Gyrus	Brain
'Afferent pathway'	Pathway
Lemniscus	Brain
Tract	'Central nervous system'
Subnucleus	Tract
Brain	'Central nervous system'

2.3 Find all “English Label” form terms in CUMBO:

```

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
SELECT ?subject ?object
      WHERE { ?subject rdfs:label ?object } LIMIT 10
    
```

SPARQL Query sample output:

subject	object
<http://www.incf.org/resource/neuraxis>	"neuraxis" <http://www.w3.org/2001/XMLSchema#string>
<http://www.incf.org/resource/Sensory_system>	"Sensory system" <http://www.w3.org/2001/XMLSchema#string>
<http://www.incf.org/resource/Motor_system>	"Motor system" <http://www.w3.org/2001/XMLSchema#string>
<http://www.incf.org/resource/peripheral_nervous_system>	"peripheral nervous system" <http://www.w3.org/2001/XMLSchema#string>
<http://www.incf.org/resource/fascicle>	"fascicle" <http://www.w3.org/2001/XMLSchema#string>
<http://www.incf.org/resource/Transverse>	"Transverse" <http://www.w3.org/2001/XMLSchema#string>
<http://www.incf.org/resource/Neuropil>	"Neuropil" <http://www.w3.org/2001/XMLSchema#string>
<http://www.incf.org/resource/Nucleus>	"Nucleus" <http://www.w3.org/2001/XMLSchema#string>
<http://www.incf.org/resource/Projection_neuron>	"Projection neuron" <http://www.w3.org/2001/XMLSchema#string>
<http://www.incf.org/resource/Nervous_System>	"Nervous System" <http://www.w3.org/2001/XMLSchema#string>

2.4 Find 10 terms with “Chinese Label” in CUMBO:

```

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
SELECT ?subject ?object
    
```

```
WHERE { ?subject <http://www.incf.org/property/ChineseName> ?object } LIMIT 10
```

SPARQL Query sample output:

```
-----  
| s | o |  
-----  
| <http://www.incf.org/resource/Central_nervous_system> | "中枢神经系统"^^<http://www.w3.org/2001/XMLSchema#string> |  
| <http://www.incf.org/resource/Axon> | "轴突"^^<http://www.w3.org/2001/XMLSchema#string> |  
| <http://www.incf.org/resource/Rostral-caudal_axis> | "延髓尾轴"^^<http://www.w3.org/2001/XMLSchema#string> |  
| <http://www.incf.org/resource/Motor_system> | "运动系统"^^<http://www.w3.org/2001/XMLSchema#string> |  
| <http://www.incf.org/resource/Meninges> | "脑膜"^^<http://www.w3.org/2001/XMLSchema#string> |  
| <http://www.incf.org/resource/Gray_matter> | "灰质"^^<http://www.w3.org/2001/XMLSchema#string> |  
| <http://www.incf.org/resource/Neuron> | "神经元"^^<http://www.w3.org/2001/XMLSchema#string> |  
| <http://www.incf.org/resource/Nerve> | "神经"^^<http://www.w3.org/2001/XMLSchema#string> |  
| <http://www.incf.org/resource/Nervous_system> | "神经系统"^^<http://www.w3.org/2001/XMLSchema#string> |  
| <http://www.incf.org/resource/Spinal_cord> | "脊髓"^^<http://www.w3.org/2001/XMLSchema#string> |  
-----
```

2.5 Find the definition of "Brain" in CUMBO:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
```

```
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
```

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
SELECT ?o
```

```
WHERE { ?s INCF_Relation:Definition1 ?o.
```

```
      ?s rdfs:label "Brain"^^xsd:string.
```

```
} LIMIT 10
```

SPARQL Query output:

```
-----  
| <http://www.incf.org/resource/Brain> | "The part of the central nervous system contained within the cranium, comprising the prosencephalon, mesencephalon, and rhombencephalon. It is derived from the anterior part of the embryonic neural tube. Functions include muscle control and coordination, sensory reception and integration, speech production, memory storage, and the elaboration of thought and emotions." |  
-----
```

3. CUMBO Related Information and Updates:

General information on CUMBO can be found through the following link:

<http://www.incf.org/activities/our-programs/pons/cumbo>

The most updated version of CUMBO is available through the following link:

<http://www.linked-neuron-data.org/cumbo.jsp>