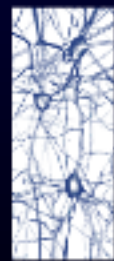


Working with Neuroscience Ontologies Using `rdflib`

Eilif Muller



Blue
Brain
Project

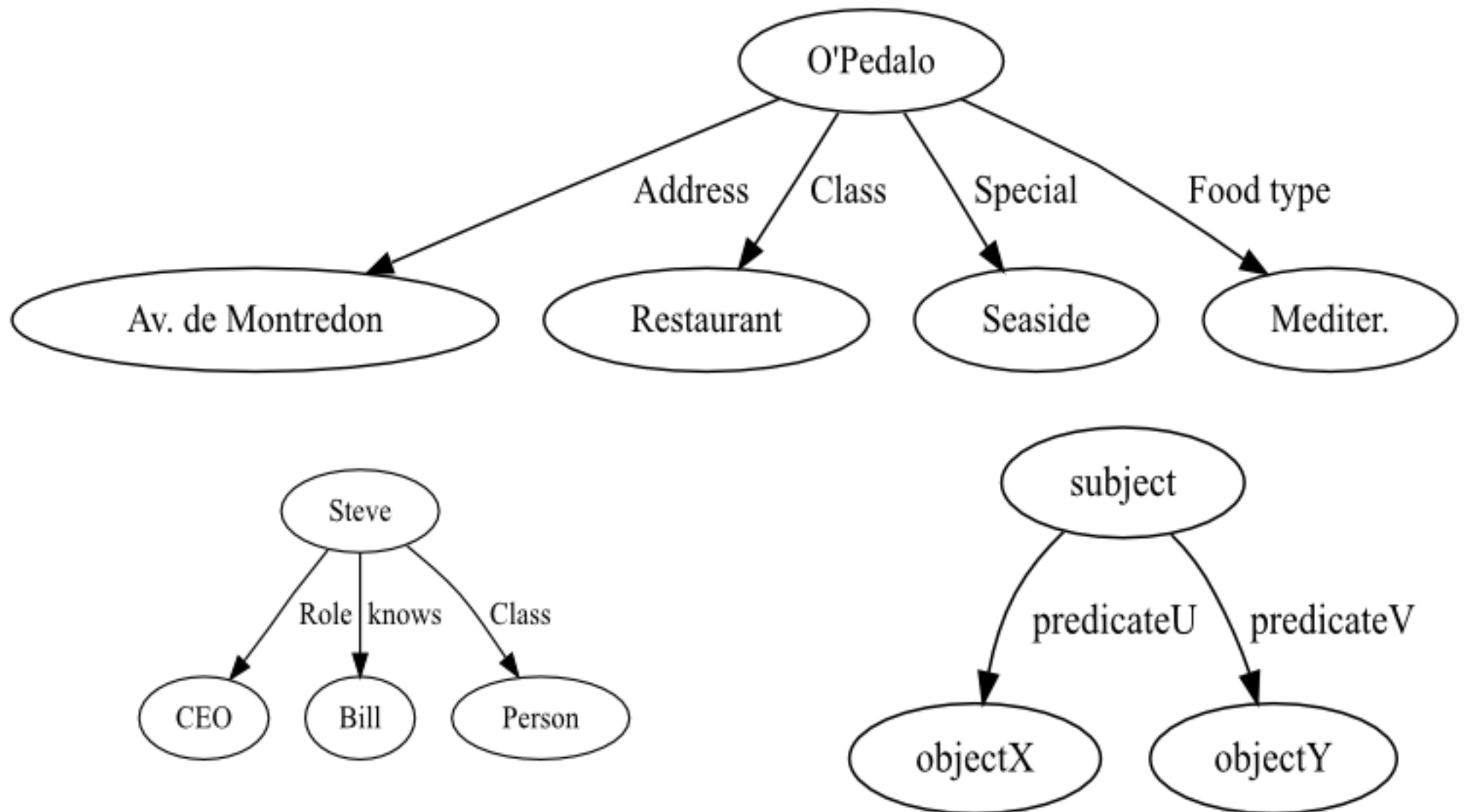


What is the Semantic Web ?

Answer: The GGG (Giant Global Graph)

- generic structured data repr. as graph
- joining of many small graphs
- easy for software to process

Structured Data as a Graph



Data as a Graph: RDF

- Resource Description Format (RDF)
- A W3C recommendation since 1999
- Assert facts about something
- Collection of triples:
subject - *predicate* - **object**
- URIs: <http://example.org/URI8234>
- Literals: "Steve", 20, 3.14
- Namespaces, e.g.: FOAF, RDFS, OWL

Three layers of Semantic Web

- RDF: Assertion of facts

```
@prefix ex: <http://example.org/> .
@prefix FOAF: <http://xmlns.com/foaf/0.1/> .
ex:URI0 FOAF:name "Steve".
ex:URI0 RDF:type FOAF:Person.
ex:URI0 FOAF:knows ex:URI1.
ex:URI1 FOAF:name "Bill".
```

- RDF Schema (RDFS): Definition of Vocab, Classes

```
ex:CEO RDF:type RDFS:Class.
ex:CEO RDFS:subClassOf FOAF:Person.
```

- Web Ontology Language (OWL):
 - Reasoning, Relationships between vocabularies
 - Used by: NIF Neurolex, ABA

```
@prefix abamouse: <http://.../atlas/index.html#>.

abamouse:COAa3 a owl:Class;
  rdfs:label "Cortical amygdalar area ...";
  rdfs:comment "";
  rdfs:isDefinedBy "... COAa3.html";
  rdfs:subClassOf abamouse:COAa.
```

rdflib - RDF in Python

```
from rdflib import ConjunctiveGraph,
from rdflib import Namespace, Literal

foaf = Namespace('http://xmlns.com/foaf/0.1/')
ex = Namespace('http://example.org/')

#print foaf.name
#rdflib.URIRef('http://xmlns.com/foaf/0.1/name')

g = ConjunctiveGraph()
g.add((ex.id123, foaf.name, Literal('Steve')))
g.add((ex.id124, foaf.name, Literal('Bill')))
g.add((ex.id123, foaf.knows, ex.id124))

print g.serialize(format='n3')
```

```
@prefix _3: <http://example.org/>.
@prefix _4: <http://xmlns.com/foaf/0.1/>.

_3:id123 _4:knows _3:id124;
  _4:name "Steve".

_3:id124 _4:name "Bill".
```


SQL Triple-store for rdflib

```
from rdflib import plugin
from rdflib.store import Store

# Here also MySQL, PostgreSQL, ...
store = plugin.get('SQLite', Store)('aba_local.sqlite')
try:
    status = store.open('.', create=True)
except:
    print "db exists, reusing."
    status = store.open('.', create=False)

g = ConjunctiveGraph(store)
g.parse('.onto_data/ABA.owl')
g.commit()
```

Queries - Simple RDF

```
g = ConjunctiveGraph(store)

for x in g.triples((None, RDFS.subClassOf, aba.Brain)):
    print shorten(x)
    for y in g.triples((x[0], None, None)):
        print '\t', shorten(y[1:])
```

```
-----
(u'CH', u'subClassOf', u'Brain')
(u'type', u'Class')
(u'label', 'Cerebrum')
(u'subClassOf', u'Brain')
(u'disjointWith', u'CB')
(u'disjointWith', u'BS')
(u'CB', u'subClassOf', u'Brain')
(u'label', 'Cerebellum') ...
(u'BS', u'subClassOf', u'Brain')
(u'label', 'Brain stem') ...
```

Queries - SPARQL

```
sparq = """
```

```
SELECT ?part
```

```
WHERE { ?part rdfs:subClassOf aba:Brain . }
```

```
"""
```

```
r = g.query(sparq, initNs={'aba': aba,  
                           'rdfs': rdfs})
```

```
CH, CB, BS
```

RDFAlchemy - ORM for RDF

```
from rd falchemy.rdfsSubject import owlClass
from rd falchemy import rdfSingle, rdfMultiple

class ABAStruct(owlClass):
    isDefinedBy = rdfSingle(RDFS.isDefinedBy)
    subClassOf = rdfSingle(RDFS.subClassOf)
    ID = rdfSingle(RDF.ID)
    label = rdfSingle(RDFS.label)
    disjointWith = rdfMultiple(owl.disjointWith)

# Apply ORM to a graph
ABAStruct.db = g

for x in ABAStruct.filter_by(subClassOf=aba.Brain):
    print x.label
```

Cerebrum, Cerebellum, Brain stem

Further reading

- Protege - OWL Editor
- SPARQL
- RDFAlchemy
- Existing Vocabularies: FOAF, Neurolex, ...
- Swoogle



ontology [document](#) [term](#) [more >>](#)

neuron

Swoogle Search



ve

list ontologies matching ontology
search

1 - 10 of total 110 results for **neuron** in 1.222
seconds

sort by | [date](#) | [triple](#) |

<http://relay.med.yale.edu:81/NeuroWeb/owl/senselab.owl>

[DEF] , NeostriatalCholinergicInterneuron, NeostriatalSpinyNeuron, Neostriatum, **Neuron**, NeuronProperty

SemanticWebDocument, RDFXML, 2006-02-24, 174K, ontoRatio(0.93), [metadata](#), [cached](#)

http://onto.eva.mpg.de/obo/fly_anatomy.owl

[DEF] , A2_neuron, A3_neuron, A4_neuron, A5_neuron, A6_neuron, A7_neuron, A8_neuron, ACC, ACC **neuron**, ACT

SemanticWebDocument, RDFXML, 2006-11-16, 4M, ontoRatio(1.00), [metadata](#), [cached](#)

<http://onto.eva.mpg.de/obo/celltype.owl>

[DEF] , Neuroepithelial, Neuroepithelial_cell, **Neuron**, Neutrophil, Odontoblast, Oligodendroblast

SemanticWebDocument, RDFXML, 2006-11-16, 98K, ontoRatio(1.00), [metadata](#), [cached](#)

<http://www.co-ode.org/ontologies/testset/breaksmetrics.owl>

[DEF] Bionsv Binolar Binolar **Neuron** Birbeck Birbeck Granule Bisoprolol Bizzozero

