XPTO Prolog Treatment for Ontologies

Contextual Logic Programming for Ontology Representation and Querying

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Presentation and Motivation

- Semantic Web Ontologies
- CxLP

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- Enable being queried using SPARQL
- Be able to query SPARQL web services

GNU Prolog/CX

- Units:

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:- unit(foo(A)).

item(A).
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foo(1) :> bar(a) :> item(X).
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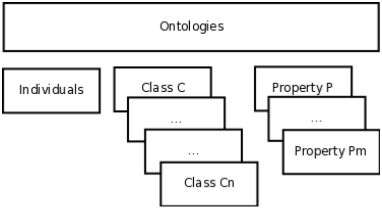
```
foo(b) :> item(X).                  X = b

foo(1) :> bar(a) :> item(X).        X = a ;
                                    X = 1
```

Representation of the ontology



Ontologies are represented using units:

- one unit that lists the classes and properties of the ontology;
- another unit for individuals;
- one for each OWL class
- one for each property

Ontology Unit

This unit represents the ontology information:

- XML namespaces
- headers
- classes
- properties

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Individual relations:

- `differentFrom(IND1, IND2).`
- `sameAs(IND1, IND2).`

Class Units

- Each unit represents a class of the ontology
- Stores as facts the information about the class
  - restrictions on the individual properties
  - class inheritance
- some predicates that help querying the representation:
  - class_name(NAME)
  - superClassOf(CLASS)

Property Units

Each property unit contains the information relative to a specific property.

- type of the property (datatype or object)
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These units also define the predicate to access its value, given the individual name.

```
item(B) :-
 :^ item(B),
 property(B, hasMaker, A).
```

Querying the representation

- The most direct way of retrieving the class individuals is to use the goal `item/1`
- The `item/1` goal binds, by backtrack, its argument to each individual of the class.
- There is also the possibility of querying all the individuals in the ontology by omitting a class in the query.

```
| ?- 'ClassName' /> item(A).
A = 'IndividualName'
```

- The value of the properties can be accessed by including the unit that represents the property in the context query.
- The argument of the property unit will be bound to the value of the property for the corresponding individual.

```
| ?- 'IceWine' /> hasFlavor(F) :> hasBody(B) :>
  item(I).
B = 'Medium'
F = 'Moderate'
I = 'SelaksIceWine' ?
```

Other query forms

- **individual/1** unifies its argument with the name of the individual (same as `item/1`)
- **class/1** unifies its argument with the class of the individual.
- **property/2** allows to query for the property name based on the property value.
- **optional/1** receives as its argument a another defined unit and will succeed with the results if the unit specified in its argument succeeds. Otherwise it will succeed leaving any variables in its argument unbound.

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- And formatted according to the XML specefications

```
SELECT
       ?flavor ?body
WHERE {
   ?t :hasFlavor    ?flavor   .
   ?t :hasBody      ?body   .
}
```

```
[where([set([
     triple(A,hasFlavor,B),
     triple(A,hasBody,C) ])
       ]),
 select([flavor=B,body=C]),
 vars([flavor=B,body=C,t=A]),
]
```

SPARQL engine

- Each SPARQL functionality is implemented as a unit
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/> property(hasFlavor,F) :> item(I).
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Mapping Prolog/CX queries to SPARQL

- Merge the reasoning of the system internal knowledge base with external ontologies available from third parties by means of the SPARQL query language:

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- Merge the reasoning of the system internal knowledge base with external ontologies available from third parties by means of the SPARQL query language:
  - Translates a Prolog/CX query into SPARQL;
  - Sends the SPARQL query to the indicated Semantic Web SPARQL service;
  - Fetch the XML result file, parse it and return the solutions as Prolog variable bindings.

Formal Query Form

```
QUERY := sparql(IRI) /> P1 ... Pn :> ITEM
 URI  :=  url
 P    := property(VALUE) || where(PROP, VALUE)
 ITEM := item(INDIVIDUAL)
```

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```
?- sparql('http://xmlarmyknife.org/api/rdf/sparql/') />
   hasBody(A) :> hasColor(B) :> item(IND).

A ='http://www.w3.org/2001/sw/WebOnt/wine#Medium'
B ='http://www.w3.org/2001/sw/WebOnt/wine#SelaksIceWine'
IND ='http://www.w3.org/2001/sw/WebOnt/wine#White' ? ;

```

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Future work:

- Allow multiple ontologies to be loaded
- Semantics of OWL
- Complete the SPARQL support in answering queries
- Complete the external query SPARQL generation

Questions?