

Querying with SPARQL

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An Example SPARQL Query

PREFIX : <http://protege.stanford.edu/ontologies/groceries/>

SELECT ?x

WHERE {
 ?x rdfs:subClassOf :GroceryItem
}

Class description Snap SPARQL query

Snap SPARQL query:



PREFIX : <http://protege.stanford.edu/ontologies/grocery-ontology/>

SELECT ?x

WHERE {
 ?x rdfs:subClassOf :GroceryItem
}

Execute

?x

- :WalkersPureButterShortbread
- :LotusBiscoffCookies
- ☰ :GroceryItemMadeInNorthAmerica
- :ProductMadeOnlyInScotland
- :WalkersPureButterShortbreadFingers-5.3ozBox
- ☰ :GroceryItemThatContainsSoy
- ☰ :GroceryItemMadeInEurope

13 results

An Example SPARQL Query

PREFIX : <http://protege.stanford.edu/ontologies/groceries/>

SELECT ?x

WHERE {
 ?x rdfs:subClassOf :GroceryItemThatContainsGluten .
 ?x rdfs:subClassOf :GroceryItemThatContainsSoy
}

Class description Snap SPARQL query

Snap SPARQL query:



PREFIX : <http://protege.stanford.edu/ontologies/grocery-ontology/>

SELECT ?x

WHERE {

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}

Execute

?x

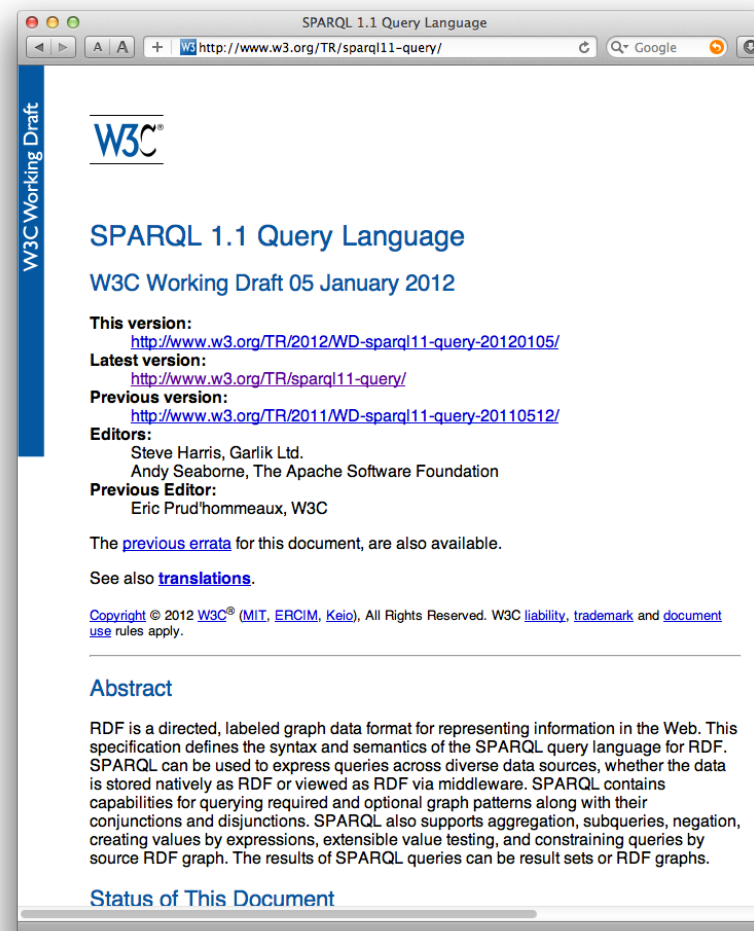
● :LotusBiscoffCookies

● owl:Nothing

2 results

SPARQL

SPARQL Protocol And RDF Query Language



<http://www.w3.org/TR/sparql11-query/>

SPARQL

Primarily designed for querying RDF Graphs

... however, the **kinds** of queries that can be asked
are applicable to OWL ontologies...

.... it's a W3C Standard

RDF

The Resource Description Framework

For describing properties of resources on the web

An RDF Graph is a set of statements - Triples

Subject - Predicate - Object

RDF Graph Example

:Matthew — :hasCountryOfBirth — :England

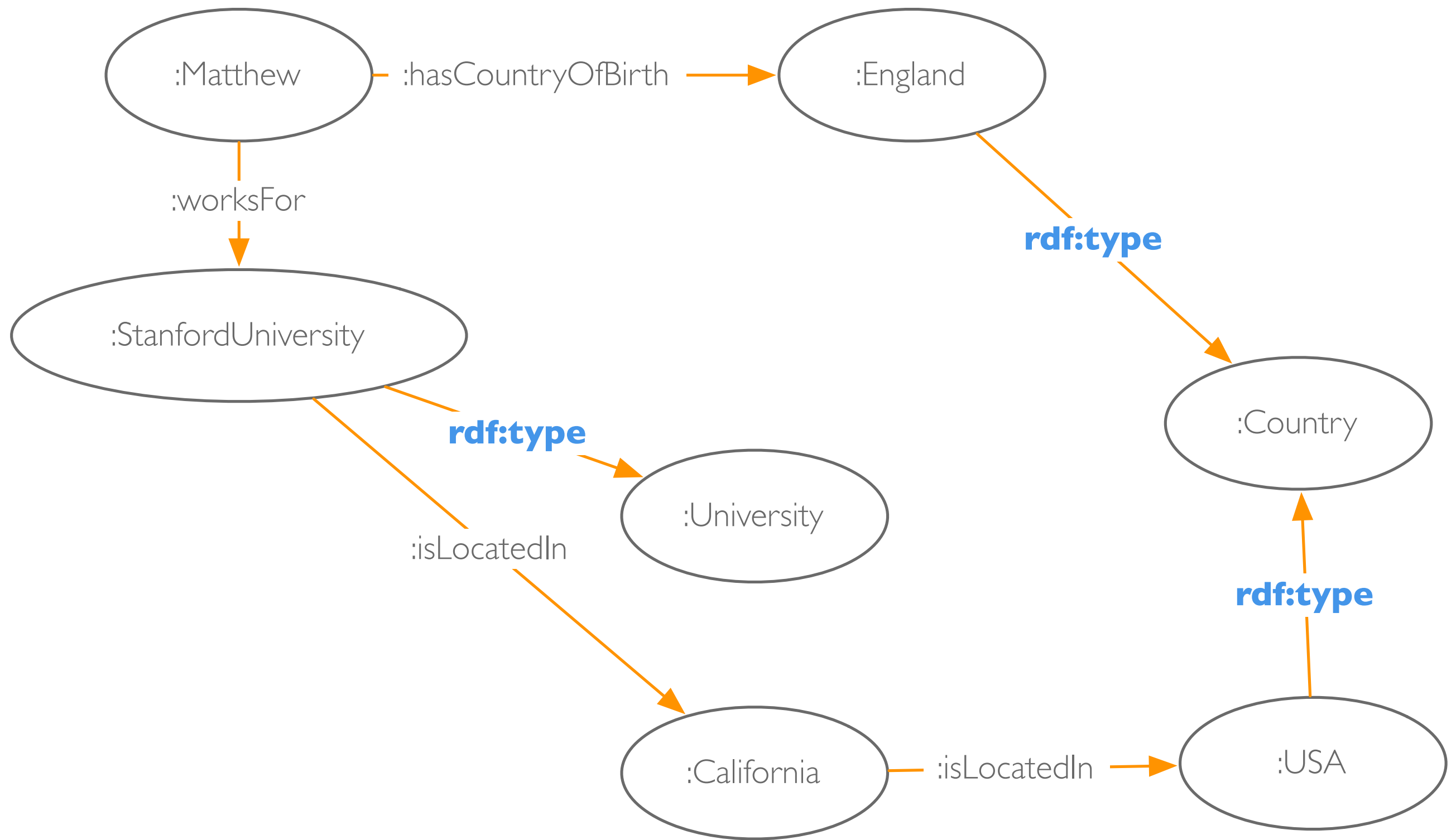
:England — rdf:type — :Country

:Matthew — :worksFor — :StanfordUniversity

:StanfordUniversity — rdf:type — :University

:StanfordUniversity — :locatedIn — :California

:California — :locatedIn — :USA



An Example SPARQL Query

PREFIX : <<http://protege.stanford.edu/rdf/employees#>>

SELECT ?x ?y

WHERE {
 ?x :locatedIn ?y .
}

:StanfordUniversity — :locatedIn — :California

:California — :locatedIn — :USA

?x	?y
:StanfordUniversity	:California
:California	:USA

rdf:type

(built in vocabulary)

:Matthew — :hasCountryOfBirth — :England

:England — **rdf:type** — :Country

:Matthew — :worksFor — :StanfordUniversity

:StanfordUniversity — **rdf:type** — :University

:StanfordUniversity — :locatedIn — :California

:California — :locatedIn — :USA

RDF and Entailment

PREFIX : <<http://protege.stanford.edu/rdf/employees#>>

SELECT ?x ?y

WHERE {
 ?x :locatedIn ?y .
}

?x	?y
:StanfordUniversity	:California
:California	:USA

?x	?y
:StanfordUniversity	:USA

Not entailed!

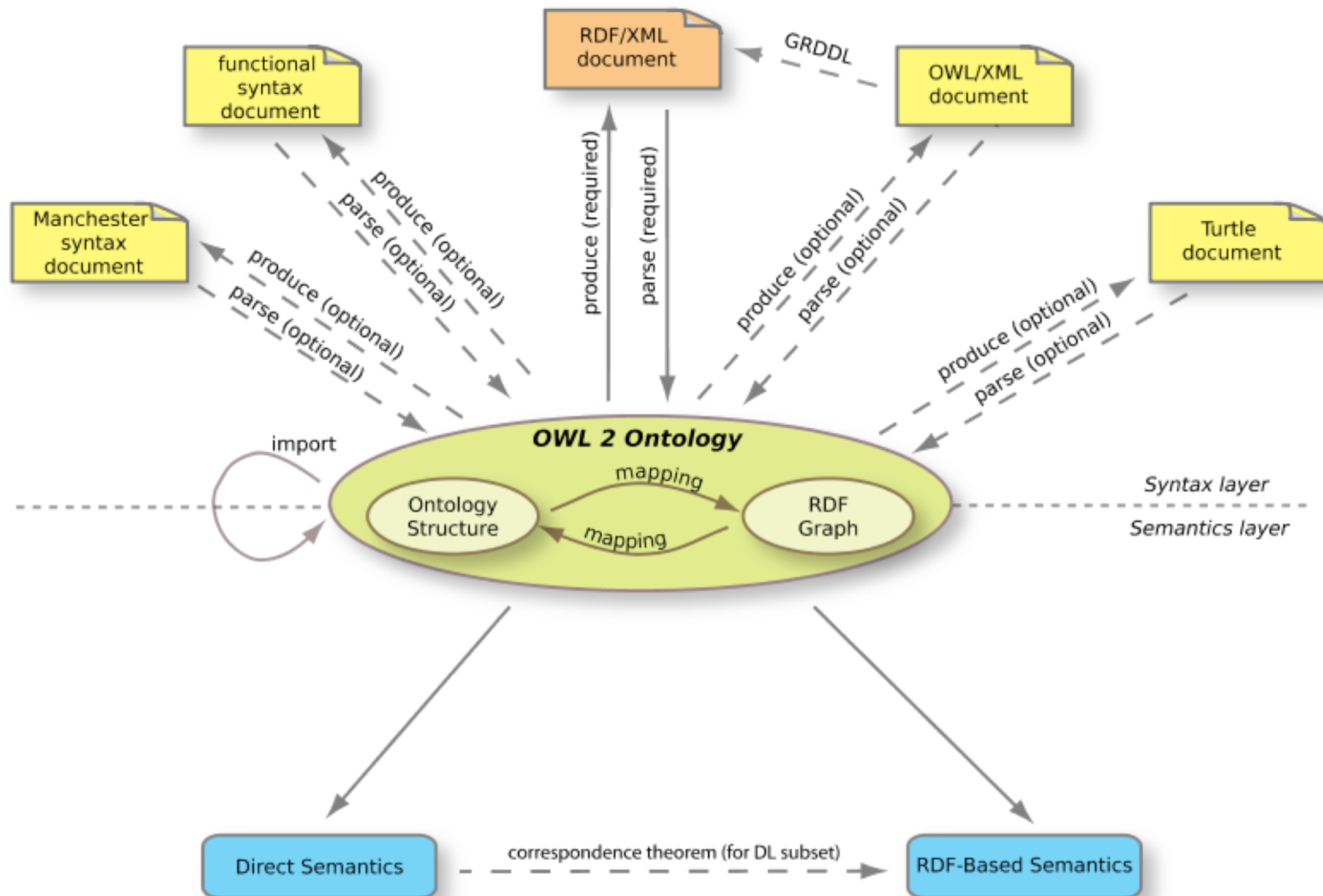
(Can't say locatedIn is transitive in RDF)

What is RDF good for?

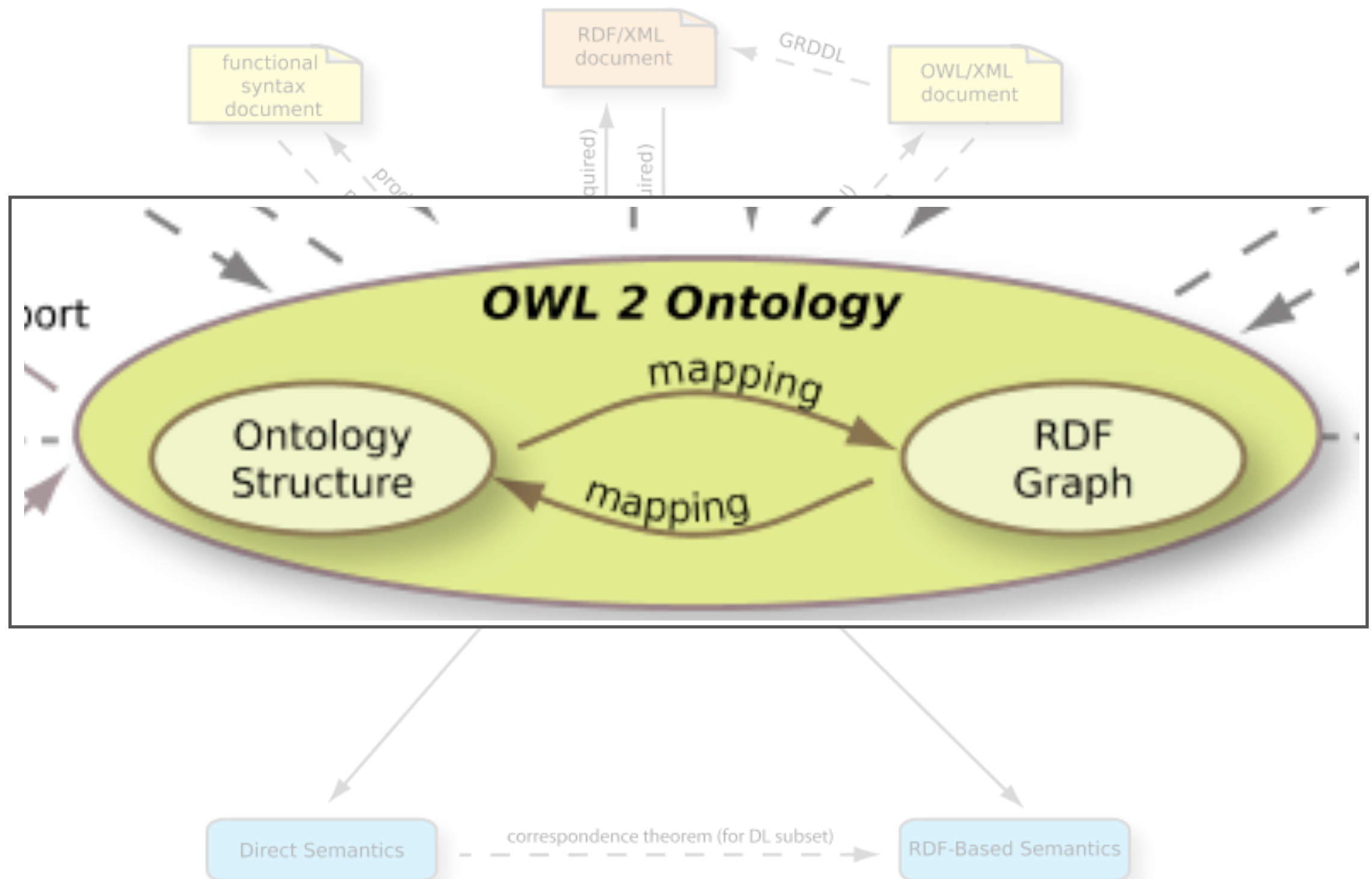
Storing (semi-structured) **data** - facts about things

Off-the-shelf tools for storing and querying with standard query languages (SPARQL)

SPARQL and OWL



SPARQL and OWL



Mapping an OWL Ontology into an RDF Graph

(Example I)

WheatFlour **SubClassOf** Flour



```
<http://protege.stanford.edu/ontologies/groceries/WheatFlour>  
<http://www.w3.org/2000/01/rdf-schema#subClassOf>  
<http://protege.stanford.edu/ontologies/groceries/Flour> .
```



```
PREFIX : <http://protege.stanford.edu/ontologies/groceries/>  
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>  
  
:WheatFlour rdfs:subClassOf :Flour .
```

Mapping an OWL Ontology into an RDF Graph

(Example II)

hasIngredient **Domain** FoodStuff



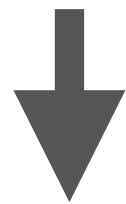
(Assuming prefixes have been specified)

:hasIngredient **rdfs:domain** :FoodStuff

Mapping an OWL Ontology into an RDF Graph

(Example III)

Shortbread **SubClassOf** hasIngredient **some** Butter



(Assuming prefixes have been specified)

:Shortbread **rdfs:subClassOf** **_:x**

_:x **rdf:type** owl:Restriction

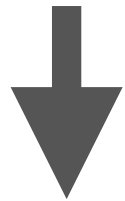
_:x **owl:onProperty** :hasIngredient

_:x **owl:someValuesFrom** :Butter

Mapping an OWL Ontology into an RDF Graph

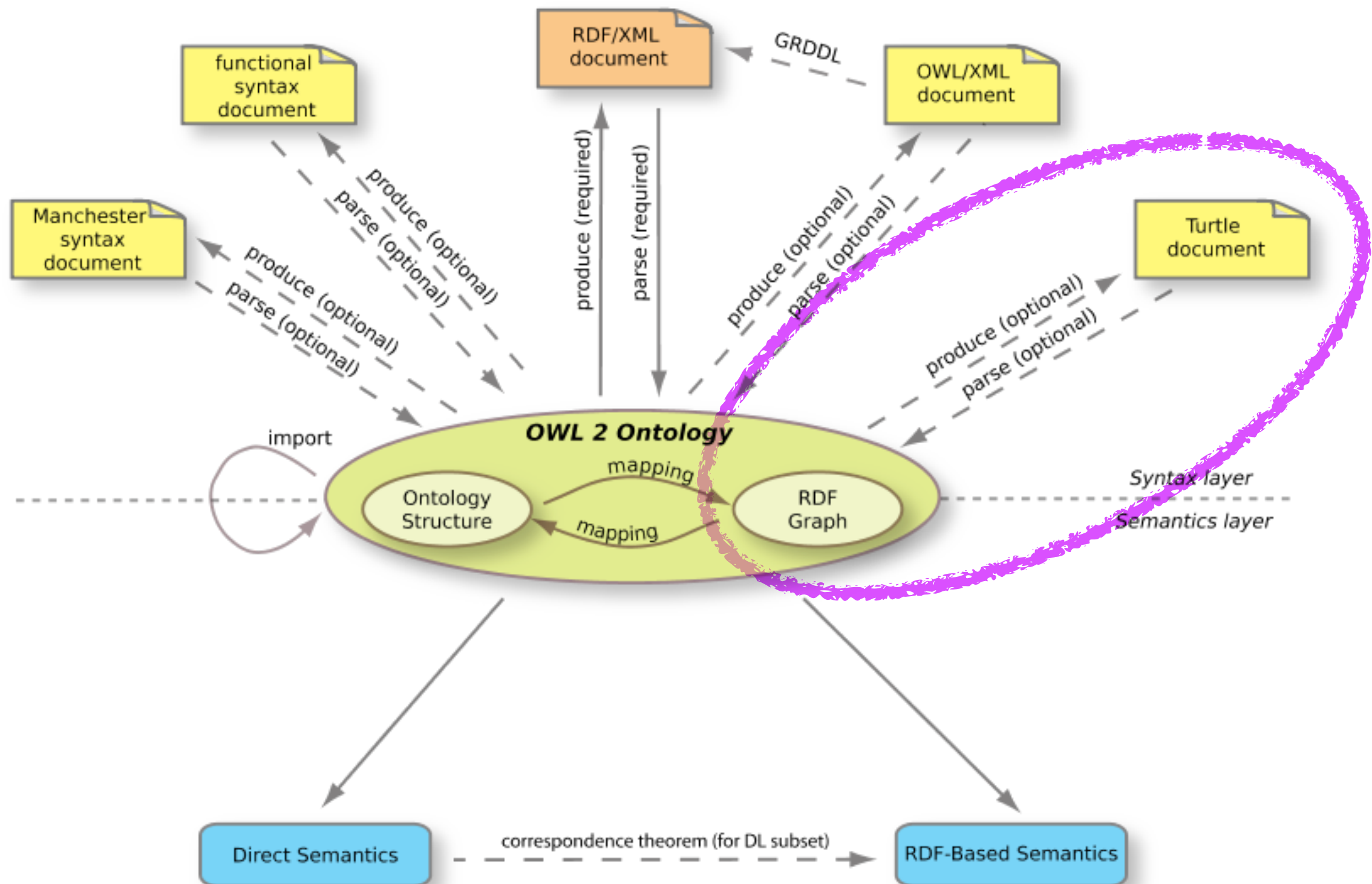
(Example IV)

BiscoffCookie **SubClassOf** hasIngredient **some** (CanolaOil **or** PalmOil)



```
:BiscoffCookie rdfs:subClassOf _:x1 .  
  _:x1 owl:onProperty :hasIngredient .  
  _:x1 owl:someValuesFrom _:x2 .  
    _:x2 owl:unionOf _:x3 .  
      _:x3 rdf:type rdf:List .  
      _:x3 rdf:first :CanolaOil .  
      _:x3 rdf:rest _:x4 .  
        _:x4 rdf:type rdf:List .  
        _:x4 rdf:first :PalmOil .  
        _:x4 rdf:rest rdf:nil .  
    _:x2 rdf:type owl:Class .  
  _:x1 rdf:type owl:Restriction .
```

SPARQL Syntax



SPARQL Graph Pattern Syntax (Turtle Syntax)

?x **rdfs:subClassOf** :GroceryItemThatContainsGluten .

?x **rdfs:subClassOf** :HighFatGroceryItem

SPARQL Graph Pattern Syntax (Turtle Syntax)

?x **rdfs:subClassOf** :GroceryItemThatContainsGluten .

?x **rdfs:subClassOf** :HighFatGroceryItem

Don't forget the dot between multiple triples!



Anatomy of a (simple) SPARQL Query

PREFIX : <http://protege.stanford.edu/ontologies/groceries/>

SELECT ?x

WHERE {
 ?x rdfs:subClassOf :GroceryItemThatContainsSoy .
 ?x rdfs:subClassOf :GroceryItemThatIsHighInSaturatedFat
}

Anatomy of a (simple) SPARQL Query

```
PREFIX : <http://protege.stanford.edu/ontologies/groceries/>
```

```
SELECT ?x
```

```
WHERE {  
    ?x rdfs:subClassOf :GroceryItemThatContainsSoy .  
    ?x rdfs:subClassOf :GroceryItemThatIsHighInSaturatedFat  
}
```

PREFIX declaration (part of prologue)

BASE declarations are also possible here

Anatomy of a (simple) SPARQL Query

PREFIX : <http://protege.stanford.edu/ontologies/groceries/>

SELECT ?x

```
WHERE {  
  ?x rdfs:subClassOf :GroceryItemThatContainsSoy .  
  ?x rdfs:subClassOf :GroceryItemThatIsHighInSaturatedFat  
}
```

SELECT keyword (query form).

Other possibilities include ASK, DESCRIBE, CONSTRUCT etc.

Variable name to
show in results list

Anatomy of a (simple) SPARQL Query

PREFIX : <http://protege.stanford.edu/ontologies/groceries/>

SELECT ?x

WHERE {
 ?x rdfs:subClassOf :GroceryItemThatContainsSoy .
 ?x rdfs:subClassOf :GroceryItemThatIsHighInSaturatedFat
}

Basic Graph Pattern
(Specifies axiom template to match)

WHERE keyword

Some SPARQL Queries

(which make sense for OWL)

A few examples:

“Give me all foods that are [DairyProducts](#)”

“What is [WalkersShortbread](#) a subclass of?”

“What are the [instances of Country](#)?”

“List [places](#) and their [locations](#)”

“List classes that have [rdfs:comment](#) annotations on them”

SPARQL and Entailment

“Give me all the **GroceryItem** that **contains Soy**”

Class description

Snap SPARQL query

Snap SPARQL query: ⌵ ⌵ ⌵ ⌵

```
PREFIX : <http://protege.stanford.edu/ontologies/grocery-ontology/>

SELECT ?x WHERE {
    ?x rdfs:subClassOf :GroceryItemThatContainsSoy
}
```

Execute

?x

● :LotusBiscoffCookies

● owl:Nothing

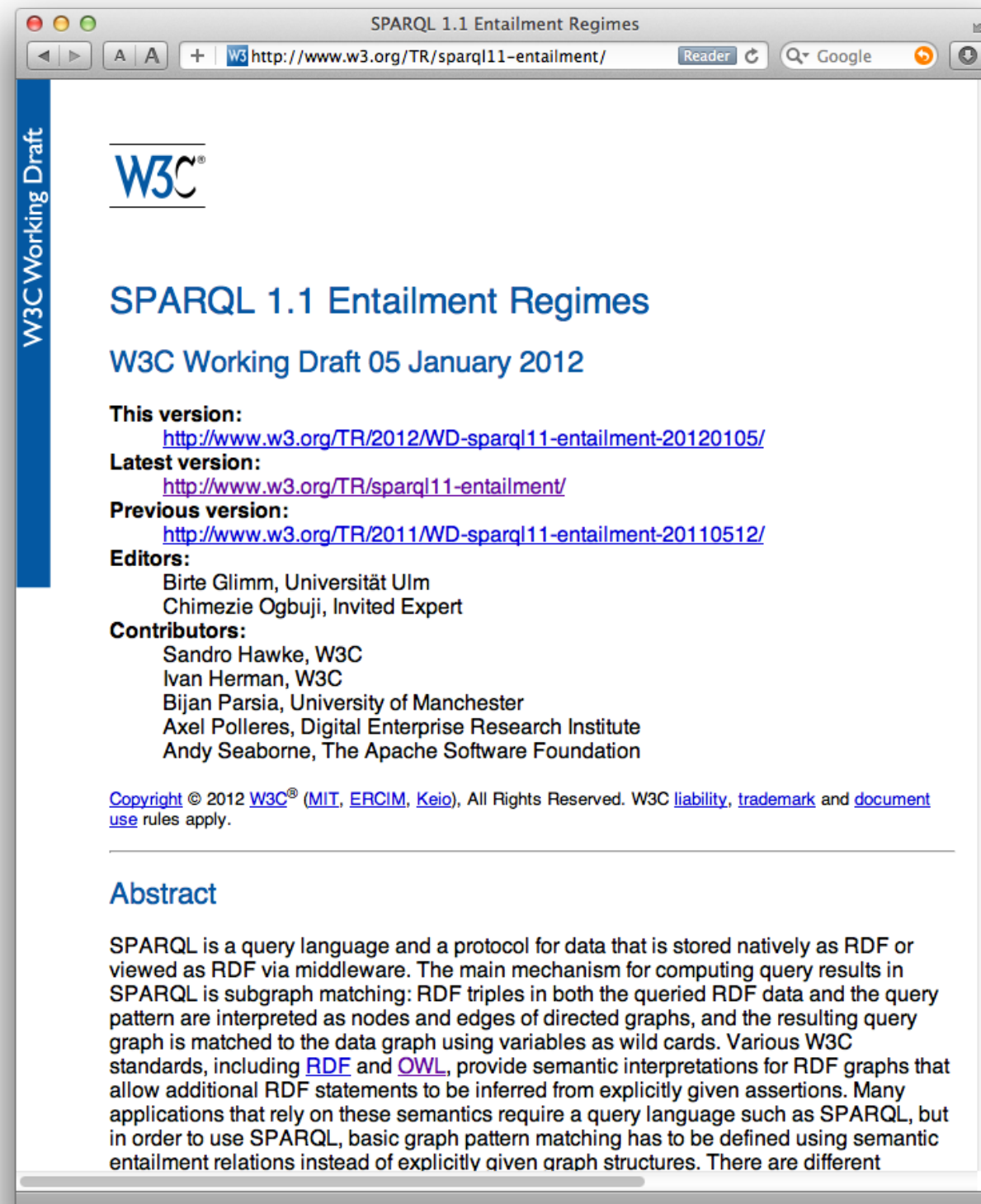
☰ :GroceryItemThatContainsSoy

3 results



Entailed results!

SPARQL Entailment Regimes



SPARQL Summary

Certain **classes of SPARQL queries make sense in** the context of **OWL**

SPARQL can be used to write **expressive queries for OWL ontologies**
(multiple variables in most positions are allowed)

SPARQL 1.1 has an **entailment regimes specification**, which makes it clear
how to use reasoning when answering SPARQL queries

Native SPARQL syntax is **based on Turtle**, which can be ugly for complex
class expressions in OWL, but for small queries is perfectly readable

Where do I store my ontology for others to query?

Triple Stores

Purpose-built data stores for **RDF graphs**...

...and for retrieving RDF data **through SPARQL**

When to use a triple store

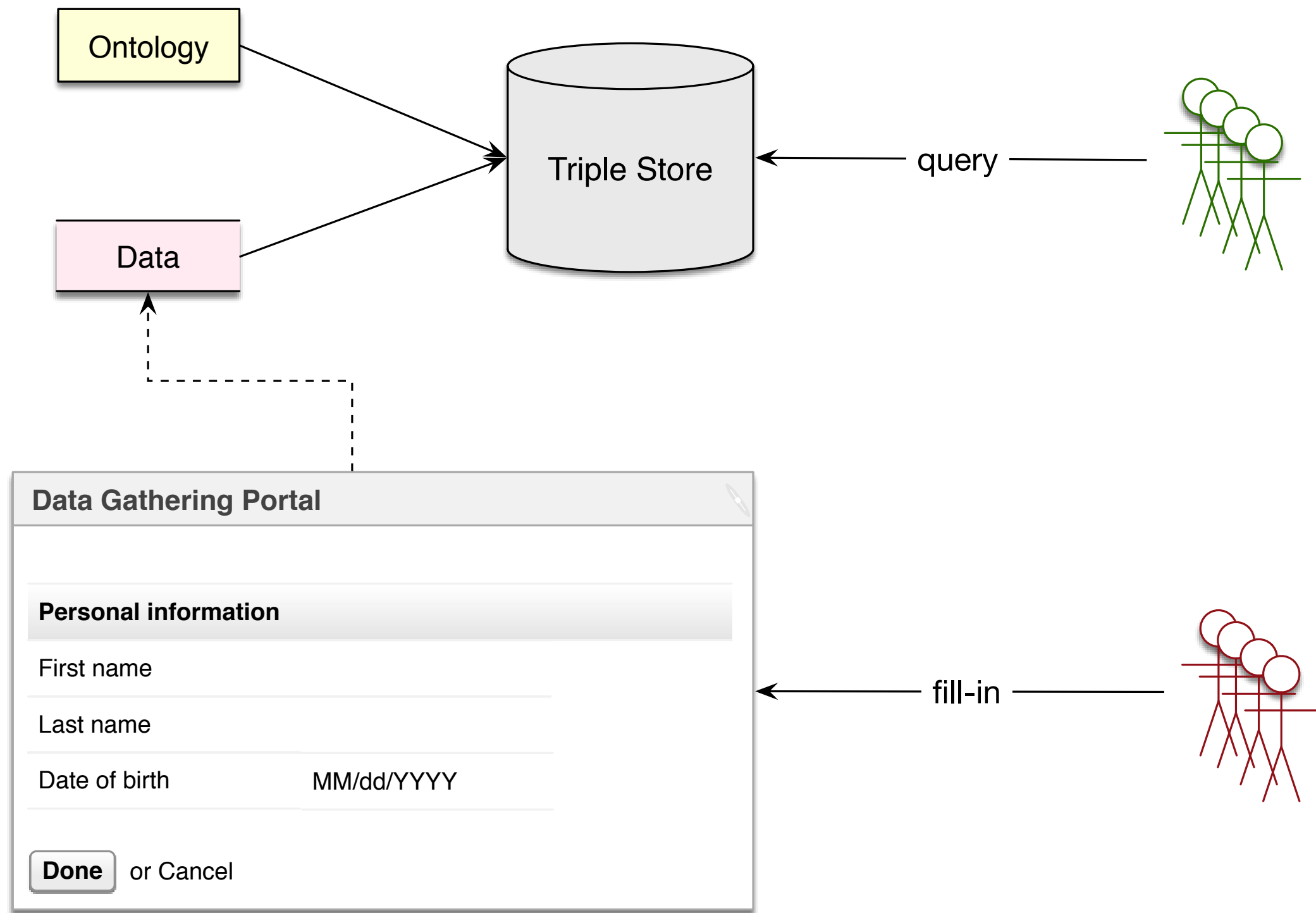
W3C standards: RDF, RDFS, SPARQL, OWL, ...

Portability

Fast query answering over RDF using SPARQL

Reasoning support

Example Usage Scenario



Triple Stores Summary

Triple stores excel at storing and querying [data that can be represented in RDF](#) (e.g., OWL ontologies)

Provide some reasoning support

Versatile

Based on [W3C standards](#)