SPAR-QL

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Introduction

SPARQL = SPARQL Protocol and RDF Query Language

SPARQL - query language for getting information from RDF graphs. It provides facilities to:

- extract information in the form of URIs, blank nodes, plain and typed literals.
- extract RDF subgraphs.
- construct new RDF graphs based on information in the queried graphs

matching graph patterns

variables – global scope; indicated by '?' or '$'

query terms – based on Turtle syntax

terms delimited by "<>" are *relative URI references*

data description format - Turtle

Basic graph patterns

Set of Triple Patterns

- **Triple Pattern** – similar to an RDF Triple (subject, predicate, object), but any component can be a query variable; literal subjects are allowed

    ?book dc:title ?title

- Matching a triple pattern to a graph: bindings between variables and RDF Terms

Basic graph patterns - 2

Matching a triple pattern to a graph: bindings between variables and RDF Terms

SELECT ?x ?v
 WHERE { ?x ?x ?v }

rdf:type rdf:type rdf:Property

x	v
rdf:type	rdf:Property

Multiple Matches

@prefix foaf: <http://xmlns.com/foaf/0.1/> .
_:a foaf:name "Johnny Lee Outlaw" .
_:a foaf:mbox <mailto:jlow@example.com> .
_:b foaf:name "Peter Goodguy" .
_:b foaf:mbox <mailto:peter@example.org> .

PREFIX foaf: <http://xmlns.com/foaf/0.1/>
SELECT ?name ?mbox
WHERE { ?x foaf:name ?name .
            ?x foaf:mbox ?mbox }

name	mbox
"Johnny Lee Outlaw"	<mailto:jlow@example.com>
"Peter Goodguy"	<mailto:peter@example.org>

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Blank nodes

```
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
_:a foaf:name "Alice" .
_:b foaf:name "Bob" .
```

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
SELECT ?x ?name
WHERE { ?x foaf:name ?name }
```

x	name
_:c	"Alice"
_:d	"Bob"

Group patterns

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
SELECT ?name ?mbox
WHERE
{ ?x foaf:name ?name .
  ?x foaf:mbox ?mbox }
```

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
SELECT ?name ?mbox
WHERE
{ {?x foaf:name ?name;
      foaf:mbox ?mbox } }
```

Value constraints

```
@prefix dc:
<http://purl.org/dc/elements/1.1/> .
@prefix : <http://example.org/book/> .
@prefix ns: <http://example.org/ns#> .
:book1 dc:title "SPARQL Tutorial" .
:book1 ns:price 42 .
:book2 dc:title "The Semantic Web" .
:book2 ns:price 23 .
```

```
PREFIX dc:
<http://purl.org/dc/elements/1.1/>
PREFIX ns: <http://example.org/ns#>
SELECT ?title ?price
WHERE { ?x ns:price ?price .
        FILTER ?price < 30 .
        ?x dc:title ?title . }
```

title	price
"The Semantic Web"	23

Optional graph patterns

@prefix dc:
<http://purl.org/dc/elements/1.1/> .
@prefix : <http://example.org/book/> .
@prefix ns: <http://example.org/ns#> .
:book1 dc:title "SPARQL Tutorial" .
:book1 ns:price 42 .
:book2 dc:title "The Semantic Web" .
:book2 ns:price 23 .

```
PREFIX dc:
<http://purl.org/dc/elements/1.1/>
PREFIX ns: <http://example.org/ns#>
SELECT ?title ?price
WHERE { ?x dc:title ?title .
          OPTIONAL { ?x ns:price ?price .
                     FILTER ?price < 30
                   }
}
```

title	price
"SPARQL Tutorial"	
"The Semantic Web"	23

Multiple optional blocks

```
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
_:a foaf:name "Alice" .
_:a foaf:homepage <http://work.example.org/alice/> .
_:b foaf:name "Bob" .
_:b foaf:mbox <mailto:bob@work.example> .
```

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
SELECT ?name ?mbox ?hpage
WHERE { ?x foaf:name ?name .
    OPTIONAL { ?x foaf:mbox ?mbox }.
    OPTIONAL { ?x foaf:homepage ?hpage } }
```

name	Mbox	hpage
"Alice"		<http://work.example.org/alice/>
"Bob"	<mailto:bob@example.com>	

Alternative graph patterns

@prefix dc10: <http://purl.org/dc/elements/1.0/> .
@prefix dc11: <http://purl.org/dc/elements/1.1/> .
_:a dc10:title "SPARQL Query Language Tutorial" .
_:b dc11:title "SPARQL Protocol Tutorial" .
_:c dc10:title "SPARQL" .
_:c dc11:title "SPARQL (updated)" .

x	y
	"SPARQL (updated)"
	"SPARQL Protocol Tutorial"
"SPARQL"	
"SPARQL Query Language Tutorial"	

PREFIX dc10: <http://purl.org/dc/elements/1.0/>
PREFIX dc11: <http://purl.org/dc/elements/1.1/>
SELECT ?x ?y
WHERE { { ?book dc10:title ?x }
        UNION { ?book dc11:title ?y } }

Evaluation order

Optional-1: an optional pattern that has a common variable with a(more) basic graph pattern(s) must be executed after the basic graph pattern(s)

Optional-2: there can't be two optionals with a common variable, if that variable does not occur in a basic graph pattern as well

Constraint: constraints are evaluated after variables are assigned values

RDF Dataset

RDF data stores may hold multiple RDF graphs:

- record information about each graph
- queries that involve information from more than one graph
- *RDF Dataset* in SPARQL terminology
- the background graph, which does not have a name, and zero or more named graphs, identified by URI reference

the relationship between named and background graphs:

- (i) to have information in the background graph that includes provenance information about the named graphs (the application is not directly trusting the information in the named graphs)
- (ii) to include the information in the named graphs in the background graph as well.

RDF Dataset - 2

Background graph
@prefix dc: <http://purl.org/dc/elements/1.1/> .
<http://example.org/bob> dc:publisher "Bob" .
<http://example.org/alice> dc:publisher "Alice" .

Graph: http://example.org/bob
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
_:a foaf:name "Bob" .
_:a foaf:mbox <mailto:bob@oldcorp.example.org> .

Graph: http://example.org/alice
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
_:a foaf:name "Alice" .
_:a foaf:mbox <mailto:alice@work.example.org> .

RDF Dataset - 3

Background graph
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
_:x foaf:name "Bob" .
_:x foaf:mbox <mailto:bob@oldcorp.example.org> .
_:y foaf:name "Alice" .
_:y foaf:mbox <mailto:alice@work.example.org> .

Graph: http://example.org/bob
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
_:a foaf:name "Bob" .
_:a foaf:mbox <mailto:bob@oldcorp.example.org> .

Graph: http://example.org/alice
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
_:a foaf:name "Alice" .
_:a foaf:mbox <mailto:alice@work.example.org> .

Querying dataset

Graph: http://example.org/foaf/aliceFoaf
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
_:a foaf:name "Alice" .
_:a foaf:mbox <mailto:alice@work.example> .
_:a foaf:knows _:b .
_:b rdfs:seeAlso <http://example.org/foaf/bobFoaf> .
<http://example.org/foaf/bobFoaf> rdf:type
foaf:PersonalProfileDocument .
_:b foaf:name "Bob" .
_:b foaf:mbox <mailto:bob@work.example> .
_:b foaf:age 32 .

Graph: http://example.org/foaf/bobFoaf
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
 _:1 foaf:mbox <mailto:bob@work.example> .
 _:1 rdfs:seeAlso <http://example.org/foaf/bobFoaf> .
_:1 foaf:age 35 .
<http://example.org/foaf/bobFoaf> rdf:type
foaf:PersonalProfileDocument .

Querying dataset

Accessing graph labels

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
SELECT ?src ?bobAge
WHERE { GRAPH ?src
          { ?x foaf:mbox <mailto:bob@work.example> .
            ?x foaf:age ?bobAge }
        }
```

src	bobAge
<http://example.org/foaf/aliceFoaf>	32
<http://example.org/foaf/bobFoaf>	35

Querying dataset

Resticting by graph label

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX data: <http://example.org/foaf/>
SELECT ?age
WHERE
    {
        GRAPH data:bobFoaf  {
                ?x foaf:mbox <mailto:bob@work.example> .
                 ?x foaf:age ?age  }
    }
```

age
35

Querying dataset

Resticting via query pattern

```
PREFIX .....
SELECT ?mbox ?age ?ppd
 WHERE
    { GRAPH data:aliceFoaf
        { ?alice foaf:mbox <mailto:alice@work.example> ; foaf:knows ?whom .
          ?whom foaf:mbox ?mbox ;   rdfs:seeAlso ?ppd .
          ?ppd a foaf:PersonalProfileDocument . } .
      GRAPH ?ppd { ?w foaf:mbox ?mbox ;  foaf:age ?age } }
```

mbox	age	ppd
<mailto:bob@work.example>	35	<http://example.org/foaf/bobFoaf>

Query forms

- **SELECT**
  - returns all, or a subset of the variables bound in a query pattern match
  - formats : XML or RDF/XML
- **CONSTRUCT**
  - returns an RDF graph constructed by substituting variables in a set of triple templates
- **DESCRIBE**
  - returns an RDF graph that describes the resources found.
- **ASK**
  - returns whether a query pattern matches or not.

Construct

@prefix foaf: <http://xmlns.com/foaf/0.1/> .
_:a foaf:name "Alice" .
_:a foaf:mbox <mailto:alice@example.org> .

CONSTRUCT {
  <http://example.org/person#Alice> vcard:FN ?name
} WHERE { ?x foaf:name ?name }

@prefix vcard: <http://www.w3.org/2001/vcard-rdf/3.0#>.
<http://example.org/person#Alice> vcard:FN "Alice" .

#extracting a whole graph from the target RDF dataset
CONSTRUCT { ?s ?p ?o }
WHERE { GRAPH <http://example.org/myGraph> { ?s ?p ?o } . }

Describe

```
PREFIX ent: <http://myorg.example/employees#>
DESCRIBE ?x
WHERE { ?x ent:employeeId "1234" }
```

```
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix vcard: <http://www.w3.org/2001/vcard-rdf/3.0> .
@prefix myOrg: <http://myorg.example/employees#> .
 _:a myOrg:employeeId "1234" ;
     foaf:mbox_sha1sum "ABCD1234" ;
      vcard:N [ vcard:Family "Smith" ;
                  vcard:Given "John" ] .
foaf:mbox_sha1sum rdf:type owl:InverseFunctionalProperty .
```

Ask

```
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
_:a foaf:name "Alice" .
_:a foaf:homepage <http://work.example.org/alice/> .
_:b foaf:name "Bob" .
_:b foaf:mbox <mailto:bob@work.example> .
```

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
ASK { ?x foaf:name "Alice" } .
```

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