
SPARQL

SPARQL

- SPARQL: SPARQL Protocol And RDF Query Language
 - Standard query language for RDF(S) Graphs
 - Is a W3C Recommendation
 - It supports RDFS (or OWL) under specific entailments
- Based on (navigational) pattern matching
 - Simple RDF graphs are used as query patterns
 - `Select x,z where x Lectures y, y TaughtIn z, z
rdf:Type Faculty`
 - **The semantics applied are those of homomorphism**

SPARQL: Basics

- 4 query forms that retrieve either result sets or RDF graphs
 - SELECT: Returns all, or a subset of, the variables bound in a query pattern match
 - CONSTRUCT: Returns an RDF graph constructed by substituting variables in a set of triple templates
 - ASK: Returns a boolean indicating whether a query pattern matches or not
 - DESCRIBE: Returns an RDF graph that describes the resources found
- SPARQL Endpoints: It is an endpoint accepting SPARQL queries and returning results via HTTP

SPARQL SELECT Example

- Select all pairs lecturer, course such that the lecturer lectures the course

```
PREFIX fib:      <http://www.fib.edu/elements/>
```

```
SELECT ?lecturer ?course OUTPUT
```

```
WHERE
```

```
{
```

```
?lecturer fib:lectures ?course
```

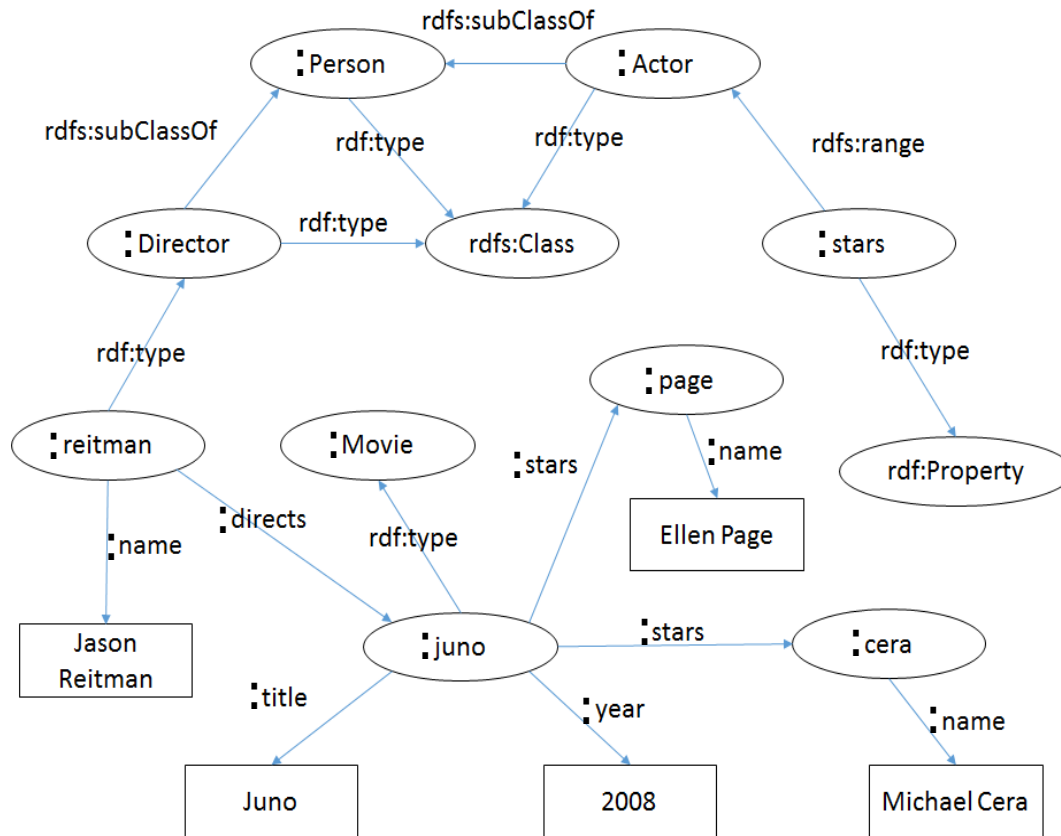
PATTERN

```
}
```

Which is equivalent to: Select x, y Where x lectures y

SPARQL allows property paths based on regular expressions (check the syntax here): <https://www.w3.org/TR/sparql11-property-paths/>

Example of RDF(S) Graph



Write the following queries (assuming no entailment regime):

- Get the name of all actors that participated in Juno
- Get the name of all directors
- Get the name of all persons
- Get the title of all movies

SPARQL 1.1 - Entailment Regimes

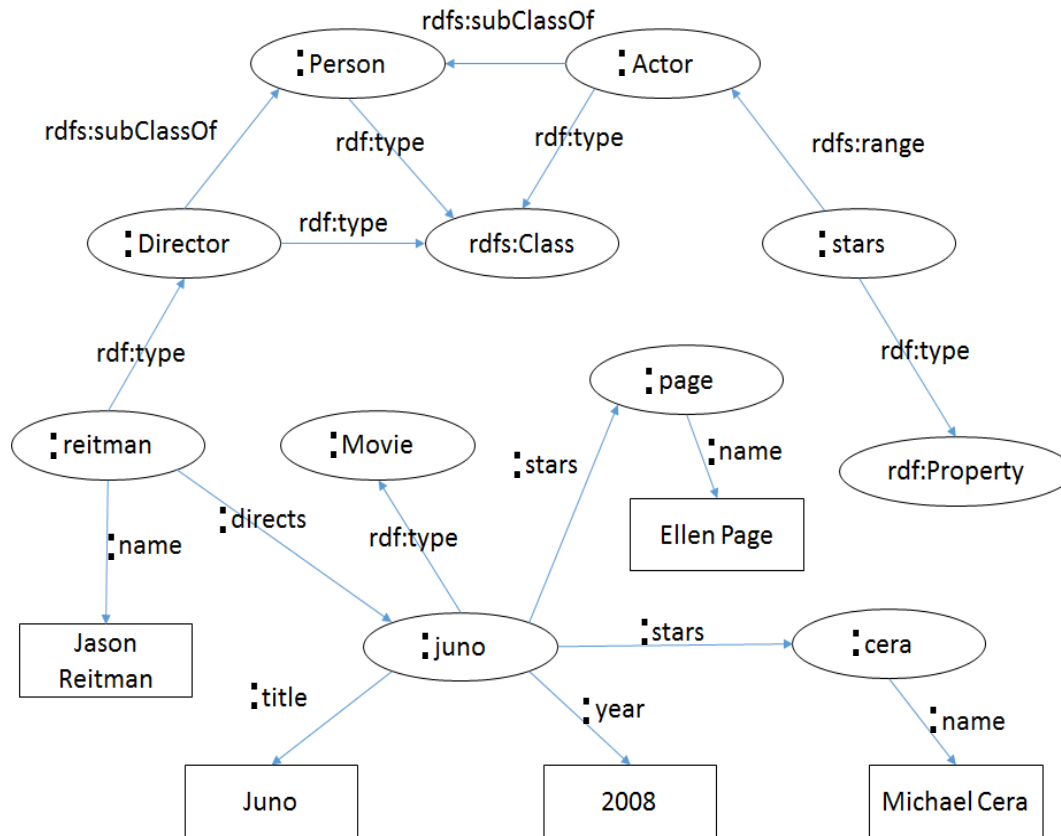
- ❑ Simple entailment: evaluation of basic graph pattern by means of pattern matching under homomorphism
- ❑ More elaborate entailment relations have been developed
 - To retrieve solutions that *are logical consequences* of the axioms asserted
- ❑ Most popular ones:
 - RDF Schema entailment,
 - OWL 2 RDF-Based Semantics entailment,
 - Etc.

RDFS Regime Entailment (Inference Rules)

RDFS entailment patterns.

	If S contains:	then S RDFS entails recognizing D:
<i>rdfs1</i>	xxx aaa yyy .	aaa <i>rdf:type</i> <i>rdf:Property</i> .
<i>rdfs2</i>	aaa <i>rdfs:domain</i> xxx . yyy aaa zzz .	yyy <i>rdf:type</i> xxx .
<i>rdfs3</i>	aaa <i>rdfs:range</i> xxx . yyy aaa zzz .	zzz <i>rdf:type</i> xxx .
<i>rdfs4a</i>	xxx aaa yyy .	xxx <i>rdf:type</i> <i>rdfs:Resource</i> .
<i>rdfs4b</i>	xxx aaa yyy .	yyy <i>rdf:type</i> <i>rdfs:Resource</i> .
<i>rdfs5</i>	xxx <i>rdfs:subPropertyOf</i> yyy . yyy <i>rdfs:subPropertyOf</i> zzz .	xxx <i>rdfs:subPropertyOf</i> zzz .
<i>rdfs6</i>	xxx <i>rdf:type</i> <i>rdf:Property</i> .	xxx <i>rdfs:subPropertyOf</i> xxx .
<i>rdfs7</i>	aaa <i>rdfs:subPropertyOf</i> bbb . xxx aaa yyy .	xxx bbb yyy .
<i>rdfs8</i>	xxx <i>rdf:type</i> <i>rdfs:Class</i> .	xxx <i>rdfs:subClassOf</i> <i>rdfs:Resource</i> .
<i>rdfs9</i>	xxx <i>rdfs:subClassOf</i> yyy . zzz <i>rdf:type</i> xxx .	zzz <i>rdf:type</i> yyy .
<i>rdfs10</i>	xxx <i>rdf:type</i> <i>rdfs:Class</i> .	xxx <i>rdfs:subClassOf</i> xxx .
<i>rdfs11</i>	xxx <i>rdfs:subClassOf</i> yyy . yyy <i>rdfs:subClassOf</i> zzz .	xxx <i>rdfs:subClassOf</i> zzz .
<i>rdfs12</i>	xxx <i>rdf:type</i> <i>rdfs:ContainerMembershipProperty</i> .	xxx <i>rdfs:subPropertyOf</i> <i>rdfs:member</i> .
<i>rdfs13</i>	xxx <i>rdf:type</i> <i>rdfs:Datatype</i> .	xxx <i>rdfs:subClassOf</i> <i>rdfs:Literal</i> .

Example of RDF(S) Graph



Write the following queries (assuming RDFS entailment regime):

- Get the name of all actors that participated in Juno
- Get the name of all directors
- Get the name of all persons
- Get the title of all movies

RDFS Entailment Regime

- More details here:

- Section 5 from:

- <http://www.w3.org/TR/2013/REC-sparql11-overview-20130321/>

- Section 4 from:

- <http://www.w3.org/TR/sparql11-entailment/#RDFSEntRegime>

Activity: Learning SPARQL

- Go to the last version of the RDF Query Language document by the W3C:
<http://www.w3.org/TR/2013/REC-sparql11-query-20130321/> and read the following sections:
 - 4. SPARQL Syntax,
 - 5. Graph Patterns,
 - 7. Matching Alternatives,
 - 8. Negation,
 - 9. Property Paths (equivalent to Navigational Pattern Matching: i.e., regular expressions on paths),
 - 10. Assignment,
 - 11. Aggregates,
 - 12. Subqueries and
 - 16. Query forms
- A tutorial can be found here:
<https://www.w3.org/2009/Talks/0615-qbe/>

Activity: Learning SPARQL

- Solve the exercise handed out by the lecturer (find it attached to this session in the LearnSQL website)
 - This is a set of **basic** queries useful to explore a dataset
 - Train yourself later to be able to trigger advanced queries
- This exercise requires connecting to the DBPedia SPARQL endpoint. There are several of them, for example:
<http://dbpedia.org/snorql/>

Summary

- ❑ SPARQL is the de facto standard to query knowledge graphs (RDF, RDFS, OWL)
- ❑ It is based on pattern matching, but it also provides most of the relational operators (e.g., group by, set operators, etc.)
- ❑ One may want to enable SPARQL entailment regimes, which extend pattern matching with basic reasoning capabilities

Bibliography

- SPARQL. W3C Recommendation. Latest at <http://www.w3.org/TR/rdf-sparql-query/>