SPARQL
(and the Regime Entailments)

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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

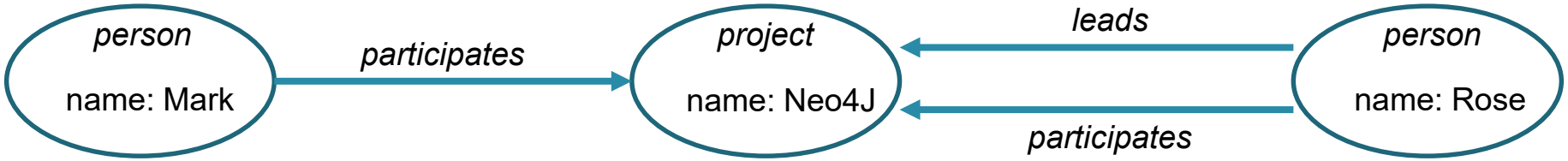
- Simple RDF graphs are used as query patterns

```
Select x,z where x Lectures y, y TaughtIn z, z rdf:Type Faculty
```

The pattern matching semantics applied are those of homomorphism

Recap: Pattern Matching Semantics

Consider the following graph and pattern matching query (in Cypher syntax):




```
MATCH (p1:Person)-->(pr:Project{name:'Neo4j'})<--(p2:Person)
RETURN p1.name, p2.name
```

1. Which is the result of this query under Cypher's semantics (i.e., non-repeated edges isomorphism)?

2. Which would be the result of the same query under homomorphism semantics?

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 lecture lectures the course

```
PREFIX fib: <http://www.fib.edu/elements/>
SELECT ?lecturer ?course
WHERE
  {
      ?lecturer fib:lectures ?course
  }
```

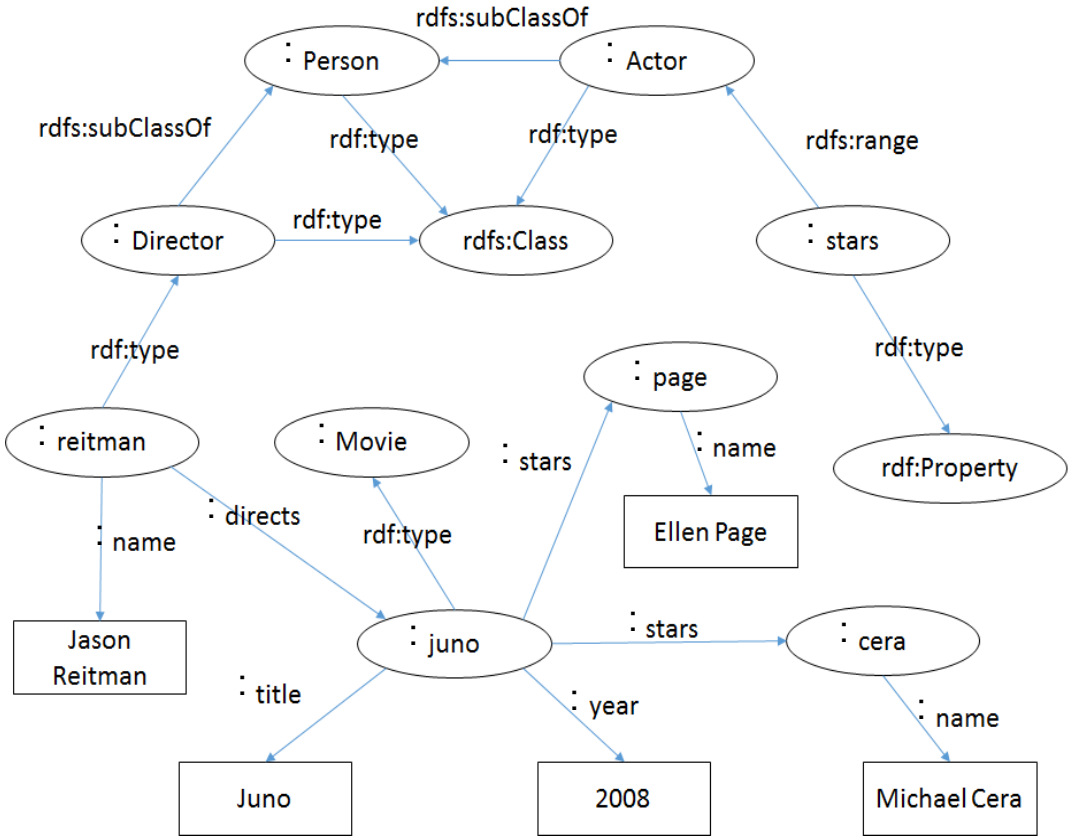
OUTPUT

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 (asuming **no entailment regime**):

a) Get the name of all actors that participated in Juno
b) Get the name of all directors
c) Get the name of all persons
d) 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

Advanced entailment regimes have been developed based on inference

- To retrieve solutions that *are logical consequences* of the axioms asserted

Most popular **advanced entailments**:

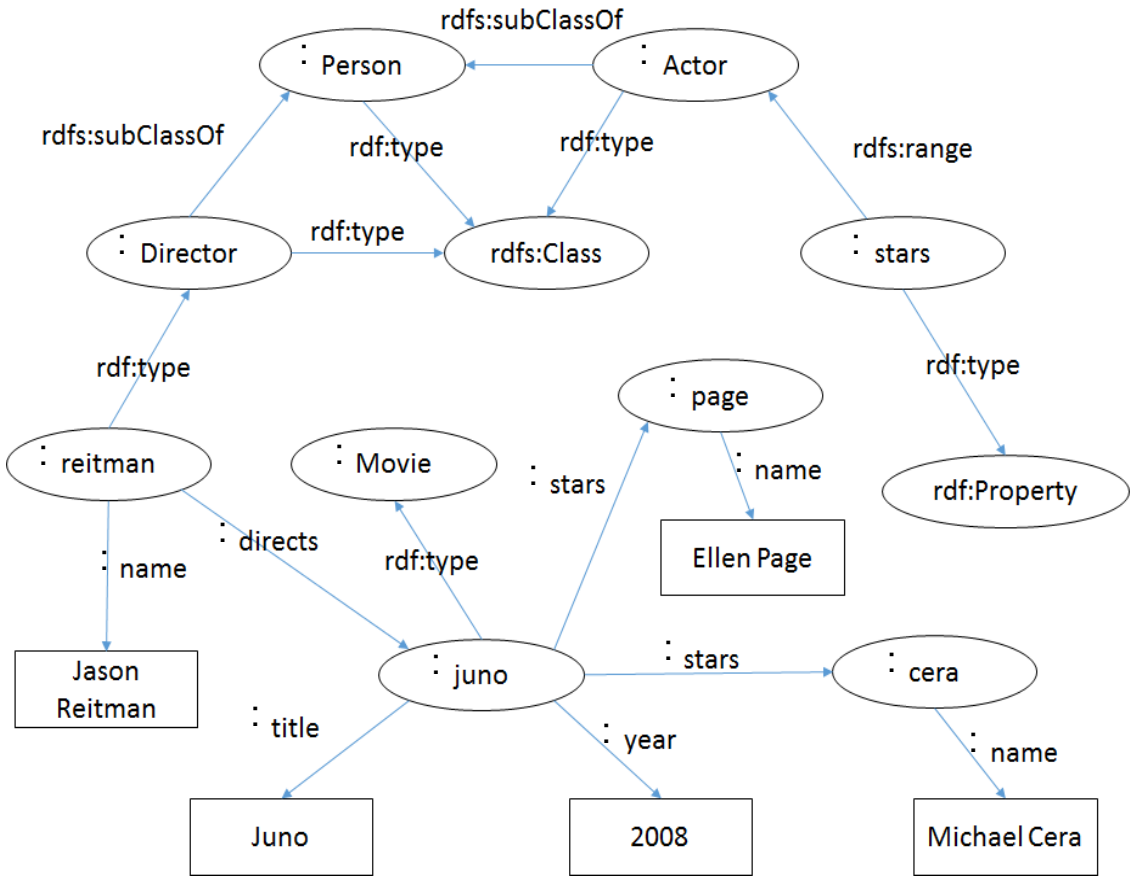
- RDF Schema entailment,
- OWL 2 RDF-Based Semantics entailment,
- Etc.

Some tools, like GraphDB, allow you to define your own entailment regime or define their own

RDFS Regime Entailment (Inference Rules)

See the RDFS Slides and recap the inference rules generated by each core RDFS property

Example of RDF(S) Graph



Write the following queries (assuming the **RDFS entailment regime**):

a) Get the name of all actors that participated in Juno
b) Get the name of all directors
c) Get the name of all persons
d) Get the title of all movies

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/