Linked Data Engineering

Lecture 4: Querying RDF with SPARQL
4.2 Complex Queries with SPARQL

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SPARQL - Filter Constraints

- Example: Filter results only for English labels

```
PREFIX : <http://dbpedia.org/resource/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dbo: <http://dbpedia.org/ontology/>
SELECT ?author_name ?title ?pages
FROM <http://dbpedia.org/>
WHERE {
       ?author rdf:type dbo:Writer .
       ?author rdfs:label ?author_name .
       FILTER (LANG(?author_name)="en")
       ?author dbo:notableWork ?work .
       ?work dbo:numberOfPages ?pages .
       FILTER (?pages > 500)
       ?work rdfs:label ?title .
       FILTER (LANG(?title)="en")
} LIMIT 100
```

More SPARQL Operators

- Logical connectives `&&` and `||` for xsd:boolean
- Comparison operators `=`, `!=`, `<`, `>`, `<=`, and `>=` for numeric datatypes, xsd:dateTime, xsd:string, and xsd:boolean
- Comparison operators `=` and `!=` for other datatypes
- Arithmetic operators `+`, `-`, `*`, and `/` for numeric datatypes

- and in addition:
  - `REGEX(String,Pattern)` or `REGEX(String,Pattern,Flags)`
  - `sameTERM(A,B)`
  - `langMATCHES(A,B)`

SPARQL - Filter Constraints

- Example: Book titles that contain the word “love”

```
PREFIX : <http://dbpedia.org/resource/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dbo: <http://dbpedia.org/ontology/>
SELECT ?author_name ?title
FROM <http://dbpedia.org/>
WHERE {
       ?author rdf:type dbo:Writer .
       ?author rdfs:label ?author_name .
       FILTER (LANG(?author_name)="en")
       ?author dbo:notableWork ?work .
       ?work rdfs:label ?title .
       FILTER (LANG(?title)="en")
       FILTER REGEX (?title, "love", "i")
} LIMIT 100
```

string

regular expression

flags

learn more about regular expressions at http://regexone.com/

query SPARQL endpoint

SPARQL - Filter Constraints

- Example: Retrieve also the German book title, **if available**

```
PREFIX : <http://dbpedia.org/resource/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dbo: <http://dbpedia.org/ontology/>
SELECT ?author_name ?en_title ?de_title
FROM <http://dbpedia.org/>
WHERE {
       ?author rdf:type dbo:Writer .
       ?author rdfs:label ?author_name .
       FILTER (LANG(?author_name)="en")
       ?author dbo:notableWork ?work .
       ?work rdfs:label ?en_title .
       FILTER (LANG(?en_title)="en")
       OPTIONAL { ?work rdfs:label ?de_title .
                FILTER (LANG(?de_title)="de")
       }
} LIMIT 100
```

optional constraint

- The keyword **OPTIONAL** selects optional elements from the RDF graph
- complies to a Left Outer Join

query SPARQL endpoint

SPARQL - Alternative Results via UNION

- Example: Retrieve all influencers of and people influenced by **Jules Verne**

```
PREFIX : <http://dbpedia.org/resource/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dbo: <http://dbpedia.org/ontology/>

SELECT ?influencer ?influenced
FROM <http://dbpedia.org/>
WHERE {
   { :Jules_Verne dbo:influenced ?influenced . }
  UNION
   { :Jules_Verne dbo:influencedBy ?influencer . }
}
```

logical disjunction

- The keyword **UNION** allows for alternatives (logical disjunction)

Disclaimer
This query was used in the video, but does not deliver any result in the current release of DBpedia.

query SPARQL endpoint

SPARQL - Alternative Results via UNION

- Example: Retrieve all influencers of and people influenced by **Jules Verne**

```
PREFIX : <http://dbpedia.org/resource/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dbo: <http://dbpedia.org/ontology/>

SELECT ?influencer ?influenced
FROM <http://dbpedia.org/>
WHERE {
   { :Emilio_Salgari dbo:influenced ?influenced . }
  UNION
   { :Emilio_Salgari dbo:influencedBy ?influencer . }
}
```

logical disjunction

- The keyword **UNION** allows for alternatives (logical disjunction)

Disclaimer
This query was not used in the video, but delivers a non-empty result in the current release of DBpedia.

query SPARQL endpoint

SPARQL - Negation

- Example: Retrieve authors that don‘t have an entry for “notable work”

```
PREFIX : <http://dbpedia.org/resource/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dbo: <http://dbpedia.org/ontology/>

SELECT ?author
FROM <http://dbpedia.org/>
WHERE {
       ?author rdf:type dbo:Writer .
       OPTIONAL { ?author dbo:notableWork ?work . }
       FILTER (!BOUND(?work))
} LIMIT 100
```

no variable binding

- Negation in SPARQL
- complies to “NOT EXISTS” in SQL

query SPARQL endpoint

SPARQL - Negation (2)

- Example: Retrieve authors that don‘t have an entry for “notable work”

```
PREFIX : <http://dbpedia.org/resource/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dbo: <http://dbpedia.org/ontology/>

SELECT ?author
FROM <http://dbpedia.org/>
WHERE {
        ?author rdf:type dbo:Writer .
        FILTER NOT EXISTS {?author dbo:notableWork ?work .}

} LIMIT 100
```

filter query result for existency

- SPARQL 1.1 also provides `FILTER` expressions `NOT EXISTS` and `EXISTS`

SPARQL - Negation (3)

- Example: Retrieve authors that don‘t have an entry for “notable work”

```
PREFIX : <http://dbpedia.org/resource/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dbo: <http://dbpedia.org/ontology/>

SELECT ?author
FROM <http://dbpedia.org/>
WHERE {
        ?author rdf:type dbo:Writer .
        MINUS {?author dbo:notableWork ?work .}

} LIMIT 100
```

remove from query result

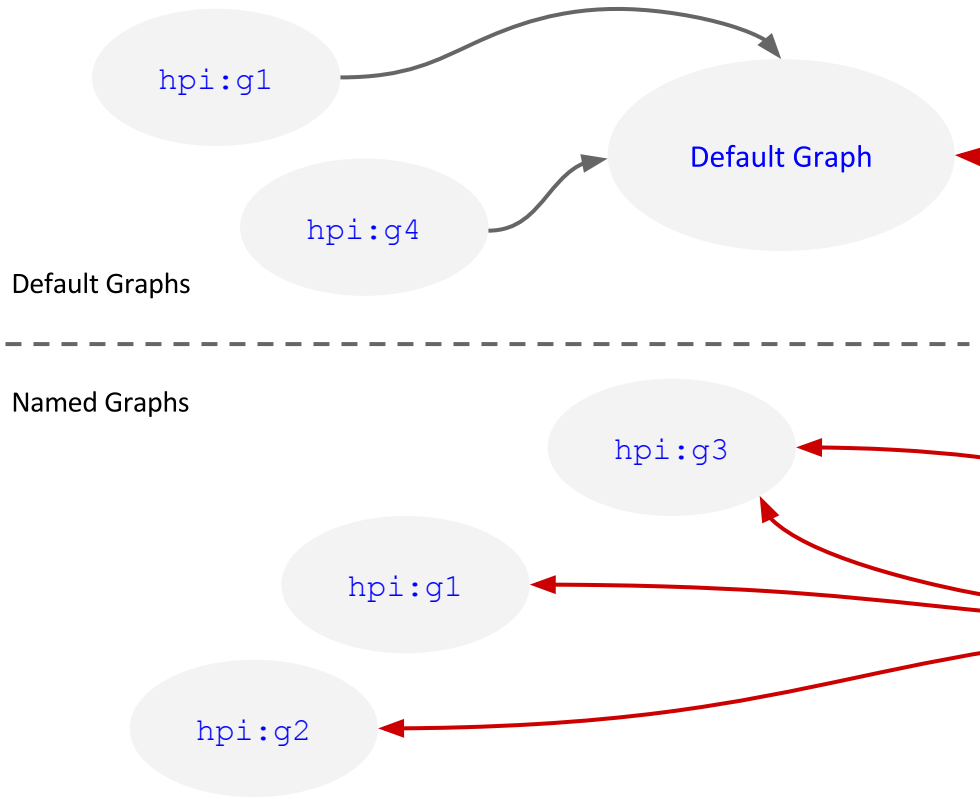
- Filtering of query solutions by removing possible solutions with `MINUS`.
- Difference to `NOT EXIST`:
- `MINUS` changes the graph pattern
- query result is dependent on position of `MINUS`

SPARQL - RDF Graphs

- SPARQL queries are executed over an RDF dataset
  - one (or more) **default RDF graph** (`FROM`)
  - zero or more **named RDF graphs** (`FROM NAMED`, `GRAPH`)
- **Named Graphs** can be explicitly addressed via the keyword `GRAPH` and the URI of the named graph

```
SELECT ...
WHERE {
  ...
  GRAPH <http://example.org/graph1.rdf> {
    ?x foaf:mbox ?mbox .
  }
  ...
}
```

SPARQL - RDF Graphs




```
PREFIX hpi: ...
SELECT ...
FROM hpi:g1
FROM hpi:g4
FROM NAMED hpi:g1
FROM NAMED hpi:g2
FROM NAMED hpi:g3
WHERE {
  ... A ...
  GRAPH hpi:g3 {
    ... B ...
  }
  GRAPH ?g {
    ... C ...
  }
}
```

SPARQL - RDF Graphs

- How to ask a SPARQL Endpoint which RDF Graphs are available?

```
SELECT DISTINCT ?g
WHERE {
  GRAPH ?g { ?s ?p ?o . }
}
```

query SPARQL endpoint

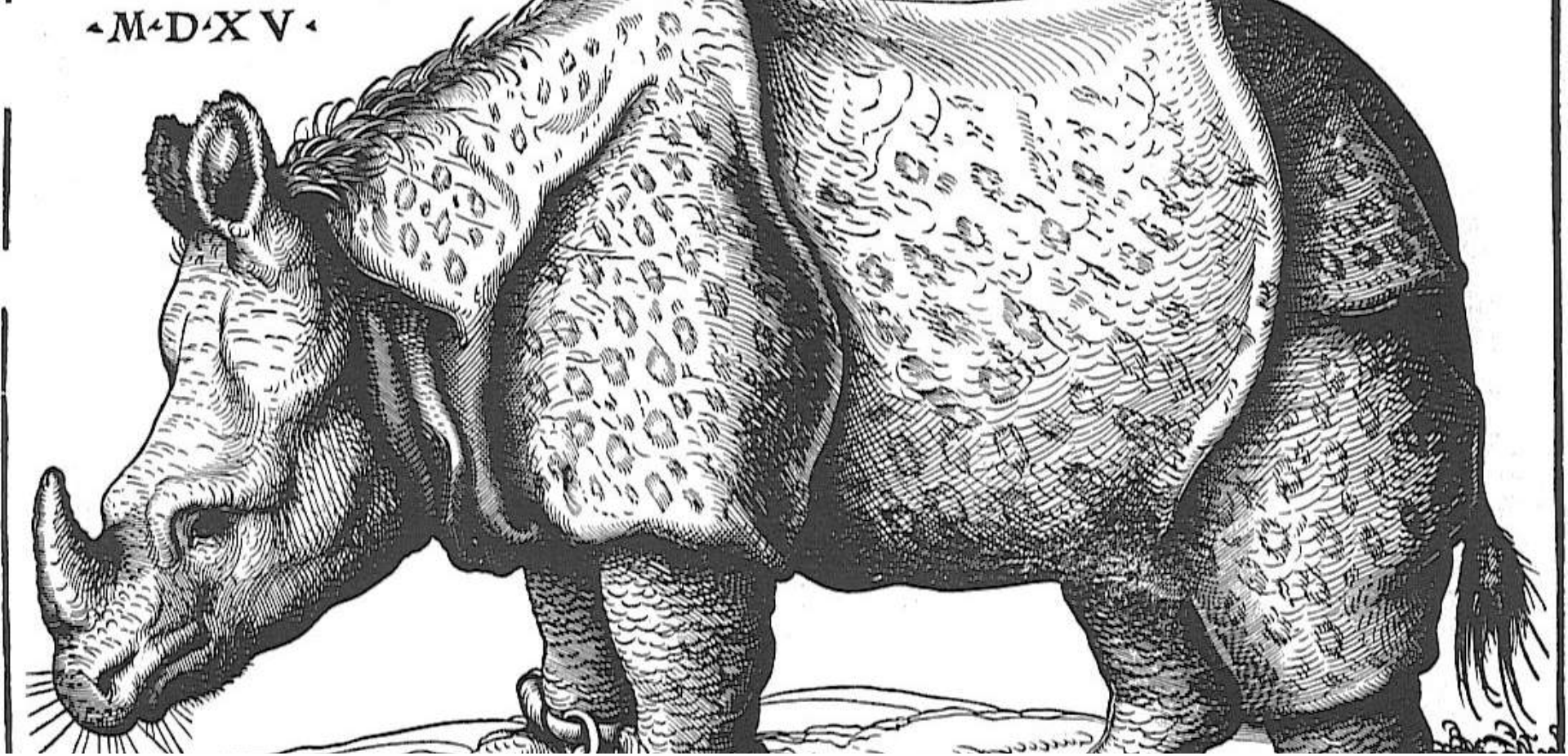
SPARQL - Federated Queries

- SPARQL enables federated queries over several RDF datasets or SPARQL endpoints via the **SERVICE** objective

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX movie: <http://data.linkedmdb.org/resource/movie/>
PREFIX dcterms: <http://purl.org/dc/terms/>

SELECT ?film ?label ?subject WHERE {
    SERVICE <http://data.linkedmdb.org/sparql> {
        ?film a movie:film .
        ?film rdfs:label ?label .
        ?film owl:sameAs ?dbpediaLink .
        FILTER regex(STR(?dbpediaLink), "dbpedia", "i")
    }
    SERVICE <http://dbpedia.org/sparql> {
        ?dbpediaLink dcterms:subject ?subject .
    }
}
LIMIT 100
```

- Example: connect the Linked Movie Database with DBpedia
- only possible, if SPARQL endpoints permit federation



Next: 03 - More Complex SPARQL Queries

Lecture 4 - Querying RDF with SPARQL - OpenHPI - Course Linked Data Engineering