INF3580 – Semantic Technologies – Spring 2010
Lecture 4: The SPARQL Query Language

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DEPARTMENT OF INFORMATICS

UNIVERSITY OF OSLO

Today's Plan

1. Gruppeundervisning

2. Repetition: RDF

3. Common Vocabularies

4. SPARQL By Example

5. SPARQL Systematically

6. Executing SPARQL Queries

Outline

1. **Gruppeundervisning**

2. Repetition: RDF

3. Common Vocabularies

4. SPARQL By Example

5. SPARQL Systematically

6. Executing SPARQL Queries

Gruppeundervisning

- Tirsdager 12:15–14:00: 12–14 studenter
- Fredager 10:15–12:00: 1–2 studenter
- Vi er blitt bedt å gjennomgå oppgavene på gruppetimene
- Termstuene mangler prosjektor
- Forslag:
    - gruppetimer med gjennomgang på tirsdager
    - flytte tirsdager til rom 107 i VB hus, som har lerret
    - Beholde timene på termstuer fredager.

Outline

Reminder: RDF triples

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- The subject maybe a resource or a blank node

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- The subject maybe a resource or a blank node
- The predicate must be a resource

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- A triple consists of *subject*, *predicate*, and *object*
- The subject maybe a resource or a blank node
- The predicate must be a resource
- The object can be a resource, a blank node, or a literal

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    - Plain, with language tag:
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        geo:germany geo:name "Germany"@en .
        ```

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  - Typed, with a URI indicating the type:
    geo:berlin geo:population "3431700"^^xsd:integer .

Reminder: RDF Blank Nodes

Blank nodes are like resources without a URI

There is a city in Germany called Berlin

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_:x rdf:type geo:City .
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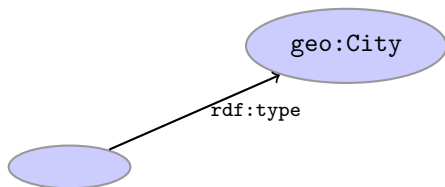
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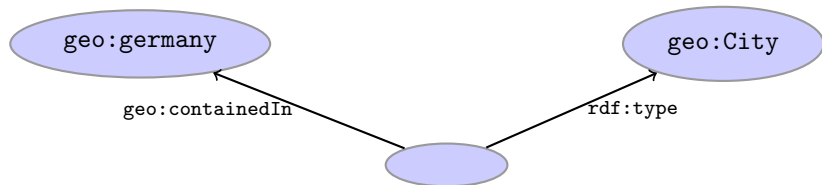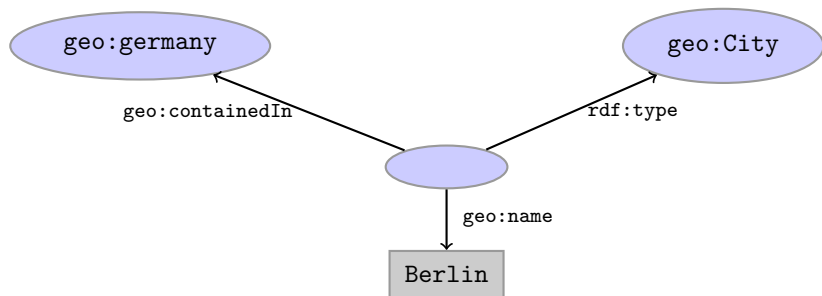
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- Retrieval of information via methods in `Model` and `Resource`
- Simple pattern matching with `null` as wildcard possible

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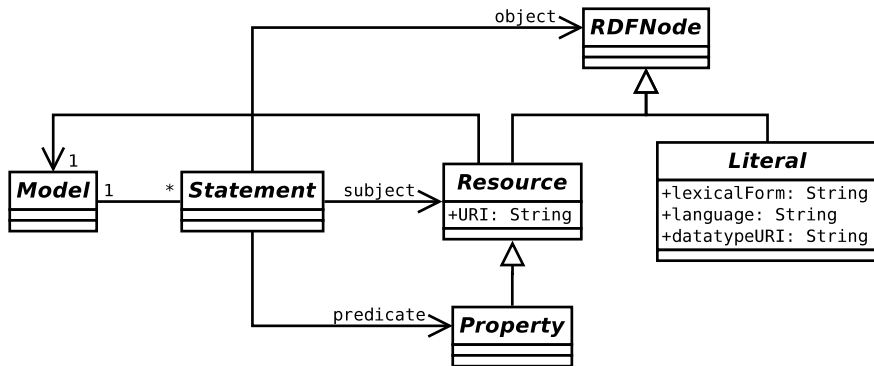
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- Examples:

```
geo:berlin rdf:type rdf:Resource .
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- Examples:

  ```
  <http://heim.ifi.uio.no/martingi/foaf.rdf#me>
      rdf:type foaf:Person ;
      foaf:name "Martin Giese" ;
      foaf:mbox <mailto:martingi@ifi.uio.no> ;
      foaf:knows <http://.../martige/foaf.rdf#me> .
  ```

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- Examples:

```
<http://heim.ifi.uio.no/martingi/>
    dcterms:creator <http://.../foaf.rdf#me> ;
    dcterms:created "2007-08-01" ;
    dcterms:description "Martin Giese's homepage"@en ;
    dcterms:replaces <http://my.old.homepage/> .
```

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SPARQL

- SPARQL Protocol And RDF Query Language

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People called "Martin Giese"

```
PREFIX foaf:  <http://xmlns.com/foaf/0.1/>
SELECT ?mg WHERE {
    ?mg foaf:name "Martin Giese" .
}
```

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Answer:

?mg
<http://dblp.l3s.de/d2r/resource/authors/Martin_Giese>

Simple Examples (cont.)

Publications by people called "Martin Giese"

```
PREFIX foaf:  <http://xmlns.com/foaf/0.1/>
PREFIX dc:    <http://purl.org/dc/elements/1.1/>
SELECT ?pub WHERE {
    ?mg foaf:name "Martin Giese" .
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```

Simple Examples (cont.)

Publications by people called "Martin Giese"

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PREFIX foaf:  <http://xmlns.com/foaf/0.1/>
PREFIX dc:    <http://purl.org/dc/elements/1.1/>
SELECT ?pub WHERE {
    ?mg foaf:name "Martin Giese" .
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Answer:

?pub
<http://dblp.l3s.de/d2r/resource/publications/conf/cade/Giese01>
<http://dblp.l3s.de/d2r/resource/publications/conf/cade/BeckertGHKRSS07>
<http://dblp.l3s.de/d2r/resource/publications/conf/fase/AhrendtBBGHHMMS02>
<http://dblp.l3s.de/d2r/resource/publications/conf/jelia/AhrendtBBGHHMS00>
<http://dblp.l3s.de/d2r/resource/publications/conf/lpar/Giese06>
...

Simple Examples (cont.)

Titles of publications by people called "Martin Giese"

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SELECT ?title WHERE {
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    ?pub dc:title ?title .
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SELECT ?title WHERE {
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    ?pub dc:title ?title .
}
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Answer:

?title
"Incremental Closure of Free Variable Tableaux."^^xsd:string
"The KeY system 1.0 (Deduction Component)."^^xsd:string
"The KeY System: Integrating Object-Oriented Design and Formal Methods."^^xsd:string
"The KeY Approach: Integrating Object Oriented Design and Formal Verification."^^xsd:string
"Saturation Up to Redundancy for Tableau and Sequent Calculi."^^xsd:string
...

Simple Examples (cont.)

Names of people who have published with "Martin Giese"

```
SELECT ?name WHERE {
    ?mg foaf:name "Martin Giese" .
    ?pub dc:creator ?mg .
    ?pub dc:creator ?other .
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}
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Answer:

?name
"Martin Giese"
"Bernhard Beckert"
"Martin Giese"
"Reiner Hähnle"
"Vladimir Klebanov"
...

Simple Examples (cont.)

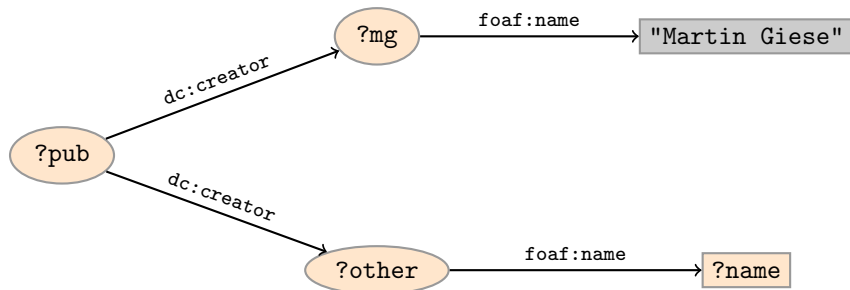### Names of people who have published with "Martin Giese"

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SELECT DISTINCT ?name WHERE {
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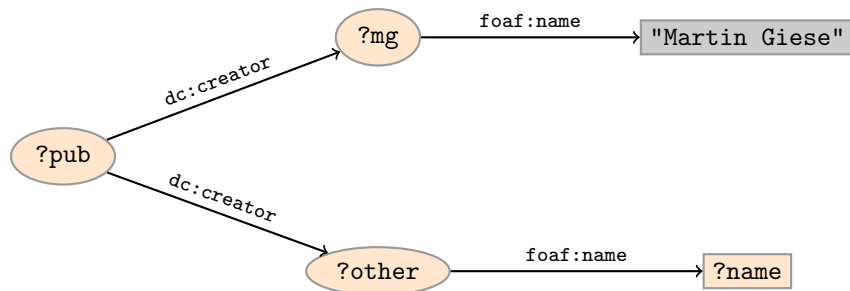| ?name |
|---|
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| "Bernhard Beckert" |
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| "Philipp Rümmer" |
| ... |

Graph Patterns

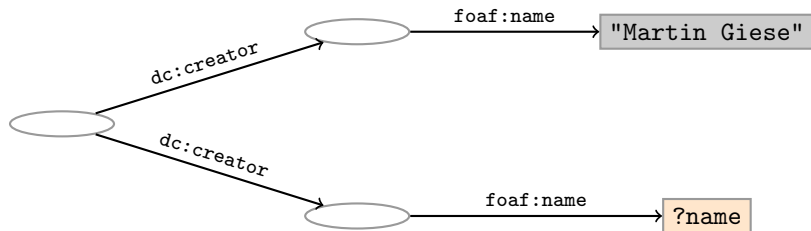The previous SPARQL query as a graph:

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Assign values to variables to make this a sub-graph of the RDF graph!

Graph with blank nodes

Variables not SELECTed can equivalently be blank:

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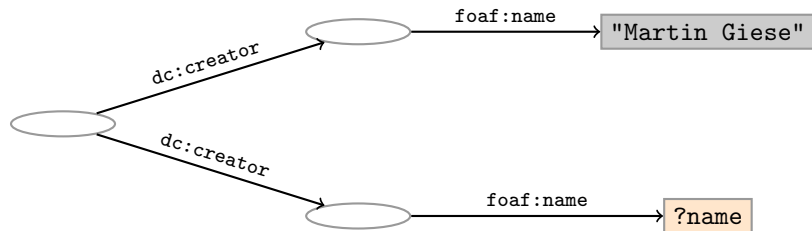
Assign values to variables and blank nodes to make this a sub-graph of the RDF graph!

SPARQL Query with blank nodes

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    _:pub dc:creator _:other .
    _:other foaf:name ?name.
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SPARQL Query with blank nodes

Names of people who have published with "Martin Giese"

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Outline

1. Gruppeundervisning

2. Repetition: RDF

3. Common Vocabularies

4. SPARQL By Example

5. **SPARQL Systematically**

6. Executing SPARQL Queries

Basic Graph Patterns

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    - to a resource, a blank node, or a literal in the RDF graph (an "RDF term")

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- Need to match all the patterns in the group.

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- Match of one pattern leaves rest of variables unbound

RDF Datasets

- SPARQL contains a mechanism for named RDF graphs
- Collections of named graphs are called "RDF datasets"
- Syntax for declaring named graphs in SPARQL
- Syntax for matching graph patterns in a given graph
- Beyond the scope of this course. Read the docs!

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DESCRIBE Answer available information about matching resources

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- standard defines sorting conventions for literals, URIs, etc.

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Some of this is probably coming. . .

```
http://www.w3.org/TR/2009/WD-sparql-features-20090702/
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- CONSTRUCT and DESCRIBE return Models, ASK a Java boolean.

Constructing a Query and a QueryExecution

- Query objects are usually constructed by parsing:

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Constructing a Query and a QueryExecution

- Query objects are usually constructed by parsing:
  ```
  String qStr =
        "PREFIX foaf:  <" + foafNS + ">"
     + "SELECT ?a ?b WHERE {"
     + "  ?a foaf:knows ?b ."
     + "} ORDER BY ?a ?b";
  Query q = QueryFactory.create(qStr);
  ```
- Programming interface deprecated and badly documented
- A Query can be used several times, on multiple models
- For each execution, a new QueryExecution is needed
- To produce a QueryExecution for a given Query and Model:
  ```
  QueryExecution qe =
        QueryExecutionFactory.create(query,model);
  ```

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- Query has methods to get list of variables, value of single variables, etc.
- Important to call close() on query executions when no longer needed.

Example: SPARQL in Jena

```
String qStr = "SELECT ?a ?b ...";
Query q = QueryFactory.create(qStr);

QueryExecution qe =
   QueryExecutionFactory.create(query,model);

try {
   res = qe.execSelect();
   while( res.hasNext()) {
       QuerySolution sol = response.next();
       RDFNode a = soln.get("?a");
       RDFNode b = soln.get("?b");
       System.out.println(""+a+" knows "+b);
   }
} finally {
   qe.close();
}
```

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- Nothing you would want to do manually!

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- Use one of the sparqlService in QueryExecutionFactory
- E.g.
```
String endpoint = "http://dblp.l3s.de/d2r/sparql";
String qStr = "SELECT ?a ?b ...";
Query q = QueryFactory.create(qStr);

QueryExecution qe =
   QueryExecutionFactory.sparqlService(endpoint,query);

try {
   res = qe.execSelect();
   ...
} finally {
   qe.close();
}
```

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- It is built about "graph patterns"
- Only queries compatible with "open world assumption"
- Comes with a protocol to communicate with "endpoints"
- Can be conveniently used with Jena