INF3580 – Semantic Technologies – Spring 2011

Lecture 3: Jena – A Java Library for RDF

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University of Oslo

Today's Plan

1. Repetition: RDF
2. Jena: Basic Datastructures
3. Jena: Inspecting Models
4. Jena: I/O
5. Example
6. Jena: `ModelFactory` and `ModelMaker`
7. Jena: Combining Models

Outline

Reminder: RDF triples

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- Expanded:
  `<http://geo.example.com/#germany>`
  `<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>`
  `<http://geo.example.com/#Country> .`

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Berlin is a City in Germany, which is a country

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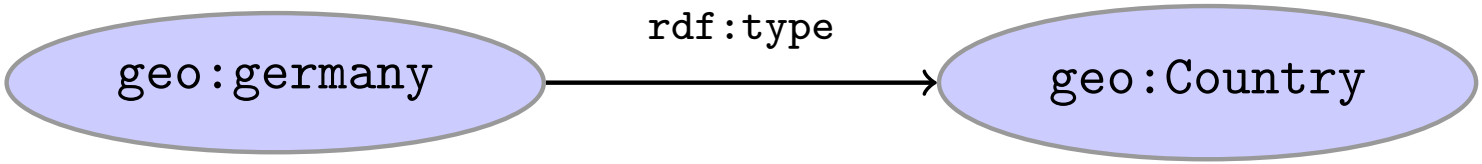

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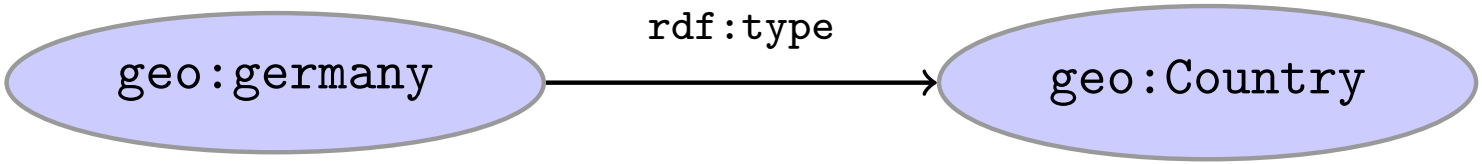

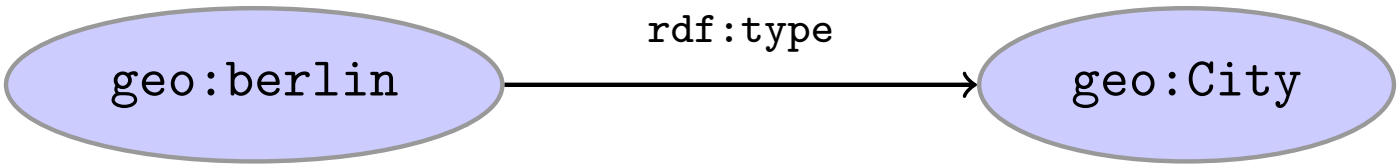

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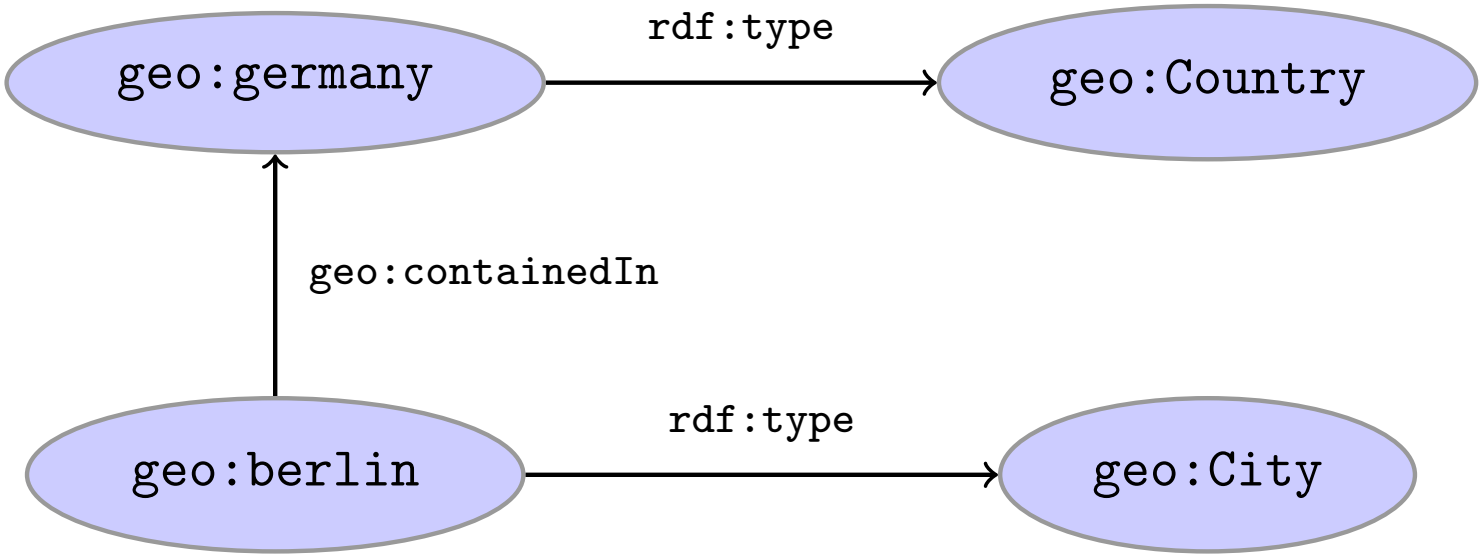

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Berlin is contained in Germany, and containment is a property

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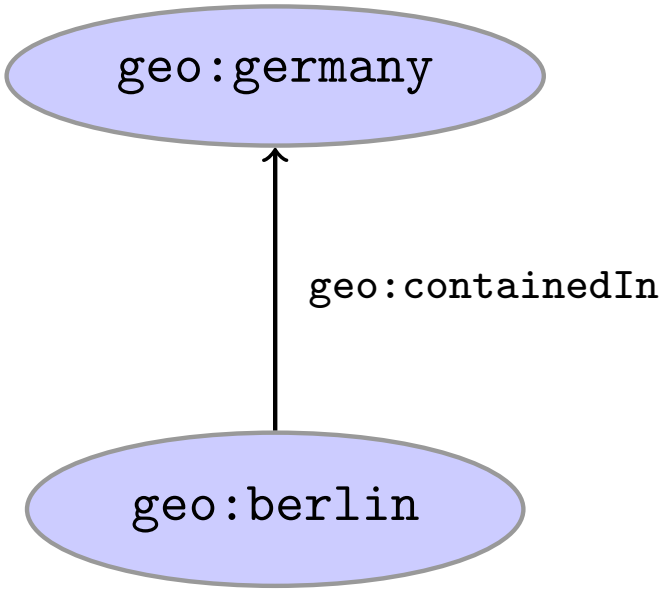

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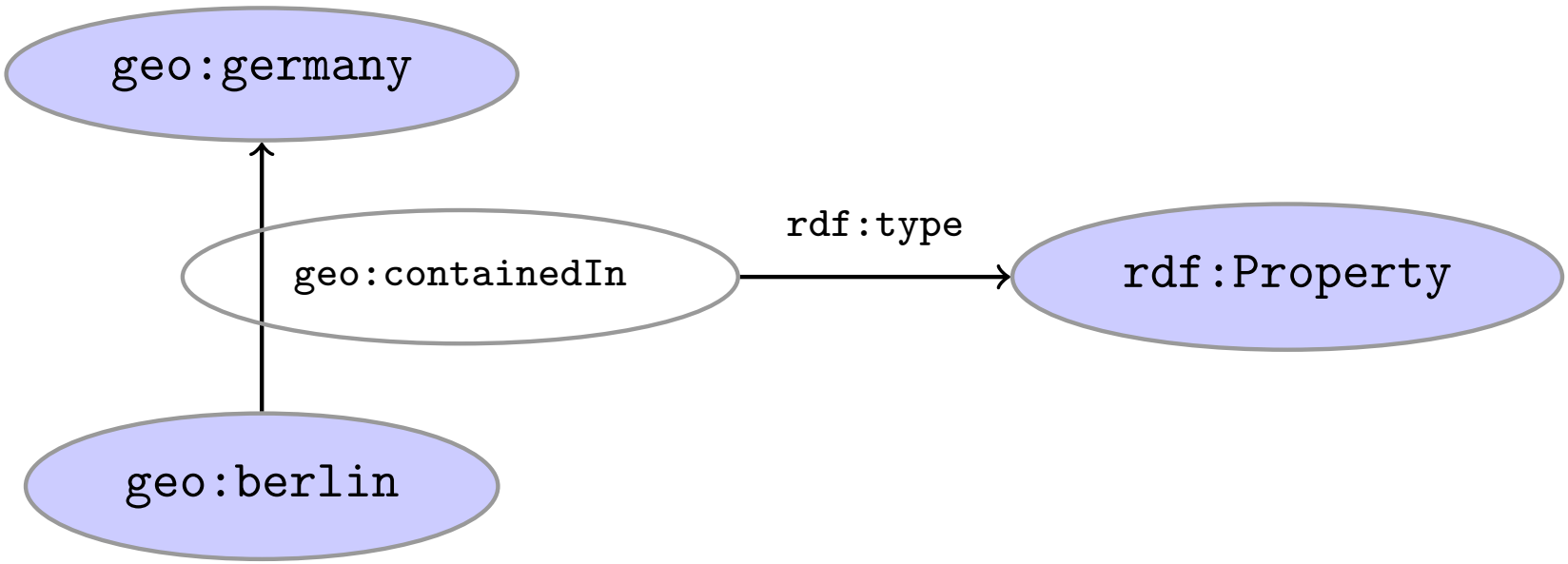

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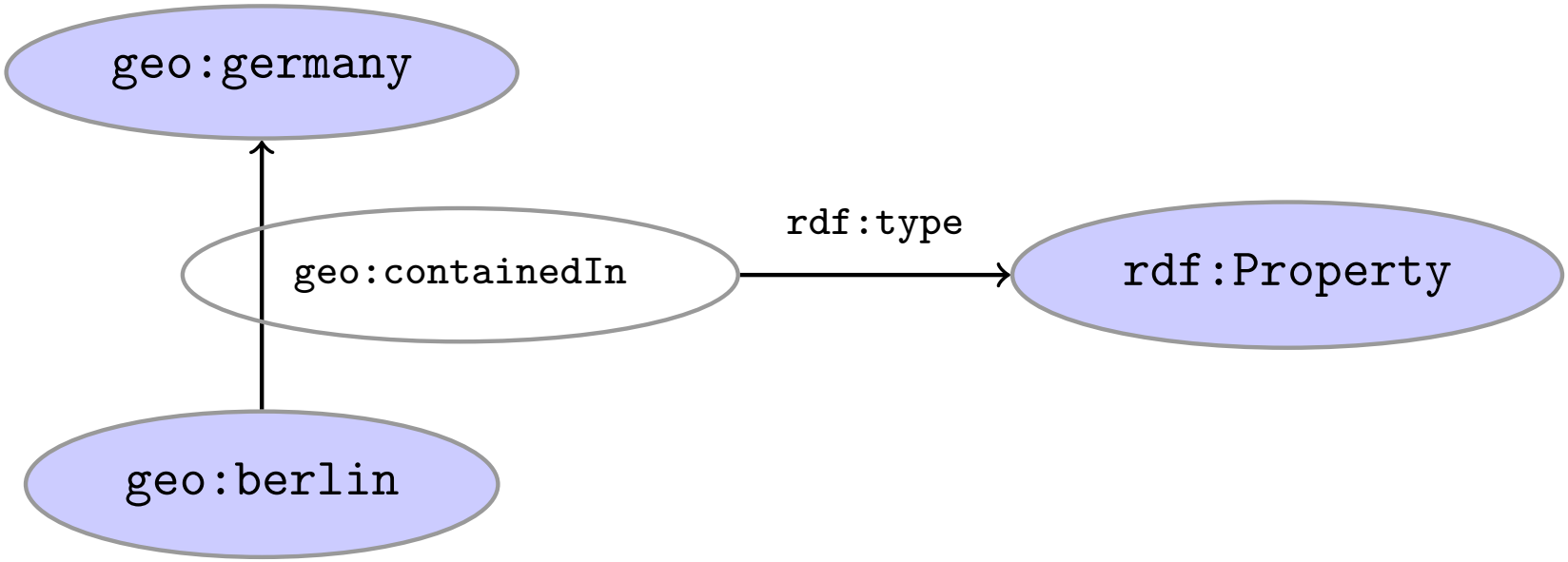

Usually speak about *RDF graphs* anyway

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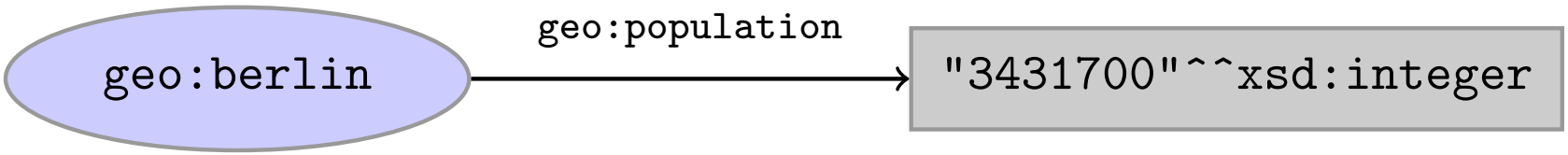
- Usually represented with rectangles:



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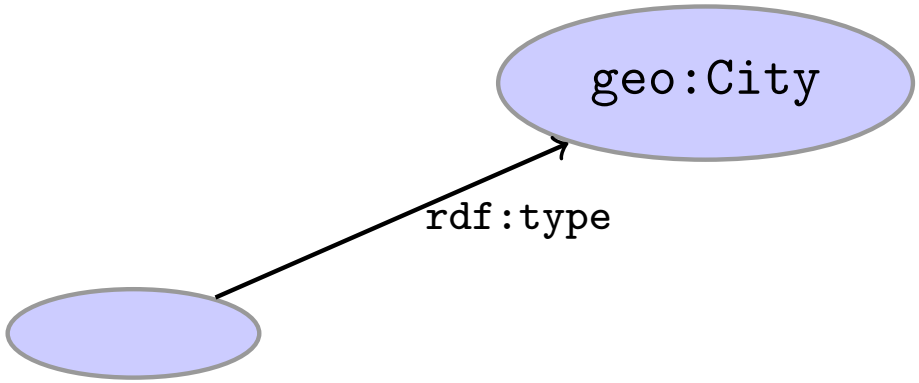

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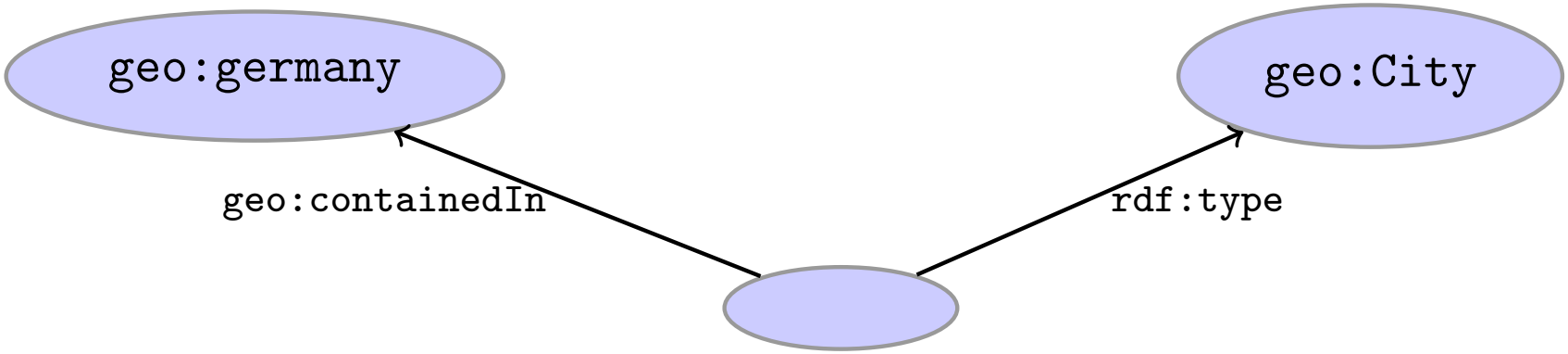

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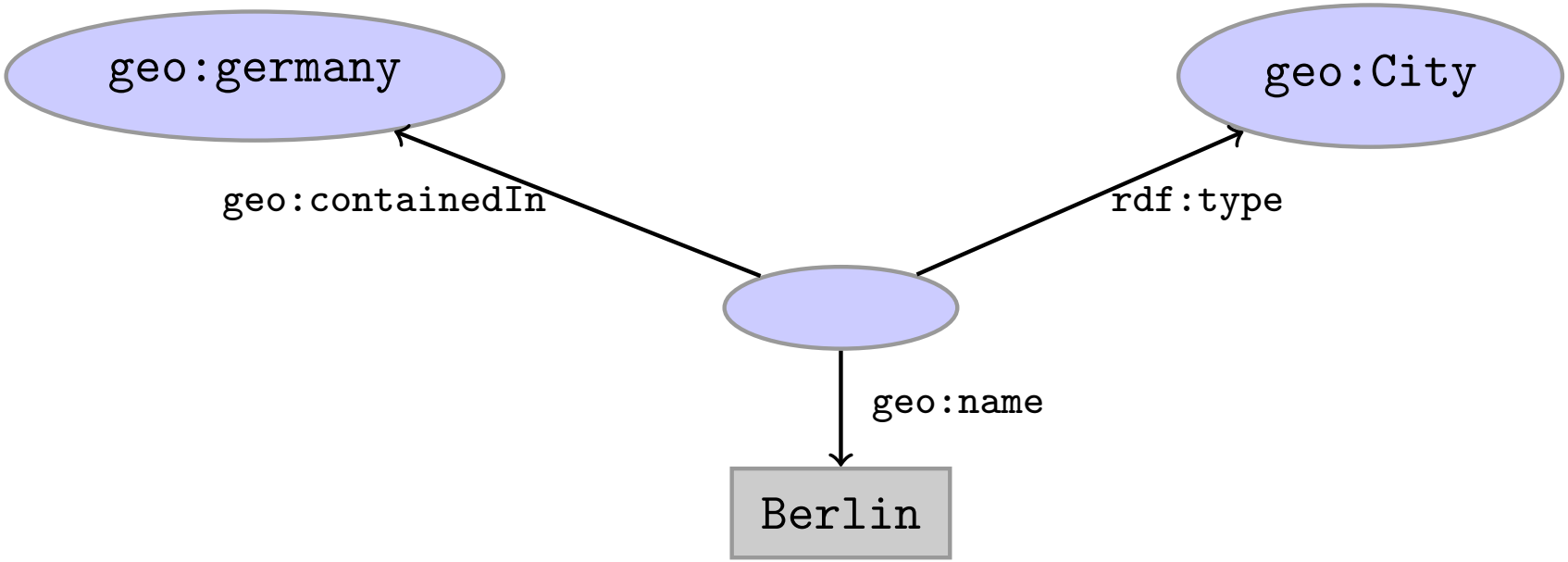

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- Probably a good idea to put namespaces in separate strings:

```
String geoNS="http://geo.example.com/#";
String germanyURI=geoNS+"germany";
String berlinURI =geoNS+"berlin";
```

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- Beware: this is not usually what you want!

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- Also deals with reading & writing various formats

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- For a fresh blank node:

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Resource blank = model.createResource();
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Property name = model.createProperty(geoNS+"name");
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Literal n = model.createTypedLiteral("42",type);
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- Or, with a `com.hp.hpl.jena.datatypes.RDFDatatype`:

```
import com.hp.hpl.jena.datatypes.xsd.XSDDatatype;

RDFDatatype type = XSDDatatype.XSDbyte;
Literal n = model.createTypedLiteral("42",type);
```

Data Representation: Statements

- To construct a `Statement`, you need

$$\langle s, p, o \rangle$$

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- Again, use the methods in `Model`:

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Resource berlin = model.createResource(geoNS+"berlin");
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Statement stmt = model.createStatement(berlin,name,b);
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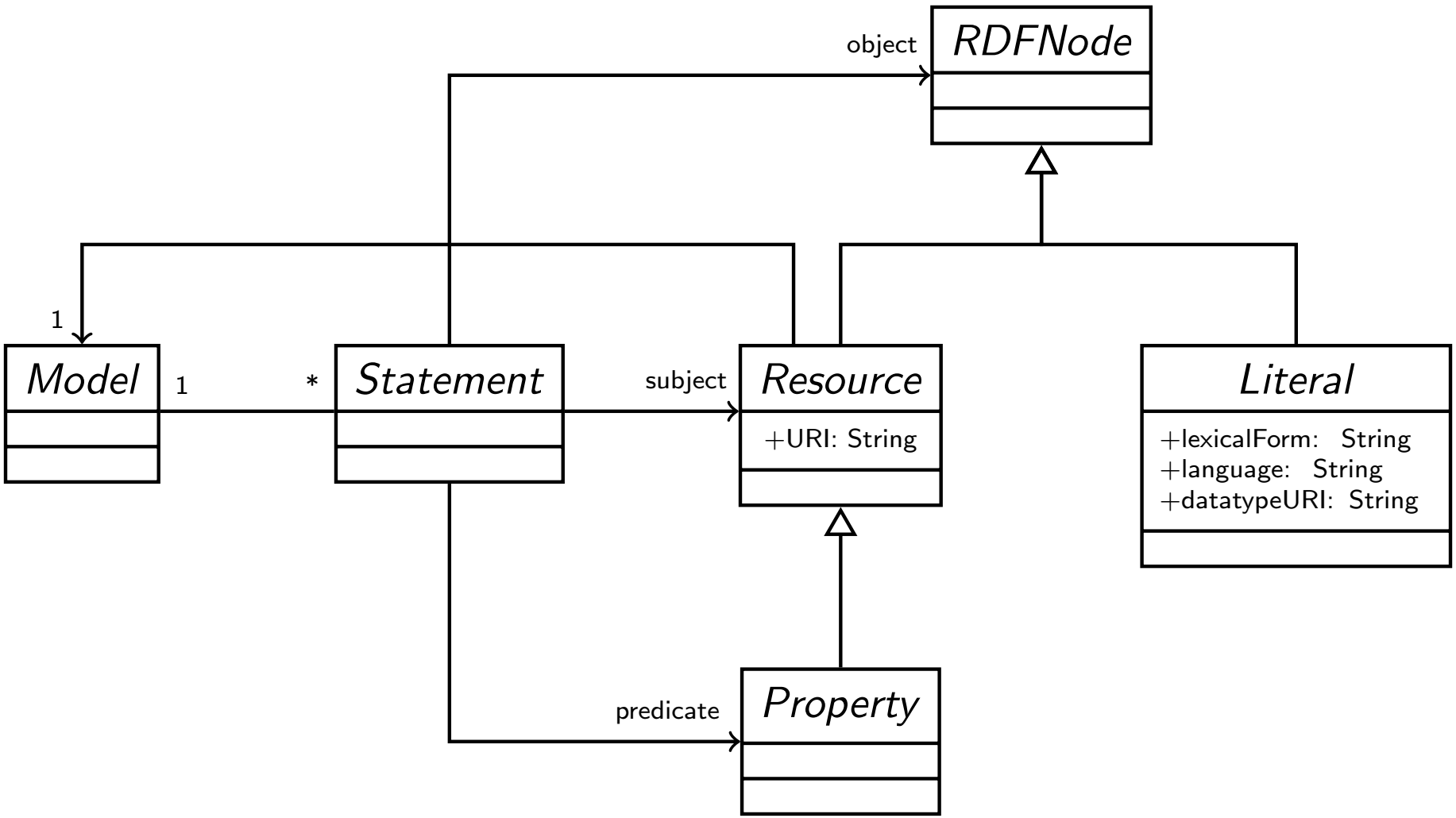
- Not yet asserted in the model.
- To add this statement to the model:

```
model.add(stmt);
```

Overview


object
RDFNode
1
Model
1
*
Statement
subject
Resource
+URI: String
Literal
+lexicalForm: String
+language: String
+datatypeURI: String
predicate
Property

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- ...we can write:

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- Navigation through resources delegates to model, but sometimes more convenient

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- to find all statements with a particular predicate:

```
Property name = model.createProperty(geoNS+"name");
Iterator<Statement> it = berlin.listProperties(name);
```

Retrieving Information from a `Resource` (cont.)

- To get *some* statement, without iterating:

```
Property pop = model.createProperty(geoNS+"population");
berlin.getProperty(pop)
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Iterator<Resource> rit =
    model.listResourcesWithProperty(name);
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- To get all resources with a statement for a given predicate:

```
Iterator<Resource> rit =
    model.listResourcesWithProperty(name);
```

- . . . with a given value for a property:

```
Iterator<Resource> rit =
    model.listResourcesWithProperty(cont, germany);
```

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- where `subj`, `pred`, `obj` can be `null` to match any value ("wildcard")

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```
Iterator<Statement> sit =
    model.listStatements(subj, pred, obj);
```

- where `subj`, `pred`, `obj` can be `null` to match any value ("wildcard")
- e.g. to print everything contained in Germany:

```
Iterator<Statement> sit =
    model.listStatements(null, cont, germany);
while (sit.hasNext()) {
    System.out.println(sit.next().getSubject());
}
```

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- More about this next week!

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- Example: Load Martin Giese's FOAF file from the 'net:

```
Model model = ModelFactory.createDefaultModel();
model.read("http://heim.ifi.uio.no/martingi/foaf");
```

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- Example: write `model` to a file:

```
try {
    model.write(new FileOutputStream("output.rdf"));
}catch (IOException e) {
    // handle exception
}
```

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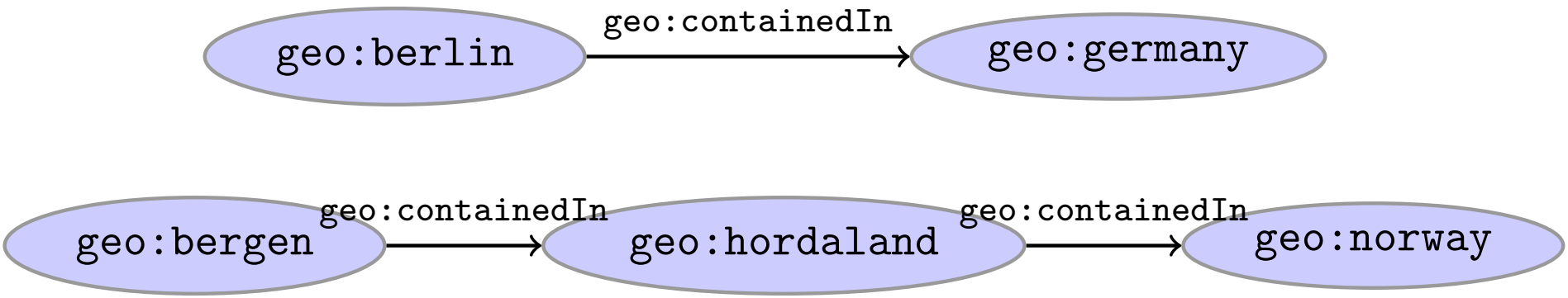
Outline

A Containment Example

Given an RDF/XML file with information about containment of places in the following form:

Geographic containments

```
geo:berlin geo:containedIn geo:germany .
geo:bergen geo:containedIn geo:hordaland .
geo:hordaland geo:containedIn geo:norway .
...
```

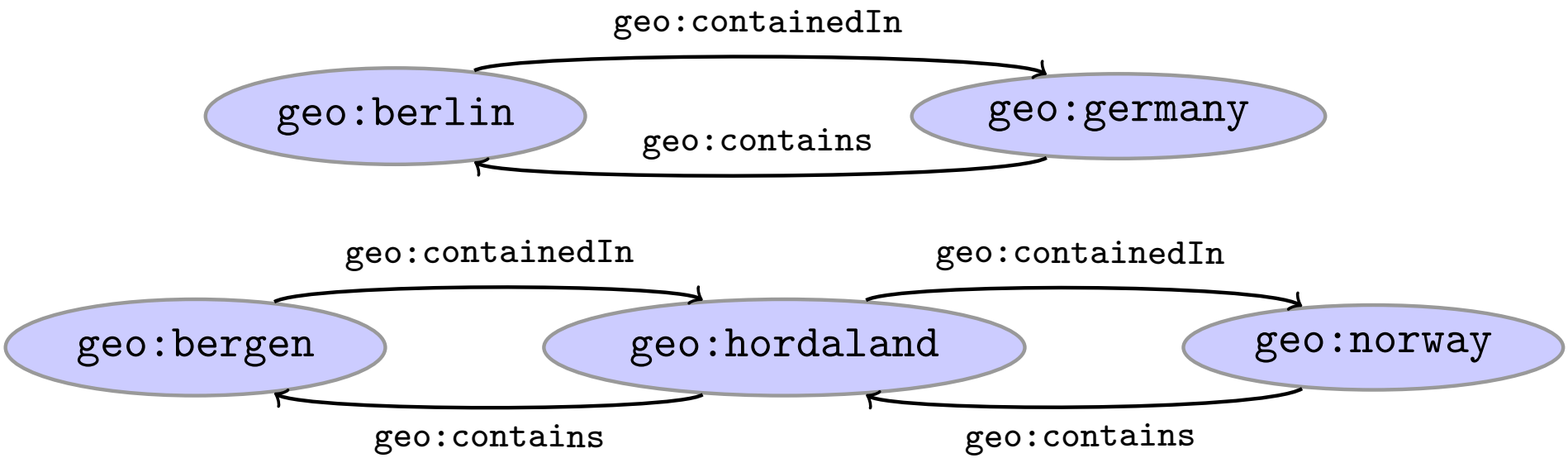


A Containment Example (cont.)

Add inverse statements using property `geo:contains`:

Inverted Containment Statements

```
geo:germany geo:contains geo:berlin .
geo:hordaland geo:contains geo:bergen .
geo:norway geo:contains geo:hordaland .
...
```



Solution: Creating the Model, Reading the File

```
import java.io.*;
import java.util.*;
import com.hp.hpl.jena.rdf.model.*;

public class Containment {

   public static String GEO_NS = "http://geo.example.com/#";

   public static void main(String[] args) throws IOException {
      Model model = ModelFactory.createDefaultModel();
      model.read(new FileInputStream("places.rdf"), null);

      Property containedIn =
         model.getProperty(GEO_NS+"containedIn");
      Property contains =
         model.getProperty(GEO_NS+"contains");
```

Solution: Adding Statements, Writing a File

```
        Iterator<Statement> it =
              model.listStatements((Resource)null,
                                   containedIn,
                                   (Resource)null);
        while ( it.hasNext() ) {
           Statement st = it.next();
           model.add((Resource)st.getObject(),
                     contains,
                     st.getSubject());
        }

        model.write(new FileOutputStream("output.rdf"));
    } // main()

} // class Containment
```

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- See book for example of creating a `DBConnection`!

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- All models are stored as tables in one RDB, files in one file system directory, etc.

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- Union model delegates storage to other models

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- ...but to get it right, some theory is needed!

Outlook

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- All this will be explained with examples

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Lecture 6: Intro to Reasoning
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- All this will be explained with examples
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Outlook

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- All this will be explained with examples
- There will be practical exercises
- But there are some theoretical concepts to grasp!