INF3580 – Semantic Technologies – Spring 2010

Lecture 2: The Resource Description Framework

Audun Stolpe

1st February 2011

Department of Informatics

University of Oslo

Today's Plan

Outline

A web of data

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- user-agents can find and combine published information in appropriate ways to answer the user's information needs.

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- we shall have a closer look at it today ...

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  - the idea is born that URIs can be used to stand for *anything*

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- depending on the type of HTTP request (headers and MIME types)

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- .. the benefits of which will be revealed to you as we go ...

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Request a page displaying a list of Martin Giese's publications

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- they are, in any case, commonly referred to as resources

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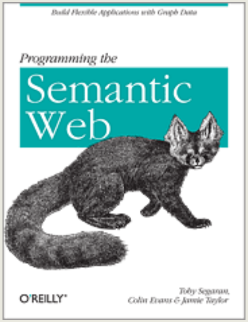
  - Dublin Core
  - DBpedia
  - GeoNames
- thus URIs tend to represent *uniquely* across the Web

A habit to suspend

Many are in the habit of thinking of it this way.....

"Because URIs uniquely identify resources (things in the world), we consider them *strong identifiers*. There is no ambiguity about what they represent, and they always represent the same thing, regardless of the context we find them in."


Build Flexible Applications with Graph Data
Programming the
Semantic Web
O'REILLY
Toby Segaran, Colin Evans & Jamie Taylor

A good book

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  - URIs is an established mechanism for reference
  - that is surrounded by a sufficiently stable practice
  - to keep the risk of name clashes fairly low

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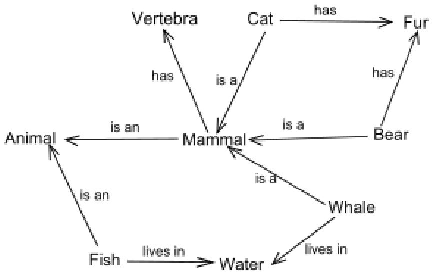

Figure: A graph describing relationships between mammals

A sample RDF graph

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Connecting three facts

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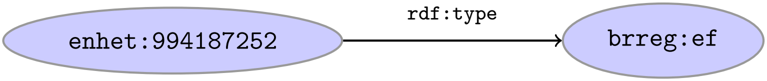

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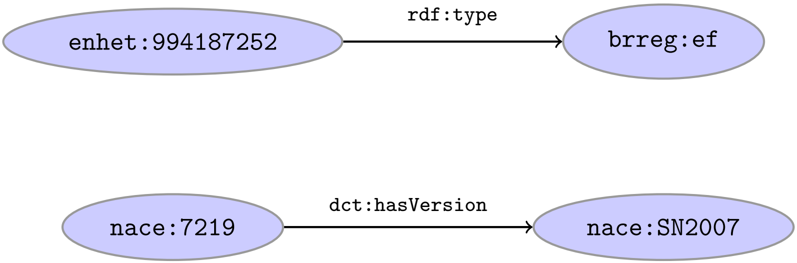

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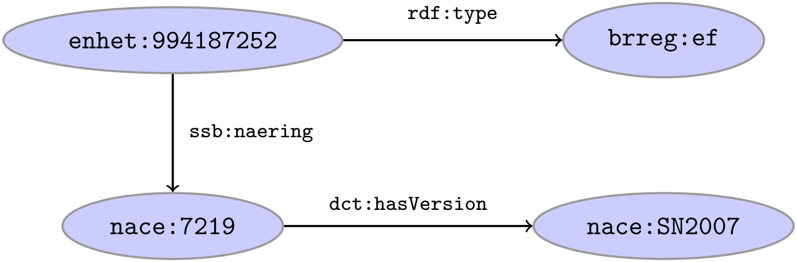

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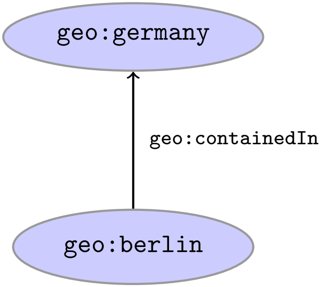

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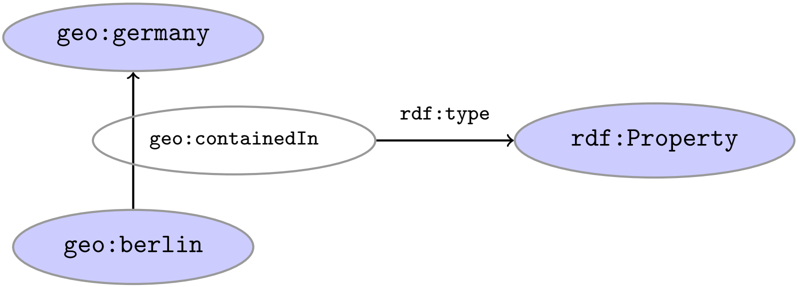

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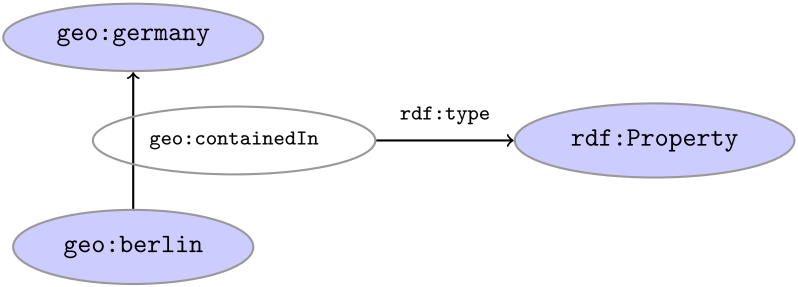

... since arrows are also nodes. We usually speak about *RDF graphs* anyway

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- the concepts *creator* and *contributor*, under respectively

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  - `dct:contributor` as short forms of the URIs above

… cont

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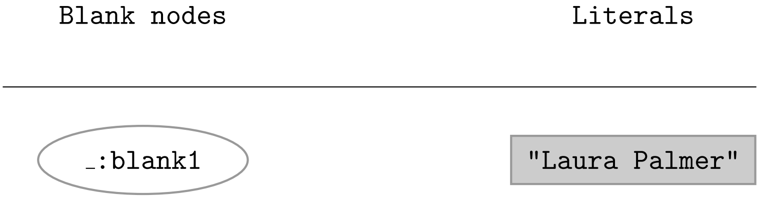
- FOAF, Dublin Core, VCard and the Basic Geo Vocabulary are other examples

RDF graphs: A closer look at nodes

As hinted at on slide 12, a node need not be a URI

- it can also be a literal value such as the string "Death in Venice"
- or a blank node acting as a mere placeholder for a stipulated object

Common visual representations are:



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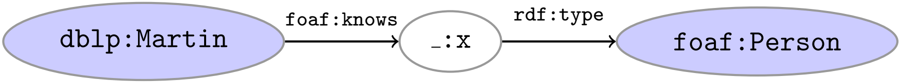
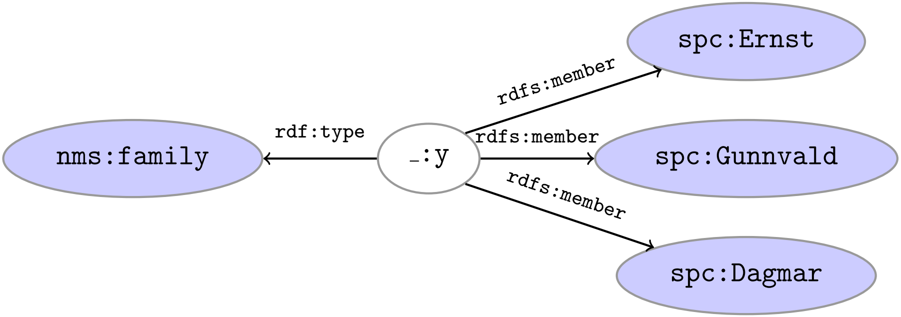
- we wish to group statements together
- for many-valued relationships such as e.g. ‘x buys y from z’
- a blank node is essentially an existentially quantified variable
  - $(\_ : blank1, b, c)$ means ‘*there is an object* x such that x is b-related to c’

Graphs with blanks nodes

Martin knows someone:



Ernst, Dagmar and Gunnvald are members of the same family:



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Capice?

العربية

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Outline

Serialization formats

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  - N3 (a superset of Turtle)
  - N-Triples (very convenient format for machines)
- they all express the same *abstract* data model, namely RDF

A quick look at Turtle

A Turtle file starts with a declaration of prefixes

```
@prefix place:   <http://sws.geonames.org/>.
@prefix geoont:  <http://www.geonames.org/ontology/>.
@prefix rdf:     <http://www.w3.org/1999/02/22-rdf-syntax-
@prefix foaf:    <http://xmlns.com/foaf/0.1/>.
@prefix xsd:     <http://www.w3.org/2001/XMLSchema#>.
```

- here as everywhere in Turtle, URIs are ecnlosed in angled brackets
- prefixes start with `@` and end with a dot
- you will see the ones above a lot
- of course, the abbreviations will vary since they don't matter

Statements in Turtle

Triples in Turtle (i.e. statements or facts) are

- written on the same line separated by a white space
- and terminated by a dot, e.g.

```
place:390903 rdf:type geoont:Country.
place:2945356 rdf:type geoont:Municipality.
```

- statements with the same subject admit a short form;

```
place:390903 rdf:type geoont:Country;
             geoont:Population "11262000;
             rdfs:label "Greece".
```

... cont

- so do statments with the same subject *and* predicate

```
place:390903 rdf:type geoont:Country, geoont:Region;
             geoont:Population "11262000";
             rdfs:label "Greece", "Hellas".
```

- `rdf:type` may be abbreviated `'a'`:

```
place:390903 a geoont:Country, geoont:Region;
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             rdfs:label "Greece", "Hellas".
```

Datatypes and language tags in Turtle

- Datatypes are represented wit double carets;

```
place:390903 a geoont:Country, geoont:Region;
             geoont:Population "11262000"^^xsd:int;
             rdfs:label "Greece", "Hellas".
```

- and language tags with ‘@’;

```
place:390903 a geoont:Country, geoont:Region;
             geoont:Population "11262000"^^xsd:int;
             rdfs:label "Greece"@en, "Hellas"@nb.
```

Greece is a Country with a population of 11.2 million people

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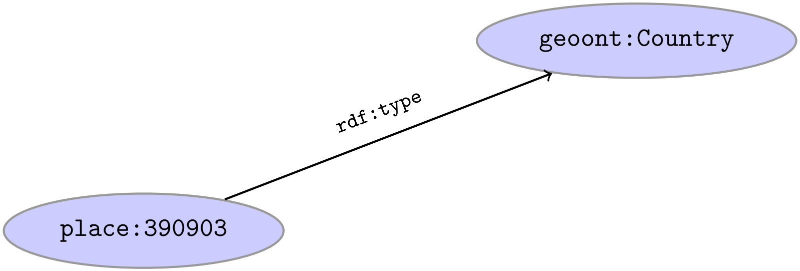

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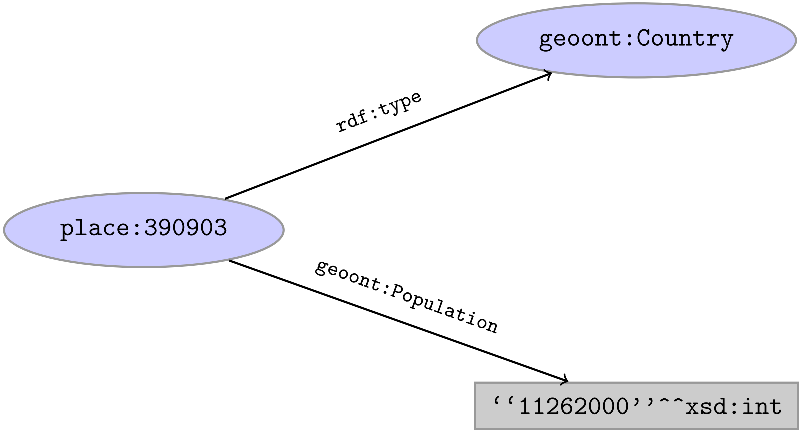

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DBtunes	`http://dbtune.org/musicbrainz/`

An example

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" .
    ?pub dc:creator ?mg .
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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>
... ...

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- matches for the variables outside the pattern are returned as results

Outline

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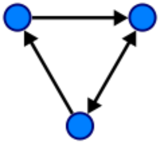
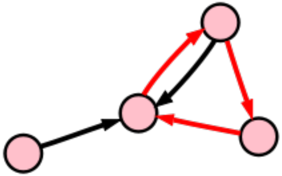
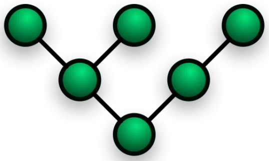


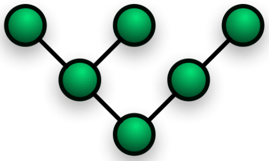


If you add one digraph to another, then you get another digraph.

Compare with trees

This contrasts with trees





- the union of the two trees lacks a common root
- hence it is not a tree
- special steps must therefore be taken to merge trees

Merging contd.

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- hence, any number of triples (that is, any graph) can be added to any other
- without ever violating the RDF data model
- whence querying several RDF-graphs as once is (almost) as simple as combining them

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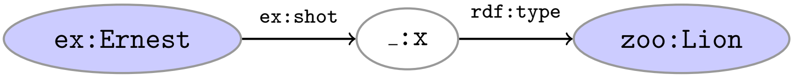
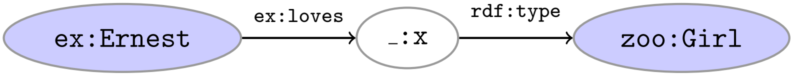
  - so special steps must again be taken
- blank nodes must be renamed apart
  - they are not prefixed by URIs
  - i.e. they are not globally uniqye
  - so you might otherwise get unintended name clashes

Blank nodes must be renamed

Ernest shot a lion,

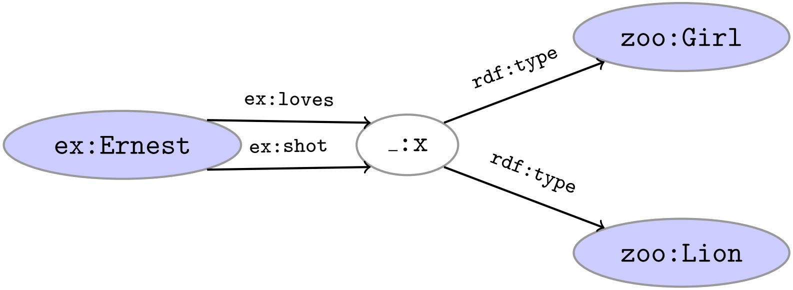


and Ernest loves a girl,



Renaming contd.

But he probably did not shoot a female lion that he loves:



The procedure

Thus, merging becomes a two-step procedure:

1. First rename blank nodes, so that no two blanks have the same id,
2. next, collapse all other nodes with the same id.

The renaming step stems from the semantics of blank nodes, which behave as existentially quantified variables.

Outline

Locating RDF in the Semantic Web Stack architecture

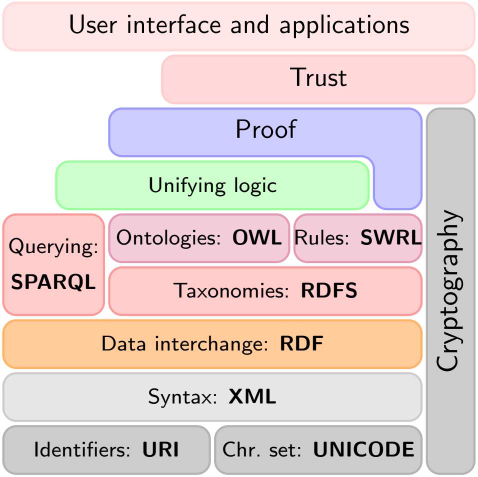


Figure: Semantic Web Stack