INF3580/4580 – Semantic Technologies – Spring 2018

Lecture 13: Publishing RDF Data on the Web

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17th April 2018

Department of Informatics

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Repetition

- 22nd May is reserved for "Repetition"
- No fixed lecture material
- You, the students, say what you want to hear
- Let us know by Friday 18 May, so we are prepared.
- If Martin recieves no mail, there will be no repretition.
- So drop a mail to `martingi@ifi.uio.no`.

Guest Lectures

- 8 May: Martin Skjæveland – Ontology Templates and Applications
  - A kind of macro mechanism for ontologies
  - Generate large ontologies from tables, etc.
  - Note: relevant for exam!
- 29 May: Mara Abel from Univ. Rio Grande do Sul
  - Ongology Engineering
  - Probably examples from modeling Geology

Today's Plan

1. Relevant highlights from RDF lecture
2. Linked (Open) Data
   - Examples
3. Linking RDF to HTML
4. RDFa

Outline

RDF

- Why URIs?
  - URIs naturally have a "global" scope, unique throughout the web.
  - URLs are also addresses.
  - *"A web of data."*

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  - URIs naturally have a "global" scope, unique throughout the web.
  - URLs are also addresses.
  - *"A web of data."*
- Why triples?
  - Any information format can be transformed to triples.
  - Relationships are made explicit and are elements in their own right
  - Again, *"A web of data"*.

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    - by direct SPARQL query: `http://dbpedia.org/sparql`.

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- In this lecture, we look at some of the technicalities.

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  - "information resources": downloadable documents.
  - "non-information resources": other entities.

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- Two W3C-recommended solutions:
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  - The slash-namespace solution (aka HTTP 303 redirects).
- To fully understand them, we need to have a look at HTTP.

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GET /martingi/ HTTP/1.1
User-Agent: Mozilla/5.0 (X11; U; Linux i686; ...
Accept: text/html,application/xhtml+xml,...
Accept-Language: no, en
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- Other "methods": `HEAD`, `POST`, `PUT`,...

HTTP (cont.)

- A typical response to the GET request:

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HTTP/1.1 200 OK
Date: Wed, 05 May 2010 14:15:24 GMT
Server: Apache/2.2.14 (Unix) ...
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Content-Type: text/html

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  - `303 See Other`

Fragment identifiers

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  `http://en.wikipedia.org/wiki/Fragment_identifier#Examples`
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  - Browser will jump to element identified by fragment identifier.

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- This is known as a "hash namespace".

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  - Fetching the right document is done automatically by HTTP.
  - It is enough to publish the RDF file on an HTTP server.
  - Very low tech and fool proof, in other words.
- However:
  - All data published this way about all entities in a hash namespace needs to be stored in the same RDF file

    `http://brreg.no/bedrifter.rdf#974760673`

Hash namespaces – pros and cons

- Hash namespaces solve our problem:
  - Resources are separate from documents about them.
  - It is possible to find a document given a resource URI.
- Moreover:
  - Fetching the right document is done automatically by HTTP.
  - It is enough to publish the RDF file on an HTTP server.
  - Very low tech and fool proof, in other words.
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  - Too tight coupling of URI schema (name design) and physical storage (file name).

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```

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```
GET / HTTP/1.1
Host:  www.oracle.com
```

- Server at `www.oracle.com` responds:

```
HTTP/1.1 200 OK
Content-Type:  text/html
...
```

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- Server `dbpedia.org` recognizes this as a non-information resource.
- Redirects to a file with data about the city of Oslo:
  ```
  HTTP/1.1 303 See Other
  Location: http://dbpedia.org/data/Oslo.xml
  ```
- Browser can now send a new request for that location:
  ```
  GET /data/Oslo.xml HTTP/1.1
  Accept: application/rdf+xml
  ```
- This time the server responds with the requested document:
  ```
  HTTP/1.1 200 OK
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- See also `http://linkeddatabook.com/`.

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- Should also serve the vocabulary description for the "vocabulary URI":

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- Also possible with hash namespaces, see `http://www.w3.org/TR/swbp-vocab-pub/`.

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  - Client requests `http://dbpedia.org/page/Oslo`

Example: dbpedia.org

- Requesting the URI `http://dbpedia.org/resource/Oslo`
- From an HTML web browser:
  - Sends `Accept: text/html` in request
  - Server returns:

    ```
    HTTP/1.1 303 See Other
    Location: http://dbpedia.org/page/Oslo
    ```

  - Client requests `http://dbpedia.org/page/Oslo`
  - Server sends HTML document:

    ```
    HTTP/1.1 200 OK
    Content-Type: text/html
    ```

Example: dbpedia.org (cont.)

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```
HTTP/1.1 303 See Other
Location: http://dbpedia.org/data/Oslo.xml
```

Example: dbpedia.org (cont.)

- Requesting the URI `http://dbpedia.org/resource/Oslo`
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  - Sends `Accept: application/rdf+xml` in request
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    ```

  - Client requests `http://dbpedia.org/data/Oslo.xml`

Example: dbpedia.org (cont.)

- Requesting the URI `http://dbpedia.org/resource/Oslo`
- From a semantic web browser:
  - Sends `Accept: application/rdf+xml` in request
  - Server returns:

```
HTTP/1.1 303 See Other
Location: http://dbpedia.org/data/Oslo.xml
```

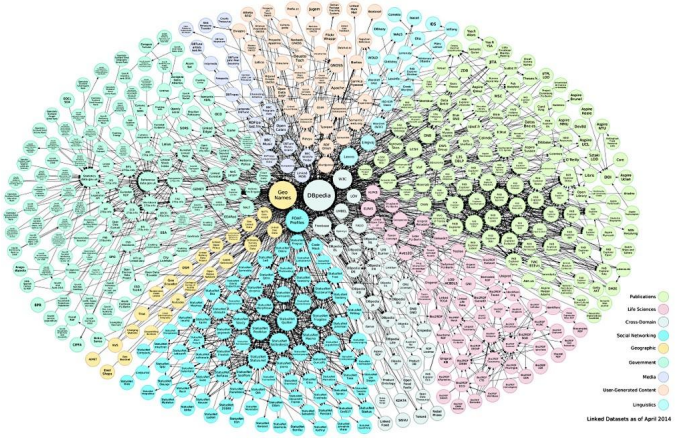
  - Client requests `http://dbpedia.org/data/Oslo.xml`
  - Server sends RDF/XML document:

```
HTTP/1.1 200 OK
Content-Type: application/rdf+xml
```

Examples of Linked Open Data

- http://babelnet.org
- http://en.wikipedia.org/wiki/SNOMED_CT and http://browser.ihtsdotools.org/
- http://dbpedia.org

The Linked Open Data Cloud

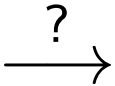


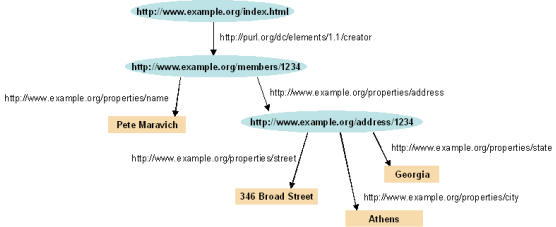
http://lod-cloud.net/

Outline

The Problem

- The HTML web contains lots of human-readable information
- How can clients discover the location of corresponding machine-readable information?





Embedding RDF/XML in (X)HTML

- First idea: Embed RDF/XML in HTML or XHTML:

```
<html>
  <head>
    <title>My Homepage</title>
    <rdf:RDF>
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        ...
```

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- Not recommended:

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        ...
```

- Not recommended:
- Does not fit HTML or XHTML DTDs
- No satisfactory solution, due to flexible RDF vocabulary
- B.t.w. there *is* a `metadata` element in SVG for this!

HTML LINK elements

- `LINK` may occur inside HTML `HEAD` elements

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  - `type` – the media type of the related document
  - `href` – the URL of the other document
  - `title` – the title of the other document
  - (and some more)
- E.g. a style sheet:

```
<html>
  <head>
    <title>My Homepage</title>
    <link rel="stylesheet" type="text/css" href="style.css">
```

LINKing to RDF

- To link to an RDF representation:

```
<LINK rel="alternate"
      type="application/rdf+xml"
      title="RDF/XML version"
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- Various web browser plugins exist to detect these LINKs

HTTP `Link:` response headers

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  - requires only HEAD request

Outline

Once More: Embedding RDF in (X)HTML

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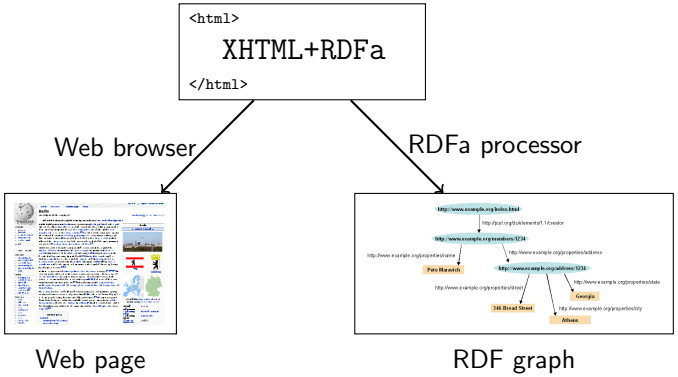
The aim of RDFa is to allow a single RDF graph to be carried in various types of document mark-up.

- XHTML in spec., but works with HTML and other XML
- RDFa adds a *fixed* set of attributes to (X)HTML
- Document type:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML+RDFa 1.0//EN"
    "http://www.w3.org/MarkUp/DTD/xhtml-rdfa-1.dtd">
```

RDFa Processing

- Web browsers ignore RDFa attributes
- RDFa processors extract a *single* RDF graph from a document



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  - hyper-links (`href`)
  - textual content
- RDFa attributes can appear in (almost) any element
- As the XHTML is processed, there is always a "current subject" that generated triples refer to
- The current subject starts as the base URI of the document, but can change on the way

Reminder: (X)HTML Meta and Link

- Links and metadata in HTML header:

```
<html xmlns="http://www.w3.org/1999/xhtml">
  <head>
    <title>Page 507</title>
    <meta name="author" content="Sigrid Undset" />
    <link rel="prev" href="page506.html" />
    <link rel="next" href="page508.html" />
  </head>
  <body>...</body>
</html>
```

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</html>
```

- Meaning of `name` and `rel` informal
- Only a few values defined by the standard

RDFa property and rel

- "semantic" meta and link in RDFa:

```
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:foaf="http://xmlns.com/foaf/0.1/"
      xmlns:dc="http://purl.org/dc/elements/1.1/">
  <head>
    <title>MG's home page</title>
    <meta property="dc:creator" content="Martin Giese" />
    <link rel="foaf:topic" href="foaf.rdf#me" />
  </head>
  <body>...</body>
</html>
```

RDFa property and rel

- "semantic" meta and link in RDFa:

```
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    <title>MG's home page</title>
    <meta property="dc:creator" content="Martin Giese" />
    <link rel="foaf:topic" href="foaf.rdf#me" />
  </head>
  <body>...</body>
</html>
```

- Extracted triples: (<> is base URI!)

```
<> dc:creator "Martin Giese" .
<> foaf:topic <foaf.rdf#me> .
```

Attribute `rel` on `A` elements

- Any hyper-link can be given a "meaning":

```
This document is licensed under a
<a xmlns:cc="http://creativecommons.org/ns#"
   rel="cc:license"
   href="http://creativecommons.org/licenses/by-nc-nd/3.0/">
  Creative Commons License
</a>.
```

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- Extracted triple:

```
<> cc:license <http://creativecommons.org/.../3.0/> .
```

- Can use `rev` instead of `rel` to swap subject and object:

```
Made by <a rev="foaf:made" href="http://.../foaf#me">me</a>.
```

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  Creative Commons License
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```

- Extracted triple:

```
<http://.../foaf#me> foaf:made <> .
```

The property attribute

- `rel` is for resource objects, `property` for literal objects:

```
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:dc="http://purl.org/dc/elements/1.1/">
  <head>...</head>
  <body>
    <h1 property="dc:title">Kransen</h1>
    Written in <span property="dc:created">1920</span>
  </body>
</html>
```

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<> dc:title "Kransen" ; dc:created "1920" .
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</html>
```

- Extracted triples:

```
<> dc:title "Kransen" ; dc:created "1920" .
```

- Can also use `content` attribute together with `property`:

```
<span property="dc:created" datatype="xsd:dateTime"
      content="2007-09-16T16:00:00-05:00">
  September 16th at 4pm
</span>
```

Changing the Subject

- about changes subject of contained rel and property annotations:

```
<div about="http://.../foaf.rdf#me"
     xmlns:foaf="http://xmlns.com/foaf/0.1/">
  <p property="foaf:name">Martin Giese</p>
  <p> Email:
    <a rel="foaf:mbox" href="mailto:mg@mail.no">
      mg@mail.no</a></p>
  <p> Phone:
    <a rel="foaf:phone" href="tel:+47-31415926">
      31 41 59 26</a></p>
</div>
```

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      mg@mail.no</a></p>
  <p> Phone:
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</div>
```

- Extracted triples:

```
<http://.../foaf.rdf#me> foaf:name "Martin Giese" ;
                         foaf:mbox <mailto:mg@mail.no> ;
                         foaf:phone <tel:+47-31415926> .
```

Types and Blank Nodes

- `typeof` adds an `rdf:type` triple

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- Missing URIs can lead to blank nodes:

```
<div typeof="foaf:Person"
     xmlns:foaf="http://xmlns.com/foaf/0.1/">
  <p property="foaf:name">Martin Giese</p>
  <p> Email:
    <a rel="foaf:mbox" href="mailto:mg@mail.no">
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```

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  <p property="foaf:name">Martin Giese</p>
  <p> Email:
    <a rel="foaf:mbox" href="mailto:mg@mail.no">
     mg@mail.no</a></p>
</div>
```

- Extracted triples:

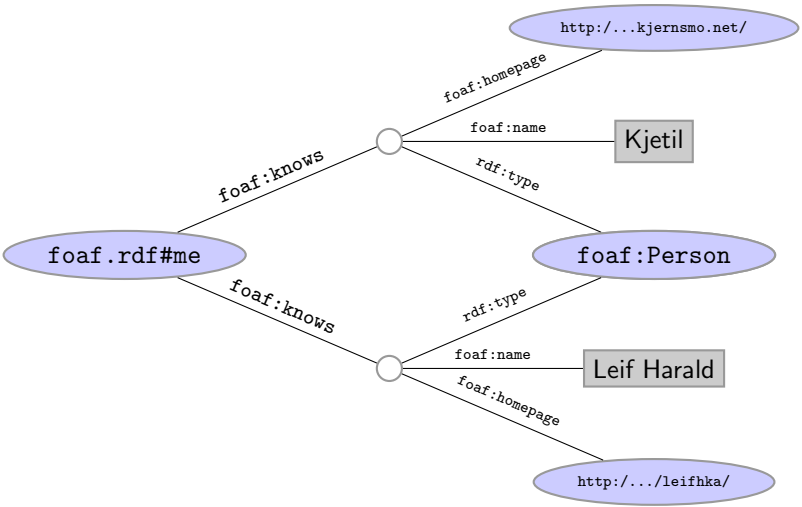
```
[] a foaf:Person ;
   foaf:name "Martin Giese" ;
   foaf:mbox <mailto:mg@mail.no> ;
```

Know Your Friends

- Missing objects collected from contained elements (chaining):

```
<div xmlns:foaf="http://xmlns.com/foaf/0.1/"
     about="foaf.rdf#me" rel="foaf:knows">
  <ul>
    <li typeof="foaf:Person">
      <a property="foaf:name" rel="foaf:homepage"
         href="http://www.kjetil.kjernsmo.net/">Kjetil</a>
    </li>
    <li typeof="foaf:Person">
      <a property="foaf:name" rel="foaf:homepage"
         href="http://heim.ifi.uio.no/leifhka/">Leif Harald</a>
    </li>
  </ul>
</div>
```

Triples From Chaining Example



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- NOTE: this lecture was about RDFa 1.0. Search the web for RDFa 1.1!