










Annotation

Oscar Corcho, Boris Villazón-Terrazas, Asunción Gómez-Pérez
 ({ocorcho,bvillazon,asun}@fi.upm.es)
 Universidad Politécnica de Madrid

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Main References

Gómez-Pérez, A.; Fernández-López, M.; Corcho, O. *Ontological Engineering*. Springer Verlag. 2003
Chapter 5: Ontology tools

Corcho, O.
Ontology-based document annotation: trends and open research problems
International Journal of Metadata, Semantics and Ontologies 1(1):47-57. 2006

Handschuh S, Staab S (2003)
Annotation for the Semantic Web. IOS Press

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2. **Web Resource Annotation**
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 - 3.1 Approaches for database annotation
 - 3.2 R2O and ODEMapster
 - 3.3 Practical Example: NeOn Toolkit

What is the metadata of this HTML fragment?

Based on Dublin Core

The *contributor* and *creator* is the flight booking service "www.flightbookings.com".
The *date* would be January 1st, 2003, in case that the HTML page has been generated on that specific date.
The *description* would be something like "flight details for a travel between Madrid and Seattle via Chicago on February 8th, 2004".
The document *format* is "HTML".
The document *language* is "en", which stands for English

Flight details

Outbound

Leaving from **Madrid** - Barajas - Spain
on Saturday 08 February 2003 at **11:50**
Arriving in **Chicago** - O'Hare International - United States of America
same day at **14:10**
Airline: American Airlines
Flight No. AA 7815
Type of aircraft: Airbus Industrie A340 All Series PAX/H

Leaving from **Chicago** - O'Hare International - United States of America
on Saturday 08 February 2003 at **16:48**
Arriving in **Seattle** - Seattle/Tacoma International - United States of America
same day at **19:23**
Airline: American Airlines
Flight No. AA 1805
Type of aircraft: non referenced/B

Based on thesauri

Madrid is a reference to the term with ID 7010413 in the thesaurus, which refers to the city of Madrid in Spain.
Spain is a reference to the term with ID 1000095, which refers to the kingdom of Spain in Europe.
Chicago is a reference to the term with ID 7013596, which refers to the city of Chicago in Illinois, US.
United States of America is a reference to the term "United States" with ID 7012149, which refers to the US nation.
Seattle is a reference to the term with ID 7014494, which refers to the city of Seattle in Washington, US.

Based on ontologies

Concept instances relate a part of the document to one or several concepts in an ontology. For example, "Flight details" may represent an instance of the concept *Flight*, and can be named as *AA7615_Feb08_2003*, although concept instances do not necessarily have a name.

Attribute values relate a concept instance with part of the document, which is the value of one of its attributes. For example, "American Airlines" can be the value of the attribute *companyName*.

Relation instances that relate two concept instances by some domain-specific relation. For example, the flight *AA7615_Feb08_2003* and the location *Madrid* can be connected by the relation *departurePlace*

Annotation

assert facts using terms (*metadata in RDF*)
Represent terms and their relationships (*ontology in RDFS/OWL*)

The screenshot shows the Schizophrenia Research Forum website. Annotations are placed over various parts of the page:

- News**: Points to the 'Research News' section.
- Videocast**: Points to the 'Live NIH Videocasts' section.
- Grant Application**: Points to the 'Preparing for Electronic Grant Application' link.
- Research**: Points to the 'Current Papers—Show Us the Nuggets!' link.
- Events**: Points to the 'SRF CALENDAR' section.
- Organisation**: Points to the 'SRF COMMUNITY' section.
- Gene Database**: Points to the 'Schizophrenia Gene' section.

Ontologies and Metadata

Ontologies

```

xmlns:rd="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:NS0="http://www.esperonto.net/semanticportal/RDFS/Person_Ontology#"
xmlns:NS1="http://www.esperonto.net/semanticportal/RDFS/Organization_Ontology#"

```

Person (Subclass of **Associate Prof.**)

Organization (Subclass of **Partner**)

Relationships: **Person** *Belongs_To* **Organization**, **Person** *Has_contact_Person* **Person**

Annotation (RDF)

```

<rdf:Description rdf:about="Asunción Gómez-Pérez">
<rdf:type rdf:resource="Associate Prof"/>
<NS0:Full_Name>A. GomezPerez</NS0:Full_Name>
<NS0:Belongs_To>UPM</NS0:Belongs_To>
<NS0:e-mail>asun@fi.upm.es</NS0:e-mail>

```

Web Page

| | |
|-----------|----------------------|
| Full Name | Asuncion Gomez-Perez |
| e-mail | asun@fi.upm.es |
| Photo | |

Asunción Gómez-Pérez is contact person UPM (Partner).
Asunción Gómez-Pérez belongs to UPM (Partner).

URL

<http://www.esperonto.net>

UPM

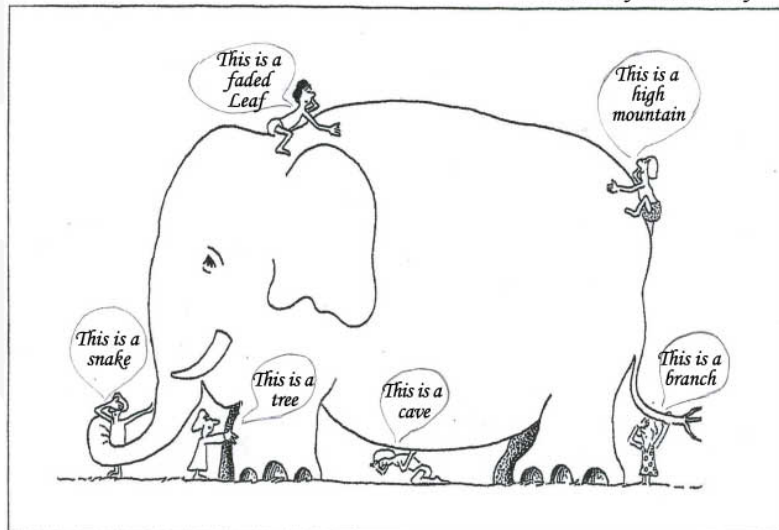
| | |
|-----------|-----------------------------------|
| Full Name | Universidad Politécnica de Madrid |
| Acronym | UPM |
| Logo | |

UPM has contact person Asunción Gómez-Pérez (Associate Professor).
UPM participates in Esperonto (Project).
IIPM team is formed by:

URL

<http://www.esperonto.net>

An Indian Tale: Blind Men and an Elephant



The early days of annotation in the Web

- The main objective in the early days was the agreement on how to include annotations on the Web

- (KA)2
- SHOE (Simple HTML Ontology Extension)

- ...

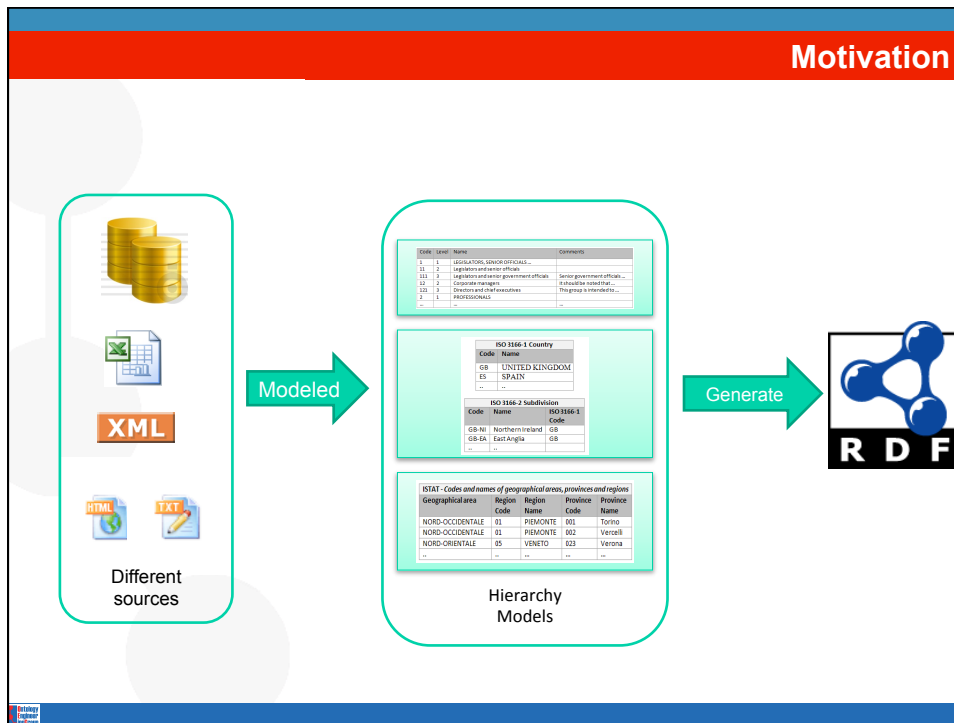
```
<html>
<head><TITLE> Richard Benjamins </TITLE>
<a ONTO="page:Researcher"> </a>
</head>

<H1> <A HREF="pictures/id-rich.gif">
<IMG align="middle" SRC="pictures/richard.gif"></A>
<a ONTO="page[photo=href]"
HREF="http://www.iiia.csic.es/~richard/pictures/richard.gif" ></a>
<a ONTO="page[firstName=body]">Richard</a>
<a ONTO="page[lastName=body]">Benjamins </a>
</h1> <p>

<A ONTO="page[affiliation=body]" HREF="#card">
Artificial Intelligence Research Institute (IIIA)</A> -
<a href="http://www.csic.es/">CSIC</a>, Barcelona, Spain <br>
and <br>
<A ONTO="page[affiliation=body]" HREF="http://www.swi.psy.uva.nl/">
Dept. of Social Science Informatics (SWI)</A>
-
<A HREF="http://www.uva.nl/uva/english/">UvA</A>, Amsterdam, the
Netherlands
```

- Not so far from RDFa

Motivation



The early days of the Semantic Web

Availability of content

- Including the "Deep Web" and Web Services

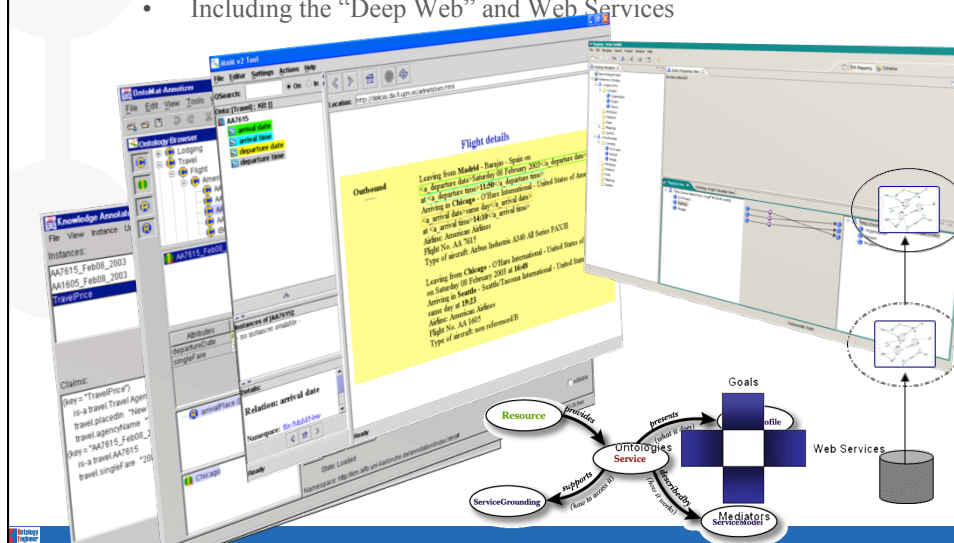


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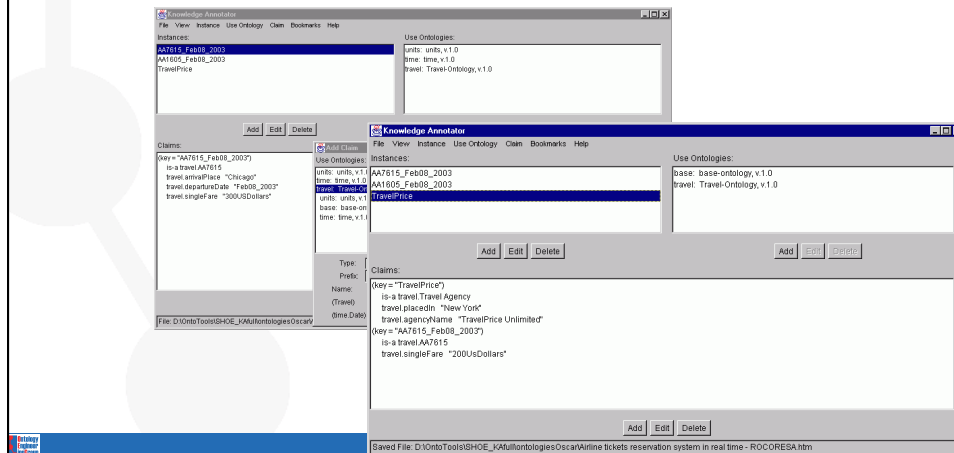
1. **Ontology-based Annotation**
2. **Web Resource Annotation**
3. **Database Annotation**
 - 3.1 **Approaches for database annotation**
 - 3.2 **R2O and ODEMapster**
 - 3.3 **Practical Example: NeOn Toolkit**

Web Resource Annotation. Dimensions

- Sources
 - Source type
 - Text: HTML, XML, PDF, etc.
 - Multimedia: images, video, audio
 - Web Services
 - Origin
 - Static: files
 - Dynamic: databases and forms
 - Very dynamic: data streams
- Technologies
 - Natural Language Processing
 - Information Extraction
 - Layout Analysis
 - Clustering
 - Topic identification
 - Wrapper generation
- Annotation Process
 - Maintenance (adaptivity to changes in the sources)
 - Verification
 - Robustness
 - Auto-adaptivity
 - Annotation Supervision
 - Manual
 - Supervised (semi-automatic)
 - Unsupervised (automatic)
- Degree of formality
 - Web 2.0 tagging
 - Dublin-core based
 - Thesauri
 - Ontology-based

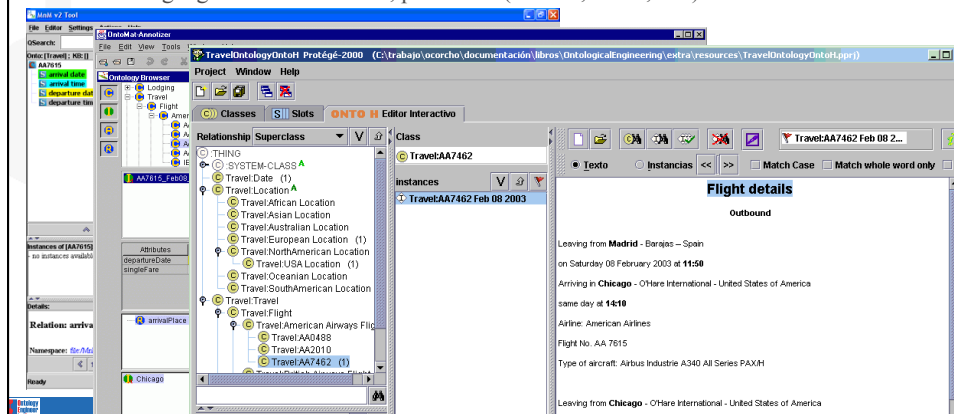
Web 1.0. SHOE Knowledge Annotator

- Standalone application with no Web browser
- Manual annotation
- SHOE



Web 1.0. MnM, OntoMat, ONTO-H, etc.

- Standalone applications
- Manual annotation with drag&drop
- Some features
 - MnM: Semi-automatic annotation with information extraction tools (Amilcare)
 - ONTO-H: cascading annotation rules
- Languages: RDF and OWL, plus other (OCML, XML, etc.)



Web 1.0. AeroSWARM

- Web server for any Web document
- Automatic annotation with predefined ontologies: OpenCyc, SUMO and AeroSWARM
- RDF

The screenshot shows the AeroSWARM web interface. At the top, there's a header with "LOCKHEED MARTIN" and "DAML UBOT Project". Below this, the "AeroSWARM" logo is displayed. The main content area explains that AeroSWARM is a web service that takes a web page as input and generates OWL markup. It lists predefined ontologies: OpenCyc, SUMO, and AeroSWARM. A form is provided for users to enter a URL and generate markup. On the right, a sidebar displays "Organization: HareInternational" with details like "Also Known As: Hare International (source)" and "Located In: United States of America (source)". Below this, "Flight details" are shown, including "Outbound" information: "Leaving from Madrid - Barajas - Spain on Saturday 02 February 2003 at 11:40", "Arriving in Chicago - O'Hare International - United States of America same day at 14:10", "Aircraft: Airbus A340-300", "Flight No.: AA 7615", and "Type of aircraft: Airbus Industrie A340-300".

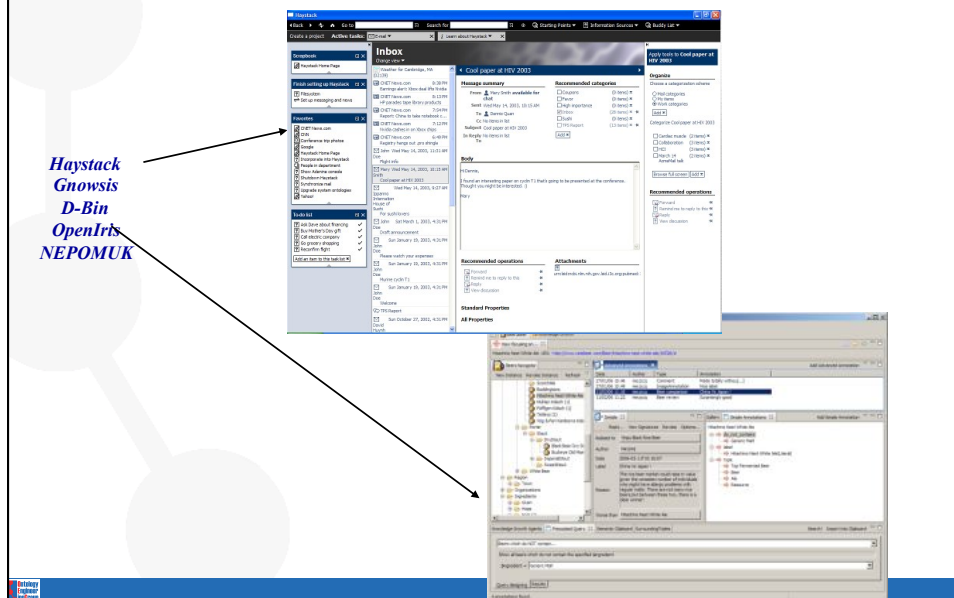
Web 2.0. Semantic wikis

RDF presentation
Rhizome
HTML + RDF page edition
IkeWiki
SemanticMediaWiki
SemPerWiki
SweetWiki
WikSAR
Ontology-based population
OntoWiki
COW
Non-ontology based attribute-value annotation
DiamondWiki

The screenshot shows a Semantic Wikipedia page for "Oscar Corcho". The page includes a navigation sidebar with links like "Main Page", "People", "Groups", "Help", "PDF Export", "Recent changes", and "Search". The main content area displays "Oscar Corcho" with a brief description: "This person attended ESWC2006. This person attended ESWC2006." It also lists "Relations to other articles" such as "Member of: University of Manchester" and "Participant of: ESWC2006". A table of "Attribute values" is shown, including "Name", "Homepage", and "See also". The page footer indicates it was last modified on 03/26/7 November 2006 and has been accessed 317 times.

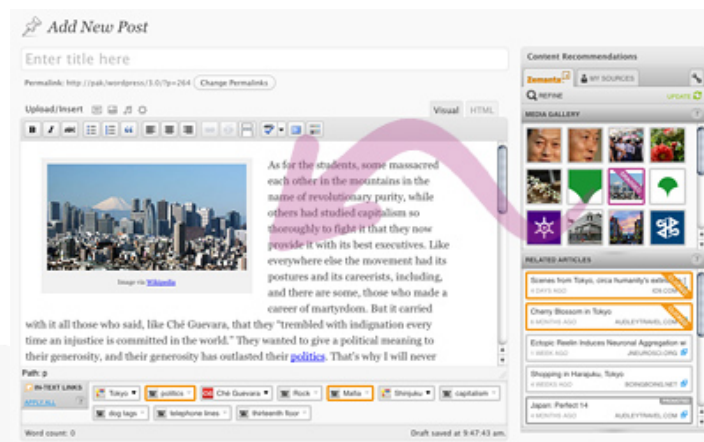
Semantic Wikipedia

Web 2.0. Semantic desktop (including semantic e-mail)



Web 2.0. Semantics in blogs

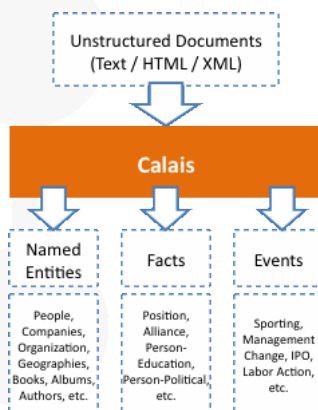
- Zemanta



Web 2.0. Semantics in microblogs

- Not much yet to help on microblog semantic enrichment during creation
- But some work done on semantic characterisation of hashtags

Linked Data. OpenCalais, DBpedia Spotlight



Confidence: 0.0

Contextual score: 0.0

Prominence (support): 0

No 'common words'

Default Disambiguation

Show best candidate

SELECT TYPES... ANNOTATE

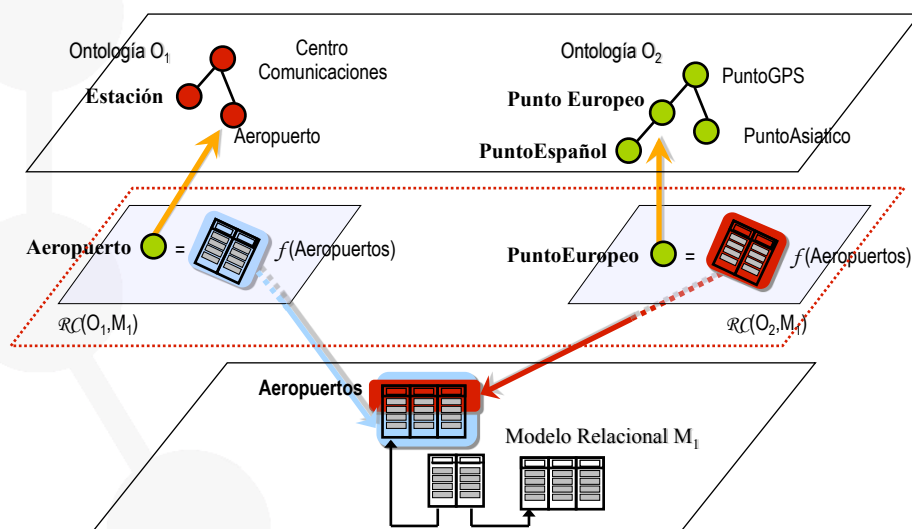
President Obama on Monday will call for a new minimum tax rate for individuals making more than \$1 million a year to ensure that they pay at least the same percentage of their earnings as other taxpayers, according to administration officials.

BACK TO TEXT

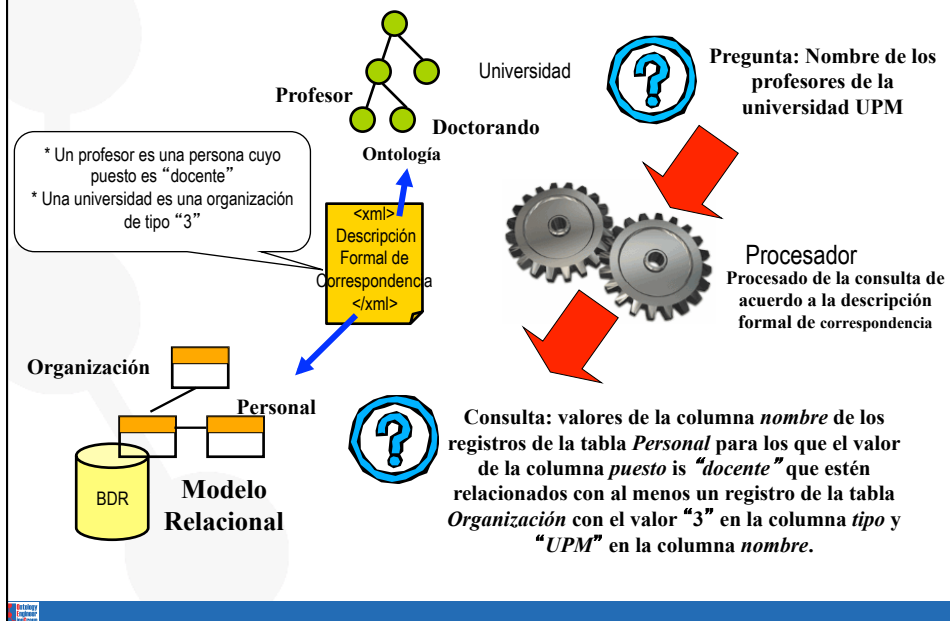
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Ontology-based view over a relational model (I)

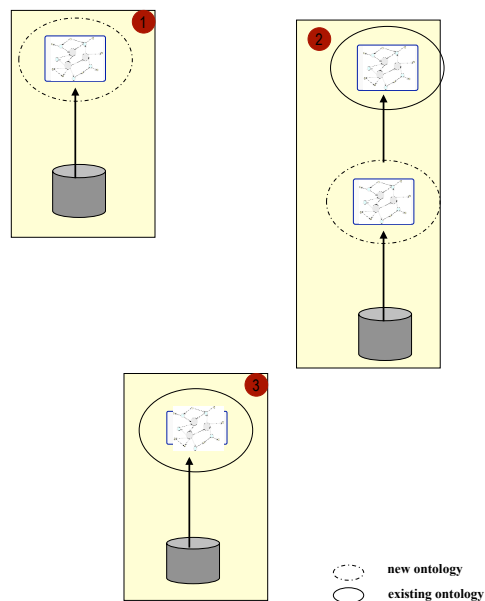


Ontology-based view over a relational model (II)

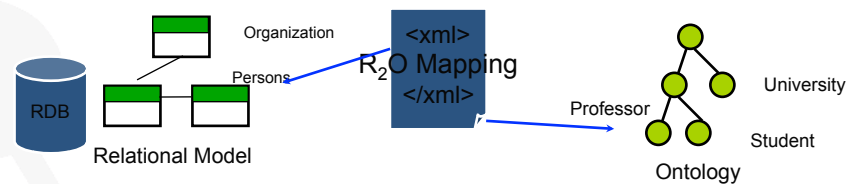


Existing approaches

1. To build a **new ontology** from a database schema and content (OntoStudio, KaOn Reverse)
2. To map the ontology created in approach (1) to a **legacy ontology** (NeOn toolkit UKARL)
3. To map an existing DB to a **legacy ontology** (NeOn Toolkit UPM)

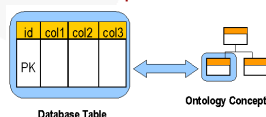


- R₂O is an extensible, fully declarative language to describe mappings between relational database schemas and ontologies.

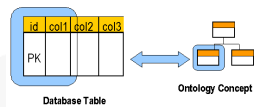


R2O (Relational-to-Ontology) Language

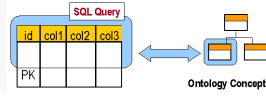
For concepts...



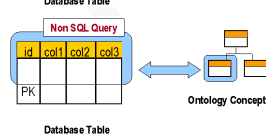
A view maps exactly one concept in the ontology.



A subset of the columns in the view map a concept in the ontology.



A subset (selection) of the records of a database view map a concept in the ontology.

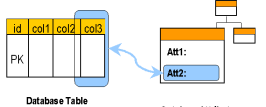


A subset of the records of a database view map a concept in the onto, but the selection cannot be made using SQL.



One or more concepts can be extracted from a single data field (not in 1NF).

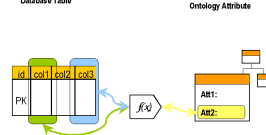
For attributes...



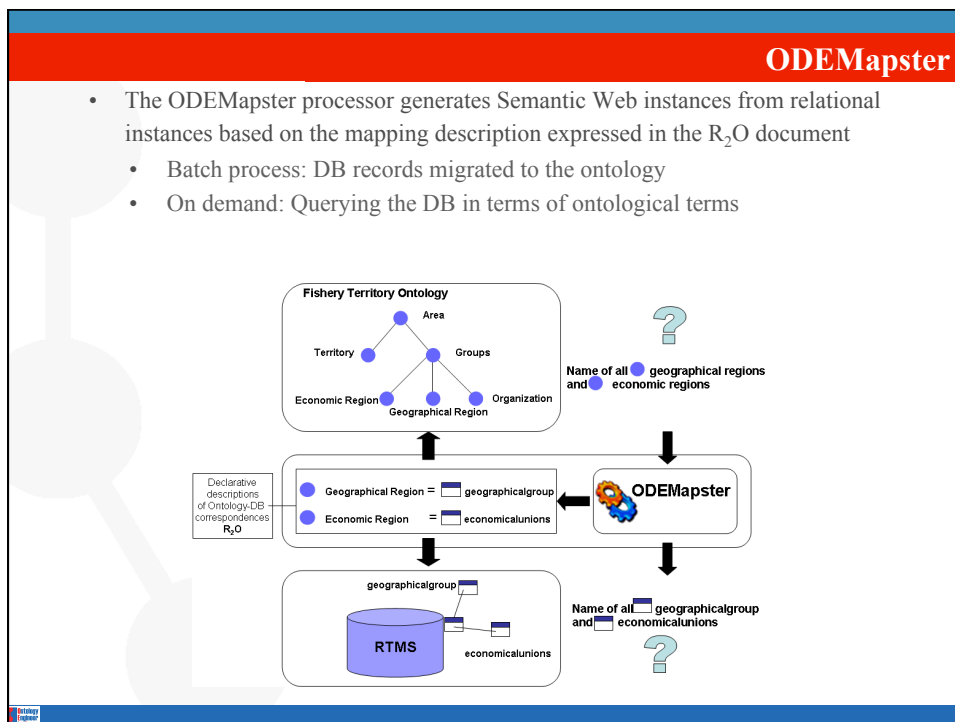
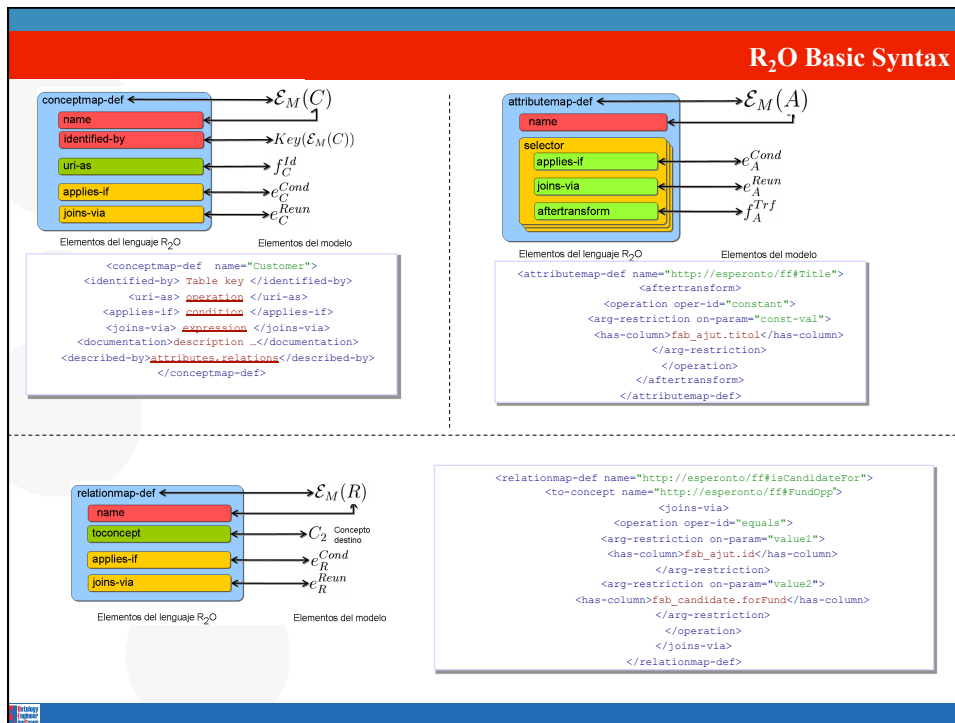
A column in a database view maps directly an attribute or a relation.



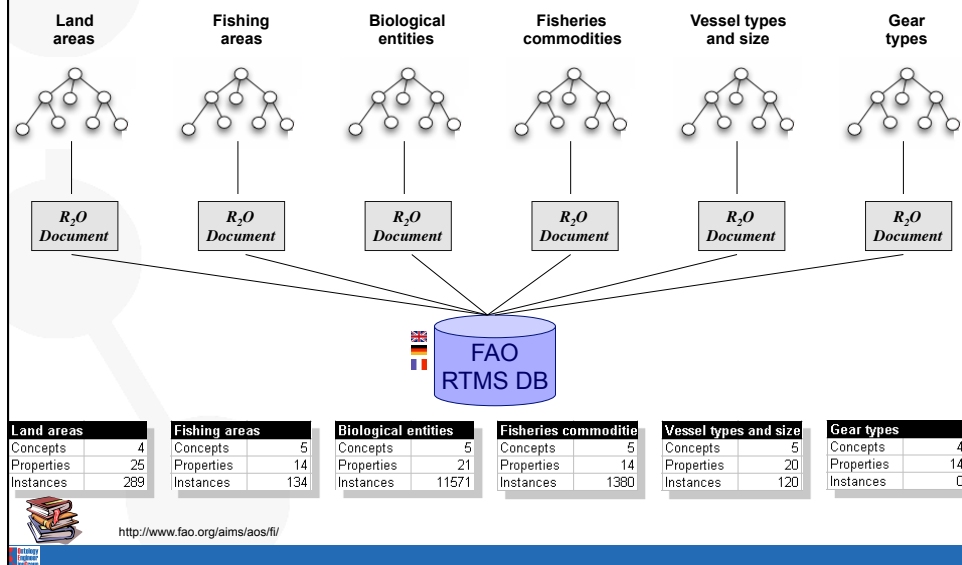
A column in a database view maps an attribute or a relation after some transformation.



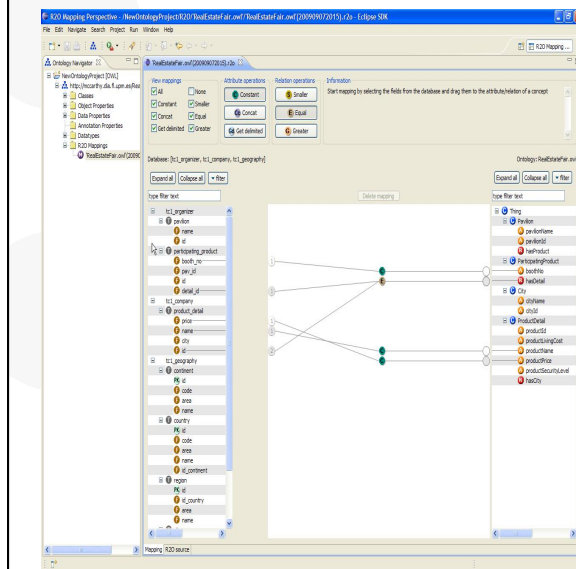
A set of columns in a database view map an attribute or a relation.



FAO Use Case



Mapping Design



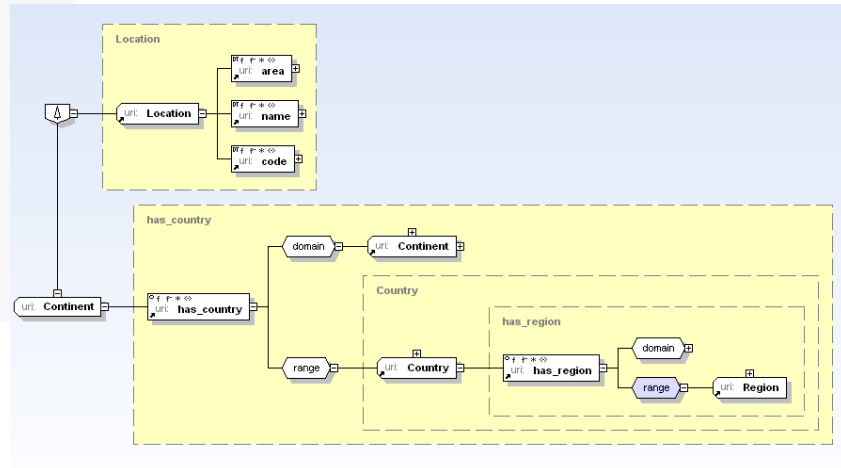
3 Mapping Creation Steps

- Load Ontology
- Load Database(s)
- Create mapping

2 Usage Modes

- Online mode (run time query execution)
- Offline mode (materialized RDF dump)

Example: Geography Ontology



Geography Database

[Table] continent @geography ()

| id | code | name | area |
|----|------|------------|----------|
| 1 | AF | AFRICA | 30000000 |
| 2 | AN | ANTARCTICA | 14000000 |
| 3 | AS | ASIA | 40000000 |
| 4 | EU | EUROPE | 10000000 |
| 5 | AM | AMERICA | 41000000 |
| 6 | OC | OCEANIA | 9000000 |

Record 1 of 6 in Page 1

Continent Table

[Table] country @geography ()

| id | code | name | area |
|----|------|-------|--------|
| 40 | ES | SPAIN | 500000 |

Record 1 of 1 in Page 1

Country Table

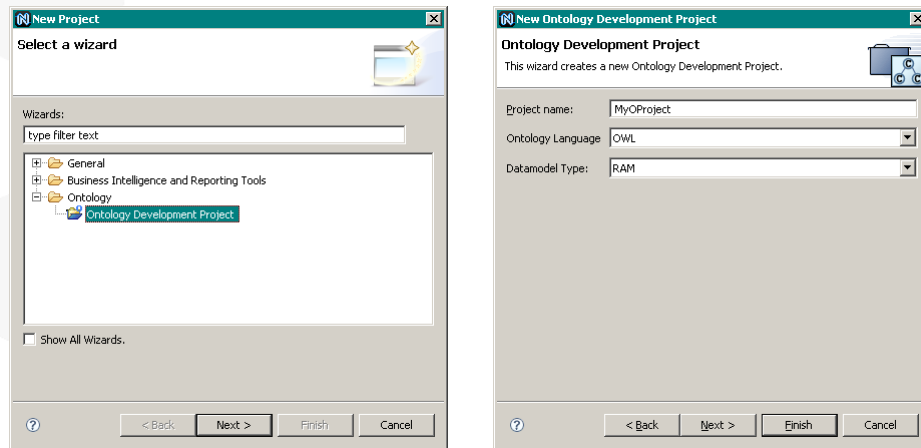
[Table] region @geography ()

| id | code | name | area |
|-----|------|--------------|------|
| 404 | 40 | CATALONIA | 0 |
| 405 | 40 | VASK COUNTRY | 0 |
| 406 | 40 | GALICIA | 0 |
| 407 | 40 | ARABALUCIA | 0 |
| 408 | 40 | MADRID | 0 |
| 409 | 40 | MURCIA | 0 |
| 410 | 40 | VALENCIA | 0 |

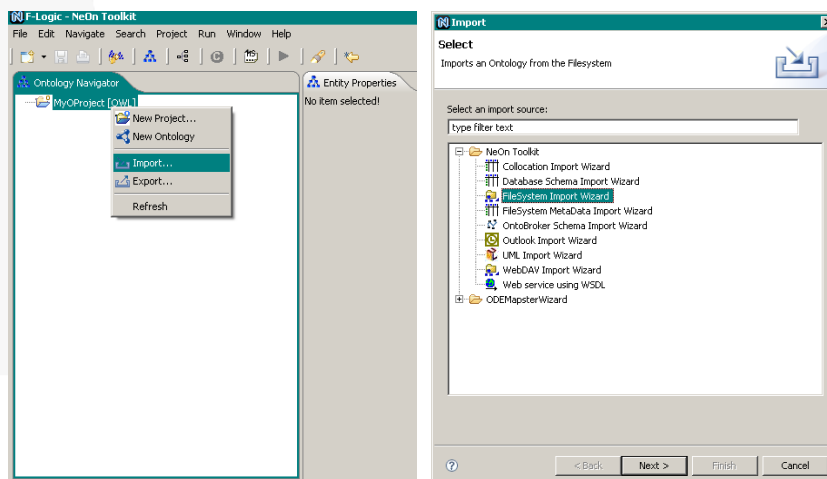
Record 1 of 7 in Page 1

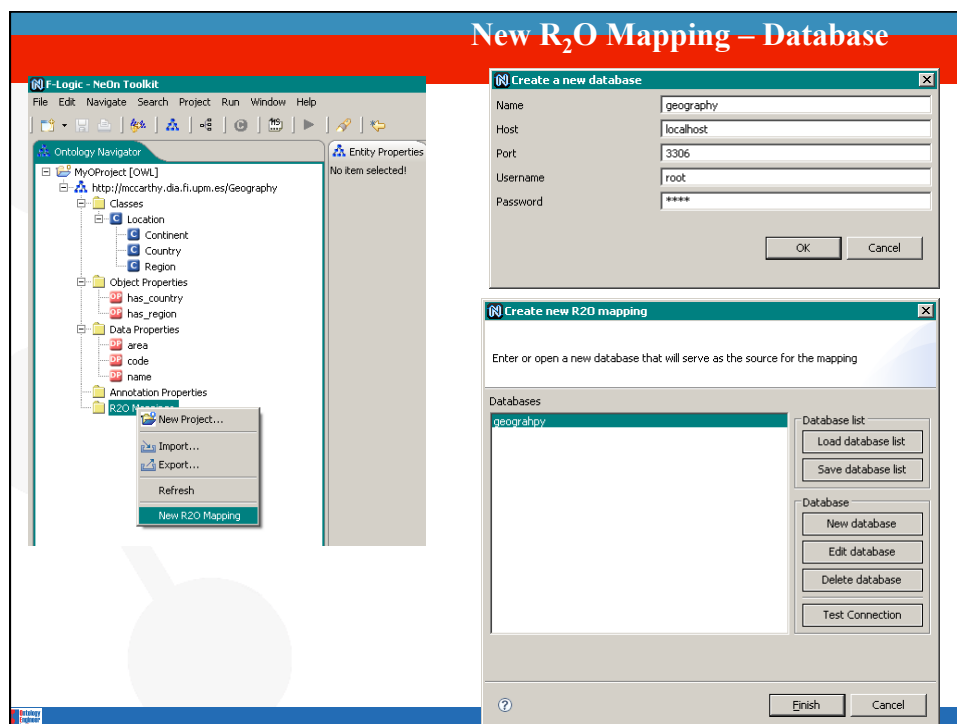
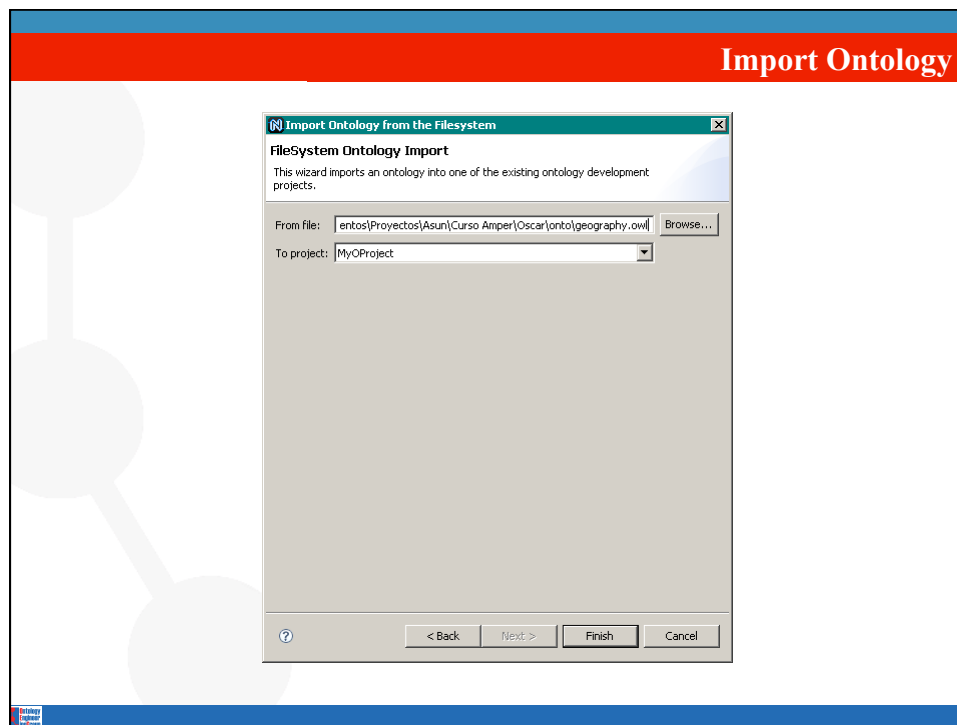
Region Table

NeOn Toolkit – New Ontology Project



Import Ontology





R₂O Mapping Perspective

An attribute mapping example

The screenshot displays the Protege software interface, specifically the 'Mappings' tab. The interface is divided into several sections:

- View mappings:** Contains checkboxes for 'All', 'None', 'Constant', 'Smaller', 'Concat', 'Equal', 'Get delimited', and 'Greater'.
- Attribute operations:** Includes buttons for 'Constant', 'Concat', and 'Get delimited'.
- Relation operations:** Includes buttons for 'Smaller', 'Equal', and 'Greater'.
- Information:** A text area for notes, currently containing 'Start mapping by selecting the fields from the database and drag them to the attribute/relation of a concept'.

Below these sections, the 'Database: geography' and 'Ontology: Geography' are listed. The 'Database: geography' section shows a tree structure with nodes like 'continent', 'country', and 'region', each with sub-attributes like 'id', 'code', 'name', and 'area'. The 'Ontology: Geography' section shows a similar tree structure with nodes like 'Location', 'Region', 'Continent', and 'Country', each with sub-attributes like 'code', 'area', 'name', and 'has_country'.

A mapping is being created between the 'continent' node in the database and the 'Continent' node in the ontology. A line connects the 'continent' node to the 'Continent' node, with a green dot indicating the mapping point. The 'Continent' node is highlighted with a blue circle, and the 'continent' node is highlighted with a green circle.

The 'Mappings' tab is active, showing a list of mappings. The first mapping is selected, showing the mapping between the 'continent' node and the 'Continent' node. The mapping is defined as:

```
continent <--> Continent
```

The 'Mappings' tab also shows a list of mappings. The first mapping is selected, showing the mapping between the 'continent' node and the 'Continent' node. The mapping is defined as:

```
continent <--> Continent
```

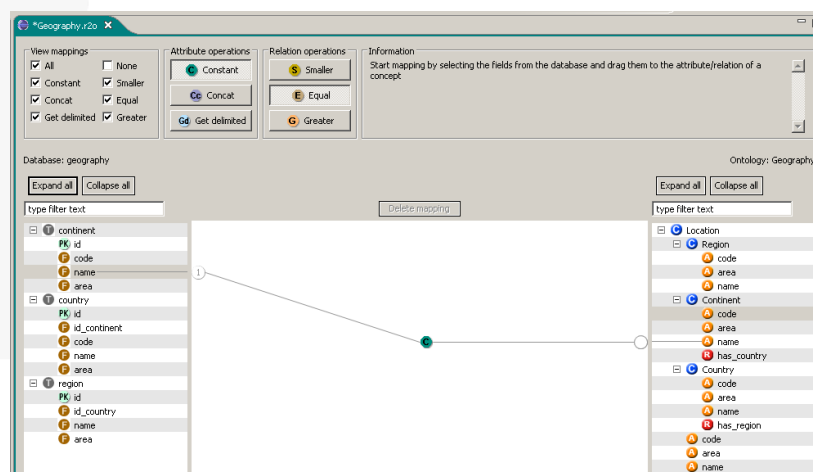
The 'Mappings' tab also shows a list of mappings. The first mapping is selected, showing the mapping between the 'continent' node and the 'Continent' node. The mapping is defined as:

```
continent <--> Continent
```

An attribute mapping example – R₂O Code

```
<attributemap-def name="http://mccarthy.dia.fi.upm.es/Geography#code">
  <selector>
    <aftertransform>
      <operation oper-id="constant">
        <arg-restriction on-param="const-val">
          <has-column>continent.code</has-column>
        </arg-restriction>
      </operation>
    </aftertransform>
  </selector>
</attributemap-def>
```

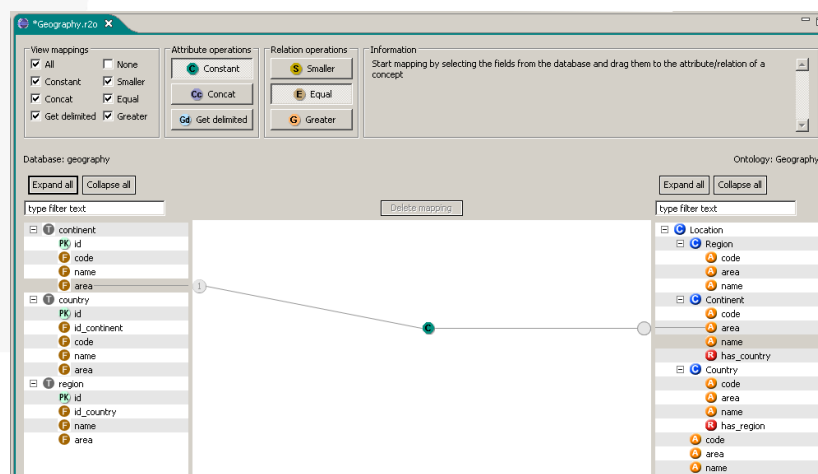
An attribute mapping example



An attribute mapping example – R₂O Code

```
<attributemap-def name="http://mccarthy.dia.fi.upm.es/Geography#name">
  <selector>
    <aftertransform>
      <operation oper-id="constant">
        <arg-restriction on-param="const-val">
          <has-column>continent.name</has-column>
        </arg-restriction>
      </operation>
    </aftertransform>
  </selector>
</attributemap-def>
```

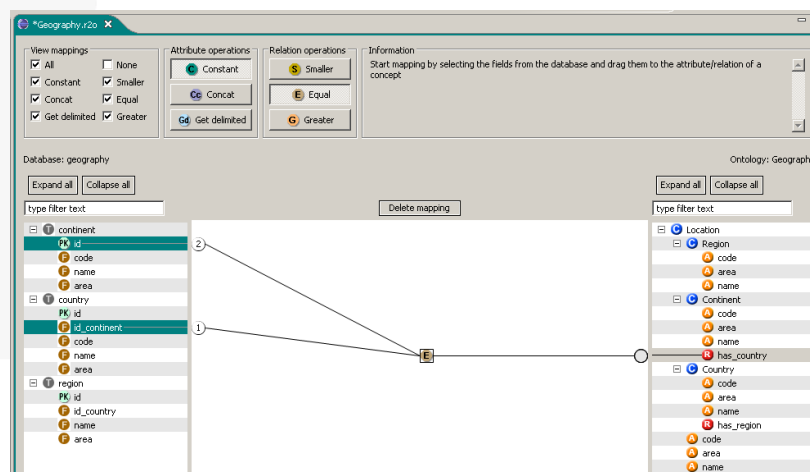
An attribute mapping example



An attribute mapping example – R₂O Code

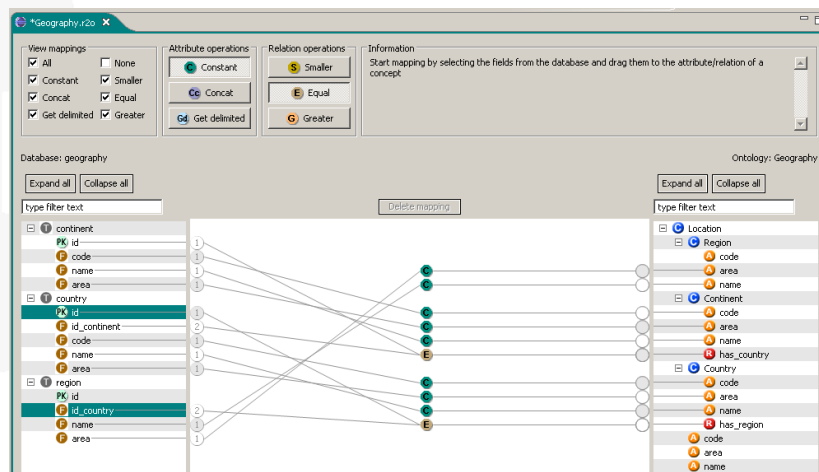
```
<attributemap-def name="http://mccarthy.dia.fi.upm.es/Geography#area">
  <selector>
    <aftertransform>
      <operation oper-id="constant">
        <arg-restriction on-param="const-val">
          <has-column>continent.area</has-column>
        </arg-restriction>
      </operation>
    </aftertransform>
  </selector>
</attributemap-def>
```

A relation mapping example



A relation mapping example – R₂O Code

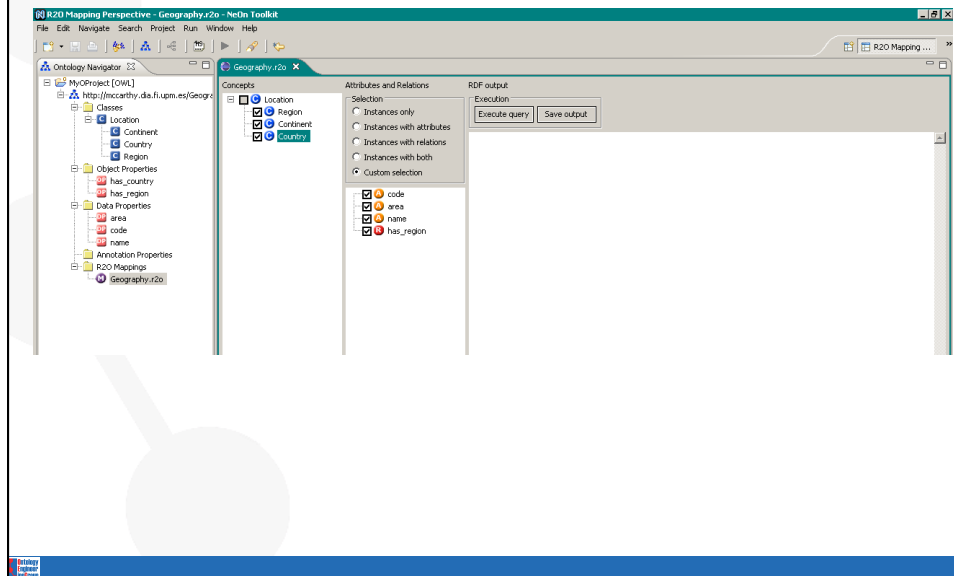
```
<dbrelationmap-def name="http://mccarthy.dia.fi.upm.es/Geography#has_country" toConcept="http://mccarthy.dia.fi.upm.es/Geography#Country">
  <joins-via>
    <condition oper-id="equals">
      <arg-restriction on-param="value1">
        <has-column>continent.id</has-column>
      </arg-restriction>
      <arg-restriction on-param="value2">
        <has-column>country.id_continent</has-column>
      </arg-restriction>
    </condition>
  </joins-via>
</dbrelationmap-def>
```



```
<conceptmap-def name="http://mccarthy.dia.fi.upm.es/Geography#Region">
  <uri-as>
    <operation oper-id="concat">
      <arg-restriction on-param="string1">
        <has-value>http://mccarthy.dia.fi.upm.es/Geography#Region</has-value>
      </arg-restriction>
      <arg-restriction on-param="string2">
        <has-column>region.id</has-column>
      </arg-restriction>
    </operation>
  </uri-as>
  <described-by>
</conceptmap-def>
```

Querying the Ontology Instances

Querying the Ontology Instances



Querying the Ontology Instances – SPARQL code

```
<onConcept conceptUri="http://mccarthy.dia.fi.upm.es/Geography#Country">
  <attSelect>
    .....
    <onAtt attName="http://mccarthy.dia.fi.upm.es/Geography#code"/>
  </attSelect>
  <attSelect>
    .....
    <onAtt attName="http://mccarthy.dia.fi.upm.es/Geography#area"/>
  </attSelect>
  <attSelect>
    .....
    <onAtt attName="http://mccarthy.dia.fi.upm.es/Geography#name"/>
  </attSelect>
  <relSelect>
    .....
    <onRel relName="http://mccarthy.dia.fi.upm.es/Geography#has_region"/>
  </relSelect>
</onConcept>
```

Retrieving the instances

The screenshot displays the Geopgraphy v2.0 application window. It is divided into three main panels:

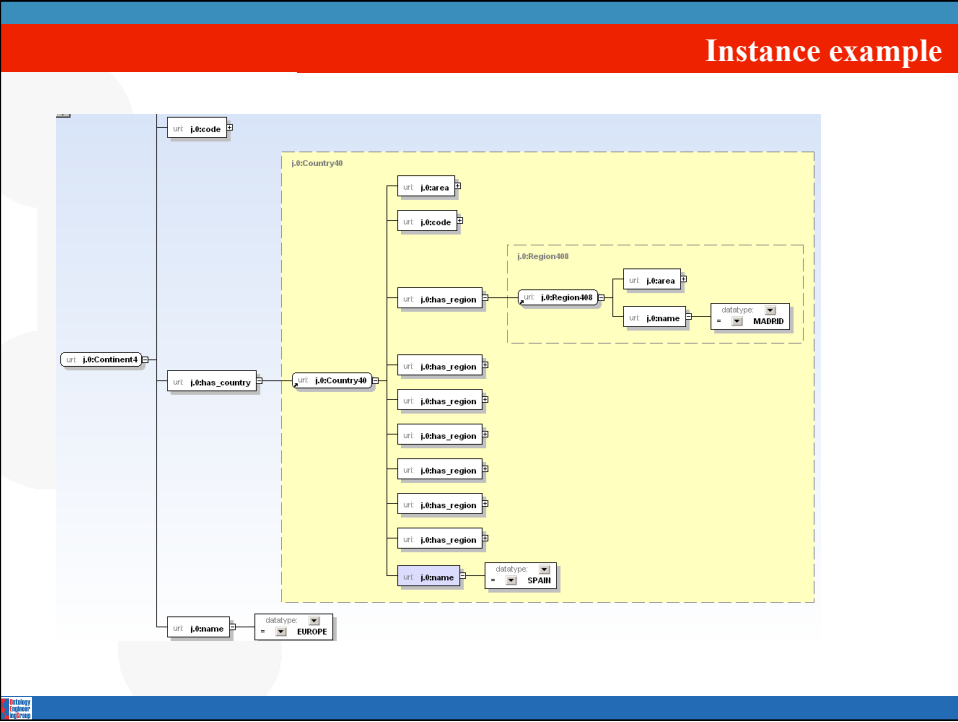
- Concepts:** A tree view on the left showing a hierarchy of concepts: Location (checked), Region (checked), Continent (checked), and Country (checked). Below this, there are radio buttons for 'Instances only', 'Instances with attributes', 'Instances with relations', 'Instances with both', and 'Custom selection'.
- Attributes and Relations:** A panel on the right with a 'Selection' section containing checkboxes for 'code', 'area', 'name', and 'has_region'. The 'code' checkbox is checked.
- RDF output:** A large text area on the right showing the generated RDF query. The query is an SPARQL query that retrieves instances of the 'Region' class, filtered by 'code' and 'area'. The query is as follows:


```

<?xml?>
<rdf:RDF>
  <xml:base href="http://www.w3.org/1999/02/22-rdf-syntax-ns#" />
  <xml:lang="en" />
  <http://imccarthey.da.fi.upm.es/Geopgraphy# ">
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Continent2">
      <code>AM</code>
      <area>14000000</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Region405">
      <code>VASK_COUNTRY</code>
      <area>0</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Region409">
      <code>MURCIA</code>
      <area>0</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Continent5">
      <code>AM</code>
      <area>14000000</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Continent4">
      <code>EU</code>
      <area>10000000</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Country107">
      <code>ES</code>
      <area>500000</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Region406">
      <code>GALLICIA</code>
      <area>0</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Region407">
      <code>ES</code>
      <area>500000</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Region409">
      <code>MURCIA</code>
      <area>0</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Region410">
      <code>ANDALUCIA</code>
      <area>0</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Country440">
      <code>ES</code>
      <area>500000</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Region407">
      <code>ES</code>
      <area>500000</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Region409">
      <code>MURCIA</code>
      <area>0</area>
    </rdf:Description>
    <rdf:Description rdf:about="http://imccarthey.da.fi.upm.es/Geopgraphy#Region410">
      <code>ANDALUCIA</code>
      <area>0</area>
    </rdf:Description>
  </rdf:RDF>

```

The application is running on a Windows operating system, as indicated by the taskbar at the bottom.



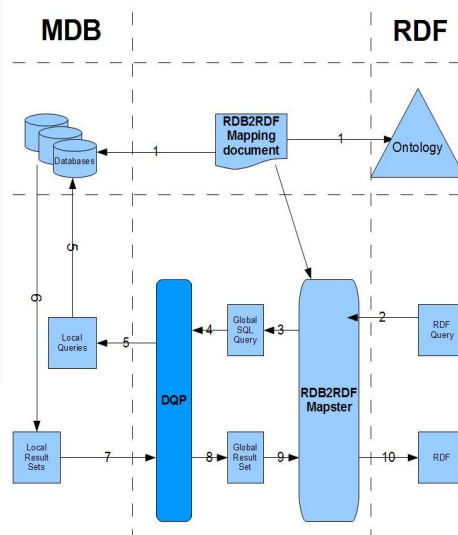
How to embed the ODEMapster Processor

```
public void testFunction() throws Exception
{
    Properties props = new Properties();

    props.setProperty(MapsterConnector.DATABASE_DRIVER, "com.mysql.jdbc.Driver");
    props.setProperty(MapsterConnector.DATABASE_URL, "jdbc:mysql://rtms_figis");
    props.setProperty(MapsterConnector.DATABASE_USER, "root");
    props.setProperty(MapsterConnector.DATABASE_PWD, "root");
    props.setProperty(MapsterConnector.OUTPUT_FILE_PATH, "c:/develop/space/mapster/examples/jan/output.rdf");
    props.setProperty(MapsterConnector.OWO_FILE_PATH, "c:/develop/space/mapster/examples/jan/onto.owl");
    props.setProperty(MapsterConnector.R2O_FILE_PATH, "c:/develop/space/mapster/examples/jan/r2o");
    props.setProperty(MapsterConnector.QUERY_FILE_PATH, "c:/develop/space/mapster/examples/jan/q1.xml");

    MapsterConnector mp = new MapsterConnector();
    mp.setProperties(props);
    mp.process();
}
```

MDB2RDF



- Mapping defined
- RDF Query Posed
- RDF Query to Global Query
- Global query is sent to DQP
- DQP distributes global queries into local queries and evaluate them
- Databases return local results
- Local results sent to DQP
- DQP integrates the results into global result
- Global result is sent to be transformed into RDF
- RDF documents containing RDF instances

Other topics not covered today

- Blog annotation tools
 - E.g., Zemanta
- Linguistic-based data annotation
 - E.g., GATE-based tools
- RDF data publishing
 - RDFa
 - Linked Data
- Ontology-based data integration techniques



Annotation

Oscar Corcho, Boris Villazón-Terrazas, Asunción Gómez-Pérez
({ocorcho,bvillazon,asun}@fi.upm.es)
Universidad Politécnica de Madrid

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