



R₂O/ODEMapster Engine and Linked data Web service

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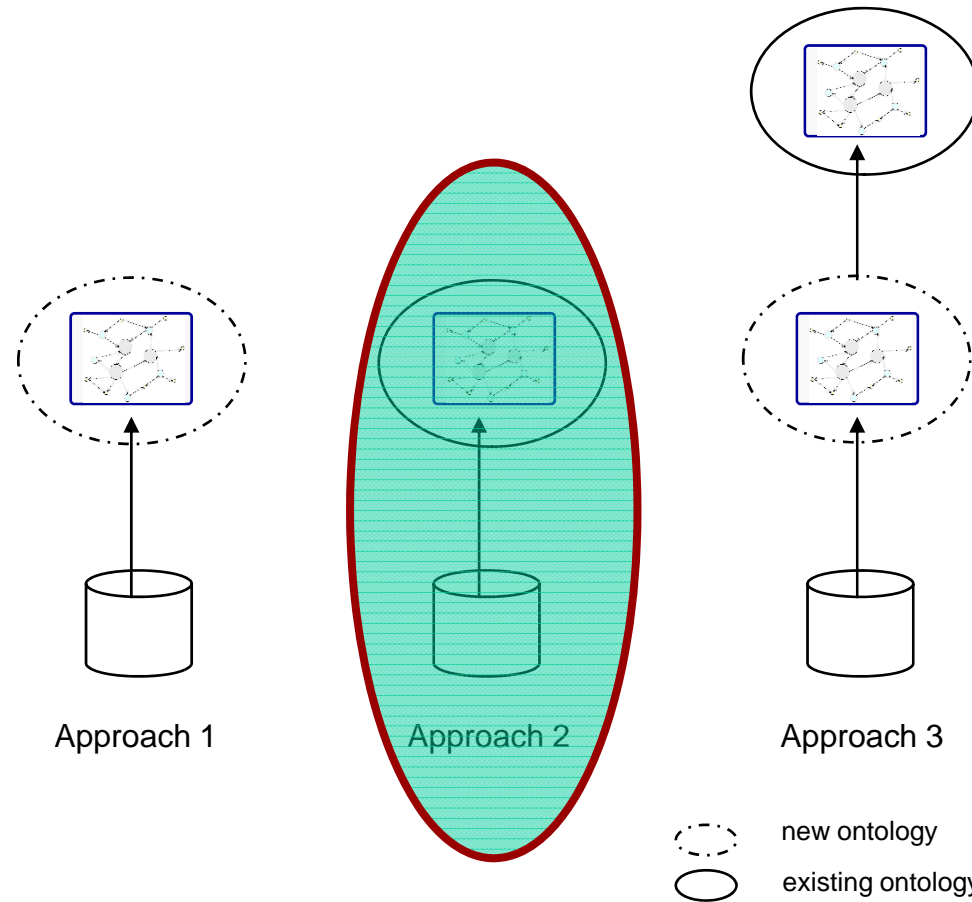
Facultad de Informática

Universidad Politécnica de Madrid

WWW09 - Madrid, Spain

- Introduction
- R₂O
- ODEMapster
- NeOn Toolkit plug in
- Service Based Access to provide linked data

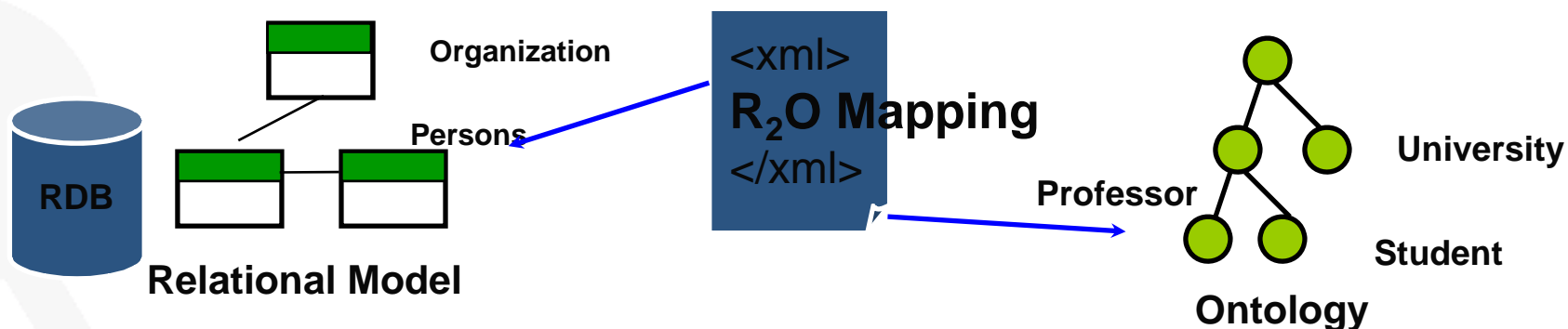
Existing approaches



Lifting XML Schemas to Ontologies – The concept finder algorithm Philipp Kunfermann, Christian Drumm
SAP Research Center CEC Karlsruhe
SAP AG

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



- Out of scope: to create an ontology that reflects the DB schema.

ConceptMap definition

$$\mathcal{E}_M(C) = [f_C^{Id}, e_C^{Cond}, e_C^{Reun}]$$

BNF:

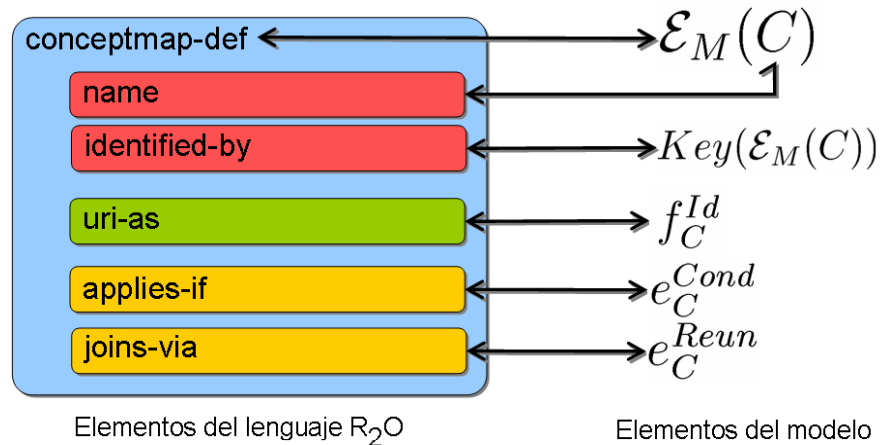
```

conceptmapping-definition ::= conceptmap-def name
                             identified-by+
                             (uri-as selector)?
                             (applies-if cond-expr)?
                             (joins-via concept-join-expr)?
                             documentation?
                             (described-by propertymap-def)*

identified-by ::= identified-by literal

concept-join-expr ::= (join-expr conceptJoinOpers cond-expr)?

conceptJoinOpers ::= join | union | difference
    
```



Example:

```

<conceptmap-def name="Customer">
  <identified-by> Table key </identified-by>
  <uri-as> operation </uri-as>
  <applies-if> condition </applies-if>
  <joins-via> expression </joins-via>
  <documentation>description ...</documentation>
  <described-by>attributes,relations</described-by>
</conceptmap-def>
    
```

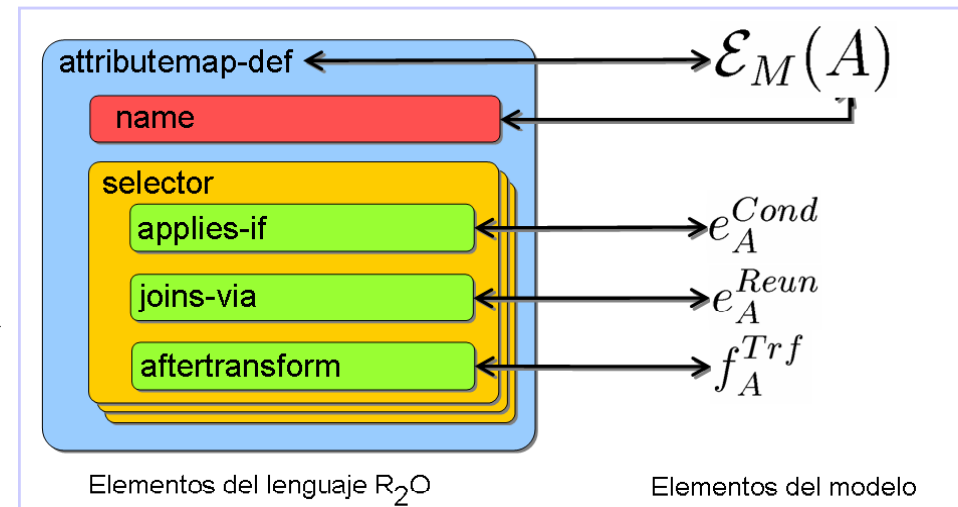
AttributeMap definition

$$\mathcal{E}_M(A) = [C, e_A^{Cond}, e_A^{Reun}, f_A^{Trf}]$$

BNF:

```

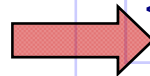
attributemap-def ::= attributemap-def name
                    (selector* | use-dbcol)
                    documentation?
use-dbcol ::= use-dbcol literal
selector ::= selector (applies-if cond-expr)?
              (aftertransform transformation)?
newobj-type ::= newobject-type literal
to-concept ::= to-concept literal
    
```



Example:

```

<attributemap-def name="http://esperonto/ff#Title">
  <aftertransform>
    <operation oper-id="constant">
      <arg-restriction on-param="const-val">
        <has-column>fsb_ajut.titol</has-column>
      </arg-restriction>
    </operation>
  </aftertransform>
</attributemap-def>
    
```



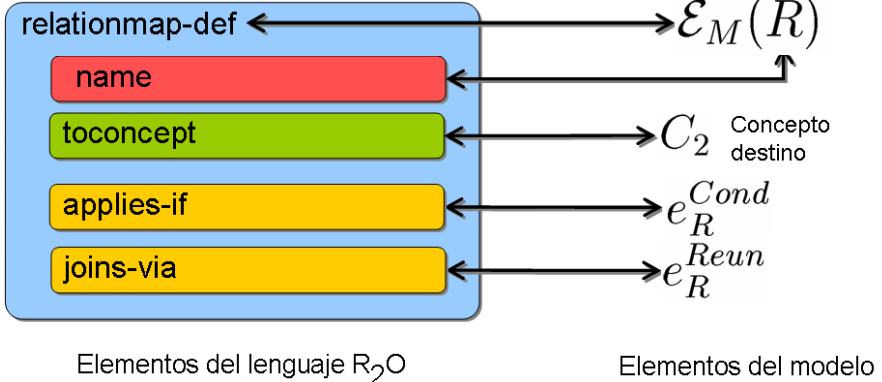
RelationMap definition

$$\mathcal{E}_M(R) = [C_O, C_D, e_R^{Cond}, e_R^{Reun}]$$

BNF:

```

relationmap-def ::= relationmap-def to-concept
                  (applies-if cond-expr)?
                  (joins-via relation-join-expr)?
relation-join-expr ::= join (join-expr cond-expr)?
to-concept ::= to-concept literal
    
```



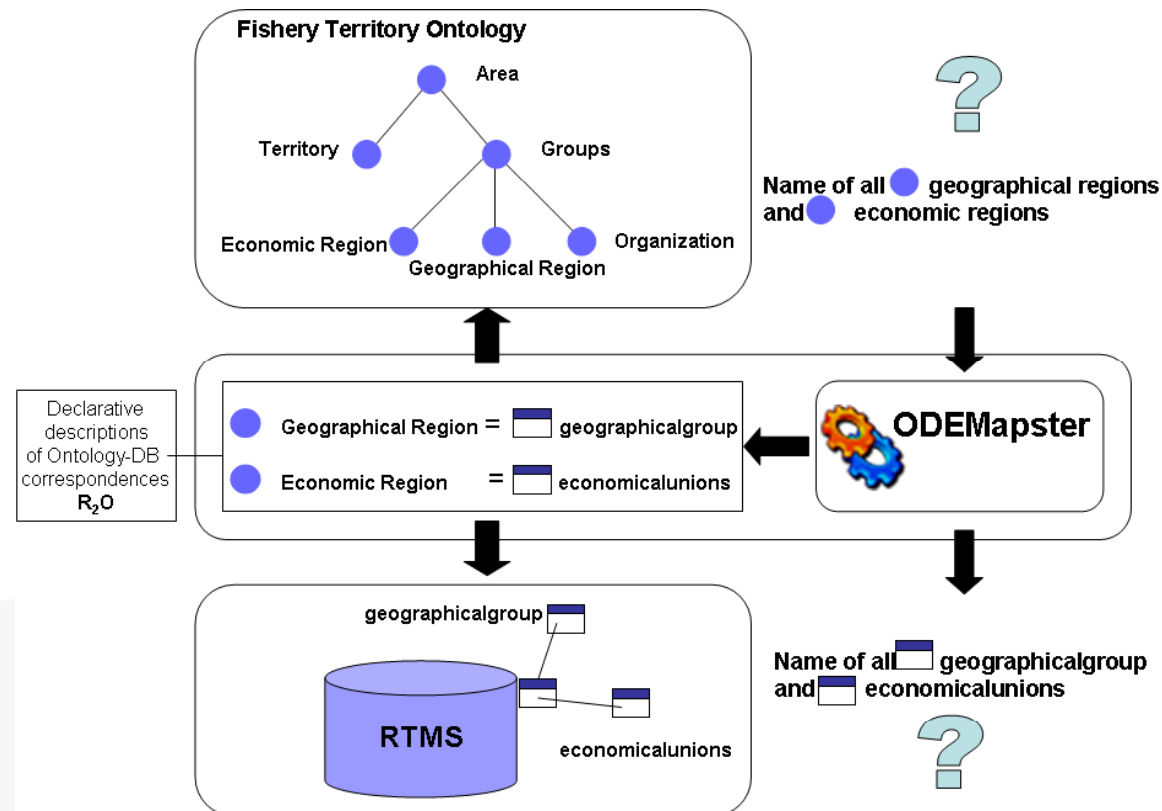
Example:

```

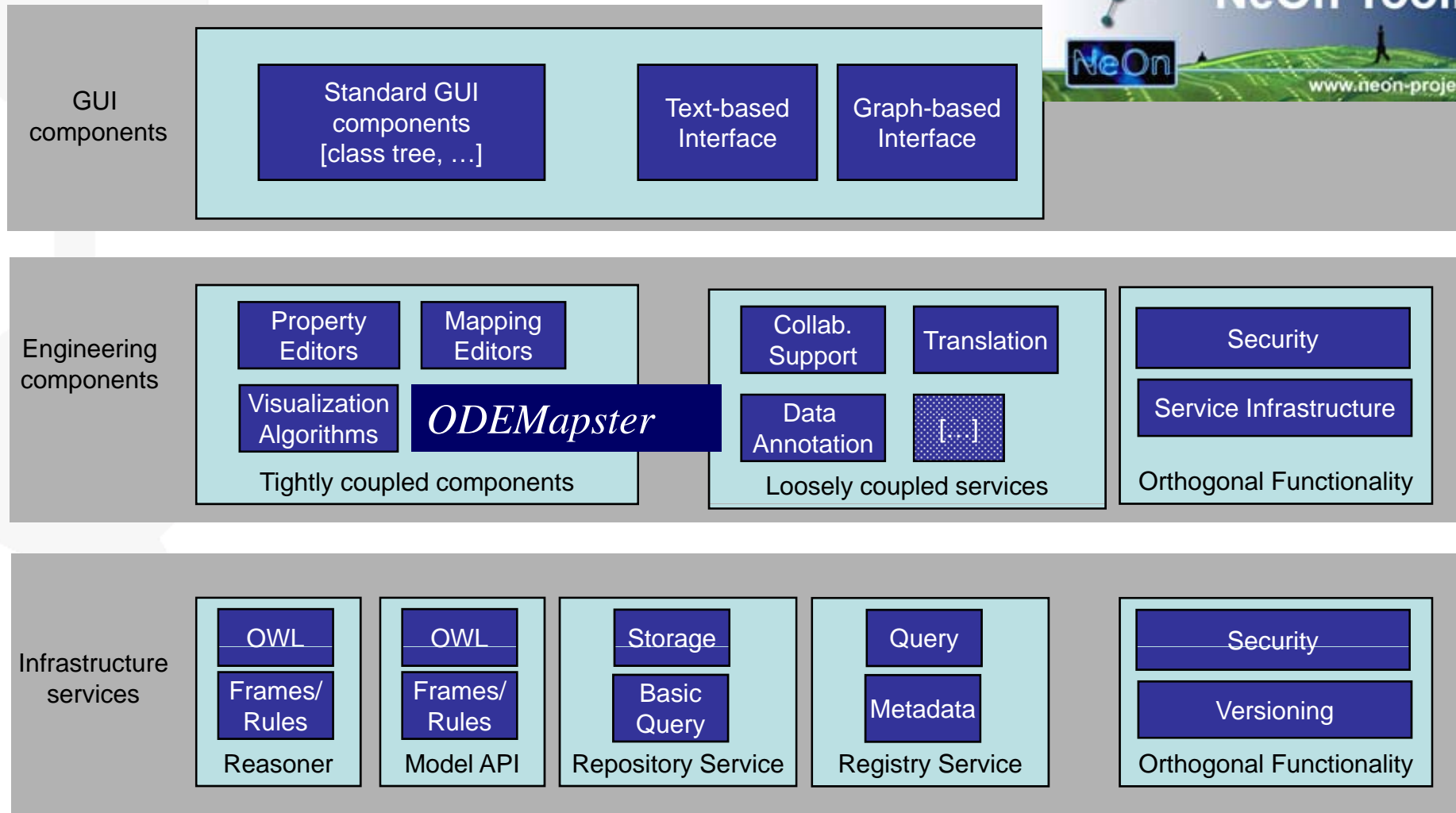
<relationmap-def name="http://esperonto/ff#isCandidateFor">
  <to-concept name="http://esperonto/ff#FundOpp">
    <joins-via>
      <operation oper-id="equals">
        <arg-restriction on-param="value1">
          <has-column>fsb_ajut.id</has-column>
        </arg-restriction>
        <arg-restriction on-param="value2">
          <has-column>fsb_candidate.forFund</has-column>
        </arg-restriction>
      </operation>
    </joins-via>
  </relationmap-def>
    
```


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- The ODEMapster processor generates Semantic Web instances from relational instances based on the mapping description expressed in the R₂O document
 - Batch process/materialization: DB records migrated to the ontology
 - On demand/virtualization: Querying the DB in terms of ontological terms



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Create a DB to Ontology mapping

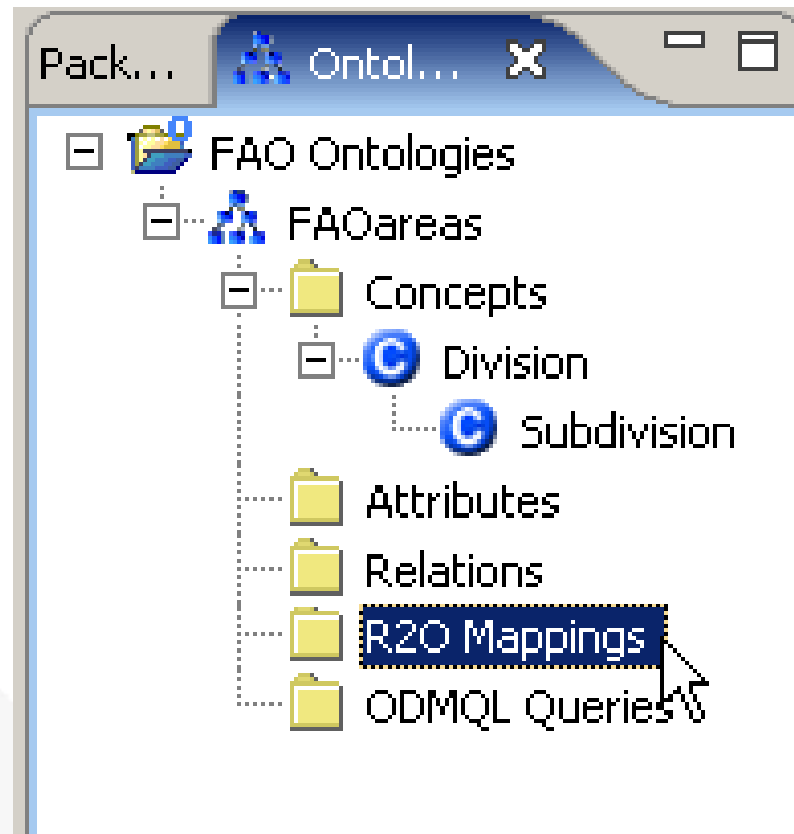
Select Mappings

Click new Mapping

Select Database

Mapping File created

Mapping Editor opens



Create a DB to Ontology mapping

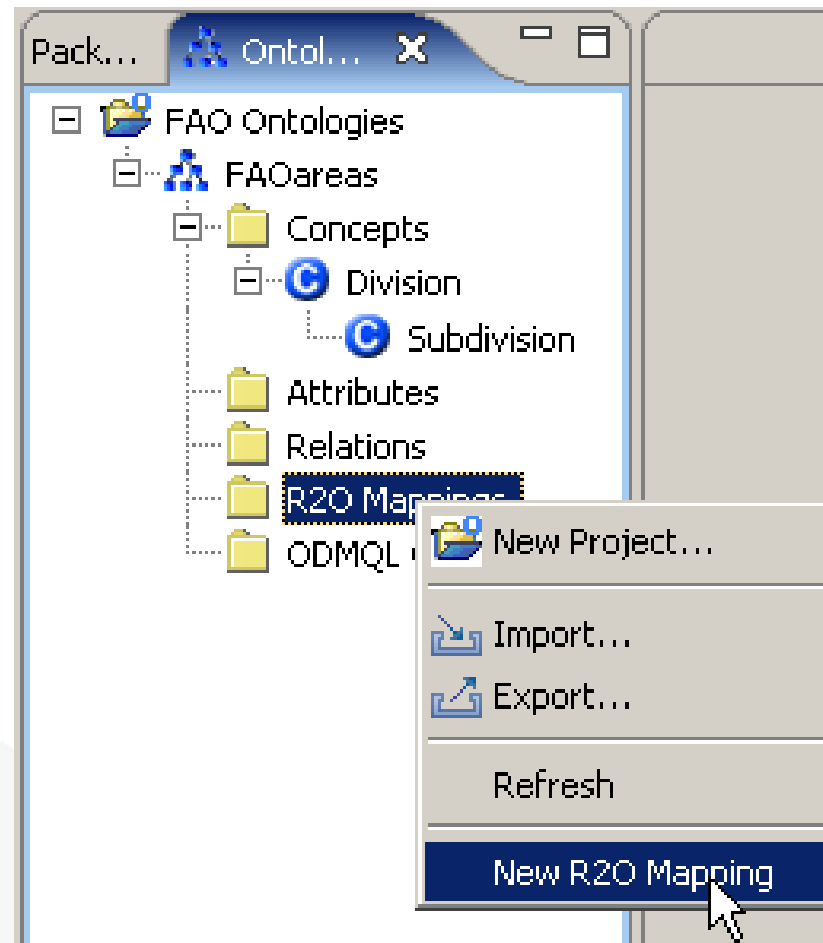
Select Mappings

Click new Mapping

Select Database

Mapping File created

Mapping Editor opens



Create a DB to Ontology mapping

Select Mappings

Click new Mapping

Select Database

Mapping File created

Mapping Editor opens

The screenshot shows the 'ODEMapster Wizard' dialog box, specifically the 'Database Information' step. The dialog has a title bar with a question mark icon, a close button, and the text 'ODEMapster Wizard'. Below the title bar is the section 'Database Information'. The form contains the following fields:

- Database: A dropdown menu with 'MySQL' selected.
- Database name: A text box containing 'figis'.
- Host: A text box containing 'localhost'.
- Port: A text box containing '3306'.
- User: A text box containing 'root'.
- Password: A text box containing four dots (masked).

At the bottom of the dialog, there are four buttons: a help button (question mark), '< Back', 'Next >', and 'Cancel'.

Create a DB to Ontology mapping

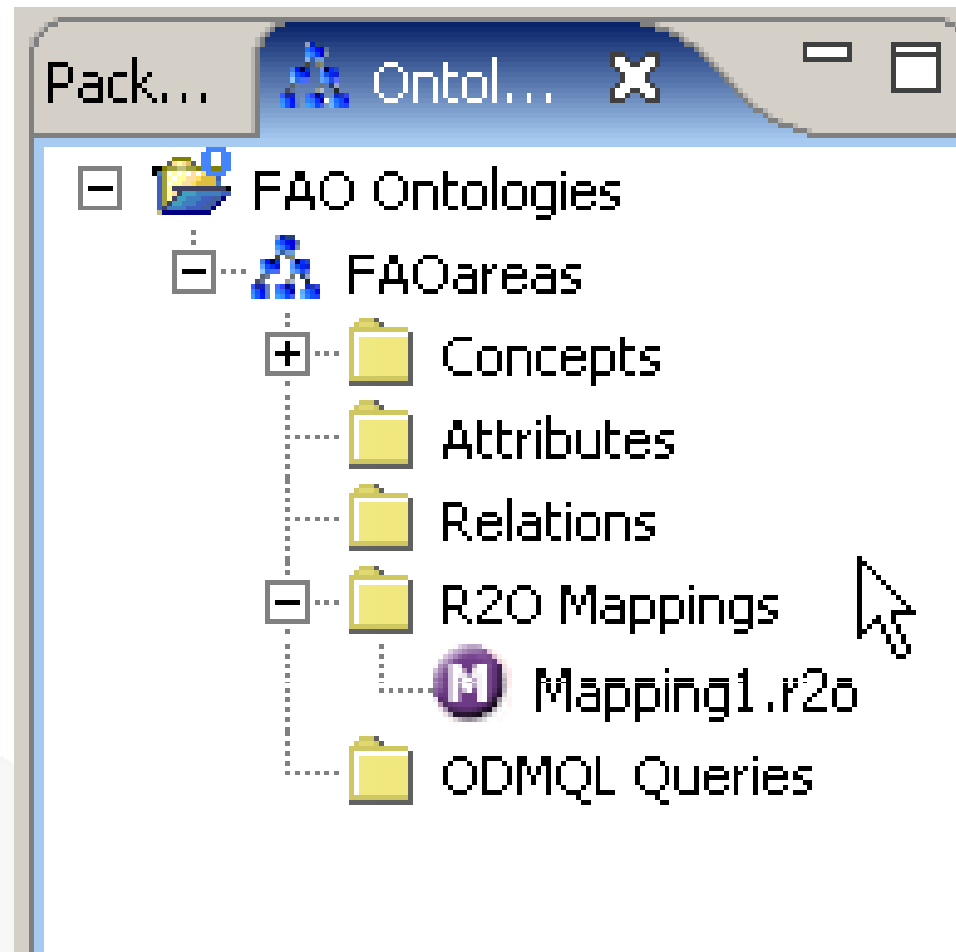
Select Mappings

Click new Mapping

Select Database

Mapping File created

Mapping Editor opens



Create a DB to Ontology mapping

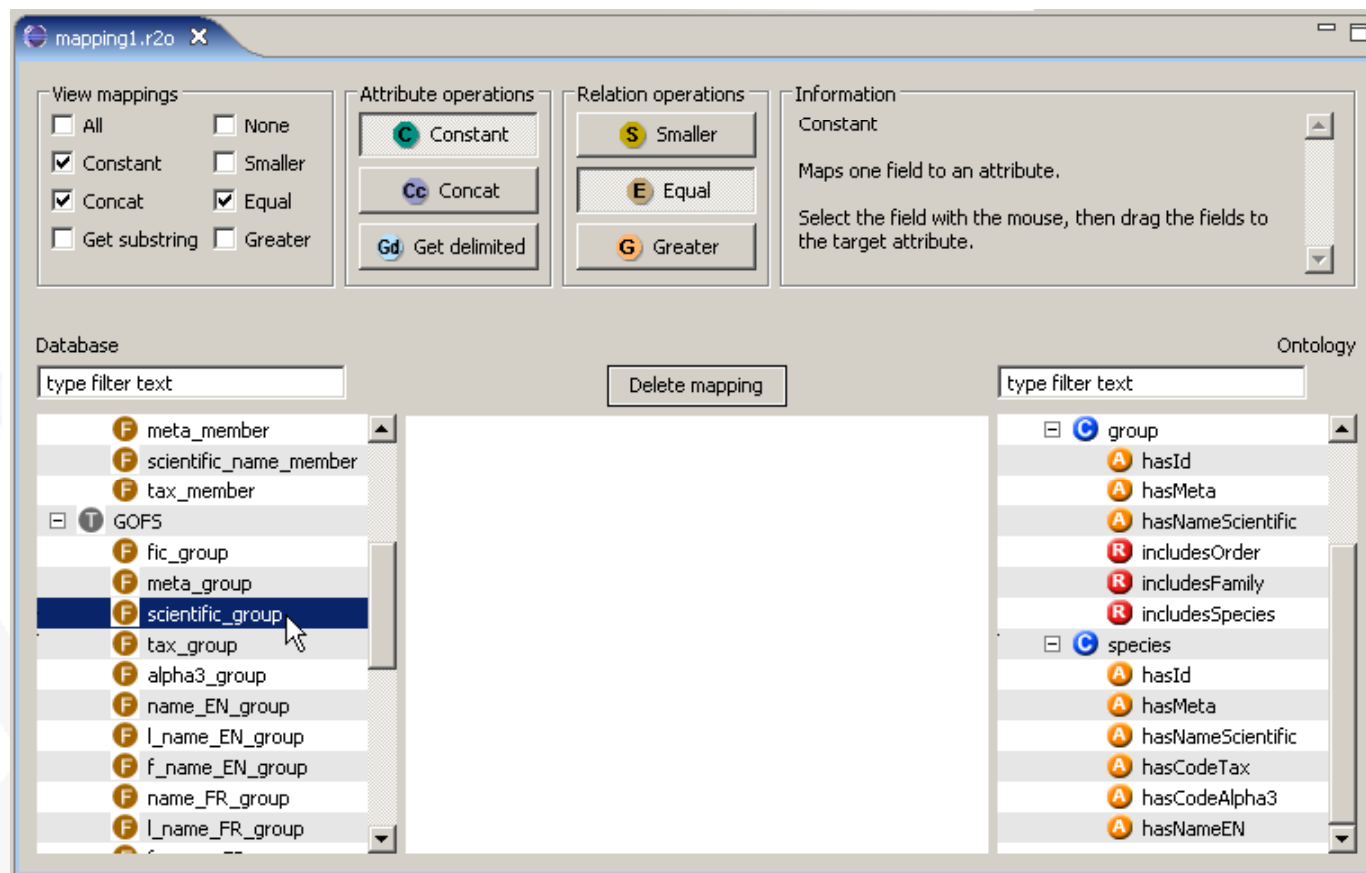
Select Mappings

Click new Mapping

Select Database

Mapping File created

Mapping Editor opens



Create attribute mapping – Constant Operation

Select Field

Drag Field

Drop Field

Mapping established

The screenshot shows the 'mapping1.r2o' application window. At the top, there are four panels: 'View mappings', 'Attribute operations', 'Relation operations', and 'Information'. The 'Attribute operations' panel has the 'Constant' button selected. The 'Information' panel displays the 'Constant' operation details: 'Maps one field to an attribute. Select the field with the mouse, then drag the fields to the target attribute.'

Below these panels are two panes: 'Database' and 'Ontology'. The 'Database' pane shows a list of fields, with 'scientific_group' selected. The 'Ontology' pane shows a list of classes, with 'group' selected. A 'Delete mapping' button is located between the two panes.

Create attribute mapping – Constant Operation

Select Field

Drag Field

Drop Field

Mapping established

The screenshot shows a software interface for creating attribute mappings. At the top, there are four chevron-shaped buttons: 'Select Field' (black), 'Drag Field' (blue), 'Drop Field' (black), and 'Mapping established' (black). Below these is a window titled 'mapping1.r2o'. The window has several panels:

- View mappings:** A grid of checkboxes for 'All', 'None', 'Constant', 'Smaller', 'Concat', 'Equal', 'Get substring', and 'Greater'. 'Constant', 'Concat', and 'Equal' are checked.
- Attribute operations:** Three buttons: 'Constant' (selected with a green 'C' icon), 'Concat' (with a blue 'Cc' icon), and 'Get delimited' (with a blue 'Gd' icon).
- Relation operations:** Three buttons: 'Smaller' (with a yellow 'S' icon), 'Equal' (with a yellow 'E' icon), and 'Greater' (with a yellow 'G' icon).
- Information:** A text box containing the text: 'Constant', 'Maps one field to an attribute.', and 'Select the field with the mouse, then drag the fields to the target attribute.'
- Database:** A list of fields with a search filter 'type filter text'. The 'scientific_group' field is selected and highlighted in blue.
- Ontology:** A tree view of ontology classes. The 'group' class is expanded, showing properties like 'hasId', 'hasMeta', 'hasNameScientific', 'includesOrder', 'includesFamily', and 'includesSpecies'. The 'species' class is also expanded, showing properties like 'hasId', 'hasMeta', 'hasNameScientific', 'hasCodeTax', 'hasCodeAlpha3', and 'hasNameEN'.
- Central workspace:** A large empty area with a 'Delete mapping' button at the top. A 'scientific_group' field is being dragged from the Database panel into this workspace, indicated by a mouse cursor icon.

Create attribute mapping – Constant Operation

Select Field

Drag Field

Drop Field

Mapping established

The screenshot shows the 'mapping1.r2o' application window. At the top, there are four panels: 'View mappings', 'Attribute operations', 'Relation operations', and 'Information'. The 'Attribute operations' panel has the 'Constant' button selected. The 'Information' panel displays the text: 'Constant', 'Maps one field to an attribute.', and 'Select the field with the mouse, then drag the fields to the target attribute.' Below these panels are two panes: 'Database' and 'Ontology'. The 'Database' pane shows a list of fields, with 'scientific_group' selected. The 'Ontology' pane shows a list of classes and their attributes, with 'hasNameScientific' selected under the 'group' class. A 'Delete mapping' button is located between the two panes.

Create attribute mapping – Constant Operation

Select Field

Drag Field

Drop Field

Mapping established

The screenshot shows the 'mapping1.r2o' application window. It features a top toolbar with 'View mappings', 'Attribute operations', 'Relation operations', and 'Information' sections. The 'Attribute operations' section has the 'Constant' button selected. Below the toolbar are two panes: 'Database' on the left and 'Ontology' on the right. The 'Database' pane shows a list of fields including 'scientific_group'. The 'Ontology' pane shows a tree structure with 'group' and 'species' categories, each containing attributes like 'hasId', 'hasMeta', and 'hasNameScientific'. A mapping is established between the 'scientific_group' field in the database and the 'hasId' attribute in the 'group' class of the ontology. A green 'C' icon is placed on the line connecting the two, indicating the 'Constant' operation. A 'Delete mapping' button is located between the two panes. The 'Information' section on the right provides details about the 'Constant' operation: 'Maps one field to an attribute.' and 'Select the field with the mouse, then drag the fields to the target attribute.'

Create attribute mapping - Concat operation



The screenshot shows the 'mapping1.r2o' application window. At the top, there are four panels: 'View mappings' with checkboxes for 'All', 'Constant', 'Concat', 'Get substring', 'None', 'Smaller', 'Equal', and 'Greater'; 'Attribute operations' with buttons for 'Constant', 'Concat', and 'Get delimited'; 'Relation operations' with buttons for 'Smaller', 'Equal', and 'Greater'; and 'Information' with text describing the 'Concat' operation: 'Concatenates two fields. Select the first field with the mouse, then hold down ctrl and select the second field. Now drag the fields to the'. Below these panels are two panes: 'Database' on the left and 'Ontology' on the right. The 'Database' pane shows a tree view with 'GOFS' expanded, listing various group types like 'fic_group', 'meta_group', 'scientific_group', etc. The 'Ontology' pane shows a tree view with 'group' and 'species' expanded, listing attributes like 'hasId', 'hasMeta', 'hasNameScientific', etc. A mapping is being created in the center workspace, indicated by a line connecting a circle on the 'scientific_group' field in the Database pane to a circle on the 'hasNameScientific' field in the Ontology pane. A green 'C' icon is positioned on the line, representing the 'Concat' operation.

Create attribute mapping - Concat operation



The screenshot shows the 'mapping1.r2o' application window. At the top, there are four panels: 'View mappings' with checkboxes for 'All', 'Constant', 'Concat', 'Get substrings', 'None', 'Smaller', 'Equal', and 'Greater'; 'Attribute operations' with buttons for 'Constant', 'Concat', and 'Get delimited'; 'Relation operations' with buttons for 'Smaller', 'Equal', and 'Greater'; and 'Information' with text describing the 'Concat' operation: 'Concatenates two fields. Select the first field with the mouse, then hold down ctrl and select the second field. Now drag the fields to the'. Below these panels are two panes: 'Database' on the left and 'Ontology' on the right. The 'Database' pane shows a tree view with 'GOFS' expanded, listing various group types, with 'alpha3_group' selected. The 'Ontology' pane shows a tree view with 'group' and 'species' expanded, listing various attributes, with 'hasNameScientific' selected. A line connects the 'alpha3_group' field in the Database pane to the 'hasNameScientific' field in the Ontology pane, with a 'C' icon in the middle, indicating the 'Concat' operation.

Create attribute mapping - Concat operation



The screenshot shows the R2O software interface with the following components:

- View mappings:** All, None, Constant, Smaller, Concat, Equal, Get substring, Greater.
- Attribute operations:** Constant, Concat, Get delimited.
- Relation operations:** Smaller, Equal, Greater.
- Information:** Concat. Concatenates two fields. Select the first field with the mouse, then hold down ctrl and select the second field. Now drag the fields to the
- Database:** type filter text. List of fields: meta_member, scientific_name_member, tax_member, GOF5 (expanded), fic_group, meta_group, scientific_group, tax_group, alpha3_group, name_EN_group, l_name_EN_group, f_name_EN_group, name_FR_group, l_name_FR_group.
- Ontology:** type filter text. List of classes: group (expanded), species (expanded).
 - group: hasId (A), hasMeta (A), hasNameScientific (A), includesOrder (R), includesFamily (R), includesSpecies (R).
 - species: hasId (A), hasMeta (A), hasNameScientific (A), hasCodeTax (A), hasCodeAlpha3 (A), hasNameEN (A).
- Mapping:** A line connects the 'scientific_group' field in the Database to the 'hasNameScientific' property in the 'group' class of the Ontology. A green 'C' icon is placed on the line, indicating the 'Concat' operation.

Create attribute mapping - Concat operation



The screenshot shows the 'mapping1.r2o' application window. At the top, there are four panels: 'View mappings' (with checkboxes for All, Constant, Concat, Get substring, None, Smaller, Equal, Greater), 'Attribute operations' (with buttons for Constant, Concat, Get delimited), 'Relation operations' (with buttons for Smaller, Equal, Greater), and 'Information' (describing the Concat operation). Below these is a 'Database' panel with a search box containing 'type filter text' and a list of fields including 'alpha3_group' and 'f_name_EN_group'. To the right is an 'Ontology' panel with a search box containing 'type filter text' and a list of classes including 'group' and 'species'. In the center workspace, a 'Concat' operation (represented by a green 'C' icon) is being established between the 'alpha3_group' field from the Database and the 'f_name_EN_group' field from the Ontology. A 'Delete mapping' button is also visible above the workspace.

Create attribute mapping - Concat operation



The screenshot shows the 'mapping1.r2o' application window. At the top, there are four panels: 'View mappings' (with checkboxes for All, Constant, Concat, Get substring, None, Smaller, Equal, Greater), 'Attribute operations' (with buttons for Constant, Concat, Get delimited), 'Relation operations' (with buttons for Smaller, Equal, Greater), and 'Information' (describing the 'Concat' operation: 'Concatenates two fields. Select the first field with the mouse, then hold down ctrl and select the second field. Now drag the fields to the').

Below these panels are two panes: 'Database' and 'Ontology'. The 'Database' pane shows a list of attributes including 'alpha3_group' and 'f_name_EN_group'. The 'Ontology' pane shows a list of attributes including 'hasMeta' and 'hasNameScientific'. A line with a green 'C' icon connects the 'alpha3_group' attribute in the Database pane to the 'hasMeta' attribute in the Ontology pane. A 'Delete mapping' button is located between the two panes.

Create attribute mapping - Concat operation



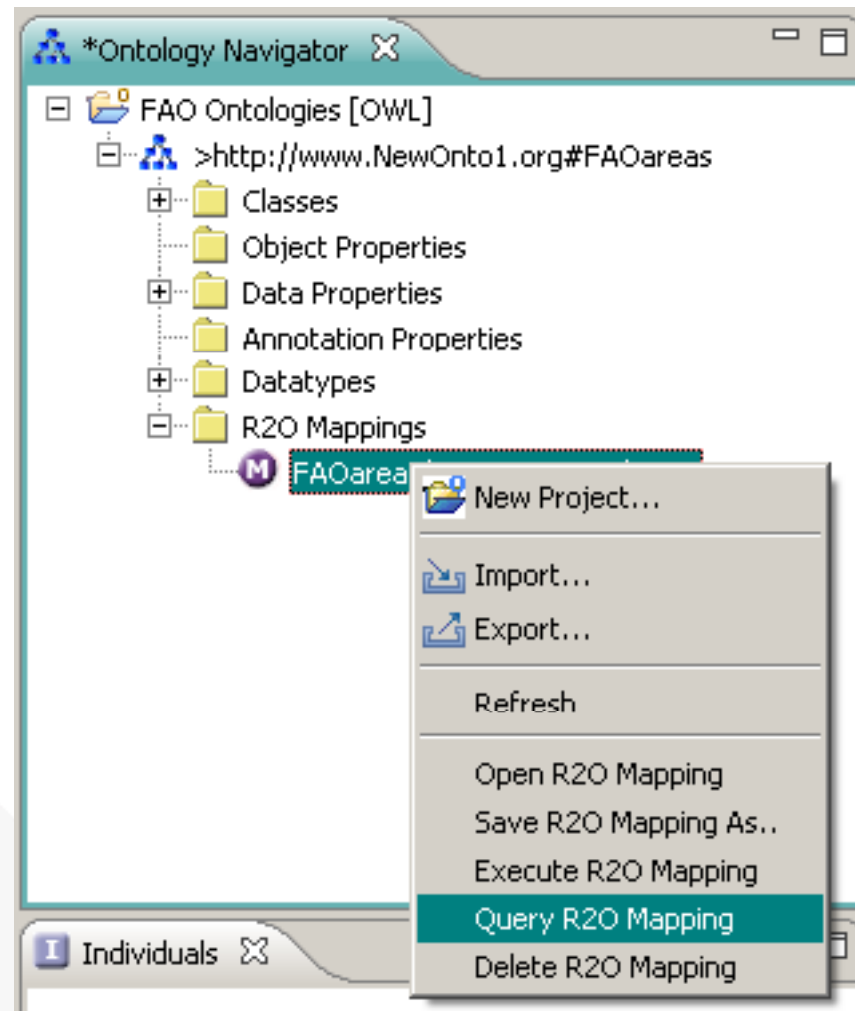
The screenshot shows a software window titled 'mapping1.r2o'. It features several panels: 'View mappings' with checkboxes for 'All', 'Constant', 'Concat', 'Get substrings', 'None', 'Smaller', 'Equal', and 'Greater'; 'Attribute operations' with buttons for 'Constant', 'Concat', and 'Get delimited'; 'Relation operations' with buttons for 'Smaller', 'Equal', and 'Greater'; and an 'Information' panel describing the 'Concat' operation: 'Concatenates two fields. Select the first field with the mouse, then hold down ctrl and select the second field. Now drag the fields to the...'. Below these panels are two panes: 'Database' and 'Ontology'. The 'Database' pane shows a list of fields including 'meta_member', 'scientific_name_member', 'tax_member', and a 'GOFS' group with various 'group' fields. The 'Ontology' pane shows a 'group' class with attributes like 'hasId', 'hasMeta', 'hasNameScientific', and 'includesOrder', and a 'species' class with similar attributes. In the center workspace, a mapping is being created. A green 'C' icon (Concat) is connected to two source fields: 'scientific_group' from the Database and 'hasNameScientific' from the Ontology. A blue 'Cc' icon (Concat) is also connected to two source fields: 'alpha3_group' from the Database and 'hasNameEN' from the Ontology. A 'Delete mapping' button is located between the two panes.

Query the ontology instances

Select Mapping
& Click on Query

Query Editor Opens &
Select ontology elements

Click on Execute query



Query the ontology instances

Select Mapping
& Click on Query

Query Editor Opens &
Select ontology elements

Click on Execute query

The screenshot displays the Query Editor interface with three tabs: FAOareas(200904141151).r2o, FAOareas(200904141150).r2o, and FAOareas(200904141131).r2o. The interface is divided into three main sections:

- Concepts:** A tree view showing a hierarchy where 'group' is expanded to show 'species' selected with a checkmark.
- Attributes and Relations:** A section with two sub-sections:
 - Selection:** Radio buttons for 'Instances only', 'Instances with attributes', 'Instances with relations', 'Instances with both', and 'Custom selection' (which is selected).
 - Attributes and Relations List:** A list of selected elements with checkboxes and labels: 'hasMeta' and 'hasNameScientific' (highlighted with a blue border).
- RDF output:** An 'Execution' section containing three buttons: 'Execute query', 'Save output', and 'Stop execution'.

Query the ontology instances

Select Mapping
& Click on Query

Query Editor Opens &
Select ontology elements

Click on Execute query

The screenshot displays a query editor window with three tabs: 'FAOareas(200904141151).r2o', 'FAOareas(200904141150).r2o', and 'FAOareas(200904141131).r2o'. The interface is divided into three main sections: 'Concepts', 'Attributes and Relations', and 'RDF output'.

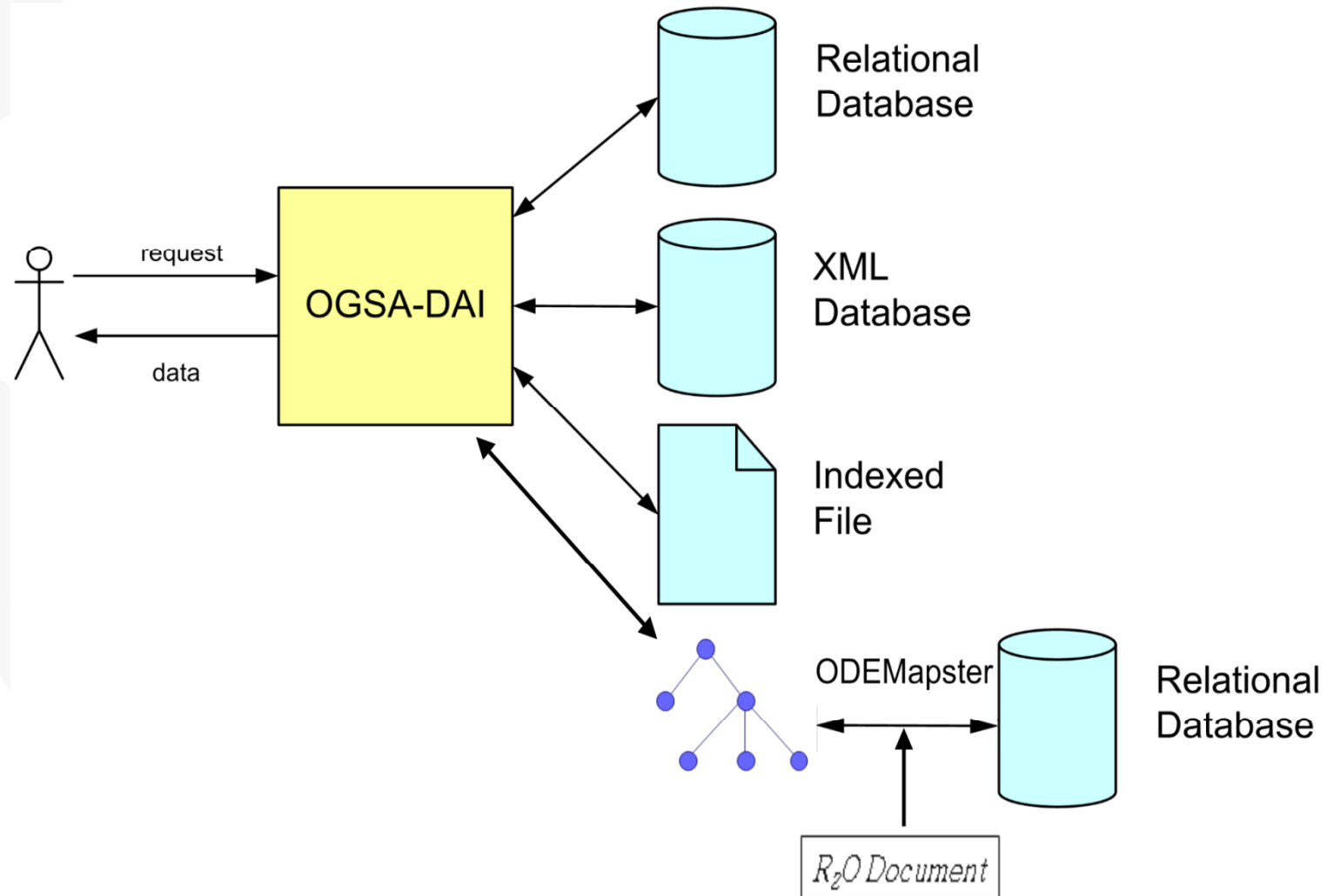
- Concepts:** A tree view showing a 'group' containing a 'species' element, which is selected with a checkmark.
- Attributes and Relations:** A 'Selection' panel with radio buttons for 'Instances only', 'Instances with attributes', 'Instances with relations', 'Instances with both', and 'Custom selection'. Below it, a list of attributes shows 'hasMeta' and 'hasNameScientific' selected with checkmarks.
- RDF output:** An 'Execution' panel with buttons for 'Execute query', 'Save output', and 'Stop execution'. Below the buttons, the resulting RDF output is displayed as a list of XML snippets, each representing a species instance with its name, type, and meta-information.

```
<j.0:hasNameScientific>Spanish artisanal fisheries with set gillnets in the CE...
<rdf:type rdf:resource="http://www.NewOnto1.org#species"/>
</rdf:Description>
<rdf:Description rdf:about="http://www.NewOnto1.org#species300">
  <j.0:hasNameScientific>Stock sud, PÃfÃcherie C de sardine de la zone du C...
  <rdf:type rdf:resource="http://www.NewOnto1.org#species"/>
  <j.0:hasMeta>110000</j.0:hasMeta>
</rdf:Description>
<rdf:Description rdf:about="http://www.NewOnto1.org#species294">
  <rdf:type rdf:resource="http://www.NewOnto1.org#species"/>
  <j.0:hasNameScientific>PÃfÃcherie Nord des senneurs sardiniers cÃfÃtier...
  <j.0:hasMeta>110000</j.0:hasMeta>
</rdf:Description>
<rdf:Description rdf:about="http://www.NewOnto1.org#species344">
  <j.0:hasMeta>110000</j.0:hasMeta>
  <j.0:hasNameScientific>PÃfÃcherie artisanale avancÃfÃe aux poissons c...
  <rdf:type rdf:resource="http://www.NewOnto1.org#species"/>
</rdf:Description>
<rdf:Description rdf:about="http://www.NewOnto1.org#species221">
  <j.0:hasNameScientific>Purse Seine in WCPO Tuna fishery</j.0:hasNameSci...
  <j.0:hasMeta>110000</j.0:hasMeta>
  <rdf:type rdf:resource="http://www.NewOnto1.org#species"/>
</rdf:Description>
```

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- Current approach needs high amount of time
 - Batch mode may be running for a long time
 - Even on demand mode depending on the database length
- WS-DAI Web services specification allows to make synchronous and asynchronous calls
- OGSA-DAI
 - Framework that allows to access, integrate, transform and deliver distributed and heterogeneous sources of data
 - Implements part of the WS-DAI specification
 - Resources, activities and workflows
- Output: stream of RDF data

New Resource (ODEMapster Engine)





R₂O and ODEMapster

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