Master's Thesis

Configurable Schema-Aware RDF Data Input Forms

Dávid Konkoly

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Albert-Ludwigs Universität Freiburg

Department of Computer Science

Chair of Databases and Information Systems

Candidate
Dávid Konkoly
Matr. number
3757311
Working period
18. 10. 2016 – 18. 04. 2017
Examiner
Prof. Dr. Georg Lausen
Supervisor
Victor Anthony Arrascue Ayala

Abstract

Abstract in English

Kurzfassung

Kurzfassung auf Deutsch

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Introduction.
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2.1.1 Introduction

Usually web applications do not consist of one single page, but of several different pages. In order to navigate between the pages of the application, the HTML document contains links that trigger further HTTP requests. Links in HTML can be defined by means of the <a/> tag. The most important parameter of this tag is href, whose value contains the URL of the HTTP request. Let assume that an application's main page is accessible through the URL http://newsPortal.com. Common practice that subpages of the application can be called through various url-mappings, which means the main URL is extended with a keyword that denotes the page to be requested.

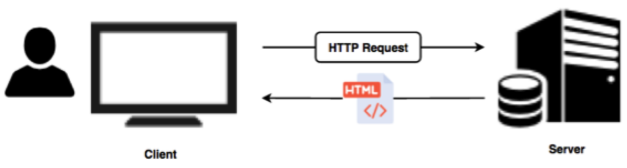
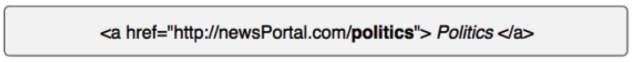


Figure 2.1: Client server communication

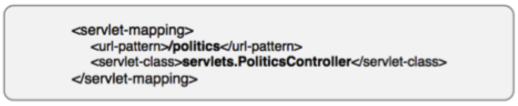
Usually web applications do not consist of one single page, but of several different pages. In order to navigate between the pages of the application, the HTML document contains links that trigger further HTTP requests. Links in HTML can be defined by means of the <a/> tag. The most important parameter of this tag is href, whose value contains the URL of the HTTP request. Let assume that an application's main page is accessible through the URL http://newsPortal.com. Common practice that subpages of the application can be called through various url-mappings, which means the main URL is extended with a keyword that denotes the page to be requested.



```
<a href="http://newsPortal.com/politics"> Politics </a>
```

Figure 2.2: HTML Link

The link in Figure 2 shows the link for the subpage. Programming the server incorporates the task of assignment of the url-mappings to particular classes, which are responsible for the response preparation. In Java web application these responder classes are called servlets an the definition of the mapping-class assignment looks as follows:

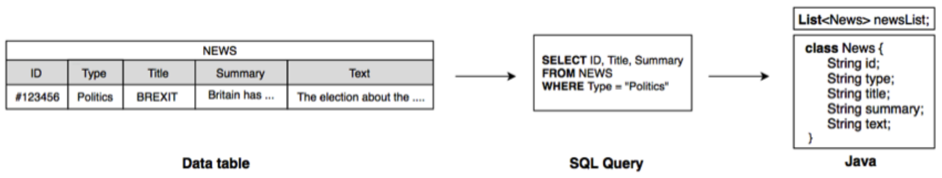


```
<servlet-mapping>
    <url-pattern>/politics</url-pattern>
    <servlet-class>servlets.PoliticsController</servlet-class>
</servlet-mapping>
```

Figure 2.3: Servlet mapping definition in web.xml

A modern web application do not just send static web pages to the client, that contains in this case the political articles, but the articles are stored in a database, and the pages are generated dynamically by substituting the retrieved data into so-called template files. First of all the task of responding requires a query that retrieves that data from the database. By applications using relational data model, the tables and attributes are always modeled by classes of the used object oriented programming (OOP) language. So the data retrieval is the instantiation of the classes in scope.

In our example the news are stored in the NEWS table and the application has a class named News with the same attributes that the table has. Consequently one single row of the table can be stored in an instance of the News class. As the database returns a table with multiple news, thus the resulting Java data will have the type List<News>. Then this in this simple case the list is passed to the template engine together with the template file.



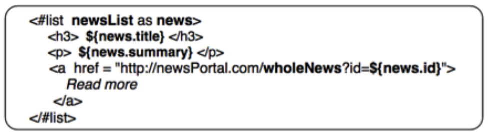
NEWS				
ID	Type	Title	Summary	Text
#123456	Politics	BREXIT	Britain has ...	The election about the ....

```
SELECT ID, Title, Summary
FROM NEWS
WHERE Type = "Politics"
```

```
List<News> newsList;

class News {
    String id;
    String type;
    String title;
    String summary;
    String text;
}
```

Figure 2.4: Data flow



```
<#list  newsList as news>
   <h3>  ${news.title} </h3>
   <p>  ${news.summary} </p>
   <a  href = "http://newsPortal.com/wholeNews?id=${news.id}">
      Read more
   </a>
</#list>
```

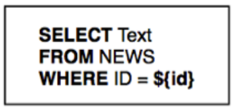
Figure 2.5: Template file

The template file is a description of how the data has to be converted into HTML document. It can be seen that it is possible for instance to declare a list on the input variable newsList. Then the template engine iterates through the News objects and by accessing its fields (title, summary, id) and generates the HTML for each element.

The template file contains the following link

<a href="http://newsPortal.com/wholeNews?id=$news.id" >Read more <a>

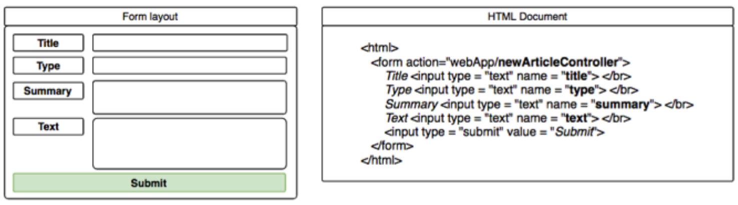
which redirects to the page where the whole article can be seen. To achieve this it is necessary to equip each link with the parameter id that holds the ID of NEWS item, order to inform the server about which article's whole text has to be displayed. Then the servlet class of the mapping /wholeNews has to perform the following query where the id is the input.



```
SELECT Text
FROM NEWS
WHERE ID = ${id}
```

Figure 2.6: SQL query with parameter

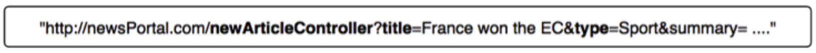
Web applications do not only just display existing data, but they allow the users to enter their new data. In HTML the element used for data input is called form. Form is a container, and it consists of particular form elements according to the data to be added.



```
<html>
  <form action="webApp/newArticleController">
    Title <input type = "text" name = "title"> </br>
    Type <input type = "text" name = "type"> </br>
    Summary <input type = "text" name = "summary"> </br>
    Text <input type = "text" name = "text"> </br>
    <input type = "submit" value = "Submit">
  </form>
</html>
```

Figure 2.7: Form layout and HTML document

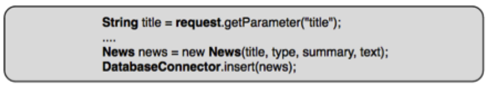
Submitting the form to the server send an HTTP request with multiple parameters, where they are divided through the & character.



```
"http://newsPortal.com/newArticleController?title=France won the EC&type=Sport&summary= ...."
```

Figure 2.8: Request with parameters

By the data entry creation the task of the controller is to get the values from the request an instantiate the class representing the data to be created. Then initialized class instance is passed to the database where the entered data will be persistently stored.



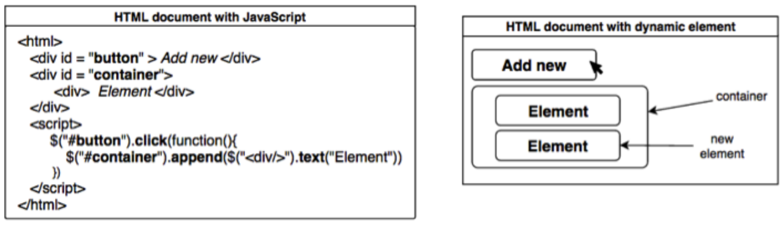
```
String title = request.getParameter("title");
....
News news = new News(title, type, summary, text);
DatabaseConnector.insert(news);
```

Figure 2.9: Example Java routine for data storage

2.1.2 JavaScript

JavaScript (JS) is the programming language of the web browser. A JS code can be embedded into any HTML document between <script></script> tags. The most fundament capability of JS, is that it is capable of manipulating the elements of the web page. The following example illustrates a simple case, where clicking a button can change the page by adding a new div to an other div.

The HTML page contains with two divs with the id-s button and container. JavaScript handles each element on the page as objects. These objects can be referenced by $(“#id”) where the id is the id parameter of


HTML document with JavaScript
HTML document with dynamic element
Add new
Element
Element
container
new element

```
<html>
  <div id = "button" > Add new </div>
  <div id = "container">
      <div>  Element </div>
  </div>
  <script>
     $("#button").click(function(){
        $("#container").append($("<div/>").text("Element"))
     })
  </script>
</html>
```

Figure 2.10: Simple JavaScript example

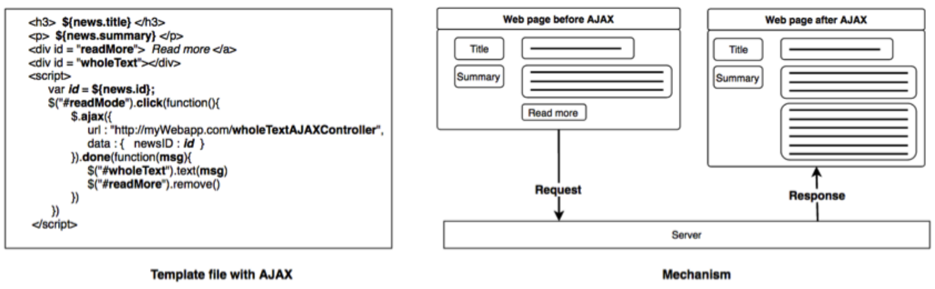
the html tag. Thus the definition of a click event to the first div is done by writing the following code:

$("#button").click(. . . the handler function . . .)

to the script. The added function defines only one single operation, which uses the append function on the $("#container") div object. The input parameter is a new div object, created by JS with the text value Element.

2.1.3 AJAX

AJAX is an abbreviation for Asynchronous JavaScript And XML. This is a technology that allows the web browser to exchange data with the server without reloading the whole page. AJAX calls are initiated from JavaScript and of course JS itself is responsible for handling the response. The following example shows and AJAX based solution for loading the whole text of an article.



```
<h3>  ${news.title} </h3>
<p>  ${news.summary} </p>
<div id = "readMore">  Read more </a>
<div id = "wholeText"></div>
<script>
    var id = ${news.id};
    $("#readMode").click(function(){
          $.ajax({
              url : "http://myWebapp.com/wholeTextAJAXController",
              data : {   newsID : id  }
          }).done(function(msg){
              $("#wholeText").text(msg)
              $("#readMore").remove()
          })
    })
 </script>
```

Figure 2.11: Loading new element through AJAX

The example from the image illustrates extends the previous case so that the click function contains the AJAX call. This call is practically the same as basic request from the <a/> tag in HTML. It has a URL and a data object. The data object in this example consists of only one key-value pair, with the key newsID. The value is the JavaScript variable id, whose own value was set at the beginning of the script part by $news.id template variable. This is the way that Java variables can be passed the JavaScript variables. The done function of the AJAX routine defines what has to be done with the data that arrives. The response data coming from the server is accessible in the msg variable. In the example we assume the server return only the string of the whole text, which will be set as the text of the new div.

2.2 Semantic Web

2.2.1 RDF

In RDF, abbreviation for Resource Description Framework, the information of the web is represented by means of triples. Each triple consists of a subject, predicate and object. The set of triples constitute to an RDF graph, where the subject and object of the triples are the nodes, the predicates are the edges of the graph. An RDF triple is called as well statement, which asserts that there is a relationship defined by the predicate, between subject and the object. The subjects and the objects are RDF resources. A resource can be either an IRI (Internationalized Resource Identifier) or a literal or a blank node (discussed later). A resource represents any physical or abstract entity, while literals hold data values like string, integer or datum. Basically there are two types of triples, the one that links two entities to each other, and the other that links a literal to an entity. The former expresses a relationship between two entities, and the latter in turn assign an attribute to the entity. Common practice is to represent IRI with the notation prefix:suffix, where the prefix represents the namespace, and the expression means the concatenation of the namespace denoted by the prefix, with the suffix. This convention makes the RDF document more readable. The namespace of RDF is the http://www.w3.org/1999/02/22-rdf-syntax-ns#, whose prefix is in most cases "rdf". This is defined on the following way:

@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.

Literals are strings consisting of two elements. The first is the lexical form, which is the actual value, and the second is the data type IRI. RDF uses the data types from XML schema. The prefix (commonly xsd) is the following :

@prefix xsd: «http://www.w3.org/2001/XMLSchema#>.

So a literal value in RDF looks as follows:

"Some literal value"^^xsd:string

The RDF vocabulary provides some built-in IRIs. The two most important are, the rdf:type property, and the rdf:Property class. The meaning of the triples, where the predicate is the property rdf:type is that the subject IRI is the instance of the class denoted by the object. Therefore the following statement holds in the RDF vocabulary:

rdf:type rdf:type rdf:Property.

It is maybe confusing that an IRI appears in a triple as subject and predicate as well, but we will see by the RDFS vocabulary that it is inevitable to express rules of the language. To be able to represent information about a certain domain, it is necessary to extend the RDF vocabulary with properties and classes. The classes will be discussed in the next section, but here it is explained how custom properties can be defined. The namespace of the example is the following:

@prefix eg: <http://example.org#>.

The example dataset intends to express information about people, which university they attend and how old are them. To achieve this two properties are needed:

eq:attends rdf:type rdf:Property .
eq:age rdf:type rdf:Property .

The actual data about a person:

eg:JanKlein eq:attends eq:UniversityOfFreiburg .
eg:JanKlein eq:age "21"^^xsd:integer .

2.2.2 RDF Schema

The previous section gave an insight into RDF world by showing how can information stored by means of triples. However the explanation did not mention that each RDF dataset has to have scheme, which is also called ontology. The ontology describes the set of properties and classes and how are they are related to each other. RDFS provides a mechanism to define such ontologies using RDF triples. The most important elements of the RDFS vocabulary can be seen on the following image.

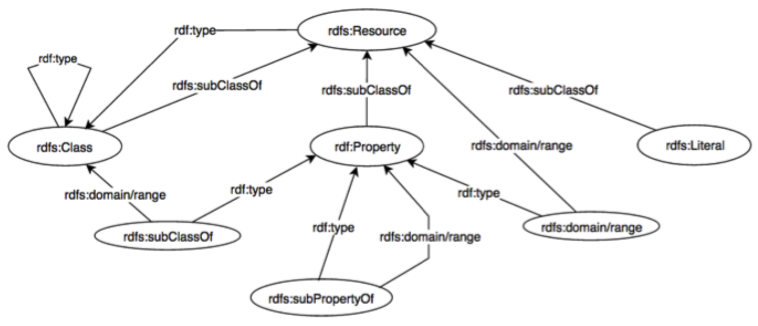


Figure 2.12: Main structure of the RDFS vocabulary

The two most important classes in the RDFS vocabulary is the rdfs:Class and the rdfs:Resource. The rdfs:Class is class, because it is the instance of itself, and the same way the rdfs:Resource is a class. The rdf:Propery and the rdfs:Literal are both classes as well. The rdfs:domain, rdfs:range, rdfs:subPropertyOf and rdfs:subClassOf are properties. Important to note that these properties are subjects and predicates in the same time in the RDFS vocabulary graph. Also they describe themselves like rdf:type. The properties rdfs:domain and rdfs:range describe for the property the type of the subject and object respectively, which with it can build a triple as predicate. The following image illustrates their meaning:

Since both the rdfs:domain and rdfs:range are properties themselves, they have as well their domain and range, which is the class rdfs:Resource. The property rdfs:subClassOf expresses subclass relationship between classes. It means if a class B is a subclass of class A, and resource R is the instance of class B, then resource R is the instance of class A as well. Since it describes the relationship between two classes its both domain and range is

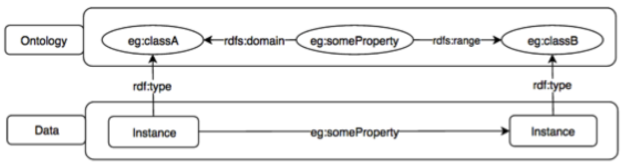


Figure 2.13: RDFS domain and range definition

the class rdfs:Class. The property rdf:subPropertyOf expresses the relationship between two properties. If property P2 is sub property of P1 and two instances are related by P2 then they are related by P1 as well. Its domain and range is the class rdf:Property. Now everything is given to define the ontology for the example of the previous section.

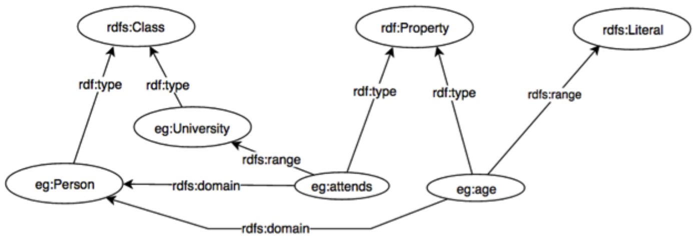


Figure 2.14: RDFS domain and range definition

2.2.3 OWL

OWL, abbreviation for Ontology Web Language is an extension of the RDFS vocabulary. OWL allows expressing additional constraints on the data, above the range and domain definitions. These constraints are called restrictions. Restrictions are conventionally expressed by blank nodes. Blank nodes do not have IRIs, but it is defined through the triples in which they participate as a subject. For example a restriction stating that the instances of the class eg:FootballTeam can build a triple through the eg:hasPlayer property only with the instances of eg:FootballPlayer class can be expressed the following way:

```
eg:FootballTeam rdfs:subClassOf  [
        rdf:type                owl:Restriction ;
        owl:onProperty         eg:hasPlayer ;
        owl:allValuesFrom      eg:FootballPlayer ] .
}
```

Listing 2.1: OWL restriction in N3 format

owl:Restriction is class and owl:onProperty and owl:allValuesFrom are properties. It can be seen that class, on which the restriction applies is the subclass of the restriction blank node. Furthermore OWL is capable of expressing qualified cardinality restriction. For example the statement that a basketball team has to have exactly five players, look as follows in OWL:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX eg: <http://example.org>

eg:BasketballTeam rdfs:subClassOf  [
        rdf:type        owl:Restriction ;
        owl:onProperty  eg:hasPlayer ;
        owl:onClass       eg:Player ;
        owl:qualifiedCardinality "5"^^xsd:nonnegativeInteger ] .
```

Listing 2.2: OWL restriction in N3 format

These two examples cover the thesis related features of OWL. The next image depicts the OWL vocabulary.

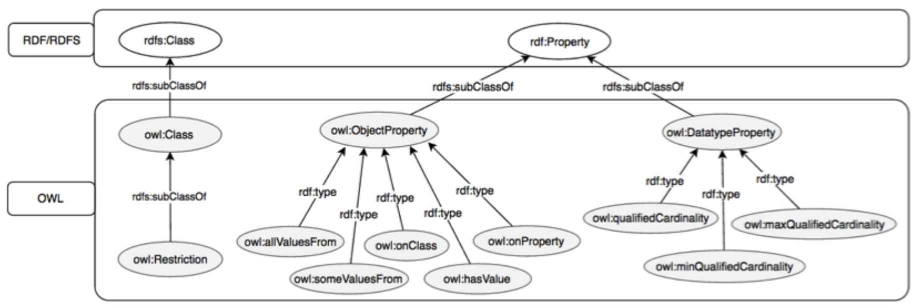


Figure 2.15: A subset of OWL vocabulary

There are two new class types are the owl:Class and the owl:Restriction. The rdf:Property has two subclasses, the owl:ObjectProperty and owl:DataTypeProperty. owl:ObjectProperty represent the properties that links instances to instances, and the owl:DataTypeProperty is those that link instances to literals. The following two images shows the domain and range definitions of the OWL properties used to describe restrictions.

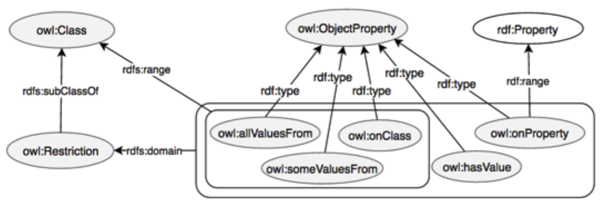


Figure 2.16: OWL object properties

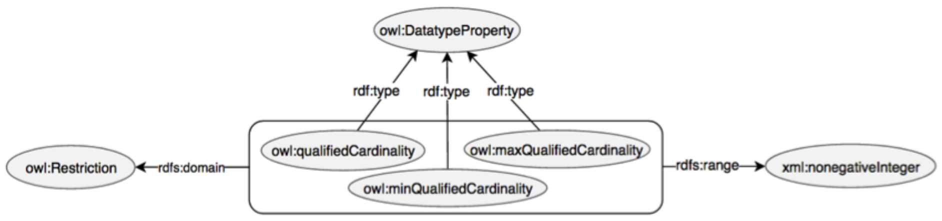


Figure 2.17: Properties for qualified cardinalities

2.2.4 SPARQL

SPARQL is a query language for querying data in RDF graphs. A SPARQL query is a definition of a graph pattern through variables and constants. The following example query returns all IRIs that represent a football player:

```
SELECT ?player
WHERE {
        ?player         rdf:type                 eg:FootballPlayer .}
}
```

Listing 2.3: SPARQL Query

In the example the query consist of only one triple. The subject is a variable and the predicate and the object are constant. Therefore the triple store looks all the triples and checks the predicate is rdf:type and the object is eg:FootballPlayer. It is well possible to not just ask the IRI of the players but further information by adding additional triples to the query in order to ask the name for example of the player:

```
SELECT ?player ?name
WHERE {
?player         rdf:type                eg:FootballPlayer .
?player         eg:name                 ?name .
}
```

Listing 2.4: SPARQL Query

The result table in this case will contain two columns, one with the IRI of the person and one with their name. Important that it is as well possible to query blank nodes by introducing a variable for it. So if we want to list all the instances that are coming into question as player to a football team we can formulate the following query:

```
SELECT ?person ?name
WHERE {
eg:FootballTeam rdfs:subClassOf         ?restriction .
?restriction    rdf:type                owl:Restriction .
?restriction    owl:onProperty          eg:hasPlayer .
?restriction    owl:allValuesFrom       ?playerType .
?player         rdf:type                ?playerType .
?player eg:name ?name . }
```

Listing 2.5: SPARQL Query

2.3 VIVO Framework

VIVO is an open source web application framework, developed particularly for browsing and editing RDF data. VIVO utilizes that the data scheme in RDF is stored by means of triples as well, and it can adopt the pages to the ontology. It offers an ontology editor and there are particular features of the application that can be customized through a specific configuration dataset. This dataset is in RDF too, and describes the way in which the data is displayed and edited on the web pages. VIVO allows to manipulate this configuration triples via the web interface, which enables the extension of the application to some extent conveniently without coding. Finally there is a possibility to import any RDF file to VIVO's triple store.

2.3.1 Class groups

One important feature of the VIVO framework is the possibility to order the classes of the ontology into so-called class groups. If a class is assigned to a class group then it appears in the list of the admin panel, which is used to select the type of the new instance.

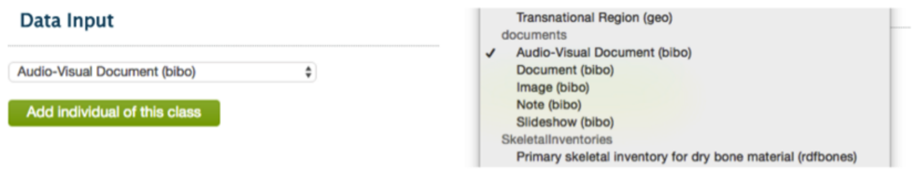

Data Input
Audio-Visual Document (bibo)
Add individual of this class
Transnational Region (geo)
documents
✓ Audio-Visual Document (bibo)
Document (bibo)
Image (bibo)
Note (bibo)
Slideshow (bibo)
SkeletalInventories
Primary skeletal inventory for dry bone material (rdfbones)

Figure 2.18: Document class group on the admin panel

Further possibility of class groups that it is possible to create links on the main menu (can be seen on the top of Figure 16), which redirects to a page where all the instances are listed that belong to one of the classes of the class group.

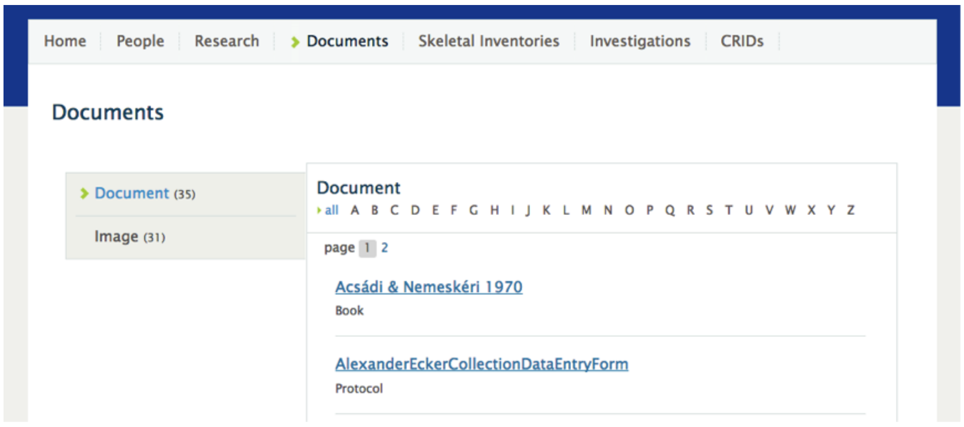


Figure 2.19: VIVO class group page for documents

The application configuration showed in the last two images is defined by the following set of configuration triples.

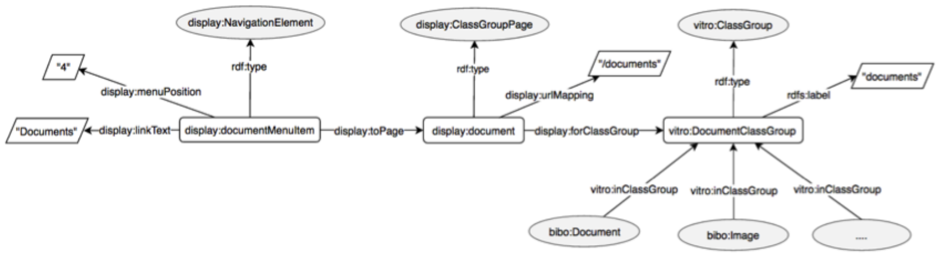
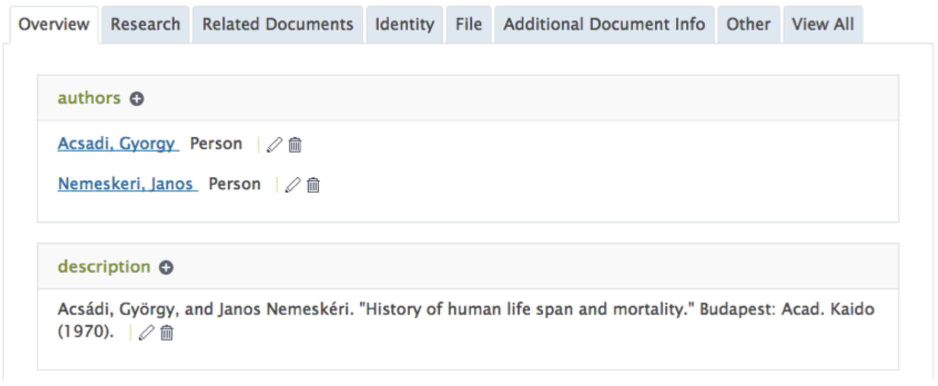


Figure 2.20: RDF configuration data in VIVO

There are three instances of the classes display:NavigationElement, display:ClassGroupPage and for vitro:ClassGroup. The triples itself are self-explanatory, but important to note that property vitro:inClassGroup is the one that connects the configuration dataset to the domain ontology.

2.3.2 Profile Pages

A profile pages in VIVO displays information about a particular RDF instance. These pages can be reached from the list on the class group pages. The profile page organizes the information into tabs. Each tab displays the properties of a specific property group. The next image shows a screenshot from the profile page under the Overview tab.



authors

Acsadi, Gyorgy Person

Nemeskeri, Janos Person

description

Acsádi, György, and Janos Nemeskéri. "History of human life span and mortality." Budapest: Acad. Kaido (1970).

Figure 2.21: VIVO profile page layout

As it was already addressed this page adopts to the ontology by querying the properties whose domain or range is the type of the instance to display. The properties bibo:author and vivo:description are assigned to the property group overview, and they appear on the page only because the both have the domain bibo:Document class.

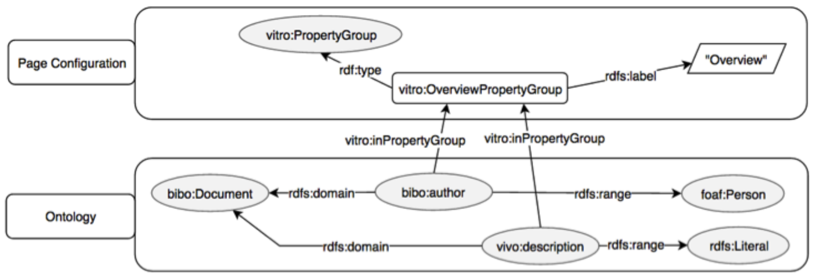


Figure 2.22: Triples contributing to the displayed profile page layout

2.3.3 Default Data Entry Forms

On Figure 21, next to the predicate labels (authors, description) there are plus image elements, which are a links. These links redirect the user to data entry forms where new triple can be added.

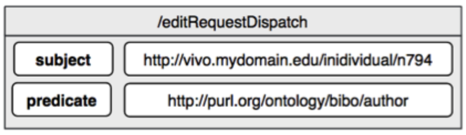
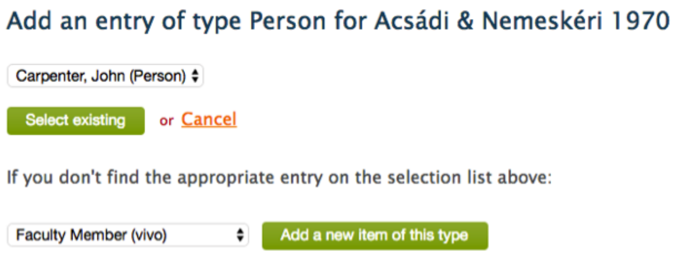

/editRequestDispatch
subject
http://vivo.mydomain.edu/inidividual/n794
predicate
http://purl.org/ontology/bibo/author

Figure 2.23: HTTP request for data entry form

They initiate the HTTP request depicted on Figure 23. The server gets with which subject and predicate the triple has to be created.

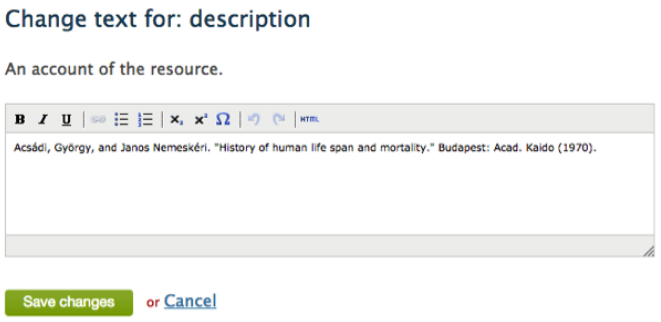
The subject of the triple is the instance; from whose the profile page the request has been initiated. The predicate is the property to which the link belongs. The data entry forms allows the user to set the object of this triple. By the property bibo:author the domain is the class foaf:Person, thus application offers each existing instance of this class to select, or allows to add a new instance as an object.

In the case of the property vivo:description, the domain is the class rdfs:Literal thus the entry form displays a text input field.


Add an entry of type Person for Acsádi & Nemeskéri 1970

If you don't find the appropriate entry on the selection list above:

Figure 2.24: Object property entry form for bibo:author


Change text for: description

An account of the resource.

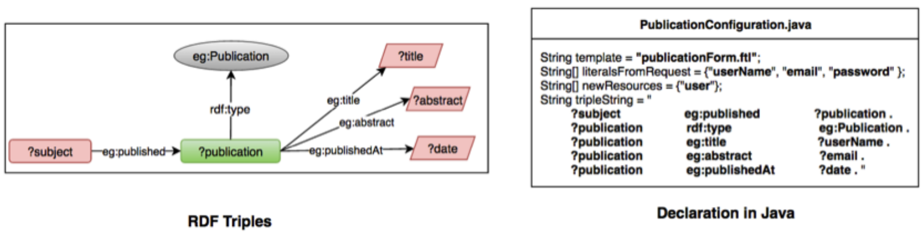
Acsádi, György, and Janos Nemeskéri. "History of human life span and mortality." Budapest: Acad. Kaido (1970).

Figure 2.25: Data property entry form

2.3.4 Custom Entry Forms

VIVO allows the editing of the triples through default entry forms only one by one. However it is often the case that it desired to add multiple triples, thus larger dataset by one entry form. This is as well possible in VIVO through custom entry form definition. Let assume an entry form, which let the user add new publications to person instance. About the publication its title, abstract and the date of publishing can be stored. The left part of following image shows dataset of the example. The red nodes denote the variables that are coming as input from the entry form; the green means that its value has to be an unused IRI, and the grey stands for constants.

The variable ?subject is the instance from whose profile page entry form was called. To declare the information held by the graphical representation of the triples from Figure 25, three static Java variables are needed. Two arrays of string for the inputs and new resources (literalsFromRequest, newResources) and a string for the triples (tripleString). Moreover the con-



```
String template = "publicationForm.ftl";
String[] literalsFromRequest = {"userName", "email", "password" };
String[] newResources = {"user"};
String tripleString = "
        ?subject            eg:published          ?publication .
        ?publication        rdf:type               eg:Publication .
        ?publication        eg:title               ?userName .
        ?publication        eg:abstract            ?email .
        ?publication        eg:publishedAt         ?date . "
```

Figure 2.26: Data definition graphical (left) and lexical (right)

figuration class has an additional variable for defining the template file for the form layout (VIVO uses Freemarker template engine, and the .ftl extension stands for Freemarker Template File). The last step towards the definition of the custom entry form is to connect the property eg:Published with the predicate vitro:customEntryFormAnnotation to the literal value that holds the name of the entry form configuration class.

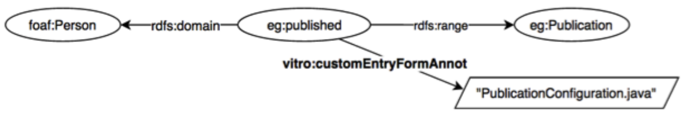


Figure 2.27: Definition of custom entry form configuration class

Chapter 3

Problem Statement

3.1 Challanges of the RDFBones project

3.1.1 Human skeleton

The subject of the anthropological investigations is primarily human skeletal remains. To be able to create data about these remains, first of all an ontology is required. As the human skeleton is complex, the ontology is not developed by us, but an existing have been taken. The used ontology is the subset of FMA (Foundation Model of Anatomy) ontology. For us the two most important classes are the following:

- Subdivision of skeletal system - fma:85544
- Bone Organ – fma:5018

The class Bone Organ is the superclass of all bones in the human skeleton. Each bone belongs to a skeletal subdivision and a skeletal subdivision can be a part of another skeletal subdivision. This relationship in both case is expressed by the property fma:systemic_part_of. To define which bone organ belongs to which skeletal subdivision FMA uses OWL restrictions.

The most important skeletal subdivision for our project is the skull. Skull has the peculiarity that it consists not directly of bones but two of other subdivisions, which consists of the Bone Organ subclasses.

The following image illustrates then the data structure of skull.

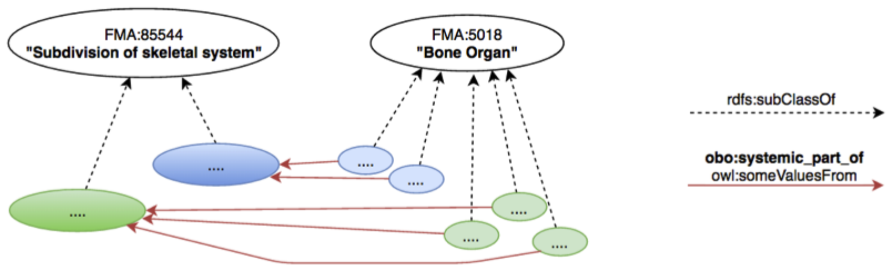


Figure 3.1: Ontology structure for skeleton

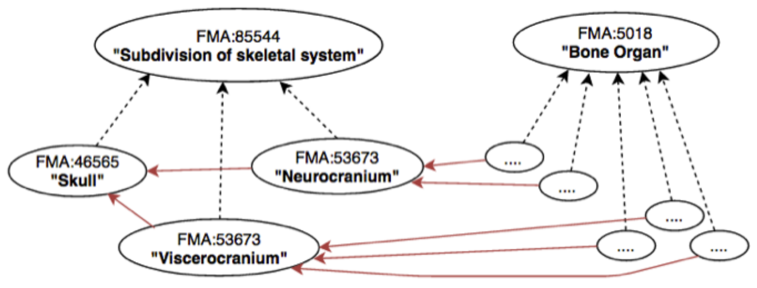


Figure 3.2: FMA scheme for skull

To implement an entry form that allows the user to create such triple set takes considerably more effort then the cases explained in the previous sections, because not only key value pairs has to be sent from the client to the server, but a multi dimensional dataset.

3.1.2 Ontology Extensions

It is often the case that in an investigation not only the bone itself, but also particular segments has to be addressed. However the bone segments of the bones are not standard, and they can differ according to researcher or research project. Therefore FMA do not contain any bone segment of the bone organs, and consequently we have to define it on our own. Important that the skeletal subdivision instances do not appear on the dataset on their own, but they are connected to Skeletal Inventories. Skeletal inventories are used to gather information about particular skeletal remains. The following

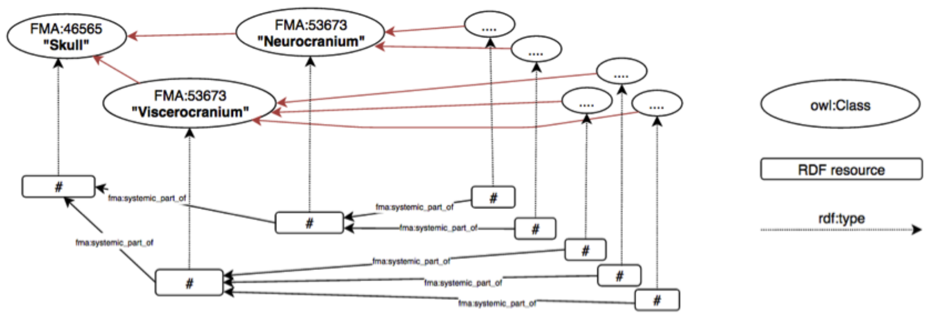


Figure 3.3: RDF Triple representation of a skull

image show the triple structure of skeletal inventories.

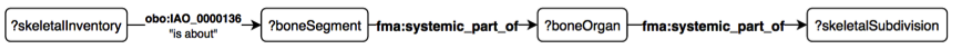
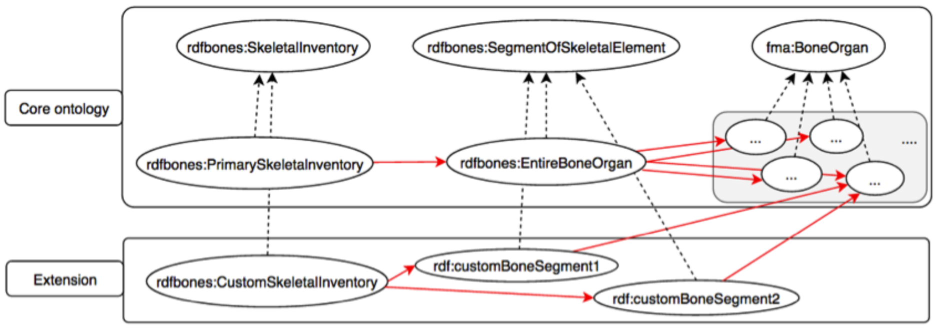


Figure 3.4: Skeletal Inventory Data Structure

The variable ?skeletalInventory is the instance of the class rdfbones:SkeletalInventory, while the ?boneSegment is from the class rdfbones:SegmentOfSkeletalElement. The core ontology of the project contains a subclass of the rdfbones:SkeletalInventory, the rdf:PrimarySkeletalInventory. This skeletal inventory type is for skeletal remain collections where only the whole bone organs have to be addressed. The way to define custom bone segments is always through a custom skeletal inventories, which contains restrictions on the property obo:isAbout and on the class of custom bone segments. Of course the custom bone segments has to be assigned to the bone organ class they belong to, via restrictions on property obo:systemic_part_of. The following image illustrates the extension definition.

As these extensions are expressed by OWL restriction the application can query the definitions. Consequently if the custom entry form is called from the profile of a skeletal inventory instance, then the entry form processor routine can ask, what bone segment are defined to the type of the subject variable coming as input, and can offer them on the interface.



Core ontology
Extension
rdfbones:SkeletalInventory
rdfbones:SegmentOfSkeletalElement
fma:BoneOrgan
rdfbones:PrimarySkeletalInventory
rdfbones:EntireBoneOrgan
rdfbones:CustomSkeletalInventory
rdf:customBoneSegment1
rdf:customBoneSegment2

Figure 3.5: Ontology extension scheme

3.1.3 Study Design Execution

In most investigations the researcher take a set of bones belong to one individual and examine different tokens. Tokens refer to specific features of parts or regions of bones. These token have particular expressions.

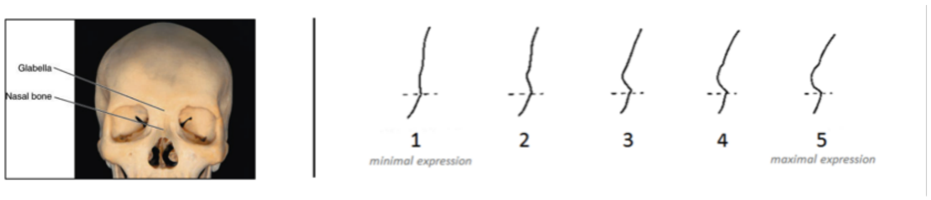


Figure 3.6: Glabella and its expressions

The previous images show the token called glabella, and its expressions. The task of the web application is let the researcher select one of the already added Nasal Bones (because on that bone is the glabella token), and set the expression of it. The following data structure models the process.

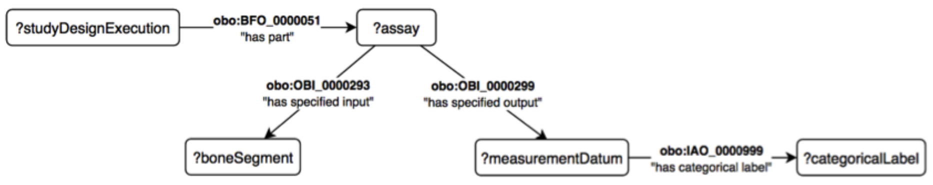


Figure 3.7: Study Design Execution Data Structure

Where the variable ?categoricalLabel represents the expression of the token. The values this variable can take are defined in the ontology extension. The variable ?boneSegment is the bone on which the glabella can be found. This instance won't be as well newly created, but an already added bone has to be selected on the interface. The ?assay and the ?meausurementDatum variables are new instances. To be able to generate an entry form for the problem, the following ontology extension has to be defined.

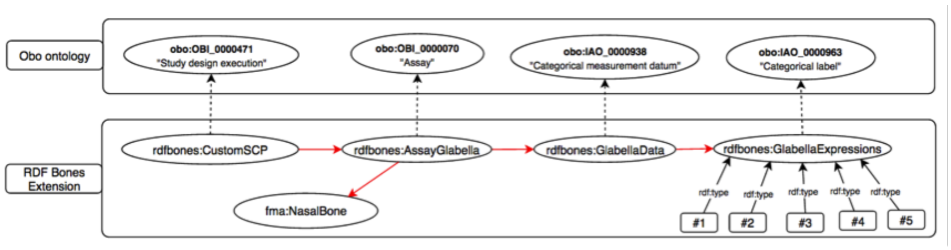


Figure 3.8: Ontology extension for Glabella

3.2 RDF Data input

3.2.1 Multi dimensional form

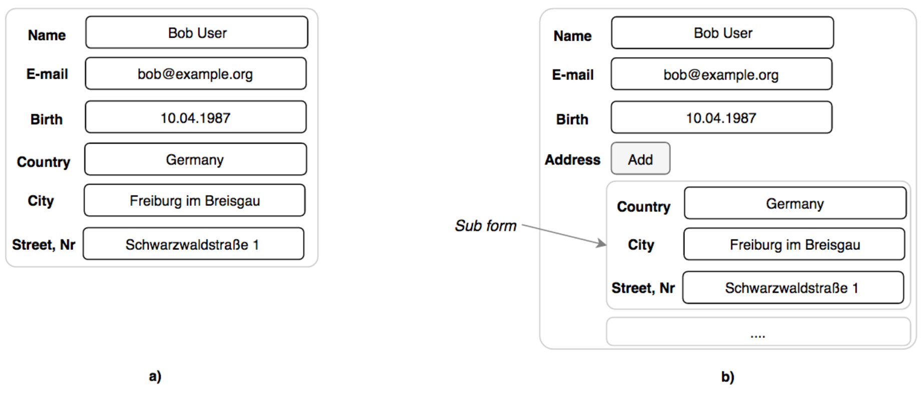
Imagine a problem of registering a new user to a web portal. The form offers the fields for name, e-mail address, birth, and address. The address consists of three fields, of the country city and the street-nr field. The following image illustrates two types of user registry form. The first (a) is single form, which consists of the six fields. It has been already discussed in the Preliminaries.

It is possible to add multiple arrays.

This requires a JavaScript routine that initiates the sub forms.

3.2.2 Existing instance dependencies

- By form loading we need to ask the existing countries
- Then by the selection of country of other field has to be updated according to the constraint



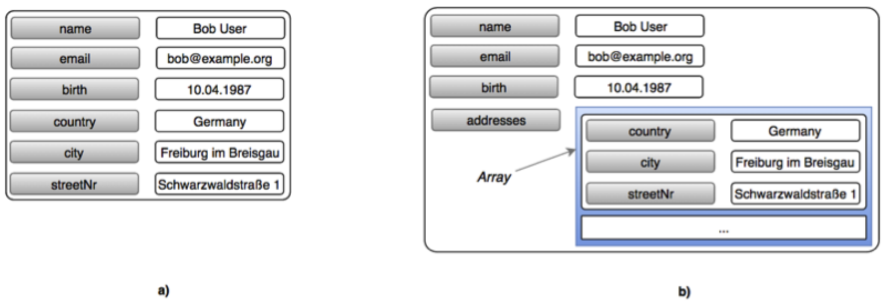
Name Bob User
E-mail bob@example.org
Birth 10.04.1987
Country Germany
City Freiburg im Breisgau
Street, Nr Schwarzwaldstraße 1

a)

Name Bob User
E-mail bob@example.org
Birth 10.04.1987
Address Add
Country Germany
City Freiburg im Breisgau
Street, Nr Schwarzwaldstraße 1
....

b)

Figure 3.9: Single vs. multi dimensional form



name Bob User
email bob@example.org
birth 10.04.1987
country Germany
city Freiburg im Breisgau
streetNr Schwarzwaldstraße 1

a)

name Bob User
email bob@example.org
birth 10.04.1987
addresses
country Germany
city Freiburg im Breisgau
streetNr Schwarzwaldstraße 1
...

b)

Figure 3.10: JSON object for multi dimensional forms

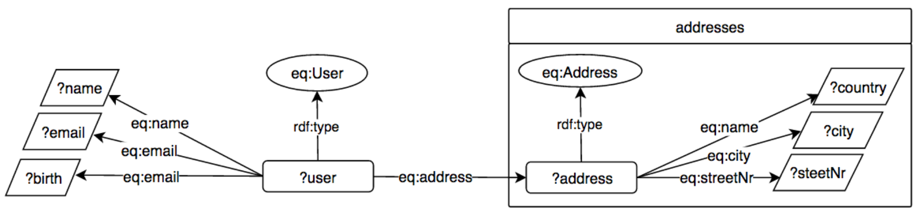


Figure 3.11: Data model

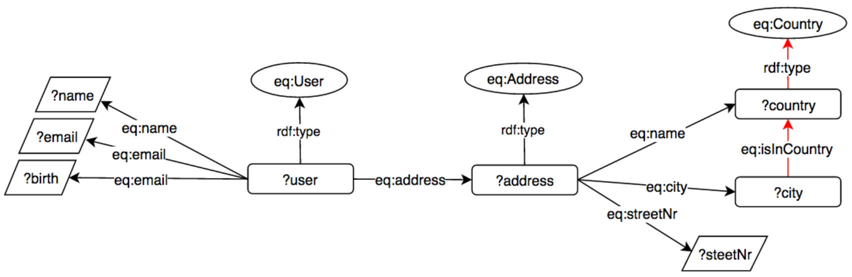


Figure 3.12: Instance selection and dependency

Chapter 4

Implementation

4.1 Architecture

Chapter 5

Evaluation

5.1 Experiments

5.2 Results

Chapter 6

Conclusion

Write here you conclusions

6.1 Future work

Appendix A

Glossary

Just comment `\input{AppendixA-Glossary.tex}` in Masterthesis.tex if you don't need it!

Symbols

$	US. dollars.

A

A	Meaning of A.

B

C

D

P

Q

R

S

T

U

V

W

X

Appendix B

Appendix

B.1 Something you need in the appendix

Just comment `\input{AppendixB.tex}` in Masterthesis.tex if you don't need it!

Erklaerung

Hiermit erkläre ich, dass ich diese Abschlussarbeit selbständig verfasst habe, keine anderen als die angegebenen Quellen/Hilfsmittel verwendet habe und alle Stellen, die wörtlich oder sinngemäß aus veröffentlichten Schriften entnommen wurden, als solche kenntlich gemacht habe. Darüber hinaus erkläre ich, dass diese Abschlussarbeit nicht, auch nicht auszugsweise, bereits für eine andere Prüfung angefertigt wurde.

Ort, Datum	Unterschrift

Bibliography

[1] Marcelo Arenas, Claudio Gutierrez, and Jorge Pérez. On the semantics of sparql. In *Semantic Web Information Management*, pages 281–307. 2009.