veritas iustitia libertas

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D2R MAP

A Database to RDF Mapping Language

The vision of the Semantic Web is to give data on the web a well-defined meaning by representing it in RDF and linking it to commonly accepted ontologies. Most formatted data today is stored in relational databases. To be able to use this data on the Semantic Web, we need a flexible but easy to use mechanism to map relational data into RDF. This poster presents D2R MAP, a declarative language to describe mappings between relational database schemata and OWL ontologies.

Language Features

- Flexible mapping of complex relational structures without having to change existing database schema.
- Handling of highly normalized table structures, where instance data is spread over several tables.
- References to resources and blank nodes created on the fly.
- Support for multivalued class properties and RDF containers like rdf:Bag, rdf:Alt or rdf:Seq.
- Support for XML datatypes and xml:lang attributes.
- Property value transformations using patterns and value substitution tables.

d2r:ClassMap

ClassMaps are used to map the result of a SQL query to a class or to a group of similar classes. An example of a group of similar classes are different subclasses of a person class, all with similar properties, e.g. Student, Researcher, Professor, PhDStudent, Employee.	
Id	ID of the ClassMap. Used to refer to the map with d2r:referredClass attributes.
type	URI of an OWL Class, defining the rdf:type property of the instances created.
sql	SQL-Statement used for selecting data from the database.
groupBy	Column or column list used to group the rows of the result set. All rows with the same groupBy column values are used to create one instance.
uriColumn	Database column containing instance URIs.
uriPattern	Pattern to create instance URIs.

d2r:DatatypePropertyBridge

A DatatypePropertyBridge defines a bridge between a column of the result set and a literal property of the instances created.	
property	Qualified name of the property.
column	Column name in the result set.
pattern	Pattern to create the property value.
value	Adds an additional property with a fixed value to all instances of the class.
translate	Id of a d2r:TranslationTable used to translate values of the result set to property values.
xml:lang	Language identifier, e.g. "de", "en".
datatype	XML datatype URI.
UseCollection	Instructs the processor to use a RDF collection for multiple values of a single property. Options are: rdf:Bag, rdf:Alt, rdf:Seq.

d2r:ObjectPropertyBridge

ObjectPropertyBridge defines a bridge between a column of the result set and an object property of the instances created.	
property	Qualified name of the property.
column	Column name in the result set.
pattern	Pattern to create the property value.
value	Adds an additional property with a fixed value to all instances of the class.
translate	Id of a d2r:TranslationTable used to translate values of the result set to property values.
referredClass	Reference to a d2r:ClassMap. The referredClass attribute is used to refer to dynamically created instances.
referredGroupBy	Column or columnlist to identifiy the target instances of the referedClass.
useCollection	Instructs the processor to use a RDF collection for multiple values of a single property. Options are: rdf:Bag, rdf:Alt, rdf:Seq.

Processor Prototype

- Exports data as RDF, N3, N-TRIPLES and Jena models.
- Compliant with all relational databases offering JDBC or ODBC access.
- Implemented in Java, based on the Jena API.
- Available under GNU LGPL license.

The processor can be used

- in a servlet environment to dynamically publish XHTML pages containing RDF.
- as a database connector in applications working with Jena models.
- as a command line tool.

Example

The following example illustrates the use of a D2R MAP to export data about authors and their publications from a database into RDF.

D2R MAP

```
<?xml version="1.0"?>
<d2r:Map xmlns:d2r="http://www.wiwiss.fu-berlin.de/suhl/bizer/D2RMap/0.1#">
   <d2r:DBConnection d2r:odbcDSN="bookDB"/>
   <d2r:ProcessorMessage d2r:outputFormat="RDF/XML"/>
   <d2r:Namespace d2r:prefix="ex" d2r:namespace="http://example.org#"/>
   <d2r:Namespace d2r:prefix="rdf" d2r:namespace="http://www.w3.org/1999/02/22-rdf-syntax-ns#"/>
   <d2r:ClassMap d2r:type="ex:Book" d2r:sql="SELECT isbn, title FROM books;" d2r:groupBy="isbn"
       d2r:uriPattern="ex:book@@isbn@@">
       <d2r:DatatypePropertyBridge d2r:property="ex:title" d2r:column="title" xml:lang="en"/>
   </d2r:ClassMap>
   <d2r:ClassMap d2r:type="ex:Author" d2r:sql="SELECT authors.aid, name, URL, isbn
       FROM authors, bookauthor WHERE authors.aid = bookauthor.aid;" d2r:groupBy="authors.aid">
       <d2r:DatatypePropertyBridge d2r:property="ex:fullname" d2r:column="name"/>
       <d2r:ObjectPropertyBridge d2r:property="ex:homepage" d2r:column="URL"/>
       <d2r:ObjectPropertyBridge d2r:property="ex:autor_of" d2r:referredClass="ex:Book" d2r:referredGroupBy="isbn">
   </d2r:ClassMap>
</d2r:Map>
```

Database tables

authors

aid	name	url
1	David Flanagan	http://www.davidflanagan.com/
2	William Crawford	http://teamjava.com/members/tjc0302.html

books

isbn	title
596001525	Java Enterprise in a Nutshell (2nd Edition)
596002831	Java in a Nutshell, Fourth Edition

bookauthors

isbn	aid
596001525	1
596001525	2
596002831	1

RDF Output

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:ex="http://example.org#">
   <rdf:Description rdf:nodeID="A0">
       <rdf:type rdf:resource="http://example.org#Author"/>
       <ex:fullname>David Flanagan</ex:fullname>
       <ex:homepage rdf:resource="http://www.davidflanagan.com/"/>
       <ex:autor_of rdf:resource="http://example.org#book596001525"/>
       <ex:autor_of rdf:resource="http://example.org#book596002831"/>
   </rdf:Description>
   <rdf:Description rdf:nodeID="A1">
       <rdf:type rdf:resource="http://example.org#Author"/>
       <ex:fullname>William Crawford</ex:fullname>
       <ex:homepage rdf:resource="http://teamjava.com/members/tjc0302.html"/>
       <ex:autor_of rdf:resource="http://example.org#book596001525"/>
   </rdf:Description>
   <rdf:Description rdf:about="http://example.org#book596001525">
       <rdf:type rdf:resource="http://example.org#Book"/>
       <ex:title xml:lang="en">Java Enterprise in a Nutshell (2nd Edition)</ex:title>
   </rdf:Description>
   <rdf:Description rdf:about="http://example.org#book596002831">
       <rdf:type rdf:resource="http://example.org#Book"/>
       <ex:title xml:lang="en">Java in a Nutshell, Fourth Edition</ex:title>
   </rdf:Description>
</rdf:RDF>
```

The Mapping Process