Resource Description Framework (RDF) Model

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Overview

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What is RDF?

- RDF is the foundation for processing metadata (data about data).
- It provides interoperability between applications that exchange machine-understandable information on the Web.
- It emphasizes facilities to enable automated processing of Web resources.
- Its syntax uses the Extensible Markup Language [XML].

Goals of RDF

- To make it possible to specify semantics for data based on XML in a standardized, interoperable manner.
- To define a mechanism for describing resources that makes no assumptions about a particular application domain, nor defines (a priori) the semantics of any application domain.
**Basic RDF Model**

- RDF is like a object-oriented programming and modeling system.
- An RDF model resemble an entity-relationship diagram.
- The RDF data model is a syntax-neutral way of representing RDF expressions.
- The data model representation is used to evaluate equivalence in meaning.

**Basic RDF Model (contd.)**

The basic data model consists of three object types:

- Resources-all things being described by RDF expressions.
- Properties- a specific aspect, characteristic, attribute, or relation used to describe a resource.
- Statements-A specific resource together with a named property plus the value of that property for that resource. The three individual parts of a statement:
  - Subject
  - Predicate
  - Object
Sample RDF Model

Sentences: The individual referred to by employee id 85740 is named Ora Lassila and has the email address lassila@w3.org. The resource http://www.w3.org/Home/Lassila was created by this individual.

RDF Model:

```
http://www.w3.org/Home/Lassila
```

```
Name
```

```
Email
```

```
Ora Lassila
```

```
lassila@w3.org
```

RDF Model (contd).

- RDF/XML form of the sentence:

```
<rdf:RDF>
  <rdf:Description about="http://www.w3.org/Home/Lassila">
    <s:Creator>
      <rdf:Description about="http://www.w3.org/staffId/85740">
        <v:Name>Ora Lassila</v:Name>
        <v:Email>lassila@w3.org</v:Email>
      </rdf:Description>
    </s:Creator>
  </rdf:Description>
</rdf:RDF>
```
Containers and Container Model

- RDF Containers are used to hold a collection of resources.
- A common use of containers is as the value of a property.
- RDF defines three types of container objects:
  - Bag-An unordered list of resources or literals
  - Sequence-An ordered list of resources or literals.
  - Alternative-A list of resources or literals that represent alternatives for the (single) value of a property.

Simple Bag Container

Sentence: *The students in course 6.001 are Amy, Tim, John, Mary, and Sue.*
Simple Alternative Container

Sentence: The source code for X11 may be found at ftp.x.org, ftp.cs.purdue.edu, or ftp.eu.net.

Modeling Statements

- Statements are made about resources.
- RDF can be used for making statements about other RDF statements - higher order statements.
- To make higher order statement we need to build a model of the original statement; this model is a new resource to which we can attach additional properties.
A model of a statement is the resource we need in order to be able to make new statements (higher-order statements) about the modeled statement.

To model statements RDF defines the following properties:

- Subject -identifies the resource being described.
- Predicate -identifies the original property.
- Object -identifies the property value.
- Type -its value describes the type of new resource.

Reification-Modeling the original statement as a resource with 4 properties.

Consider sentence:

*Ralph Swick says that Ora Lassila is the creator of the resource* http://www.w3.org/Home/Lassila.

To model the example we could attach another property to the reified statement (say, "attributedTo") with an appropriate value (in this case, "Ralph Swick").
Using base-level RDF/XML syntax, this could be written as

```xml
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:a="http://description.org/schema/">
  <rdf:Description>
    <rdf:subject resource="http://www.w3.org/Home/Lassila"/>
    <rdf:predicate resource="http://description.org/schema/Creator"/>
    <rdf:object>Ora Lassila</rdf:object>
    <rdf:type resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#Statement"/>
    <a:attributedTo>Ralph Swick</a:attributedTo>
  </rdf:Description>
</rdf:RDF>
```
The RDF data model is defined formally as follows:
- There is a set called Resources.
- There is a set called Literals.
- There is a subset of Resources called Properties.
- There is a set called Statements, each element of which is a triple of the form \{pred, sub, obj\}
  Where pred is a property (member of Properties), sub is a resource (member of Resources), and obj is either a resource or a literal (member of Literals).

**Sample Formal RDF Model**

Sentence: *Ora Lassila is the creator of the resource http://www.w3.org/Home/Lassila*

Graphical representation:

```
http://www.w3.org/Home/Lassila creator Ora Lassila
```

Corresponding Triple:
\{creator, [http://www.w3.org/Home/Lassila], "Ora Lassila"\}
Non-Binary Relations in RDF

To represent higher arity relations in RDF using just binary relations:
- use an intermediate resource with additional properties of this resource giving the remaining relations. For example:

Statement: The cost of the book 0201000237 is $45.00

RDF Model:

RDF/XML form of the statement:

```xml
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:s="http://www.schemas.org/Units/>
  <rdf:Description about="urn:ISBN:0-201-00023-7">
    <s:price rdf:parseType="Resource">
      <rdf:value>45.00</rdf:value>
      <s:units rdf:resource="http://www.schemas.org/Units/USdollar"/>
    </s:price>
  </rdf:Description>
</rdf:RDF>
```
Content hiding for RDF inside HTML

- Since RDF is well-formed XML, it can be directly included in HTML.

- Browsers will render any exposed string content - anything that appears between the ">" that ends one tag and the "<" that begins the next tag.

Sample RDF code:
```xml
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc="http://purl.org/metadata/dublin_core#">
  <rdf:Description about="http://www.foo.com/cool.html">
    <dc:Creator>
      <rdf:Seq ID="CreatorsAlphabeticalBySurname">
        <rdf:li>Mary Andrew</rdf:li>
        <rdf:li>Jacky Crystal</rdf:li>
      </rdf:Seq>
    </dc:Creator>
  </rdf:Description>
</rdf:RDF>
```
Content hiding for RDF inside HTML (contd.)

- RDF code with no exposed content

```xml
<rdf:RDF
   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
   xmlns:dc="http://purl.org/metadata/dublin_core#">
   <rdf:Description about="http://www.foo.com/cool.html">
     <dc:Creator>
       <rdf:Seq ID="CreatorsAlphabeticalBySurname"
                rdf:_1="Mary Andrew"
                rdf:_2="Jacky Crystal"/>
     </dc:Creator>
   </rdf:Description>
</rdf:RDF>
```

References

- The W3C’s RDF home page at http://www.w3.org/RDF/.
- www.cs.rpi.edu/~puninj/XMLJ/classes/
QUESTIONS ?