RDF und OWL

Wissenspräsentation im Semantic Web
Structure

1. Introduction
2. RDF: Resource Description Framework
3. RDF Schema
4. OWL: Web Ontology Language
2. RDF: Resource Description Framework

2.1. Key Concepts of RDF
2.2. Three views of a statement
2.3. RDF: Not mentioned
2.4. RDF: Summary
2.1. Key Concepts of RDF

- **Resources:**
  The objects we want to talk about

- **Properties:**
  Relations between resources

- **Statements:**
  Statements assert the properties of the resources
2.2. Three views of a statement

**Example**: Discrete Mathematics is taught by David Billington.

**Graph model:**

```
Discrete Mathematics --> David Billington
```

Is-taught-by
2.2. Three views of a statement

Object-attribute-value triple =
• Resource-property-resource/literals
• Subject-predicate-object

2.2. Three views of a statement

**XML-based syntax:**

```xml
<?xml version="1.0" encoding="UTF-16"?>
<rdf:RDF
   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
   xmlns:mydomain="http://www.mydomain.org/my-rdf-ns">
  <rdf:Description rdf:about="Discrete Mathematics">
    <mydomain:isTaughtBy>
      David Billington
    </mydomain:isTaughtBy>
  </rdf:Description>
</rdf:RDF>
```
2.3. RDF: Not mentioned

- Reification: Statements about statements
- Datatypes
- Nested Descriptions
- rdf:type
- Container Elements: rdf:Bag, rdf:Seq, rdf:Alt
- rdf:List
2.4. RDF: Summary

- RDF provides a foundation for representing and processing metadata.
- It is a universal language that lets users define resources using their own vocabulary.
- Decentralized philosophy: Incremental building of knowledge, and its sharing and reuse are possible.
3. RDF Schema

3.1. Importance of RDF Schema
3.2. Basic Ideas of RDF Schema
3.3. RDF/RDFS: Example
3.1. Importance of RDF Schema

Example:

```xml
<academicStaffMember>Grigoris Antoniou</academicStaffMember>
<pre>Michael Maher</pre>
<course name="Discrete Mathematics">
  <isTaughtBy>David Billington</isTaughtBy>
</course>
```

Xpath: //academicStaffMember
3.2. Basic Ideas of RDF Schema

- Resources: Individual objects
- Classes: Types of objects
  They are used to restrict the domain/range of a property.
- Instances:
  Individual objects that belong to a class
3.2. Basic Ideas of RDF Schema

Key concepts of RDFS:
- Class and subclass relations
- Property and subproperty relations
- Domain and range restrictions

Syntax: The XML-based syntax of RDF
→ an RDFS document is an RDF document
3.3. RDF/RDFS: Example

- **Course**: involves
- **isTaughtBy**: domain
- **range**
  - **subPropertyOf**
  - **subClassOf**
- **Professor**: involves
- **Associate Professor**: involves
- **Assistant Professor**: involves
- **Academic Staff Member**: involves
- **Discrete Mathematics**: involves
- **David Billington**: involves
- **type**
- **RDF**
- **RDFS**
4. OWL: Web Ontology Language

4.1. Ontology Languages
4.2. Description Logics
4.3. OWL constructors and axioms
4.4. Syntax of OWL
4.5. Three species of OWL
4.6. OWL: Summary
4.1. Ontology Languages

Gruber:
„An ontology is an explicit specification of a conceptualisation“

Conceptualisation = abstract model
Explicit specification = the model should be specified in some unambiguous language
4.2. Description Logics

- Description Logics are a family of knowledge representation languages.
- Logic offers
  - a formal language
  - a well-understood formal semantics
  - automated reasoners can deduce conclusions from the given knowledge
4.3. OWL constructors and axioms

Example:
An African Wildlife Ontology
4.3. OWL constructors and axioms

```xml
<rdf:RDF
 xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
 xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
 xmlns:owl="http://www.w3.org/2002/07/owl#"
 xmlns="http://www.mydomain.org/african">

<owl:Ontology rdf:about=""
  <owl:VersionInfo>My example version 1.2</owl:VersionInfo>
  <owl:imports
    rdf:resource="http://www.mydomain.org/animals"/>
</owl:Ontology>
```
4.3. OWL constructors and axioms

Class
subClassOf
equivalentClass

<owl:Class rdf:ID="plant"
  <rdfs:comment>Plants form a class</rdfs:comment>
</owl:Class>
4.3. OWL constructors and axioms

<owl:Class rdf:ID="tree">
   <rdfs:comment>
      Trees are a type of plants
   </rdfs:comment>
   <rdfs:subClassOf rdf:resource="#plant"/>
</owl:Class>
4.3. OWL constructors and axioms

unionOf  intersectionOf
complementOf  disjointWith

<owl:Class rdf:ID="animal">
  <rdfs:comment>
    Animals form a class disjoint from plants
  </rdfs:comment>
  <owl:disjointWith="#plant"/>
</owl:Class>
4.3. OWL constructors and axioms

Property
subPropertyOf
equivalentProperty

<owl:ObjectProperty rdf:ID="eats">  
  <rdfs:domain rdf:resource="#animal"/>  
</owl:ObjectProperty>
4.3. OWL constructors and axioms

SymmetricProperty
TransitiveProperty
FunctionalProperty
inverseOf

<owl:TransitiveProperty rdf:ID="isPartOf"/>
<owl:ObjectProperty rdf:ID="eatenBy">
  <owl:inverseOf rdf:resource="#eats"/>
</owl:ObjectProperty>
4.3. OWL constructors and axioms

- allValuesFrom
- someValuesFrom
- hasValue
- minCardinality
- maxCardinality
4.3. OWL constructors and axioms

<owl:Class rdf:ID="carnivore">  
  <rdfs:comment>
    Carnivores are exactly those animals that eat animals
  </rdfs:comment>
  <owl:intersectionOf rdf:parseType="Collection">
    <owl:Class rdf:about="#animal"/>
    <owl:Restriction>
      <owl:onProperty rdf:resource="#eats"/>
      <owl:someValuesFrom rdf:resource="#animal"/>
    </owl:Restriction>
  </owl:intersectionOf>
</owl:Class>
</rdf:RDF>
4.4. Syntax of OWL

- XML-based syntax of RDF
- XML-based syntax which does not follow the RDF conventions
- Abstract syntax which is used in the language specification document (more compact and readable)
- Graphical syntax which is based on the UML language
4.5. Three species of OWL

- *OWL Full* uses all the entire language.
- *OWL DL* restricts the way in which the constructors from OWL and RDF can be used.
- *OWL Lite* limits OWL DL to a subset of the language constructors.
4.6. OWL: Summary

- OWL builds upon RDF and RDFS.
- Downward compatibility only for OWL Full
- Formal semantics and reasoning support is provided by using Description Logics.
- Semantics of knowledge are machine-accessible
- Proposed standard for Web ontologies
- Is less more?
Literature

G. Antoniou, F. v. Harmelen:  
*A Semantic Web Primer*  

S. Staab, R. Studer (Ed.):  
*Handbook on Ontologies*  
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