RDF und OWL

Wissenspräsentation
im Semantic Web

Structure

1. Introduction
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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

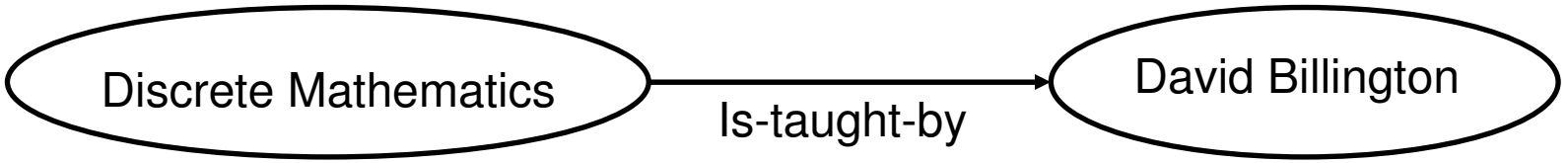
2.1. Key Concepts of RDF

- 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:



2.2. Three views of a statement

Object-attribute-value triple =

- Resource-property-resource/literals
- Subject-predicate-object

(“Discrete Mathematics“,
http://www.mydomain.org/is-taught-by,
“David Billington“)

2.2. Three views of a statement

XML-based syntax:

```
<?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:

<academicStaffMember>Grigoris Antoniou
</academicStaffMember>

<professor>Michael Maher</professor>

<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

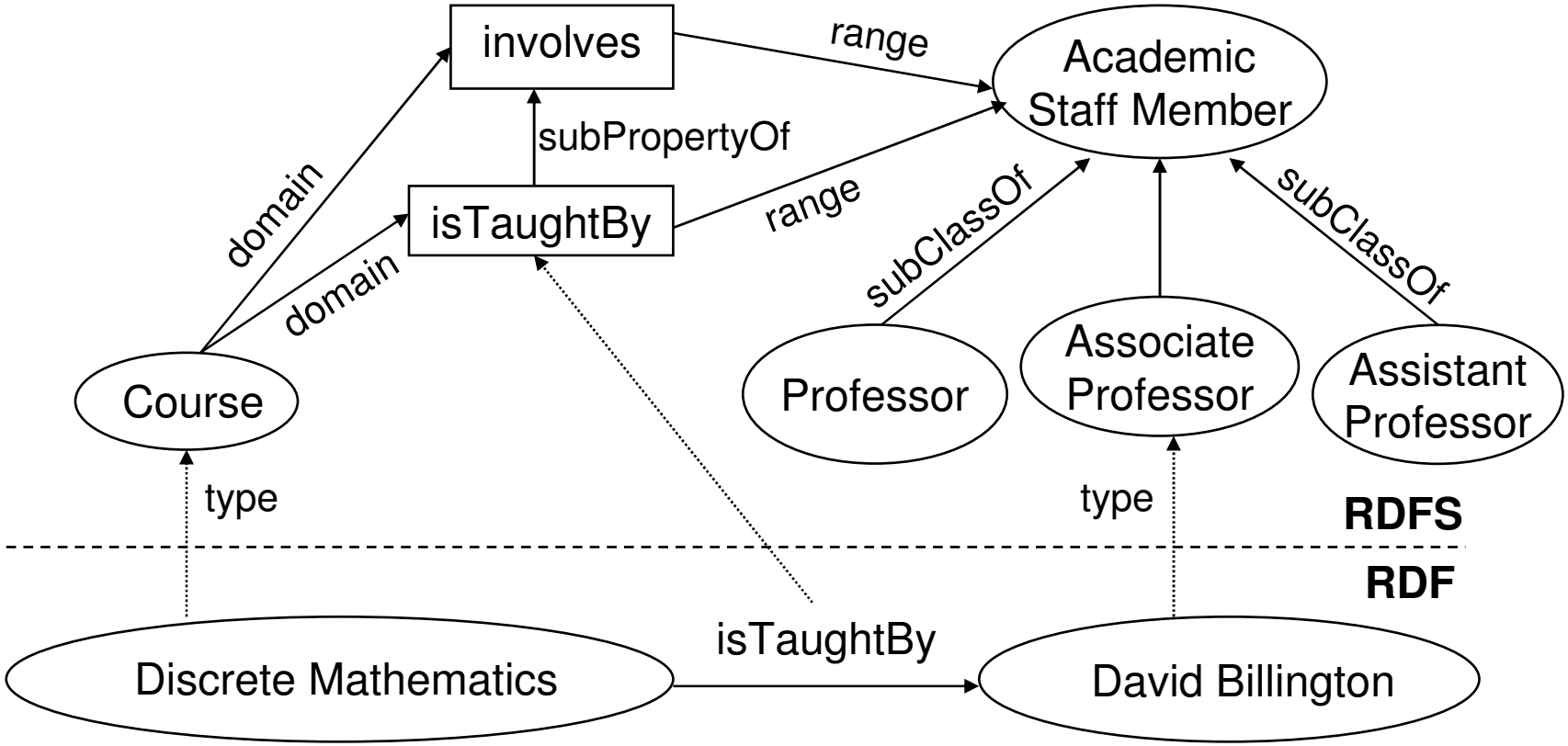
3.2. Basic Ideas of RDF Schema

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



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

```
<rdf:RDF
      xmlns:rdf="http://www.w3.org/1999/92/22-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
Cambridge, MA: The MIT Press, 2004.

S. Staab, R. Studer (Ed.):
Handbook on Ontologies
Berlin: Springer, 2004