

ece 627

intelligent web: ontology and beyond

lecture 5: rdf schema

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RDF and RDF Schema

basic ideas

RDF is about graphs – it creates a graph structure to represent data

RDFS is about sets – it provides guidelines how to use this graph structure in a disciplined way; how to talk about the vocabulary used in an RDF graph: which individuals are related to each other and how; how properties are related

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RDF and RDF Schema

basic ideas

RDFS

provides information about the ways in which we describe our data

tells us about the information that is expressed in the system (the schema is information about the data)

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RDF and RDF Schema

basic ideas

RDF Schema is defined in RDF form

**all schema information in RDFS is
defined with RDF triples**

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RDF and RDF Schema

basic ideas

RDF Schema extends RDF by introducing a set of distinguished resources

certain specific resources are “new keywords” (certain triples have a special meaning – we will know more about the data than what is explicitly expressed in the data)

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RDF and RDF Schema

basic ideas - example

a construct to specify a set in RDFS is `rdfs:Class` since RDFS is expressed in RDF – then in a triple `rdf:type` is the predicate, and the object is `rdfs:Class`

`:professor rdf:type rdfs:Class`

(not an XML format)

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RDF and RDF Schema

basic ideas – example cont.

```
<rdf:Description rdf:about="professor">
  <rdf:type
    rdf:resource=
      http://www.w3.org/2000/01/rdf-schema#Class
  </rdf:Description>
```

(an XML format)

RDF and RDF Schema

basic ideas – example cont.

```
<rdfs:Class rdf:about="professor"/>
```

(an abbreviated XML format)

RDF and RDF Schema

basic ideas

RDF Schema is a primitive ontology language

RDF Schema

basic ideas

meaning can be added to the data in RDF Schema using the following concepts:

- classes and properties
- class hierarchies and inheritance
- property hierarchies

... classes and instances

two “types” of information

- concrete “things” (individual objects) in the domain: discrete math, David Billington etc.
- sets of individuals sharing properties called classes: lecturers, students, courses etc.

... classes and instances

individual objects that belong to a class are referred to as instances of that class

the relationship between instances and classes in RDF is through **rdf:type**

...

classes and instances - example

- discrete math is taught by concrete math
- we want courses to be taught by lecturers only
 - restriction on values of the property "is taught by" (**range restriction**)
- room MZH5760 is taught by David Billington
- only courses can be taught
 - this imposes a restriction on the objects to which the property can be applied (**domain restriction**)

...

class hierarchies

- classes can be organized in hierarchies
- A is a **subclass** of B if every instance of A is also an instance of B
 - then B is a **superclass** of A
- a subclass graph need not be a tree
a class may have multiple superclasses

...

inheritance

range restriction:

courses must be taught by academic staff members only

Michael Maher is a professor (member of academic staff)

...

inheritance

Michael inherits the ability to teach from the class of academic staff members

this is done in RDF Schema by fixing the semantics of "is a subclass of"

(an application (RDF processing software) does not interpret "is a subclass of")

...

property hierarchies

hierarchical relationships for properties

- e.g., "is taught by" is a subproperty of "involves"
- if a course C is taught by an academic staff member A, then C also involves A

the converse is not necessarily true

- e.g., A may be the teacher of the course C, or
- a tutor who marks student homework but does not teach C

P is a subproperty of Q, if $Q(x,y)$ is true whenever $P(x,y)$ is true

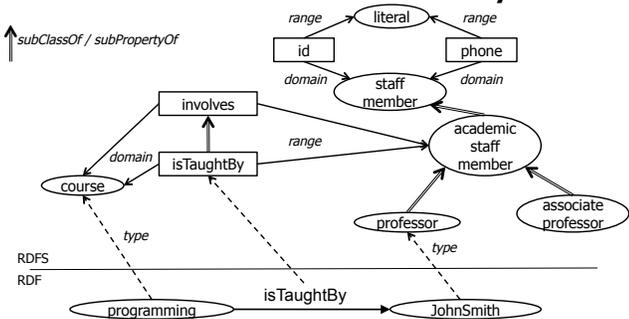
RDF vs RDF Schema Layer

discrete mathematics is taught by David Billington

the schema is itself written in a formal language, RDF Schema, that can express its ingredients:

subClassOf, Class, Property, subPropertyOf, Resource, etc.

RDF vs RDF Schema Layer



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RDF Schema in RDF

resources and properties are used to define modeling primitives of RDF Schema (RDF itself is used!)

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RDF Schema in RDF

to define that “professor” is a subclass of “academic staff member” we need to define:

- resources **professor**, **academicStaffMember**, and **subClassOf**
- property **subClassOf**

(**professor**, **subClassOf**, **academicStaffMember**)

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RDF Schema in RDF

```
<rdfs:Class rdf:about="professor">
  <rdfs:subClassOf
    rdf:resource="academicStaffMember"/>
</rdfs:Class>
```

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RDF Schema

core classes

- rdfs:Resource**, the class of all resources
- rdfs:Class**, the class of all classes
- rdfs:Literal**, the class of all literals (strings)
- rdf:Property**, the class of all properties.
- rdf:Statement**, the class of all reified statements

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RDF Schema

core properties

- rdf:type**, which relates a resource to its class (the resource is declared to be an instance of that class)
- rdfs:subClassOf**, which relates a class to one of its superclasses (all instances of a class are instances of its superclass)
- rdfs:subPropertyOf**, relates a property to one of its superproperties

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RDF Schema

core properties

rdfs:domain, which specifies the domain of a property P

- the class of those resources that may appear as subjects in a triple with predicate P
- if the domain is not specified, then any resource can be the subject

rdfs:range, which specifies the range of a property P

- the class of those resources that may appear as values in a triple with predicate P

example

```
<rdfs:Class rdf:about="#professor">  
  <rdfs:subClassOf rdf:resource="#academicStaffMember"/>  
</rdfs:Class>
```

individual:

```
<rdfs:Description rdf:ID="John Smith">  
  <rdf:type  
    rdf:resource="http://www.ece.ualberta.ca/schema/professor"/>  
</rdfs:Description>  
  
<my:professor rdf:ID="John Smith"/>
```

example

```
<rdf:Property rdf:ID="phone">  
  <rdfs:domain rdf:resource="#academicStaffMember"/>  
  <rdfs:range rdf:resource="http://www.w3.org/  
    2000/01/rdf-schema#Literal"/>  
</rdf:Property>
```

individual:

```
<my:professor rdf:ID="John Smith">  
  <my:phone rdf:resource="7801234567"/>  
</my:professor>
```

RDF Schema

core classes and properties

rdfs:subClassOf and **rdfs:subPropertyOf**
are transitive, by definition

rdfs:Class is a subclass of **rdfs:Resource**
because every class is a resource

rdfs:Resource is an instance of **rdfs:Class**
rdfs:Resource is the class of all resources, so it is a class
every class is an instance of **rdfs:Class**
for the same reason

RDF Schema

reification

rdf:subject, relates a reified statement to its subject

rdf:predicate, relates a reified statement to its predicate

rdf:object, relates a reified statement to its object

RDF Schema

containers

rdf:Bag, the class of bags

rdf:Seq, the class of sequences

rdf:Alt, the class of alternatives

rdfs:Container, which is a superclass of all container classes, including the three above

RDF Schema

utility properties

rdfs:seeAlso relates a resource to another resource that explains it

rdfs:isDefinedBy is a subproperty of **rdfs:seeAlso** and relates a resource to the place where its definition, typically an RDF schema, is found

RDF Schema

utility properties

rdfs:comment - comments, typically longer text, can be associated with a resource

rdfs:label - a human-friendly label (name) is associated with a resource

example: a university

```
<rdfs:Class rdf:ID="professor">
  <rdfs:comment>
    the class of professors, all professors are academic staff
    members
  </rdfs:comment>
  <rdfs:subClassOf rdf:resource="#academicStaffMember"/>
</rdfs:Class>
```

example: a university (2)

```
<rdfs:Class rdf:ID="course">
  <rdfs:comment>the class of courses</rdfs:comment>
</rdfs:Class>

<rdf:Property rdf:ID="isTaughtBy">
  <rdfs:comment>
    inherits its domain ("course") and range ("professor")
    from its superproperty "involves"
  </rdfs:comment>
  <rdfs:subPropertyOf rdf:resource="#involves"/>
</rdf:Property>
```

example: a university (3)

```
<rdf:Property rdf:ID="phone">
  <rdfs:comment>
    a property of staff members, takes literals as values
  </rdfs:comment>

  <rdfs:domain
    rdf:resource="#staffMember"/>

  <rdfs:range
    rdf:resource="http://www.w3.org/2000/01/rdf-schema#Literal"/>
</rdf:Property>
```