

INFS3101 / 7100 Ontology and the Semantic Web

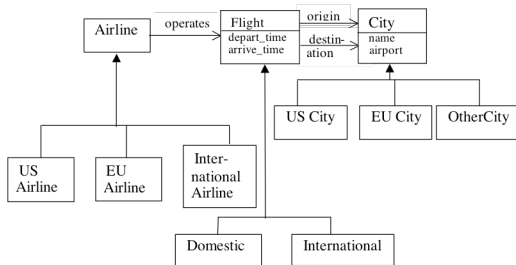
Module 10 RDFS

Last lecture: Key Terms



- Taxonomy of ontologies: **model-centric** perspectives and **application-centric** perspectives. Latter are **authoritativeness**, **source of structure**, **degree of formality**, **model dynamics**, **instance dynamics**. Former are **control**, **application changeability**, **coupling**, **integration focus** and **lifestyle usage**.

Airline Ontology



Why not UML?

- ❖ UML Class diagrams rich representation, widely used, with good tool support.
- ❖ But
 - UML not support individuals well
 - Not easy to combine models
 - Not used at run time
 - Lacks model theory, so hard to verify commitment
- ❖ W3C is developing representations based on XML
- ❖ We will look at XML, RDF, RDFS and in the next lecture OWL.

XML

- ❖ XML is a meta-markup language, used to define markup languages.
- ❖ First specify markup language in XSL, then use it to mark up a document.
- ❖ In our case, what to mark up?
 - Some text
 - Boxes and arrows
 - No individuals
 - Integrity constraints don't appear
- ❖ XML is a representation of a structure
- ❖ UML has an XML representation, called XMLI, but UML not adequate

RDF

- ❖ Resource Description Framework (RDF) is a structure represented in XML intended for ontology applications.
- ❖ Hypertext link connects source anchor with target anchor
- ❖ RDF triple has predicate connecting subject with object
- ❖ Subject, predicate and object are definite objects called resources.
- ❖ N3 notation
 - QF1 is operated by QANTAS

RDF

- ❖ Collection of triples called RDF Graph
- ❖ Collection in same document called RDF document
- ❖ Resources can be anywhere
 - QANTAS booking site <http://www.qantas.com>
- ❖ All resources can be in different documents from the triple
 - `<http://www.ontologies.org/airline#QANTAS>`
 - `<http://www.ontologies.org/linktypes#booking-site>`
 - `<http://www.qantas.com>`

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Names in RDF

- ❖ We want to say our airline ontology expressed in English
 - airline ontology language English
- ❖ How does program know how to interpret this as N-triple?
- ❖ Knows document in html document. Header is
 - `<?xml version="1.0" encoding="UTF-8" ?>`
 - `<!DOCTYPE rdf:RDF>`
- ❖ Terms represented using URIs and namespaces
 - `<http://www.ontologies.org/airline >`
 - `<http://purl.org/dc/terms#language>` “en”

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Standard Namespaces

Namespace	prefix	namespace URI
RDF	rdf:	http://www.w3.org/1999/02/22-rdf-syntax-ns#
RDFS	rdfs:	http://www.w3.org/2000/01/rdf-schema#
Dublin Core	dc:	http://purl.org/dc/terms
OWL	owl:	http://www.w3.org/2002/07/owl#
XML Schema	xsd:	http://www.w3.org/2001/XMLSchema#

Not all URIs designate locations

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Abbreviating Namespaces

- ❖ Declaration
 - `<rdf:RDF xmlns:dc = "http://purl.org/dc/terms">`
- ❖ Allows
 - `<http://www.ontologies.org/airline > dc:language "en"`
 - dc:language called qualified name or QName
- ❖ Can declare own namespace
 - `<rdf:RDF xmlns:air = "http://www.ontologies.org/airline"`
 - `xmlns:linktypes = "http://www.ontologies.org/linktypes#">`
- ❖ So examples can be represented as
 - `air:QF1 air:is operated by air:QANTAS`
 - `air:QANTAS linktypes:booking site <http://www.qantas.com>`

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Literals

- ❖ URI too heavyweight for primitive types like string, integer, date
- ❖ Called literal
- ❖ But type is a resource
- ❖ RDF uses XML literals, in XML Schema namespace
- ❖ So 8:15 am Brisbane time is
 - `"08:15:00+08:00"^^`
 - `http://www.w3.org/2001/XMLSchema#time`
- ❖ Using QName
 - `"08:15:00+08:00"^^xsd:time`

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Blank Nodes

- ❖ Abstract concept without definite representation
- ❖ RDF uses blank nodes
- ❖ Eg several resources tied together by concept
 - `_:NewYork air:name "New York"^^xsd:string`
 - `_:NewYork air:airport iata:JFK`
 - `_:NewYork air:airport iata:LGA`
 - `_:NewYork air:airport iata:EWR`
 - `_:NewYork air:map <http://www.mapquest.com>`
 - `_:NewYork air:weather`
 - `http://www.wunderground.com/US/NY/New_York.html`
 - `_:NewYork` a blank node
- ❖ A blank node is essentially an existentially quantified variable

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XML Syntax

- ❖ `<rdf:Description rdf:about = "http://www.ontologies.org/airline">`
- ❖ `<dc:language>en</dc:language> </rdf:Description>`

- ❖ `<rdf:Description`
- ❖ `rdf:about = "http://www.ontologies.org/airline#QANTAS">`
- ❖ `<air:operates rdf:resource = "air:QF1" />`
- ❖ `<air:booking-site rdf:resource = "http://www.qantas.com" />`
- ❖ `</rdf:Description>`

- ❖ `<rdf:Description rdf:nodeID = "NewYork">`
- ❖ `<air:name rdf:datatype = "xsd:string">New York</air:name>`
- ❖ `</rdf:Description>`

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RDF Pros and Cons

- ❖ UML doesn't fully specify individuals. Also large granularity, so too much ontological commitment
- ❖ RDF has individuals and small granularity
- ❖ But
- ❖ No distinction between more general and more specific, in particular no distinction between class and instance.
- ❖ UML model a bounded object, with owner, etc. Not possible in RDF

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So RDF Schema

- ❖ Introduces concepts `rdfs:Class`, `rdfs:subclassOf` with `rdf:Property` and `rdf:type`.
- ❖ At class level
 - `air:Flight` `rdf:type` `rdfs:Class`
 - `air:Domestic` `rdf:type` `rdfs:Class`
 - `air:Domestic` `rdfs:subclassOf` `air:Flight`
 - `air:City` `rdf:type` `rdfs:Class`
- ❖ Instances
 - `air:QF1` `rdf:type` `air:Flight`
 - `city:Sydney` `rdf:type` `air:City`
 - `city:Los Angeles` `rdf:type` `air:City`

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RDF Schema

- ❖ Properties (associations, attributes)
 - `air:depart_time` `rdf:type` `rdf:Property`
 - `air:arrive_time` `rdf:type` `rdf:Property`
 - `air:origin` `rdf:type` `rdf:Property`
 - `air:destination` `rdf:type` `rdf:Property`
- ❖ Built-in `rdfs:Class` `rdfs:Resource`
- ❖ Any `rdf:Property` has domain and range `rdfs:Resource`
- ❖ So
 - `air:QF1` `air:origin` `air:QF2`
- ❖ Is valid

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RDF Schema

- ❖ Can constrain the domain or range of a property
 - `air:origin` `rdfs:domain` `air:Flight`
 - `air:origin` `rdfs:range` `air:City`
- ❖ UML declarations form a type system, so domain of `air:origin` must be already declared as of type `air:Flight`
- ❖ Not so in RDF. From
 - TG992 `air:origin` `SYD`
- ❖ Can conclude TF992 is a Flight and SYD a City
- ❖ RDFS not strongly typed

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RDF Schema

- ❖ Uses XML literals
 - `air:depart_time` `rdfs:range` `xsd:time`
 - `air:arrive_time` `rdfs:range` `xsd:time`
- ❖ And subproperties
 - `air:international_operates` `rdfs:type` `rdf:Property`
 - `air:international_operates` `rdfs:subPropertyOf` `air:operates`
 - `air:international_operates` `rdfs:range` `air:International`
- ❖ Resolves multiple domains or ranges by intersection

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More Open World

- ❖ In Oracle, a literal includes
 - The type designation
 - Parsing rules
 - Implementation
- ❖ In RDFS, a literal includes only a pointer to the type designation in another system, XML
- ❖ If you want semantics, parsing rules or implementation you have to import them from somewhere else.

RDFS Pros and Cons

- ❖ RDFS is RDF with more structure
- ❖ But can't specify
 - Cardinality constraints
 - Mandatory, functional, etc
 - Defined subclass predicates
 - Ontology as bounded object
- ❖ For these and other structure specifications we need OWL (next week)

Summary: Key Terms



- ❖ **RDF** elaboration of hyperlink as **triple**, **resources** linking resources in **namespaces**. Allows **literals** and **blank nodes**. **RDFS** allows **class**, **subclass**, **subproperty**, **domain**, **range**. But not structure comparable to **UML**. Need **OWL** for that.

Resources

- ❖ **Essential**
 - Notes chapter 10 Representations of Ontologies
- ❖ **Further**
 - W3C RDF Primer (on web site)