The Semantic Web

SET09103 Advanced Web Technologies

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Outline

The Semantic Web

RDF and OWL

Ontologies

The Semantic Web

The Semantic Web was suggested by Tim Berners-Lee (et al.) in 2001 as a means for representing and using semantics on the WWW.

Quotes from his paper:
(The emphasised keywords indicate terms whose semantics, or meaning, were defined for the agent through the Semantic Web.)

Berners-Lee, 2001

"Lucy, was on the line from the doctor's office: 'Mom needs to see a specialist and then has to have a series of physical therapy sessions. Biweekly or something. I'm going to have my agent set up the appointments.'

Lucy instructed her Semantic Web agent through her handheld Web browser. The agent promptly retrieved information about Mom's *prescribed treatment* from the doctor's agent, looked up several lists of *providers*, and checked for the ones *in-plan* for Mom's insurance within a *20-mile radius* of her *home* and with a *rating* of *excellent or very good* on trusted rating services."

Traditional research in this area (since 1950s)

- Artificial Intelligence
- Knowledge Representation and Reasoning
- Expert Systems
- Natural Language Processing
- Conceptual Structures

Applications that are currently feasible

- Scheduling, “calendaring”
- trip planning
- shopbots, auction bots
- bio-informatics

How is semantics encoded?

RDF: Resource Description Framework
here using Dublin Core (DC)

```
<rdf:RDF
xmlns:rdf=’http://www.w3.org/1999/02/22-rdf-syntax-ns#’
xmlns:dc=’http://purl.org/dc/elements/1.1/’>
<rdf:Description rdf:about=’http://servername/something’>

<dc:creator>John Doe</dc:creator>
<dc:title>This is my book</dc:title>
<dc:date>2000</dc:date>
</rdf:Description>
</rdf:RDF>
```

RDF uses triples:

A resource has a property which points to another resource.

```
<rdf:Description rdf:about='http://servername/something'>
<dc:creator>John Doe</dc:creator>
```

Resource: http://servername/something
Property: <dc:creator>
Resource: John Doe

OWL: Web Ontology Language

OWL provides reasoning mechanisms. It can be automatically determined whether ...

- an instance is a member of a class
- several classes have common members
- a class is more general than another class
- an instance has a certain property
- whether a set of definitions is consistent

OWL Example

```
<rdfs:Class rdf:ID="Airport">
<rdfs:subClassOf>
<owl:Restriction>
<owl:onProperty rdf:resource="#name"/>
<owl:allValuesFrom rdf:resource="...#string"/>
</owl:Restriction>
</rdfs:subClassOf>
<owl:DatatypeProperty rdf:ID="name"/>
```

Older examples similar to ontologies

- plant taxonomies
- classification systems
- philosophical ontologies
- Roget's Thesaurus

Why develop ontologies?

- Share common understanding of information among people or agents
- Reuse of domain knowledge
- Make domain assumptions explicit
- Separate domain knowledge from operational knowledge
- Analyse domain knowledge

(Note: the following 6 slides are based on "Ontology Development 101: A Guide to Creating Your First Ontology" by Natalya F. Noy and Deborah L. McGuinness (2001).)

What is an ontology

- classes (or concepts)
- relations (a subset of classes)
- slots (features, attributes, roles or properties)
- values with restrictions (facets), cardinality, type, scope
- instances (individuals, objects or entities)

→ similar to object-oriented modelling, relational databases, library thesauri.

Examples: An ontology for dogs

- classes: dog, poodle, terrier, ...
- slots: fur colour, size, ...
- value restrictions: size is between 30 cm and 1 m, ...
- instances: Greyfriar's Bobby

Some rules for creating ontologies:

- There is no one single correct way for building an ontology.
- Ontology development is iterative.
- Concepts of the ontology should be close to objects and relationships in the domain of interest.

→ rules are similar to those for entity relationship modelling in relational databases and for (library) thesaurus construction.

Class hierarchy

- Poodle is a subclass of Dog.
- Toy-Poodle is a subclass of Poodle.

All poodles are dogs.
The class Poodle has the same slots as Dog, but it can have additional ones.

Slots

Slots can be

- intrinsic properties (such as fur colour for dogs).
- extrinsic properties (such as region of origin).
- parts
- relations with other individuals (such as dog/breeder).

Constructing a class hierarchy:

- should be transitive
- avoid cycles
- create a list of synonyms for each class
- preserve level of granularity
- use neither too few, nor too many subclasses for each class
- multiple inheritance is ok
- there is no clear rule for deciding whether something is a class, a property value or an instance
- rules for naming (capitalisation, singular/plural, prefix/suffix) should be established