Annotation Classes: A Structuring Mechanism for OWL Ontologies

Mike Dean

BBN Technologies
1300 N. 17th St., Arlington, VA 22209 USA
mdean@bbn.com

Abstract. OWL provides AnnotationProperties as a means of providing extra-logical information about ontologies, classes, properties, and individuals. We propose analogous AnnotationClasses as a means of adding hierarchical or other structure to an ontology without additional entailments, primarily for the benefit of human users. We use the RadLex vocabulary as a motivating example and also address the more general problem of understanding OWL ontologies.

Keywords: OWL, AnnotationClass, RadLex, ontology visualization

1 Introduction

OWL [1] supports AnnotationProperties which are specified formally but provide no logical entailments. OWL defines some AnnotationProperties such as owl:versionInfo, rdfs:label, and rdfs:comment. Users can also specify their own AnnotationProperties, and might do so to specify information about how a class should be rendered or ontology metadata such as dc:creator[1].

While working with the RadLex vocabulary [3], we identified a potential use for AnnotationClasses. These are analogous to AnnotationProperties in that they appear within the ontology and contribute useful information (particularly for human users) but don't lead to additional entailments.

The rest of this paper is organized as follows: Section 2 introduces RadLex and motivates AnnotationClasses. Section 3 discusses approaches for adding AnnotationClasses to OWL. Section 4 discusses some more general issues in making OWL ontologies understandable to humans. Section 5 discusses related work. Section 6 concludes.

[1] http://dublincore.org

2 RadLex

RadLex[2] is “a lexicon for uniform indexing and retrieval of radiology information resources” being developed by the Radiological Society of North America. RadLex was not developed using OWL, but is mappable to OWL.

RadLex 2.0 consists of 11,962 terms related through 11,373 links. Table 1 shows the distribution of these links. Links with relation_type “isa” correspond to rdfs:subClassOf and a small number of rdfs:subPropertyOf relationships. Those with relation_type "synonymof” correspond primarily to owl:equivalentClass relationships (but could also include owl:equivalentProperty or owl:sameAs relationships). “partOf” and the rest of the named relationship_types correspond to owl:ObjectProperties that are themselves defined as RadLex terms. The 60 links with an unnamed relation_type motivate our suggestion for AnnotationClasses as discussed below. Links with a preferred value of 1 are displayed by the RadLex Viewer.

Table 1. RadLex link types

relation_type	preferred	count
	1	60
isa	1	5,853
synonymof	0	1,860
partof	1	2,464
branchof	1	732
containedin	0	73
continuouswith	0	1
continuouswith	1	69
segmentof	1	67
tributaryof	1	194

The terms are arranged in a hierarchy rooted at RadLex term. Figure 1 shows the top of this hierarchy as represented in the RadLex Viewer at radlex.org. The hierarchy contains a mixture of isa, partof, containedin, and other relationships. This works well for organizing major subhierarchies like anatomic entity by location

[2] http://radlex.org

(abdomen, head, heck, etc.). Links from Table 1 with a preferred value of 1 are included in the hierarchy.

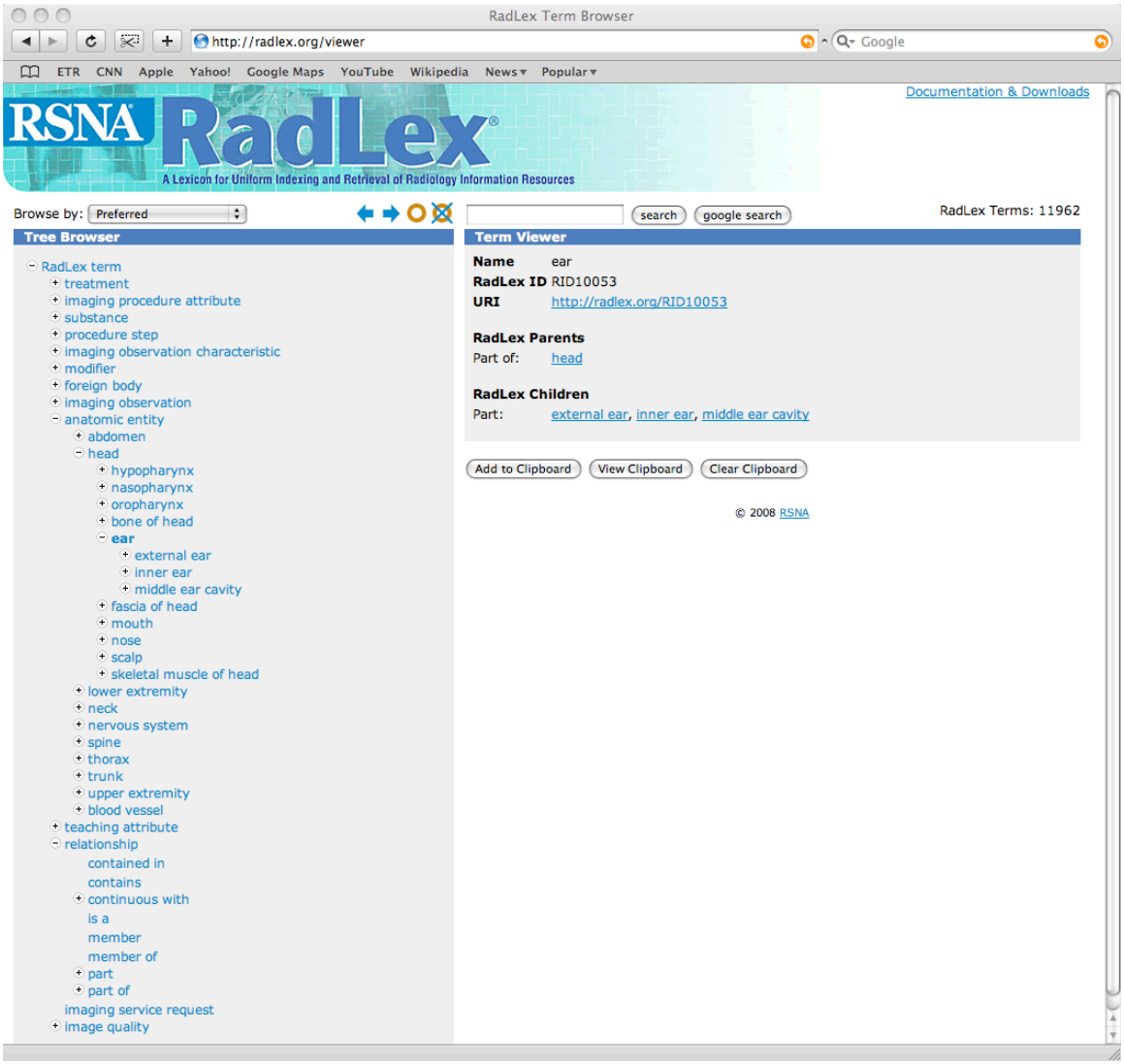

Figure 1. RadLex hiearchy and viewer

The 60 unnamed (but preferred) links from Table 1 represent relationships that are meaningful to users but don't have logical significance. Most of these involve terms near the top of the hierarchy. Terms involved only in unnamed links led us to think of AnnotationClasses. The unnamed links themselves could be represented using an owl:AnnotationProperty.

Upon closer examination, we found that 62 terms are used in unnamed links. Table 2 lists the 9 terms that are only used in unnamed links, and are thus candidates for AnnotationClasses. Of these, the first four seem appropriate; the other five seem to be included due to artifacts or errors.

Table 2: RadLex terms used only in unnamed links

Radlex
RadLex attribute
Relationship
RadLex synonym
contained in
contains
member of
member
origin

The use of a root class such as RadLex term is common in many ontologies. Often such classes are meaningless or essentially synonyms for owl:Thing and could effectively be represented as AnnotationClasses.

3 Implementation

We propose that OWL 1.1 include owl:AnnotationClass as an owl:Class. Such classes would be included by ontology editors and other tools when rendering the class hierarchy, but would not result in additional rdf:type or rdfs:subClassOf entailments. This would also avoid logical "clutter" or worse in forward-chaining reasoners.

We don't propose specific changes to the OWL semantics to incorporate AnnotationClasses.

A key decision heavily impacting the semantics would be whether to use rdfs:subClassOf to associate AnnotationClasses and other classes, or to create a new standard owl:AnnotationProperty. Such a new standard AnnotationProperty linking classes in hierarchical but extra-logical ways might be more important than AnnotationClass (e.g. in allowing links between non-AnnotationClasses), and might be sufficient by itself.

Like the developers of RadLex, we're at a bit of a loss for what this new standard AnnotationProperty should be named.

The universal role introduced in SROIQ [2]. an implicit object superproperty analogous to owl:Thing for classes, could potentially be used for this purpose, although it has logical significance. Such an owl11:universal property has been discussed[3] but is not currently included in OWL 1.1 [4].

[3] http://www.w3.org/2007/OWL/wiki/Universal_Property

4 Understanding OWL Ontologies

The RadLex hierarchy points to a more general issue in making OWL ontologies understandable. The mixture of relationships in the RadLex hierarchy seems to be quite effective, although we would prefer that it be more explicit.

As a graphically-based representation, UML[4] (which is a competitor to OWL in some respects) has the advantage that it can directly convey important extra-logical attributes and relationships (as well as aggregation and composition). The most important class(es) can be placed prominently at the center of the first class diagram, and colors, subdiagrams, alternative views, and other visual mechanisms can also be employed.

Given the unordered RDF statements associated with even the relatively small Friend-of-a-Friend vocabulary[5], consider how difficult it would be to quickly determine that foaf:Person is the most important class.

Additional standard owl:AnnotationProperties to identify the key classes in an ontology (such as a keyClass owl:OntologyProperty) and perhaps even represent diagrams would also be helpful.

5 Related Work

Bijan Parsia's OWL Annotation System[6] proposes a modular means of defining and grouping annotation properties, including "mustUnderstand" properties with logical significance. It would provide an effective mechanism for defining additional standardized annotation properties, including presentation properties as discussed in Section 4, but does not directly address AnnotationClasses.

6 Conclusions

Based on our work with a major emerging vocabulary, RadLex, we propose the addition of AnnotationClasses and/or a standard owl:AnnotationProperty to OWL 1.1 to hierarchically associate owl:Classes (primarily for the benefit of human users seeking to understand the ontology) without producing additional entailments. We believe that RadLex represents a use case for a large class of applications.

Other extensions to make OWL ontologies more easily understood by humans are also encouraged.

[4] http://www.omg.org/uml/
[5] http://xmlns.com/foaf/0.1/
[6] http://www.w3.org/2007/OWL/wiki/Annotation_System

References

1. Dean, M., Schreiber, G., eds. OWL Web Ontology Language Reference. W3C Recommendation 10 February 2004. http://www.w3.org/TR/2004/REC-owl-ref-20040210/.
2. Horrocks, I., Kutz, O., and Sattler, U. The Even More Irresistible SROIQ. Proc. 10th Intl. Conf. on Principles of Knowledge Representation and Reasoning (KR 2006), AAAI Press, 2006.
3. Langlotz, C. RadLex: A New Method for Indexing Online Educational Materials. RadioGraphics 2006;26:1595-1597. http://radiographics.rsnajnls.org/cgi/content/full/26/6/1595.
4. Motik, B., Patel-Schneider, P.F., and Horrocks, I. OWL 1.1 Web Ontology Language: Structural Specification and Functional-Style Syntax. W3C Working Draft 8 January 2008. http://www.w3.org/TR/2008/WD-owl11-syntax-20080108/