Using OWL to Describe Pedagogical Resources

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Abstract

In this paper we present an example of a part of a pedagogical ontology for a grande école. OWL is intended to help users to formalize ontologies and to be a support for the semantic Web, for example to enable the interchange of resources and the inference of knowledge while querying these resources.

1. Introduction

In the semantic Web, one of the main purposes is to represent the knowledge contained within the Web resources in order to make it available for applications or Web services. In the educational area, resources can be described thanks to the LOM [1]. Ontologies are used to help authors clarifying the domain and the content of the resources. The Web Ontology Language (OWL) [2] was carried by the W3C to formalize ontologies on the Web. In this paper, we propose first to explicit a part of the pedagogical ontology of our grande école: Supélec. Subsequently, we present some examples of OWL representations and we give some possibilities to exploit them by the way of existing tools, such as Protegee2000 [3].

2. Building a part of a pedagogical ontology at Supélec

The pedagogical ontology concerns both the pedagogical organization of Supélec and the content of a teaching program.

We first present (Figure 1) a simplified UML model of the pedagogical organization at Supélec. At Supélec, the education lasts three years, each year is divided into four sequences and contains several teaching modules (each module corresponding to one course per sequence). A module contains learning resources which are either atomic or composite. Each learning resource is described with metadata.

This UML schema can be easily transformed into an RDF representation. Because exact cardinalities cannot be expressed with RDF, we added an example of a cardinality constraint upon a property of the Education class. With OWL it is possible to specify that one member of the class Education has exactly three Teaching_Programs instances corresponding to year 1, 2 or 3. This is an extract of the OWL schema that we get:

```
<owl:Restriction>
  <owl:cardinality rdf:datatype="&xsd:nonNegativeInteger">3</owl:cardinality></owl:Restriction>
</owl:subclassOf></owl:Class>
```

![Figure 1. Educational organization](image-url)
3. Using OWL to describe metadata of learning resources

The pedagogical ontology contains the metadata of the learning resources participating in a teaching program, created by teachers or educational organizations and that are to be retrieved by a search tool. In order to preserve the semantics given by the LOM, we mentioned some definitions from it:

**Learning Object**: any entity that may be used for learning, education or training

**Category**: a group of related data elements

**Data element**: a data element for which the name, explanation, size, ordering, value space, and datatype are defined in the LOM standard.

The preliminary task consisted in translating the model of the LOM into a schema in OWL. We did it with the Protégé 2000 editor in Figure 2. We considered the Learning Object as a class, the categories and data elements as the properties of the Learning Object, and we explained the constraints on the space value. The following task consisted in classifying the concepts of our pedagogical ontology and specifying the properties and constraints:

```xml
<owl:Ontology rdf:about="">
  <owl:imports rdf:resource="file:/C:/BLD/Recherche/Articles/2003-2004/onto1-supelec.owl "/>
</owl:Ontology>
```

In our example, the concepts introduced in section 2.1: education, teaching_program, module, and learning_resources are considered as learning objects. The Learning_Object class is divided into two subclasses: Atomic_Object and Composite_Object. To express the level of granularity of the different learning objects, we used the following data elements of the LOM: General.Structure with value space in \{atomic, collection, networked, hierarchical, linear\} and General.AggregationLevel with value space in \{1,2,3,4\}. Thanks to OWL, we can easily specify that an Atomic_Object must values General.Structure = atomic, General.AggregationLevel = 1, or that a teaching program has value General.AggregationLevel > 2.

![Figure 2. Edition of classes and properties](image)

4. Conclusion

In the building of a pedagogical ontology at Supélec, we distinguished two domains. The first one represented an educational organization. It has been enriched with the second one that represented a pedagogical content using standardized metadata (LOM). We use Protégé 2000 for our examples. We edited the entire LOM schema, the schema and instances of our pedagogical ontology. Protégé 2000 enabled us to detect and solve some inconsistencies in the classes and relations and therefore to validate our schema. It is possible to query some simple facts and to make some inferences.

5. References