PROTEGE AT THE HEART OF THE TRANSFORMATION FROM UML2 CLASS DIAGRAM CONCEPTS TO FULL OWL

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Abstract. This paper evaluates the transformation of UML to OWL. We focus on the transformation of each concept of the UML2 class diagram into its FULL OWL equivalent concept. Some concepts of UML class diagram (class, association …), already present in OWL (w3c 1998) are directly represented in Protégé. But some other concepts (aggregation, composition, qualification …) can not be represented in Protégé directly, and require a specific transformation towards FULL OWL.

1 Introduction

UML (Unified Modeling Language) (Gaertner and al. 2002) is a semi-formal language for object modelling frequently used in companies. On one side, we have the old applications and the applications modelled in UML, and on other side, knowledge bases written in OWL by using Protégé or a tool from edition and building knowledge base. It would be of great interest to be able to build a knowledge base for these old systems and applications modelled in UML. A way of reasoning consists of starting from the modelling of the knowledge base in UML (class diagram) then, translates this modeling in OWL in order to implement it in Protégé. Protégé is a tool for building and editing Ontologies. It allows the user to create concepts, relationships between concepts, and to organize them in subsumption hierarchies.

First, we will define the semantic web and Ontology, then we will present our transformations and at the end, we will talk about our experiences.

2 Semantic Web and Ontology

The web semantic makes it possible to give more semantic to the resources used on the web and help more effectively the users in their research (Berner-Lee and al. 2001). It is based on ontologies. « An Ontology is a formal, explicit specification of a shared conceptualization » (Gruber 1993). Four languages result from the semantic web for the formalization of Ontologies: RDF (Lassila and al. 2000), RDFS, DAML+OIL and OWL (Bechhofer and al. 2004) splitted into OWL lite, OWL DL and full OWL.

3 Transformations

3.1 Aggregation Concept

In UML, an aggregation is a transitive and antisymmetric relation of the type «is part of». The aggregation relation is easily translatable in OWL by defining a transitive and antisymmetric property.

Example. «A book of known name has two covers». In this example, the two definite classes are : the class « Book» and the class «Cover». The object property «has» is an aggregation, therefore transitive and

antisymmetric. The domain is «Book» and the image is «Cover». The reciprocal object property is «belong to». The data property of the class « Book» is «name». We will not give in this paper, code corresponding to aggregation. Let us note that the OWL code of this example can be obtained from Protégé 2000.

3.2 Composition concept

In UML, the composition is a particular aggregation with a strong membership and dependence between the cycles of life of composed and its components. The multiplicity on the side of the composed is always 1 (Gaertner and al. 2002). Each composed must be linked to at least one component. But, in OWL, the composition relation is more complicated to translate; we need to define a transitive and antisymmetric property with the concept of container materialized by "Bag" (not sorted resources) or "Seq" (sorted resources) and with a cardinality of "one" on the side of the composed. The containers "Bag and Seq" are collections and make possible to mean that the disappearance of the composed involves the disappearance of the components.

Example. Graph of the UML class diagram example : «A book published, contains at least a page».

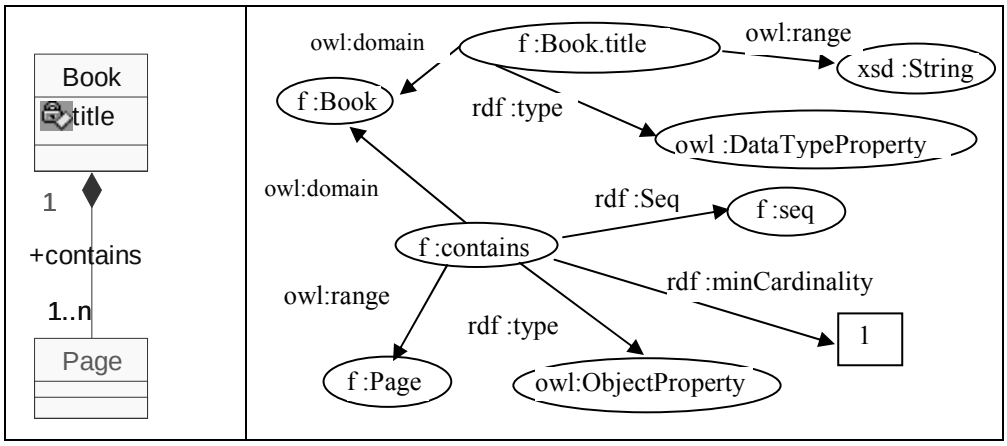

FIG. 2 –*UML class diagram & OWL Graph corresponding to the example of composition.*

A part of output OWL code corresponding to the composition from protégé 2000 :

```
<owl:Class rdf:ID="Page"/>
<owl:ObjectProperty rdf:about="#contains">
   <rdfs:range rdf:resource="#Page"/>
   <rdfs:domain>
    <owl:Class>
     <owl:unionOf rdf:parseType="Collection">
       <owl:Class rdf:about="#Book"/>
       <rdf:Description rdf:about="http://www.w3.org/2000/01/rdf-schema#Seq"/>
     </owl:unionOf>
    </owl:Class>
   </rdfs:domain>
   <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#TransitiveProperty"/>
 </owl:ObjectProperty>
```

4 Experiences

Recent advances in artificial intelligence, multi-agent systems, and knowledge representation and discovery made possible knowledge extraction from complex simulation results. However, adequate simulation models are developed for complex behaviours such as the case for humans (Desmier and al. 2005). An artificial agent endowed with both rational and emotional behaviours is integrated in the psychological expertise model. The UML language is used to describe the model. For realisation, we used our transformations to put in Protégé the UML model of emotional agents for building the knowledge base and then generate the OWL code.

5 Conclusions

In this article, we studied the possibility of transforming the UML class diagram concepts into OWL. The translation of UML to OWL facilitates the development of semantic web represented by the knowledge base. After the transformation of each concept of UML class diagram, one will be able to use them to put the models of class diagram in management knowledge tool (Protégé for example). In the future, we will extend this work to the transformation of all the other concepts of UML class diagram into OWL and study the interest of using Meta models.

6 References

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