CMAPS supporting the development of OWL ontologies

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ABSTRACT

In this paper, we present MAP2OWL, a software tool that allows the development of OWL ontologies as concept maps. MAP2OWL uses existing OWL constructs to represent conceptual maps; in this way, domain experts develop ontolologies in a graphical conceptual way, not having to be aware of syntactic matters, or issues related to interfaces that were designed for knowledge engineers. MAP2OWL facilitates the transitions form concepts to classes as well as relations to properties –as specified by OWL. MAP2OWL natively uses OWL; there is no translation from the concept map format to OWL. The tool is build as a Protégé plug-in, MAP2OWL establishes a real time interaction with the OWL protégé plug-in; as the concept map is being developed, an OWL file is being generated. This OWL file can, at any time, be manipulated by the Protégé OWL plug-in, or by any other Protégé Plug-in. The software can be downloaded from http://map2owl.sourceforge.net/.

Categories and Subject Descriptors

D.3.2 [**Programming Languages**]: *Constraint and logic languages.*

General Terms

Ontologies, conceptual maps.

Keywords

Conceptual maps, ontologies, OWL, user centric design.

1. INTRODUCTION

Ontology development is central for the realization of the Semantic Web (SW) vision. Several steps should be undertaken for the development of ontologies, being particularly difficult those in which knowledge should be elicited and represented from and by domain experts; they are not always aware of the development process, nor are they aware of the syntactical structures of those languages used to represent knowledge. Moreover, development tools such as Protégé (http://protege.stanford.edu/) have been conceived for engineers, not for domain experts. The domain analysis and knowledge acquisition phases, within the ontology development process, may thus become a bottleneck due to difficulties in establishing formal means of communication (*i.e.* in sharing knowledge).

Conceptual maps (CMAPS) have been demonstrated to be an effective means of representing and communicating knowledge [1] in a wide variety of domains [2]; the gap between the CMAP and the OWL structure has been considered a problematic issue as the translation is prone to error [2]. Currently the CMAPS syntax is independent ontology formalisms such as OWL; the syntactical structure of the CMAP is rather simple when compared to that presented by OWL, however due to its simplicity it is easy to use those constructs available in OWL in order to represent a CMAP. In this way the translation is not necessary, as the CMAP may be represented directly in OWL.

The relationship between CMAPS and ontologies has been investigated by Hayes *et al* [3]. They propose a Collaborative Ontology development Environment (COE); COE uses concept maps to display, edit and compose OWL. Central to their approach is the use of CMAPS in its native XML-based format, and the importance of an effective support for the collaboration process by means of those tools available in CMAPS-Tools (http://cmap.ihmc.us/). Garcia [4] also studied the use of CMAPS when developing ontologies in both centralized and decentralized settings –those in which domain experts are in one place, and those in which domain experts are geographically distributed. The main difference between these two approaches leis in the role and conception of the software tool supporting the development of the ontology. The availability of supporting tools such as those facilitating the visualization, query formulation, consistency checking by means of reasoners, is important when developing ontologies. This support is provided by IDEs built on top of an open plug-in based architecture like the one provided by Protégé.

This paper presents MAP2OWL, a protégé plug-in that allows the representation of CMAPS in the OWL formalism. More specifically, it supports knowledge representation by domain experts with no previous exposure to ontologies. MAP2OWL

A significant difference between a CMAP and an OWL ontology is the presence of concepts and relationships versus classes and properties –both, data type and object properties. Concepts can be seen as non-formalized classes; by the same token relationships can be assimilated to non-formalized properties. The transition from a concept into a class is defined by the knowledge engineer; usually during the knowledge elicitation phase. As concepts are being gathered, higher levels of abstractions are required; consequently classes can be defined. A similar process occurs when defining properties, initially simple relationships are elicited, as they are being formalized, better abstracted and

defined properties emerge. MAP2OWL establishes a direct communication with the OWL plug-in. This allows the manipulation of the OWL file via CMAPS; users not only "draw" their ontologies, but also are able to carry on operations such as defining domain and range without interacting with the OWL syntax, or the OWL plug-in. Figure 1 illustrates how MAP2OWL facilitates the development of OWL ontologies.

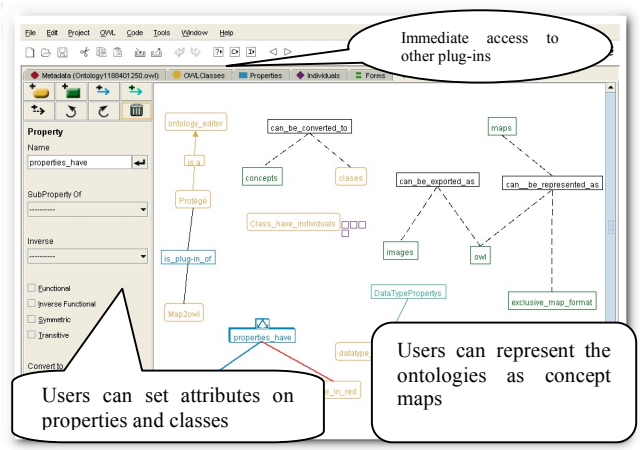


Figure 1. MAP2OWL

These graphical manipulations supporting the ontology development process provide several advantages, for instance: *i)* novices can learn basic functionality quickly, usually through a demonstration by a more experienced user, *ii)* experts can work extremely rapidly to carry out a wide range of tasks, even defining new functions and features, *iii)* knowledgeable intermittent users can retain operational concepts, *iv)* error messages are rarely needed, *v)* users can see immediately if their actions are furthering their goals; if not, they can simply change the direction of their activity, *vi)* users have reduced anxiety because the system is comprehensible and because actions are so easily reversible.

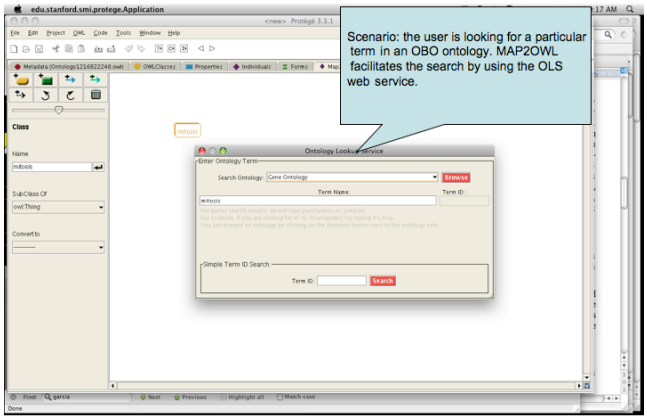
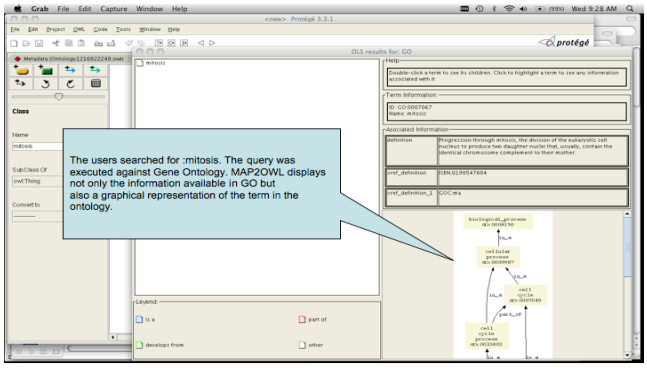


Figure 3. Executing OLS from MAP2OWL

Within the biomedical context, an important feature of MAP2OWL is the access to the Ontology Lookup Service (OLS http://www.ebi.ac.uk/ontology-lookup/) that allows users to verify if the term they are using has already been defined by any of the Open Biomedical Ontologies (OBO) [5].



Figures 3. OLS in MAP2OWL

2. Discussion and Future work

A major bottleneck when developing ontologies can be minimized if domain experts are able to represent their knowledge; this makes it easier for knowledge engineers to better-formalize this representation. Continuity is one important aspect in this process; knowledge engineers should be able to understand those models built by domain experts in a seamless manner. From experiences reported by Hayes *et al* as well as by Garcia *et al* it is evident that CMAPS can facilitate this process. MAP2OWL makes this possible. Although MAP2OWL was conceived as a Protégé Plug-in the increasing need for easy-t-use tools for representing knowledge and the need for sharing and reusing has make it obvious that it is more effective to have a web based tool. We are currently using the Google development tool kit in order to migrate our tool to a web-based environment. In this way we are planning to support various domain experts collaborating as well as access to repositories so that reuse of ontologies is eased by the tool.

3. Reference

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