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Knowledge editing and maintenance tools for a semantic portal in oncology

Mathieu d'Aquin*, Christophe Bouthier, Sébastien Brachais, Jean Lieber, Amedeo Napoli

LORIA CNRS, INRIA, Nancy Universities, BP 239, 54506 Vandœuvre-lès-Nancy, France

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Abstract

The research work presented in this paper is about the design of a knowledge system architecture applied to oncology and relying on the semantic Web principles. The core of this architecture is a working knowledge system, called KASIMIR, using an object-based representation formalism and classification-based reasoning. The ontology editor PROTÉGÉ is connected with the KASIMIR system, and is adapted to the particular requirements of KASIMIR. The PROTÉGÉ system enables the integration of several editing and visualization modules. A first knowledge editing module relies on classification-based reasoning for detecting mismatches and redundancies in the edited knowledge hierarchy. A second knowledge editing module also uses classification-based reasoning for comparing two versions of the knowledge base for maintenance purposes. This last module is particularly useful for extracting and analysing the changes occurred during an editing session. Three modules are combined to visualize hierarchies, based on three different techniques having complementary advantages. All these modules—including KASIMIR and PROTÉGÉ—are integrated in a semantic portal architecture based on semantic Web principles. The proposed architecture takes advantage of the semantic Web technologies for integrating the different modules, and for providing a reusable environment for distributed knowledge management in oncology.

Keywords: Knowledge management; Editing; Representation; Reasoning; Maintenance; Visualization; Semantic Web; Semantic portal

*Corresponding author. Tel.: +333 83 59 20 45; fax: +333 83 41 30 79.
E-mail addresses: daquin@loria.fr (M. d'Aquin), bouthier@loria.fr (C. Bouthier), brachais@loria.fr (S. Brachais), lieber@loria.fr (J. Lieber), napoli@loria.fr (A. Napoli).

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1. Introduction

The idea of a semantic Web relies on the extension of the present Web in order to make its contents fully available and understandable by machines (Fensel et al., 2003). One of the key issues is the need for ontologies on a particular domain, and for reasoning mechanisms relying on these ontologies. More generally, the design of knowledge system in the framework of the semantic Web relies on a number of (classical) operations: acquiring, maintaining, accessing and exchanging the knowledge elements in a domain or an organization. These operations require the development of tools and new architectures based on adequate languages and terminologies, to provide support for applications (see for example the SESAME architecture (Broekstra et al., 2003) and SEAL (Maedche et al., 2003)).

The KASIMIR system follows the same idea: it aims at managing knowledge in oncology with respect to the semantic Web principles (Lieber et al., 2002; Brachais et al., 2003). In this way, the KASIMIR architecture has to be open, reusable and adaptable, for extensions to other contexts, according to the principles of declarative knowledge system design (see for example Stefik, 1995), where the knowledge components are separated from the manipulation mechanisms. Following this idea, a modular architecture underlying the KASIMIR system is proposed hereafter, with a number of components that can be plugged—or unplugged as well—among which a knowledge management module, a Web portal with a set of associated services depending on the domain. The main tasks that are considered for managing knowledge are the follows:

- Acquiring and modelling knowledge through domain expert interactions.
- Editing knowledge with a knowledge editor, representing knowledge within a knowledge representation formalism, e.g. object-based representation systems or description logics, and controlling the evolution of the knowledge base. The knowledge editing can be guided and controlled by the reasoning module associated with the knowledge representation formalism.
- Visualizing the elements of the knowledge base and the results of the reasoning processes with visualization modules providing different viewpoints on the knowledge base.

Hereafter, we detail the modular architecture of the KASIMIR system, and describe the functionalities of each module (see Fig. 1). A knowledge editor based on the PROTÉGÉ system has been connected with the KASIMIR system, for taking into account the knowledge model and the reasoning process in KASIMIR. The extensibility and the flexibility of the PROTÉGÉ environment allow the integration of companion visualization modules offering visualization with respect to different viewpoints, for helping manipulation and validation of the knowledge units. In addition, a module for comparing two versions of a knowledge base is integrated to the editing environment, having in charge the visualization of the modifications between two consecutive versions of a knowledge base. A discussion on the design