PREFACE

Contemporary knowledge engineering constitutes a wide subfield of artificial intelligence located at the intersection of knowledge representation formalisms, automated inference techniques, rule-based and expert systems, as well as agent and Semantic Web technologies. It is an area of intensive research and numerous practical applications. Current developments are possible not only thanks to the non-disputable technological progress in computer hardware but also to theoretical advances, including conceptual and logical design and development, new logical formalisms and agent technologies.

Contrary to the rather narrow, classical understanding of knowledge engineering as the activity of developing expert systems, we are now coming back to a wider definition provided by Edward Feigenbaum and Pamela McCorduck: *Knowledge engineering is an engineering discipline that involves integrating knowledge into computer systems in order to solve complex problems normally requiring a high level of human expertise*[1]. In fact, today—in the year 2011—the definition is still valid, but there is a new content, concepts, and a better understanding of the tools in use.

In order to build a knowledge-based system, one has to solve at least the following problems: (i) design an appropriate knowledge representation formalism, (ii) build in an efficient inference engine, (iii) deal with inference control in order to avoid combinatorial explosion, (iv) perform knowledge acquisition, (v) take care of knowledge verification, validation and quality, (vi) consider knowledge management, and, last but not least, (vii) provide a friendly (often graphical and based on restricted natural language) user interface for efficient interaction. All these tasks are even more complicated than in the times when the term *knowledge engineering* was coined.

There is now a common agreement that there are different types of knowledge. As a consequence, different knowledge representation and processing methods should be used. An abundant repository of tools-at-hand is still being enlarged. But there are also different ways of using the knowledge contained in a knowledge base as well as different knowledge management activities.

What appears symptomatic, a kind of *introspection* into the knowledge itself seems to be a crucial success factor. In fact, without *understanding* the knowledge, its processing tends to be mechanical and shallow, with search engines being most significant examples. Despite all the computational power, most semantics-related questions do not have satisfactory answers. Understanding the question appears to be a key issue for efficient knowledge processing. An in-depth penetration of knowledge types, structure and properties allows better use of the knowledge at hand. Developing domain ontologies is an attempt at rigorous introspection into restricted domain knowledge.

It is more and more important to focus on *semantic* aspects of knowledge: its application for humans, but also how it can be processed automatically by machines in an "intelligent" fashion. Without truly understanding the problem to be solved and answering the user question, an inference engine turns into a search engine. The provided results may be of low quality or even irrelevant to the issues under investigation. Understanding the question also means having a common language and vocabulary; moreover, a common model of the world, its components, structure and properties. In fact, we touch here the principal problems of artificial intelligence. These are some of the problems that the Semantic Web initiative aims to address. The semantic technologies developed so far have not only changed the Internet but have also enriched knowledge engineering itself.

We use the term *semantic knowledge engineering* to underline the principal role of handling such semantic aspects in the engineering of contemporary knowledge-based systems. It seems that it can also serve as a common denominator for this special section, presenting six papers selected out of thirteen submissions, all of which passed a rigorous review procedure. Let us briefly introduce their contents and their relationship to semantic knowledge engineering based on the abstracts provided by the authors.

The paper by Amelia and Costin Bădică concerns agent-based modeling of e-commerce services omnipresent in a Semantic Web environment. The authors propose a formal framework aimed at precise characterization of the so-called middle-agents brokers between service requesters and providers. The approach is based on capturing interaction protocols between requesters, providers and middle-agents as finite state processes represented using FSP process algebra. The resulting specifications are formally verifiable using the FLTL temporal logic.

Joachim Baumeister, Jochen Reutelshoefer and Frank Puppe discuss important issues of practical development of intelligent systems. The authors observe that, in this process, domain knowledge is often present at different levels of formalization ranging from text documents to explicit rules. They describe the knowledge formalization continuum as a metaphor to aid domain specialists in the knowledge acquisition phase. They advocate using a semantic wiki as a flexible tool for engineering knowledge on the knowledge formalization continuum.

[1] Feigenbaum, E.A. and McCorduck, P. (1983). *The Fifth Generation*, 1st Edn., Addison-Wesley, Reading, MA.

In their paper, Joaquín Cañadas, José Palma and Samuel Túnez discuss defining the semantics of rule-based Web applications through model-driven development. The paper presents an approach for specifcation and development of Web applications performing the usual functionalities of data management and incorporating a rule engine for reasoning capabilities. The proposed approach is based on the definition of a high-level representation of the semantics of rule-based applications through a formalism for conceptual modeling combining lightweight ontologies and production rules.

Ireneusz Czarnowski and Piotr Jędrzejowicz apply agent-based simulated annealing and tabu search procedures to solving the data reduction problem in a supervised machine learning process. This problem concerns deciding which features and instances from the training set should be retained for further use during the learning process. Data reduction can result in increased capabilities and generalization properties of the learning model, shorter time of the learning process, or it can help in scaling up to large data sources. Their paper focuses on data reduction through simultaneous instance and feature selection. The main contribution of the paper consists of a proposal for a new data reduction approach with the learning process executed by a team of agents organized in several architectures and its evaluation through a computational experiment. The goal of the paper is to experimentally establish how the different variants of the proposed approach can influence learning performance.

The paper by Adrianna Kozierkiewicz-Hetmańska and Ngoc Thanh Nguyen concerns intelligent tutoring systems. The authors propose an intelligent e-learning system. The main purpose of this system is to teach effectively by providing an optimal learning path in each step of the educational process. It offers a modification of the initial student learning scenarios using data gathered during the functioning of the system and based on a Bayesian network.

Finally, Adam Meissner presents an experimental analysis of computation rules in a parallel reasoning system for the ALC description logic. A computation rule determines the order of selecting premises during an inference process. In the paper the author empirically analyzes three particular computation rules in a tableau-based, parallel reasoning system for the ALC description logic, which is built in the relational programming model in the Oz language. The system acts as a convenient test-bed for comparison of various inference algorithms and their elements. The author evaluates the examined methods of selecting premises with regard to their efficiency and the speedup which can be obtained by parallel processing.

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