Chapter IV
Towards an Implicit and Collaborative Evolution of Terminological Ontologies

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ABSTRACT

This chapter is concerned with the evolution of terminological ontologies used for representing personal knowledge. It first argues that each member of the knowledge society will need a personal knowledge model representing his/her knowledge. Subsequently, it presents a method for implicitly and collaboratively evolving such personal knowledge models, improving by these means the knowledge transfer in the knowledge society over the Internet. The authors hope that an understanding of the importance of personal terminological ontologies, and especially of a low-bias approach to their implicit and collaborative evolution, will contribute to the transformation from the information to the knowledge society.

INTRODUCTION

In recent years, the significance of knowledge sharing and exchange over the Internet has been recognized by the scientific community to be crucial for the arising knowledge society, which will be based on the next generation of the Internet, that is, the semantic Web (see e.g., Abidi & Pang, 2004). The transfer and management of knowledge over the Internet demand the existence of several technologies, per se.

First, it demands techniques for representing knowledge in a way accessible to both machines and human users. Much work has been done in the areas of knowledge representation (KR) and artificial intelligence (AI). In the seventies, several approaches to KR methods, such as connectionist (Block, 1962; McCulloch & Pitts, 1943) and logic based (Tarski, 1956) were already developed. In the following decade, main KR projects such as Cyc (Lenat & Guha, 1989) arose. KR languages and formats such as CycL (Lenat & Guha, 1989), the knowledge interchange format (KIF) (Hayes & Menzel, 2001) and Loom (McGregor, 1990) were subsequently developed. These methods then made room for ontology representation

languages. Meanwhile, they are the standard for representing machine-readable knowledge with RDF/OWL (resource description framework/Web Ontology Language) as W3C (World Wide Web Consortium) standards (W3C, 2006). Ontologies are considered to be the backbone of the future semantic Web and hence, of the knowledge representation in the knowledge society based on it. They are universally utilizable KR structures that have already been used in several contexts such as data description (Dwight, Harris, Dolinski, Ball, Binkley, Christie, et al., 2002), knowledge communication for software agents (Takeda, Iino, & Nishida, 1995), modeling of linguistic knowledge (Omelayenko, 2001), and Information Retrieval (Müller, Kenny, & Sternberg, 2004). A rapidly growing number of organizations have realized the need to make their knowledge accessible in such a way (Kingston, 2008).

Second, exchanging knowledge demands a knowledge transfer architecture, which can be based on shared knowledge bases, personal knowledge bases (linked using peer-to-peer technologies for example), or a combination of both (personalized knowledge bases). In knowledge-intensive organizations, techniques for KR will be potentially used not only to represent global knowledge shared by the members from a certain domain, but also the personal knowledge of each user, enabling intelligent agents to perform tasks demanding specific knowledge about the context, needs, and preferences of the user, for example, personalized semantic information retrieval, customized translation, automatic planning, and so forth. By these means, contextually relevant content and knowledge will be made accessible to the user, improving his/her effectiveness and therefore, the competitiveness of the whole organization. Improved innovation cycles, shorter time-to-market, and better reuse are only a few of the advantages that such an approach promises. In order to enable such personalized and customized operations and services, Knowledge Management (KM) systems will necessitate a representation of the interests, knowledge, and requirements of each user. Yet modeling such knowledge manually would be a very costly process with regard to time and resources. Other operations, such as updating personal knowledge bases, would also demand a considerable amount of resources. Due to the fact that the knowledge of single individuals grows with time, productive KM systems will need to continuously capture the growth of personal knowledge, and include it in the personalized knowledge models. Thus, the need for approaches for the evolution of personal knowledge bases is undeniable. Yet, updating solely the personal ontologies of employees would not be of use to a company if the growth of knowledge of the employees is not reflected in the global ontology of the company. A method for subsuming personal ontologies to a global ontology is thus, also needed.

The goals of this chapter are twofold: first, chosen approaches to KR in the context of KM will be presented, and the use of ontologies for KR in KM will be discussed. The main goal of this chapter will yet be to introduce a user-centered collaborative evolution approach for personal knowledge bases. Several technical concepts necessary to implement concepts, such as the similarity of users within a community and of ontologies, will be introduced. Finally, a possible approach for collaborative and semiautomatic ontology evolution, based on natural language processing, will be presented.

This chapter is structured as follows: In the following section, background knowledge on KR and the use of KR mechanisms for IT-supported KM will be presented. Criteria for selecting an appropriate technique for KM will be defined and applied to state-of-the-art approaches. Furthermore, existing approaches for automatic extraction and evolution will be presented. The subsequent section will be concerned with a collaborative and user-centered ontology evolution, focusing on personal terminological ontologies. Finally, the conclusion will be concerned with present-