Chapter 11
Evolution in Ontology-Based User Modeling

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ABSTRACT

Web-ontologies are becoming the de facto standard for WWW-based knowledge representation. As a consequence, user modeling has been associated to Web-ontologies. However, data schemes evolve, and therefore ontologies also evolve. Thus, adaptive systems, more than other ontology-based system, are directly affected by changes in ontologies. Because of this, it is important that adaptive systems can be prepared to deal with the problems that occur after changes are applied to ontologies. In this chapter, the authors perform a literature review on the field of ontology evolution aiming at serving as a point of reference for user modeling area. Therefore, adaptive systems developed on ontology-based user modeling could adapt to changes when the ontologies change.

INTRODUCTION

A lot of research activity has been generated on the border of user modeling and web-ontologies. According to Sosnovsky & Dicheva (2010), both disciplines attempt to model the real world phenomena qualitatively: ontologies – a particular area of knowledge, user modeling – the internal state of a human user. Many user-modeling approaches exploit the content-based characteristics of a user (user’s knowledge, interests, etc.) and hence can directly benefit of the high-quality domain models provided by ontologies. Besides, as the majority of user modeling projects has been deployed on the Web, and Web-ontologies are becoming the de facto standard for WWW-based knowledge representation, the cooperation between user modeling and Web-ontologies seems inevitable (Sosnovsky & Dicheva, 2010).
During some years, the research about ontologies focused on providing tools for better edit, construct, and visualize these knowledge structures. Nowadays, researchers try to address incompatibility and inconsistence issues that occur after an ontology change, mainly considering that ontologies are part of an environment composed of systems and other ontologies. Thus, this environment must remain functional after some ontology had its structure changed by adding some new knowledge. Adaptive systems, more than any other ontology-based system, are directly affected by changes in the ontologies, as ontologies are increasingly used for model user knowledge and characteristics.

In this chapter, we perform a literature review on the field of ontology evolution that will, hopefully, serve as a point of reference for user modeling area. Our purpose is to give an overview of relevant ontology evolution approaches that can be useful for adaptive system researches and developers. We first make an overview about user modeling and ontology-based user modeling. After that, we discuss the ontology evolution process, its phases and major problems. Then, ontology evolution approaches applied to user modeling area are presented and, finally, we present some final remarks.

USER MODELING

User modeling is mainly used in adaptive systems and in general the precision of modeling assumptions about a user defines, in many aspects, the effectiveness of these systems. An incorrect interpretation of a user leads to wrong adaptive decisions, which may result in user’s frustration, loss of trust, decreased motivation to use the system, etc (Sosnovsky & Dicheva, 2010). Crucial factors for the success of adaptive web systems are: adequate representation of knowledge about a user, effective elicitation of user-related information, and utilization of this information for organizing coherent and meaningful adaptation. This section aims to present a brief overview about the user modeling area. For more detailed information, see (Brusilovsky, 1996; Devedzic, 2001; Pierrakos et al, 2003; Stewart et al, 2004; Frias-Martinez et al, 2006; Sosnovsky & Dicheva, 2010).

Several users’ characteristics can influence the individual utility of a provided service or information. Some systems model users considering multiple dimensions. Sosnovsky & Dicheva (2010) identify six main dimensions used by user modeling systems over the years (I) knowledge, beliefs, skills, background; (II) interests and preferences; (III) goals, plans, tasks, needs; (IV) demographic information; (V) emotional state and (VI) context. The first dimension is important to information and knowledge systems, which are used for assessing incorrect knowledge or misconceptions (Mabbott et al., 2004), representing procedural knowledge (Corbett & Anderson, 1994), and detailing the relevant experience gained outside the system (so called background knowledge) (Horvitz et al., 1998). The second and third dimensions are most used for recommendation systems such as adaptive recommenders (Pazzani & Billsus, 2007), adaptive search engines (Micarelli et al., 2007) and adaptive browser agents (Lieberman, 1995). The fourth and fifth dimensions can be important in cognitive setting (Desimone, 1999), adapting the system using demographic and emotional characteristics from users (Rodrigo et al., 2007). Demographic characteristics are also used in adaptive e-commerce systems (Bowne, 2000) and personalized ubiquitous applications (Fink & Kobsa, 2002). These last kind of systems can model user contextual information (sixth dimension).

As stated in (Sosnovsky & Dicheva, 2010), there are several approaches to model a user:

- Overlay user modeling is used for modeling user knowledge as a subset of the domain employed by an expert’s knowledge. Commonly, this oldest approach is used in adaptive educational systems, as these