Chapter 1.6
Semantic Web Standards and Ontologies in the Medical Sciences and Healthcare

Sherrie D. Cannoy
The University North Carolina at Greensboro, USA

Lakshmi Iyer
The University North Carolina at Greensboro, USA

ABSTRACT

This chapter will discuss Semantic Web standards and ontologies in two areas: (1) the medical sciences field and (2) the healthcare industry. Semantic Web standards are important in the medical sciences since much of the medical research that is available needs an avenue to be shared across disparate computer systems. Ontologies can provide a basis for the searching of context-based medical research information so that it can be integrated and used as a foundation for future research. The healthcare industry will be examined specifically in its use of electronic health records (EHR), which need Semantic Web standards to be communicated across different EHR systems. The increased use of EHRs across healthcare organizations will also require ontologies to support context-sensitive searching of information, as well as creating context-based rules for appointments, procedures, and tests so that the quality of healthcare is improved. Literature in these areas has been combined in this chapter to provide a general view of how Semantic Web standards and ontologies are used, and to give examples of applications in the areas of healthcare and the medical sciences.

INTRODUCTION

"One of the most challenging problems in the healthcare domain is providing interoperability among healthcare systems" (Bicer, Laleci, Dogac, & Kabak, 2005). The importance of this interoperability is to enable universal forms of knowledge representation integrate heterogeneous information, answer complex queries, and pursue data integration and knowledge sharing in healthcare (Nardon & Moura, 2004). With the recent emergence of EHRs and the need to distribute medical information across organizations, the Semantic Web can allow advances in sharing such information across disparate systems by utilizing ontologies to create a uniform language and by using standards to allow interoperability in transmission. The purpose of this article is to provide an overview of how Semantic Web standards and ontologies are utilized in the medical sciences and healthcare fields. We examine the healthcare field as the inclusion of hospitals, physicians, and others who provide or collaborate in patient healthcare. The medical sciences field provides much of the research to support the care of patients, and their need lies in being able to share and find medical research being performed by their colleagues to build upon current work. Interoperability between these different healthcare structures is difficult and there needs to be a common "data medium" to exchange such heterogeneous data (Lee, Patel, Chun, & Geller, 2004).

Decision making in the medical field is often a shared and distributed process (Artemis, 2005). It has become apparent that the sharing of information in the medical sciences field has been prevented by three main problems: (1) uncommon exchange formats; (2) lack of *syntactic* operability; and (3) lack of *semantic* interoperability (Decker et al., 2000). Semantic Web applications can be applied to these problems. Berners-Lee, Hendler, and Lassila (2001), pioneers in the field of the Semantic Web, suggest that "the semantic web will bring structure to the meaningful content of web pages". In this article published in *Scientific American*, they present a scenario in which someone can access the Web to retrieve information—to retrieve treatment, prescription, and provider information based on one query. For example, a query regarding a diagnosis of melanoma may provide results which suggest treatments, tests, and providers who accept the insurance plan with which one participates. This is the type of contextually based result that the Semantic Web can provide. The notion of ontologies can be utilized to regulate language, and standards can be used to provide a foundation for representing and transferring information. We will focus on the lack of semantic and syntactic interoperabilities in this article. The semantic interoperable concept will be utilized in the context of ontologies, and syntactic interoperabilities are referred to as standards of interoperability.

BACKGROUND

The Semantic Web is an emerging area of research and technology. Berners-Lee (1989) proposed to the Centre Europeen pour la Recherche Nuclaire (CERN) the concept of the World Wide Web. He has been a pioneer also in the concept of the Semantic Web and has expressed the interest of the healthcare field to integrate the silos of data that exist to enable better healthcare (Updegrove, 2005). He has been involved with the World Wide Web Consortium (W3C) Web site (http://www.w3.org), which offers a vast array of Semantic Web information in a variety of subject areas, including the medical sciences and healthcare. Miller (2004) states that the Semantic Web should provide common data representation to "facilitate integrating multiple sources to draw new conclusions;" and to "increase the utility of information by connecting it to its definitions and context". Kishore, Sharman, and Ramesh (2004) wrote two articles which provide detailed information about ontologies and information systems.

The concept of the Semantic Web is to extend the current World Wide Web such that context and meaning is given to information (Gruetter & Eikemeier, 2004). Instead of information being produced for machines, information will

Related Content