

Semantic Web Portals

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INTRODUCTION

Web portals, based on traditional Web technologies developed in the late 1990s, present serious limitations regarding information search, extraction, and portal maintenance (Fensel & Musen, 2001). Semantic Web technologies, explored in the past several years, attempt to overcome these limitations. Semantic Web portals are portals based on Semantic Web technologies. Recently, a few Semantic Web portals in their very early stages can be found on the Internet (Lara, Han, Lausen, Stollberg, Ding, & Fensel, 2004). This article will explain the definition of Semantic Web portals, the unique features of Semantic Web portals, and a general framework of architectures of Semantic Web portals.

BACKGROUND

Web portals allow users to share information and process information through the Internet. However, given the vast variety of structures, contexts, and contents of Web portals, it is difficult for software agents to process information of Web portals. It is also difficult to automate the process of construction and maintenance of portals. The motivation of Semantic Web portals is to make information on portals processable to both humans and software agents, and make automation of Web portal construction and maintenance feasible.

According to Tim Berners-Lee (Berners-Lee, Hendler, & Lassila, 2001), a co-founder of the World Wide Web Consortium (W3C, 2006) and a principal architect of the Internet, the Internet will evolve toward the Semantic Web. Currently, most of the Web's content is designed mainly for humans to read, not for computer programs to manipulate meaningfully. Computers can parse Web pages for layout and keywords, but in general, computers have no effective way to process the semantics of the associated Web pages. The Semantic Web will bring structure to the meaningful content of Web pages, and create an environment for software agents that carry out sophisticated tasks for humans. Such a software agent is able to process knowledge represented by the Web pages.

In pursuing this direction of Internet evolution, Semantic Web portals have been created during the past several years, such as Esperanto (2006), OntoWeb (2006), Empolis K42 (2006), and Mondeca ITM (2006).

UNIQUE FEATURES OF SEMANTIC WEB PORTALS

Semantic Web portals are Web portals based on Semantic Web technologies. There are three major types of Semantic Web technologies, as now described.

- Ontology:** The methodological foundation of the Semantic Web is ontology (Kim, 2002). Ontology is a science that studies explicit formal specifications of the terms in the domain and relations among them (Gruber, 1993). In general philosophical terms, an ontology is a specification of a conceptualization (Gruber, 1995; Guarino, 1995). In the Semantic Web domain, an ontology is typically a data structure containing the relevant resources along with their properties and relationships. Ontologies are usually expressed in logic-based languages used for the automation of Web services (W3C Ontology, 2006). An ontology allows people to share common understanding of the subject domain of the Web portal. For example, suppose several Web sites contain information about commercial software packages. If these Web sites share and follow the same underlying ontology of the terms and the structure that describe commercial software packages, people can understand these software packages and compare them to make purchase decisions. Furthermore, ontologies make specifications of the terms and their relations of the Web portal explicit so that software agents can analyze information related to the Web portal. Following this example, if the terms and the structures of these Web sites are explicit, then a software agent can extract and aggregate information from these Web sites and answer user queries based on massive information about commercial software packages.

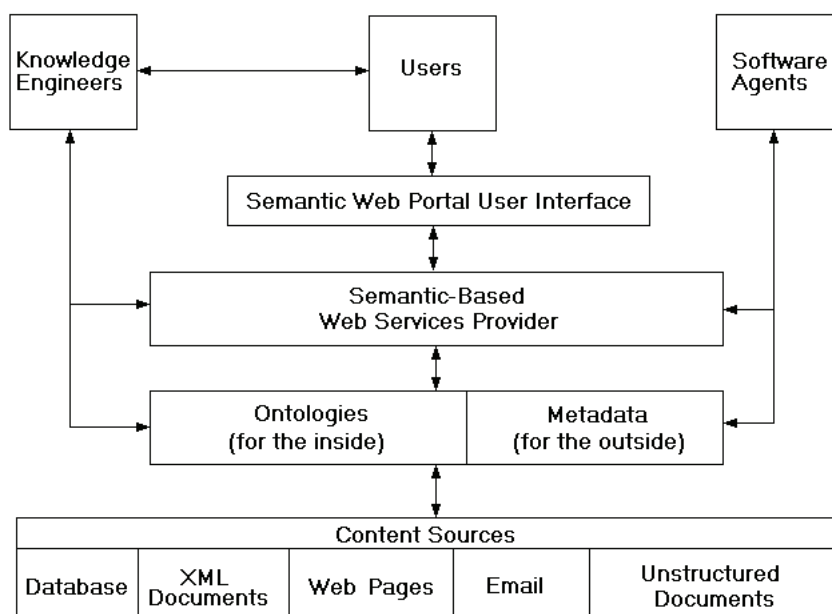
- Semantic Web Development Tools:** At the implementation level of Semantic Web portals, there have been several Semantic Web development tools and standards developed by W3C (2006) during the past several years. The eXtensible Markup Language (XML) is a fundamental tool for developing Semantic Web portals. XML provides an interoperable syntactical instrument to represent relationships and meaning of data. Uniform resource identifiers (URI) provide the ability for uniquely identifying resources as well as relationships among resources. The resource description framework (RDF) family of standards further leverages the powers of URI and XML for Semantic Web development. According to RDF, human semantics are represented in sets of triples, and each triple is similar to the subject, verb, and object of an elementary sentence. These triples can be written using XML tags. Subject and object are each identified by a universal resource identifier similar to a link on a Web page. This framework ensures that concepts are not just words in a Web document, but are tied to a unique definition. There has been an increasing need for specific tools at a more expressive level for Semantic Web development, such as OWL Web ontology language (2006) and the extensible rule markup language (Lee, & Sohn, 2003).
- Agent-Enabled Semantic-Based Web Services:** Web portals provide applications to Web users. The programmatic interfaces to those applications are referred to as Web services (W3C, 2006). Specifically, browsing, querying, searching, portal maintenance,

and other functions provided by Web portals are all Web services. Semantic Web services add two unique features to non-Semantic Web portals (Ermolayev, Keberle, Plaksin, Kononenko, & Terziyan, 2004; Payne & Lassila, 2004). First, Semantic Web services are semantic-based. Ontologies and Semantic Web development tools are used to power Web services. Inside the Semantic Web portal, Web services are accomplished based on the ontology. Outside the Semantic Web portal, metadata are gathered through crawling Web pages. Here, metadata is computer understandable information about the data contained in the Web documents. Second, intelligent software agents and ubiquitous computing techniques are applied to fully automate the Web services processes.

SEMANTIC WEB PORTALS AND KNOWLEDGE MANAGEMENT

The ultimate objective of Semantic Web portals is to assist knowledge management including knowledge acquisition, knowledge representation, knowledge sharing, and evolution of human knowledge through the Internet. Semantic Web portals allow knowledge workers to express new concepts (or knowledge) using the unified terminology. These concepts will be organized into well-formatted structures (i.e., ontologies) and retained in the Web portals. These structures will open to meaningful analysis by knowledge workers as well as software agents. In the view of knowledge management, Semantic Web portals provide a new class of environment

Figure 1.



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