Category: Concepts, Trends, and Challenges

Ontology Development Tools for Ontology-Based Knowledge Management

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INTRODUCTION

Ontologies play a key role in realizing the full power of e-technology. Ontologies allow for machine-understandable semantics of data, and facilitate the search, exchange, and integration of knowledge for B2B (business-to-business) and B2C (business-to-consumer) e-commerce. Ontology is defined as the specification of shared knowledge (Waterson & Preece, 1999). By using semantic data, the usability of e-technology can be facilitated. There are several languages like XML (extensible markup language), RDF (resource description framework), RDFS (RDF schema), DAML+OIL (DARPA Markup Language+Web Ontology Language), and OWL. Many tools have been developed for implementing metadata of ontologies using these languages. However, current tools have problems with interoperation and collaboration. The primary goal of this survey is to introduce and understand several tools through their use. Therefore, we can develop a new generation of tools that not only support more capabilities, but also solve the problems of current tools.

BACKGROUND

Ontology tools can be applied to all stages of the ontology life cycle including the creation, population, implementation, and maintenance of ontologies (Polikoff, 2003). An ontology can be used to support various types of knowledge management including knowledge retrieval, storage, and sharing (Pundt & Bishr, 1999). In one of the most popular definitions, an ontology is the specification of shared knowledge (Waterson & Preece, 1999). For a knowledge-management system, an ontology can be regarded as the classification of knowledge. Ontologies are different from traditional keyword-based search engines in that they are metadata, able to provide the search engine with the functionality of semantic matching. Ontologies are able to search more efficiently than traditional methods. Typically, an ontology consists of hierarchical descriptions of important concepts in a domain and the descriptions of the properties of each concept.

Traditionally, ontologies are built by both highly trained knowledge engineers and domain specialists who may not be familiar with computer software. Ontology construction is a time-consuming and laborious task. Ontology tools also require users to be trained in knowledge representation and predicate logic.

XML is not suited to describe machine-understandable documents and interrelationships of resources in an ontology (Gunther, 1998). Therefore, the World Wide Web Consortium (W3C) has recommended the use of RDF, RDFS, DAML+OIL, and OWL. Since then, many tools have been developed for implementing the metadata of ontologies by using these languages.

MAIN THRUST OF THE ARTICLE

There are several ontology languages like XML, RDF(S), DAML+OIL, and OWL that are used to implement tools for implementing the metadata of ontologies.

Protégé 2000

Protégé (Noy, Sintek, Decker, Crubezy, Fergerson, & Musen, 2001) is developed by Stanford Medical Informatics. With Protégé, a user can construct domain ontologies, customize data entry forms, and enter data. Protégé has an extensible plug-in architecture, allowing users to add functionality by using plug-ins. Hence, Protégé can be easily extended to use knowledge-based embedded applications. Tables and diagrams are constructed using graphical widgets. However, new basic types cannot be added in Protégé.

Protégé 2000 assumes that knowledge-based systems are usually very expensive to build and maintain because knowledge-based system development is done by a team including both developers and domain experts who may be less familiar with computer software. Protégé 2000

guides developers and domain experts through the process of system development. Developers can reuse domain ontologies and problem-solving methods with Protégé 2000, shortening the time for development and program maintenance. One domain ontology that solves different problems can be used in several applications, and different ontologies can use the same problem-solving methods.

OilEd

OilEd (Bechhofer, Horrocks, Goble, & Stevens, 2001) is developed by the Information Management Group of the CS Department at the University of Manchester, United Kingdom. OilEd is an OIL editor that allows a user to create and edit OIL ontologies. OilEd is primarily intended to demonstrate the use of DAML+OIL, but it does not support a full ontology-development environment. OilEd does not support many activities such as the creation of large-scale ontologies, versioning, augmentation, and the migration and integration of ontologies that are involved in ontology construction. OilEd has no extensibility, but arbitrary class expressions, primitive and defined classes, and concrete-type expressions can be used.

Apollo

Apollo (Koss, 2002) is developed by the Knowledge Media Institute of Open University, United Kingdom. Apollo allows a user to model an ontology with basic primitives such as classes, instances, functions, relations, and so forth. The internal model is a frame system based on the Open Knowledge Base Connectivity (OKBC) protocol. The knowledge base of Apollo consists of hierarchically organized ontologies. Ontologies can be inherited from other ontologies and can be used as if they were their own ontologies. Every ontology has a default ontology, which includes all primitive classes. Each class can create a number of instances, and an instance inherits all slots of the class. Each slot consists of a set of facets. Apollo can be extended with plug-ins, but it does not support collaborative working.

RDFedt

RDFedt is developed by Jan Winkler of Germany. RDFedt allows a user to build complex and structured RDF and RSS (RDF site summary) documents. It provides an overview of complex data structures with element trees. Also, it allows a user to test data and to give comments and error messages with the help of additional functions.

RDFedt supports RDF, RDFS, and Dublin core elements. RSS 1.0 provides modules like aggregation, notation, content, cut, organization, change of page, threading, and so forth. RSS 0.91 supports declaration and levels of styles in XML, sets of imported elements, and the automatic generation of an RDF-based linked list from an HTML (hypertext markup language) document.

RDFedt is a textual language editor. It is not a Java program, is not platform independent, and works only on Windows.

OntoLingua

OntoLingua (Fikes, Farquhar, & Rice, 1997) is developed by the Knowledge Systems Lab of Stanford University. It provides a user-distributed collaborative environment, a suite of ontology-authoring tools, and a library of modular, reusable ontologies. It also supports a World Wide Web (WWW) interface and translation into different formats. OntoLingua is an ontology library and server that can be accessed with a traditional Web browser. By assembling and extending the ontologies obtained from the library and tools in OntoLingua, authorization can be provided. Using Chimaera, the taxonomy is reorganized and name conflicts in the knowledge base are resolved. Multiple users can use OntoLingua via write-only locking and user access-level assignment.

OntoEdit

OntoEdit (Sure, Angele, & Staab, 2003) is developed by Ontoprise of Germany. There are freeware and professional versions. Our survey focused on freeware. OntoEdit offers export interfaces to all major ontology-representation languages and has a flexible plug-in framework. This feature allows a user to customize the tool in a user-friendly fashion. Several functions are modularized, so it can be easily extended.

An ontology requirements-specification document describing what an ontology should support is needed for ontology development. According to the ontology requirements-specification document, an ontology engineer determines relevant concepts and their hierarchical structure in the ontology. OntoEdit can be used in this phase using two plug-ins, OntoKick and Mind2Onto5, for metaontology description with the automatic calculation of statistic information.

WebODE

WebODE (Arpirez, Corcho, Fernandez-Lopez, & Gomez-Perez, 2001; Corcho, Fernandez-Lopez, Gomez-Perez, & Vicente, 2002) is developed by the Technical School of Computer Science in Madrid, Spain. It was made to use and test the methontology methodology. The motivation