Classification of Semantic Web Technologies

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INTRODUCTION

Semantic Web is the name of the next generation World Wide Web, that has been recently proposed by Tim Berners-Lee and the World Wide Web Consortium (W3C)[1]. In this new Web architecture, information and Web services will be easily understandable and usable by both humans and computers. The objective is not to make computers understand the human language, but to define a universal model for the expression of the information and a set of inference rules that machines can easily use in order to process and relate the information as if they really understood it (Berners-Lee, 1998). Though, as the current Web provided sharing of documents among previously incompatible computers, the Semantic Web intends to go beyond, allowing stovepipe systems, hardwired computers, and other devices to share contents embedded in different documents. The most known architecture for Semantic Web is based on a stack of related technologies, each one being a whole research area by itself (Berners-Lee, Hendler, & Lassila. 2001; Pereira & Freire, 2005).

Accomplishment of the Semantic Web is considered a great challenge, not only due to the complexity of implementation but also because of the vast applicability in several areas. In spite of this, Semantic Web is still one of the most promising research areas among those which aim to define a new architecture for the Web.

Semantic Web goes far beyond previous information retrieval and knowledge representation projects, presenting a non-centralized way to represent and contextualize real-world concepts, unambiguously, for several areas of knowledge. Semantic Web-enabled machines will handle information at our communication level. It is clear that the ability to interpret reality is still very primitive, however, Semantic Web points a way towards machine interaction and learning (Pereira et al., 2005). Semantic Web will integrate, interact with, and bring benefits to most human activities. Its full potential will go beyond the Web to real-world machines, providing increased interaction between machines and with humans—smarter phones, radios, and other electronic devices. Semantic Web will bring a different kind of approach in the understanding of reality by the machines and will constitute a mark in the evolution of human knowledge (Pereira et al., 2005).

BACKGROUND

The arrival of many new Semantic Web technologies over the last few years reveals the acceptance and credibility of the Semantic Web architecture. Nevertheless, the fast appearance of these new technologies and the wide diversity of areas and forms where they can apply demand a high effort of knowledge updating about actual features used in Semantic Web technologies to all future developers. Due to the urgent need of eliminating a huge lack of information about recent Semantic Web technologies, we provide a classification in categories for 80 of more than 100 recent Semantic Web technologies that are accessible from the Web. Their main features are also presented.

This work is mainly based on information presented in Bizer (2005) and SemWebCentral (2005). We have classified the 80 Semantic Web technologies in 11 categories: Visualization, validation, conversion, annotation, brower, query, editor, integration, repository, API (Application Programming Interface), and reasoner. Next section provides a detailed description by category of the main existing Semantic Web technologies.

SEMANTIC WEB TECHNOLOGIES BY CATEGORY

In this section we present eleven tables with technologies grouped by each category and up to ten of their main characteristics:

- **Developer:** Developer name;
- **Release:** Latest release number and publication date;
- **License:** License under which the technology is distributed;
- **Language:** Language development used to develop the technology;
- **API-Paradigm:** API-Paradigm for the manipulation of RDF data;
- **Query-Languages:** Query-Languages used by technology;

Table 1. Main features of annotation technologies

	Developer	Release	License	Language	Input	Output	O.S.
AeroSWARM[2]	UBOT Team	-	-	-	HTML	OWL	Independent
OntoMat--Annotizer[3]	Handschuh, S., Braunv, M., Buerkle, C., Kühn, K., Meyer, L. and Krekeler, T.	0.8.2 Feb-05	LGPL	Java	N3 OWL RDF	N3 OWL RDF	Independent
PhotoStuff[4]	Mindswap	2.11 Mar-05	Mozilla	-	-	-	Independent
RIC[5]	Michael Grove (Mindswap)	3.0 Alpha	(Grove, 2002)	Java	-	-	Independent
SemanticWord[6]	Teknowledge Corporation	Alfa 1.0 Aug-04	-	Visual Basic	OWL	OWL	Windows NT/2000
Swangler[7]	STET	1.0.1 Apr-05	GPL	Java	OWL RDF	OWL	Independent

Table 2. Main features of API technologies

	Developer	Release	License	Language	API-Paradigm	Storage Model	Input	Output	O.S.
CARA[8]	Stefan Kokkelink	Pre0.001 Mar-01	GPL	Perl	Resource-centric	Memory	RDF/XML N-Triples	RDF/XML N-Triples	-
CODIP[9]	DARPA	0.9.0 Dec-04	BSD	Java	-	-	OWL UML XMI	OWL UML XMI	Independent
HAWK[10]	SWAT Lab, Lehigh University	1.1 Beta Dec-04	GPL	Java PL/SQL	-	-	OWL RDF	OWL RDF	Independent
Kazuki[11]	Self, T., Lerner, J., and Rager D.	1.2 Jun-04	BSD	Java	-	-	OWL	-	Independent
NG4J[12]	Chris Bizer Richard Cyganiak Rowland Watkins	0.4 Fev-05	BSD	Java	Statement-centric	Memory MySQL	RDF/XML N-Triples N3 TriX TriG	RDF/XML N-Triples N3 TriX TriG	Independent
OWL API[13]	Bechhofer, S., Volz, R., Kalyanpur, A., Crowther, P., Horan, B., Turi, D., and Lord, P.	1.4.2 Mar-05	LGPL	Java	-	-	OWL	OWL	Independent
OWL-S API[14]	Paolucci, M., Srinivasan, N. Softagents Group	0.1 beta Dec-04	LGPL	Java	-	-	OWL	OWL	Independent
OWL Semantic Search Services[15]	Bhanu Vasireddy John Li	0.1 beta Dec-04	-	Java Java-Script Prolog	-	-	-	-	Linux
Pyrple[16]	Sean B. Palmer	Jun-04	-	Python	Statement-centric	Memory	RDF/XML N3 N-Triples	RDF/XML N3 N-Triples	-
SOFA[17]	Alishevskikh, A. Mihalik, I. and Ganesh, S.	0.3 Mar-05	LGPL	Java	Resource-centric Ontology-centric	Memory JDBC compliant DB	OWL RDF	OWL RDF	Independent
Sparta[18]	Mark Nottingham	0.6	-	Python	Resource-centric	-	RDF/XML N3 N-Triples	RDF/XML N3 N-Triples	-