International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 02 Issue: 09 | Dec-2015 www.irjet.net p-ISSN: 2395-0072

Semantic Web: An approach for Effective Teaching and Learning

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Abstract - *Semantic web represents a potential technology for realizing e-Learning requirements. Research works in the field of e-Learning are represented by a wide range of applications, ranged from virtual classrooms to remote courses or distance learning. However, studies show that still it demands more effective approach. Semantic web has played an important role in designing such applications by either extending already existing applications to semantic web or creating new applications that are completely semantic web based. Use of semantic web techniques is a step further towards increasing the efficiency of applications by providing s of the knowledge as these are more effective in expressing an idea. Semantic Web enhances the capability of the semantic Web technology to access and process data from websites, databases, XML documents, and other systems to increase the amount of useful data retrieved exponentially. During the last few years semantic web has achieved long milestones and also during this period it brought up new ideas to set up a new form of web. This paper focuses on analyzing the semantic web development and discussing the milestones that semantic web has covered in teaching Learning and the challenges it is facing in its progress. The main objective of this paper is to identify the main reasons that brought up the semantic web development and also to identify the basic technologies in semantic web used for effective teaching and learning.*

Key Words: **Semantic Web, eXtensible Markup Language (XML), Resource Description Framework (RDF), RDF Schema, Ontology, Web Ontology Language (OWL).**

1.INTRODUCTION

The Semantic Web offers new technologies to the developers of Web-based applications aiming at providing more intelligent access and management of the Web information and semantically richer modeling of the applications and their users. An important target for the Web application developers nowadays is to provide means to unite, as much as possible, their efforts in creating information and knowledge components that are easily accessible and usable. To achieve interoperability among various educational systems and to have automated, structured and unified authoring support for their creation is a challenging task. A central role in achieving unified authoring support plays the process-awareness of authoring tools, which should reflect the semantic evolution of e-learning systems.

The learning technology community is quickly adopting many of the Web technologies (XML, RDF(S), streaming video etc.) Simultaneously, the educational technology standardization is moving forward at rapid pace. Both bring important contributions with respect to the management of educational resources. There is a growing concern though towards the need of extending the existent educational standards in the context of the Semantic Web so as to allow improved semantic annotation of learning resources.

Semantic Web enhances the capability of the semantic Web technology to access and process data from websites, databases, XML documents, and other systems to increase the amount of useful data retrieved exponentially. Moreover relational databases already contain a large amount of semantic information. Databases are organized in tables and columns on the basis of relations between the tasks at home, and these relationships show the meaning (semantics) of data. Many technologies have been developed for constructing and developing the semantic web [4]. During the last few years semantic web has achieved long milestones and also during this period it brought up new ideas to set up a new form of web. Therefore, in this chapter an attempt shall be made firstly to analyze the semantic web development thereby discussing the milestones that semantic web has covered in teaching Learning and the challenges it is facing in its progress. Then the impact of this semantic web development on current research in academic and business environment shall be dwelt upon. Thus, the major objectives of this chapter would be

- To identify the main reasons that brought up the semantic web development [2]
- To identify the basic technologies in semantic web used for effective teaching learning [3]

The Semantic Web as explained above is a network that not only takes apparently infinite amount of data on the World Wide Web, but also connects this information with data in relational databases and other non-compatible archives. Relational databases are databases that are organized in tables and columns on the basis of relations between the tasks and these relationships show the meaning (semantics) of data. Semantic Web, however, can be a machine to connect to another machine and the

exchange of data and process effectively on the basis of built-in, available semantic information describing each of the resources [1]. The fact is that the Semantic Web makes it possible for us to have all the information mentioned as a large database. The Semantic Web data itself becomes part of the web and can be processed, regardless of application, platform, or domain. This is in contrast to the World Wide Web as we know it today, which contains virtually unlimited information in written form. Computers, can be used to search these documents, but have not yet been read and interpreted by the people before any useful information can be transmitted. Computers can transmit information, but cannot understand what information is useful to view that is most relevant in a given circumstance. Semantic Web, on the other hand, is to have access to information and documents on the Web so that machines can process, transform, assemble and even act on the data in usable form [2] [3].

2. SEMANTIC WEB FRAMEWORK

There are a number of technologies available to create semantics on the web. Some of these core technologies are as shown in figure 1:

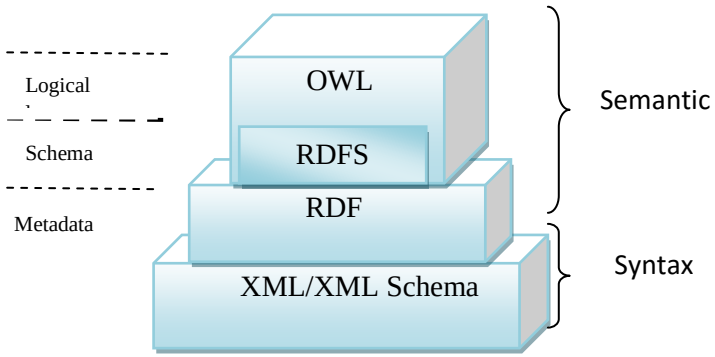

Figure1: Semantic Web technologies

2.1 XML and XML Schemas: The SW metadata uses XML syntax. Extensible Markup Language (XML) [9] is a standard text format for serializing data using tags and offers many technologies and tools available for XML data processing. These are the tools used to go beyond the fixed-oriented structure of the HTML page that provides vocabulary. With XML, it is possible to describe the structure of data and documents under a personal or Community defined vocabulary. These vocabularies can be a kind of semantics and support for an open exchange of data within communities and the tools to understand the vocabulary [5].

An XML schema is a description of a type of XML document. Some languages are developed specifically to express XML schemas and the Document Type Definition (DTD) language, is native to the XML specification. DTD is a schema language useful for expression of schemas [8].

2.2. RDF and RDF Schema: RDF is based on existing XML and URI (Uniform Resource Identifier) technology, a URI to identify all the resources and the use of URI to make statements about resources. RDF statements are often called triple, which consists of a subject, predicate and object. It does not structure the syntax of the data, but defines semantic meaning for data on the web. Multiple semantic perspectives of the same data are possible. The technology is based on lower level technologies: URI's to identify web resources and Namespaces to identify different vocabularies. RDF is used to create the vocabulary that describes groups of RDF-related resources and the relationship between these resources. An RDF vocabulary permitted defines properties that can be allocated to the RDF resources within a given domain. In figure 2 “triples” are shown for RDF statement which has the subject, predicate and object. After defining the “triples” as graphically we can code it either in RDF or XML [6] [7].

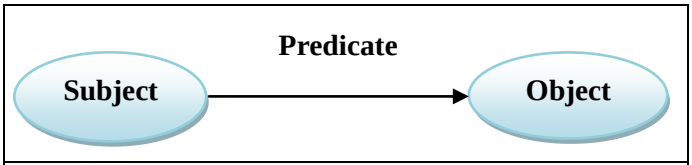

Figure2 : RDF Triples

Thus, Resource Description Framework (RDF) is a simple resource–property–value model designed for expressing metadata about resources on the Web. RDF has a graphical syntax as well as XML-based serialisation syntax.

2.3 RDF Schema is a set of predefined resources (entities with uniform resource identifiers) and relationships between them that define simple meta-model including concepts of classes, properties, and subclass and sub property relationships. It [10] is a language to describe RDF vocabularies (ontologies). It also allows describe class and property hierarchies, give labels to URIs, constrain domain and range of properties. Although RDF Schema and XML Schema [11] are both “schemas”, with different purposes: RDFS is for inference and XMLS is for validation.

2.4 Web ontology language (OWL) Ontology language gives greater machine interpretability of Web content to support for XML, RDF, and RDF Schema. They do this by providing additional vocabulary along with formal semantics. OWL is possible to implement a semantic description of a specific domain, indicating the concepts and relationships between concepts. There are three particular sublanguages: OWL Lite, OWL DL and OWL Full as shown in figure3 [14].

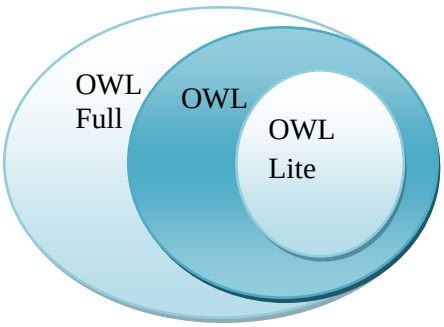

Figure3: OWL Family

The description of Ontology requires the definition of "ontology" in connection with the Semantic Web .The Ontology can be defined as a system that formally defines hierarchies and relations between different resources. Ontology, which is the heart of semantic web, with concept instantiations serves as a domain knowledge base i.e. semantic web technology information centre. The ontology is designed for the system to incorporate the domain information in the form of instances and data type values, classes and object properties i.e. to model the knowledge domain. Ontologies allow for machine-understandable semantics of data, and facilitate the search, exchange, and integration of knowledge [15].

For a knowledge-management system, 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, ontology consists of hierarchical descriptions of important concepts in a domain and the descriptions of the properties of each concept [16].

3. ONTOLOGY DEVELOPMENT TOOLS

Finding an appropriate tool to develop ontology is the first step towards ontology development. Ontology development is a complex and largely domain-oriented process that can be benefited from tool support. Various tools for ontology development are available like protégé, OilED, Apollo, etc as mentioned in table 1. Though there are enormous ontology development tools [17] available for free on the web. Ontology development tools are compared based on certain features such as modeling features/limitations, base language, web support and use, import/export format, graph view, consistency checks, multi-user support, merging, lexical support, and information extraction as shown in table 1 given below[6]. Several important aspects of the tools exist. Most of the tools are moving toward Java platforms and extensible architectures as well. Interoperability and storage in databases are still weak points of ontology tools. The most dominant and domain-independent tool used is protégé as it supports many features like GUI, storage through JDBC etc [12] [13] which are not supported by other many tools. Semantic Web ontology is taxonomy and a set of rules for the inference that the machines can make logical conclusions. Taxonomy, in this context is the system of classification, groups of resources into classes and sub-classes based on their relationship and common property. Since the taxonomy to express the hierarchical relationships between resources, OWL can be used to

Table 1: Ontology tools

Features	Protege	OilEd	Apollo
Import Format	XML, RDF(S), XML Schema	RDF(S), OIL, DAML+OIL	OCML, CLOS
Export format	XML, RDF(S), XML schema, FLogic, CLIPS, Java, HTML	RDF(S), OIL, DAML+OIL, SHIQ, dotty, HTML	OCML, CLOS
GUI	Via plugins like GraphViz and Jambalaya	No	No
Consistency check	Via plug-ins like PAL and FaCT	Via FaCT	Yes
Multiuser	Limited (multiuser capability added to it in 2.0 version)	No	No
Web support	Via Protégé-OWL plug-in	Very limited name spaces	No
Collaborative working	No	No	No
Ontology library	Yes	Yes	Yes
Ontology storage	File & DBMS (JDBC)	File	Files
Extensibility	Via plug-ins	No	Via plug-ins
Availability	Free	Free	Free

assign characteristics of classes of resources and allow their sub-classes that inherit the same characteristics.

4. CONCLUSION

The Semantic Web paradigm enhances human accessibility to the current Web technology by enabling the useful accessing of knowledge. Semantic Web development posses on its enormous success and has shown significant growth in different directions, from research to industry and institutions to business. As well as on the other hand, challenges are also enormous, especially these ideas about semantic web have to become a reality according to the Web level in the near future. Semantic Web technologies probably shall play a decisive role in the semantics of intranet enterprise level in the near future. Research is also being carried out on ontology alignment system and framework too.

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