Using Semantic Web in Web-Based Education

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Abstract. The technologies needed for the realization of the Semantic Web build upon work in the area of Intelligence Artificial (IA). The Semantic Web should not repeat one of the big errors of the IA: big promises that raise too high expectations. This paper we make a proposal of a development platform Learning LMS based on a of our advances in Semantic Web, using Intelligent Reusable Learning Components Object Oriented (IRLCOO), being the metadata a fundamental component in the Semantic Web in systems WBE. Producing learning materials standardized with SCORM 2004. The multiagent architecture is a software framework implemented in JADE. The MultiAgent Systems (MAS) is a middleware that complies with the FIPA specifications, the middleware implemented is for the LMS-WBE system is for sequencing and delivery of learning materials composed of IRLCOOs, in function of the student's metric personalized measures, to give a personalized intelligent answer, based on the metadata.

1 Introduction

A fundamental problem of AI is the difficulties in achieving human level Artificial Intelligence within ten or twenty years, as promised at some points in the past. A fundamental advantage of the Semantic Web on the IA is that partial solutions will work in Semantic Web. Even if an agent is not able to come to all conclusions that a human user might, the agent will still contribute to a better Web superior to the current Web. The ultimate goal of AI is to build an intelligent agent exhibiting human-level intelligence or better, while the ultimate goal of the Semantic Web is to assist human users in their online activities. The goal of semantic web it is much more accessible and more realizable in the short time that the goal of the IA. There are enough advances at the moment that can be implemented specifically without problems in the Semantic Web in a platform WBE, as is described next in the paper. The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential [1]. The W3C is the leader in the development of technologies for the Web. The organization is guided for Tim Berners-Lee, who has been promoting the development of the Semantic Web. The W3C on the Semantic Web has a diagram labeled Architecture. This diagram denominated: "Semantic Web layer", is depicted in the Fig. 1.

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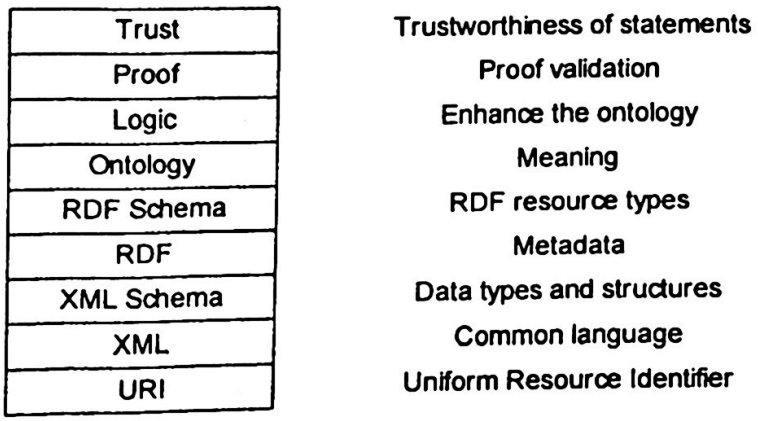

Fig. 1. A layered approach to the Semantic Web.

All resources have a Universal Resource Identifier URI, (URI). A URI can be a Unified Resource Locator (URL) or some other type of unique identifier; an identifier does not necessarily enable access to a resource. Extensible Markup Language (XML), used to define almost all new languages that are used to interchange data over the Web. XML Schema, a language used to define the structure of specific XML languages [2]. Resource Description Framework (RDF) a language of describing all sorts of information and metadata. RDF Schema is a framework that provides a means to specific basic vocabularies [3-4]. The Ontology is a language used to define vocabularies and establish the usage of words and terms in the context of a vocabulary [5]. Logical reasoning is used to establish to consistency and correctness of data sets and to infer conclusions that are not explicitly stated [6]. The Proofs explain the steps of logical reasoning. The Trust is a means of providing authentication of identity and evidence of the trustworthiness of data, services and agents [7].

There are a great variety of problems to solve in the development of systems WBE using Semantic Web, next we show some.

2 Learning Objects and metadata

There are different definitions of what is a Learning Object (LO); a simple definition is the following: "a resource which helps a learner achieve a particular learning objective". Another fundamental concept is denominated Learning Object Metadata (LOM) defines a wide range of metadata to classify and characterize an LO [8].

2.1 Granularization

The word Granularization refers to the size of LO, is important to know the size, the Granularization is a necessary condition for LOs to be shared and reused. Reuse is necessary to gain diverse benefits from viewpoint educational technology.

2.1.1 Levels of granularity

The principle of granularization of LOs is easy to define, but it is much more difficult to find consensus on describing the various levels of granularity. There are different visions to define granularity levels: educational terms, size terms, purpose terms, technical terms etc.

2.2 Using and reusing LOs

The LOs can be developed to conform a learning experience. The Individual LOs that are fully self-contained and reused directly are not common, primarily because learning is more than just simple experiences. Most learning experiences are built from a group of LOs. Reuse of the experience as a whole.

Standards such as IMS Content Packaging and the Sharable Content Object Reference Model (SCORM 2004) provide the interoperability standards [9-10].

An interesting case of reuse is assembling and sequencing new learning experiences from existing LOs. But that factors to take into account for assembling and sequencing of a new learning experience, extract relevant information, and assembling and sequencing the new experience on Run-Time to meet both desired learning objectives and the learner's experiences and preferences. Decomposition of an existing learning experience and reassembly are complex problems. All the LOs will have associated metadata. The collections will have descriptions of the learner's intended interactions with the LOs and the constraints on the learner's behaviour. The original group and experience are joined together by having a single context, a learning purpose, an approach, a style, an objective, etc. Metadata descriptions express this context and join. The join and context are not formally expressed, but are hidden or implicit throughout the LOs and the descriptions of the learning experiences, the Fig. 2 shows this.

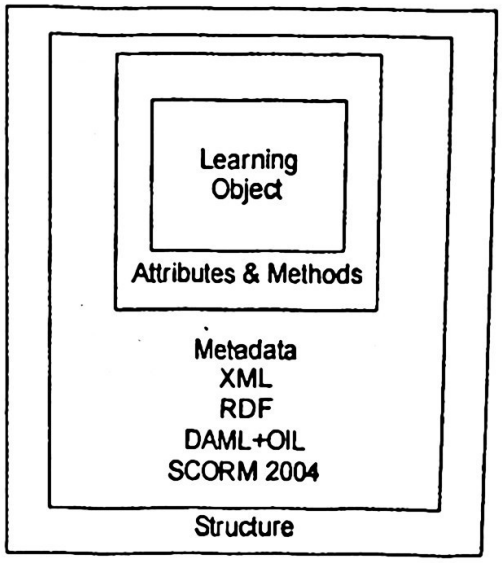

Fig. 2. Descriptions layered onto a LOM.

3 Encapsulation and Metadata in LOs

The Encapsulation helps the software designer by forcing information hiding. Objects encapsulate data and the methods for manipulating that data. In a sense, the object hides the details of the implementation from the user of that object. There are two very real benefits from encapsulation conceptual and physical independence. Conceptual independence results from hiding the implementation of an object from the user of that object. Consequently, the user is prevented from doing anything with an object that depends on the implementation of that object. Physical independence arises from the fact that the behavior of an object is determined by the object itself.

The main idea behind of the components IRLCOOs is: to reduce the complexity of elaboration of materials technically, to reduce the complexity of meta labeled SCORM 2004 of the materials, to standardize the interfaces and functionality, this was solved in the first phases of the project [11-12]. Later on the components were redefined with the following improvements: redesign and implementation to the paradigm object oriented, separation of content and control, communication between IRLCOO and LMS, communication between IRLCOO and Agents [13].

The fundamental idea of the components IRCLOOs is to encapsulate functionalities and properties of the different didactic materials of a course, reducing the elaboration complexity and of meta labeled, simplifying its production. But the meta labeled SCORM 2004 is not enough to take the following step toward the Semantic Web, for what had to use other technologies in the labeled goal of the materials to advance in that address.

IRLCOO were implemented with a group of technologies to be able to enable the Semantic Web with the components IRLCOOs, besides the SCORM 2004 other technologies were used like: Uniform Resource Identifier (URI), Extensible Markup Language (XML), XML Schema, Resource Description Framework (RDF), RDF Schema and DARPA Agent Markup Language (DAML) + Ontology Inference Layer (OIL) [2-6, 14].

While the metadata SCORM 2004 is useful to add information, to structure documents, and navigation it is correct from the XML viewpoint, this answer is semantically unsatisfactory. This kind of information makes use of the semantic model of the particular domain, and cannot be represented in XML or in RDF but is typical of knowledge written in RDF Schema. Thus RDFS makes semantic information machine accessible, from the viewpoint of the Semantic Web vision. Serialization converts an object into a persistent form. RDF/XML is the serialization technique used in the rest of this paper, the serializing RDF to XML provides a means of documenting an RDF model in a text-based format, literally serializing the model using XML.

Annotea enhances collaboration via shared metadata based Web annotations, book-marks, and their combinations. By annotations we mean comments, notes, explanations, or other types of external remarks that can be attached to any Web document or a selected part of the document without actually needing to touch the document. When the user gets the document he or she can also load the annotations attached to it from a selected annotation server or several servers and see what his peer group thinks. Similarly shared bookmarks can be attached to Web documents to help organize them under different topics, to easily find them later, to help find related

material and to collaboratively filter bookmarked material [15]. Annotea uses an RDF based annotation schema for describing annotations as metadata and XPointer for locating the annotations in the annotated document.

4 Ontology for components IRLCOOs

There are different definitions of ontologies; one of those most accepted is the following: "an explicit representation of the meaning of terms in a vocabulary, and their interrelationships. In an ontology definition language, ontology is the collection of statements or other semantic definitions for a domain" [7]. The term ontology originates from philosophy. it is used as the name of a subfield of philosophy, namely, the study of the nature of existence.

The relationship between hypertext and semantic networks has long been realized, but one of the earliest description logic systems to realize this relationship was the Untangle system [16].

The DAML program was one of the programs initiated in order to provide the foundation for the next generation of the Web, utilize agents and programs. The OIL language is designed to combine frame-like modeling primitives with the increased (in some respects) expressive power, formal rigor and automated reasoning services of an expressive description logic [16].

Taking into account all the above mentioned proceeded to develop an ontology for the components. The ontology of the components IRLCOOs in DAML+OIL is the following:

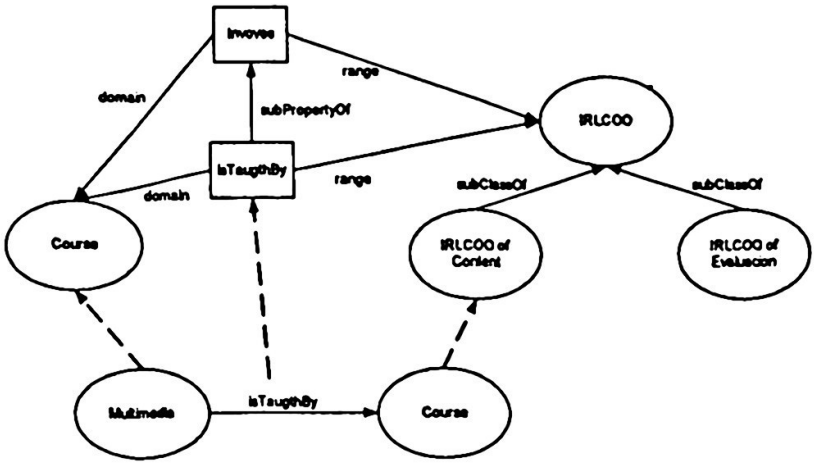

Fig. 3. Descriptions layered onto a LOM.

5 Platform LMS-Semantic Web

EVA was a Learning Management System (LMS) developed in the institution [17], and it allowed us to introduce us in the WBE, later on the Run-Time of SCORM like

LMS that we use as platform, but to the which we made him some attaches to enable the Semantic Web, like it is shown in the Fig. 4.

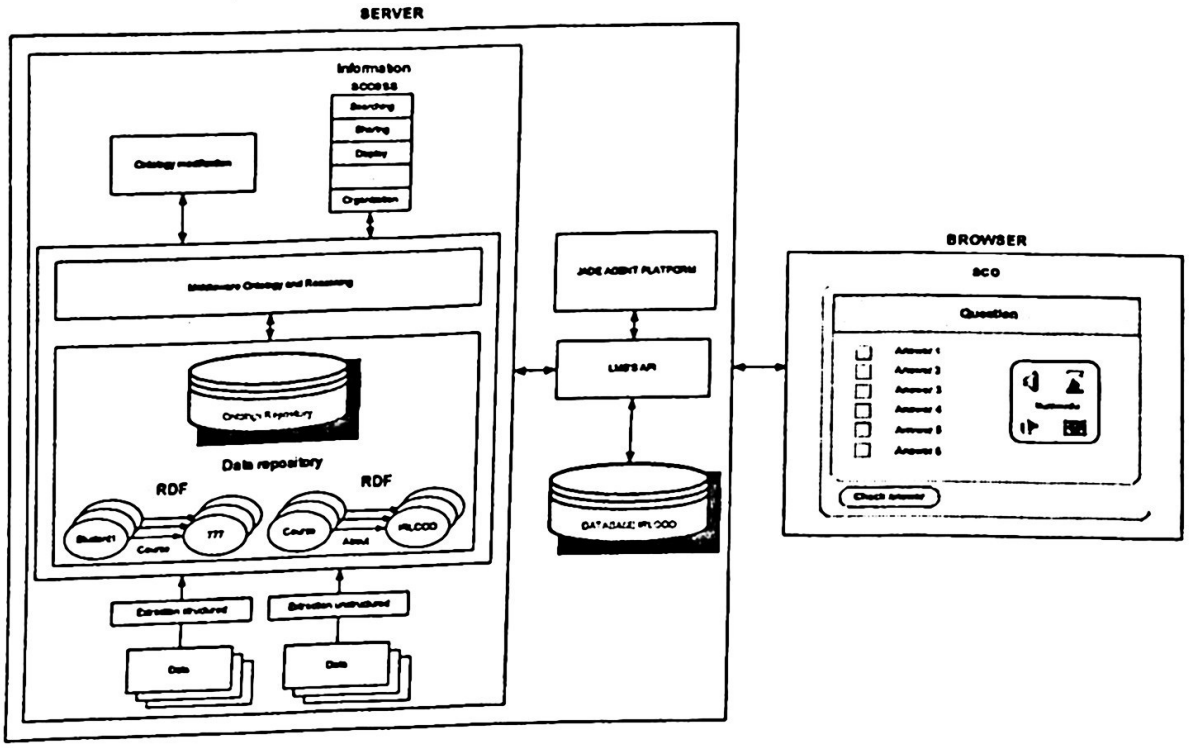

Fig. 4. LMS Semantic Web and IRLCOOs.

The Fig. 4 shows the following functional blocks of the platform LMS - Semantic Web on the side of the server:

- Agent platform,
- LMS,
- Semantic Web platform,
- Database IRLCOO.

While on the side of the client the IRLCOO is serving as interface toward the student. Being the central point on the side of the server the LMS type ADL, that joins the other functional blocks.

The set of IRLCOO objects are basically of two types: content and evaluation, all the IRLCOO are Web resource, its metadata, a movement associated with the resource, presentation, sound, image, animation, video and type information, navigation and other related resources. The IRLCOO allows the bidirectional of the Semantic Web, since they allow to capture the student's actions and to store them on the side of the server, so much in the handling of the means like of the trajectory that the student continues, taking the control the LMS to allow to the system composition and dynamic sequence, depending on the student's metric measures and of the inferences carried out in function of their evaluations.

Java Agent DEvelopment Framework (JADE) [18], it is a platform that has gone taking relevance along the time, their main advantage and disadvantage at the same time is that Java uses [19], allowing to implement the specifications of FIPA by

means of libraries that are very simple of using, their weaker point is that has some details, as the fact that it is necessary to be careful when installing the platform, since it doesn't support the long names of Windows in an appropriate way, making that many applications don't run appropriately. A middleware has been generated for communication, feedback, to compose and sequences by means of agents that it allows to enable the Semantic Web, has been modified to support the handling of metadata type: SCORM 2004, RDF and DAML+OIL, to be able to make inferences and to adapt the trajectory of the student's learning from a more appropriate way to their true necessities.

6 Conclusions

The combination of components IRLCOOs and the additional meta labeled, besides other technologies of IA, enable the Semantic Web, with the following advantages:

- Reduces the complexity for the potential developers,
- Standardizes functionalities and attributes,
- Establishes a set of APIs with functionalities,
- Establishes a platform Semantic Web.

In the aspects of work future to work inside the vision of the Semantic Web are:

- Logic,
- Proof,
- Trust.

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