OnLearn: The ontology for managing e-learning resources

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Abstract

In this article, we propose to apply Semantic Web technologies to the field of e -learning. Today, the resources available on the web increases significantly. Information Systems Research existing does not allow users to return documents that meet their exact needs expressed by a query on a document collection. To optimize information retrieval, we propose an approach based on the use of domain ontology for indexing a database and use semantic links between documents or fragments of documents collection, to allow the inference of all relevant documents. This ontology, in OWL format facilitate the management of learning resources. The development environment is used protected ontology. We describe how to semantically index the e-learning resources through semantic annotations. To test the prototype, we use language SeRQL middleware Sesame.

Keywords: *Semantic Web, ontology, semantic annotation, e-learning*.

1. Introduction

On the Web, you can find everything, including many resources that could be used as part of training from e-learning. Some of its resources are privately owned and produced internally, others are against public. The e-learning or online learning is a learning method based on the provision of educational content via the Internet by a method of information retrieval.

Indeed, the search for information is an ancient discipline, it goes back to the 1950s. His problem can be seen as the fulfillment of a requirement of a user information, which is expressed by a query on a set of documents called corpus or collection [13]. Information systems research helps to automate the task of information retrieval. The evaluation of such systems appears to be a necessity. This assessment is based on the concept of relevance of information. Note that the content remains useless until it can be easily searched and indexed. A question that may arise is: How to organize e-learning resources (courses, summaries, exercises, etc.) for obtaining relevant resources and time?

The literature identifies several models of information retrieval and content: the Boolean model, the vector model, the probabilistic model, the connectionist model, LSI, etc. Work has focused on the representation of information needs or educational content, the length of the query [14] or the reformulation of the query [11].

In addition, other work has been done on indexing, processes and languages (technical) indexing. Several techniques have been proposed: the lists of keywords have the ambiguity problem due to the polysemy; thesauri unlike semantic networks are not limited to links defining lexical relations between nodes [12], such as Mesh in the medical field and Wordnet [8] for the English language. Approximate poor and partial representation of semantic content of documents using indexing techniques (keywords or thesaurus) has pushed the use of representation formalisms more precise and rich expression skills. Among these formalisms, ontologies are used to characterize a domain by a set of concepts and relationships between concepts.

The Semantic Web has emerged as a promising technology to meet certain requirements of an e-learning system content search [6].

In this paper, we propose a prototype of an e-learning architecture based on ontology, one of the key concepts of the Semantic Web [3]. Our ontology is part of this trend that seeks to build a tool to automatically perform intelligent applications. It allows semantically annotate learning resources to facilitate research.

This paper is organized as follows: section 2 presents the problem of the management of e-learning resources. In section 3, we give the structure of our ontology, named OnLearn. Section 4 provided the architecture of the e-learning based on ontology. Finally we conclude and present opportunities to improve the prototype.

2. Management issues of e-learning resources

Problems that are the subject of research in e-learning revolve around modeling and synchronization of teaching or learning objects available resources on the Web. This in order to:

- facilitate indexing, access and reuse of learning objects;
- create customized learning environments and adaptable ;
- help teachers to produce educational materials with Web resources ;
- modeling resources for collaborative learning ;
- make learning scenarios sophisticated.

But what is a learning object?

Learning or teaching objects are granules (or grains of knowledge) training and re-reusable principle predictable with different objectives and environments. In other words, a good learning object is complete in itself and goes around a particular point of knowledge. So if someone needs this knowledge, he can use the learning object. For him to integrate it into a coherent approach. Learning objects are any entity, digital medium or not, can be used for learning, education or training. Transparencies, lecture notes, web pages, exercises, ... are learning objects.

LOM (Learning Object Metadata), describes the learning object according to 70 attributes divided into nine categories [7] - General - Lifecycle - Meta-Metadata - Technical - Educational - Rights - relationship - Annotation - Classification. Within each category, several elements can be repeated (sometimes recursively).

At the top of the hierarchy of LOM elements we find elements of "category" previously stated. These elements may be of type briefly described as follows. Element category "General" refers to the entire learning object and defines several data elements that have equivalents in the DCMES (as the title, description, and scope - coverage-). The second category, "Lifecycle", uses a hierarchical element "Contribute" construction in which the data model "Electronic Business Card" (vCard) and the encoding format to save the roles and identities of the contributors. In the category "metadata" this element "Contribute" for the construction of product in a slightly modified for the award of the creation and validation of the metadata record itself forms. The category "Technical" indicates the format, size, and other characteristics - called - "objective" of the learning object. This element also provides a class element building "requirements" that allows the formulation of instructions (statements) machine-readable about specific technical support for the use of the object. The category "Educational" for the most "subjective" characteristics of the object, indicating attributes of the audience such as age, role, and institutional context (among others). The categories "Rights" and "Relationships" are simple, using a few elements that indicate the terms and conditions of use for the legal use of the object of learning, and its possible relationship to other resources. Similarly the category "Annotation" uses only four elements to "allow educators to share their feedback, suggestions "and other" comments on the educational use of the learning object. The last category, "Classification" uses elements such as source taxon, taxon path, and identify other taxon that can be adapted for purposes of classification and taxonomy.

Management of e-learning resources is faced with the same kinds of problems that all other resources on the Web: content misunderstood by computers. To facilitate understanding by software agents and thus their accessibility and integration, semantic web technologies seem most appropriate.

3. Ontologies

The term "ontology" comes from the field of philosophy where it means science or theory of being. In the field of artificial intelligence direction is different. Etymologically speaking, ontology is a set of recognized objects existing in the field. Build an ontology is also deciding how to be and there are objects. In this definition, the objects are not taken in a computer sense but as real-world objects that the system models. In the specific context of the Semantic Web - where the final goal is to specify a computer artifact, ontology becomes a model existing objects that references through concepts, concepts of the domain [1, 2]. That is to say, an ontology includes or implies a certain view of the world with respect to a given domain. This view is often conceived as a set of concepts - e.g. entities, attributes, processes - their definitions and their interrelations. This is called a conceptualization. This allows you to specify the constraints imposed on the succession of ontologies Designer [5]: 1 to 1 ontology is a conceptualization defining concepts; 2 - to be subsequently used in a computer artefact which we want to specify the behavior, ontology should also be a logical theory for which the vocabulary handled be specified; 3 - Finally, the conceptualization is sometimes specified very precisely, a logical theory cannot always report accurately: they cannot afford the interpretive richness of the area conceptualized in the ontology and therefore only partially.

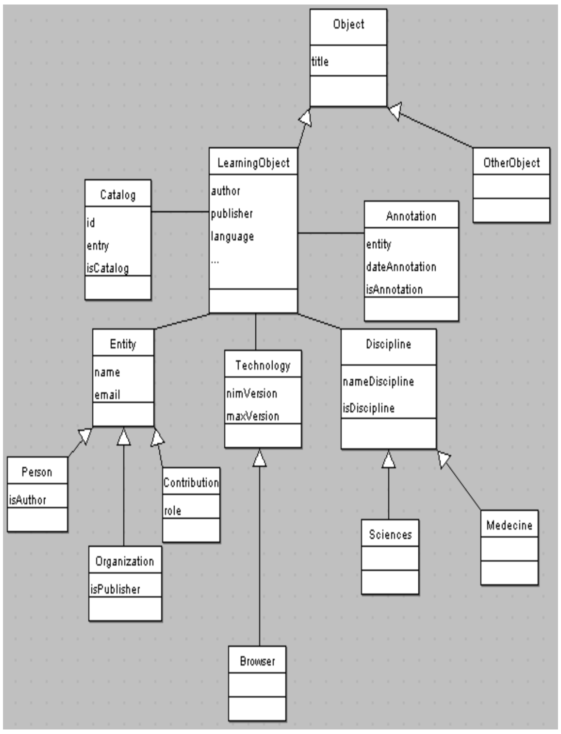

Fig. 1 UML Classes Diagram

Ontologies can be classified according to several dimensions [10]: The purpose of conceptualization, level of detail, the level of completeness, the level of representation formalism. An ontology can be used for indexing documents. In this case, the descriptors are not directly selected in documents but within the ontology. The texts are then indexed by concepts that reflect their meaning rather than words are often ambiguous. Appropriate in this case to use an ontology reflecting or knowledge areas covered in the document collection.

The ontology allows the organization of learning material around small pieces of learning objects semantically annotated (enriched) [9]. To do this, in the context of computer systems, the ontology consists of a set of classes with properties and a set of subsumption relationships between classes or domain (Raynaud, 2009). Therefore, an ontology O is defined by a tuple (C, R) where C = $c_1, c_2, ..., c_n$ is the set of classes and where R = $r_1, r_2, ..., r_m$ includes all relations classes (R_i) and the properties of the classes (R_j).

The set of classes and relationships between classes and class properties are often represented in the modeling using UML (Unified Modeling Language). Figure 1 below shows the UML taxonomy of learning objects where each rectangle represents a class with its attributes, and the lines represent the rectangle with a generalization relationship between classes.

Based on Figure 1, we transform UML class taxonomy on taxonomy of OWL (Ontology Web Language) [4]: UML classes become OWL classes, attributes of UML classes are translated into OWL properties, and UML generalization relationships are translated into relations subclasses OWL. The OWL adds more vocabulary for describing properties and classes among others, relations between classes, cardinality, equality, richer typing of properties, characteristics of properties and property hierarchies and classes. OWL has been designed to be used by applications that process the content of information instead of just presenting it to humans. OWL greatly facilitates interoperability machine-level Web content

4. E-learning architecture based on ontology

To enable efficient use of learning or e-learning resource objects, you must: 1 - build an ontology to make unambiguous concepts used as metadata in the LOM (Learning Object Metadata) standard. This will prevent content providers to use two different concepts, such as author and creator, to mean the same thing; 2 - Annotate semantically learning objects using a conceptual vocabulary provided by an ontology. This will allow students to research based on concepts provided by the ontology.

In fact, ontologies are used mainly to describe the shared vocabulary (set of symbols) direction. Thus, ontology forced all correspondences (mappings) possible between symbols and their meaning. The problem of common understanding in the e-Learning occurs on multiple orthogonal levels that describe different aspects of use of the documents.

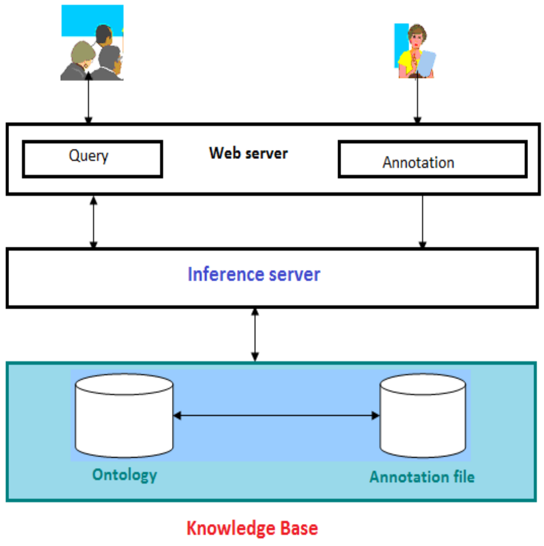

Fig. 2 Architecture of an e-learning portal based on ontology

Thus, the problem of common understanding can occur at several levels: 1 - when creating content: the probability that two different content authors express the same concept is very high. In other words, anyone can provide the content but using different keywords. For example, the former can use the word "author" while the second uses the term "creator" to reference an actor who has provided a learning resource; 2 - when the access and retrieval of content by a user: There is a problem with the keywords to use to search learning materials.

The figure 2 illustrates a proposed architecture of an e-Learning portal where metadata are based on ontology. In this architecture, content providers and learners use the same ontological vocabulary (shared common, treatable metadata machine direction).

The annotation of learning objects is done using ontology learning. Navigation and access to learning objects are by using proposed ontology concepts. In this architecture, two servers are required. As everything is done on the web, you need a web application Tomcat server. Similarly, we need an intermediate server between the Web interface and knowledge base (ontology annotations + file) for making queries.

This architecture seems to meet the needs of navigation, access and delivery of learning materials. Indeed, it is clear that users can use the context, structure and content (through ontology) to formulate their queries adequately and thus seek learning content effectively. Content providers (by annotation) for their part, can build learning objects, based on the same rules (context, content, structure). This allows suppliers to learning content and learners to be somewhat on the same wavelength (a common language) and can better share equipment.

5. Conclusion

Enter the text here. This article has enabled us to develop a prototype of an ontology might help, firstly, to semantically annotate learning objects and, on the other hand, allow to query to find different information in context of e-learning.

We realized how difficult it was to achieve an ontology in the field of e-learning. The choice of OWL has encountered the following problem related to the software tools used. Environment Protected does not yet have an inference engine for OWL ontologies written. In addition, it currently lacks a suitable browser for ontologies developed with Protégé. Sesame inference server, used to query the ontology is not yet able to exploit OWL ontologies. SeRQL the language is very limited and not expressive power as SQL.

As an extension to this paper, we propose: 1 - to enrich the prototype by knowledge from experts in engineering education; 2 - Sesame expand to take into account OWL ontologies; 3 - Develop an automatic or semi-automatic tool for annotation of learning objects; 4 - to actually build an e-learning portal based on the Semantic Web.

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