Ontology Enabled Learning Resource Modeling and Management

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Abstract

In this paper, we proposed the learning resource ontology(LRO) models to formally describe learning content and learning context, respectively. In addition to utilizing the models to formally describe content, we also derived ontological relation between the content and context at semantic level. Furthermore, we have built a semantic similarity algorithm to measure the similarity between ontologies. Based on the similarity measure, the process of LRO retrieval is presented.

1. Introduction

The term learning resource (LR) is one of the main research topics in the e-learning community in the recent years, and most researchers pay attention to the issue of LRs' reusability. Several standards have been developed so far aiming to improve LOs reusability such as IEEE Learning Object Metadata (LOM) [1].However, today's standards do not cover the instructional function of a learning resource. In order to address this issue we advocate the idea that ontologies can be used to describe LRs content.

This paper will discuss how to build a unified model of learning resource ontology (LRO) and using ontology to organize the learning resource so as to construct a knowledge base which can support the intelligent management of learning resources.

2. Relative Works

There is few studies address the use of Semantic Web and ontologies ateducational area. Devedzic introduces the key ideas of GET-BITS, a framework for building intelligent educational systems. This framework is just experimental, but it includes important development principles from the beginning, like educational ontologies based on Semantic Web and learning objects. Stojanovic et al. [2] point out, among others, the following advantages of using the Semantic Web in E-Learning: Delivery, Access, Symmetry, Modality, Authority, Personalization and Adaptability.

3. Models of learning resource ontology

Figure1 shows the model of learning resource ontology.

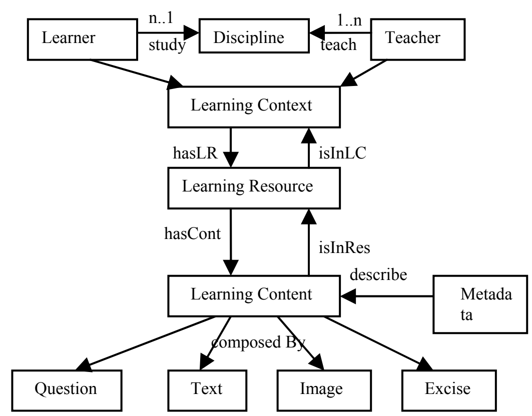

Figure 1: the model of learning resource ontology

In terms of the multilevel ontology resource model there are two types of ontological objects: learning content and learning context. Learning content, which is described by metadata, is the steady component of the learning resource. It can value values the creation of learning resource that can be reused in multiple learning contexts. It is the fundamental idea behind learning resource: instructional designers can build small instructional components, which can be reused a number of times in different learning contexts. Learning context accurately describes semantics of ontological domains, such as the discipline of the learning resource. It determines conditions for

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interoperability among learning contents and consumers (teachers or learners) [3].

The learning resource ontology can form the knowledge base of learning resource, which contains one or more ontologies. Therefore, the inference mechanisms will act over the knowledge base.

4. The knowledge query based on similarity measure between ontologies

4.1. Semantic similarity between ontologies

In the paper, We use an ontology measure (OM) Algorithm as the figure2 showed to calculate the ontology similarity between the LRO.In the algorithm, the inputs are two semantic code sequences: a query ontology (QO) with word length n and a knowledge base ontology (KBO) with word length m that are denoted as:

QO = {C0, C1,⋯, Cn} and KBO = {C0', C1',⋯, Cm'}

```
OM(QO[C0, C1,⋯, Cn], KBO [C0', C1',⋯, Cm'], e)
{
a= 0, b= 0;
While (a <=n and b<= m)
{
For (i from a to n )
For (j fromb to m )
If (Sim (Ci, Cj') > e)
{
Sim(QO ,KBO) += Sim (Ci, Cj');
a = i + 1; b = j + 1; Break;
}
}
return OM(QO ,KBO);
}
```

Figure 2: OM Algorithm

Where Ci, Cj' are the semantic codes of word i in QO and word j in KBO, respectively. The algorithm, described Fig.2, uses the similarity scoring function to find a KBO that is the most common between this sequence and the query ontology QO. We define a similarity measure function Sim(C_i, C_j') to calculate the abstract similarity between the semantic ontology C_i and C_j' in the thesaurus.

The semantic similarity measure function is mathematically defined as:

$$sim(c_i, c_j) = \frac{2 \times \max_{c \in s(c_i, c_j)} [\log(p(c))]}{\log(p(c_i)) + \log(p(c_j))}$$

Where Sim(Ci , Cj)comprises the set of parent terms shared by both terms Ci , Cj , and 'max' represents the maximum operator, p(c)is the probability of finding a child of c in the taxonomy.

4.2. Semantic LRO Retrieval

Based on the clustering and ontological relation between LRO, we can complete a semantic search as follows:

1. User input query, system will identify the query.
2. Computing the similarity between query and concept of LRO, and determine possible LRO,
3. Confine search domain to possible LRO in knowledge base,

(1) Compute the similarity between each query with each LRO

(2) Rank all candidates based on ontology similarity.

4. Rate the matched results from knowledge base. When ontology similarity is great than a predefined threshold, then arrange the sequence of knowledge base on the result of ontology similarity, and then reply to user for selection
5. If there is no qualified candidates to reply to user, system will ask user refine input query.

5. Conclusions and Future Works

In our future research, we will build an ontology enabled knowledge management system to demonstrate our ideas. And make the semantic search more context awareness to meet the collaborator's need by extending the knowledge base with additional user profiles, device profile, and service profiles.

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