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ONTOLOGIES: A SOLUTION FOR THE LEARNING

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Abstract. This paper presents an ontology model used for specifying a knowledge domain in the teaching/learning process and a proper methodology for the personalization of the didactic/training experience of single students basing on their didactic objectives and domains, their acquired knowledge and learning preferences. In our vision, it is important to preserve a specific ontology used in the definition of a given didactic domain that could be reused in different learning contexts. Therefore, particular attention is given to a number of operations that allow to recover and adjust the existing ontologies. Today's topical and growing Social phenomenon on the Web is represented by the folksonomies, and moving forward by the so-called **Social** Semantic Tagging, or simply, "rich tagging". This study outlines its framework and use.

1 Introduction

A needful condition for the success of a formative experience in the formal learning context is an obligatory relation among quality- validity-credibility of contents (Erkunt, H. 2004).

In accordance with an objective paradigm, the credibility of a didactic source fundamentally depends on several base factors that are included in specific taxonomies. For major experts, especially in ITS domains, the learning by ontology seems to be the nearest solution to share the content validity.

In this paper different strategies were investigated in order to approach the objective validity of knowledge. Our experience, conducted within the centre of research in Learning and Knowledge, has allowed us to look exhaustively at the ontological solutions for the learning and to manage domains more easily. Ontologies are conceived as an instrument for reusing and sharing the knowledge; so a typical operation in such a direction is a comparison among different ontologies to identify a possible correspondence (*Ontology Matching*) or to merge them (*Ontology Merging*).

The research, conducted in our centre, takes into account new perspectives on the knowledge and their representation. The Web 2.0 technologies are transforming the access modalities and the information management; the usage of different instruments, such as the social tagging, modifies the relationship that the students have with the knowledge. In the last section of the paper, it is presented an integration between ontologies and folksonomies (also known as *social tagging*). The folksonomy is the practice and method of collaboratively creating and managing tags to annotate and categorize content.

2 The Ontology Model

This model describes the knowledge domain through concepts (that represent topics for teaching) and relationships between concepts (that represent the connections between two topics).

The typical **relationships** between concepts are:

- *HasPart(x,y)*: the concept *y* is a component of the concept *x;*
- *IsRequiredBy(x,y)*: the acquisition of the concept *y* has as prerequisite the concept *x*;
- *SuggestedOrder(x,y)*: in order to encourage the learning process it is advisable to start by studying the concept *x* and then the concept *y*.

The *HasPart* relation is a hierarchical relationship; the *IsRequiredBy* relation indicates a bond with respect to the order of acquisition of two concepts; to end, the relationship *SuggestedOrder* suggests an order in the development of the learning process.

From a formal point of view, an ontology is represented by a multi-graph $G(V, A_1,\ldots A_n)$ with a set of knots V that represent the single concepts and with a set of arrows A_i for each relation i .

In the following figure an example of ontology is depicted.

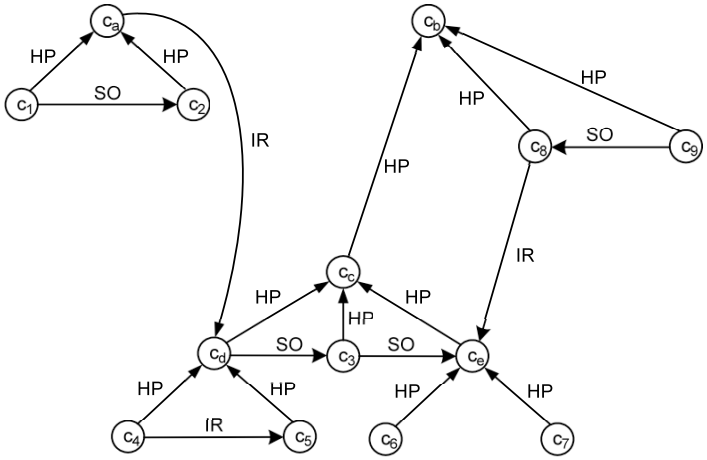

Figure 1: A typical ontology

This ontology, however, does not provide information about the best modalities for the knowledge transfer on the concepts. In other words, it is not "contextualized", being the term "**context**" the characteristics of the learners that have to learn the specific domain, the modalities of interaction with the learning material related to the ontology and the learning objectives concerned with the fixed ontology.

In order to "contextualize" an ontology, it is possible to associate a couple to each concept (property, value), this is named "teaching preferences". The properties specify the optimal modalities of knowledge transfer for each concept. These properties can be represented by the *didactic method*, the *typology of the activity*, the *interactive level*, etc.

2.1 The generation process of a Learning Path

The generation phase of a Learning Path LP, foresees the following input data:

- an ontology $O(C, (R_1,\ldots,R_n))$ where C is the set of concepts and $R_1,\ldots,R_n$ are the relationships between the concepts;
- a set of objective concepts *TC*;
- a relationship of decomposition *D* (for example the relationship *HasPart*);
- an ordered list *A* of some order relationships used to define the elements of the Learning Path (for example the relationship *IsRequiredBy*);
- an ordered list *B* of some order relationships used to define the elements of the Learning Path (for example the relationships *IsRequiredBy* and *SuggestedOrder*);
- a learner's cognitive state *CS*.

Taking into account these input data, the algorithm can be described using the following diagrams $A' = A \cup D$ and $B' = B \cup D$.

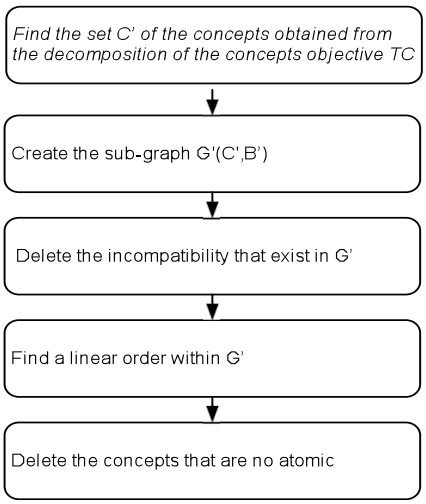

Figure 2 The algorithm of the LP generation

3 Modifying and extending an ontology

The ontologies are not static and evolve in time by the addition of new information which take into account the different changes in the interested domain. So, it needs a suitable strategy to manage the various versions of an ontology. We define as "*ontology versioning*" the capability to manage the changes within the ontology through the creation of different versions of them. The changes are referred to as domain changes, shared conceptualization, specification. A support to the versioning is needed since any change to the ontologies can produce some inconsistency problems with respect to the related objects (documents, web pages, learning objects, tasks..).

Though, given that the ontologies are considered as instruments for the knowledge sharing and reusing, it is important to compare them for individualizing possible correspondences (*ontology matching*) or merging them (*ontology merging*) to increase the knowledge base. The *ontology matching* is often associated to the *ontology merging*; the **union** and the **intersection** are the most used approaches. In the *union* approach, the resulting ontology is constituted by all the entities defined in the source ontologies. On the contrary, in the *intersection* approach the resulting ontology is given only by the sections of the source ontologies that overlap.

4 Ontologies and folksonomies: towards Ontonomies, a knowledge representation tool considering the semantic side of social processes.

The vision of our Pole is, coherently with the Knowledge Model for Learning based on the social constructivism and connectionism (Cross, 2006; Siemens 2006), to experiment a convergence process between the Web 2.0 and the Semantic Web. It is necessary to invest in a method/solutions able to support the management of high level educational objects and the collaborative ontology creation, according to a mediated approach which goes from folksonomies and social tagging processes (Mates, 2004), (Petrucco, 2006) to formalizable knowledge extraction.

The management of the high-level educational objective allows to answer to the users' needs to express their educational requirements in a natural language and to interact with ontology target concepts for defining personalized learning experiences. A Collective Intelligence Management Systems, able to integrate the social side of Web 2.0 and Semantic Web, can have functionalities of learning requirements sharing or learning objectives rating.

The attention is focused on the **Social Semantic Tagging**, or simply, "**rich tagging**", enabling to start a good communication process with didactic ontologies built through a bottom up method and able to receive feedbacks from the lower part (the networking layer). This action can be divided in two micro-objectives: RichTags for ontology learning, RichTags for learning resource update and, in particular, RichTags for learner profile update helping the system to recommend and suggest the best personalized "learning experience". This

set of indicators also contributes to build more or less heterogeneous collaborative groups for specific collaborative didactic activities.

5 Summary

This paper has showed an ontology model for describing a specific knowledge domain through concepts and typical relationships between them. One of the fundamental aspects of the ontology management, is to allow the ontologies developers to compare the existing ontologies in view of their possible reusing in other contexts. In general, a full management of the ontologies within a learning platform can allow a teacher, or a general user, to carry out different operations, such as versioning, merging and matching of ontologies.

The formalizing approach based on ontologies for the knowledge representation in distributed and shared learning experiences has provided methods and tools able to support a dynamic process through which lexicons and meanings are negotiated and renegotiated, inside and outside specific learning and teaching communities.

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