Abstract – As more e-learning platforms are deployed there is a greater need of suitable intermediary systems that allow potential students to ease the searching and location of appropriate e-learning courses. Techniques and mechanisms that ensure that the time and efforts spent in discovering suitable courses is minimized need to be developed. Our work aims at contributing to the definition of such techniques and mechanisms by the identification of a Semantic-based E-learning Brokerage Architecture that supports intelligent filtering of information. In particular, this paper focuses on the identification of logic rules required for preprocessing collected data in order to obtain significant information.

Index Terms – E-learning Brokerage, Standardization, Semantic Augmentation, Semantic Web.

INTRODUCTION

Progress in Information and Communication Technologies fostered the development of a myriad of new generation e-learning systems. Thus, the number of courses that are delivered online, either partially or totally, has grown during the last years. This fact, intrinsically positive, raises the need of appropriate systems that allow particular users and organizations to match their requirements with the inherent and contextual features of the courses internationally available in order to locate the most suitable courses for their needs and pedagogical characteristics.

In [1] we presented the foundations of the architecture of an innovative brokerage system in the e-learning domain that, bringing together the last recommendations defined in the learning technologies standardization process and making use of the new techniques related to the Semantic Web, can provide high level services to people looking for appropriate online courses. That paper focused on the underlying ontology required for the construction of such a brokerage system, introducing sub-ontologies about Users, Courses and Educational Resources, Educational Services Providers and Educational Providers.

Our current work in this project are centered on the definition of appropriate logic rules for extracting useful implicit knowledge from the knowledge base and for matching the information about a particular user (a potential student) with the information about the registered courses in order to obtain more personalized results.

The Brokerage Framework

Figure 1 shows the functional elements of a scalable and adaptable Semantic E-learning Broker.

CONCEPTUAL BROKERAGE ARCHITECTURE

The brokerage system, by means of the data collection component, gathers the descriptions of the courses from the academic institutions, as well as the referring contextual information in which they are given (data about the institution, delivering tools, dates for enrolment/delivery, etc.). These institutions or Educational Services Providers (ESPs) should be registered in a Broker and provide, among other data, the profile of the institution and the mechanism for accessing to the catalogues of the courses they offer. Specifications like “Digital Repositories Interoperability” [2], from the IMS Consortium, or CORDRA [3], from the ADL Initiative, define machine to machine interfaces that partially cover the interoperability of this kind of information transfers.

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ENRICHING THE SEMANTICS

The data manually provided by the ESPs managers and the data automatically harvested by the Broker collector must accomplish a process of adaptation of the metadata registries obtained to the canonical format of the Broker. It must be transformed into OWL statements –or facts– that use the terms and properties defined in ELEARNING-ONT [1]. Because of the present version of IMS-DRI and CORDRA are oriented to the storage and interchange of XML-LOM [4] descriptions, a set of transformation rules, defined on XSLT, aimed at this task, is available in the knowledge base of the system.

The ontology-based kernel of the broker can see as a Knowledge Information System where facts (that describe and inter-relate registered courses, e-learning platforms, educational institutions and users) are stored. Logic rules can be used by an inference engine for processing and enriching the stored information and for drawing semantic conclusions. We define two basic groups of rules:

- **Semantic augmentation rules**: These rules allow making explicit knowledge that is hidden or implicit in the knowledge base. For example, the following rule (that checks the “Learning Resource Type” properties of all the elements “E” of a course “C” in order to find an element of type “simulation”):

  \[
  \text{element}(C,E), \text{learningResourceType}(E,"\text{simulation"}) \rightarrow \text{interactivityType}(C,"\text{active")}
  \]

  can be used to identify courses that are actives or with a high degree of interactivity. These other two rules allow establishing a normalized “Level” property to a course and a user respectively:

  \[
  \text{courseContext}(C,"\text{high school")} \rightarrow \text{courseLevel}(C,"\text{10")}
  \]

  \[
  \text{userStudies}(U,"\text{high school")} \rightarrow \text{courseLevel}(C,"\text{10")}
  \]

- **Matching rules**: These rules allow inferring new knowledge by matching the preferences and characteristics of a particular user with the properties of the registered courses and their particular context. This set of rules is established in order to facilitate the searching processes. For example, the following rule (that checks the particular level “X” of a course “C” with the particular level of a user “U”):

  \[
  \text{courseLevel}(C,X), \text{userLevel}(U,X) \rightarrow \text{levelFitting}(C,U)
  \]

  can be used to identify those courses that are “Level Appropriate” for a particular user.

CONCLUSIONS AND FUTURE WORKS

This paper has briefly introduced the use of inference rules in a E-learning Brokerage System in order to enrich its core knowledge base to obtain more relevant results. A prototype of a Broker that makes use of these semantic techniques is being developed. The set of currently identified rules are in a prototypical state. This means that they are oriented to a particular context, and therefore, they are just truly useful for such a context. Next steps in our work will focus on the determination of open rules that can be the base for generic and arbitrary e-learning domains.

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REFERENCES


[3] CORDRA (Content Object Repository Discovery and Registration/Resolution Architecture) at http://cordra.net/


