

Simple E-learning Semantic Tool

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Introduction

In this paper we introduce a simple e-learning tool (SET) that can be used by students, teachers and librarians to build, evaluate, maintain and test knowledge of an arbitrary domain terminology. The core of the tool is a conceptual model developed in Protégé. The knowledge base used for testing the tool is from the Business Strategies domain and it contains more than 10,000 definitions from domain experts. The main advantages of using Protégé were in providing a valid and consistent structure for the initial set of largely unstructured data and in generating interfaces for the tool implementation. Compared to the other on-line glossaries, the emphasis here is on quality, by using domain expert knowledge; on diversity of that knowledge (a typical term will be accompanied with two or more definitions from different sources) and on simple to use additional e-learning features such as definition search, essay “helper”, visual domain explorer, test generator, etc. The related work has mainly been focused on the following areas, namely - development of domain ontologies, development of ontologies of learning resources ¹ (e.g. Chimera’s Project Delta, as described in Gardner, 2007) and development of on-line glossaries (e.g. Merriam Webster Online) and encyclopaedias (e.g. Wikipedia). Our work differs from each of the above mentioned in that it builds on development of a general and reusable glossary ontology that uses as instances, definitions taken from domain textbooks and refereed journals. In addition to that, we provide an application built on top of this ontology that can be used as a cognitive support tool.

Scenarios

In order to discover main usage scenarios for the tool, we have experimented with the underlying ontology in Protégé (“what can be done”) and have identified main users and their goals (“what should be done first”) as a basis for the tool’s requirements specification. The main Student scenarios are: “Definition Search” (student enters a search term - the tool returns most likely expected definition and all contexts in which the term usage occurs); “Essay Helper” (student enters the essay title - the tool returns the best sources to start with and optionally, the next level of recommended readings); “Visual Domain Explorer” (student enters a search term - the tool returns a visual representation of the term context neighbourhood). The main Teacher scenarios are: “Student Report” (teacher enters the student/or group id - the tool returns visual representation of the search history); “Test Generator” (teacher generates practice test using randomized set of terms and question templates). All of the identified users can perform the role of an Editor i.e. be authorised to maintain the underlying ontology by adding new or modifying existing definition and source instances.

Ontology

For the purpose of implementing the main scenarios, we have developed a simple glossary ontology using Protégé that consists of three main OWL classes (Term, Source, and Definition) and a number of properties and relations amongst them. We define a “term” as a relevant word or sequence of words that has been defined in the domain, has one or more context in which it has been defined and is related with other terms by relations such as: synonym, acronym, part-of etc. Terms are organized in a tree hierarchy, using a “part-of” relation, and with the domain term (e.g. Business Strategies) as

¹ Also known as “pedagogical ontologies” (Antoniu and van Harmelen, 2004)

the root of the tree. A “context” of a term is the tree branch leading to that term starting from the root of the tree. A term name can be shared between one or more term instances, depending on the term context (homonymy). For example, a term instance Agent in the context Business-Marketing and another term instance Agent in the context of Business-Information System-Software. A “definition” is a relevant set of sentences that associates meaning to a domain term. A definition has a unique source that is the source where definition has appeared the first and a definition can be quoted in more than one source. A “source” is a published and searchable item such as a book, journal or other forms of literature or media. An important concept in this ontology is that of term and definition “ranking”. For example, a definition “rank” is a number that can be based on different factors such as the corresponding source ranking (e.g. citations index, or number of source recommendations) or number of the definition quotations. Terms can be ranked using some of the following ordering criteria: level of ambiguity (number of contexts that include one or more definitions of the term), or context rank (number of definitions of the term in a particular context).

Application

The implementation model for the tool is the standard 3-tier model and the technologies employed are: HTML/JS for the client forms; Java Servlet and JSP technology for the ResponseBuilder module; Java 1.5 for the BusinessLogic module and DataAccess module that implements the interfaces generated by Protégé; JavaBeans using extensions to SHrIMP (www.thechiselgroup.org/shrimp) applet for the Visual Domain Explorer feature. The tool has been deployed using the Apache Tomcat server on both Windows XP and MAC platforms (version 6.0 for Windows XP and 4.1.31 on Mac). In addition to that a simple data mapping tool has been developed for importing original definitions and terminology (Excel) spreadsheets into the ontology.

Conclusions

Initially, the tool will be used to gather research data for analysis of search patterns of various categories of students (e.g. undergraduate/postgraduate, local/international etc) and the results will be used for further extensions of the tool’s “business logic” tier. Subsequent enhancements of the tool will include support for personalization and customization, such as adapting the test questions to the educational level of individual or group users, similar to Aroryo and Dicheva’s “adaptive web-based educational systems” (Aroryo and Dicheva 2004) The ideas presented here can be further extended to re-use some of the Chimera Project Delta (www.essex.ac.uk/chimera/DELTA/) tool’s capabilities in basing initial skeleton for a domain glossary on Wikipedia’s subject context hierarchies.

References

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