Deontic Logic Based Ontology Alignment Technique for E-Learning

Lazarus Jegatha Deborah, Anna University, India
Ramachandran Baskaran, Anna University, India
Arputharaj Kannan, Anna University, India

ABSTRACT

The recent explosion in web services usage and information technology has led to the challenging issue of Ontology Construction and Alignment in order to enhance the semantics of web documents in E-Learning scenarios. In such a circumstance, it is necessary to provide an effective solution for Ontology Alignment that can help in student performance evaluation. The authors propose a rule-based solution for evaluating the students using Ontology Alignment techniques. For this purpose, they make use of the rules based on Deontic Logic and hence make a positive attempt in analyzing the presence of some of the non-dominant categorization of words like determiners, time clauses and modal verbs occurring in the text documents using Standard Deontic rules. The experiments have been carried out on evaluating the learning of C programming language using an E-Learning framework. From these evaluations, it has been observed that the proposed evaluation technique improves the accuracy of student evaluation significantly.

Keywords: Description Logic, E-Learning, Ontology Alignment, Ontology Construction, Semantic Web, Standard Deontic Rules

1. INTRODUCTION

Semantic Web (Berners-Lee, Hendler, & Las-sila, 2001) focuses on effective management of documents intelligently which are present in the Web by considering the properties of the entities (terms) and the relationships involved among them. This conceptual organization is facilitated by building ontology pertaining to a particular domain (Gomez-Perez, Fernandez, & Corcho, 2003; Bateman, 2010). One of the major areas of research in retrieving the web information intelligently is the provision of learning course contents through online (E-learning) (Jegatha-Deborah, Baskaran, & Kannan, 2011). The prerequisite of the semantic-driven resource management and content delivery in E-learning web service has been facilitated in such systems by building Ontology.

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1.1. Need for Semantics

Automatic exchanging and reusing of data or information in the universal medium for information exchange (WWW) is very limited due to two main reasons namely the heterogeneity problem prevailing in the information resources and the non-semantic nature of HTML and URL. Information heterogeneity occurs in syntax, structure and semantics. Though enhanced techniques are developed to solve syntactic and structural heterogeneity problems (Giunchiglia, Yatskevich, & Shvaiko, 2007), the problem of semantic heterogeneity is still prevailing to be a great challenge. When two contexts do not share the same interpretation of information, semantic heterogeneity occurs. Several approaches were proposed in the past (Doan et al., 2003) to solve semantic heterogeneity problems like synonym sets, concept lattices, features and constraints. However, all these existing approaches could solve this problem only partially.

1.2. Ontology Alignment

In the semantic web, Ontologies play a key role to solve the problem of semantic heterogeneity. Ontology Alignment aims to find semantic correspondences between similar elements of different Ontologies and has been the subject of research in various web domains and applications (Kim & Storey, 2011; Sridevi & Nagaveni, 2011; Thangamani & Thangaraj, 2011). An ontology is an explicit formal specification of a shared conceptualization. In the ontology, a set of concept types and a set of formal axioms are explicitly defined with both human-readable and machine-readable text (Dahlem, 2011). The ontology is also widely used as an important component in many areas, such as knowledge management (Bateman, 2010), electronic commerce (Meng & Chatwin, 2010), E-Learning (Jegatha-Deborah et al., 2011; Cristani, 2008), and information retrieval systems (Bateman, 2010).

Ontology alignment can be carried out either manually or using automated tools (Ehrig & Staab, 2004). Such alignment becomes very critical when it is performed manually as the size and complexity of the ontology structure increases. Hence, automatic ontology alignment became a well-known technique in many practical applications including information transformation and data integration, query processing, E-commerce, and E-Learning. Several categories of Ontology Alignment techniques exist in the literature which includes String-based, Language-based, Constraint-based and Semantic-based methodologies (De Marnee & Manning, 2010). However, all these existing Ontology Alignment techniques suffer from two main limitations:

1. They have only limited expressivity,
2. Relationships between the entities in the existing systems are retrieved based on the occurrence of only dominant words in the input text documents (Ehrig et al., 2004). These shortcomings may lead to reduction in the accuracy of evaluation in an E-Learning scenario. Therefore, it is necessary to provide intelligent techniques for effective Ontology Alignment.

In this paper, we propose a new framework that derives deontic relations from the input text documents for identifying non-dominant words which helps to perform better evaluation in an E-Learning environment. In addition, a measure for similarity/conflict resolution between two ontologies is also proposed. In this paper, deontic relationships are used to perform Ontology Alignment instead of propositional logic. The application of deontic logic allows us to use universal and existential quantifiers in rules. Moreover, it enhances the efficiency of Semantic Matching techniques through the use of additional predicates such as can, could, ought, each, every, any, before, after and when. This proposed framework considers not only the predicate logic features namely equals and partially equals, but also the newly added consistency checking deontic predicate ‘conflicts’ and hence it covers all the aspects of logic including unification, resolution, subsumption and conflict identification.


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