

Multi-Agent based Approach to Ontology Alignment



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October 2012

Declaration

I declare that this dissertation does not incorporate, without acknowledgment, any material previously submitted for a Degree or a Diploma in any University and to the best of my knowledge and belief, it does not contain any material previously published or written by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for interlibrary loans, and for the title and summary to be made available to outside organization.

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Dedication

To my Wife and Parents



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Abstract

Modern information systems extensively use ontologies to model domain knowledge. Nowadays, with the large amount of already available ontologies, there is a high demand for sharing and reusing the knowledge in existing ontologies. Since ontologies are complex structures, sharing of knowledge coming from various ontologies has become a tedious task. This has resulted in the birth of research area called ontology alignment. There are numerous techniques for the alignment of ontologies, and the field still faces many challenges. For instance, these techniques are rather domain dependent and expect considerable amount of human interaction.

Due to the inherent nature of multiple relationships among the ontologies, it postulates that the Multi-Agent System technology is a better technology to automate the ontology alignment with little human intervention. Multi-agent system technology has shown promising results in modeling domains with interconnected and distributed entities.

This thesis presents a multi-agent based approach for ontology alignment. The proposed solution simulates how different processes interactively operate inside the human mind to perform certain activities, intelligently. In fact, none of these individual entities are supposed to be intelligent, nevertheless, through their interactions, intelligence is emerged. Based on this idea, a novel solution for ontology alignment is proposed. Indeed, the proposed solution uses agent communication, negotiation, and coordination as the primary method of exploring the semantic relationships between the ontologies. The system accepts ontologies maintained in any major form of ontology representation languages as its inputs and generates ontology with new semantic relationships as its output. The generated ontology could be used as a shared understanding between information systems that are running on input ontologies. The system is designed based on Request-Resource-Message Space-Ontology architecture. The solution is developed as a plugin for the popular ontological modeling environment known as Protégé. The system initiates an agent to represent each concept in input ontologies, and these agents execute on behalf of their respective concept. Further, the system also uses string, linguistic, and structural similarity matching agents together with upper ontology matching agent to

determine the similarity between the concepts. The linguistic matching agent accesses the WordNet database to fetch synonyms information whereas the upper ontology matching agent uses the DOLCE upper ontology to fetch domain independent information. In general, operational knowledge and the rules required for above agents to operate are maintained in agent system's ontology. The user could explicitly provide domain knowledge at the beginning of the alignment process. In fact, this step is optional. However, the accuracy of the alignment results are heavily depends on the amount of the domain knowledge agents could access during the alignment process. Because of its flexible design, user could easily expand the system's ontology to suit any domain, and thus, the solution could be used over ontologies of any domain. For example, if there is an upper ontology that suits more for the current ontological domain, user could link that ontology with the system. The success of the proposed approach was evaluated by using ontologies of conference organizing and agricultural domains. It was evident that system could discover over 70% accurate semantic relationships, and thus, the author claims that the proposed approach could resolve the complexity in ontology alignment.



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