Abstract

With the emergence of new knowledge sources such as machinery knowledge and organizational knowledge, knowledge creation process has shifted to a new level of co-creation process where multiple participants share and utilize other's knowledge to create newly collaborative knowledge. One issue of knowledge co-creation is the heterogeneity and conflict among knowledge from various sources. Ontologies are the solution for heterogeneous problem since they can explicitly represent the knowledge within each participant to make the knowledge understandable and manipulatable by the others. They have been used widely in many areas relating to Knowledge Science such as knowledge managements, service science, bioinformatics, e-healthcare, e-learning, among others. There are various specification for ontology representation among which description logics (DLs) is chosen as the recommendation in Semantic Web environment due to their good tradeoff between expressive power and computational efficiency. DL ontology represents the world by concepts, which correspond to groups of objects, and roles, which correspond to the relationship among concepts. A DL ontology contains logical axioms, which are understandable by a computer and make it is possible to automatically handle an ontology.

This research aims to accelerate and accurate knowledge co-creation process by studying and extending ontology abilities to handle heterogeneous and conflict knowledge shared among collaborators. We construct an expressive ontology for School of Knowledge Science, **KS ontology**, and propose an extension of description logic (DL) ontology, named **defeasible DL**, which can handle conflict knowledge in inconsistent ontologies. The KS ontology is an explicit representation of educational program of School of Knowledge Science which allows students to exchange and create their own knowledge about studying plan with the assistant of computer. DL axioms are used to express educational program so that computer programs can process the ontology to provide assistant services. The application of KS ontology demonstrates the role of DL ontology to support knowledge sharing and co-creation process in real world situation.

Upon building ontology for real-world application, we recognize the problem of conflict knowledge. Conflict appears naturally because of the incompleteness of participant's knowing in a knowledge co-creation environment. For example, the advances of machine learning and data processing techniques can allow computer to generate the knowledge that have not been discovered by human being. Conflict knowledge can make an ontology inconsistent and infer meaningless conclusion. Reasoning with inconsistent ontologies is necessary and has attracted much attention in recent years. Those researches extend ontology reasoning ability by integrating non-monotonic reasoning mechanisms or providing uncertainty representation to handle conflict knowledge in ontology.

We propose defeasible DL, an extended representation of DL ontology, which contains defeasible axiom and priority relation. Defeasible axiom provides a mean to represent knowledge that can be retracted when there is contradict evidence and priority relation is used to assign the preference among axioms to resolve conflict among defeasible knowledge. Based on the principle of defeasible reasoning, we propose a reasoning framework for defeasible DL ontology which utilizes a selection function to select axioms and create a consistent sub-theory of original ontology and perform reasoning. The selection function is skeptical because it looks ahead to see whether there is any contradict conclusion that can be inferred and only select an axiom if all contradict conclusions are eliminated. Compared with other related works, our approach has simplicity and flexibility, expressive power, and computational efficiency as the advantages. Therefore, this research can help to accurate the conflict issue in knowledge co-creation application. Due to the simplicity, our approach also has the limitation of not exploiting the semantics of elements in the knowledge. This limitation can be solved by integrating our reasoning approach with more complicated uncertainty representation, which is the future perspective of our research.

Keywords: ontology, defeasible reasoning, description logics, knowledge representation and reasoning, conflict knowledge