

Doctoral Thesis Defense

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ABSTRACT

Ontologies play a crucial role in current web-based biomedical applications for capturing contextual knowledge in the domain of life sciences. They are continuously evolving in order to fix the problems and provide valid knowledge. Moreover, many problems in ontology evolution often originate from incomplete knowledge about the given domain. As our knowledge improves, the related definitions in the ontologies will be altered.

This problem is inadequately addressed by available tools and algorithms, mostly due to the lack of suitable knowledge representation formalisms to deal with temporal abstract notations, and the overreliance on human factors. Also most of the current approaches have been focused on changes within the internal structure of ontologies, and interactions with other existing ontologies have been widely neglected.

In this research, after revealing and classifying some of the common alterations in a number of popular biomedical ontologies, we present a novel agent-based framework, RLR (Represent, Legitimate, and Reproduce), to semi-automatically manage the evolution of bio-ontologies, with emphasis on the FungalWeb Ontology, with minimal human intervention. RLR assists and guides ontology engineers through the change management process in general, and aids in tracking and representing the changes, particularly through the use of category theory. Category theory has been used as a mathematical vehicle for modeling changes in ontologies and representing agents' interactions, independent of any specific choice of ontology language or particular implementation. We have also employed rule-based hierarchical graph transformation to propose a more specific semantics for analyzing ontological changes and transformations between different versions of an ontology, as well as tracking the effects of a change in different levels of abstractions. Thus, the RLR framework enables one to manage changes in ontologies, not as standalone artifacts in isolation, but in contact with other ontologies in an openly distributed semantic web environment. The emphasis upon the generality and abstractness makes RLR more feasible in the multi-disciplinary domain of biomedical Ontology change management.