OWL 2: Towards Support for Context Uncertainty, Fuzziness and Temporal Reasoning

Wilbard Nyamwihula and Burchard Bagile

Department of Computer Science and Engineering,
University of Dar es Salaam,
Tanzania
{wbilungi,bbagile}@yahoo.com

1 Introduction

Context-awareness plays a vital role in pervasive computing. Context-aware applications relay on context information in order to provide appropriate and consistent adaptive services by integrating sensor data from a diverse range of sources with varying degree of accuracy, precision, dynamism, and are failure prone. Therefore, context information are inherently imperfect, they exhibit various types of uncertainties: incomplete, imprecise. vague, inconsistency, and/or temporal. Therefore context-aware applications must be supported by an adequate context information modeling and reasoning formalism.

There have been several efforts in modeling context information with uncertainty, but still there is a lack of a hybrid context modeling framework capable of modeling and support reasoning for all various types of uncertainties and temporal characteristics. The web ontology language (OWL) has been recommended as standard language for Semantic web by World Wide Web Consortium (W3C) [1]. Unfortunately, OWL1 and its predecessor OWL2 are not sufficient for handling context imperfections: Imprecise, vague, incomplete, inconsistency, inaccurate, and temporal information that is commonly found in applications and domains [2].

To address these problems, this PhD research focuses on extending OWL 2 framework to support context uncertainty, fuzziness and temporal modeling and reasoning.

2 Related Work

Over a decade, some efforts have been made in representing and reasoning with uncertainty in the Semantic Web. These works are mainly focused on how to extend the classical description logics (SHOIN(D) for OWL1 & SROIQ(D) for OWL2) behind Semantic Web ontology languages to the probabilistic and possibilistic logics [,3,4,5,6,7,8,9.10.11], fuzzy logics {12,13,14,15,16}, and temporal description logics[17,18,19]

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3 Research Hypotheses/Questions

- What extension for OWL 2 able handle contextual uncertainty, fuzziness and temporal information?
- What are optimization and reasoning techniques for an extended Description Logic (i.e., SROIQ a logical model for OWL2) able to support reasoning with uncertainty, fuzziness and temporal information for extended OWL2?

4 Methods / Work Plan

Different approaches for contextual uncertain and temporal information modeling and reasoning will be reviewed and analyzed for possible extension of Web Ontology Language OWL2 with theories (i.e., probabilistic/possibilistic logics, fuzzy logics, and temporal description logic theories) able to handle contextual uncertainty, fuzziness and temporal information. The description logic (SROIQ) [1], underlying logic model for OWL2 will be extended to support reasoning with uncertainty, fuzziness, and temporal information taking into account the balance between expressiveness, tractability, soundness and completeness.

5 Conclusion

This PhD research, will contribute to knowledge by providing formalism on extending the OWL 2 framework to handle contextual uncertainty, fuzziness and temporal information as well as extending underlying description logic (SROIQ) for OWL2 to support reasoning with uncertainty, fuzziness, and temporal information; taking into account the balance between expressiveness, tractability, soundness and completeness.

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