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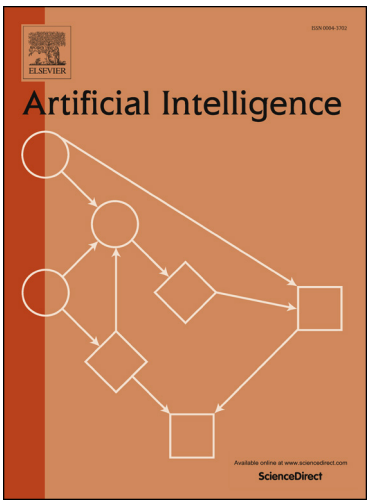

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Tractable Approximate Deduction for OWL ☆

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Abstract

Today's ontology applications require efficient and reliable description logic (DL) reasoning services. Expressive DLs usually have high worst case complexity while tractable DLs are restricted in terms of expressive power. This brings a new challenge: can users use expressive DLs to build their ontologies and still enjoy the efficient services as in tractable languages? Approximation has been considered as a solution to this challenge; however, traditional approximation approaches have limitations in terms of performance and usability. In this paper, we present a tractable approximate reasoning framework for OWL 2 that improves efficiency and guarantees soundness. Evaluation on ontologies from benchmarks and real-world use cases shows that our approach can do reasoning on complex ontologies efficiently with a high recall.

Keywords:
Ontology, Approximation, OWL 2, Reasoning

1. Introduction

With the growing volume and complexity of ontologies [27] and large-scale linked data [2] available, there is a pressing need for efficient ontology reasoning services. Modern ontology language OWL 2, the second version of OWL (Web Ontology Language), is based on a family of different Description Logics (DLs) [3]. For example, OWL 2 DL, the most expressive and decidable OWL, is based on $\mathcal{SROIQ}$ [30], a very expressive but complex DL. Its three tractable profiles OWL 2 EL, OWL 2 QL and OWL 2 RL are based on simpler but less expressive formalisms $\mathcal{EL}^{++}$ [1], DL-Lite$_R$ [11] and DLP [26], respectively. Such a spectrum of DLs leads to different approaches of ontology reasoning.

One approach is to develop fully-fledged universal algorithms that can be applied on any decidable DL. For example, tableau-based algorithms [17, 31, 32] with complexity up to N2EXPTIME-complete [40] can provide TBox (terminology) reasoning services, such as classification for very expressive DLs including $\mathcal{SROIQ}$. ABox (assertion) reasoning, such as checking whether a

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☆This paper is an extended version of our previous work. Particularly, the technical work presented in Sec. 5 is based on our AAAI2010 paper [65] but revised and extended with support to more expressive power. The technical work presented in Sec. 6 is based on our DL workshop 2010 paper [66] but significantly improved with different completion rule sets and completeness proofs. We refer to the corresponding summary sections for discussion of gaps.

[2]http://wifo5-03.informatik.uni-mannheim.de/lodcloud/state/