Formally Verified Tableau-Based Reasoners for a Description Logic

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Abstract Description Logics are a family of logics used to represent and reason about conceptual and terminological knowledge. One of the most basic description logics is $\mathcal{ALC}$, used as a basis from which to obtain others. Description logics are particularly important to provide a logical basis for the web ontology languages (such as OWL) used in the Semantic Web. In order to increase the reliability of the Semantic Web, formal methods can be applied, and in particular formal verification of its reasoning services can be carried out. In this paper, we present the formal verification of a tableau-based satisfiability algorithm for the logic $\mathcal{ALC}$. The verification has been completed in several stages. First, we develop an abstract formalization of satisfiability-checking of $\mathcal{ALC}$-concepts. Secondly, we define and formally verify a tableau-based algorithm in which the order of rule application and branch selection can be flexibly specified, using a methodology of refinements to transfer the main properties from the $\mathcal{ALC}$ abstract formalization. Finally, we obtain verified and executable reasoners from the algorithm via a process of instantiation.

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