Rule-Based Ontologies: From Semantics to Syntax

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Abstract

An ontology specifies an abstract model of a domain of interest via a formal language that is typically based on logic. Tuple-generating dependencies (tgds) and equality-generating dependencies (egds) originally introduced as a unifying framework for database integrity constraints, and later on used in data exchange and integration, are well suited for modeling ontologies that are intended for data-intensive tasks. The reason is that, unlike other popular formalisms such as description logics, tgds and egds can easily handle higher-arity relations that naturally occur in relational databases. In recent years, there has been an extensive study of tgd- and egd-based ontologies and of their applications to several different data-intensive tasks. In those studies, model theory plays a crucial role and it typically proceeds from syntax to semantics. In other words, the syntax of an ontology language is introduced first and then the properties of the mathematical structures that satisfy ontologies of that language are explored. There is, however, a mature and growing body of research in the reverse direction, i.e., from semantics to syntax. Here, the starting point is a collection of model-theoretic properties and the goal is to determine whether or not these properties characterize some ontology language. Such results are welcome as they pinpoint the expressive power of an ontology language in terms of insightful model-theoretic properties. The main aim of this tutorial is to present a comprehensive overview of model-theoretic characterizations of tgd- and egd-based ontology languages that are encountered in database theory and symbolic artificial intelligence.

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