Trustworthiness-related Uncertainty of Semantic Web-style Metadata: A Possibilistic Approach

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Abstract. We discuss the specific type of uncertainty deriving from the non-uniform *trustworthiness* of Semantic Web style metadata sources, arguing toward the feasibility of modal possibilistic reasoning based on trust assertions expressing such uncertainty.

1 Introduction

A cornerstone of the Semantic Web vision is the notion that resource descriptions can be modeled as Description Logics (DL) assertions. Indeed, many innovative applications enabled by the Semantic Web are based on the idea of reasoning on knowledge about network resources made available as Semantic Web-style metadata. However, intuition suggests that generalized manual annotation of Web resources is simply not feasible; and while automatic metadata generation is of paramount importance, manually validating (semi-)automatically generated assertions would require an effort comparable to manually writing metadata from scratch. In this scenario, performing approximate reasoning on Semantic Web metadata requires solving two major open problems related to their expressive power:

- *Non-uniform representation of uncertainty.* Current Semantic Web description languages cannot specify neither uncertainty degrees nor their semantics. Two main reasons motivate the introduction of explicit representation of uncertainty of Semantic Web metadata: (i) representing each assertion's degree of *fulfillment* on the part of the Web resource it describes (e.g., "the image at URL so-and-so is a high resolution one") [1], or (ii) each assertion's *importance* w.r.t. other assertions regarding the same resource. In principle, this type of uncertainty can be represented by stating the assertions in some kind of *fuzzy description logics* (fuzzy DL). Several fuzzy extensions to DLs are have been proposed [5], whose decidability property and deduction algorithms widely differ; choosing the right formalization for performing reasoning a given setting would require all the assertions involved to have a uniform semantics, quite a tall order for heterogeneous Web environments.
- *Lack of support for modalities.* Semantic Web description languages cannot express assertions belonging to different modalities, including *alethic* or *deontic* ones. Alethic rules are used to model necessities (e.g. implied by physical laws) which cannot be violated, even

in principle. For example, an alethic rule may state that an image file has a (single) date of creation. Deontic rules are used to model obligations (e.g., resulting from company policy) which ought to be obeyed, but may be violated in real world scenarios. For example, a deontic rule may state that all landscape images must carry the indication of the country where they were taken .

2 A Possibilistic Approach

While the two problems outlined above are hard to tackle in a generalized setting, they can be successfully approached in a restricted case, i.e. the specific type of uncertainty deriving from the non-uniform *trustworthiness* of Semantic Web metadata sources[2]. In a typical Semantic Web setting, assertions about network resources can be generated by different sources, including automatic extraction by autonomous software agents, as well as manual annotation by the data owner or other users. The degree associated to the assertions provided by a data source represents the trustworthiness of that source w.r.t. the specific assertion. We propose to express such a degree by stating a special purpose *trust assertion* expressing the level of trustworthiness of an ordinary Semantic Web assertion. Trust assertions follow the pattern "the (reified) assertion so-and-so has a level of trustworthiness of X", are built using their own reserved vocabulary (expressed as a suitable task ontology). More importantly, their associated degree has a uniform semantics which can be modeled as a possibility. Trust assertions can be used to rank assertions about a specific resource; also, the uniform semantics of the associated degree enables formalization using possibilistic fuzzy logics. More specifically, a modal possibilistic logics formulation can capture both the the missing modalities[4]; also, reasoning can be carried out using extensions of the tableaux methods available for ordinary modal logics[3].

References

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