Requirements for a Semantic Web Rule Language

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1 Position

The need for integrating rules within the Semantic Web framework was clear since the early developments. However, up to the last few years, the research community focused its efforts on the design of the so called *Ontology Layer*. Nowadays, this layer is fairly mature in the form of Description Logics based languages [1, 6] such as the OWL Web Ontology Language [2], which is now a W3C recommendation.

In this paper, we argue for three characteristics that a Semantic Web rule langauge should have.

- A decidable rule language.
- A Semantic Web rule language that support datatype predicates.
- A Semantic Web rule language that supports weights.

In the rest of the paper, we assume that a Semantic Web rule language should be compatible with the existing Semantic Web standards, in particular the standard ontology langauge OWL.

2 Characteristics and Requirements

2.1 A decidable rule language

Like OWL, a Semantic Web rule language could contain increasingly expressive sub-languages designed for use by specific communities of implementers and users. Rules can be seen as a form of new axioms that one could add into ontologies. For example, SWRL [4] is an extension of OWL DL with (negation-as-failure free) rule axioms; it coherently extends OWL DL in both abstract syntax and model-theoretical semantics. If we regard SWRL as a language with medium expressive power, like OWL DL, we can see demands for a more expressive language SWRL Full and a less expressive language SWRL Lite. While a candidate

for SWRL Full, called SWRL FOL [8], has been proposed, in this section we focus on SWRL Lite.

Since SWRL is not decidable, we argue that the main characteristic of SWRL Lite is its decidability. It is not hard to see why decidability is useful and important here; the reasons that we need SWRL Lite to be decidable are similar to those for OWL Lite and OWL DL. The need to use rules in ontologies simply do not justify the claim that we do not have to care about decidability any more. Although we have not seen any (decidable) candidates for SWRL Lite, Levy and Rousset [5] have shown that rule[1] extended Description Logics are undecidable if they contain value restriction ($\forall R.C$), exists restriction ($\exists R.C$) or qualified number restrictions ($\leqslant nR.C$, $\geqslant nR.C$).

2.2 Support datatype predicates in rules

Applications in the Web use many concrete information such as products' prices and people's age. Business rules in such applications should be able to express constraints on these concrete information. An example business rules is "for products that are over 50 pounds, no shipping fees are charged". In this example, "over 50" is an integer constraint. These concrete constraints are called *datatype predicates*, they are also known as *built-ins* in SWRL and in the database community.

When we design a Semantic Web rule langauge that supports datatype predicates, there are some technical concerns.

Firstly, datatype predicates and datatypes are different but closely related. OWL supports only datatypes but not datatype predicates; therefore, when we design the semantics for datatypes and datatype predicates in the rule language, we can not simply take the OWL datatype theory. Pan [6] provides a formalism to unify datatypes and datatype predicates and integrate customised datatypes and datatype predicates into Description Logics.

Secondly, simply allowing the use of datatype and datatype predicate URI references[2] in rules is not enough. This is because it is often necessary to allow user to define their own datatypes and datatype predicates in their applications. For example, applications for online bookstores could have the following discount rule "for books published in 1980's (except 1983), we provide 10% discount". Here "1980's (except 1983)" can be represented by a customised datatype of integer.

2.3 Supporting weights in rules

Another useful feature of a Semantic Web rule language is to provide weights for atoms (to show the difference on importance) in the condition and consequence of a rule. For example, given a rule "if a man is rich and healthy, then he is happy", one could argue that here healthy is actually more important than rich by giving healthy a weight (e.g. 0.8) that is higher than that of rich (e.g., 0.6). In general, the

[1] Here we mean the kind of rule axioms that SWRL provides.

[2] It would even rule out enumerated datatypes supported in OWL.

weights of atoms in a rule can be either quantitative [7] or qualitative [3]. Note that supporting weights might be too strong a requirement for SWRL Lite; however, it is a desirable feature for (at least) SWRL Full.

References

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