Chapter I
Rule Markup Languages and Semantic Web Rule Languages

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ABSTRACT

Rule markup languages will be the vehicle for using rules on the Web and in other distributed systems. They allow publishing, deploying, executing and communicating rules in a network. They may also play the role of a lingua franca for exchanging rules between different systems and tools. In a narrow sense, a rule markup language is a concrete (XML-based) rule syntax for the Web. In a broader sense, it should have an abstract syntax as a common basis for defining various concrete languages addressing different consumers. The main purposes of a rule markup language are to permit the publication, interchange and reuse of rules. This chapter introduces important requirements and design issues for general Web rule languages to fulfill these tasks. Characteristics of several important general standardization or standards-proposing efforts for (XML-based) rule markup languages including W3C RIF, RuleML, R2ML, SWRL as well as (human-readable) Semantic Web rule languages such as TRIPLE, N3, Jena, and Prova are discussed with respect to these identified issues.

INTRODUCTION AND MOTIVATION

Web rule languages provide the required expressiveness enabling machine-interpretation, automated processing and translation into other such Web languages, some of which also being the execution syntaxes of rule engines. One of these languages may act as a "lingua franca" to interchange rules and integrate with other markup languages, in particular with Web languages based on XML and with Semantic Web languages (e.g. W3C's RDF Schema, OWL and its new OWL 2

version) for ontologies serialized in RDF/XML or directly in XML. Web rule languages may also be used for publication purposes on the Web and for the serialization of external data sources, e.g. of native online XML databases or RDF stores. Recently, there have been several efforts aiming at rule interchange and building a general, practical, and deployable rule markup standard for the (Semantic) Web. These encompass several important general standardization or standards-proposing efforts including RuleML (www.ruleml.org), SWRL (www.w3.org/Submission/SWRL/), SWSL (http://www.w3.org/Submission/SWSF-SWSL/), R2ML (oxygen.informatik.tu-cottbus.de/rewerse-i1/?q=R2ML), RIF (www.w3.org/2005/rules/), and others such as XCL (http://www.altheim.com/specs/xcl/1.0/), designed as a concrete (serialization) syntax for ISO's Common Logic (CL) standard.

In this chapter, a system of general requirements and design choices for Web rule languages will be introduced and instantiations discussed in the context of the current prominent general Rule Markup Languages and Semantic Web rule languages. This chapter is intended to be of help to a wide audience. In particular, it is targeted to rule practitioners who want to serialize the declarative rules of their applications in a general rule markup language, and publish and interchange them on the Web. Rule practitioners will find here a discussion of general design criteria with examples from the current rule markup languages. These examples, together with a discussion of advantages and drawbacks, will offer guidance to readers when declaratively representing their own rule-based applications in a Web rule language. The structure of the rest of this chapter is as follows: Section 2 introduces current rule markup languages and rule interchange formats as well as Semantic Web rule languages. Section 3 comprises the main part of this chapter, discussing important design issues and characteristics of the introduced rule languages. Section 4 presents future research issues in Web rule language design. Section 5 concludes this chapter with a summary.

WEB RULE LANGUAGES

Rule markup (serialization) languages have been developed for the Web-based interchange of, e.g., privacy policies, business rules, and - as focused here - Semantic Web rules. Rules are central to knowledge representation for the Semantic Web (Boley, 2007), hence are increasingly considered as being side by side with ontologies, e.g. in W3C's layered Semantic Web architecture (2007 version shown in Figure 1).

Rule interchange in an open format is important for all higher Semantic Web layers, including a Web of Trust and, generally, a Pragmatic Web (Paschke et al, 2007), and is crucial for applications in eBusiness, eGovernment, eHealth, etc. This section introduces major *rule markup languages* including RuleML, R2ML, and RIF, as well as human-readable *Semantic Web rule languages* such as TRIPLE and N3, and platform-specific rule engine languages such as Jena and Prova.

Figure 1. Semantic Web Layer Cake [adapted from (W3C, 2007)]