Axiomé: a Tool for the Elicitation and Management of SWRL Rules

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Abstract. The Semantic Web Rule Language (SWRL) provides the means of specifying rules within OWL ontologies. As the size and complexity of SWRL rule bases within ontologies increases, developers and end users need tools to help manage them. We have developed a tool, called Axiomé, that can paraphrase rules into a simple form in English and categorize SWRL rules based on their syntactic structure. Our categorization approach supports rule templates that provide a mechanism to facilitate rule elicitation. Axiome also allows users to visualize the structure of individual rules as well as graphically browse relationships among the bodies and heads of rules in a rule base. We have implemented our tool as a Protégé-OWL plug-in for which we will provide a demonstration of how users can rapidly explore content and patterns in SWRL rule bases.

Keywords: Rule Management, Rule Elicitation, Rule Visualization, Rule Paraphrasing, Rule Categorization, OWL, SWRL.

1 Introduction

Rules are increasingly being used to represent knowledge in ontology-based systems on the Semantic Web. As the size of such rule bases increases, users face the age old problem in understanding and managing the complexity of the knowledge represented by the rules. To support rapid exploration of rule bases and meet the scalability goals of the Semantic Web, techniques are needed to provide simplified interpretations of rules as well as high-level abstractions of their computational structures. In particular, rule paraphrasing and rule visualization can help non-specialists understand the meaning of logically complex rules. Abstraction of common patterns in rule bases can also enable automatic categorization of rules into related groups for knowledge management. Such categorized patterns can also be used as a basis of rule elicitation tools that guide non-specialists entering new rules.

To tackle this problem, we have developed rule management software called Axiomé [3]. Axiomé was developed as a plug-in to the popular Protégé-OWL ontology development environment and provides an array of tools for managing SWRL [4] rule bases in OWL ontologies. These tools supports visual rule base

exploration, automated rule categorization, rule paraphrasing, and rule elicitation functionality with the goal of facilitating the management of large SWRL rule bases.

2 Axiomé: Core Features

Axiomé was developed as a Protégé-OWL plug-in and has five main functional areas. These are available as sub-tabs within the plug-in: (1) a Rule Graph tab that provides a graph structure to browse and explore the SWRL rule base; (2) a Rule Visualization tab to visualize individual rules; (3) a Rule Paraphrasing tab that displays an English-like text explanation for each rule; (4) a Rule Categorization tab to automatically categorize rules in a rule base; and (5) a Rule Elicitation tab that provides a graphical templates to acquire new rules based on analysis of existing rules in a rule base. A Rule Browser component is permanently displayed to show a tree-table representation of the SWRL rules in an ontology. This tree-table enables users to explore the rule base and launch any of five sub-tabs for the rule or group being explored.

2.1 Rule Graph

The Rule Graph tab provides a graphical representation of a SWRL rule base (Figure 1). Each rule in the rule base is shown as a node, and edges between two rules indicate the SWRL atoms shared by the rules and the dependency direction. A number of graphical layouts are supported, using the JUNG visualization framework [2] to produce optimal layouts. Search functionality is also provided and rules matching the search term can be highlighted in the graph. Rule groups and the types of dependencies between rules can also be indicated visually.
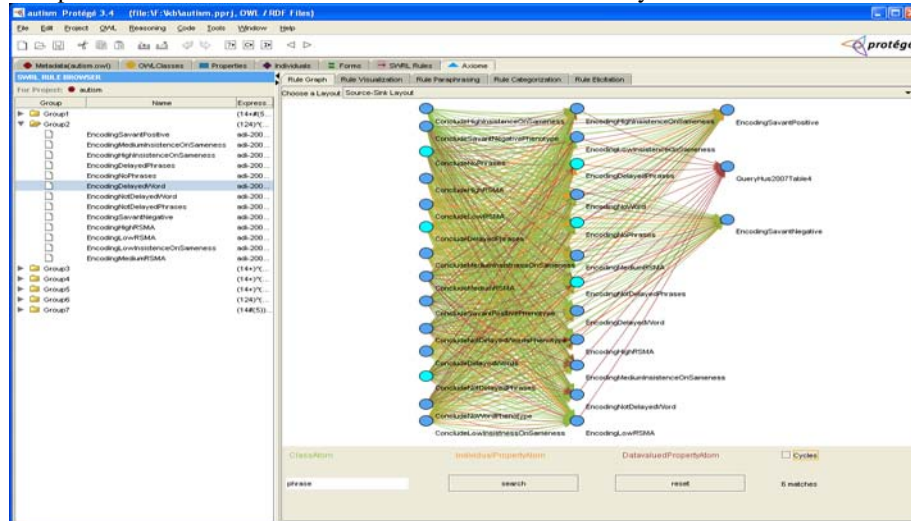

Figure 1. Example of rule base visualization in Rule Graph tab for ontology related to autism. The figure also shows process of searching a rule base for a particular term.

2.2 Rule Visualization

The Rule Visualization tab (Figure 2) allows individual rules to be visualized as a tree structure. Trees are generated by depth-first search for each variable chain in the rule, with more prominent atoms being placed near the root of each tree. A number of heuristics are employed to ensure that the most important clauses in a rule are given more prominence [1].
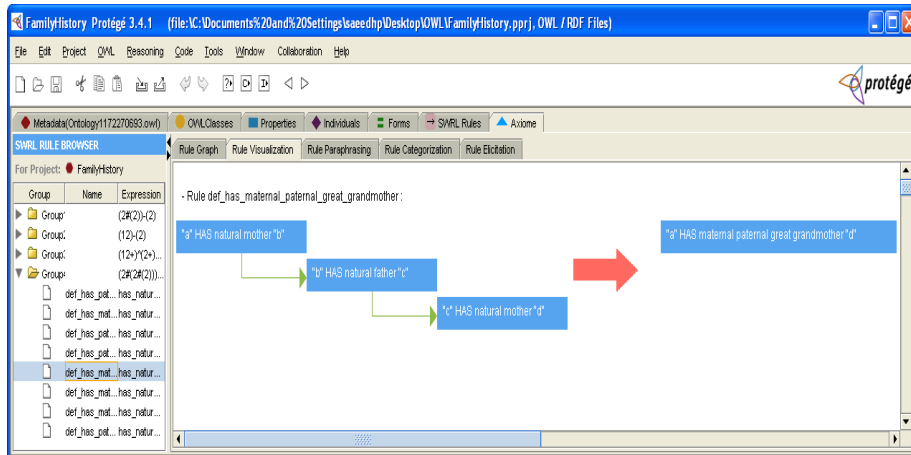

Figure 2. Example of the visualization of a simple rule from the family history ontology in the Rule Visualization tab.

2.3 Rule Paraphrasing

The Rule Paraphrasing tab (Figure 3) uses a similar approach to build a tree structure for each rule and then uses additional heuristics to generate understandable English paraphrases of that rule [1].
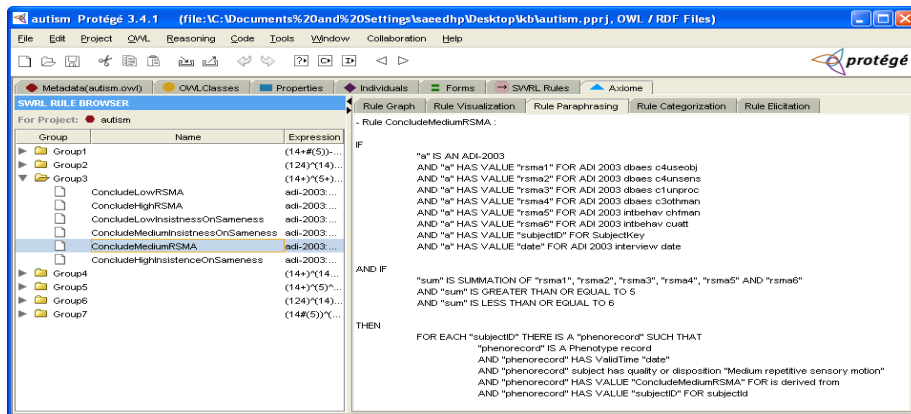

Figure 3. Example of rule paraphrasing of a rule from an autism ontology in the Rule Paraphrasing tab.

2.4   Rule Categorization

The Rule Categorization tab uses the data structure that is generated for the rule visualization and paraphrasing tabs to automatically group the rules with a similar syntactic structure [1]. It then graphically displays the results of this grouping. These groupings can then be used in the Rule Graph tab when exploring the rule base.

2.5   Rule Elicitation

The Rule Elicitation tab (Figure 4) provides graphical rule templates to facilitate acquisition of rules. It generates these templates using the syntactic structures generated for rule groupings. Users can select an appropriate rule group and then generate a graphical acquisition template to enter rules with the structure of other rules in that group.
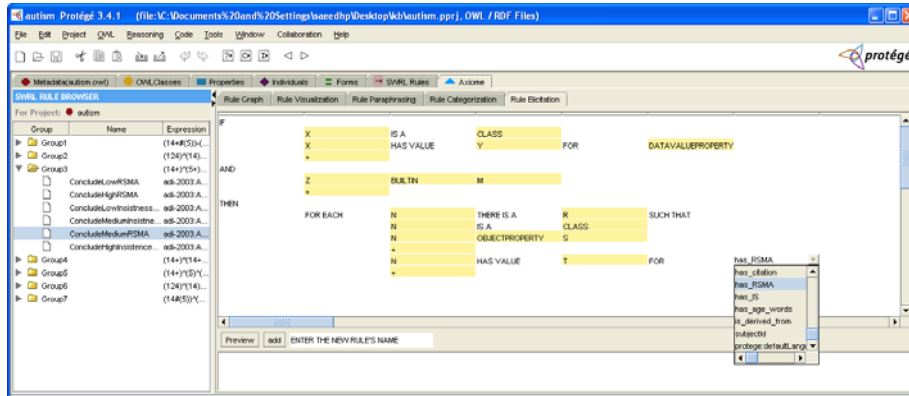

Figure 4. Example of rule elicitation in rule elicitation tab for autism ontology.

3   Summary

We have described Axiomé, a free, open-source Protégé-OWL plug-in for SWRL rule management. It is compatible with the latest Protégé-OWL 3.4 release and is available for download from the Axiomé web site [3].

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