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Enhancing semantic consistency in anti-fraud rule-based expert systems[☆]

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ABSTRACT

In this study, an ontology-driven approach is proposed for semantic conflict detection and classification in rule-based expert systems. It focuses on the critical case of anti-fraud rule repositories for the inspection of Card Not Present (CNP) transactions in e-commerce environments. The main motivation is to examine and curate anti-fraud rule datasets to avoid semantic conflicts that could lead the underpinning expert system to incorrectly perform, e. g., by accepting fraudulent transactions and/or by discarding harmless ones. The proposed approach is based on Web Ontology Language (OWL) and Semantic Web Rule Language (SWRL) technologies to develop an anti-fraud rule ontology and reasoning tasks, respectively. The three main contributions of this work are: first, the creation of a conceptual knowledge model for describing anti-fraud rules and their relationships; second, the development of semantic rules as conflict-resolution methods for anti-fraud expert systems; third, experimental facts are gathered to evaluate and validate the proposed model. A real-world use case in the e-commerce (e-Tourism) industry is used to explain the ontological knowledge design and its use. The experiments show that ontological approaches can effectively discover and classify conflicts in rule-based expert systems in the field of anti-fraud applications. The proposal is also applicable to other domains where knowledge rule bases are involved.

1. Introduction

Rule-based Expert Systems (RBESs) are the simplest form of artificial intelligence, which uses rules as the representation for encoding knowledge from a fairly narrow area into an automated system (Durkin, 1998). RBESs mimic the reasoning procedure of a human expert when solving a knowledge-intensive problem. A rule-based system consists of a set of `IF-THEN` rules, a set of *facts* and an interpreter controlling the application of the rules, given the facts. Rule-based systems are very simple models and can be adapted and applied to a wide set of different problems, whenever the domain of knowledge can be expressed in the form of `IF-THEN` rules.

In the case of fraud prevention and detection in e-commerce transactions, RBESs are used to identify customers' suspicious activities by automatically generating risk scoring reports of their transactions (Ketkar, Shankar, & Banwet, 2014). They analyze behaviors such as repetitive and quick access attempts, domestic/foreign transactions, and abnormal transactions compared with the customer‘s past behavior. A final decision is then delivered by the system, commonly: *Accept*, *Reject*, or *Revise*. A small subset of rules that might contribute to a negative risk assessment could be as follows (Ward, 2010): A single IP address has been used with multiple payment cards in the last few days; the shopper‘s billing address is more than “x” kilometers from the shipping address; the e-mail address has been flagged in a negative database (black list) of known fraud activity by other merchants participating in the same fraud detection strategy; the BIN (Bank Identification Number) on the payment card indicates the transaction comes from a high-risk country.

Using a combination of these and many other factors could benefit e-merchants, who are presently demanding autonomous expert systems, to quickly update their rule-bases and flag suspicious transactions (Wong, 2013). In the current market, there exist a series of tools that use rule-based knowledge engines for

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