Chapter 7.23
Extended Action Rule Discovery Based on Single Classification Rules and Reducts

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ABSTRACT

Action rules can be seen as logical terms describing knowledge about possible actions associated with objects that are hidden in a decision system. Classical strategy for discovering them from a database requires prior extraction of classification rules that next are evaluated, pair by pair, with a goal to build a strategy of action based on condition features, in order to get a desired effect on a decision feature. An actionable strategy is represented as a term r = $[(\omega) \wedge (\alpha \rightarrow \beta)] \Rightarrow [\phi \rightarrow \psi]$*, where* ω*,* α*,* β*,* φ*, and* ψ *are descriptions of events. The term r states that when the fixed condition* ω *is satisfied and the changeable behavior* $(\alpha \rightarrow \beta)$ *occurs in objects represented as tuples from a database, so does the expectation* $(\varphi \rightarrow \psi)$*. With each object, a number of actionable strategies can be associated, and each one of them may lead to different expectations and the same to different reclassifications of objects. This chapter will focus on a new strategy of construction of action rules directly from single classification rules instead of pairs of classification rules. This way we do not only gain on the simplicity of the method of action rules construction, but also on its time complexity. The chapter will present a modified tree-based strategy for constructing action rules, followed by a new simplified strategy of constructing them. Finally, these two strategies will be compared.*

INTRODUCTION

There are two aspects of interestingness of rules that have been studied in data mining literature, objective and subjective measures (Adomavicius

& Tuzhilin, 1997; Liu, Hsu, Chen, 1997; Silberschatz & Tuzhilin, 1995, 1996). Objective measures are data driven and domain independent. Generally, they evaluate the rules based on their quality and similarity between them. Subjective measures, including unexpectedness, novelty, and actionability, are user driven and domain dependent.

The notion of an action rule, constructed from certain pairs of association rules, has been proposed in Ras and Wieczorkowska (2000). Its different definition was given earlier in Geffner and Wainer (1998). Also, interventions introduced in Greco, Matarazzo, Pappalardo, and Slowinski (2005) are conceptually very similar to action rules. Action rules have been investigated further in Tsay and Ras (2005, 2006), Tzacheva and Ras (2005), and Ras and Dardzinska (2006). To give an example justifying the need of action rules, let us assume that a number of customers have closed their accounts at one of the banks. We construct possibly the simplest description of that group of people and next search for a new description, similar to the one we have, with a goal to identify a new group of customers from which no one left that bank. If these descriptions have a form of rules, then they can be seen as actionable rules. Now, by comparing these two descriptions, we may find the cause why these accounts have been closed, and formulate an action that, if undertaken by the bank, may prevent other customers from closing their accounts. For example, an action rule may say that by inviting people from a certain group of customers for a glass of wine by the bank, it is almost guaranteed that these customers will not close their accounts and they do not move to another bank. Sending invitations by regular mail to all these customers, or inviting them personally by giving them a call, are examples of an action associated with that action rule.

In Tzacheva and Ras (2005), the notion of a cost and feasibility of an action rule was introduced. The cost is a subjective measure and feasibility is an objective measure. Usually, a number of action rules or chains of action rules can be applied to reclassify a certain set of objects. The cost associated with changes of values within one attribute is usually different than the cost associated with changes of values within another attribute. The strategy for replacing the initially extracted action rule by a composition of new action rules, dynamically built and leading to the same reclassification goal, was proposed in Tzacheva and Ras (2005). This composition of rules uniquely defines a new action rule. Objects supporting the new action rule also support the initial action rule, but the cost of reclassifying them is lower or even much lower for the new rule. In Ras and Dardzinska (2006), authors propose a new simplified strategy for constructing action rules. In this chapter, we present an algebraic extension of this method, and show the close correspondence between the rules generated by tree-based strategy (Tsay & Ras, 2005) and rules constructed by this newest method.

BACKGROUND

In the paper by Ras and Wieczorkowska (2000), the notion of an action rule was introduced. The main idea was to generate, from a database, special types of rules that basically form a hint to users showing a way to reclassify objects with respect to some distinguished attribute (called a decision attribute). Values of some attributes used to describe objects stored in a database can be changed, and this change can be influenced and controlled by the user. However, some of these changes (for instance "profit") cannot be done directly to a decision attribute. In such a case, definitions of this decision attribute in terms of other attributes (called classification attributes) have to be learned. These new definitions are used to construct action rules, showing what changes in values of some attributes for a given class of objects are needed to reclassify objects the way users want. But users may still be either unable