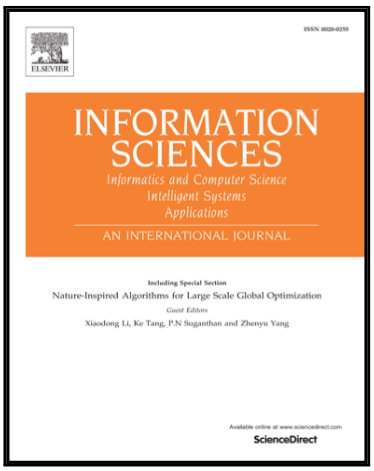

Three-way decision perspectives on class-specific attribute reducts

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PII: S0020-0255(18)30229-9
DOI: 10.1016/j.ins.2018.03.049
Reference: INS 13527

To appear in: *Information Sciences*

Received date: 12 December 2017
Revised date: 15 March 2018
Accepted date: 18 March 2018

Please cite this article as: Xi-Ao Ma, Yiyu Yao, Three-way decision perspectives on class-specific attribute reducts, *Information Sciences* (2018), doi: 10.1016/j.ins.2018.03.049

Three-way decision perspectives on class-specific attribute reducts

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Abstract

In rough set theory, a decision class (i.e., a subset of objects) is approximated by three pair-wise disjoint positive, boundary, and negative regions. The concept of three-way decisions is introduced to provide a new interpretation of the three regions. We construct acceptance, non-commitment, and rejection rules, respectively, from the positive, boundary, and negative regions. The notion of class-specific attribute reducts concerns a minimal set of attributes used in constructing such rules. Existing studies on class-specific attribute reducts only consider the positive region and hence only the acceptance rules. In many situations such as medical diagnosis, we are also interested in negative rules or rule-out rules. This motivates the present study on three-way decision perspectives on class-specific attribute reducts. In addition to positive-region based attribute reducts, we study negative-region and positive-and-negative-region based attribute reducts. We investigate relationships among the three types of reducts. Although the three types of reducts are equivalent in consistent decision tables, they are not equivalent in inconsistent decision tables. By extending the framework, we study the three types of class-specific attribute reducts in probabilistic rough set models and their relationships. Finally, we give a general definition of class-specific attribute reducts.

Keywords: Class-specific attribute reduct, Pawlak rough set model, Probabilistic rough set model, Three-way decision

1. Introduction

A major application of rough set theory is to induce classification or decision rules that classify an object into decision classes. A decision class is a subset of a universe of objects and is approximated by a triplet of positive, boundary, and negative regions. Semantically, the three regions can be interpreted in terms of three-way decisions [38, 41]. The positive region can induce positive rules for making a decision of acceptance. The negative region can induce negative rules for making a decision of rejection. The boundary region consists of objects that we can neither accept nor reject and, hence, make a non-commitment decision. Usually, we must collect more useful information about objects in the boundary region in order to make an acceptance or a rejection decision.

Attribute reducts are an important notion in rough set theory for constructing classification rules by using a minimal set of attributes [1, 3, 7, 11, 12, 14, 16, 18, 19, 20, 21, 25, 26, 30, 45, 50]. There are two types of attribute reducts, i.e., classification-based attribute reducts and class-specific attribute reducts [43]. The former uses the same set of attribute reducts for all decision classes. The latter allows different sets

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