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ORIGINAL ARTICLE

An Algorithm on the Parameter Reduction of Soft Sets

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Abstract Soft set theory is a mathematical tool for dealing with uncertain. In this paper, the parameter reduction of soft sets is investigated by means of the attribute reduction in information systems and its algorithm is obtained. Moreover, an example is given by using this algorithm.

Keywords Soft set · Binary relation · Parameter reduction · Discernibility function · Discernibility matrix · Algorithm

1. Introduction

Problems in many fields involve data which may contain uncertainties. Uncertainties may be dealt with by using a wide range of existing theories such as probability theory, fuzzy set theory [20], interval mathematics and rough set theory [16]. But all these theories have their own difficulties (see [12]). For example, probability theory can be used only to deal with stochastically stable phenomena. To overcome these difficulties, in 1999, Molodtsov [11] proposed a completely new approach, which is called soft set theory, to dealing with uncertainties.

It is very different using soft sets to describe objects with traditional mathematics tools. We can approximately describe the original objects in soft set theory. There

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is no limiting conditions when objects are described. Researchers can choose parameters and their forms according to needs. The fact that setting parameters is nonbinding greatly simplifies decision-making process and then we can still do effective decisions under the circumstances of less information.

Rough set theory was initiated by Pawlak [16] for coping with vagueness and granularity in information systems. This theory handles the approximation of an arbitrary subset of a universe by two definable or observable subsets. It has been successfully applied to machine learning, intelligent systems, inductive reasoning, pattern recognition, mereology, image processing, signal analysis, knowledge discovery, decision analysis, expert systems and others in many fields (see [15, 17]).

The parameter reduction of soft sets is an important problem in soft set theory. It is worthwhile to mention that some effort has been made on this problem. To solve decision-making problems by using soft set theory, Maji et al. [14] proposed the concept of parameter reduction of soft sets. Chen et al. [3] pointed out that this concept in [14] is unreasonable, and then presented another concept of parameter reduction of soft sets. To overcome the problem of suboptimal choice in [3], Kong et al. [9] introduced the concept of normal parameter reduction of soft sets. However, the concept is too complex, the algorithm is hard to understand and involves a great amount of computation. Ma et al. [15] investigated the normal parameter reduction and improved this algorithm in [9].

The purpose of this paper is to investigate further the parameter reduction of soft sets by means of attribute reductions in information systems.

The remaining part of this paper is organized as follows: In Section 2, some basic concepts is called about rough sets and soft sets. In Section 3, the relationship is discussed between soft sets and information systems. In Section 4, the binary relations induced by a soft set is introduced. In Section 5, the parameter reduction of soft sets is discussed by using attribute reductions of information systems. In Section 6, discernibility matrices and discernibility functions of soft sets is investigated with the help of knowledge on mathematical logic. In Section 7, an algorithm on the parameter reduction of soft sets is proposed by means of discernibility matrices and discernibility functions with an example by using this algorithm given. Conclusion is in Section 8.

2. Preliminaries

In this section, we briefly recall some basic concepts about rough sets and soft sets.

Throughout this paper, U denotes the universe, E denotes the set of all possible parameters and 2^U denotes the family of all subsets of U. We only consider the case where both U and E are finite sets.

2.1. Rough Sets

Let R be an equivalence relation on U. Then the pair (U, R) is called a Pawlak approximation space. Based on (U, R), one can define the following two rough approximations:

$$R_*(X) = \{x \in U \mid [x]_R \subseteq X\},$$