Soft Set Based Decision Support System

Xiuqin Ma, Hongwu Qin

Northwest Normal University, Lanzhou Gansu, 730070, China

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Abstract: Molodtsov initiated soft set theory as a new general mathematical tool for dealing with uncertainties. Based on soft set theory, some researchers proposed decision making and normal parameter reduction of soft set. However, up to the present, real-life applications of them are less studied. Consequently, we propose a new framework based on soft set for the practical decision support system. In order to validate the proposed framework, we apply the proposed framework into one practical decision support system. Experimental results show that the proposed framework is not only suitable but feasible for dealing with the practical decision support system.

1. Introduction

A lot of practical and complicated problems in many fields involve uncertain, fuzzy, not clearly defined data. Soft set [1] is a new efficient tool to deal with uncertainty.

Presently, theoretic study [2, 3] and application on soft set are progressing rapidly. It is worthwhile to mention that some effort has been done to such issues concerning application of soft sets in decision making. Maji et al. [4] firstly employed soft sets to solve the decision-making problem. Some effort has been done to such issues concerning reduction of soft sets in decision making. Chen et al. [5] pointed out that the conclusion of soft set reduction offered in [4] was incorrect, and then present a new notion of parameterization reduction in soft sets in comparison with the definition to the related concept of attributes reduction in rough set theory. The concept of normal parameter reduction was introduced in [6, 7, 8, 9], which overcomes the problem of suboptimal choice and added parameter set of soft sets. The article of [11] proposed a weighted normal parameter reduction of soft set for decision making. The idea of parameter value reduction was given in [10]. However, up to the present, real-life applications of them are less studied. Consequently, we propose a new framework based on soft set for the practical decision support system. In order to validate the proposed framework, we apply the proposed framework into one practical decision support system.

The rest of this paper is organized as follows. Section 2 reviews the basic notions of soft set theory. Section 3 proposes a new framework for decision support system based on soft sets. Section 4 applies the proposed framework into one real-life dataset. Finally Section 5 presents the conclusion from our study.

2. Soft set theory

In this section, we review some definitions with regard to soft sets. Let U be a non-empty initial universe of objects, E be a set of parameters in relation to objects in U, $P(U)$ be the power set of U, and $A \subset E$. The definition of soft set is given as follows.

Definition 2.1 (See [1]). *A pair (F, A) is called a soft set over U, where F is a mapping given by* $F : A \rightarrow P(U)$.

That is, a soft set over U is a parameterized family of subsets of the universe U.

3. The proposed framework for soft set based decision support system

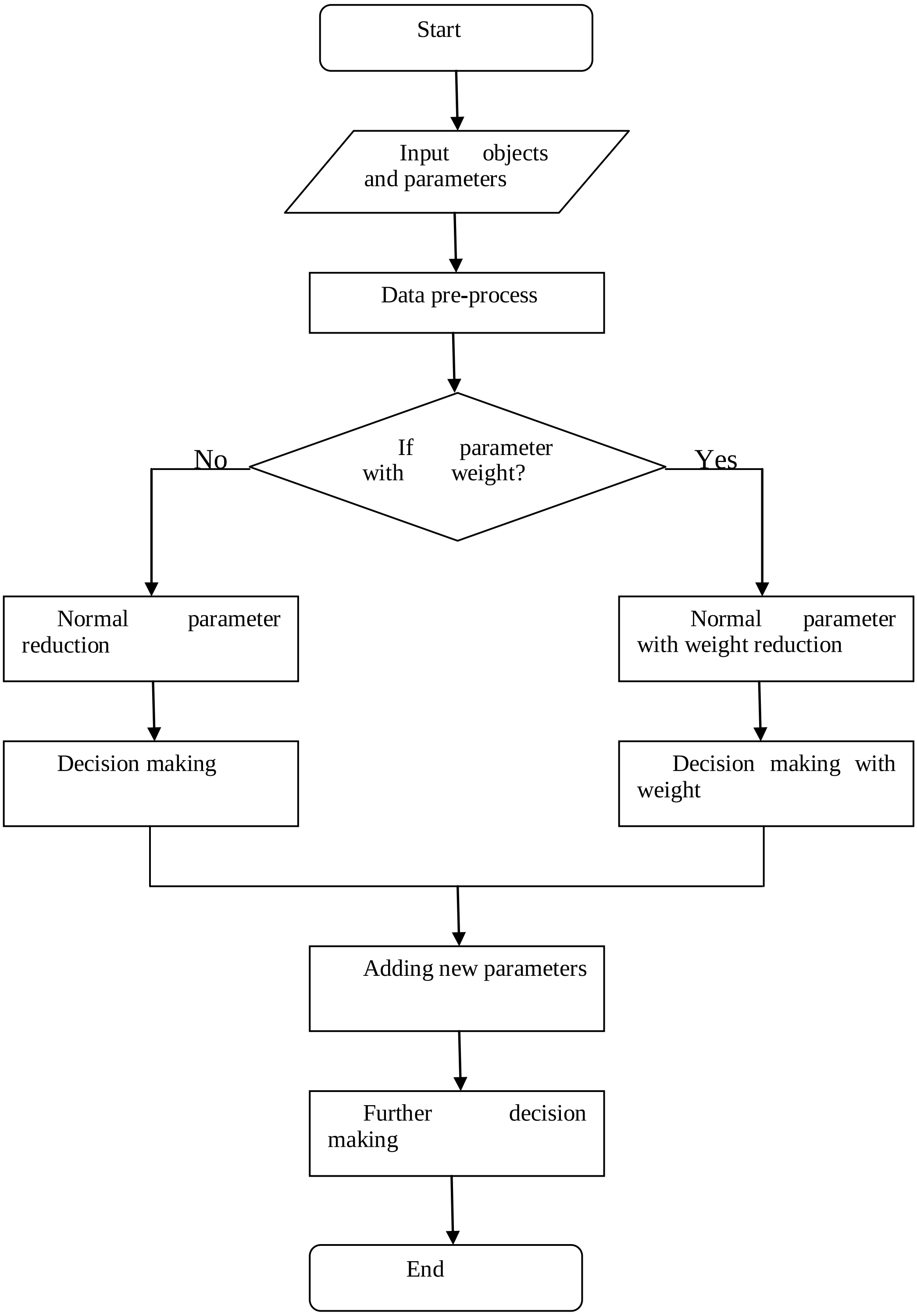

Figure 1. Flowchart of the proposed framework

In this section, we propose a new framework based on soft set in order to support decision making.

3.1 Data pre-process

Before making decision, it is necessary to transform inputted information into a Boolean-valued information system. A soft set can be represented as a Boolean-valued information system. According to the classification of parameter values, there are two available methods.

a.If the parameter values are Boolean-valued, it is natural to denote two states by “1” and “0”.

b.If the parameter values are non-Boolean-valued, decision maker should give the threshold. If the parameter value is greater than or equal to this given threshold, it will be denoted as “1”; if the parameter value is less than this given threshold, it will be expressed as “0”.

3.2 Parameter reduction

parameter reduction is a minimum subset of parameters that provides the same descriptive or decision ability as the entire set of parameters in especial, normal parameter reduction of soft set can keep the same decision ability while reduces the redundant parameters. In other words, parameters in a parameter reduction are jointly sufficient and individually necessary, which help us to get the key parameters for this decision support system from a set of parameters. Therefore we should find the parameter reduction to more efficiently make decision. According to whether parameter with weights, two distinguished normal parameter reduction algorithms are provided as New Efficient Normal Parameter Reduction (NENPR) [7] and Normal Parameter with Weight Reduction (NPWR) [11].

3.3 Decision making

After parameter reduction, we can carry out the making decision. According to whether parameter with weights, two decision making methods are given as follows.

a.If the given parameters without weights, after NPR, find k, for which $c_k = \max c_i$, where $c_i = \sum_j h_{ij}$. h_{ij} are the entries in the Boolean-valued information system. In other words, find out the optimal choice.

b.If decision makers consider the weights of the related parameters, after NPWR, find k, for which $c^w{}_k = \max c^w{}_i$, where $c^w{}_i = f^w{}_E(h_i) = \sum_j w_j h_{ij}$.

3.4 Adding new parameters and further decision making

Some decision support systems intend to extend the system in order to get more accurate and effective decision. Soft set is flexible and NPR and NPWR keep the same decision ability as the original decision systems while reduce the redundant parameters, hence, adding new parameters is feasible. After adding new parameters, we can carry out the second decision making in order to obtain more accurate and effective decision.

4. Experimental results on one real-life decision support system

Shenzhou Laptop Decision Support System (SLDSS)

4.1 Data pre-process

Shenzhou Laptop Decision Support System is obtained from one website which is online evaluations for the laptops. Evaluated objects are 124 available Shenzhou laptops, for instance, ShenzhouYouya A460P-i7GD2, Shenzhou Jingdun K580N-i7D1, Shenzhou Feitian U43D1 and Shenzhou Feitian U45D2 so on. To evaluate, search and compare theses laptops, this website shows twelve parameters, such as “CPU”, “Memory capacity”, “Hard disk capacity”, “Screen size”, “Video card type” and “Product positioning” so on. In this decision support system, if the kind of laptop has four cores, the corresponding value is defined as 1, otherwise, the value is defined as 0; if CPU clock speed is more than 2GHZ, the corresponding value is denoted as 1, otherwise, the value is denoted as 0; the value is given as 1 if cache involves three level and capacity is not less than 3M; for memory, if memory capacity is not less than 4G, the value is described as 1; for hard disk, if its capacity is not less than 500G, the value is described as 1; the parameter value of “Screen size” is defined as 1 when it is not less than 14 inches; if the laptop involves independent video card, the corresponding value is denoted as 1; in case the capacity of video card is greater than 1GB, the value is defined as 1; if there are built-in camera in the laptop, the value is given as 1; for price, if it is higher than 4000 RMB, the corresponding value is defined as 1; the parameter value of "Product positioning” is equal to 1, if this laptop is designed for students;

U is the set including 124 shenzhou laptops and $U = \{h_1, h_2, \cdots, h_{99}, h_{124}\}$. E is the set of parameters and $E = \{e_1, e_2, e_3, e_4, e_5, e_6, e_7, e_8, e_9, e_{10}, e_{11}\}$={The number of cores, CPU clock speed, Cache, Memory, Hard disk, Screen size, Video card type, Video card capacity, Built-in carema, Price, Product positioning }. Customers want to book a Shenzhou laptop which satisfies the criteria in E to the utmost extent.

4.2 Normal parameter reduction and decision making

A normal parameter reduction is a minimum subset of parameters that provides the same descriptive or decision ability as the entire set of parameters. In other words, after executing NENPR to get normal parameter reduction, laptops which satisfies the criteria in E to the utmost extent can not be changed, moreover, rank of laptops are consistent with the list of original table. NENPR is executed for capturing the normal parameter reduction on Shenzhou Laptop Dataset. From the executed results, we can get that $C = \{e_9\}$ and one set satisfies $f_A(h_1) = f_A(h_2) = \cdots = f_A(h_{124})$, A= $\{e_1, e_2, e_{10}, e_{11}\}$. Therefore, there are one normal parameter reductions of Shenzhou Laptop Dataset. Finally E-C-A=$\{e_3, e_4, e_5, e_6, e_7, e_8\}$ is denoted as the optimal normal parameter reduction.

4.3 Normal parameter with weight reduction (npwr) and decision making with weight

If consumers consider the weight of every parameter, it is necessary to adopt Normal Parameter with Weight Reduction to obtain the related parameter reduction. Here this decision support system only focuses on the normal parameter reduction.

4.4 Adding the new parameters

Due to the need of decision making for the laptop consumers, we adds the parameter of “score from customers”. Because the added parameter values are non-Boolean-valued, consumers should give the threshold. The parameter value of “score from customers” is up to 1, if the score which is given by customers from the website is greater than 4.0 (the maximal score is 5.0).

Both of NPR and NPWR can support the extension of the decision support system due to immovability of decision ability by NPR and NPWR while reducing redundant parameters. Further decision making with the weights and without the weights are similar, here we give the further decision making without the weights. In order to get more effective decision making, we combine the original table and the added new parameter into an extended Shenzhou Laptop Decision Support System.

Finally, we can make decision and then the 24 best choices are as follows: 3K580S-i7D1, JingdunK580N-i7D1, K580P-i7D4, YouyaA560P-i7D5, Jingdun K470P-i7D2, Jingdun K580P-i7D1, YouyaA560P-i5 D3, JingdunK480P-i5GD5, JingdunK580P-i7D3, YouyaA560P-i7D3, JingdunK470P-i7D1, YouyaA560P-i3D4, JingdunK470P-i3D1, JingdunK580P-i7D2, JingdunK480P-i3GD6, JingdunK480P-i3GD5, YouyaA560P-i7D2, YouyaA560P-i5D3, YouyaA460P-i5RD2, YouyaA460P-i5RD1, YouyaA460P-i5GD2, YouyaA460P-i5GD2, JingdunK480P-i3GD2, YouyaA460P-i5GD1.

5. Conclusion

In this paper, we propose a new framework based on soft set for the practical decision support system. In order to validate the proposed framework, we apply the proposed framework into one practical decision support system. Experimental results show that the proposed framework is not only suitable but feasible for dealing with the practical decision support system.

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