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Application of a New Efficient Normal Parameter Reduction Algorithm of Soft Sets in Online Shopping

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***Abstract*—**A new efficient normal parameter reduction algorithm of soft set in decision making was proposed. However, up to the present, few documents have focused on real-life applications of this algorithm. Accordingly, we apply a New Efficient Normal Parameter Reduction algorithm into real-life datasets of online shopping, such as Blackberry Mobile Phone Dataset. Experimental results show that this algorithm is not only suitable but feasible for dealing with the online shopping.

***Keywords*—**Normal parameter reduction, Online shopping, Parameter reduction, Soft sets.

I. Introduction

SOFT set theory is a new mathematical tool for dealing with uncertainties, which was firstly proposed by a Russian Mathematician Molodtsov [1] in 1999. In recent years, there has been a rapid growth in interest in soft set theory and its applications. It has a rich potential for applications in several directions, such as data mining [2], decision making [3]-[6] and data analysis [7], [8]. It is worthwhile to mention that some effort has been done to such issues concerning parameter reduction of soft sets in decision making. Maji et al. [3] employed soft sets to solve the decision-making problem. Later, Chen et al. [9] pointed out that the conclusion of soft set reduction offered in [3] was incorrect, and then presented 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 [10], which overcome the problem of suboptimal choice and added parameter set of soft sets. An algorithm for normal parameter reduction was also presented in [10]. However, the algorithm is hard to understand and involves a great amount of computation. To improve this algorithm, Ma et al. [11] proposed a new efficient normal parameter reduction algorithm of soft set. However, up to the present, few documents have focused on real-life applications of this algorithm. Accordingly, we apply a New Efficient Normal Parameter Reduction algorithm into real-life datasets of online shopping, such as Blackberry Mobile Phone Dataset and Shenzhou Laptop Dataset. Experimental results show that this algorithm is not only suitable but feasible for dealing with the real-life applications.

This paper is organized as follows. Section II reviews the basic notions of soft set. Section III recalls a new efficient normal parameter reduction algorithm (NENPR) of soft set by Ma et al. [11]. Section IV applied NENPR into real-life application of online shopping, such as Blackberry Mobile Phone Dataset. Finally, Section V presents the conclusion from our work.

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II. 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 $A \subseteq E$. The definition of soft set is given as follows.

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

$$F : A \to P(U).$$

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

III. A New Efficient Normal Parameter Reduction Algorithm (NENPR)

Fig. 1 describes the details of NENPR algorithm. Here for soft set (F, E), $U = \{h_1, h_2, \cdots, h_n\}$, and $E = \{e_1, e_2, \cdots, e_m\}$. Define h_{ij} is an entry in the table of (F, E). For $e_j \in E$, if $h_{1j} = h_{2j} = \cdots = h_{nj} = 0$ or $h_{1j} = h_{2j} = \cdots = h_{nj} = 1$, we denote e_j as e_j^0 and e_j^1, respectively.

IV. Real-life Application of NENPR on Online Shopping

In this section, we apply NENPR into real-life application of online shopping, such as Blackberry Mobile Phone Dataset. NENPR is implemented in C program. It is executed on a processor Intel Core i5 CPUs. The total main memory is 4 gigabyte and the operating system is Windows 7 Professional.

(1) Input the soft set (F, E) and the parameter set E;

(2) If there exists e_j^1 and e_j^0, they will be put into the reduced parameter set denoted by C and a new soft set (F, E') will be established without e_j^1 and e_j^0, where $U = \{h_1, h_2, \cdots, h_n\}$, $E' = \{e_{1'}, e_{2'}, \cdots, e_{t'}\}$;

(3) For the soft set (F, E'), calculate $S(e_{j'})$ of $e_{j'}$ (that is, oriented-parameter sum), for $j' = 1', 2', \cdots, t'$;

(4) Find the subset $A \subset E'$ in which S_A is a multiple of $|U|$, then put A into a candidate parameter reduction set;

(5) Check every A in the candidate parameter reduction set, if $f_A(h_1) = f_A(h_2) = \cdots = f_A(h_n)$,it will be kept; otherwise it will be omitted;

(6) Find the maximum cardinality of A in the candidate parameter reduction set, then $E - A - C$ as the optimal normal parameter reduction.

Fig. 1 NENPR

Blackberry Mobile Phone Dataset is obtained from www.mobile88.com which is online mobile website. This website provides a lot of information about different mobile brands such as Blackberry, Nokia, Samsung, Apple, HTC, LG and Huawei so on. In this paper, the dataset concerning 28 Blackberry mobiles is only collected before May 9, 2012. Twelve phone features involving GPRS, MP3, FM radio, EDGE, 3G, GPS, Touch Screen, TV, WiFi, NFC support, hotspot, Qwerty Keyboard are displayed as advanced search and comparison. Besides, Camera capacity, Bluetooth and USB port are used to describe these mobiles. It should be noticed that for GPRS, MP3, FM radio, EDGE, 3G, GPS, Touch Screen, TV, WiFi, NFC support, hotspot, Qwerty Keyboard, Bluetooth and USB port, No = 0 and Yes = 1; for Camera capacity, if Camera capacity is more than or equal to 3Megapixel, it can be defined as 1, if Camera capacity is less than 3Megapixel, it can be defined as 0.

Hence, there are 28 Blackberry mobile phone under consideration, namely the universe $U = \{u_1, u_2, u_3, ..., u_{27}, u_{28}\}$ ={Blackberry 7130g, Blackberry 7130v, Blackberry 8700v, Blackberry 8800, Blackberry 8820, Blackberry 8830 World edition, Blackberry 7290, Blackberry 8700g, Blackberry 8707g, Blackberry 8707v, Blackberry 9300 javelin, Blackberry 9700, Blackberry bold, Blackberry bold 9700, Blackberry curve 3G 9300, Blackberry curve 3G 9330, Blackberry curve 8300, Blackberry curve 8310, Blackberry curve 8520, Blackberry curve 9320, Blackberry Pearl 8100, Blackberry Pearl 8110, Blackberry Pearl 8220, Blackberry Porsche design 9981, Blackberry Storm, Blackberry Storm2 9580, Blackberry Torch 9800, Blackberry Torch 9860} and the parameter set $E = \{e_1, e_2, e_3, ..., e_{14}, e_{15}\}$, where e_i stand for "GPRS", "MP3", "FM radio", "EDGE", "3G", "GPS", "Touch Screen", "TV", "WiFi", "NFC support", "hotspot", "Qwerty Keyboard", "Camera capacity", "Bluetooth", "USB port", respectively. The tabular representation of a soft set as Blackberry Mobile Phone Dataset is shown in Table I. Customers want to book a Blackberry mobile phone which satisfies the criteria in E to the utmost extent.

TABLE I
BLACKBERRY MOBILE PHONE DATASET

U/E	e_1	e_2	e_3	e_4	e_5	e_6	e_7	e_8	e_9	e_{10}	e_{11}	e_{12}	e_{13}	e_{14}	e_{15}	$f(.)$
h_1	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	5
h_2	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	5
h_3	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	4
h_4	1	1	0	1	0	1	0	0	0	0	0	1	0	1	1	7
h_5	1	0	0	1	0	1	0	0	0	0	0	1	0	1	1	6
h_6	1	1	0	1	0	1	0	0	0	0	0	1	0	1	1	7
h_7	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	4
h_8	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	5
h_9	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	4
h_{10}	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3
h_{11}	1	1	0	1	0	1	0	0	0	0	0	1	1	1	1	8
h_{12}	1	1	0	1	0	1	0	0	0	0	0	1	1	1	1	8
h_{13}	1	0	1	1	1	1	0	0	0	0	0	1	0	1	1	8
h_{14}	1	1	0	1	0	0	0	0	1	0	0	0	1	1	0	6
h_{15}	1	1	0	1	0	1	0	0	0	0	0	1	0	1	1	7
h_{16}	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	5
h_{17}	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3
h_{18}	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	5
h_{19}	1	0	0	1	0	1	0	0	0	0	0	1	0	1	1	6
h_{20}	1	1	1	1	0	1	0	0	0	0	0	1	1	1	1	9
h_{21}	1	1	0	1	0	0	0	0	0	0	0	1	0	1	1	6
h_{22}	1	1	1	1	0	1	0	0	0	0	0	0	0	1	1	7
h_{23}	1	1	0	1	0	1	0	0	0	0	0	0	0	1	1	6
h_{24}	1	1	0	1	0	1	1	0	1	0	0	1	1	1	0	9
h_{25}	1	1	0	1	0	1	0	0	0	0	0	0	1	1	1	7
h_{26}	1	1	0	1	0	1	0	0	0	0	0	0	1	1	1	7
h_{27}	1	1	0	1	0	1	1	0	0	0	0	1	1	1	1	9
h_{28}	1	1	0	1	0	1	1	0	1	0	0	0	1	1	0	8

From Table I, we can see that Blackberry mobile phone h_{20}, h_{24}, h_{27}, namely blackberry curve 9320, blackberry Porsche design 9981 and blackberry Torch 9800 are the best choice because $f_E(h_{20}) = f_E(h_{24}) = f_E(h_{27}) = 9$. $h_{11}, h_{12}, h_{23}, h_{28}$ are the suboptimal choice objects.

NENPR for capturing the normal parameter reduction on Blackberry Mobile Phone Datasetis implemented. From the executed results, we can get that $C = \{e_8, e_{10}, e_{11}, e_{14}\}$ and one set satisfies $f_A(h_1) = f_A(h_2) = \cdots = f_A(h_{28})$,$A = \{e_9, e_{15}\}$. Finally E-C-$A = \{e_1, e_2, e_3, e_4, e_5, e_6, e_7, e_{12}, e_{13}\}$ is considered as the optimal normal parameter reduction. In other words, after deleting $e_8, e_{10}, e_{11}, e_{14}$ and e_9, e_{15}, it is clear that Blackberry mobile phone h_{20}, h_{24}, h_{27}, namely blackberry curve 9320, blackberry Porsche design 9981 and blackberry Torch 9800 are still the best choice because $f_E(h_{20}) = f_E(h_{24}) = f_E(h_{27}) = 7$. $h_{15}, h_{22}, h_{24}, h_{25}, h_{26}$ are still the suboptimal choice objects.

V. CONCLUSION

Pioneering work on parameter reduction of soft sets in decision making has been done. However, up to the present, few documents have focused on real-life applications of these algorithms. Therefore, we apply a new efficient normal parameter reduction algorithm into real-life datasets of online shopping, such as Blackberry Mobile Phone Dataset. Experimental results show that this algorithm is not only suitable but feasible for dealing with the online shopping.

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