Programming And Algorithm for Attributes Reduction Using Multi Soft Sets

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Abstract

Real life problems often contains uncertainty and vagueness which cannot be solved by classical mathematical model. By soft set theory, one can model the problem and get the approximate solution. Soft sets have applications in decision making problems. In this paper we have taken an real life problem and converted non Boolean information to Boolean information. And used reduct approach under soft set theory. We have developed a program in MATLAB software for finding reducts for any number of parameters for a given multi soft set. For this we have taken a real life problem: Best suitable crops for Parbhani district based on collected data.

1 Introduction

This research article deals with reduction of attributes in multi valued information system, based on the concept of multi soft sets. The AND operation is used in multi-soft sets to present the notion of attribute reduction. A reduct is a subset of attributes that are jointly sufficient and individually necessary for preserving a particular property of a given information system. In lots of applications information and knowledge are stored and represented in an information table, where a set of objects is described by a set of attributes. But all these attributes are not always necessary to preserve the property. Using the entire attribute set for describing the property is time consuming and the constructed rules may be difficult to understand, apply. The objective of attribute reduction is to reduce the number attributes and at the same time, preserve the property of information. Many researches like Maji, Moldostov, Pawlak, Tutut, Zhao, have worked in this area. This paper

is based on the notion of multi soft set and AND operation.
In this paper, we have taken in to account a real life problem and converted the non-Boolean information to boolean information and developed an algorithm for finding all reducts for any general real problem containing any number of parameters.

2 Preliminaries

Definition 2.1. Soft Set
Let U be an universe and E be a set of parameters. Let $P(U)$ denote the power set of U and A be a non-empty subset of E. A pair (F, A) is called a soft set over U, where F is a mapping given by $F : A \to P(U)$.
In other words, a soft set over U is a parameterized family of subsets of the universe U. For $\epsilon \in A$, $F(\epsilon)$ may be considered as the set of ϵ-elements of the soft set (F, A) or as the set of ϵ-approximate elements of the soft set.

Definition 2.2. The class of all value sets of a soft set (F, E) is called value-class of the soft set and is denoted by $C_{(F,E)}$. Clearly $C_{(F,E)} \subseteq P(U)$.

Definition 2.3. Information Sysytems
An information system is a 4-tuple (quadruple) $S = (U, A, V, f)$, where $U = \{u_1, u_2, u_3, ..u_{|U|}\}$ is a non empty finite set of objects, $A = \{a_1, a_2, a_3, ..a_{|A|}\}$ is a non empty finite set of attributes,$V = \cup_{a \in A} V_a$, V_a is the domain (value set) of attributes a, $f : U \times A \to V$ is an information function such that $f(u, a) \in V_a$, for every $(u, a) \in U \times A$, called information (knowledge) function.
An information system is also called a knowledge representation system s or an attribute valued system. An information system can be intuitively expressed in terms of an information table as shown below:

U	a_1	a_2	...	a_k	...	$a_{\|A\|}$
u_1	$f(u_1, a_1)$	$f(u_1, a_2)$	...	$f(u_1, a_k)$	...	$f(u_1, a_{\|A\|})$
u_2	$f(u_2, a_1)$	$f(u_2, a_2)$	...	$f(u_2, a_k)$	...	$f(u_2, a_{\|A\|})$
u_3	$f(u_3, a_1)$	$f(u_3, a_2)$	...	$f(u_3, a_k)$	...	$f(u_3, a_{\|A\|})$
.	.	.	...	.	...	.
$u_{\|v\|}$	$f(u_{\|v\|}, a_1)$	$f(u_{\|v\|}, a_2)$	...	$f(u_{\|v\|}, a_k)$	...	$f(u_{\|v\|}, a_{\|A\|})$

Information System

Definition 2.4. [6] We define $(F, E) = \big((F, a_1), (F, a_2), (F, a_3), ...(F, a_|A|)\big)$ as a multi soft set over universe U representing a multi valued information system $S = (U, A, \vee, f)$.

Definition 2.5. [6] Let $(F, E) = ((F, a_i) : i = 1, 2, |A|)$ be a multi soft set over U representing a multi valued information system $S = (U, A, \vee, f)$, The AND operation between (F, a_i) and (F, a_j) is defined as
$(F, a_i)\, AND\, (F, a_j) = (G, a_i \times a_j)$ Where
$G(V_{a_i}, V_{a_j}) = F(V_{a_i}) \cap F(V_{a_j}), \quad \forall\, (V_{a_i}, V_{a_j}) \in a_i \times a_j$,for $1 \leq i, j \leq |A|$.

Definition 2.6. [6] Let $(F, A) = ((F, a_i) : i = 1, 2, ...|A|)$ be a multi soft set over U representing a multi valued information system $S = (U, A, \vee, f)$. A set of attributes $B \subseteq A$ is called reduct for A
if $C_{F(b_1 \times b_2 \times ... \times b_{|B|})} = C_{F(a_1 \times a_2 \times ... \times a_{|B|})}$.

Definition 2.7. [6] Core for A is the intersection of all reducts for A.

3 Program and Algorithm

Program

```
%Clearing memory and command window
clc;clear all;close all;
%--------------------------
disp('--------------------------');
%--------------------------
tabs=input('Enter the number of tables: ');
tables=zeros(tabs);
tab={};
tab{1}=zeros(1,1);
p={};
p{1}=cell(1,1);
for i=1:tabs
fprintf('Enter the number of coln of table no. %d  n',i);
x=input('');
% tables(i)=x;
tab{i}= zeros(5,x);
p{i}=cell(1,x);

    end

    for i=1:tabs
[m, n] = size(tab{i});
fprintf('Enter the elements of table no. %d n',i);
for r=1: m
for c=1:n
```

```
x=input(”);
tab{i}(r,c)= x;
end
end
fprintf('Enter the labels of table no. %d n',i);
d=length(p{i});
for j=1:d
fprintf('Enter the label of coln . %d n',j);
y=input(”,'s');
p{i}(j)= cellstr(y);

    end
end

    %————————————
% functions for all probabilities
while(1)
for i=2:tabs
fprintf('For testing %d tables please Enter %d n',i,i);
end

    %————————————————————————————
y=input(”);
if (y==2)
fprintf('Dear .. Now you are going to test 2 tables  n');
fprintf('The available tables from 1 to %d  n Please Enter the number of first
table',tabs);
a1=input(”);
fprintf('Please Enter the number of second table');
a2=input(”);
for12(tab{a1},tab{a2},p{a1},p{a2});
fprintf('For continue Enter 1... Otherwise Enter 0  n');
x=input(”);
if (x==0)
disp('Thank You For Using This Program');
break;
end
end

    if (y==3)
fprintf('Dear .. Now you are going to test 3 tables  n');
```

```
fprintf('The available tables from 1 to %d  n Please Enter the number of first
table',tabs);
a1=input('');
fprintf('Please Enter the number of second table');
a2=input('');
fprintf('Please Enter the number of Third table');
a3=input('');
for3(tab{a1},tab{a2},tab{a3},p{a1},p{a2},p{a3});
fprintf('For continue Enter 1... Otherwise Enter 0  n');
x=input('');
if (x==0)
disp('Thank You For Using This Program');
break;
end
end
if (y==4)
fprintf('Dear .. Now you are going to test 4 tables  n');
fprintf('The available tables from 1 to %d  n Please Enter the number of first
table',tabs);
a1=input('');
fprintf('Please Enter the number of second table');
a2=input('');
fprintf('Please Enter the number of Third table');
a3=input('');
fprintf('Please Enter the number of fourth table');
a4=input('');
for4(tab{a1},tab{a2},tab{a3},tab{a4},p{a1},p{a2},p{a3},p{a4});
fprintf('For continue Enter 1... Otherwise Enter 0  n');
x=input('');
if (x==0)
disp('Thank You For Using This Program');
break;
end
end

    if (y==5)
fprintf('Dear .. Now you are going to test 5 tables  n');
fprintf('The available tables from 1 to %d  n Please Enter the number of first
table',tabs);
a1=input('');
fprintf('Please Enter the number of second table');
```

```
a2=input('');
fprintf('Please Enter the number of Third table');
a3=input('');
fprintf('Please Enter the number of fourth table');
a4=input('');
fprintf('Please Enter the number of fifth table');
a5=input('');
for5(tab{a1},tab{a2},tab{a3},tab{a4},tab{a5},p{a1},p{a2},p{a3},p{a4},p{a5});
fprintf('For continue Enter 1... Otherwise Enter 0  n');
x=input('');
if (x==0) disp('Thank You For Using This Program');
break;
end
end

    if (y==6)
fprintf('Dear .. Now you are going to test 6 tables  n');
fprintf('The available tables from 1 to %d  n Please Enter the number of first
table',tabs);
a1=input('');
fprintf('Please Enter the number of second table');
a2=input('');
fprintf('Please Enter the number of Third table');
a3=input('');
fprintf('Please Enter the number of fourth table');
a4=input('');
fprintf('Please Enter the number of fifth table');
a5=input('');
fprintf('Please Enter the number of sixth table');
a6=input('');
for6(tab{a1},tab{a2},tab{a3},tab{a4},tab{a5},tab{a6},p{a1},p{a2},p{a3},p{a4},p{a5},p{a6});
fprintf('For continue Enter 1... Otherwise Enter 0  n');
x=input('');
if (x==0)
disp('Thank You For Using This Program');
break;
end
end

    if (y==7)
fprintf('Dear .. Now you are going to test 6 tables  n');
```

```
fprintf('The available tables from 1 to %d  n Please Enter the number of first
table',tabs);
a1=input('');
fprintf('Please Enter the number of second table');
a2=input('');
fprintf('Please Enter the number of Third table');
a3=input('');
fprintf('Please Enter the number of fourth table');
a4=input('');
fprintf('Please Enter the number of fifth table');
a5=input('');
fprintf('Please Enter the number of sixth table');
a6=input('');
fprintf('Please Enter the number of seventh table');
a7=input('');
for7(tab{a1},tab{a2},tab{a3},tab{a4},tab{a5},tab{a6},tab{a7},p{a1},p{a2},p{a3},p{a4},p{a5}
fprintf('For continue Enter 1... Otherwise Enter 0  n');
x=input('');
if (x==0)
disp('Thank You For Using This Program');
break;
end
end
end
```

3.1 Algorithm

1. Input the number of tables N, where $N > 1$.
2. Constructs each table i, where i= 1 to N.
3. While(1)
4. Input the number of tables M which you are going to test it, where 1¡M¡=N.
5. Input the number of desirable table which belonging to [1, N].
6. Repeat the step 5 until the number of tables encounter M.
7. Take each element of first row of the first table X.

8. Apply logical AND operation between X and all possibilities to each columns of the first row for each remaining tables.

9. If the result of AND operation is equal to 1, then display the head of each column of all tables with the number of row on the screen.

10. Repeat the steps from 7 to 9 until all elements of each row of the first table scanned with the other elements of the other rows of all tables.

11. For continue to new tables testing, just input 1 and repeat the steps from 3 to 10.

12. For exit, input 0 then, break.

13. End

Example 3.1. We have collected the different crops data of jowar, wheat, soyabeen, toor and cotton from farmers of Lohgaon, Pingli, Zari, Bori, Takli, Dhudhgao, Mirkhel,Talkalas, Sonpeth etc different villages of Parbhani districts and taken the average values of the formers response and converted the numerical value in to the High, Medium, Low parameters by using proper scale. And converted this non-Boolean information to boolean information as follows:

Crpos/Parameter	Capital (e_1)	Production(e_2)	Expenditure(e_3)	Water(e_4)	Return(e_5)
Jowar (C_1)	Low	Low	Low	Low	Low
Wheat (C_2)	High	Medium	Low	Medium	Medium
Cotton (C_3)	High	Medium	High	Medium	High
Soybean (C_4)	High	Medium	Medium	Medium	High
Toor (C_5)	Low	Low	Low	Low	Medium

Table 1 Information System of the crops

The multi Boolean information systems representing above Table is given below:

U	e_1	
	Low	High
C_1	1	0
C_2	0	1
C_3	0	1
C_4	0	1
C_5	1	0

Table 2 Boolean Information System for the attribute e_1

U	e_2	
	Low	Medium
C_1	1	0
C_2	0	1
C_3	0	1
C_4	0	1
C_5	1	0

Table 3 Boolean Information System for the attribute e_2

U	e_3		
	Low	Medium	High
C_1	1	0	0
C_2	1	0	0
C_3	0	0	1
C_4	0	1	0
C_5	1	0	0

Table 4 Boolean Information System for the attribute e_3

U	e_4	
	Low	Medium
C_1	1	0
C_2	0	1
C_3	0	1
C_4	0	1
C_5	1	0

Table 5 Boolean Information System for the attribute e_4

U	e_5		
	Low	Medium	High
C_1	1	0	0
C_2	0	1	0
C_3	0	0	1
C_4	0	0	1
C_5	0	1	0

Table 6 Boolean Information System for the attribute e_5

From the above Boolean information we have the following corresponding soft sets:
$(F, e_1) = \big\{\{Low = C_1, C_5\}, \{High = C_2, C_3, C_4\}\big\}$
$(F, e_2) = \big\{\{Low = C_1, C_5\}, \{Medium = C_2, C_3, C_4\}\big\}$
$(F, e_3) = \big\{\{Low = C_1, C_2, C_5\}, \{Medium = C_4\}, \{High = C_3\}\big\}$
$(F, e_4) = \big\{\{Low = C_1, C_5\}, \{Medium = C_2, C_3, C_4\}\big\}$
$(F, e_5) = \big\{\{Low = C_1\}, \{Medium = C_2, C_5\}, \{High = C_3, C_4\}\big\}$
The multi soft set for the above Boolean information table is:

$$\begin{aligned}(F, A) &= \big((F, e_1), (F, e_2), (F, e_3), (F, e_4), (F, e_5)\big)\\ &= \big(\big\{\{Low = C_1, C_5\}, \{High = C_2, C_3, C_4\}\big\}, \big\{\{Low = C_1, C_5\}, \{Medium = C_2, C_3, C_4\}\big\},\\ &\quad \big\{\{Low = C_1, C_2, C_5\}, \{Medium = C_4\}, \{High = C_3\}\big\}, \big\{\{Low = C_1, C_5\}, \{Medium = C\\ &\quad \big\{\{Low = C_1\}, \{Medium = C_2, C_5\}, \{High = C_3, C_4\}\big\}\big)\end{aligned}$$

1. For $(F, \{e_1, e_2, e_3\})$:

$$\begin{aligned}(F, e_1 \times e_2 \times e_3) &= (F, e_1)\, AND\, (F, e_2)\, AND (F, e_3)\\ &= \big((Low, Low, Low) = \{C_1, C_5\}, (High, Medium, Low) = \{C_2\},\\ &\quad (High, Medium, Medium) = \{C_4\}, (High, Medium, High) = \{C_3\}\big)\end{aligned}$$

Here we observe that,

$$C_{F(e_1 \times e_2 \times e_3)} = \big\{\{C_1, C_5\}, \{C_2\}, \{C_4\}, \{C_3\}\big\} \qquad (3.1)$$

2. For $(F, \{e_1, e_3, e_5\})$:

$$\begin{aligned}(F, e_1 \times e_3 \times e_5) &= (F, e_1)\, AND\, (F, e_3)\, AND (F, e_5)\\ &= \big\{(Low, Low, Low) = \{1\}, (Low, Low, Medium) = \{5\}\\ &\quad (High, Low, Medium) = \{2\}, (High, Medium, High) = \{4\}\\ &\quad (High, High, High) = \{3\}\big\}\end{aligned}$$

$$C_{F(e_1 \times e_3 \times e_5)} = \big\{\{C_1\}, \{C_2\}, \{C_4\}, \{C_3\}, \{C_5\}\big\} \qquad (3.2)$$

3. For $(F, \{e_2, e_3, e_5\})$:

$$\begin{aligned}(F, e_2 \times e_3 \times e_5) &= (F, e_2)\, AND\, (F, e_3)\, AND (F, e_5)\\ &= \big\{(Low, Low, Low) = \{C_1\}, (Low, Low, Medium) = \{C_5\},\\ &\quad (Medium, Low, Medium) = \{C_2\}, (Medium, Medium, High) = \{C_4\},\\ &\quad (Medium, High, High) = \{C_3\}\big\}\end{aligned}$$

$$C_{F(e_2 \times e_3 \times e_5)} = \big\{\{C_1\}, \{C_2\}, \{C_4\}, \{C_3\}, \{C_5\}\big\} \qquad (3.3)$$

4. For $(F, \{e_3, e_4, e_5\})$:

$$\begin{aligned}(F, e_3 \times e_4 \times e_5) &= (F, e_3)\, AND\, (F, e_4)\, AND (F, e_5) \\ &= \big\{(Low, Low, Low) = \{C_1\}, (Low, Low, Medium) = \{C_5\}, \\ &\quad (Low, Medium, Medium) = \{C_2\}(Medium, Medium, High) = \{C_4\} \\ &\quad (High, Medium, High) = \{C_3\}\big\}\end{aligned}$$

$$C_{F(e_3 \times e_4 \times e_5)} = \big\{\{C_1\}, \{C_2\}, \{C_3\}, \{C_4\}, \{C_5\}\big\} \qquad (3.4)$$

5. For $(F, \{e_1, e_2, e_3, e_5\})$:

$$\begin{aligned}(F, e_1 \times e_2 \times e_3 \times e_5) &= (F, e_1)\, AND\, (F, e_2)\, AND (F, e_3)\, AND (F, e_5) \\ &= \big\{(Low, Low, Low, Low) = \{C_1\}, (Low, Low, Low, Medium) = \{C_5\}, \\ &\quad (High, Medium, Low, Medium) = \{C_2\}(High, Medium, Medium, High) = \{C \\ &\quad (High, Medium, High, High) = \{C_3\}\big\}\end{aligned}$$

$$C_{F(e_1 \times e_2 \times e_3 \times e_5)} = \big\{\{C_1\}, \{C_2\}, \{C_3\}, \{C_4\}, \{C_5\}\big\} \qquad (3.5)$$

6. For $(F, \{e_1, e_3, e_4, e_5\})$:

$$\begin{aligned}(F, e_1 \times e_3 \times e_4 \times e_5) &= (F, e_1)\, AND\, (F, e_3)\, AND (F, e_4)\, AND (F, e_5) \\ &= \big\{(Low, Low, Low, Low) = \{C_1\}, (Low, Low, Low, Medium) = \{C_5\}, \\ &\quad (High, Low, Medium, Medium) = \{C_2\}(High, Medium, Medium, High) = \{C \\ &\quad (High, High, Medium, High) = \{C_3\}\big\}\end{aligned}$$

$$C_{F(e_1 \times e_3 \times e_4 \times e_5)} = \big\{\{C_1\}, \{C_2\}, \{C_3\}, \{C_4\}, \{C_5\}\big\} \qquad (3.6)$$

$$\begin{aligned}(F, e_2 \times e_3 \times e_4 \times e_5) &= (F, e_2)\, AND\, (F, e_3)\, AND (F, e_4)\, AND (F, e_5) \\ &= \big\{(Low, Low, Low, Low) = \{C_1\}, (Low, Low, Low, Medium) = \{C_5\}, \\ &\quad (Medium, Low, Medium, Medium) = \{C_2\}(Medium, High, Medium, High) = \\ &\quad (Medium, Medium, Medium, High) = \{C_4\}\big\}\end{aligned}$$

$$C_{F(e_2 \times e_3 \times e_4 \times e_5)} = \big\{\{C_1\}, \{C_2\}, \{C_3\}, \{C_4\}, \{C_5\}\big\} \qquad (3.7)$$

From 3.1,3.2,3.3,3.5 and 3.6, we have following reducts
$\{e_1, e_3, e_5\}, \{e_2, e_3, e_5\}, \{e_3, e_4, e_5\}, \{e_1, e_2, e_3, e_5\}, \{e_1, e_3, e_4, e_5\}$ and $\{e_2, e_3, e_4, e_5\}$
Hence, core$A = \{e_3, e_5\}$

4 Conclusions

We conclude that the attributes e_3 (expenditure) and e_5 (Return) are taken into account when discussing the difference between the crops and attributes e_1(Capital), e_2 (Production) and e_4 (Water) can be mutually replaced. The reducts obtained by multi soft set theory are similar two Pawlaks reduction.

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