APPLICATION OF INTUITIONISTIC SETS

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ABSTRACT. In this paper, an effectual method for association rule mining which is based on intuitionistic sets using initial support as constraints is shown. In this method, initial support constraints used to filter out the inexact frequent items and rarely occured items. Removal of these items results in an improved structure of dataset so that the result is produced faster and accurate.

1. INTRODUCTION

The "intuitionistic set" accords with information system, thus a transactional dataset can be interpreted as an intuitionistic set. Applying parameter co-occurance in a transaction, we determine the notion of regular association rules amidst two sets of parameters. Their support and confidence are interpreted by intuitionistic sets.

2. PRELIMINARIES

Definition 2.1. [4] An intuitionistic set A is an object having the form $\langle X, A_1, A_2\rangle$ where A_1 and A_2 are subsets of X satisfying $A_1 \cap A_2 = \varphi$. The set A_1 is called the set of members of A, while A_2 is called the set of nonmembers of A. Furthermore, let $\{A_i : i \in I\}$ be an ar bitrary family of intuitionistic sets in X,

- $\varphi_{\sim} = \langle X, \varphi, X\rangle$, $X_{\sim} = \langle X, X, \varphi\rangle$
- A if $A_1 \subseteq B_1$ and $A_2 \supseteq B_2$
- $A = \langle X, A_2, A_1\rangle$
- $A - B = \mathrm{A} \cap B$
- $[\ ]A = \langle X, A_1, A^c\rangle$

Definition 2.2. [4] An intuitionistic topological space on a nonempty set X is a family τ of intuitionistic sets in X satisfying the following axioms:

- $\varphi_{\sim}, X_{\sim} \in \tau$
- $G_1 \cap G_2 \in \tau$ for $G_1, G_2 \in \tau$
- $\cup G_i \in \tau$ for any arbitrary family $\{G_i : i \in J\} \subseteq \tau$

In this case the pair (X, τ) is called intuitionistic topological space and any intu- itionistic set in τ is known as an intuitionistic open set in X, and the complement of intuitionistic open sets is known as intuitionistic closed set in X.

Definition 2.3. [10] Let (X, τ) be an intuitionistic topological space.

An intuitionistic set A of X is said to be

- Intuitionistic semiopen if $A \subseteq Icl(Iint(A))$
- Intuitionistic preopen if $A \subseteq Iint(Icl(A))$
- Intuitionistic regular open if $A = Iint(Icl(A))$

The family of all intuitionistic preopen and intuitionistic regular open sets of (X, τ) are denoted by $IPOS(X)$ and $IROS(X)$ respectively.

Definition 2.4. [4] Let (X, τ) be an intuitionistic topological space on X and $A = \langle X, A_1, A_2 \rangle$ be an intuitionistic set in X. Then the several topologies generated by (X, τ) are

- $\tau_{0,1} = \{[\,]A : A \in \tau\}$
- $\tau_{0,2} = \{\langle\,\rangle A : A \in \tau\}$
- $\tau_1 = \{A_1 : \langle X, A_1, A_2 \rangle \in \tau\}$
- $\tau_2 = \{(A_2)^c : \langle X, A_1, A_2 \rangle \in \tau\}$

Definition 2.5. [4]

- If $B = \langle Y, B_1, B_2 \rangle$ is an intuitionistic set in Y, then the preimage of B under f, denoted by $f^{-1}(B)$, is the intuitionistic set in X defined by $f^{-1}(B) = \langle X, f^{-1}(B_1), f^{-1}(B_2) \rangle$
- If $A = \langle X, f(A_1), f(A_2) \rangle$ is an intuitionistic set in X, then the image of A under f, denoted by $f(A)$ is the intuitionistic set in Y defined by $f(A) = \langle Y, f(A_1), f_-(A_2)) \rangle$ where $f_-(A_2) = Y - (f(X - A_2))$.

3. Approach for Association Rule Mining Using Intuitionistic Sets

Determining association rules is the core of data mining. It reveals hidden link- ages of irrelevant data. These links can furnish rules. Those which exceed a reliable threshold are known to be interesting.

These rules permit actions to be taken based on these data pattern. In addition they help to justify decisions. Market-basket problem is the best example for Data Mining. The literal meaning of Market-basket problem is to determine what items commoners purchase together without knowing the person so that the salespersons can position goods accordingly in the mart to achieve higher volumes of sales and in order to make sales decisions. It is the ability to determine interesting rules which makes association rules beneficial and contributes to knowledge discovery.

Determining association rules can be concluded into two steps:

(i) Finding large itemsets.
(ii) Achieving rules from these itemsets.

The association rules are said to be interesting if it satisfies predefined minimum support and minimum confidence. For rule $Y \rightarrow Z$ their support and confidence is calculated as:

Support$(Y \rightarrow Z) = (Y \cup Z).count/N$
where N is the total number of transaction.
Confidence$(Y \rightarrow Z) = (Y \cup Z).count/Y.Count$

The objective of association rule mining is to determine all rules with support and confidence more than user specified thresholds. The association rules was prospered principally for the evaluation of transactional databases. A massive number of association rules is originated from a transactional dataset. The rules that gratify the minimum support threshold and minimum confidence threshold is said to be strong and the leftovers are discarded.

4.ALGORITHM

In this method we lessen the dataset with the help of initial reduced support. Consequently the false frequent items and rare items are deleted from the input transaction dataset and the response time for rule generation is quicker.
Input : Transaction dataset D (N is the total number of transactions, n is the total number of items present), initial reduced support, minimum support threshold and minimum confidence threshold.
Output : Strong Association rule.

THE ALGORITHM USED IN THIS METHOD IS GIVEN BELOW:

Step 1: Scan the dataset *D* for all transactions 1 to *N*.
Step 2: Evaluate the support for all items in the transaction dataset.
Step 3: For the items present in the dataset, if initial reduced support is greater than item support then delete that item from transaction dataset.
Step 4: Convert the reduced dataset obtained in step 3 into information system. Step 5: Apply the Intuitionistic sets on the information system.
Step 6: Apply the principle of parameter co-occurence and calculate the count of various itemsets.
Step 7: Generate the association rule from the frequent patterns and check with minimum confidence threshold to find out the rule is strong or not.
Step 8: End

PROBLEM:
Transaction dataset contains 10 transactions. Suppose initial reduced support is 2, minimum support is also 2 and confidence is 40 percent. The transaction dataset is used as an input for the proposed example. We perform different steps of our algorithm on it and also show the results.

Suppose that δ arbitrarily equals 3; that means qualified transaction is regarded as a transaction with no more than 3 items purchased in the transaction. There is a dataset given with two categories
i.e., $T = \{Countries, Items\}$,

where Countries $=\{RUSSIA, IRAN, USA, AFRICA\}$
and Items $= \{I_1, I_2, I_3, I_4, I_5, I_6, I_7, I_8, I_9, I_{10}, I_{11}\}$.

TRANSACTION DATASET

THE TRANSACTION ID IS GIVEN BY THE NUMBERS {1,2,3,4,5,6,7,8,9,10}

TID	Items
1	RUSSIA, IRAN, USA, I_1, I_2
2	RUSSIA, IRAN, USA, I_1, I_2, I_3
3	USA, I_4
4	USA, I_5, I_6
5	USA, I_5, I_6
6	USA, I_4, I_6, I_7
7	RUSSIA, I_8, I_9
8	RUSSIA, USA, AFRICA, I_{10}, I_{11}
9	RUSSIA, USA, I_{10}, I_{11}
10	RUSSIA, USA, I_4

Now the first step of the algorithm is to scan the transaction dataset. Further, the support of various items present in the dataset is calculated and the results are tabulated below.

SUPPORT OF VARIOUS ITEMS

SUPPORT	VALUE
RUSSIA	*6*
USA	*9*
IRAN	*2*
I_{10}	*2*
I_1	*2*
I_{11}	*2*
I_8	*1*
I_9	*1*
I_4	*3*
AFRICA	1
I_3	1
I_6	3
I_2	2

Now we apply step 3 of the algorithm to delete those items from transaction dataset whose support is less than reduced support threshold. Since the minimum reduced support threshold is 2 then the result of step 3 is shown below.

REDUCED TRANSACTION DATASET

TID	Items
1	RUSSIA, IRAN, USA, I_1, I_2
2	RUSSIA, IRAN, USA, I_1, I_2
3	USA, I_4
4	USA, I_5, I_6
5	USA, I_5, I_6
6	USA, I_4, I_6
7	RUSSIA
8	RUSSIA, USA, I_{10}, I_{11}
9	RUSSIA, USA, I_{10}, I_{11}
10	RUSSIA, USA, I_4

After deletion we get the more accurate dataset that contains no false frequent items and no rare items.

Now we apply the algorithm to convert the reduced dataset into information system after which intuitionistic sets are applied on them.

INTUITIONISTIC SET REPRESENTATION

A = ⟨*X*, {1, 2, 7, 8, 9, 10} , {3, 4, 5, 6}⟩	RUSSIA
B = ⟨*X*, {1, 2, 3, 4, 5, 6, 8, 9, 10} , {7}⟩	USA
C = ⟨*X*, {1, 2} , {3, 4, 5, 6, 7, 8, 9, 10}⟩	IRAN
D = ⟨*X*, {8, 9, } , {1, 2, 3, 4, 5, 6, 7, 10}⟩	I_{10}
E = ⟨*X*, {8, 9, } , {1, 2, 3, 4, 5, 6, 7, 10}⟩	I_{11}
F = ⟨*X*, {3, 6, 10} , {1, 2, 4, 5, 7, 8, 9}⟩	I_4
G = ⟨*X*, {1, 2} , {3, 4, 5, 6, 7, 8, 9, 10}⟩	I_1
H = ⟨*X*, {4, 5, 6} , {1, 2, 3, 7, 8, 9, 10}⟩	I_6
I = ⟨*X*, {1, 2} , {3, 4, 5, 6, 7, 8, 9, 10}⟩	I_2
J = ⟨*X*, {4, 5} , {1, 2, 3, 6, 7, 8, 9, 10}⟩	I_5

After the intuitionistic set is applied in step 5, we apply the parameter co- occurance inorder to generate the support of various combination of itemsets and delete those item sets whose support is less than minimum support.

PARAMETER CO−OCCURANCE

Coo(u_1)	RUSSIA, IRAN, USA, I_1, I_2
Coo(u_2)	RUSSIA, IRAN, USA, I_1, I_2
Coo(u_3)	USA, I_4
Coo(u_4)	USA, I_5, I_6
Coo(u_5)	USA, I_5, I_6
Coo(u_6)	USA, I_4, I_6
Coo(u_7)	RUSSIA
Coo(u_8)	RUSSIA, USA, I_{10}, I_{11}
Coo(u_9)	RUSSIA, USA, I_{10}, I_{11}
Coo(u_{10})	RUSSIA, USA, I_4

Now with the help of parameter co-occurance we calculate the support of various items.

SUPPORT OF ITEMSETS

Support (*RUSSIA*)	6
Support (*USA*)	9
Support (*IRAN*)	2
Support (*RUSSIA, USA*)	5
Support (*RUSSIA, IRAN*)	2
Support (*RUSSIA, IRAN, USA*)	2
Support (I_1)	2
Support (I_2)	2
Support (I_4)	3
Support (I_5)	2
Support (I_6)	3
Support (I_{10})	2
Support (I_{11})	2

i.e., Support(*RUSSIA*) = $\{u_1, u_2, u_7, u_8, u_9, u_{10}\}$ = 6, similarly we calculate for all other items in the dataset.

In the last step we generate association rule from the frequent patterns generated[7] in step 6 and check the rules satisfying the minimum threshold. Rules that satisfies the minimum confidence threshold are said to be strong association rules and the rules which does not satisfy minimum confidence threshold are rejected.

Step 7:

Association Rule : $Y \rightarrow Z$
Then for, $USA, RUSSIA \rightarrow I_2 \Rightarrow 5 \rightarrow 2$

Confidence(Y $\rightarrow$ Z) = 2/5 = 40 percent
Support(Y $\rightarrow$ Z) = 2/10 = 20 percent

Therefore confidence of rule $USA, RUSSIA \rightarrow I_2$ is 40 percent which is equal to minimum conference threshold. Therefore this rule is strong association rule and hence accepted.

In the same manner all other rules is generated and their confidence is calculated then on basis of minimum confidence thresholds we decide rule is strong or not.

5. REFERENCES

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