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ROUGHSET IMPLEMENTATION FOR RHEUMATOID ARTHRITIS DATASET

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ABSTRACT

In the medical field[4] for the diagnosis process of rheumatoid arthritis disease is a tedious job to deal with different complicating attributes such as the relative importance of symptoms, varied pattern of symptoms and the relation between the rheumatoid arthritis diseases. Based on decision theory, many mathematical models such as crisp set, probability distribution, intuitionistic fuzzy set, fuzzy set, were used to deal with complicating aspects of diagnosis on large dataset. But, they are failed to include important aspects of the expert decisions. Therefore, an effort has been made to process inconsistencies, data being considered by Pawlak with the introduction of rough set theory. Rough set theory has major advantages over the other methods, but it generates too many rules that create difficulties while taking decisions for correct results. Therefore, we have to minimize the steps in decision rules. In this paper, we use two processes such as preprocess and post process to make suitable rules and to explore the relationship among the attributes. In preprocess, we use rough set theory to mine suitable rules, whereas in post process we use formal concept analysis from these suitable rules to explore better knowledge and most important factors affecting the decision making.

KEYWORDS: Rough Sets, Information Table, Indiscernibility, Upper approximation, Lower approximation and Decision Rules.

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I .INTRODUCTION

The Rough Set theory is proposed by Zdzislaw Pawlak in 1982. Its methodology is concerned with the analysis of uncertain or incomplete information and knowledge and it is the non-statistical approaches in data analysis. The fundamental concept is the approximation of lower and upper specifications of a set. The subset generated by lower approximation is characterized by the objects that will definitely form a part of an interesting subset, and the upper approximation is characterized by objects that will be possible from a part of an interest subset. Every subset defined through upper and lower approximation is called the Rough Set. A set of objects that has similar characteristics it is a fundamental part of mathematics. All the mathematical objects, such as relations, functions and numbers can be considered as a set. The components of a set are known as elements, and the relationship between an element and a set is called of a pertinence relation. Cardinality is the process of measuring the number of elements in a set. Rough Set is an approach and is proposed by Zdzislaw Pawlak. It is a tool to treat the imprecise and vague. This is similar to Fuzzy Set Theory, because the imprecision and uncertain in this approach is expressed by the boundary region of a set, and not by a partial membership as in Fuzzy Set Theory.

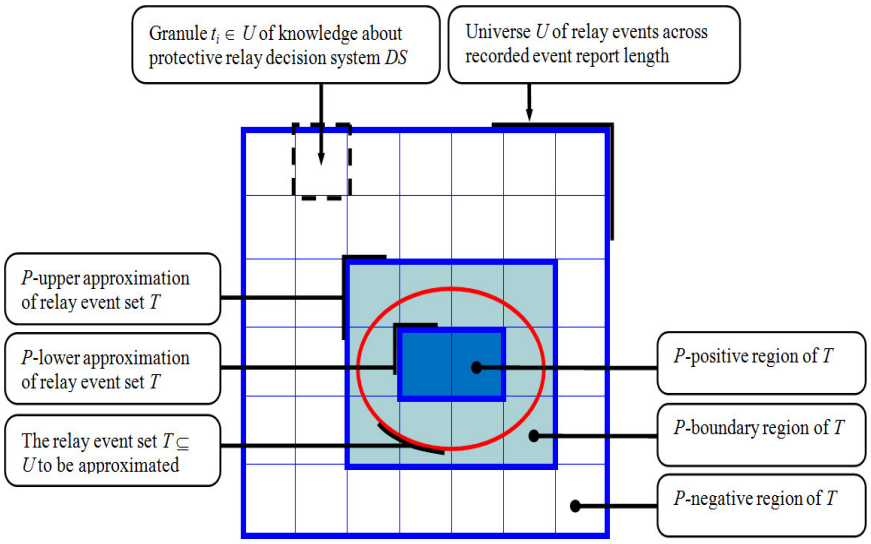

Figure 1
Approximation Process Diagran

II. INFORMATION TABLE FOR RHEMATOID ARTHRITIS DISEASE DATASET:

A. Information Table:

In this section, a data set of Images is shown with possible rheumatoid arthritis symptoms. Data are analysis using a Rough Set approach for the elimination of redundant data and to produce the set of rules that it useful for the doctor for the elaboration of the diagnosis of disease. The Table1 denotes the presence or absence of rheumatoid arthritis disease[4].

TABLE 1
Information table dataset for Rheumatoid Arthritis

Images	Mean	Standard Deviation	Entropy	Area	Perimeter	BMD	Result
Image 1	Normal	Low	Small	Low	Low	Low	Yes
Image 2	Normal	Low	Small	Low	Low	Low	Yes
Image 3	High	Low	Small	Low	Low	Low	Yes
Image 4	Low	Normal	Small	Low	Low	Low	Yes
Image 5	High	High	Small	High	Low	Low	Yes
Image 6	High	Low	Small	Low	Low	Low	Yes
Image 7	High	High	Small	Low	Low	Low	Yes
Image 8	Normal	Normal	Large	High	High	High	No
Image 9	Normal	Normal	Large	High	High	High	No
Image 10	Normal	High	Large	Low	Low	Low	Yes
Image 11	Normal	Normal	Large	High	High	High	No
Image 12	Low	Normal	Small	Low	Low	Low	Yes
Image 13	High	High	Small	Low	Low	Low	Yes
Image 14	High	Low	Small	Low	Low	Low	Yes
Image 15	Low	High	Large	Low	Low	Low	Yes
Image 16	Normal	High	Large	High	Low	Low	Yes
Image 17	High	Low	Small	High	Low	High	Yes
Image 18	Normal	Normal	Small	High	High	High	No
Image 19	Normal	Low	Small	High	High	Low	Yes
Image 20	Normal	Normal	Large	Low	High	High	No
Image 21	Normal	Normal	Small	High	High	High	Yes
Image 22	Normal	Normal	Large	High	High	High	No
Image 23	Normal	Normal	Small	High	Low	Low	Yes

Table1 consists of the images of the blood sample of patients with respective symptoms where, S are all of the images of the system, in set B={Image1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 8, Image 9, Image 10, Image 11, Image12 , Image 13, Image 14, Image 15, Image 16, Image 17, Image 18, Image 19, Image 20, Image21 , Image 22, Image23 } the set conditional attributes is represented by C={Mean, Standard deviation, Entropy, Area, perimeter, BMD} and the set the decision attribute is represented as D, where D={Result}.

A. Nominal Attribute Table

TABLE 2
Nominal Attributes table

	Attributes	**Nominal values**
Conditional attributes	Mean	Low, Normal, High
	Standard Deviation	Low, Normal, High
Conditional Attributes	Entropy	Small, Large
	Area	Low, High
	Perimeter	Low, High
	BMD	Low, High
Decision Attributes	Result	Yes, NO

Table 2 represents the nominal attribute[3] table which represents the decision attributes where C= {Mean, Standard Deviation, Entropy, Area, Perimeter, BMD}, and Decision attribute D= {Result}.

B. Indiscernibility Elements of Mean

TABLE 3
Result of Indiscernibility Elements of Mean attributes

Images	*Mean*	Standard Deviation	Entropy	Area	Perimeter	BMD	Result
Image 4	*Low*	Normal	Small	Low	Low	Low	Yes
Image 12	*Low*	Normal	Small	Low	Low	Low	Yes
Image 15	*Low*	High	Large	Low	Low	Low	Yes
Image 1	*Normal*	Low	Small	Low	Low	Low	Yes
Image 2	*Normal*	Low	Small	Low	Low	Low	Yes
Image 8	*Normal*	Normal	Large	High	High	High	No
Image 9	*Normal*	Normal	Large	High	High	High	No
Image 10	*Normal*	High	Large	Low	Low	Low	Yes
Image 11	*Normal*	Normal	Large	High	High	High	No
Image 16	*Normal*	High	Large	High	Low	Low	Yes
Image 18	*Normal*	Normal	Small	High	High	High	No
Image 19	*Normal*	Low	Small	High	High	Low	Yes
Image 20	*Normal*	Normal	Large	Low	High	High	No
Image 21	*Normal*	Normal	Small	High	High	High	Yes
Image 22	*Normal*	Normal	Large	High	High	High	No
Image 23	*Normal*	Normal	Small	High	Low	Low	Yes
Image 3	*High*	Low	Small	Low	Low	Low	Yes
Image 5	*High*	High	Small	High	Low	Low	Yes
Image 6	*High*	Low	Small	Low	Low	Low	Yes
Image 7	*High*	High	Small	Low	Low	Low	Yes
Image 13	*High*	High	Small	Low	Low	Low	Yes
Image 14	*High*	Low	Small	Low	Low	Low	Yes
Image 17	*High*	Low	Small	High	Low	High	Yes

Table 3 represents the Mean attribute generates three indiscernibility elementary sets: INDA({Mean})={{Image 4, Image 12, Image 15}, { Image 1, Image 2, Image 8, Image 9, Image 10, Image 11, Image 16, Image 18, Image 19, Image 20, Image 21, Image 22, Image 23}, { Image 3, Image 5, Image 6, Image 7, Image 13, Image 14, Image 17}}

C. Indiscernibility Elements of Standard Deviation

Table 4
Result of Indiscernibility Elements of Standard deviation attributes

Images	Mean	*Standard Deviation*	Entropy	Area	Perimeter	BMD	Result
Image 1	Normal	*Low*	Small	Low	Low	Low	Yes
Image 2	Normal	*Low*	Small	Low	Low	Low	Yes
Image 3	High	*Low*	Small	Low	Low	Low	Yes
Image 6	High	*Low*	Small	Low	Low	Low	Yes
Image 14	High	*Low*	Small	Low	Low	Low	Yes
Image 17	High	*Low*	Small	High	Low	High	Yes
Image 19	Normal	*Low*	Small	High	High	Low	Yes
Image 4	Low	*Normal*	Small	Low	Low	Low	Yes
Image 8	Normal	*Normal*	Large	High	High	High	No
Image 9	Normal	*Normal*	Large	High	High	High	No
Image 11	Normal	*Normal*	Large	High	High	High	No
Image 12	Low	*Normal*	Small	Low	Low	Low	Yes
Image 18	Normal	*Normal*	Small	High	High	High	No
Image 20	Normal	*Normal*	Large	Low	High	High	No
Image 21	Normal	*Normal*	Small	High	High	High	Yes
Image 22	Normal	*Normal*	Large	High	High	High	No
Image 23	Normal	*Normal*	Small	High	Low	Low	Yes
Image 5	High	*High*	Small	High	Low	Low	Yes
Image 7	High	*High*	Small	Low	Low	Low	Yes
Image 10	Normal	*High*	Large	Low	Low	Low	Yes
Image 13	High	*High*	Small	Low	Low	Low	Yes
Image 15	Low	*High*	Large	Low	Low	Low	Yes
Image 16	Normal	*High*	Large	High	Low	Low	Yes

Table 4 represents the Standard Deviation attribute generates three indiscernibility elementary sets: INDA({Standard Deviation})={ { Image 1, Image 2, Image 3, Image 6, Image 14, Image 17, Image 19},{ Image 4, Image 8, Image 9, Image 11, Image 12, Image 18, Image 20, Image 21, Image 22, Image 23},{ Image 5, Image 7, Image 10, Image 13, Image 15, Image 16}}

Similar to the above process the indiscernibility elements for all the other attributes are done.

E.Indiscernibility Elements of Entropy

The Entropy attribute generates two indiscernibility elementary sets:
({Entropy})={{ Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 12, Image 13, Image 14, Image 17, Image 18, Image 19, Image 21, Image 23},{ Image 8, Image 9, Image 10, Image 11, Image 15, Image 16, Image 20, Image 22}} produces TABLE 5, result of indiscernibility elements of Entropy in Table 5.

F.Indiscernibility Elements of Area

The Area attribute generates two indiscernibility elementary sets:
({Area})= { Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 20}, { Image 5, Image 8, Image 9, Image 11, Image 16, Image 17, Image 18, Image 19, Image 21, Image 22, Image 23}} produces TABLE 6, result of indiscernibility elements of Area in Table 6.

G. Indiscernibility Elements of Perimeter

The perimeter attribute generates two indiscernibility elementary sets:
({Perimeter})={{ Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 16, Image 17, Image 23}, { Image 8, Image 9, Image 11, Image 18, Image 19, Image 20, Image 21, Image 22}}produces TABLE 7, result of indiscernibility elements of Perimeter in Table 7.

H. Indiscernibility Elements of BMD

The BMD attribute generates two indiscernibility elementary sets:
({BMD})={ { Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 16, Image 19, Image 23}, { Image 8, Image 9, Image 11, Image 17, Image 18, Image 20, Image 21, Image 22}}produces TABLE 8, result of indiscernibility elements of BMD in table 8.

I- Approximation Process

The lower approximation[8] and the upper approximation of a set are generated by an indiscernibility relation. The types of approximations are followed using in the Rough Set Theory. The approximations are applied to the TABLE 1, as follows.

J. Indiscernibility Elements of Result

The Result attribute generates two indiscernibility elementary sets as Yes and No:

Table5
Result of Indiscernibility Elements of Entropy attributes

Images	Mean	Standard Deviation	*Entropy*	Area	Perimeter	BMD	Result
Image 1	Normal	Low	*Small*	Low	Low	Low	Yes
Image 2	Normal	Low	*Small*	Low	Low	Low	Yes
Image 3	High	Low	*Small*	Low	Low	Low	Yes
Image 4	Low	Normal	*Small*	Low	Low	Low	Yes
Image 5	High	High	*Small*	High	Low	Low	Yes
Image 6	High	Low	*Small*	Low	Low	Low	Yes
Image 7	High	High	*Small*	Low	Low	Low	Yes
Image 12	Low	Normal	*Small*	Low	Low	Low	Yes
Image 13	High	High	*Small*	Low	Low	Low	Yes
Image 14	High	Low	*Small*	Low	Low	Low	Yes
Image 17	High	Low	*Small*	High	Low	High	Yes
Image 18	Normal	Normal	*Small*	High	High	High	No
Image 19	Normal	Low	*Small*	High	High	Low	Yes
Image 21	Normal	Normal	*Small*	High	High	High	Yes
Image 23	Normal	Normal	*Small*	High	Low	Low	Yes

Image 8	Normal	Normal	*Large*	High	High	High	No
Image 9	Normal	Normal	*Large*	High	High	High	No
Image 10	Normal	High	Large	Low	Low	Low	Yes
Image 11	Normal	Normal	*Large*	High	High	High	No
Image 15	Low	High	Large	Low	Low	Low	Yes
Image 16	Normal	High	Large	High	Low	Low	Yes
Image 20	Normal	Normal	*Large*	Low	High	High	No
Image 22	Normal	Normal	*Large*	High	High	High	No

The Entropy attribute generates two indiscernibility elementary sets

({Entropy})={{ Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 12, Image 13, Image 14, Image 17, Image 18, Image 19, Image 21, Image 23},{ Image 8, Image 9, Image 10, Image 11, Image 15, Image 16, Image 20, Image 22}} produces TABLE 5, result of indiscernibility elements of Entropy in Table 5.

*F.**Indiscernibility Elements of Area***

Table 6

Result of Indiscernibility Elements of Area attributes

Images	Mean	Standard Deviation	Entropy	*Area*	Perimeter	BMD	Result
Image 1	Normal	Low	Small	*Low*	Low	Low	Yes
Image 2	Normal	Low	Small	*Low*	Low	Low	Yes
Image 3	High	Low	Small	*Low*	Low	Low	Yes
Image 4	Low	Normal	Small	*Low*	Low	Low	Yes
Image 6	High	Low	Small	*Low*	Low	Low	Yes
Image 7	High	High	Small	*Low*	Low	Low	Yes
Image 10	Normal	High	Large	*Low*	Low	Low	Yes
Image 12	Low	Normal	Small	*Low*	Low	Low	Yes
Image 13	High	High	Small	*Low*	Low	Low	Yes
Image 14	High	Low	Small	*Low*	Low	Low	Yes
Image 15	Low	High	Large	*Low*	Low	Low	Yes
Image 20	Normal	Normal	Large	*Low*	High	High	No
Image 5	High	High	Small	*High*	Low	Low	Yes
Image 8	Normal	Normal	Large	*High*	High	High	No
Image 9	Normal	Normal	Large	*High*	High	High	No
Image 11	Normal	Normal	Large	*High*	High	High	No
Image 16	Normal	High	Large	*High*	Low	Low	Yes
Image 17	High	Low	Small	*High*	Low	High	Yes
Image 18	Normal	Normal	Small	*High*	High	High	No
Image 19	Normal	Low	Small	*High*	High	Low	Yes
Image 21	Normal	Normal	Small	*High*	High	High	Yes
Image 22	Normal	Normal	Large	*High*	High	High	No
Image 23	Normal	Normal	Small	*High*	Low	Low	Yes

The Area attribute generates two indiscernibility elementary sets

({Area})= { Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 20}, { Image 5, Image 8, Image 9, Image 11, Image 16, Image 17, Image 18, Image 19, Image 21, Image 22, Image 23}} produces TABLE 6, result of indiscernibility elements of Area in Table 6.

G. Indiscernibility Elements of Perimeter

Table 7
Result of Indiscernibility Elements of Perimeter attributes

Images	Mean	Standard Deviation	Entropy	Area	*Perimeter*	BMD	Result
Image 1	Normal	Low	Small	Low	*Low*	Low	Yes
Image 2	Normal	Low	Small	Low	*Low*	Low	Yes
Image 3	High	Low	Small	Low	*Low*	Low	Yes
Image 4	Low	Normal	Small	Low	*Low*	Low	Yes
Image 5	High	High	Small	High	*Low*	Low	Yes
Image 6	High	Low	Small	Low	*Low*	Low	Yes
Image 7	High	High	Small	Low	*Low*	Low	Yes
Image 10	Normal	High	Large	Low	*Low*	Low	Yes
Image 12	Low	Normal	Small	Low	*Low*	Low	Yes
Image 13	High	High	Small	Low	*Low*	Low	Yes
Image 14	High	Low	Small	Low	*Low*	Low	Yes
Image 15	Low	High	Large	Low	*Low*	Low	Yes
Image 16	Normal	High	Large	High	*Low*	Low	Yes
Image 17	High	Low	Small	High	*Low*	High	Yes
Image 23	Normal	Normal	Small	High	*Low*	Low	Yes
Image 8	Normal	Normal	Large	High	*High*	High	No
Image 9	Normal	Normal	Large	High	*High*	High	No
Image 11	Normal	Normal	Large	High	*High*	High	No
Image 18	Normal	Normal	Small	High	*High*	High	No
Image 19	Normal	Low	Small	High	*High*	Low	Yes
Image 20	Normal	Normal	Large	Low	*High*	High	No
Image 21	Normal	Normal	Small	High	*High*	High	Yes
Image 22	Normal	Normal	Large	High	*High*	High	No

The perimeter attribute generates two indiscernibility elementary sets
({Perimeter})={{ Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 16, Image 17, Image 23}, { Image 8, Image 9, Image 11, Image 18, Image 19, Image 20, Image 21, Image 22}}produces TABLE 7, result of indiscernibility elements of Perimeter in Table 7.

H. Indiscernibility Elements of BMD

Table 8
Result of Indiscernibility Elements of BMD attributes

Images	Mean	Standard Deviation	Entropy	Area	*Perimeter*	BMD	Result
Image 1	Normal	Low	Small	Low	*Low*	Low	Yes
Image 2	Normal	Low	Small	Low	*Low*	Low	Yes
Image 3	High	Low	Small	Low	*Low*	Low	Yes
Image 4	Low	Normal	Small	Low	*Low*	Low	Yes
Image 5	High	High	Small	High	*Low*	Low	Yes
Image 6	High	Low	Small	Low	*Low*	Low	Yes
Image 7	High	High	Small	Low	*Low*	Low	Yes
Image 10	Normal	High	Large	Low	*Low*	Low	Yes
Image 12	Low	Normal	Small	Low	*Low*	Low	Yes
Image 13	High	High	Small	Low	*Low*	Low	Yes
Image 14	High	Low	Small	Low	*Low*	Low	Yes
Image 15	Low	High	Large	Low	*Low*	Low	Yes
Image 16	Normal	High	Large	High	*Low*	Low	Yes
Image 17	High	Low	Small	High	*Low*	High	Yes
Image 23	Normal	Normal	Small	High	*Low*	Low	Yes
Image 8	Normal	Normal	Large	High	*High*	High	No
Image 9	Normal	Normal	Large	High	*High*	High	No
Image 11	Normal	Normal	Large	High	*High*	High	No
Image 18	Normal	Normal	Small	High	*High*	High	No
Image 19	Normal	Low	Small	High	*High*	Low	Yes
Image 20	Normal	Normal	Large	Low	*High*	High	No
Image 21	Normal	Normal	Small	High	*High*	High	Yes
Image 22	Normal	Normal	Large	High	*High*	High	No

The BMD attribute generates two indiscernibility elementary sets
({BMD})={ { Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 16, Image 19, Image 23}, { Image 8, Image 9, Image 11, Image 17, Image 18, Image 20, Image 21, Image 22}}produces TABLE 8, result of indiscernibility elements of BMD in table 8.

TABLE 9
Indiscernibility Elements of Decision attributes, (Result)

Images	Mean	Standard Deviation	Entropy	Area	Perimeter	BMD	*Result*
Image 8	Normal	Normal	Large	High	High	High	*No*
Image 9	Normal	Normal	Large	High	High	High	*No*
Image 11	Normal	Normal	Large	High	High	High	*No*
Image 18	Normal	Normal	Small	High	High	High	*No*
Image 20	Normal	Normal	Large	Low	High	High	*No*
Image 22	Normal	Normal	Large	High	High	High	*No*
Image 1	Normal	Low	Small	Low	Low	Low	*Yes*
Image 2	Normal	Low	Small	Low	Low	Low	*Yes*
Image 3	High	Low	Small	Low	Low	Low	*Yes*
Image 4	Low	Normal	Small	Low	Low	Low	*Yes*
Image 5	High	High	Small	High	Low	Low	*Yes*
Image 6	High	Low	Small	Low	Low	Low	*Yes*
Image 7	High	High	Small	Low	Low	Low	*Yes*
Image 10	Normal	High	Large	Low	Low	Low	*Yes*
Image 12	Low	Normal	Small	Low	Low	Low	*Yes*
Image 13	High	High	Small	Low	Low	Low	*Yes*
Image 14	High	Low	Small	Low	Low	Low	*Yes*
Image 15	Low	High	Large	Low	Low	Low	*Yes*
Image 16	Normal	High	Large	High	Low	Low	*Yes*
Image 17	High	Low	Small	High	Low	High	*Yes*
Image 19	Normal	Low	Small	High	High	Low	*Yes*
Image 21	Normal	Normal	Small	High	High	High	*Yes*
Image 23	Normal	Normal	Small	High	Low	Low	*Yes*

Table 9 represents the two indiscernibility elementary sets({Result})={ { Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 16, Image 17, Image 19, Image 21, Image 23}, { Image 8, Image 9, Image 11, Image 18, Image 20, Image 22}}

III- LOWER APPROXIMATION

1. The Lower Approximation set S"

Lower Approximation set (S") of the images of the blood sample that are definitely affected by rheumatoid arthritis are as S" = {Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 16, Image 17, Image 19, Image23} and the result for Lower Approximation set (S") of images of the blood sample that certain are not havebeen affected by rheumatoid arthritis are as S" = { Image 8, Image 9, Image 11, Image 20, Image 22}

*2. The Upper Approximation set S**

Upper Approximation set (S*) of images of the blood sample that are possibly have affected by rheumatoid arthritis are as S* = { Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 16, Image 17, Image 19, Image 21, Image 23} and the result for Upper Approximation set (S*) of images of the blood sample that possibly have not affected by rheumatoid arthritis are identified as S* = { Image 8, Image 9, Image 11, Image 18, Image 20, Image 22}

3. The Boundary Region (BR)

Boundary Region (S*) of the patients that have rheumatoid arthritis are identified as:
BR ={ Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 16, Image 17, Image 19, Image 21, Image 23}- { Image 1, Image 2, Image 3, Image 4, Image 5, Image 6, Image 7, Image 10, Image 12, Image 13, Image 14, Image 15, Image 16, Image 17, Image 19, Image 23} = { Image 21} and the Boundary Region (S*), the set of images of the blood sample that have not affected by rheumatoid arthritis are find as: BR = { Image 8, Image 9, Image 11, Image 18, Image 20, Image 22}-{ Image 8, Image 9, Image 11, Image 20, Image 22} ={ Image 18}

4. Observation

Boundary Region (BR) of the elements Image21 and Image18, which cannot be classified because they have the same characteristics values for all the attributes, but with different conclusions, which differ in the decision attribute[7].

IV-QUALITY OF APPROXIMATION

The two coefficients of quality of approximation[5] are:

For the images of the blood sample with possibility of having rheumatoid arthritis

αS(X) =16/17→Eq (1)

For the images of the blood sample with possibility of not having rheumatoid arthritis

αS (X) = 5/6 →Eq (2)

The Quality Coefficient of upper approximation[6] and lower approximation, using Eq. (1) and (2):

a) αS(S*(X)) =17/23, for the images of the blood sample that have the possibility of they be with rheumatoid arthritis.
b) αS(S*(X)) =6/23, for the images of the blood sample that not have the possibility of they be with rheumatoid arthritis.
c) αS(S”(X)) =16/23, for the images of the blood sample that have rheumatoid arthritis;
d) αS(S”(X)) =5/23, for the images of the blood sample that not have rheumatoid arthritis.

V. OBSERVATIONS ON DATASET

1. Images of the blood sample with Rheumatoid arthritis: αB(B”(X))=16/23, that is, 70% of Images sample certain with rheumatoid arthritis.

2. Images of the blood sample that don't have Rheumatoid arthritis: αB (B”(X)) = 5/23, that is, approximately 21% of images of the blood sample certainly don't have rheumatoid arthritis.

3. 9% of patients (Image 18 and Image 21) cannot be classified neither affected by rheumatoid arthritis nor not affected with rheumatoid arthritis, since the values of all attributes are same, with only the decision attribute (Rheumatoid arthritis) not being same or identical and generates an inconclusive diagnosis for Rheumatoid arthritis.

VI.DATA REDUCTION FOR INFORMATION TABLE

The form in which data must guarantee that the redundancy is completely avoided because it indicates the minimization of the complexly computational[6] in relation to the creation of decision rules for the extraction knowledge. However, when the redundancy situations occur, we should use the concept of reduction, without altering its relations. A reduction is a set of minimum necessary data, since the original properties of the information table are not altered. Therefore, the reduction must have the tendency to classify the objects, without altering the knowledge. Verification of information and the Analysis[9] of data present in Table 1is shown as, Images with similar decision attributes and conditional attributes on Table 1.

Image 8	Normal	Normal	Large	High	High	High	*No*
Image 9	Normal	Normal	Large	High	High	High	*No*
Image 11	Normal	Normal	Large	High	High	High	*No*
Image 22	Normal	Normal	Large	High	High	High	*No*

Image 1	Normal	Low	Small	Low	Low	Low	*Yes*
Image 2	Normal	Low	Small	Low	Low	Low	*Yes*

Image 4	Low	Normal	Small	Low	Low	Low	*Yes*
Image 3	Low	High	Normal	Low	Small	Low	Low	Low	*Yes*

Image 7	High	High	Small	Low	Low	Low	*Yes*
Image 13	High	High	Small	Low	Low	Low	*Yes*

VII- REDUCED DATASET

The TABLE1 has it reduced data in the newly produced version in TABLE10 shown below:

Table10
Reduction process on Information Table1

Images	Mean	Standard Deviation	Entropy	Area	Perimeter	BMD	Result
Image 1	Normal	Low	Small	Low	Low	Low	Yes
Image 3	High	Low	Small	Low	Low	Low	Yes
Image 4	Low	Normal	Small	Low	Low	Low	Yes
Image 5	High	High	Small	High	Low	Low	Yes
Image 7	High	High	Small	Low	Low	Low	Yes
Image 8	Normal	Normal	Large	High	High	High	No
Image 10	Normal	High	Large	Low	Low	Low	Yes
Image 15	Low	High	Large	Low	Low	Low	Yes
Image 16	Normal	High	Large	High	Low	Low	Yes
Image 17	High	Low	Small	High	Low	High	Yes
Image 19	Normal	Low	Small	High	High	Low	Yes
Image 20	Normal	Normal	Large	Low	High	High	No
Image 22	Normal	Normal	Large	High	High	High	No
Image 23	Normal	Normal	Small	High	Low	Low	Yes

Table 10 represents the reduction process done on Information table, Table 1 and the result produced is Images (Images 1 Images,3, Images 4, Images 5, Images 7, Images 8, Images 10, Images 15, Images 16, Images 17, Images 19, Images 20, Images 22, Images 23).

VIII- APPROXIMATION ON REDUCED DATASET

Analysis for each conditional attributes in the reduced dataset with the attributes set[1].

TABLE 11
Analysis of Attributes Mean in Table 10

Images	Mean	Result
Image 1	Normal	Yes
Image 3	High	Yes
Image 4	Low	Yes
Image 5	High	Yes
Image 7	High	Yes
Image 8	Normal	No
Image 10	Normal	Yes
Image 15	Low	Yes
Image 16	Normal	Yes
Image 17	High	Yes
Image 19	Normal	Yes
Image 20	Normal	No
Image 23	Normal	Yes

Table 11 represents the analysis of attributes Mean with Images and result attributes and produce the Image result of (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10, Image 15,Image 16,Image 17, Image19, Image20, Image 23).

TABLE 12
Analysis of Attributes Standard Deviation in Table 10

Images	Standard Deviation	Result
Image 1	Low	Yes
Image 3	Low	Yes
Image 4	Normal	Yes
Image 5	High	Yes
Image 7	High	Yes
Image 8	Normal	No

Image 10	High	Yes
Image 15	High	Yes
Image 16	High	Yes
Image 17	Low	Yes
Image 19	Low	Yes
Image 20	Normal	No
Image 23	Normal	Yes

Table 12 represents the analysis of attributes Standard Deviation with Images and result attributes and produces the Image result of (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8, Image10, Image 15,Image 16,Image 17, Image19, Image20, Image 23).

Similar process is done on all the attributes entropy, Area, Perimeter and BMD.

Analysis of Attributes Entropy in Table 10

Table 13 represents the analysis of attributes Entropy with Images and result attributes and produces the Image result of (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8, Image 10,Image 15,Image 16,Image 17, Image19, Image20, Image 23).

Analysis of Attributes Area in Table 10

Table 14 represents the analysis of attributes Area with Images and result attributes and produce the Image result of (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10, Image 15,Image 16,Image 17, Image19, Image20, Image 23).

Analysis of Attributes Perimeter in Table 10

Table 15 represents the analysis of attributes Perimeter with Images and result attributes and produce the Image result of (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10, Image 15,Image 16,Image 17, Image19, Image20, Image 23).

Analysis of conditional Attributes BMD in Table 10

Table 16 represents the analysis of attributes BMD with Images and result attributes and produce the Image result of (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10, Image 15,Image 16,Image 17, Image19, Image20, Image 23).

IX- CONCLUSION OF THE RESULT OF ANALYSIS

In this analysis, no data was excluded[2]. By this analysis it is found that the conditional attributes in Table 9, it can be found that the similar data exists in the proceeding tables.

1) Analysis of the conditional attributes Mean and Standard Deviation in Table 10.

TABLE 17

Analysis of the conditional attributes Mean and Standard Deviation in Table 10.

Images	Mean	Standard Deviation	Result
Image 1	Normal	Low	Yes
Image 3	High	Low	Yes
Image 4	Low	Normal	Yes
Image 5	High	High	Yes
Image 7	High	High	Yes
Image 8	Normal	Normal	No
Image 10	Normal	High	Yes
Image 15	Low	High	Yes
Image 16	Normal	High	Yes
Image 17	High	Low	Yes
Image 19	Normal	Low	Yes
Image 20	Normal	Normal	No
Image 23	Normal	Normal	Yes

Table 17 represents the various images by analyzing of the Images, Mean, Standard deviation and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result Analysis

TABLE18

Result for Analysis of the conditional attributes Mean and Standard Deviation in Table 10

Images	Mean	Standard Deviation	Result
Image 1	Normal	Low	Yes
Image 3	High	Low	Yes
Image 4	Low	Normal	Yes
Image 5	High	High	Yes
Image 8	Normal	Normal	No
Image 10	Normal	High	Yes
Image 15	Low	High	Yes
Image 23	Normal	Normal	Yes

Table 18 represents the result by analyzing of the Images, Mean, Standard deviation and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 17.

2) Analysis of the conditional attributes Mean and Entropy in Table 10.

TABLE 19

Analysis of the conditional attributes Mean and Entropy in Table 10.

Images	Mean	Entropy	Result
Image 1	Normal	Small	Yes
Image 3	High	Small	Yes
Image 4	Low	Small	Yes
Image 5	High	Small	Yes
Image 7	High	Small	Yes
Image 8	Normal	Large	No
Image 10	Normal	Large	Yes
Image 15	Low	Large	Yes
Image 16	Normal	Large	Yes
Image 17	High	Small	Yes
Image 19	Normal	Small	Yes
Image 20	Normal	Large	No
Image 23	Normal	Small	Yes

Table 19 represents the various images by analyzing of the Images, Mean, Entropy and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result Analysis on Table 19

TABLE 20

Result for Analysis of the conditional attributes Mean and Entropy in Table 10.

Images	Mean	Entropy	Result
Image 1	Normal	Small	Yes
Image 3	High	Small	Yes
Image 4	Low	Small	Yes
Image 8	Normal	Large	No
Image 10	Normal	Large	Yes
Image 15	Low	Large	Yes

Table 20 represents the result by analyzing of the Images, Mean, Entropy and Result for various Images (Image 1,Image 3, Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 19.

Similar to the above process the following tables are generated according to the Mean with all the other conditional attributes.

3) Analysis of the conditional attributes Mean and Area in Table 10.

Table 21 represents the various images by analyzing of the Images, Mean, Area and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result Analysis on Table 21

TABLE22

Result for Analysis of the conditional attributes Mean and Area in Table 10.

Images	Mean	Area	Result
Image 1	Normal	Low	Yes
Image 3	High	Low	Yes
Image 4	Low	Low	Yes
Image 5	High	High	Yes
Image 8	Normal	High	No
Image 16	Normal	High	Yes
Image 20	Normal	Low	No

Table 22 represents the result generated from the analyzing of the Images, Mean, Area and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 8,Image 16,Image 20) over Table 21.

4) Analysis of the conditional attributes Mean and Perimeter in Table 10.

Table 23 represents the various images by analyzing of the Images, Mean, Perimeter and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result Analysis on Table 23

Table 24

Result for Analysis of the conditional attributes Mean and Perimeter in Table 10.

Images	Mean	Perimeter	Result
Image 1	Normal	Low	Yes
Image 3	High	Low	Yes
Image 4	Low	Low	Yes
Image 8	Normal	High	No
Image 19	Normal	High	Yes

Table 24 represents the various images by analyzing of the Images, Mean, Perimeter and Result for various Images (Image 1,Image 3,Image 4,Image 8,Image 19) over Table 23.

5) Analysis of the conditional attributes Mean and BMD in Table 10.

Table 25 represents the various images by analyzing of the Images, Mean, BMD and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result Analysis on Table 25

Table26

Result for Analysis of the conditional attributes Mean and BMD in Table 10.

Images	Mean	BMD	Result
Image 1	Normal	Low	Yes
Image 3	High	Low	Yes
Image 4	Low	Low	Yes
Image 8	Normal	High	No
Image 17	High	High	Yes

Table 26 represents the various images by analyzing of the Images, Mean, BMD and Result for various Images (Image 1,Image 3,Image 4,Image 8,Image17) over Table 25.

6) Analysis of the conditional attributes Standard Deviation and Entropy in Table 10.

Table 27 represents the various images by analyzing of the Images, Standard Deviation, Entropy and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result analysis on Table 27

TABLE 28

Result for Analysis of conditional attributes Standard Deviation and Entropy inTable10.

Images	Standard Deviation	Entropy	Result
Image 1	Low	Small	Yes
Image 4	Normal	Small	Yes
Image 5	High	Small	Yes
Image 8	Normal	Large	No
Image 10	High	Large	Yes

Table 28 represents the various images by analyzing of the Images, Standard Deviation, Entropy and Result for various Images (Image 1,Image 4,Image 5,Image 8,Image 10) over Table 27.

7) Analysis of the conditional Attributes Standard Deviation and Area in TABLE10.

Table 29 represents the various images by analyzing of the Images, Standard deviation, Area and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result for Analysis on Table 29

TABLE 30

Result for Analysis of conditional Attributes Standard Deviation and Area in Table10.

Images	Standard Deviation	Area	Result
Image 1	Low	Low	Yes
Image 4	Normal	Low	Yes
Image 5	High	High	Yes
Image 7	High	Low	Yes
Image 8	Normal	High	No
Image 17	Low	High	Yes
Image 20	Normal	Low	No
Image 23	Normal	High	Yes

Table 30 represents the various images by analyzing of the Images, Standard deviation, Area and Result for various Images (Image 1,Image 4,Image 5,Image 7,Image 8,Image 17,Image 20,Image 23) over Table 29.

8) Analysis of Attributes the conditional Standard Deviation and Perimeter in TABLE10.

Table 31 represents the various images by analyzing of the Images, Standard deviation, Perimeter and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result for Analysis on Table 31

TABLE 32

Result for Analysis of conditional attributes Standard Deviation and Perimeter in Table 10

Images	Standard Deviation	Perimeter	Result
Image 1	Low	Low	Yes
Image 4	Normal	Low	Yes
Image 5	High	Low	Yes
Image 8	Normal	High	No
Image 19	Low	High	Yes

Table 32 represents the various images by analyzing of the Images, Standard deviation, Perimeter and Result for various Images (Image 1,Image 4,Image 5,Image 8,Image 19) over Table 31.

9) Analysis of the conditional attributes Standard Deviation and BMD in TABLE10.

Table 19 represents the various images by analyzing of the Images, Standard deviation, BMD and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result of Analysis on Table 33

TABLE 34

Result for Analysis of the conditional attributes Standard Deviation and BMD in Table10

Images	Standard Deviation	BMD	Result
Image 1	Low	Low	Yes
Image 4	Normal	Low	Yes
Image 5	High	Low	Yes
Image 8	Normal	High	No
Image 17	Low	High	Yes

Table 34 represents the various images by analyzing of the Images, Standard deviation, BMD and Result for various Images (Image 1,Image 4,Image 5,Image 7,Image 8,Image 17,) over Table 33.

10)Analysis of the conditional attributes Entropy and Area in TABLE10.

Table 35 represents the various images by analyzing of the Images, Entropy, Area and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result Analysis onTable 35

TABLE 36

Result of Analysis of the conditional attribute Entropy and Area in TABLE10.

Images	Entropy	Area	Result
Image 1	Small	Low	Yes
Image 5	Small	High	Yes
Image 8	Large	High	No
Image 10	Large	Low	Yes
Image 16	Large	High	Yes
Image 20	Large	Low	No

Table 36 represents the various images by analyzing of the Images,Entropy, Area and Result for various Images (Image 1,Image 5,Image 8,Image 10,Image 16,Image 20) over Table 35.

11) Analysis of the conditional attributes Entropy and Perimeter in TABLE10.

Table 37 represents the various images by analyzing of the Images, Entropy, Perimeter and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result Analysis on Table 37

TABLE 38

Result of Analysis of the conditional attributes Entropy and Perimeter in TABLE10.

Images	Entropy	Perimeter	Result
Image 1	Small	Low	Yes
Image 8	Large	High	No
Image 10	Large	Low	Yes
Image 19	Small	High	Yes

Table 38 represents the various images by analyzing of the Images, Entropy, Perimeter and Result for various Images (Image 1,Image 8,Image 10,Image 5,Image 19) over Table 37.

12) Analysis of the conditional attributes Entropy and BMD in TABLE10.

Table 39 represents the various images by analyzing of the Images, Entropy, BMD and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result Analysis on Table 39

TABLE 40

Result of Analysis of the conditional attribute Entropy and BMD in TABLE10.

Images	Entropy	BMD	Result
Image 1	Small	Low	Yes
Image 8	Large	High	No
Image 10	Large	Low	Yes
Image 17	Small	High	Yes

Table 40 represents the various images by analyzing of the Images, Entropy, BMD and Result for various Images (Image 1,Image 8,Image 10,Image 17) over Table 39.

13) Analysis of the conditional attribute Area and Perimeter in TABLE10.

Table 41 represents the various images by analyzing of the Images, Area, Perimeter and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result of Analysis on Table 41

TABLE 42

Result of Analysis of Attribute Area and Perimater in TABLE10.

Images	Area	Perimeter	Result
Image 1	Low	Low	Yes
Image 5	High	Low	Yes
Image 8	High	High	No
Image 19	High	High	Yes
Image 20	Low	High	No

Table 42 represents the various images by analyzing of the Images, Area, Perimeter and Result for various Images (Image 1,Image 5,Image 8,Image 19,Image 20) over Table 41.

14) Analysis of Attribute Area and BMD in TABLE10.

Table 43 represents the various images by analyzing of the Images, Area, BMD and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result of Analysis on Table 43

TABLE 44
Result of Analysis of Attribute Area and BMD in TABLE10.

Images	Area	BMD	Result
Image 1	Low	Low	Yes
Image 5	High	Low	Yes
Image 8	High	High	No
Image 17	High	High	Yes
Image 20	Low	High	No

Table 44 represents the various images by analyzing of the Images, Area, BMD and Result for various Images (Image 1,Image 3, Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 43.

15) Analysis of Attribute Perimeter and BMD in TABLE10.

Table 45 represents the various images by analyzing of the Images, Perimeter, BMD and Result for various Images (Image 1,Image 3,Image 4,Image 5,Image 7,Image 8,Image 10,Image 15,Image 16,Image 17,Image 19,Image 20,Image 23) over Table 10.

Result analysis

TABLE 46
Result of Analysis of the conditional attribute Perimeter and BMD in TABLE10.

Images	Perimeter	BMD	Result
Image 1	Low	Low	Yes
Image 8	High	High	No
Image 17	Low	High	Yes
Image 19	High	Low	Yes

Table 46 represents the various images by analyzing of the Images, Perimeter, BMD and Result for various Images (Image 1,Image 8,Image 17,Image 19) over Table 45.

16) VERIFICATION OF EQUIVALENT DATA

Verification of equivalent data in the Tables ofTable(18,20,22,24,26,28,30,32,34,36,38,40,42,44 and 46) correspondingly where data is the element of reduction information in relation to Table10.

Table 47
Result with reduction information of TABLE10

Images	Mean	Standard Deviation	Entropy	Area	Perimeter	BMD	Result
Image 1	Normal	Low	Small	Low	Low	Low	Yes
Image 8	Normal	Normal	Large	High	High	High	No

DECISION RULES

Rule 1:

If Images Mean=Normal and
Standard deviation=Low and
Entropy=Small and
Area=Low and

Perimeter=Low and BMD=Low
Then Result=Yes
Rule 2:
If Image
Mean=Normal and
Standard deviation=Normal and
Entropy=Large and
Area=High and
Perimeter=High
BMD=High
Then Result=No

CONCLUSION

Thus, the Rough set theory was proposed by Z. Pawlak, in 1982 for knowledge discovery from incomplete and uncertain data. It is based on the lower approximation and upper approximation. The main advantage of implementing rough set theory in dataset analysis of a rheumatoid arthritis dataset is that it does not require any additional information, as in fuzzy set theory. The Rough Set theory for the dataset of rheumatoid arthritis has many advantages such as, like finding hidden patterns in data, finds only minimal sets of data, to minimal generate sets of decision rules from the dataset. There has been research concerning be related between Rough Set Theory and the Dempster-Shafer Theory and between rough sets and fuzzy sets. Rough set theory has also provided the necessary formalism and ideas for the development of some propositional machine learning systems. It has also been used for knowledge representation; data mining; reducing knowledge representation and for analyzing of attribute dependencies.

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