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Medical Application of Pretopology

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Abstract:
The aim of this work is to generate a Pretopological model from a medical information system, and use the properties and facts of pretopology to discover the effective attributes. We compute the accuracy of approximation for decision sets of medical information system, and suggest an approach to reduce the investigations using the accuracy of decision sets with respect to different subsets of investigations and give an example to indicate our approach.

Keywords:

Information system,Pretopology,Interior.

1- Introduction:

Diagnosis of disease and discovering the most effective symptoms are very important .Many mathematical models have been used in process of data analysis in medical investigation. Our aim in this work to contract pretopology structure associated with medical data (medical information system).we suggest a measure for the accurse of approximation for decision of medical information system using pre closure and pre interior.

The rest of the paper is organized as follow in part two we present Preliminaries used in the paper, part III contains our suggested approach, and finally part is reserved for an example for our approach.

Pretopology has played an important role in different applications, game theory [2], complex systems modeling [6], image analysis [7] data analysis [5],shape recognition, image analysis [7], classification and clustering [8],supervised learning [1], text mining [5]), economic modeling [4]and data analysis [1].

2-Preliminaries

2.1-Information system [5]

We represent a data set as a table where each row represent (patient, students, etc).Every column represent (attributes, characteristic conditions, avertible, etc) the attributes may be made by human expert or by userthis table called information system we represent the information system as a pair s=(U,B) where U is an non empty finite set of objects called universe and B is an non empty finite set of attributes such that b:U V_b for every b∈ B

Where the set V_b is called the value set of b

2.1-Examble:

The following table represents the patients carry COVUD 19 and not carries with the attributes U= {Nausea, Dyspnea, Dry cough, Loss of appetites, Fever}. The objects of the information system are the patients

A= {p, q, r, e, s, t}and the values of an information table yes, no, high (H), normal (N)

Patient	Nausea	Dyspnea	A dry Cough	Loss of appetites	Fever	COVID 19
p	No	Yes	Yes	Yes	H	Yes
q	Yes	No	Yes	Yes	H	Yes
r	Yes	Yes	Yes	Yes	H	Yes
	No	Yes	No	No	N	No
e s	Yes	No	Yes	Yes	H	No
t	No	Yes	No	Yes	H	Yes

Table (1)

2.2-Pretopology[3]

Let E be a nonempty set and□: P (E) P (E) such that

$$\square\varphi=\varphi$$

$$\forall A_j \in P(E):$$

$$A_j \subset \Gamma A_j$$

In which A_j is an element of the power set.

Theorder pair (E,□) is called pretopological space

2.3-Interior [3]

If $(E,\square)$is pretopological space, $A \subset E$ the interior of A is denote by δA_j giving by $\delta A_j = {}^{-}\Gamma\,\overline{A_j}$, where A_{-} is complement of A

2.2-Example:

Let $E = \{a, b, c\}$

where $\Gamma\varphi = \varphi, \Gamma\{a\} = \{a, c\}, \Gamma\{b\} = \{b\}, \Gamma\{c\} = \{b, c\}$

$\Gamma\{a, b\} = E, \Gamma\{a, c\} = \{a, c\}, \Gamma\{b, c\} = \{b, c\}, \Gamma E = E$

$\delta A_j = \overline{\Gamma \overline{A_j}}$

$P(E) = \{\varphi, E, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}\}$,

$\delta\phi =$ $\Gamma \varphi = \Gamma \overline{E} = \overline{E} = \phi \ \delta \ \Gamma$

$E \quad E = E \quad E \quad b = =$

$\Gamma\varphi = \{a\} = \quad \{c, \{a\} \{b, c\} = \{a\}$

$\varphi = \{b\} = \{c\} = \quad a, \quad \{a, c\} = \{b\}$

$\delta\Gamma\Gamma = \{c\} = \quad \{a = , b \quad \{c \{ E =$

$\delta\Gamma\Gamma = \quad , b\} \{a, b\} \{c\} \quad = \{b , c\} = \{a$

$\delta\Gamma\Gamma\phi$

$\delta \quad \Gamma \quad \Gamma \quad \} \delta\Gamma \quad \Gamma \quad \delta$

$\Gamma \quad \{a, c\} = \quad \{b\} = \{b\} = \{a, c\}\{a, c\} =$

$\Gamma \quad \{b, c\} = \quad \{a\} = \{a, c\} = \{b\}\{b, c\} =$

3-Anapproach for symptoms

Steps for this research

In the following, we will indicate how we generate pretopology from an information system

- Steps to generate a pretopology from an information system

1) We start with an information system illustrated in a table that explains the relationship between patients and symptoms causing the COVID -19
2) In the table, the vertical row reflects the patients and the horizontal row the symptoms
3) We make a table between attributes and corresponding elementary sets
4) For each patient p, $\Gamma\{p\}$ is the set of patient

5) The pre closure of any subset of patient is the union of pre closure of its components 6) The pre interior for each subset of patient is defined by following $\delta^{A_j} = \bar{\quad} \quad \Gamma\,\overline{\bar{A}_j}$

 Steps to Find an Accurate Diagnosis

1) We find the set of patient have the diagnosis yes
2) We find the set of patient have the diagnosis No
3) We also create a pre closure for each set by combining a pre closure of its components
4) We find accuracy by dividing the number of pre interior elements by the number of elements of pre closure

 Steps to reduce symptoms

1) We find the accuracy of the diagnosis according to all the symptoms
2) We delete one of the symptoms and find the accuracy of the diagnosis and repeat that with all symptoms
3) We delete two symptoms and find the accuracy
4) Symptoms that lead to deleting the accuracy of all symptoms or more can be dispensed with
5) We define the symptom that dispensing with doesn't affect accuracy, and we do not use them in diagnosis, and this reduces effort and time

4-Case study

An example of a medical information system containing data about 6 patient ,columnsof the table by attributes (symptoms) and row objects (patients) whereas entries of the table are attributes value.

Patient	Nausea	Dyspnea	Adry Cough	Loss of appetites	Fever	COVID 19
p	No	Yes	Yes	Yes	H	Yes
q	Yes	No	Yes	Yes	H	Yes
r	Yes	Yes	Yes	Yes	H	Yes
e	No	Yes	No	No	N	No
s	Yes	No	Yes	Yes	H	No
t	No	Yes	No	Yes	H	Yes

Table (2)

The abbreviations are used to represent the fever features that are being presented H: High, N: Normal, where p, q, r, e, s, and t represent the patients

The patient p is described in the COVID -19 table as following

(Nausea, No), (Dyspnea, Yes), (A dry cough, Yes), (loss of appetites, No), (Fever,N),(COVID19,No)

The patient e is defined in the COVID -19 table as following

(Nausea, No), (Dyspnea, Yes), (A dry cough, No), (loss of appetites, Yes), (Fever, H), (COVID-19, Yes)

Table (3):attributes and corresponding elementary sets

Sr.No	Attributes	Elementary sets
1	Nausea	$\{q, r, s\}, \{p, e, t\}$
2	Dyspnea	$\{p, r, e, t\}, \{q, s\}$
3	A dry Cough	$\{p, q, r, s\}, \{e, t\}$
4	Loss of appetites	
5	Fever	
6	COVID 19	$\{p, q, r, t\}, \{e, s\}$

Table (3)

In Table (3)there are for each of the six symptoms two sets, the first means patients who carry the symptom and the other means patients who do not carry the symptom. For example, the symptom which is Nausea, we find that the set {q, r, s} are the patients who carry Nausea, {p, e, t} they are the patients who do not carry this symptom. Also in this table we can identify the patients who are carriers of COVID 19 and those who are not carriers of COVID 19. For example, we find from the table that the patients {p, q, r, t} carry COVID 19, as well as the set of patients {e, s} Not carrying COVID 19.

5-Design of Proposed Method Based on pretopolgy

We will find pretopologyfor patients

We can generate the pre topology of the information system

Where Γ: P(X) $\longrightarrow$ P(X), P(X) is the Power set

Then we can generate pre-topology from the table 1 as follow:

$\Gamma\{p\} = \{p\}$

Because there is no Patient have the same symptoms

$\{q\} = \{q, s\}$ Γ

$\{r\} = \{r\}$ Γ

$\{e\} = \{e\}$ Γ

$\{s\} = \{q, s\}$ Γ

$\{t\} = \{t\}$ Γ

5.1-Remark:

we can see that the patient q and s have the same disease then $\Gamma(q) = \{q, s\}$ and also $\Gamma(s) = \{q, s\}$ but q have a COVID 19 and s not have a COVID 19.

We will find interior for patients:

$\delta A_j = \Gamma \overline{\overline{A}_j}$

E = {p, , r, e, s, t} q

If A = {P} ⇒ $\overline{\{\overline{p}\}} = \overline{\{q, r, e, s, t\}} = \{q, r, e, s, t\}\{p\} =$ = {p}

{p} = {P}

Where {p, q, r, e, {q} ∪ {r} ∪ {e} ∪ {s} ∪ s, t} = {t}

2)If A = {q} ⇒ $\overline{\{\overline{q}\}} = \overline{\{p, r, e, s, t\}} = \{p, q, r, e, s,\{q\} = \overline{t}\} =$

{q} =

3) If A = {r} ⇒ $\overline{\{\overline{A}\}}, \{\} = \overline{\{\overline{r}\}} = \overline{\{p, q, e, s, t\}}\{A\} =$ = {r} r

{r} = r} { 1)δΓΓ

δ

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δΓΓφ

δφ δΓ δΓ Γ

δ

If A = { e} ⇒ {A} = $\overline{\{\overline{A}\}}$ {e} = $\overline{\{\overline{e}\}} = \overline{\{p, q, r, s, t\}} = \{e\}$, 4)δΓδΓΓ

{e} = {e}

) If A = {s } ⇒ {A} = $\overline{\{\overline{A}\}}$, {s} = $\overline{\{\overline{s}\}} = \overline{\{p, q, r, e, t\}} =$

{s} =

If A = { t} ⇒ {t} = $\overline{\{\overline{t}\}}, \} = p\overline{, q, r, e}, \overline{s}\} = \{\overline{p, q, e, r, s}\} = \{t\}\{$

δ

{t} = { t}

5 δ Γ δ Γ Γ φ

δ φ

6) δ Γ δt Γ $\overline{\{}$δ **pretopology generated as following**

:

$\Gamma\{p\} = \{p\}, \Gamma\{q\} = \{q, s\}, \Gamma\{r\} = \{r\}, \Gamma\{e\} = \{e\}, \Gamma\{s\} = \{q, s\}$

Interior for all subsets

$$\delta\{p\} = \{P\}, \delta\{q\} = \varphi, \delta\{r\} = \{r\}, \delta\{e\} = \{e\}, \delta\{s\} = \varphi, \delta\{t\} = \{t\}$$

Accuracy

$$(COVID-19, Yes) = \{p, q, r, t\}\ , (COVID-19, No) = \{e, s\}$$

$$\Gamma(COVID-19, Yes) = \Gamma\{p\} \cup \Gamma\{q\} \cup \Gamma\{r\} \cup \Gamma\{t\} = \{p, q, r, s, t\}$$

$$\delta(COVID-19, Yes) = \delta\{p\} \cup \delta\{q\} \cup \delta\{r\} \cup \delta\{t\} = \{p, r, t\}$$

$$(\text{Accuracy of COVID, Yes}) = \frac{|\delta(COVID-19, Yes)|}{|\Gamma(COVID-19, Yes)|} = \frac{|(p, r, t)|}{|(p, q, r, s, t)|} = |\frac{3}{5}|$$

$$\Gamma(COVID-19, No) = \Gamma\{e\} \cup \Gamma\{s\} = \{e, q, s\}$$

$$\delta(COVID-19, No) = \delta\{e\} \cup \delta\{s\} = \{e\}$$

$$(\text{Accuracy of COVID, No}) = \frac{|\delta(COVID-19, No)|}{|\Gamma(COVID-19, No)|} = \frac{|\{e\}|}{|\{e, q, s\}|} = |\frac{1}{3}|$$

pretopolgy for four attributes

1) pretopolgy for four attributes by deleting Nausea as following:

Accuracy

$$(COVID-19, Yes) = \{p, q, r, t\}\ , (COVID-19, No) = \{e, s\}$$

$$\Gamma(COVID-19, Yes) = \Gamma\{p\} \cup \Gamma\{q\} \cup \Gamma\{r\} \cup \Gamma\{t\} = \{p, q, r, s, t\}$$

$$\delta(COVID-19, Yes) = \delta\{p\} \cup \delta\{q\} \cup \delta\{r\} \cup \delta\{t\} = \{t\}$$

$$(\text{Accuracy of COVID, Yes}) = \frac{|\delta(COVID-19, Yes)|}{|\Gamma(COVID-19, Yes)|} = \frac{|\{t\}|}{|\{p, q, r, s, t|\}} = |\frac{1}{5}|$$

$$\Gamma(COVID-19, No) = \Gamma\{e\} \cup \Gamma\{s\} = \{e, q, s\}$$

$$\delta(COVID-19, No) = \delta\{e\} \cup \delta\{s\} = \{e\}$$

$$(\text{Accuracy of COVID, No}) = \frac{|\delta(COVID-19, No)|}{|\Gamma(COVID-19, No)|} = \frac{|\{e\}|}{|\{e, q, s\}|} = |\frac{1}{3}|$$

If the patient suffers from Dyspnea, dry cough, Loss of appetites and fever four out of five, then the probability of contracting COVID -19 is $\frac{1}{5}$, and the probability of not having COVID -19is also $\frac{1}{3}$

5.2-Remark:

When Nausea is removed, the other symptoms are still enough to diagnose the patient with COVID-19as the efficiency is less than $\frac{3}{5}$ Therefore; Nausea cannot be dispensed with as symptoms

2) pretopolgy for four attributes by deleting Dyspnea

Accuracy

$(\mathrm{COVID}-19,\mathrm{Yes}) = \{p,q,r,t\}$, $(\mathrm{COVID}-19,\mathrm{No}) = \{e,s\}$

$\Gamma(\mathrm{COVID}-19,\mathrm{Yes}) = \Gamma\{p\} \cup \Gamma\{q\} \cup \Gamma\{r\} \cup \Gamma\{t\} = \{p,q,r,s,t\}$

$\delta(\mathrm{COVID}-19,\mathrm{Yes}) = \delta\{p\} \cup \delta\{q\} \cup \delta\{r\} \cup \delta\{t\} = \{t\}$

$$(\text{Accuracy of COVID, Yes}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{Yes})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{Yes})|} = \frac{|\{t\}|}{|\{p,q,r,s,t\}|} = |\frac{1}{5}|$$

$\Gamma(\mathrm{COVID}-19,\mathrm{No}) = \Gamma\{e\} \cup \Gamma\{s\} = \{e,q,r,s\}$

$\delta(\mathrm{COVID}-19,\mathrm{No}) = \delta\{e\} \cup \delta\{s\} = \{e\}$

$$(\text{Accuracy of COVID, No}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{No})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{No})|} = \frac{|\{e\}|}{|\{e,q,s\}|} = |\frac{1}{4}|$$

If the patient has Nausea, dry cough, Loss of appetites, and fever four out of five, then the probability of contracting COVID -19 is $\frac{1}{5}$, and the probability of not having COVID -19 is also $\frac{1}{4}$

5.3-Remark:

When dyspnea is deleted, it does not make the accuracy like the original accuracy, i.e. less than $\frac{3}{5}$, so shortness of breath can be dispensed with in COVID-19 symptoms

3)Pretopolgy for four attributes by deleting a dry Cough

Accuracy

$(\mathrm{COVID}-19,\mathrm{Yes}) = \{p,q,r,t\}$, $(\mathrm{COVID}-19,\mathrm{No}) = \{e,s\}$

$\Gamma(\mathrm{COVID}-19,\mathrm{Yes}) = \Gamma\{p\} \cup \Gamma\{q\} \cup \Gamma\{r\} \cup \Gamma\{t\} = \{p,q,r,s,t\}$

$\delta(\mathrm{COVID}-19,\mathrm{Yes}) = \delta\{p\} \cup \delta\{q\} \cup \delta\{r\} \cup \delta\{t\} = \{p,r,t\}$

$$(\text{Accuracy of COVID, Yes}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{Yes})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{Yes})|} = \frac{|\{p,r,t\}|}{|\{p,q,r,s,t\}|} = |\frac{3}{5}|$$

$\Gamma(\mathrm{COVID}-19,\mathrm{No}) = \Gamma\{e\} \cup \Gamma\{s\} = \{e,q,s\}$

$\delta(\mathrm{COVID}-19,\mathrm{No}) = \delta\{e\} \cup \delta\{s\} = \{e\}$

$$(\text{Accuracy of COVID, No}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{No})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{No})|} = \frac{|\{e\}|}{|\{e,q,s\}|} = |\frac{1}{3}|$$

If the patient has Nausea, Dyspnea, Loss of appetites, and fever four out of five, then the probability of contracting COVID -19 is $\frac{3}{5}$, and the probability of not having COVID -19 is also $\frac{1}{3}$

5.4-Remark:

Note that when a dry cough is removed, the accuracy is not affected, that is it is not less than $\frac{3}{5}$, so we can suffice with the four other symptoms, and they are sufficient for the diagnosis **4)Pretopology for four attributes By deleting Loss of appetites**

Accuracy

$(\mathrm{COVID}-19,\mathrm{Yes}) = \{p,q,r,t\}$, $(\mathrm{COVID}-19,\mathrm{No}) = \{e,s\}$

$\Gamma(\mathrm{COVID}-19,\mathrm{Yes}) = \Gamma\{p\} \cup \Gamma\{q\} \cup \Gamma\{r\} \cup \Gamma\{t\} = \{p,q,r,s,t\}$

$\delta(\mathrm{COVID}-19,\mathrm{Yes}) = \delta\{p\} \cup \delta\{q\} \cup \delta\{r\} \cup \delta\{t\} = \{p,r,t\}$

$$(\text{Accuracy of COVID, Yes}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{Yes})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{Yes})|} = \frac{|\{p,r,t\}|}{|\{p,q,r,s,t\}|} = |\frac{3}{5}|$$

$\Gamma(\mathrm{COVID}-19,\mathrm{No}) = \Gamma\{e\} \cup \Gamma\{s\} = \{e,q,s\}$

$\delta(\mathrm{COVID}-19,\mathrm{No}) = \delta\{e\} \cup \delta\{s\} = \{e\}$

$$(\text{Accuracy of COVID, No}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{No})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{No})|} = \frac{|\{e\}|}{|\{e,q,s\}|} = |\frac{1}{3}|$$

5)Pretopology for fourattributes By deleting Fever

Accuracy

$(\mathrm{COVID}-19,\mathrm{Yes}) = \{p,q,r,t\}$, $(\mathrm{COVID}-19,\mathrm{No}) = \{e,s\}$

$(\mathrm{COVID}-19,\mathrm{Yes}) = \{p\} \cup \{q\} \cup \{r\} \cup \{t\} = \{p,q,r$ Γ Γ

$(\mathrm{COVID}-19,\mathrm{Yes}) = \{p\} \cup \{q\} \cup \{r\} \cup t\} = \{p,r,t\}$ Γ

Γ Γ ,s,t} δ δ δ δ δ{

$$(\text{Accuracy of COVID, Yes}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{Yes})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{Yes})|} = \frac{|\{p,r,t\}|}{|\{p,q,r,s,t\}|} = |\frac{3}{5}|$$

$\Gamma(\mathrm{COVID}-19,\mathrm{No}) = \Gamma\{e\} \cup \Gamma\{s\} = \{e,q,s\}$

$\delta(\mathrm{COVID}-19,\mathrm{No}) = \delta\{e\} \cup \delta\{s\} = \{e\}$

$$(\text{Accuracy of COVID, No}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{No})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{No})|} = \frac{|\{e\}|}{|\{e,q,s\}|} = |\frac{1}{3}|$$

5.5- Remark:

When the fever is removed, it also does not affect the original accuracy

5.6-Remark:

When looking(3), (4)and (5), we notice that the accuracy does not change from the original accuracy and to find the common and basic symptoms of COVID-19, we find the intersection between the

attributes in (3), (4)and (5), so the symptoms common to both are Nausea and Dyspnea **Pretopolgy for three attributes**

6)Pretopology for three attributes by Deleting Nausea and Dyspnea

Accuracy

$(\mathrm{COVID}-19,\mathrm{Yes}) = \{p,q,r,t\}, (\mathrm{COVID}-19,\mathrm{No}) = \{e,s\}$

$\Gamma(\mathrm{COVID}-19,\mathrm{Yes}) = \Gamma\{p\} \cup \Gamma\{q\} \cup \Gamma\{r\} \cup \Gamma\{t\} = \{p,q,r,s,t\}$

$\delta(\mathrm{COVID}-19,\mathrm{Yes}) = \delta\{p\} \cup \delta\{q\} \cup \delta\{r\} \cup \delta\{t\} = \{t\}$

$$(\text{Accuracy of COVID, Yes}) = \frac{\delta(\mathrm{COVID}-19,\mathrm{Yes})}{\Gamma(\mathrm{COVID}-19,\mathrm{Yes})} = \frac{\{t\}}{\{p,q,r,s,t\}} = \frac{1}{5}$$

$\Gamma(\mathrm{COVID}-19,\mathrm{No}) = \Gamma\{e\} \cup \Gamma\{s\} = \{e,q,s\}$

$\delta(\mathrm{COVID}-19,\mathrm{No}) = \delta\{e\} \cup \delta\{s\} = \{e\}$

$$(\text{Accuracy of COVID, No}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{No})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{No})|} = \frac{|\{e\}|}{|\{e,q,s\}|} = |\frac{1}{3}|$$

7)Pretopology for three attributes by Deleting a dry Cough and Loss of appetites

Accuracy

$(\mathrm{COVID}-19,\mathrm{Yes}) = \{p,q,r,t\}, (\mathrm{COVID}-19,\mathrm{No}) = \{e,s\}$

$\Gamma(\mathrm{COVID}-19,\mathrm{Yes}) = \Gamma\{p\} \cup \Gamma\{q\} \cup \Gamma\{r\} \cup \Gamma\{t\} = \{p,q,r,s,t\}$

$\delta(\mathrm{COVID}-19,\mathrm{Yes}) = \delta\{p\} \cup \delta\{q\} \cup \delta\{r\} \cup \delta\{t\} = \{t\}$

$$(\text{Accuracy of COVID, Yes}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{Yes})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{Yes})|} = \frac{|\{t\}|}{|\{p,q,r,s,t\}|} = |\frac{1}{5}|$$

$\Gamma(\mathrm{COVID}-19,\mathrm{No}) = \Gamma\{e\} \cup \Gamma\{s\} = \{e,q,s\}$

$\delta(\mathrm{COVID}-19,\mathrm{No}) = \delta\{e\} \cup \delta\{s\} = \{e\}$ $(\text{Accuracy of COVID, No}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{No})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{No})|}$

$$= \frac{|\{e\}|}{|\{e,q,s\}|} = |\frac{1}{3}|$$

8) Pretopology for three attributes by Deleting Nausea and Fever

Accuracy

$(\mathrm{COVID}-19,\mathrm{Yes}) = \{p,q,r,t\}, (\mathrm{COVID}-19,\mathrm{No}) = \{e,s\}$

$\Gamma(\mathrm{COVID}-19,\mathrm{Yes}) = \Gamma\{p\} \cup \Gamma\{q\} \cup \Gamma\{r\} \cup \Gamma\{t\} = \{p,q,r,s,t\}$

$\delta(\mathrm{COVID}-19,\mathrm{Yes}) = \delta\{p\} \cup \delta\{q\} \cup \delta\{r\} \cup \delta\{t\} = \{r,t\}$

$$(\text{Accuracy of COVID, Yes}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{Yes})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{Yes})|} = \frac{|\{r,t\}|}{|\{p,q,r,s,t\}|} = |\frac{2}{5}|$$

$\Gamma(\mathrm{COVID}-19,\mathrm{No}) = \Gamma\{e\} \cup \Gamma\{s\} = \{e,q,s\}$

$\delta(\mathrm{COVID}-19,\mathrm{No}) = \delta\{e\} \cup \delta\{s\} = \{e\}$

$$(\text{Accuracy of COVID, No}) = \frac{|\delta(\mathrm{COVID}-19,\mathrm{No})|}{|\Gamma(\mathrm{COVID}-19,\mathrm{No})|} = \frac{|\{e\}|}{|\{e,q,s\}|} = |\frac{1}{3}|$$

9) Pretopology for three attributes by Deleting Dyspnea and A dry Cough

Accuracy

$$(\text{COVID}-19,\text{Yes}) = \{p,q,r,t\}\ ,\ (\text{COVID}-19,\text{No}) = \{e,s\}$$

$$\Gamma(\text{COVID}-19,\text{Yes}) = \Gamma\{p\} \cup \Gamma\{q\} \cup \Gamma\{r\} \cup \Gamma\{t\} = \{p,q,r,s,t\}$$

$$\delta(\text{COVID}-19,\text{Yes}) = \delta\{p\} \cup \delta\{q\} \cup \delta\{r\} \cup \delta\{t\} = \varphi$$

$$(\text{Accuracy of COVID},\text{Yes}) = \frac{|\delta(\text{COVID}-19,\text{Yes})|}{|\Gamma(\text{COVID}-19,\text{Yes})|} = \frac{\varphi}{|\{p,q,r,s,t\}|} = \varphi$$

$$\Gamma(\text{COVID}-19,\text{No}) = \Gamma\{e\} \cup \Gamma\{s\} = \{q,r,e,s\}$$

$$\delta(\text{COVID}-19,\text{No}) = \delta\{e\} \cup \delta\{s\} = \{e\}$$

$$(\text{Accuracy of COVID},\text{No}) = \frac{|\delta(\text{COVID}-19,\text{No})|}{|\Gamma(\text{COVID}-19,\text{No})|} = \frac{|\{e\}|}{\{|e,q,r,s\}|} = |\frac{1}{4}|$$

When we delete more than one symptoms, we notice that the accuracy is lower than the original accuracy so the mainsymptomsin COVID 19 areNausea and Dyspnea.

Conclusion:

The pretopology generated by the medical information can be generate without coding and help to get quantitative numerical measure from non-numerical data and can be used to reduce investigations.

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