Matrix Representation of Soft Topology

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Abstract: The purpose of this paper is to represent a soft topology by matrices over $\{0,1\}$ and to characterize soft topology by using matrices. Further a data set consisting of binary matrices for diabetic patients will be created for a particular soft topology on the collection of diabetic patients and a method for the recommendations of a doctor to diabetic patients is given using the above data set. More over an algorithm has been created to choose the right recommendation for a patient.

Kew words: soft set, soft topology, soft matrix, soft addition, soft multiplication.

1 Introduction

Molodtsov [6] is a pioneer in studying soft sets to deal with the vague concepts associated with real life problems. Following this, several mathematicians developed soft set theory in various directions [7,14]. Maji and Roy[5] used tabular representation of soft sets along with rough sets [10] in a decision making problem. Topologists [1-4, 8,9,11,12,13,15] extended the notion of topology to soft sets and studied the basic properties of soft topology. In this paper, soft sets and soft topology are characterized using matrices over $\{0,1\}$. Moreover a data set consisting of binary matrices for diabetic patients will be created for a particular soft topology on the collection of diabetic patients and a method for the recommendations of a doctor to diabetic patients is given using the above data set. In this regard, an algorithm is given to implement this discussion.

2 Preliminaries

Let X be a non empty set and E be a parameter space. If $A \subseteq E$ and $F: A \rightarrow 2^X$ then the pair (F, A) is called a soft subset of X over the parameter space. Let $S(X, E)$ be the collection of all soft subsets of X with parameter space E . The pair (F, A) can be identified with $(F, E) = \tilde{F}$ by defining $F(e) = \emptyset$ for all $e \in E \setminus A$. Let $\tilde{\emptyset}$ and $\tilde{X}$ denote the null soft subset and absolute soft subset of X defined by $\tilde{\emptyset}(e) = \emptyset$ and $\tilde{X}(e) = X$ for all $e \in E$. Let $\tilde{F}$ and $\tilde{G}$ be any two soft sets in $S(X, E)$. We say that $\tilde{F} \sqsubseteq \tilde{G}$ if $\tilde{F}(e) \subseteq \tilde{G}(e)$ for all $e \in E$ and $\tilde{F} \supseteq \tilde{G}$ if $\tilde{G} \sqsubseteq \tilde{F}$. The soft sets $\tilde{F} \sqcap \tilde{G}$ and $\tilde{F} \sqcup \tilde{G}$ respectively denote the soft intersection and soft union of $\tilde{F}$ and $\tilde{G}$. The soft set $\tilde{F} \sqtriangle \tilde{G}$ is the soft difference of $\tilde{G}$ from $\tilde{F}$. In particular $\tilde{X} \sqtriangle \tilde{G}$ is the soft complement of $\tilde{G}$. A sub collection $\tilde{\tau}$ of $S(X, E)$ is a soft topology on X if (i) $\tilde{\emptyset} \in \tilde{\tau}$, (ii) $\tilde{X} \in \tilde{\tau}$, (iii) $\tilde{\tau}$ is closed

under finite soft intersection and (iv) $\tilde{\tau}$ is closed under arbitrary soft union.

If $\tilde{\tau}$ is a soft topology on X then the triplet $(X, \tilde{\tau}, E)$ is called a soft topological space and $\tilde{\tau}$ is a soft topology over (X, E) . The members of $\tilde{\tau}$ are called soft open in $(X, \tilde{\tau}, E)$. The soft complement of a soft open set is soft closed.

3 Matrix Representation

Most of the sets and associated space of parameter elements in real life applications are finite sets. Therefore we assume that X is a finite set of discourse with finite parameter space E . Let $X = \{x_1, x_2, x_3, \dots, x_m\}$ and $E = \{e_1, e_2, e_3, \dots, e_n\}$. If $\tilde{F}$ is a soft subset in $S(X, E)$ then it can be identified by a matrix $Mat(\tilde{F}) = [f_{ij}]$ with m rows and n columns where $f_{ij} = 1$ if $x_i \in \tilde{F}(e_j)$ and $=0$ if $x_i \notin \tilde{F}(e_j)$. To characterize the properties of soft sets, the following operations on $\{0,1\}$ are used. If $x, y \in \{0,1\}$ then $x \oplus y = \begin{cases} 0 & \text{if } x = y = 0 \\ 1 & \text{otherwise} \end{cases}$ and $x \odot y = \begin{cases} 1 & \text{if } x = y = 1 \\ 0 & \text{otherwise} \end{cases}$. If $[f_{ij}]$ and $[g_{ij}]$ are two matrices over $\{0,1\}$ then their addition and multiplication are defined component wise that is $[f_{ij}] \oplus [g_{ij}] = [f_{ij} \oplus g_{ij}]$ and $[f_{ij}] \odot [g_{ij}] = [f_{ij} \odot g_{ij}]$. The following lemmas will be useful in sequel. Throughout this paper $\tilde{F}$ and $\tilde{G}$ are soft sets in $S(X, E)$, $Mat(\tilde{F}) = [f_{ij}]$ and $Mat(\tilde{G}) = [g_{ij}]$. Let $Mat(\{0,1\})$ be the collection of matrices over $\{0,1\}$. The next two lemmas show that the operations $\oplus$ and $\odot$ are well defined.

Lemma 3.1: $Mat(\tilde{F}) \oplus Mat(\tilde{G}) = [f_{ij} \oplus g_{ij}]$ and $Mat(\tilde{F}) \odot Mat(\tilde{G}) = [f_{ij} \odot g_{ij}]$.

Lemma 3.2: If $[h_{ij}] \in Mat(\{0,1\})$ then there is a unique soft set $\tilde{H}$ such that $Mat(\tilde{H}) = [h_{ij}]$.

The above lemma motivates to extend operations $\oplus$ and $\odot$ on soft sets. For any two soft sets $\tilde{F}$ and $\tilde{G}$, $Mat(\tilde{F}) \oplus Mat(\tilde{G})$ and $Mat(\tilde{F}) \odot Mat(\tilde{G})$ are matrices over $\{0,1\}$. Then by using Lemma 3.2, there are softs $\tilde{H}$ and $\tilde{K}$ such that $Mat(\tilde{F}) \oplus Mat(\tilde{G}) = Mat(\tilde{H})$ and $Mat(\tilde{F}) \odot Mat(\tilde{G}) = Mat(\tilde{K})$ where $\tilde{H}$ is uniquely determined by $\tilde{F}, \tilde{G}$ & $Mat(\tilde{F}) \oplus Mat(\tilde{G})$ and $\tilde{K}$ is uniquely determined by $\tilde{F}, \tilde{G}$ & $Mat(\tilde{F}) \odot Mat(\tilde{G})$. Such soft sets $\tilde{H}$ and $\tilde{K}$ will be denoted by $\tilde{F} \oplus \tilde{G} = \tilde{H}$ and $\tilde{F} \odot \tilde{G} = \tilde{K}$. The soft sets $\tilde{F} \oplus \tilde{G}$ and $\tilde{F} \odot \tilde{G}$ are respectively known as soft addition and soft multiplication of soft sets $\tilde{F}$ and $\tilde{G}$.

The above discussion leads to the following lemma.

Lemma 3.3: $Mat(\tilde{F} \oplus \tilde{G}) = Mat(\tilde{F}) \oplus Mat(\tilde{G})$ and $Mat(\tilde{F} \odot \tilde{G}) = Mat(\tilde{F}) \odot Mat(\tilde{G})$.

The above three lemmas have been illustrated in the following example.

Example 3.4: Let $U=\{\text{Anitha, Murugesan, Sheeba, Thamizharasi, Selvi, Bageerathi, Manoharan, Usha, Sutha, Xavier}\}$ be the list of students in a class whose academic advisor is Mr.X. The advisor used the parameters $e_1=\text{'Bright'}$, $e_2=\text{'Intelligent'}$, $e_3=\text{'Weak'}$, $e_4=\text{'Dull'}$, $e_5=\text{'Average'}$ to form the groups for his academic coaching. We use the notations $x_1=\text{'Anitha'}$, $x_2=\text{'Murugesan'}$, $x_3=\text{'Sheeba'}$, $x_4=\text{'Thamizharasi'}$, $x_5=\text{'Selvi'}$, $x_6=\text{'Bageerathi'}$, $x_7=\text{'Manoharan'}$, $x_8=\text{'Usha'}$, $x_9=\text{'Sutha'}$ and $x_{10}=\text{'Xavier'}$. Therefore $E=\{e_1, e_2, e_3, e_4, e_5\}$ and $U=\{x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}\}$.

If $\tilde{F} = \{(e_1, \{x_7, x_{10}\}), (e_2, \{x_2, x_6, x_7, x_{10}, x_5\}), (e_3, \{x_1, x_4\}), (e_4, \emptyset), (e_5, \{x_3, x_8\})\}$ and

$\tilde{G} = \{(e_1, \{x_2, x_{10}\}), (e_2, \{x_9, x_7, x_{10}\}), (e_3, \{x_8, x_6\}), (e_4, \{x_4\}), (e_5, \{x_5, x_1\})\}$ then

It is easy to verify the following identities.

$$Mat(\tilde{F} \oplus \tilde{G}) = Mat(\tilde{F}) \oplus Mat(\tilde{G}) =$$

$$\begin{bmatrix} 0 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \end{bmatrix} \quad \text{and}$$

$$Mat(\tilde{F} \odot \tilde{G}) = Mat(\tilde{F}) \odot Mat(\tilde{G}) = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \end{bmatrix}$$

The soft topologies are characterized by the operations $\oplus$ and $\odot$ as shown in the next theorem.

Theorem 3.5:

Let $\tilde{\tau}$ be a collection of soft sets in $S(X, E)$ and $M(\tilde{\tau}) = \{Mat(\tilde{F}) \in Mat(\{0, 1\}) : \tilde{F} \in \tilde{\tau}\}$ be the collection of matrices of soft sets in $\tilde{\tau}$. Then $\tilde{\tau}$ is a soft topology if and only if the mathematical structures $(M(\tilde{\tau}), \oplus)$ and $(M(\tilde{\tau}), \odot)$ are monoids.

Proof: Suppose $\tilde{\tau}$ is a soft topology on X .

$\tilde{\emptyset} \in \tilde{\tau} \Rightarrow Mat(\tilde{\emptyset}) = [\phi_{ij}] \in M(\tilde{\tau})$ where $\phi_{ij} = 0$ for $i=1, 2, \dots, m$ and $j=1, 2, \dots, n$.

$$Mat(\tilde{F}) = \begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \end{bmatrix} \quad \text{and} \quad Mat(\tilde{G}) = \begin{bmatrix} 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \end{bmatrix}$$

$\tilde{X} \in \tilde{\tau} \Rightarrow Mat(\tilde{X}) = [\pi_{ij}] \in M(\tilde{\tau})$ where $\pi_{ij} = 1$ for $i=1, 2, \dots, m$ and $j=1, 2, \dots, n$.

Let $Mat(\tilde{F}), Mat(\tilde{G}), Mat(\tilde{H}) \in M(\tilde{\tau})$ where $\tilde{F}, \tilde{G}, \tilde{H} \in \tilde{\tau}$. Since $\tilde{\tau}$ is a soft topology, it is clear that $\tilde{F} \cap \tilde{G}, \tilde{F} \sqcup \tilde{G} \in \tilde{\tau}$ so that $Mat(\tilde{F} \cap \tilde{G}), Mat(\tilde{F} \sqcup \tilde{G}) \in M(\tilde{\tau})$. Let $Mat(\tilde{F} \cap \tilde{G}) = [h_{ij}]$.

Now $h_{ij} = 1 \Leftrightarrow x_i \in (\tilde{F} \cap \tilde{G})(e_j) \Leftrightarrow x_i \in \tilde{F}(e_j)$ and $x_i \in \tilde{G}(e_j)$

$$\Leftrightarrow f_{ij} = 1 \text{ and } g_{ij} = 1 \Leftrightarrow f_{ij} \odot g_{ij} = 1$$

Also $h_{ij} = 0 \Leftrightarrow x_i \notin (\tilde{F} \cap \tilde{G})(e_j)$

$\Leftrightarrow [x_i \in \tilde{F}(e_j) \text{ and } x_i \notin \tilde{G}(e_j)] \text{ or } [x_i \notin \tilde{F}(e_j) \text{ and } x_i \in \tilde{G}(e_j)] \text{ or } [x_i \notin \tilde{F}(e_j) \text{ and } x_i \notin \tilde{G}(e_j)]$

$\Leftrightarrow [f_{ij} = 1 \text{ and } g_{ij} = 0] \text{ or } [f_{ij} = 0 \text{ and } g_{ij} = 1] \text{ or } [f_{ij} = 0 \text{ and } g_{ij} = 0]$

$$\Leftrightarrow f_{ij} \odot g_{ij} = 0.$$

Therefore $Mat(\tilde{F}) \odot Mat(\tilde{G}) = [f_{ij}] \odot [g_{ij}] = [f_{ij} \odot g_{ij}] = [h_{ij}] = Mat(\tilde{F} \cap \tilde{G}) \in M(\tilde{\tau})$. Also it is easy to prove that $(Mat(\tilde{F}) \odot Mat(\tilde{G})) \odot Mat(\tilde{H}) = Mat(\tilde{F}) \odot (Mat(\tilde{G}) \odot Mat(\tilde{H}))$ and

$Mat(\tilde{F}) \odot Mat(\tilde{X}) = Mat(\tilde{X}) \odot Mat(\tilde{F}) = Mat(\tilde{F})$. This proves that $(M(\tilde{\tau}), \odot)$ is a monoid.

Let $Mat(\tilde{F} \sqcup \tilde{G}) = [h_{ij}]$. Now

$h_{ij} = 0 \Leftrightarrow x_i \notin (\tilde{F} \sqcup \tilde{G})(e_j) \Leftrightarrow x_i \notin \tilde{F}(e_j) \text{ and } x_i \notin \tilde{G}(e_j)$

$$\Leftrightarrow f_{ij} = 0 \text{ and } g_{ij} = 0 \Leftrightarrow$$

$$f_{ij} \oplus g_{ij} = 0.$$

Also $h_{ij} = 1 \Leftrightarrow x_i \in (\tilde{F} \sqcup \tilde{G})(e_j)$

$\Leftrightarrow [x_i \in \tilde{F}(e_j) \text{ and } x_i \notin \tilde{G}(e_j)] \text{ or } [x_i \notin \tilde{F}(e_j) \text{ and } x_i \in \tilde{G}(e_j)] \text{ or } [x_i \in \tilde{F}(e_j) \text{ and } x_i \in \tilde{G}(e_j)]$

$\Leftrightarrow [f_{ij} = 1 \text{ and } g_{ij} = 0] \text{ or } [f_{ij} = 0 \text{ and } g_{ij} = 1] \text{ or } [f_{ij} = 1 \text{ and } g_{ij} = 1]$

$$\Leftrightarrow f_{ij} \oplus g_{ij} = 1.$$

Therefore $Mat(\tilde{F}) \oplus Mat(\tilde{G}) = [f_{ij}] \oplus [g_{ij}] = [f_{ij} \oplus g_{ij}] = [h_{ij}] = Mat(\tilde{F} \sqcup \tilde{G}) \in M(\tilde{\tau})$.

Also it is easy to prove that $(Mat(\tilde{F}) \oplus Mat(\tilde{G})) \oplus Mat(\tilde{H}) = Mat(\tilde{F}) \oplus (Mat(\tilde{G}) \oplus Mat(\tilde{H}))$ and $Mat(\tilde{F}) \oplus Mat(\tilde{\emptyset}) = Mat(\tilde{\emptyset}) \oplus Mat(\tilde{F}) = Mat(\tilde{F})$. This proves that $(M(\tilde{\tau}), \oplus)$ is a Monoid.

Definition 3.6: If $[f_{ij}]$ is a matrix over $\{0, 1\}$ then its complement is defined as

$$[f_{ij}]^c = [g_{ij}] \text{ where } g_{ij} = 0 \text{ if } f_{ij} = 1 \text{ and } g_{ij} = 1 \text{ if } f_{ij} = 0.$$

The next lemma can be easily established.

Lemma 3.7: $Mat(\tilde{X} \boxminus \tilde{F}) = (Mat(\tilde{F}))^c = [f_{ij}]^c$.

Theorem 3.8: $\tilde{F}$ is soft closed if and only if $(Mat(\tilde{F}))^c \in M(\tilde{\tau})$.

Proof: $\tilde{F}$ is soft closed $\Leftrightarrow \tilde{X} \boxminus \tilde{F} \in \tilde{\tau} \Leftrightarrow Mat(\tilde{X} \boxminus \tilde{F}) \in M(\tilde{\tau})$

$$\Leftrightarrow (Mat(\tilde{F}))^c \in M(\tilde{\tau}).$$

4 Application to Diabetic Patients

Soft topological concepts can be used to analyse the diabetic patients for controlling their sugar level. Diabetic patients used some of the parameters namely $e_1 =$ 'regular walking', $e_2 =$ 'regular swimming', $e_3 =$ 'regular cycling', $e_4 =$ 'regular Yoga', $e_5 =$ 'diet control' and $e_6 =$ 'taking medicine' to maintain the sugar level at the desired range. Let $U = \{P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9, P_{10}\}$ be the set of diabetic patients in a reputed hospital. The problem of a doctor is to suggest appropriate parameter for a patient to control the sugar level.

$$\tilde{F} = \{(e_1, \{P_1, P_5, P_8, P_{10}\}), (e_2, \{P_2, P_4, P_9\}), (e_3, \{P_3, P_6, P_7\}), (e_4, \{P_8, P_9, P_{10}\}),$$

$$(e_5, \{P_4, P_5, P_6, P_7\}), (e_6, \{P_1, P_3, P_5, P_7, P_9\})\}.$$

$$\tilde{G} = \{(e_1, \{P_1, P_6, P_7, P_{10}\}), (e_2, \{P_2, P_5, P_8\}), (e_3, \{P_4, P_9, P_{10}\}), (e_4, \{P_1, P_2, P_3\}),$$

$$(e_5, \{P_5, P_6, P_7\}), (e_6, \{P_1, P_4, P_7, P_9\})\}.$$

Then

$\tilde{\tau} = \{\tilde{\emptyset}, \tilde{F}, \tilde{G}, \tilde{F} \cap \tilde{G}, \tilde{F} \sqcup \tilde{G}, \tilde{X}\}$ is a soft topology over (U, E) where $E = \{e_1, e_2, e_3, e_4, e_5, e_6\}$.

Clearly

$$\pi_0 = Mat(\tilde{\emptyset}) = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}, \pi_1 =$$

$$Mat(\tilde{X}) = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

$$\pi_2 = Mat(\tilde{F}) = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 \end{bmatrix}, \pi_3 =$$

$$Mat(\tilde{G}) = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 & 0 \end{bmatrix}$$

$$\tilde{F} \cap \tilde{G} = \{(e_1, \{P_1\}), (e_2, \{P_2\}), (e_3, \emptyset), (e_4, \emptyset), (e_5, \{P_5, P_6, P_7\}), (e_6, \{P_1, P_7, P_9\})\}$$

$$\tilde{F} \sqcup \tilde{G} = \{(e_1, \{P_1, P_5, P_6, P_7, P_8, P_{10}\}), (e_2, \{P_2, P_4, P_5, P_8, P_9\}), (e_3, \{P_3, P_4, P_6, P_7, P_9, P_{10}\}),$$

$$(e_4, \{P_1, P_2, P_3, P_8, P_9, P_{10}\}), (e_5, \{P_4, P_5, P_6, P_7\}), (e_6, \{P_1, P_3, P_4, P_5, P_7, P_9\})\}$$

$$\pi_4 = \text{Mat}(\tilde{F} \cap \tilde{G}) = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}, \pi_5 = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 & 0 \end{bmatrix}$$

Then $M(\tilde{\tau}) = \{\pi_0, \pi_1, \pi_2, \pi_3, \pi_4, \pi_5\}$. The following tables have been used to illustrate Theorem 3.5. That is Table 4.1 shows that $(M(\tilde{\tau}), \oplus)$ is a Monoid with identity element π_0 and Table 4.2 shows that $(M(\tilde{\tau}), \odot)$ is a Monoid with identity element π_1 .

Table 4.1:

$\oplus$	π_0	π_1	π_2	π_3	π_4	π_5
π_0	π_0	π_1	π_2	π_3	π_4	π_5
π_1	π_1	π_1	π_1	π_1	π_1	π_1
π_2	π_2	π_1	π_2	π_5	π_2	π_5
π_3	π_3	π_1	π_5	π_3	π_3	π_5
π_4	π_4	π_1	π_2	π_3	π_4	π_5
π_5	π_5	π_1	π_5	π_5	π_5	π_5

Table 4.2:

$\odot$	π_0	π_1	π_2	π_3	π_4	π_5
π_0	π_0	π_0	π_0	π_0	π_0	π_0
π_1	π_0	π_1	π_2	π_3	π_4	π_5
π_2	π_0	π_2	π_2	π_4	π_4	π_2
π_3	π_0	π_3	π_4	π_3	π_4	π_3
π_4	π_0	π_4	π_4	π_4	π_4	π_4
π_5	π_0	π_5	π_2	π_3	π_4	π_5

The choice of the soft sets in the above discussion by a doctor depends upon the patients medical history. The doctor recommends that the patient P_i has to choose compulsorily the parameter e_j if and only if $P_i \in (\tilde{F} \cap \tilde{G})(e_j)$ that is if and only if the $(i,j)^{\text{th}}$ entry in $\pi_4 = \text{Mat}(\tilde{F} \cap \tilde{G})$ is 1. The doctor recommends that the patient P_i has to choose optionally the parameter e_j if and only if $P_i \in (\tilde{F} \sqcup \tilde{G})(e_j)$ that is if and only if the $(i,j)^{\text{th}}$ entry in $\pi_5 = \text{Mat}(\tilde{F} \sqcup \tilde{G})$ is 1. If the row corresponding to the patient P_i has more than one 1's in $\text{Mat}(\tilde{F} \cap \tilde{G})$ or in $\text{Mat}(\tilde{F} \sqcup \tilde{G})$ then the doctor advised the right parameter according to the medical history of the patient. The following algorithm may be used by a doctor for his recommendations.

Algorithm 4.3:

1. Input U, the universe set of patients.
2. Input E, a set of parameters for recommendations.
3. Input the soft sets $\tilde{F}$ and $\tilde{G}$.

4. Input $\text{Mat}(\tilde{F})$ and $\text{Mat}(\tilde{G})$.
5. Compute $A = \text{Mat}(\tilde{F}) \odot \text{Mat}(\tilde{G}) = [a_{ij}]$.
6. Compute $B = \text{Mat}(\tilde{F}) \oplus \text{Mat}(\tilde{G}) = [b_{ij}]$.
7. Input the patient P_i .
8. If $a_{ij} = 1$ for some j , recommend e_j to P_i .
9. If $a_{ij} = 0$ for all j , go to 10.
10. If $b_{ij} = 1$ for some j , recommend e_j to P_i .

Conclusion

A soft set is represented by a 0-1 matrix that is used to characterize soft topology. A binary data set consisting of binary matrices has been created by using a soft topology on the list of diabetic patients and this data set may be used by a doctor for the recommendations to the patients personally or virtually. In this regard, appropriate algorithm is also given for implementing the discussion.

Acknowledgement

The first author thank the management of Erode Arts and Science College, India and R&D wing of Bharathiar University, India for giving permission to do research in this area of study.

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