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Article - February 2020
DOI: 10.26483/ijarcs.v11i1.6505

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MEDICAL DIAGNOSIS USING NEUTROSOPHIC SOFT MATRICES AND THEIR COMPLIMENTS

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Abstract: Neutrosophic soft set is a mathematical technique to solve the uncertainties and imprecisions and for decision making problems. In this paper, it is intended to use Neutrosophic soft relations and compliments for medical diagnosis. This paper deals with the symptoms, patients and diseases and then by using compliment algorithm to diagnose the disease.

Keywords: Medical Diagnosis, Soft Set, Neutrosophic Soft Matrices, Compliment of NSS.

INTRODUCTION

There are many phases of life in which we face the Uncertainty, Vagueness, complexities and unpredictability. Numerous complexities in engineering, financial, societal disciplines, therapeutic fields and numerous different arenas include provision information. All such issues, a person comes to confront within life, cannot be illuminated utilizing traditional mathematical techniques. In traditional arithmetic, a numerical model of an entity is created and concept of particular elucidation of this classical paradigm is resolved. Therefore, the numerical model is excessively mind boggling, the particular result can’t be found. To resolve these complexities many theories were introduced namely Probability theory, Fuzzy set theory introduced by LotfiZadeh in 1965[20]. Interval valued fuzzy set (IVFS) in 1975[21], Rough set theory developed by Z.Pawlak in 1982[10, 11], Intuitionistic sets were introduced by KassimirrAtanassov in 1983[7], Neutrosophic sets were proposed by Smarandache 1998[18, 19] It is more powerful deals with truthiness, indeterminacy and falseness which exist in the real world. As in uncertain environment decision making is very complex issue so to resolve this issue D. Molodtsov presented Soft set theory in 1999[8]. In 2010, Intuitionistic fuzzy matrices have been derived by Maji.et.al.[9] use these terms for decision making. Jafar et al (2019)[2] use soft matrices to disease identification, in this paper we enhance the same work and use Neutrosophic soft matrices relations and their complement for the purpose of medical diagnosis. Neutrosophic sets gives more accurate results then fuzzy or intuitionistic sets. Neutrosophic sets based on Truthiness, Indeterminacy and falseness due to these factors it give more imprecise and accuracy in results. Many researchers [3-6, and 12-17] has work on decision making using soft sets and their relative concepts.

Fuzzy set [2]
If X is a universal setand x ∈ X, then a fuzzy set B defined as: B → [0, 1] such that

B = \{ \left( x_1, \mu_B(x_1) \right) | x_1 \in X \}

Soft Set [2]
Let Ube universal set and E be the set of attributes. Let P(Ü) represents power set of Ü and A⊆E,a pair (g, B) is called a soft set over Ü, where f is a mapping defined by f:B→P(Ü)

Fuzzy Soft Set [2]
The pair (A,£) is called a FSS over ý, where Ñ: £→P (ý) defined a mapping from £ into P (ý). In fuzzy soft set we give fuzzy numbers to each alternative.

Intuitionistic Fuzzy Set [4]
Let Ü be the universal set and E is the set of attributes. IFS (Ü) are the power set of Ü. ConsiderB⊆E. The pair (g, B) is an IFS over Ü where f is the mapping defined by Ñ: B→IFS (Ü).

Neutrosophic Set [5]
A set B that deals with the order triplet contains the degree of truthiness (T), indeterminacy (I) and falseness (F) value. All Neutrosophic sets of B denoted by FN (B).

B: E→ [0, 1] × [0, 1] × [0, 1]

Neutrosophic Soft Set [5]
Let Ü be a universal set and E be a set of attributes and B⊆E, and then the set (g, B) is known as NSS over Ü, where Ñ is a mapping defined by Ñ: B→GN (B).

Complement of NSS [4]
The complement of NNS is defined as (g→B) where Ñ: B→GN (X), and Ñ(b)=<x1,Tg(x1) = Fg(x1), Ig(x1) = 1-Tg(x1), Fg(x1) = Tg(x1)> for all b∈B, x1∈X.

Neutrosophic Soft Matrices [4]
Neutrosophic soft matrices deals with the order triplet contains the degree of truthness (T), indeterminacy (I) and falseness (F) value, in matrices form.

**PRODUCT OF MATRICES**

Let Y be a nonempty set and $B^* = \langle x_1, T_b (x_1), I_b (x_1), F_b (x_1) \rangle$, $E = \langle x_2, T_e (x_2), I_e (x_2), F_e (x_2) \rangle$ be the neutrosophic fuzzy sets.

\[ B^* \times E = \langle x, \sigma (T_b (x_1), T_e (x_2)), t (F_b (x_1), F_e (x_2)) \rangle \]

$B^* \times E = \langle x, t (F_b (x_1), F_e (x_2)), \tau (I_b (x_1), I_e (x_2)), s (I_b (x_1), I_e (x_2)) \rangle$

Relations on NSS [4]

Let $\hat{H} \subseteq B \times E$. Then a NSS relation $R$ between two NSS $(\hat{g}, B)$ and $(q, E)$ is defined by $R_1 (b, e) = \hat{g} (b) \lor g (e)$ for all $b \in B$, $e \in E$, where $R_1 : \hat{H} \rightarrow \text{Gn} (U)$.

**EVALUATION OF NSS**

Let $(\hat{g}, B)$ be NSS. Then the function $(\hat{g}, B)$ is defined as $D (\hat{g}, B) = T_1^+ (1-L) - \hat{g}$, where $T_1$, $L$ and $\hat{g}$ denotes the truthiness, indeterminacy and falseness value of $(\hat{g}, B)$ respectively.

**ALGORITHM AND METHODOLOGY**

Here, we describe a process used for medical diagnosis by NSS. Suppose that a set of patients is $P^o$, set of symptoms $\hat{S}$ and the set of diseases is $D$.

**ALGORITHM**

i. The set of diseases related to its symptoms is obtained the symptoms-disease relation $R_1$

ii. The patient symptoms set is obtained the patient symptoms relation $Q_1$

iii. Evaluate their corresponding complement matrices $R_2$ and $Q_2$

iv. The relation of patient symptoms disease matrices is $T_1$

v. Compute relation $T_2$ called patient non-symptoms non-disease matrices.

vi. Evaluate $\hat{S}_{T_1}$ and $\hat{S}_{T_2}$NSS by using definition of “evaluation of NSS”

vii. Compute $\hat{S}$. i.e. Higher value of possibility of patient suffer with that disease

**CASE STUDY**

Assume that the three patients $P_1$, $P_2$, $P_3$ in hospital with symptoms headache, temperature and severe pain is represented by $c_1$, $c_2$, $c_3$. Now consider $P = \{P_1, P_2, P_3\}$ represents the patient and $\hat{S} = \{c_1, c_2, c_3\}$ shows the symptoms and set $D = \{d_1, d_2, d_3\}$ shows the diseases like fever, typhoid and malaria.

According to our data, we construct symptoms-diseases relation $R$ and patient- symptoms relation $Q_1$.

$$R_1 = \begin{bmatrix}
0.3, 0.2, 0.4 & 0.4, 0.1, 0.3 & 0.5, 0.1, 0.3 \\
0.7, 0.1, 0.1 & 0.6, 0.0, 0.1 & 0.4, 0.2, 0.1 \\
0.1, 0.5, 0.3 & 0.4, 0.4, 0.3 & 0.6, 0.2, 0.2
\end{bmatrix}$$

$$Q_1 = \begin{bmatrix}
0.4, 0.5, 0.2 & 0.4, 0.2, 0.1 & 0.3, 0.4, 0.1 \\
0.5, 0.2, 0.3 & 0.6, 0.1, 0.4 & 0.2, 0.3, 0.5 \\
0.7, 0.2, 0.1 & 0.1, 0.3, 0.6 & 0.3, 0.5, 0.1
\end{bmatrix}$$

The complement of $R_1$ and $Q_1$ is represented by $R_2$ and $Q_2$ respectively.

$$R_2 = \begin{bmatrix}
0.4, 0.8, 0.3 & 0.3, 0.9, 0.4 & 0.3, 0.9, 0.5 \\
0.9, 0.7 & 0.1, 0.6 & 0.1, 0.8, 0.4 \\
0.3, 0.5, 0.1 & 0.3, 0.6, 0.1 & 0.2, 0.4, 0.0 \\
\end{bmatrix}$$

$$Q_2 = \begin{bmatrix}
0.2, 0.5, 0.0 & 0.1, 0.8, 0.4 & 0.1, 0.6, 0.3 \\
0.3, 0.8, 0.5 & 0.4, 0.9, 0.6 & 0.5, 0.7, 0.2 \\
0.1, 0.8, 0.7 & 0.6, 0.7, 0.1 & 0.1, 0.5, 0.3
\end{bmatrix}$$

Here $R_2$ represents the non-symptoms disease matrix and $Q_2$ represents the patient non-symptoms matrix. As we have

$$T_1 = Q_1 R_1 = \begin{bmatrix}
0.4, 0.4, 0.1 & 0.4, 0.4, 0.1 & 0.5, 0.5, 0.1 \\
0.6, 0.4, 0.1 & 0.4, 0.15, 0.3 & 0.5, 0.15, 0.3 \\
0.3, 0.5, 0.3 & 0.4, 0.15, 0.3 & 0.5, 0.55, 0.3
\end{bmatrix}$$

$$T_2 = Q_2 R_2 = \begin{bmatrix}
0.2, 0.8, 0.3 & 0.2, 0.9, 0.3 & 0.2, 0.8, 0.3 \\
0.3, 0.9, 0.2 & 0.3, 0.95, 0.2 & 0.3, 0.85, 0.2 \\
0.1, 0.8, 0.3 & 0.1, 0.85, 0.3 & 0.1, 0.85, 0.3
\end{bmatrix}$$

Now calculate $\hat{S}_{T_1}$ and $\hat{S}_{T_2}$ of Neutrosophic fuzzy set

$$\hat{S}_{T_1} = \begin{bmatrix}
0.9 & 0.1 & 0.9 \\
1.1 & 0.95 & 0.55 \\
0.5 & 0.95 & 0.65
\end{bmatrix} \quad \text{and} \quad \hat{S}_{T_2} = \begin{bmatrix}
0.05 & 0 & 0.1 \\
0.2 & 0.15 & 0.25 \\
0 & -0.05 & -0.05
\end{bmatrix}$$

$$\hat{S}_s = \hat{S}_{T_1} - \hat{S}_{T_2} = \begin{bmatrix}
0.85 & 0.9 & 0.8 \\
0.9 & 0.8 & 0.3 \\
0.5 & 1 & 0.7
\end{bmatrix}$$

From the result, this is the highest possibility that patient suffer from that disease

**CONCLUSION**

We have executed the idea of NSS for medical diagnosis. The result $\hat{S}_s$ shows the highest possibility that patient suffer from that disease. It is an approach to evaluate which patient is affected from what disease. By using Neutrosophic fuzzy soft sets we can solve other decision making problems.
REFERENCES


