



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 provisional 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 Lotfi Zadeh 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 Kassimir Atanassov in 1983 [7], Neutrosophic sets were proposed by Smarandache in 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 than 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 set and $x_1 \in X$, then a fuzzy set B defined as $\lambda: B \rightarrow [0, 1]$ such that

$$B = \{(x_1, u_\lambda(x_1)), x_1 \in X\}$$

Soft Set [2]

Let \tilde{U} be universal set and E is the set of attributes. Let $\mathcal{P}(\tilde{U})$ represents power set of \tilde{U} and $\tilde{A} \subseteq E$, a pair (\check{g}, B) is called a soft set over \tilde{U} , where f is a mapping defined by $f: B \rightarrow \mathcal{P}(\tilde{U})$

Fuzzy Soft Set [2]

The pair (λ, \check{g}) is called a FSS over \check{y} , where $\lambda: \check{g} \rightarrow \mathcal{P}(\check{y})$ defined a mapping from \check{g} into $\mathcal{P}(\check{y})$. In fuzzy soft set we give fuzzy numbers to each alternative.

Intuitionistic Fuzzy Set [4]

Let \tilde{U} be the universal set and E is the set of attributes. IFS (\tilde{U}) are the power set of \tilde{U} . Consider $B \subseteq E$. The pair (\check{g}, B) is an IFS over \tilde{U} where f is the mapping defined by $\check{g}: B \rightarrow \text{IFS}(\tilde{U})$.

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 $F_N(B)$.

$$B: E \rightarrow [0, 1] \times [0, 1] \times [0, 1]$$

Neutrosophic Soft Set [5]

Let \tilde{U} be a universal set and E be a set of attributes and $B \subseteq E$, and then the set (\check{g}, B) is known as NSS over \tilde{U} , where \check{g} is a mapping defined by $\check{g}: B \rightarrow \check{g}_N(B)$.

Complement of NSS [4]

The complement of NNS is defined as $(\check{g}^c \rightarrow B)$ where $\check{g}^c: B \rightarrow \check{g}_N(X)$, and $\check{g}^c(b_1) = \langle x_1, T_{\check{g}^c}(x_1) = F_{\check{g}}(x_1), I_{\check{g}^c}(x_1) = 1 - I_{\check{g}}(x_1), F_{\check{g}^c}(x_1) = T_{\check{g}}(x_1) \rangle$ for all $b_1 \in B, x_1 \in X$.

Neutrosophic Soft Matrices [4]

PRELIMINARIES

Neutrosophic soft matrices deals with the order triplet contains the degree of truthiness (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.
 $B \vee E = \langle x, \xi(T_b(x_1), T_e(x_2)), \text{average}(I_b(x_1), I_e(x_2)), t(F_b(x_1), F_e(x_2))) \rangle$
 $B \wedge E = \langle x, t(T_b(x_1), T_e(x_2)), \text{average}(I_b(x_1), I_e(x_2)), \xi(F_b(x_1), F_e(x_2))) \rangle$

Relations on NSS [4]

Let $\hat{H} \subseteq B \times E$. Then a NSS relation \check{R} between two NSS (\check{g}, B) and (g, E) is defined by $\check{R}_1(b_1, e_1) = \check{g}(b_1) \wedge g(e_1)$ for all $b_1 \in B, e_1 \in E$, where $\check{R}_1: \hat{H} \rightarrow G_n(\tilde{U})$

EVALUATION OF NSS

Let (\check{g}, B) be NSS. Then the function (\check{g}, B) is defined as $D(\check{g}, B) = T_{b+} - (I_b) - \check{g}_b$, where T_b, I_b and \check{g}_b denotes the truthiness, indeterminacy and falseness value of (\check{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° , set of symptoms S and the set of diseases is D .

ALGORITHM

- i. The set of diseases related to its symptoms is obtained the symptoms-diseases 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 \check{S}_{T_1} and \check{S}_{T_2} NSS by using definition of "evaluation of NSS"
- vii. Compute \check{S}_i 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 $\check{S} = \{\zeta_1, \zeta_2, \zeta_3\}$ 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_1 and patient- symptoms relation Q_1 .

$$R_1 = \begin{bmatrix} (0.3,0.2,0.4) & (0.4,0.1,0.3) & (0.5,0.1,0.3) \\ (0.7,0.1,0) & (0.6,0,0.1) & (0.4,0.2,0.1) \\ (0.1,0.5,0.3) & (0,0.4,0.3) & (0,0.6,0.2) \end{bmatrix}$$

$$Q_1 = \begin{bmatrix} (0,0.5,0.2) & (0.4,0.2,0.1) & (0.3,0.4,0.1) \\ (0.5,0.2,0.3) & (0.6,0.1,0.4) & (0.2,0.3,0.5) \\ (0.7,0.2,0.1) & (0.1,0.3,0.6) & (0.3,0.5,0.1) \end{bmatrix}$$

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

$$R_2 = \begin{bmatrix} (0.4,0.8,0.3) & (0.3,0.9,0.4) & (0.3,0.9,0.5) \\ (0,0.9,0.7) & (0.1,1,0.6) & (0.1,0.8,0.4) \\ (0.3,0.5,0.1) & (0.3,0.6,0) & (0.2,0.4,0) \end{bmatrix}$$

$$Q_2 = \begin{bmatrix} (0.2,0.5,0) & (0.1,0.8,0.4) & (0.1,0.6,0.3) \\ (0.3,0.8,0.5) & (0.4,0.9,0.6) & (0.5,0.7,0.2) \\ (0.1,0.8,0.7) & (0.6,0.7,0.1) & (0.1,0.5,0.3) \end{bmatrix}$$

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

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

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

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

$$\check{S}_{T_1} = \begin{bmatrix} 0.9 & 0.9 & 0.9 \\ 1.1 & 0.95 & 0.55 \\ 0.5 & 0.95 & 0.65 \end{bmatrix} \text{ and}$$

$$\check{S}_{T_2} = \begin{bmatrix} 0.05 & 0 & 0.1 \\ 0.2 & 0.15 & 0.25 \\ 0 & -0.05 & -0.05 \end{bmatrix}$$

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

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 \check{S}_i 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.

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