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# APPLICATION OF FUZZY NEUTROSOPHIC RELATION IN DECISION MAKING

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## ABSTRACT
In this paper a new approach is proposed to meet the challenges in medical diagnosis using fuzzy neutrosophic c ompositionrelation.

**Keywords:** Fuzzy neutrosophic composition relation, Fuzzy neutrosophic value function,Fuzzyneutrosophic score function.

## 1. INTRODUCTION
Neutrosophic Logic proposed by Florentine Smarandache [ 5 ] was developed to represent mathematical model of uncertainty, vagueness, ambiguity, imprecision undefined, incompleteness, inconsistency, redundancy, contradiction. The neutrosophic logic is a formal frame to measure truth, indeterminacy and falsehood. In Neutrosophic set, indeterminacy is quantified explicitly whereas the truth membership, indeterminacy membership and falsity membership are independent. This assumption is very important in lot of situations such as information fusion when we try to combine the data from different sensors. From philosophical point of view, the neutrosophic set takes value from real standard or non-standard subset of$]^-0, 1^+[$. But in real life application in scientific and Engineering problems it is difficult to use neutrosophic set with value from real standard or non-standard subset of $]^-0, 1^+[$. Hence Arockiarani et.al.[1] introduced the fuzzy neutrosophic set which takes the value from the subset of [0,1].In this paper we define the value function and score function for the fuzzy neutrosophicsets .Furthur we apply the same with the composition relation in medical diagnosis.

## 2. PRELIMINARIES
### Definition 2.1:[1]
A Fuzzy neutrosophic set A on the universe of discourse X is defined as

A= $\langle x, T_A(x), I_A(x), F_A(x)\rangle, x \in X$ where $T, I, F: X \to[0,1]$ and $0 \le T_A(x) + I_A(x) + F_A(x) \le 3$.

### Definition2.2:[2]
A fuzzy neutrosophic set relation is defined as a fuzzy neutrosophic subset of $X \times Y$ having the form $R = \{ \langle (x,y), T_R(x,y), I_R(x,y), F_R(x,y)\rangle : x \in X, y \in Y \}$ where $T_R, I_R, F_R: X \times Y \to [0,1]$
Satisfy the condition $0 \le T_R(x,y) + I_R(x,y) + F_R(x,y) \le 3 \quad \forall (x,y) \in X \times Y$.

We will denote with $FNR(X\times Y)$ the set of all fuzzy neutrosophic subsets in $X\times Y$.

**Definition 2.3:[2]**

Given a binary fuzzy neutrosophic relation between $X$ and $Y$, we can define $R^{-1}$ between $Y$ and $X$ by means of $T_{R^{-1}}(y,x)=T_R(x,y), I_{R^{-1}}(y,x)=I_R(x,y), F_{R^{-1}}(y,x)=F_R(x,y)\forall(x,y)\in X\times Y$ to which we call inverse relation of R.

Definition 2.4:[2]

Let $\alpha,\beta,\lambda,\rho$ be t-norms or t-conorms not necessarily dual two – two, $R\in FNR(X\times Y)$ and $P\in FNR(Y\times Z)$. We will call composed relation $P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R\in FNR(X\times Z)$ to the one defined by

$$P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R=\left\{\langle (x,z), T_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z), I_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z), F_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)\rangle / x\in X, z\in Z\right\}$$

Where,

$$T_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)=\overset{\alpha}{_y}\{\beta[T_R(x,y),T_P(y,z)]\}, I_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)=\overset{\alpha}{_y}\{\beta[I_R(x,y),I_P(y,z)]\}$$

$$F_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)=\overset{\lambda}{_y}\{\rho[F_R(x,y),F_P(y,z)]\}$$

Whenever $0\le T_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)+I_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)+F_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)\le 3\ \forall(x,z)\in X\times Z$

The choice of the t-norms and t-conorms $\alpha,\beta,\lambda,\rho$ in the previous definition, is evidently conditioned by the fulfilment of

$$0\le T_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)+I_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)+F_{P \underset{\lambda,\rho}{\overset{\alpha,\beta}{\circ}} R}(x,z)\le 3\ \forall(x,z)\in X\times Z.$$

**Definition 2.5:[3]**

Let $X$ be a set and let $P,Q\in FNR(X)$. Then the composition $Q\circ P$ of $P$ and $Q$ can also be defined as follows: for any $x,y\in X$

$T_{Q\circ P}(x,y)=\underset{z\in X}{\vee}[T_P(x,z)\wedge T_Q(z,y)]$, $I_{Q\circ P}(x,y)=\underset{z\in X}{\vee}[I_P(x,z)\wedge I_Q(z,y)]$ and

$F_{Q\circ P}(x,y)=\underset{z\in X}{\wedge}[F_P(x,z)\vee F_Q(z,y)]$

## 3. APPLICATION OF FUZZY NEUTROSOPHIC COMPOSITION RELATION IN MEDICAL DIAGNOSIS

**Definition 3.1:**

Let $A$ be fuzzy neutrosophic set. Then the value function of $A$ is defined as $V(A)=T_A+(1-I_A)-F_A$ where $T_A, I_A$ and $F_A$ denotes the Truth value, indeterministic value and false value of $A$ respectively.

**Definition3.2:**

Let $A$ be fuzzy neutrosophicset.Then the score function of $A$ is defined as $S_2=T_j-I_jF_j$ We define mathematically, a patient is a fuzzy neutrosophic set, say $P_i$, on the set of symptoms $S$ and the fuzzy neutrosophic relation from the set of symptoms $S$ to the set of diseases $D$, which reveals the degree of association, indetermination and the degree of non- association between the patients and symptoms and between symptoms and diseases.

**Algorithm:**

*Step 1:* The symptoms of the patients are given in Table I .i.e. the relation $Q(P\to S)$ between the patients and symptoms are noted.

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*Step 2:* The medical knowledge relating the symptoms with the set of diseases under consideration are noted in Table II.(i.e.,)the relation of symptoms and diseases $R(S \to D)$ are given.

*Step 3:* The composition relation of patients and diseases $T(P \to D)$ are found using the definition 2.4 and noted in Table III.

*Step 4:* Calculate the value function by using the definition 3.1 for Table III and is given in Table IV.

*Step 5:* We apply score function for the table III using the definition 3.2 and it is given in Table V.

*Step 6:* The higher the score, higher is the possibility of the patient affected with the respective disease.

**Table 1: The symptoms of the patients**

| Q | Vomiting($S_1$) | Pain in Abdomen($S_2$) | Temperature($S_3$) |
|---|---|---|---|
| Patient 1($P_1$) | (0.7,0.4,0.1) | (0.8,0.6,0.7) | (0.4,0.8,0.5) |
| Patient 2($P_2$) | (0.6,0.5,0.3) | (0.6,0.5,0.2) | (0.7,0.9,0.0) |
| Patient 3($P_3$) | (0.8,0.4,0.2) | (0.5,0.1,0.5) | (1.0,0.5,1.0) |
| Patient 4($P_4$) | (0.4,0.6,0.3) | (0.5,0.4,0.8) | (0.5,0.6,0.9) |

**Table 2:The relation of symptoms and diseases.**

| R | Intestinal Obstruction (D1) | Inguinal Hernia (D2) | Appendicitis (D3) | Ureteric Colic (D4) |
|---|---|---|---|---|
| Vomiting(S1) | (0.9,0.6,0.7) | (0.9,1.0,0.5) | (0.9,0.2,0.8) | (0.6.0.2,0.3) |
| Pain in Abdomen(S2) | (0.5,0.3,0.3) | (0.4,0.6,0.6) | (0.4,0.5,0.3) | (0.9,0.5,0.8) |
| Temperature(S3) | (0.8,0.8,0.9) | (0.7,0.8,0.3) | (0.8,0.1,0.8) | (0.3,0.4,0.5) |

**Table 3: The composition relation of patients and diseases**

| T | Intestinal Obstruction ($D_1$) | Inguinal Hernia ($D_2$) | Appendicitis ($D_3$) | Ureteric Colic ($D_4$) |
|---|---|---|---|---|
| Patient 1($P_1$) | (0.7,0.8,0.7) | (0.7,0.8,0.5) | (0.7,0.5,0.7) | (0.8.0.5,0.3) |
| Patient 2($P_2$) | (0.7,0.8,0.3) | (0.7,0.8,0.3) | (0.7,0.5,0.3) | (0.6,0.5,0.3) |
| Patient 3($P_3$) | (0.8,0.5,0.5) | (0.8,0.5,0.5) | (0.8,0.2,0.5) | (0.6,0.4,0.3) |
| Patient 4($P_4$) | (0.5,0.6,0.7) | (0.5,0.6,0.5) | (0.5,0.4,0.8) | (0.5,0.4,0.3) |

**Table 4: Calculation of value function**

| Value function | $D_1$ | $D_2$ | $D_3$ | $D_4$ |
|---|---|---|---|---|
| Patient 1($P_1$) | 0.2 | 0.4 | 0.5 | 1 |
| Patient 2($P_2$) | 0.6 | 0.6 | 0.9 | 0.8 |
| Patient 3($P_3$) | 0.8 | 0.8 | 1.1 | 0.9 |
| Patient 4($P_4$) | 0.2 | 0.4 | 0.3 | 0.8 |

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**Table 5: Calculation of score function**

| Score function | $D_1$ | $D_2$ | $D_3$ | $D_4$ |
|---|---|---|---|---|
| Patient 1($P_1$) | 0.14 | 0.3 | 0.35 | **0.65** |
| Patient 2($P_2$) | 0.46 | 0.46 | **0.55** | 0.45 |
| Patient 3($P_3$) | 0.55 | 0.55 | **0.70** | 0.48 |
| Patient 4($P_4$) | 0.08 | 0.2 | 0.18 | **0.38** |

Therefore from Table V we conclude that $P_1$ and $P_4$ are suffering from $D_4$and $P_2$ and $P_3$ are suffering from $D_3$.

## 4. REFERENCES

[1] I.Arockiarani, J.Martina Jency., More on Fuzzy Neutrosophic sets and Fuzzy Neutrosophic Topological spaces,International journal of innovative research and studies ,May (2014) ,vol 3, Issue 5,643-652.

[2] I.Arockiarani, J.MartinaJency.,Fuzzyneutrosophic relations(Communicated)

[3] I.Arockiarani, J.MartinaJency.,Fuzzyneutrosophic equivalence relations,International journal of innovative research and development ,Jan(2016),Vol 5,Issue 1,219-227

[4] Deschrijver.G.,E.e.Kerre,On the composition of intuitionistic fuzzy relations , Fuzzy sets and systems,Vol .136,2003,333-361.

[5] F.Smarandache, Neutrosophic set, a generalization of the intuituionistics fuzzy sets, Inter.J.Pure Appl.Math.,24 (2005),287 – 297.