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Graphical Representation of Type-2 Neutrosophic sets

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Abstract: Neutrosophic set is the universality of the fuzzy and intuitionistic fuzzy sets. If the value of grade of membership contains uncertainty then that problems or situations can be dealt by type-2 fuzzy and intuitionistic fuzzy sets. It is not possible to work in enigmatic and uncertain situations and indeterminate situations as well. This present study introduces, graphical representation of type-2 neutrosophic set (T2NS) to deal the level of uncertainty in truth, indeterminate and false part of the information from footprint of uncertainty (FOU). This graphical representation helps as a learning strategy of type-2 neutrosophic sets. Also discussed the advantage of T2NS.

Keywords: Type 2 neutrosophic number; graphical representation; score and accuracy function

1. Introduction

Fuzzy set (FS) [32] is an extension of the conventional set where the elements have membership degrees. It encounters the uncertainty, partial truth and vagueness of each and every element in the set. FS is also called as type-1 FS. Since it has crisp membership values take from [0, 1], it is unable to deal more uncertainties generally exist in the real world problems. To sort out this issue type-2 fuzzy sets have been introduced to deal more uncertainties as its membership values itself a fuzzy number with a unique dimension called footprint of uncertainty (FOU). FOU tells about the level of uncertainty of the problem by giving more degrees of freedom and it is the fundamental difference between the type-1 and type-2 FSs.

Structure of the rule is same in these two types but the output is different. An expert can decide the membership value in type-1 fuzzy exactly where for type-2 fuzzy it is not instead expert will provide interval based membership values. Defuzzification is the method for getting crisp outputs from type-2 fuzzy sets and gives the flexibilities in decision-making. In this way, type-2 fuzzy sets have the capability of dealing uncertainty in high level by providing missing components, which is very useful in decision-making.

Atanassov[5] stated that intuitionistic fuzzy sets (IFSs) are the generalization of FSs by adding degree of non-membership of the elements in the set. It provides the theoretical support to handle the hesitation information provided by the people in judging questions. In addition, it looks more precisely to uncertainty analysis and afford the chance of having precise model using existing observation and intelligence. Both these types are soft methods and hence directed to soft computing and approximate reasoning [23]. Type-2 IFSs more successful by enhancing the ability of dealing with more uncertainties as T2FSs with extra component non-membership. T2FSs and T2IFSs have a broad range of practical applications.

Impreciseness in real world problems has become an advantageous modeling field for FSs and its generalization. Many efforts have been made to employ the approach of these sets for reducing the impreciseness from such problems [24]. Dubois et al.[15]inferred that some of the experts have disputed that demanding precision in grades of membership of the elements of the sets may sound sarcastic. Though it is a challenged one automatically, it leads to interval valued fuzzy sets. In the fields of engineering, economics intervals were used to produce the values of quantities due to uncertainty. Bustince et al.[13] mentioned that, all the above mentioned types are only because of uncertainty of human knowledge representation.

Though FSs and IFSs scope with the dealing of uncertainty in real world problems, they are unable to deal indeterminacy of the information or data. Hence, neutrosophic set introduced by Smarandache [27]. Then its special cases like single valued and interval valued neutrosophic sets have been introduced to deal more uncertainty of the problem by dealing more indeterminacy of the information and data provided by the experts or people according to the questionnaire provided [7,33].

The remaining part of the paper is organized as follows. In section 2, review of literature has been given. In section 3, basic concepts of type-2 neutrosophic set have been presented. In section 4, numerical validation is done for the concepts using type-2 neutrosophic sets. In section 5, graphical representation of type-2 neutrosophic set is presented. In section 6, advantages of T2NS are presented. In section 7, we conclude the work with the future direction.

2-Review of Literature

Atanassov [2] introduced the concept of intuitionistic fuzzy sets. Atanassov [4] described the theory of intuitionistic fuzzy concept. Atanassov [4] introduced the geometric interpretation, discrete norm, graph concepts under IFS environment. Zhao and Xia [33] proposed the concept of IFS under type-2 setting. Coung et al [14] defined some operations of IFS. Jana [21] proposed arithmetic operations on type-2 IFS and used the proposed concepts in transportation problem. Singh and Garg [29] proposed distance measure between IFSs and applied in a decision-making problem. Anusuya and Sathya [2] solved shortest path problem (SPP) using the complement of a type-2 fuzzy number. Anusuya and Sathya [1] proposed a new approach for solving SPP under type-2 fuzzy environment. Lee and Lee [25] solved SPP using type-2 fuzzy weighted graph. Basset et al [26] proposed a novel methodology for supplier selection using TOPSIS approach.

Kumar and Pandey [24] made a discussion Qwitching Type-2 fuzzy sets and IFS in an application of medical diagnosis. Khatibi and Montazer [23] analyzed the performance of medical pattern recognition using IFS and FS. Dubois et al[15]discussed about the difficulties of using the terminologies of FS theory. Bustince et al [13] presented a wider view on the relationship of interval type-2 fuzzy sets and interval valued FSs.

Smarandache [27] introduced the concept of neutrosophy and its probability, logic and set. Smarandache [28] introduced neutrosophic theory, its logic and set to solve the problem with indeterminacy. Wang et al [30] introduced single valued neutrosophic set (SVNS) as the special case of neutrosophic set (NS). Wang et al [31] introduced interval valued NSs and applied in the field computing technology. Broumi and Smarandache [6] proposed cosine similarity measure of interval valued NSs. Broumi et al [11] introduced interval valued neutrosophic sets and its operations.

Broumi et al [8] solved minimum spanning tree problem under interval valued bipolar neutrosophic setting. Broumi et al [9] solve SPP using single valued neutrosophic graphs. Broumi et al[10]analyzed SPP using trapezoidal NS. Broumi et al [11] introduced N-valued interval NSs and applied in medical diagnosis problem. Nagarajan et al [17] have done edge detection on DICOM Image using triangular norms under type-2 fuzzy. Nagarajan et al [18] have done image extraction using the concept of type-2 fuzzy.

Nagarajan et al. [19] introduced interval type2 fuzzy logic washing machine. Nagarajan et al [20], proposed fuzzy optimization techniques based on hidden Markov model using interval type-2 fuzzy parameters. Broumi et al [12] solved SPP using triangular and trapezoidal interval NSs.

Nagarajan et al [16] analyzed traffic control management using interval type-2 FSs and interval neutrosophic sets and their aggregation operators. Also proposed a new score function for interval neutrosophic numbers. Karaaslan and Hunu [22] introduced type-2 single valued neutrosophic sets and solved multicriteria group decision-making problem based on TOPSIS method under type-2 single valued neutrosophic environment.

Though many concepts and types have been introduced, type-2 neutrosophic set with truth, indeterminacy and falsity components as the subparts for all the three components truth, indeterminacy and falsity is yet to be studied. Hence the scope and aim of this paper.

3-Preliminaries

We introduce several basic concepts of T2NN and operations on T2NN.

Definition of type 2 neutrosophic number [26]

Let Z be the limited universe of discourse and $F[0,1]$ be the set of all triangular neutrosophic numbers on $F[0,1]$. A type 2 neutrosophic number set (T2NNS) $\widetilde{U}$ in Z is represented by $\widetilde{U}=\{\langle z, \widetilde{T}_{\widetilde{U}}(z), \widetilde{I}_{\widetilde{U}}(z), \widetilde{F}_{\widetilde{U}}(z) \mid z \in Z\rangle\}$, where $\widetilde{T}_{\widetilde{U}}(z): Z \to F[0,1], \widetilde{I}_{\widetilde{U}}(z): Z \to F[0,1], \widetilde{F}_{\widetilde{U}}(z): Z \to F[0,1]$. A type 2 neutrosophic number set (T2NNS) $\widetilde{T}_{\widetilde{A}}(z) = \left(T_{T_{\widetilde{U}}}(z), T_{I_{\widetilde{U}}}(z), T_{F_{\widetilde{U}}}(z)\right)$, $\widetilde{I}_{\widetilde{U}}(z) =\left(I_{T_{\widetilde{U}}}(z), I_{I_{\widetilde{U}}}(z), I_{F_{\widetilde{U}}}(z)\right)$, $\widetilde{F}_{\widetilde{U}}(z) =\left(F_{T_{\widetilde{U}}}(z), F_{I_{\widetilde{U}}}(z), F_{F_{\widetilde{U}}}(z)\right)$, respectively, denote the truth, indeterminacy, and falsity memberships of z in $\widetilde{U}$ and for every $z \in Z$: $0 \leq \widetilde{T}_{\widetilde{U}}(z)^3 + \widetilde{I}_{\widetilde{U}}(z)^3 + \widetilde{F}_{\widetilde{U}}(z)^3 \leq 3$; for convenience, we consider that

$\widetilde{U} = \left\langle \left(T_{T_{\widetilde{U}}}(z), T_{I_{\widetilde{U}}}(z), T_{F_{\widetilde{U}}}(z)\right), \left(I_{T_{\widetilde{U}}}(z), I_{I_{\widetilde{U}}}(z), I_{F_{\widetilde{U}}}(z)\right), \left(F_{T_{\widetilde{U}}}(z), F_{I_{\widetilde{U}}}(z), F_{F_{\widetilde{U}}}(z)\right)\right\rangle$ as a type 2 neutrosophic number.

Definition 2[26]

Suppose $\widetilde{U}_1= \left\langle \left(T_{T_{\widetilde{U}_1}}(z), T_{I_{\widetilde{U}_1}}(z), T_{F_{\widetilde{U}_1}}(z)\right), \left(I_{T_{\widetilde{U}_1}}(z), I_{I_{\widetilde{U}_1}}(z), I_{F_{\widetilde{U}_1}}(z)\right), \left(F_{T_{\widetilde{U}_1}}(z), F_{I_{\widetilde{U}_1}}(z), F_{F_{\widetilde{U}_1}}(z)\right)\right\rangle$ and $\widetilde{U}_2 = \left\langle \left(T_{T_{\widetilde{U}_2}}(z), T_{I_{\widetilde{U}_2}}(z), T_{F_{\widetilde{U}_2}}(z)\right), \left(I_{T_{\widetilde{U}_2}}(z), I_{I_{\widetilde{U}_2}}(z), I_{F_{\widetilde{U}_2}}(z)\right), \left(F_{T_{\widetilde{U}_2}}(z), F_{I_{\widetilde{U}_2}}(z), F_{F_{\widetilde{U}_2}}(z)\right)\right\rangle$ are two

T2NNS in the set real numbers. Then the procedures are defined as follows:

$$\tilde{U}_1 \oplus \tilde{U}_2 = \left\langle \begin{array}{c} \left(\begin{array}{c} \left(T_{T_{\tilde{U}_1}}(z) + T_{T_{\tilde{U}_2}}(z) - T_{T_{\tilde{U}_1}}(z).T_{T_{\tilde{U}_2}}(z)\right), \left(T_{I_{\tilde{U}_1}}(z) + T_{I_{\tilde{U}_2}}(z) - T_{I_{\tilde{U}_1}}(z).T_{I_{\tilde{U}_2}}(z)\right), \\ \left(T_{F_{\tilde{U}_1}}(z) + T_{F_{\tilde{U}_2}}(z) - T_{F_{\tilde{U}_1}}(z).T_{F_{\tilde{U}_2}}(z)\right) \end{array} \right), \\ \left(I_{T_{\tilde{U}_1}}(z).I_{T_{\tilde{U}_2}}(z), I_{I_{\tilde{U}_1}}(z).I_{I_{\tilde{U}_2}}(z), I_{F_{\tilde{U}_1}}(z).I_{F_{\tilde{U}_2}}(z)\right), \\ \left(F_{T_{\tilde{U}_1}}(z).F_{T_{\tilde{U}_2}}(z), F_{I_{\tilde{U}_1}}(z).F_{I_{\tilde{U}_2}}(z), F_{F_{\tilde{U}_1}}(z).F_{F_{\tilde{U}_2}}(z)\right) \end{array} \right\rangle \quad (1)$$

$$\tilde{U}_1 \otimes \tilde{U}_2 = \left\langle \begin{array}{c} \left(\left(T_{T_{\tilde{U}_1}}(z).T_{T_{\tilde{U}_2}}(z), T_{I_{\tilde{U}_1}}(z).T_{I_{\tilde{U}_2}}(z), T_{F_{\tilde{U}_1}}(z).T_{F_{\tilde{U}_2}}(z)\right)\right), \\ \left(\begin{array}{c} \left(I_{T_{\tilde{U}_1}}(z) + I_{T_{\tilde{U}_2}}(z) - I_{T_{\tilde{U}_1}}(z).I_{T_{\tilde{U}_2}}(z)\right), \left(I_{I_{\tilde{U}_1}}(z) + I_{I_{\tilde{U}_2}}(z) - I_{I_{\tilde{U}_1}}(z).I_{I_{\tilde{U}_2}}(z)\right), \\ \left(I_{F_{\tilde{U}_1}}(z) + I_{F_{\tilde{U}_2}}(z) - I_{F_{\tilde{U}_1}}(z).I_{F_{\tilde{U}_2}}(z)\right) \end{array} \right) \\ \left(\begin{array}{c} \left(F_{T_{\tilde{U}_1}}(z) + F_{T_{\tilde{U}_2}}(z) - F_{T_{\tilde{U}_1}}(z).F_{T_{\tilde{U}_2}}(z)\right), \left(F_{I_{\tilde{U}_1}}(z) + F_{I_{\tilde{U}_2}}(z) - F_{I_{\tilde{U}_1}}(z).F_{I_{\tilde{U}_2}}(z)\right), \\ \left(F_{F_{\tilde{U}_1}}(z) + F_{F_{\tilde{U}_2}}(z) - F_{F_{\tilde{U}_1}}(z).F_{F_{\tilde{U}_2}}(z)\right) \end{array} \right) \end{array} \right\rangle$$

(2)

$$\delta\tilde{U} = \left\langle \begin{array}{c} \left(1-(1-T_{T_{\tilde{U}_1}}(z))^{\delta}, 1-(1-T_{I_{\tilde{U}_1}}(z))^{\delta}, 1-(1-T_{F_{\tilde{U}_1}}(z))^{\delta}\right), \\ \left(\left(I_{T_{\tilde{U}_1}}(z)\right)^{\delta}, \left(I_{I_{\tilde{U}_1}}(z)\right)^{\delta}, \left(I_{F_{\tilde{U}_1}}(z)\right)^{\delta}\right), \\ \left(\left(F_{T_{\tilde{U}_1}}(z)\right)^{\delta}, \left(F_{I_{\tilde{U}_1}}(z)\right)^{\delta}, \left(F_{F_{\tilde{U}_1}}(z)\right)^{\delta}\right) \end{array} \right\rangle \quad \text{for} \quad \delta > 0$$

(3)

$$\widetilde{U}^{\delta} = \left\langle \begin{array}{c} \left(\left(T_{T_{\widetilde{U}_1}}(z)\right)^{\delta}, \left(T_{I_{\widetilde{U}_1}}(z)\right)^{\delta}, \left(T_{F_{\widetilde{U}_1}}(z)\right)^{\delta}\right), \\ \left(1-\left(1-I_{T_{\widetilde{U}_1}}(z)\right)^{\delta}, \quad 1-\left(1-I_{I_{\widetilde{U}_1}}(z)\right)^{\delta}, 1-\left(1-I_{F_{\widetilde{U}_1}}(z)\right)^{\delta}\right), \\ \left(1-\left(1-F_{T_{\widetilde{U}_1}}(z)\right)^{\delta}, \quad 1-\left(1-F_{I_{\widetilde{U}_1}}(z)\right)^{\delta}, 1-\left(1-F_{F_{\widetilde{U}_1}}(z)\right)^{\delta}\right) \end{array} \right\rangle$$

for $\delta > 0$

(4)

The procedures defined in definition 2 satisfy the following properties:

$\widetilde{U}_1 \oplus \widetilde{U}_2 = \widetilde{U}_2 \oplus \widetilde{U}_1$, $\widetilde{U}_1 \otimes \widetilde{U}_2 = \widetilde{U}_2 \otimes \widetilde{U}_1$;

$\delta(\widetilde{U}_1 \oplus \widetilde{U}_2) = \delta\widetilde{U}_1 \oplus \delta\widetilde{U}_2$, $(\widetilde{U}_1 \otimes \widetilde{U}_2)^{\delta} = {\widetilde{U}_1}^{\delta} \otimes {\widetilde{U}_2}^{\delta}$ for $\delta > 0$, and

$\delta_1\widetilde{U}_1 \oplus \delta_2\widetilde{U}_1 = (\delta_1 + \delta_2)\widetilde{U}_1$, ${\widetilde{U}_1}^{\delta_1} \oplus {\widetilde{U}_1}^{\delta_2} = {\widetilde{U}_1}^{(\delta_1 + \delta_2)}$ for $\delta_1, \delta_2 > 0$.

Definition 3 [26]

Suppose that $\widetilde{U}_1 = \left\langle \left(T_{T_{\widetilde{U}_1}}(z), T_{I_{\widetilde{U}_1}}(z), T_{F_{\widetilde{U}_1}}(z)\right), \left(I_{T_{\widetilde{U}_1}}(z), I_{I_{\widetilde{U}_1}}(z), I_{F_{\widetilde{U}_1}}(z)\right), \left(F_{T_{\widetilde{U}_1}}(z), F_{I_{\widetilde{U}_1}}(z), F_{F_{\widetilde{U}_1}}(z)\right)\right\rangle$

are T2NNS in the set of real numbers, the score function $S(\widetilde{U}_1)$ of $\widetilde{U}_1$ is defined as follows:

$$S(\widetilde{U}_1) = \frac{1}{12}\left\langle 8 + \left(T_{T_{\widetilde{U}_1}}(z) + 2\left(T_{I_{\widetilde{U}_1}}(z)\right) + T_{F_{\widetilde{U}_1}}(z)\right) - \left(I_{T_{\widetilde{U}_1}}(z) + 2\left(I_{I_{\widetilde{U}_1}}(z)\right) + I_{F_{\widetilde{U}_1}}(z)\right) - \left(F_{T_{\widetilde{U}_1}}(z) + 2\left(F_{I_{\widetilde{U}_1}}(z)\right) + F_{F_{\widetilde{U}_1}}(z)\right)\right\rangle \quad (5)$$

$$A(\widetilde{U}_1) = \frac{1}{4}\left\langle\left(T_{T_{\widetilde{U}_1}}(z) + 2\left(T_{I_{\widetilde{U}_1}}(z)\right) + T_{F_{\widetilde{U}_1}}(z)\right) - \left(F_{T_{\widetilde{U}_1}}(z) + 2\left(F_{I_{\widetilde{U}_1}}(z)\right) + F_{F_{\widetilde{U}_1}}(z)\right)\right\rangle$$

(6)

Definition 4 [26].

Suppose that $\widetilde{U}_1 = \left\langle \left(T_{T_{\widetilde{U}_1}}(z), T_{I_{\widetilde{U}_1}}(z), T_{F_{\widetilde{U}_1}}(z)\right), \left(I_{T_{\widetilde{U}_1}}(z), I_{I_{\widetilde{U}_1}}(z), I_{F_{\widetilde{U}_1}}(z)\right), \left(F_{T_{\widetilde{U}_1}}(z), F_{I_{\widetilde{U}_1}}(z), F_{F_{\widetilde{U}_1}}(z)\right)\right\rangle$

and $\widetilde{U}_2 = \left\langle \left(T_{T_{\widetilde{U}_2}}(z), T_{I_{\widetilde{U}_2}}(z), T_{F_{\widetilde{U}_2}}(z)\right), \left(I_{T_{\widetilde{U}_2}}(z), I_{I_{\widetilde{U}_2}}(z), I_{F_{\widetilde{U}_2}}(z)\right), \left(F_{T_{\widetilde{U}_2}}(z), F_{I_{\widetilde{U}_2}}(z), F_{F_{\widetilde{U}_2}}(z)\right)\right\rangle$ are two

T2NNS in the set of real numbers. Suppose that $S(\widetilde{U}_i)$ and $A(\widetilde{U}_i)$ are the score and accuracy functions of T2NNS $\widetilde{U}_i$(i = 1, 2), then the order relations are defined as follows:

If $\tilde{S}(\widetilde{U}_1)>\tilde{S}(\widetilde{U}_2)$, then $\widetilde{U}_1$ is greater than $\widetilde{U}_2$, that is $\widetilde{U}_1$ is superior to $\widetilde{U}_2$, denoted by $\widetilde{U}_1>\widetilde{U}_2$;

If $\tilde{S}(\widetilde{U}_1) = \tilde{S}(\widetilde{U}_2)$, $\widetilde{A}(\widetilde{U}_1)>\widetilde{A}(\widetilde{U}_2)$)then $\widetilde{U}_1$ is superior than $\widetilde{U}_2$, that is $\widetilde{U}_1$ is superior to $\widetilde{U}_2$, denoted by $\widetilde{U}_1>\widetilde{U}_2$;

If $\tilde{S}(\widetilde{U}_1) = \tilde{S}(\widetilde{U}_2)$, $\widetilde{A}(\widetilde{U}_1) = \widetilde{A}(\widetilde{U}_2)$) then $\widetilde{U}_1$ is equal to $\widetilde{U}_2$, that is $\widetilde{U}_1$ is indifferent to $\widetilde{U}_2$, denoted by $\widetilde{U}_1=\widetilde{U}_2$;

4-Numreical examples

In this section, numerical examples are given for validating the concepts.

Example 1. Consider two T2NNS in the group of real numbers:

$$\widetilde{U}_1= \left\langle \left(T_{T_{\widetilde{U}_1}}(z), T_{I_{\widetilde{U}_1}}(z), T_{F_{\widetilde{U}_1}}(z)\right), \left(I_{T_{\widetilde{U}_1}}(z), I_{I_{\widetilde{U}_1}}(z), I_{F_{\widetilde{U}_1}}(z)\right), \left(F_{T_{\widetilde{U}_1}}(z), F_{I_{\widetilde{U}_1}}(z), F_{F_{\widetilde{U}_1}}(z)\right)\right\rangle \text{ and}$$

$$\widetilde{U}_2 = \left\langle \left(T_{T_{\widetilde{U}_2}}(z), T_{I_{\widetilde{U}_2}}(z), T_{F_{\widetilde{U}_2}}(z)\right), \left(I_{T_{\widetilde{U}_2}}(z), I_{I_{\widetilde{U}_2}}(z), I_{F_{\widetilde{U}_2}}(z)\right), \left(F_{T_{\widetilde{U}_2}}(z), F_{I_{\widetilde{U}_2}}(z), F_{F_{\widetilde{U}_2}}(z)\right)\right\rangle$$

$\widetilde{U}_1 = \langle(0.65, 0.70, 0.75), (0.20, 0.15, 0.30), (0.15, 0.20, 0.10)\rangle$, $\widetilde{U}_2 = \langle(0.45, 0.40, 0.55), (0.35, 0.45, 0.30), (0.25, 0.35, 0.40)\rangle$.

From score function, we get the following outcomes:

Score value of $\tilde{S}(\widetilde{U}_1) =\big(8 + (2.8 - 0.8 - .065)\big)/12 = 0.78$, and $\tilde{S}(\widetilde{U}_2) = \big(8 + (1.8 - 1.55 - 1.35)\big)/12 = 0.58$;

Accuracy value of $A(\widetilde{U}_1)= (2.8 - 0.65)/4 = 0.54$, and $A(\widetilde{U}_2) = (1.8 - 1.35)/4 = 0.11$; it's obvious that $A_1>A_2$.

Example 2. Consider two T2NNS in the set of real numbers: $\widetilde{U}_1 = \langle(0.50, 0.20, 0.35), (0.30, 0.45, 0.30), (0.10, 0.25, 0.35)\rangle$, $\widetilde{U}_2 = \langle(0.15, 0.60, 0.20), (0.35, 0.20, 0.30), (0.45, 0.35, 0.20)\rangle$.From Eqs. (5) and (6), we obtain the following results:

Score value of $\tilde{S}(\tilde{U}_1) = (8 + (1.25 - 1.5 - 0.95))/12 = 0.57$, and $\tilde{S}(\tilde{U}_2) =$

$(8 + (1.55 - 1.05 - 1.35))/12 = 0.60$;

Accuracy value of $A(\tilde{U}_1) = (1.25 - 0.95)/4 = 0.075$, and $A(\tilde{U}_2) = (1.55 - 1.35)/12 = 0.05$;

it's obvious that $A_2 > A_1$.

5-Graphical Representation of T2NS

Here, graphical representation of type-2 neutrosophic set is introduced (Figure 1). The method of analyzing numerical data is called graphical representation. It exposes the relation between data and the concept in a diagram. Here we present the graphical representation of type-2 neutrosophic sets which is useful to exhibit the relation of truth, indeterminacy and falsity of the data and concept. This representation is a learning system of T2NS. Here footprint of uncertainty (FOU) for truth, indeterminacy and falsity represents the level of uncertainty exist.

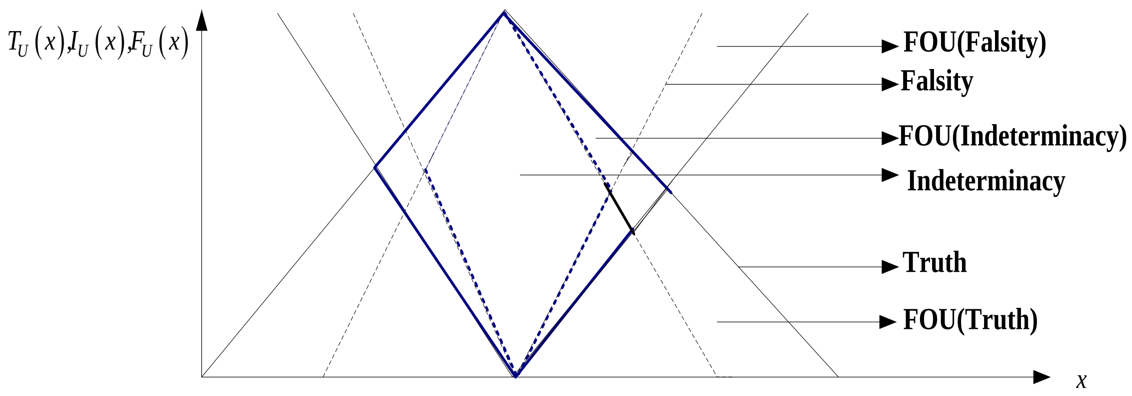

Figure 1. Graphical Representation of Type-2 Neutrosophic Set (T2NS)

z((T_T, T_I, T_F), (I_T, I_I, I_F), (F_T, F_I, F_F)) is a Type-2 Neutrosophic Number, which means that each neutrosophic component T, I, and F is split into its truth, indeterminacy, and falsehood subparts. The procedure of splitting may be executed recurrently, as many times as needed, obtaining a general Type-n Neutrosophic Number, for any integer $\eta \geq 2$.

6- Advantage of Type-2 neutrosophic set

Problems entailing linguistic variables and uncertainty can be deal with efficiently by type-2 fuzzy sets and type-2 intuitionistic fuzzy sets. But modeling the problems which involve incompatible or inconsistant information is very challenging one by these sets. Also, in a neutrosophic set, the membership functions of the three functions namely truth, indeterminacy and falsity are not uncertain. So it is not able to deal with the information which is of the form of word and sentences in artificial languages called linguistic variables as this variable reduces the overall computational complexity of any real world problem. Since FOU represents the level of uncertainty exist, T2NS has more capability of reducing uncertainty and indeterminacy of the data in real world problems than other sets. Also, in T2FS, truth, indeterminacy and falsity membership functions are independent of each other and they may be can considered as fuzzy sets and therefore assigning different linguistic variables is possible. Hence, the advantage of T2NS.

7-Conclusion

Neutrosophic logic and sets are the one, which deals uncertainty of the real world problems in an optimized way due its unique capability of handling indeterminacy of the problem. Since type-2 neutrosophic logic can deal more uncertainties using primary and secondary membership functions shortest path problem can be solved in with accurate result. In this paper, graphical representation of T2NS has been introduced and the advantage T2NS has been discussed. In future, this work may be extended to different sets.

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