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Properties of Intuitionistic L-Fuzzy Sets of Third Type

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***Abstract*:** In the last decade, there have been some extensions of fuzzy sets and their applications. In this paper, we introduce the Intuitionistic L-Fuzzy Sets of third type and additionally study some of their properties.

***Keywords*:** Fuzzy set[FS], Intuitionistic Fuzzy set[IFS], Intuitionistic L-Fuzzy set[ILFS], Intuitionistic L-Fuzzy sets of second type[ILFSST], Intuitionistic L-Fuzzy sets of third type[ILFSTT].

I. INTRODUCTION

Intuitionistic fuzzy sets are sets whose elements have degrees of membership and non - membership. Intuitionistic fuzzy sets have been introduced by Krassimir Atanassov in 1983 as an extension of Lotfi A Zadeh's notion of fuzzy set. It was extended to Intuitionistic Fuzzy sets of second type, Intuitionistic L-Fuzzy sets, Temporal Intuitionistic Fuzzy sets. In section 2, we give some basic definitions and in section 3, we define the Intuitionistic L-Fuzzy sets of third type [ILFSTT] and some basic Operations. Also we establish some of their properties. We conclude the paper in section 4.

II. PRELIMINARIES

In this section, we give some basic definitions .

Definition 2.1. Let X be a non-empty set. An Intuitionistic Fuzzy Set [IFS] A in X is defined as an object of the form

$$A = \{ \{\langle x, \mu_A(x), \upsilon_A(x)\rangle / x \epsilon E\}$$

where $\mu_A : X \to [0,1]$ and $\upsilon_A : X \to [0,1]$ denote the membership and non membership functions of A respectively, and $0 \leq \mu_A(x) + \upsilon_A(x) \leq 1$ for each $x \epsilon X$. The value $\pi_A(x) = 1 - \mu_A(x) - \upsilon_A(x)$ is the degree of uncertainity of the element $x \epsilon E$to the IFS A [1],[2],[5].

Definition 2.2. An Intuitionistic L-Fuzzy set [ILFS] A in a universal set E is defined as an object of the form

$$A = \{ \{\langle x, \mu_A(x), \upsilon_A(x)\rangle / x \epsilon E\}$$

Where $\mu_A : E \to L$ and $\upsilon_A : E \to L$ denote the degree of membership and the degree of non-membership of the element $x \epsilon E$ respectively, and $\mu_A(x) \leq N(\upsilon_A(x))$,
$N: L \to L$ is an unary involute order reversing operation and E be fixed.

The value $\pi_A(x) = N(\sup(\mu_A(x), \upsilon_A(x)))$ is the degree of uncertainity of the element
$x \epsilon E$ to the ILFS A [3].

uncertainity of the element $x \epsilon E$ to the ILFSTT A.

Definition 2.3. An Intuitionistic L-Fuzzy set of second type [ILFSST] A in a universal set E is defined as an object of the form

$$A = \{ \{\langle x, \mu_A(x), \upsilon_A(x)\rangle / x \epsilon E\}$$

where $\mu_A : E \to L$ and $\upsilon_A : E \to L$ denote the degree of membership and the degree of non-membership of the element $x \epsilon E$ respectively, and $\mu_A(x)^2 \leq N(\upsilon_A(x))^2$, $N: L \to L$
an unary involute order reversing operation and E be fixed.
The value $\pi_A(x) = \sqrt{N(\sup(\mu_A(x)^2, \upsilon_A(x)^2))}$ is the degree of uncertainty of the element $x \epsilon E$ to the ILFSST A [3].

III. Operations on Intuitionistic L- Fuzzy sets of Third type

In this section , we define the new Intuitionistic L- Fuzzy sets of third type [ILFSTT] and establish their properties.

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Definition 3.1. An Intuitionistic L-Fuzzy set of third type [ILFSTT] A in a universal set E is defined as an object of the form

$$A = \{\langle x,\ \mu_A(x), \upsilon_A(x)\rangle / x \epsilon E\}$$

where $\mu_A : E \to L$ and $\upsilon_A : E \to L$ denote the degree of membership and the degree of non-membership of the element $x \epsilon E$ respectively, and $\upsilon_A(x)^3 \leq C\ (\ \mu_A(x)^3)$, $C : L \to L$ is an unary complement operation and E be fixed.

The value $\pi_A(x) = \sqrt[3]{C(\sup(\mu_A(x)^3, \upsilon_A(x)^3)})$is the degree of

Definition 3.2. The support of an Intutitionistic L- Fuzzy Sets of third type is denoted by Supp(A) and defined as $Supp\ A = \{x: C(\ \mu_A(x)^3) > 0, \upsilon_A(x)^3 > 0, x \epsilon E\}$

Example 3.1. Let X = {1,2,3,4} and
A=$\{\langle 1,0,0.6\rangle, \langle 2,0.4,0.1\rangle, \langle 3,0.8,0\rangle, \langle 4,0.7,0.2\rangle\}$
Then $Supp(A) = \{1,2,4\}$.

Example 3.2. Let X= $\{a, b, c, d\}$ and let the ILFSTT A and B be the following form
A=$\{\langle a, 0.5,0.3\rangle, \langle b, 0.1,0.7\rangle, \langle c, 1,0\rangle, \langle d, 0,0\rangle\}$
B=$\{\langle a, 0.7,0.1\rangle, \langle b, 0.3,0.2\rangle, \langle c, 0.5,0.5\rangle, \langle d, 0.2,0.2\rangle\}$
Then
(a) Here A$\not\subset$ B, since $\mu_A(x) > \mu_B(x)$ for x= c and $C(\upsilon_A(x)) > C(\upsilon_B(x))$ for x = c,d.
(b) Also B$\not\subset$A , since $\mu_A(x) < \mu_B(x)$ for x = a,b,d and $C(\upsilon_A(x)) < C(\upsilon_B(x))$for x = a,b.
(c) A≠B , since $\mu_A(x) \neq \mu_B(x)$ and $C(\upsilon_A(x)) \neq C(\upsilon_B(x))$ for $\forall x \in X$.
(d) $A \cup B = \{\langle a, 0.5,0.1\rangle, \langle b, 0.9,0.2\rangle, \langle c, 0.5,0\rangle, \langle d, 1,0\rangle\}$
(e) $A \cap B =$
$\{\langle a, 0.3,0.3\rangle, \langle b, 0.7,0.7\rangle, \langle c, 0,0.5\rangle, \langle d, 0.8,0.2\rangle\}$
(f) $\bar{A} = \{\langle a, 0.3,0.5\rangle, \langle b, 0.7,0.1\rangle, \langle c, 0,1\rangle, \langle d, 0,0\rangle\}$

Definition 3.3. Let
A =$\{\langle x,\ \mu_A(x), \upsilon_A(x)\rangle / x\epsilon E\}$ and
$B = \{\langle x,\ \mu_B(x), \upsilon_B(x)\rangle / x\epsilon E\}$
For every two ILFSTTs , A and B, we define the following operations and relations [4].

(a). $A \subset B$ iff $\mu_A(x) \leq \mu_B(x)$ and $C(\upsilon_A(x)) \leq C(\upsilon_B(x)),\ \forall x \in E$
(b). $A \supset B$ iff $\mu_A(x) \geq \mu_B(x)$ and $C(\upsilon_A(x)) \geq C(\upsilon_B(x)), x \in E$
(c). $A = B$ iff $\mu_A(x) = \mu_B(x)$ and $C(\upsilon_A(x)) = C(\upsilon_B(x)),\ \forall x \in E$
(d).$A \cup B = \{\langle x, \sup(C(\mu_A(x)), C(\mu_B(x)))\ , \inf(\upsilon_A(x), \upsilon_B(x))\rangle / x \epsilon E\}$
(e). $A \cap B = \{\langle x, \inf(C(\mu_A(x)), C(\mu_B(x)))\ , \sup(\upsilon_A(x), \upsilon_B(x))\rangle / x \epsilon E\}$
(f).$\bar{A} = \{\langle x, \upsilon_A(x), \mu_A(x)\rangle / x \epsilon E\}$

IV. CONCLUSION

In this paper, we have defined a new extension of ILFS, namely, ILFSTT and studied the various basic operations like union, intersection, subset and complement. In future we will study some more properties and applications of ILFSTT.

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