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Some New Operations on Intuitionistic Fuzzy Soft Graphs

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Abstract
In this paper, we introduce some new operations on Intuitionistic Fuzzy Soft graphs like (α, β) cut, strong (α, β) cut, disjunctive sum, difference of two Intuitionistic Fuzzy soft graphs with proper examples. It is to be noted here that these definitions are not explored in the literature so far.
Keywords: *Fuzzy Intuitionistic Soft Graphs, disjunctive sum, (α, β) cut .*

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I. INTRODUCTION

Most of the real life problems have various uncertainties. The Theory of Probability, Evidence Theory, Fuzzy Set Theory, Intuitionistic Fuzzy Set Theory, Rough Set Theory etc. are mathematical tools to deal with such problems. The most appropriate theory to deal with uncertainties is the theory of fuzzy sets, developed by Zadeh [1] in 1965. But it has an inherent difficulty to set the membership function in each particular case. In 1986, generalization of Zadeh's fuzzy set called intuitionistic fuzzy set was introduced by Atanassov [2] which was characterized by a membership function and a non – membership function. The fuzzy sets give the degree of membership of an element in a given set, while intuitionistic fuzzy sets give both a degree of membership and a degree of non-membership which are more or less independent from each other. In Atanassov's intuitionistic fuzzy set, the sum of membership degree and non-membership degree does not exceed one [7]. intuitionistic fuzzy sets have been applied in a wide variety of fields including computer science, engineering, mathematics, medicine etc.

Molodtsov [3] gave the concept of soft sets. This new concept has potential applications in several fields including the measurement theory, game theory, operation research, probability theory. Maji et.al [4] introduced concept of fuzzy soft set by combining fuzzy set and soft set by using definition of fuzzy soft set. Many interesting applications of fuzzy soft set theory have been expanded by some researchers. Maji et.al [5] also gave the noble concept of intuitionistic fuzzy soft set and presented some operations on it.

In 1736, Euler first introduced the concept of graph theory. The theory of graph is extremely useful tool for solving combinatorial problems in different areas such as geometry, algebra, number theory, topology, operation research, optimization and computer science, etc. The first definition of fuzzy graphs was proposed by Kauffmann [8] in 1973, from Zadeh's fuzzy relations [1]. But Rosenfeld [9] introduced another elaborated definition including fuzzy vertex and fuzzy edges and several fuzzy analogs of graph theoretic concepts. The first definition of intuitionistic fuzzy graph was introduced by Atanassov [10] in 1999. Karunambigai and Parvathy [11] introduced intuitionistic fuzzy graph as a special case of Atanassov's intuitionistic fuzzy graph. Soft graph was introduced by Thumbakara and George [12]. In 2015, Mohinta and Samanta [13] introduced the concept of fuzzy soft graph. Then Shyla and Varkey [8] introduced the notions of intuitionistic fuzzy soft graphs. Zihni and Celik [6] also gave concepts of intuitionistic fuzzy soft graph.

Shyla and Varkey [7] introduced the notions of intuitionistic fuzzy soft graph strong intuitionistic fuzzy soft graph, complete intuitionistic fuzzy soft graph. They studied about union of two intuitionistic fuzzy soft graphs and proved that the collection of intuitionistic fuzzy soft graph is closed under finite union. Zihni and Celik [6] also gave concepts of intuitionistic fuzzy soft graph, intuitionistic fuzzy soft sub graph and strong intuitionistic fuzzy soft graph. In this paper, we introduce some new operations on Intuitionistic Fuzzy Soft graphs like (α, β) cut, strong (α, β) cut, disjunctive sum, difference of two Intuitionistic Fuzzy soft graphs with proper examples. It is to be noted here that these definitions are not explored in the literature so far. The organization of the paper is as follows. In Section 2, some basic definitions are given followed by Section 3 where some new operations on intuitionistic fuzzy soft graphs are discussed. Proposed work is concluded in Section 4.

II. Basic Definitions

In this section, some basic definitions and preliminaries are presented here to understand the concept of intuitionistic fuzzy soft graphs.

Fuzzy Relation: A fuzzy subset μ on a set X is a map $\mu : X \to [0,1]$. A map $\nu : X \times X \to [0,1]$ is called a fuzzy relation on X if $\nu(a,b) \le \min(\mu(a), \mu(b))$, for all $a \in X$.

Intuitionistic Fuzzy Relation : A mapping $A = (\mu_A, \nu_A) : X \to [0,1] \times [0,1]$ is called an intuitionistic fuzzy set in X if $\mu_A(a) + \nu_A(a) \le 1$ for all $a \in X$, where the mapping $\mu_A : X \to [0,1]$ and $\nu_A : X \to [0,1]$ denote the degree of membership and degree of non-membership, respectively. A mapping $A = (\mu_A, \nu_A)$: $X \to [0,1] \times [0,1]$ is called an intuitionistic fuzzy relation on X if $\mu_A(a, b) + \nu_A(a, b) \le 1$ for all $(a, b) \in X \times X$.

Soft Set: Let U be a non-empty finite set of objects called universe and let E be a non-empty set called parameters. An order pair (F, E) is said to be a soft set over U, where F is a mapping from E into the set of all subsets of the set U. That is $F: E \to P(U)$. The set of all soft sets over U is denoted by $S(U)$.

Soft Graph: Let $G = (V, E)$ be a simple graph, A any non-empty set. Let R an arbitrary relation between elements of A and elements of V. That is $R \subseteq A \times V$. A set valued function $F : A \to P(V)$ can be defined as $F(x) = \{y \in V \mid xRy\}$. The pair (F, A) is a soft set over V. Then (F, A) is said to be a soft graph of G if the sub graph induced by $F(x)$ in G, $\overline{F}(x)$ is a connected sub graph of G for all $x \in A$. The set of all soft graph of G is denoted by $SG(G)$.

Fuzzy Graph: Let V be a *non* empty finite set, $\mu: V \to [0, 1]$ and $\nu : V \times V \to [0, 1]$. If $\nu(x,y) \le \min\{\mu(x), \mu(y)\}$ for all $x, y \in V$, then the pair $G = (\mu, \nu)$ is called a fuzzy graph over the set V. Here μ and ν are called fuzzy vertex and fuzzy edge of the fuzzy graph (μ, ν) respectively.

Intuitionistic Fuzzy Soft Graph: An intuitionistic fuzzy soft graph with underlying set V is an ordered 4-tupple $\tilde{G} = (G, F, K, A)$ such that

- $G = (V, E)$ is a simple graph,
- A is non empty set of parameters,
- (F, A) is an intuitionistic fuzzy soft set over V,
- (K, A) is an intuitionistic fuzzy soft set over E,
- $(F(e), K(e))$ is an intuitionistic fuzzy graph for all $e \in A$. That is $\mu_{K(e)}(xy) \le \min\left(\mu_{F(e)}(x), \mu_{F(e)}(y)\right)$ $\nu_{K(e)}(xy) \le \max(\nu_{F(e)}(x), \nu_{F(e)}(y))$ such that $\mu_{K(e)}(xy) + \nu_{K(e)}(xy) \le 1$ for all $e \in A$ and $x, y \in V$.

III. Some New Operations on Intuitionistic Fuzzy Soft Graphs

In this section some new operations on Intuitionistic Fuzzy Soft Graphs are discussed. These results are as follows:

3.1. *(α, β) Cut of Intuitionistic Fuzzy Soft Graphs*

Let $G = (G^*, F, K, A)$ be an intuitionistic fuzzy soft graph over (V, P) and (E, P). We define the (α, β) cut of intuitionistic fuzzy soft graph $G = (G^*, F, K, A)$ denoted by $H = (G^*, F, K, A)_{(\alpha, \beta)}$ as the intuitionistic fuzzy soft graph $H = (G^*, F_{(\alpha, \beta)}, K_{(\alpha, \beta)}, A)$ such that

$F_{(\alpha, \beta)}(\varepsilon) = \{x : \mu_{F(\varepsilon)}(x) \ge \alpha, \nu_{F(\varepsilon)}(x) \le \beta ; x \epsilon V, (\alpha, \beta) \epsilon [0,1], \alpha+\beta \le 1\}$

$K_{(\alpha, \beta)}(\varepsilon) = \{y : \mu_{K(\varepsilon)}(y) \ge \alpha, \nu_{K(\varepsilon)}(y) \le \beta ; y \epsilon E, (\alpha, \beta) \epsilon [0,1], \alpha+\beta \le 1\}$

where $\varepsilon \epsilon A$, $A \subseteq P$.

*For an example l*et $G^* = (V, E)$ such that $V = \{a, b, c, d\}$ and $E = \{ab, bc, cd, ac, ad, bd\}$. Let $A = \{e_1, e_2\}$ be a parameter set and (F, A) be an intuitionistic fuzzy soft set over V defined by

$F(e_1) = \{(a, 0.7, 0.2), (b, 0.4, 0.3), (c, 0.5, 0.1), (d, 0.3, 0.5)\}$

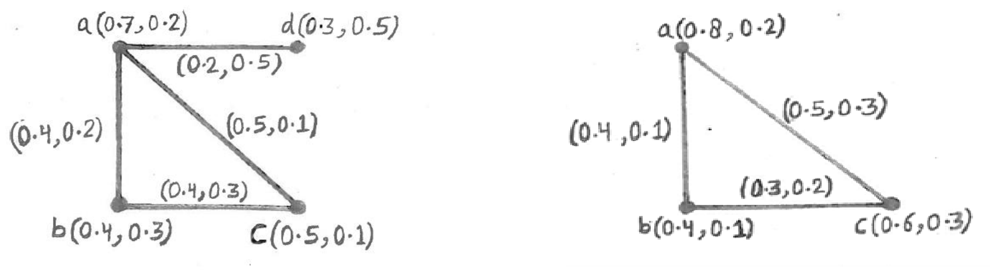
$F(e_2) = \{(a, 0.8, 0.2), (b, 0.4, 0.1), (c, 0.6, 0.3)\}$

Now let (K, A) be an intuitionistic fuzzy soft set over E defined by

$K(e_1) = \{(ab, 0.4, 0.2), (bc, 0.4, 0.3), (ac, 0.5, 0.1), (ad, 0.2, 0.5)\}$

$K(e_2) = \{(ab, 0.4, 0.1), (bc, 0.3, 0.2), (ac, 0.5, 0.3)\}$.

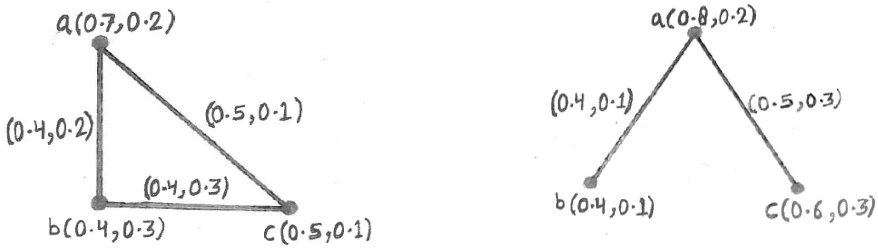
The intuitionistic fuzzy soft graph $G = (G^*, F, K, A)$ is shown below (Fig. 1(a) and Fig. 1(b))



(a) **(b)**

Fig. 1: (a) $G(e_1)$ corresponding to the parameter e_1 (b) $G(e_2)$ corresponding to the parameter e_2 .

Let α=0.4, β=0.3, α, β ϵ [0, 1]. Then, we get
$F_{(0.4, 0.3)}(e_1)$ = {(a, 0.7, 0.2), (b, 0.4, 0.3), (c, 0.5, 0.1)}
$F_{(0.4, 0.3)}(e_2)$ = {(a, 0.8, 0.2), (b, 0.4, 0.1), (c, 0.6, 0.3)} and
$K_{(0.4, 0.3)}(e_1)$ = {(ab, 0.4, 0.2), (bc, 0.4, 0.3), (ac, 0.5, 0.1)}
$K_{(0.4, 0.3)}(e_2)$ = {(ab, 0.4, 0.1), (ac, 0.5, 0.3)}
The intuitionistic fuzzy soft graph $G = (G^*, F, K, A)$ is shown below (Fig. 2(a) and Fig. 2(b)).



(a) **(b)**

Fig. 2: (a) $H(e_1)$ corresponding to the parameter e_1 (b) $H(e_2)$ corresponding to the parameter e_2 .

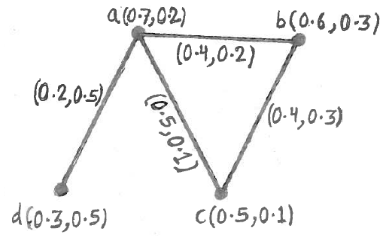
3.2. Strong (α, β) Cut of Intuitionist Fuzzy Soft Graphs

Let $G = (G^*, F, K, A)$ be an intuitionistic fuzzy soft graph over (V, P) and (E, P). We define the strong (α, β) cut of intuitionistic fuzzy soft graph $G = (G^*, F, K, A)$ denoted by $H = (G^*, F, K, A)_{(\alpha, \beta)+}$ as the intuitionistic fuzzy soft graph $H = (G^*, F_{(\alpha, \beta)+}, K_{(\alpha, \beta)+}, A)$ such that

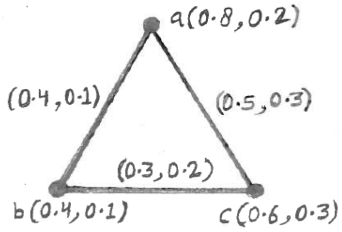
$F_{(\alpha, \beta)+}(\varepsilon) = \{x : \mu_{F(\varepsilon)}(x) > \alpha, \nu_{F(\varepsilon)}(x) < \beta ; x \in V, (\alpha, \beta) \in [0, 1], \alpha+\beta \leq 1\}$
$K_{(\alpha, \beta)+}(\varepsilon) = \{y : \mu_{K(\varepsilon)}(y) > \alpha, \nu_{K(\varepsilon)}(y) < \beta ; y \in E, (\alpha\ \beta) \in [0, 1], \alpha+\beta \leq 1\}$
where $\varepsilon \in A, A \subseteq P$.

For an example let $G^* = (V, E)$ such that V = {a, b, c, d} and E = {ab, bc, cd, ac, ad, bd}. Let $A = \{e_1, e_2\}$ be a parameter set and let (F, A) be an intuitionistic fuzzy soft set over V defined by
$F(e_1)$ = {(a, 0.7, 0.2), (b, 0.6, 0.3), (c, 0.5, 0.1), (d, 0.3, 0.5)}
$F(e_2)$ = {(a, 0.8, 0.2), (b, 0.4, 0.1), (c, 0.6, 0.3)}
Now let (K, A) be an intuitionistic fuzzy soft set over E defined by
$K(e_1)$ = {(ab, 0.4, 0.2), (bc, 0.4, 0.3), (ac, 0.5, 0.1), (ad, 0.2, 0.5)}
$K(e_2)$ = {(ab, 0.4, 0.1), (bc, 0.3, 0.2), (ac, 0.5, 0.3)}

The intuitionistic fuzzy soft graph $G = (G^*, F, K, A)$ is shown below (Fig. 3(a) and Fig. 3(b)).



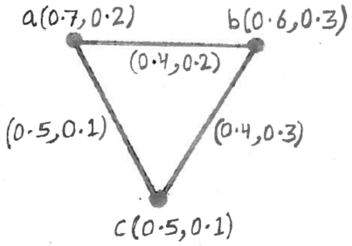
(a)



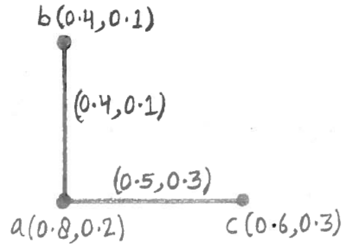
(b)

Fig. 3: (a) $G(e_1)$ corresponding to the parameter e_1 (b) $G(e_2)$ corresponding to the parameter e_2 .

Let $\alpha = 0.3$, $\beta = 0.4$, $\alpha, \beta \epsilon [0, 1]$. Then we get
$(F, A)_{(0.3, 0.4)+} = (F_{(0.3,0.4)+}, A)$
$F_{(0.4, 0.3)+}(e_1) = \{(a,0.7,0.2), (b,0.6,0.3), (c,0.5,0.1)\}$
$F_{(0.4, 0.3)+}(e_2) = \{(a,0.8,0.2), (b,0.4,0.1), (c,0.6,0.3)\}$
$K_{(0.4, 0.3)+}(e_1) = \{(ab,0.4,0.2), (bc,0.4,0.3), (ac,0.5,0.1)\}$
$K_{(0.4, 0.3)+}(e_2) = \{(ab,0.4,0.1), (ac,0.5,0.3)\}$
The intuitionistic fuzzy soft graph $G = (G^*, F_{(\alpha, \beta)+}, K_{(\alpha, \beta)+}, A)$ is shown below (Fig. 4(a) and Fig. 4(b))



(a)



(b)

Fig. 4: (a) $H(e_1)$ corresponding to the parameter e_1 (b) $H(e_2)$ corresponding to the parameter e_2 .

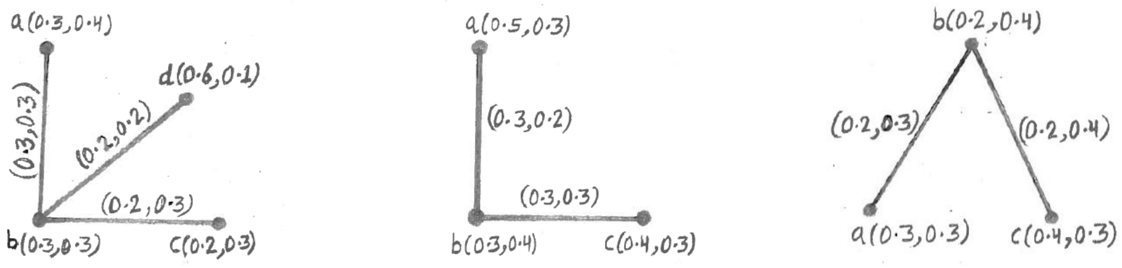
3.3. Disjunctive Sum of Intuitionistic Fuzzy Soft Graphs

Let $G_1 = (G^*, F_1, K_1\ A)$ and $G_2 = (G^*, F_2, K_2, B)$ be two intuitionistic fuzzy soft graphs over (V, P) and (E, P).We define the disjunctive sum of $G_1 = (G^*, F_1, K_1\ A)$ and $G_2 = (G^*, F_2, K_2, B)$ as the intuitionistic fuzzy soft graph $H = (G^*, F, K, C)$ over (V, P) and (E, P) written as $(G^*, F_1, K_1\ A) \oplus (G^*, F_2, K_2, B) = (G^*, F, K, C)$ such that

$\mu_{F(\varepsilon)}(x) = \max(\min(\mu_{F1(\varepsilon)}(x), \nu_{F2(\varepsilon)}(x)), \min(\nu_{F1(\varepsilon)}(x), \mu_{F2(\varepsilon)}(x)))$
$\nu_{F(\varepsilon)}(x) = \min(\max(\nu_{F1(\varepsilon)}(x), \mu_{F2(\varepsilon)}(x), \max(\mu_{F1(\varepsilon)}(x), \nu_{F2(\varepsilon)}(x)))$
$\mu_{K(\varepsilon)}(y) = \max(\min(\mu_{K1(\varepsilon)}(y), \nu_{K2(\varepsilon)}(y), \min(\nu_{K1(\varepsilon)}(y), \mu_{K2(\varepsilon)}(y)))$
$\nu_{K(\varepsilon)}(y) = \min(\max(\nu_{K1(\varepsilon)}(y), \mu_{K2(\varepsilon)}(y), \max(\mu_{K1(\varepsilon)}(y), \nu_{K2(\varepsilon)}(y)))$
where $C = A \cap B \neq \phi$ and $\forall\ \varepsilon \in C, x \in V, y \in E$ and $A, B \subseteq P$. *For an example*

Let $G^* = (V, E)$ such that $V = \{a, b, c, d\}$, $E = \{ab, bc, cd, ac, ad, bd\}$ and $P = \{e_1, e_2, e_3, e_4, e_5\}$.
Let $A = \{e_1, e_2, e_3\}$ be a parameter set and let (F_1, A) be an intuitionistic fuzzy soft set over V defined by
$F_1(e_1) = \{(a, 0.3, 0.4), (b, 0.3, 0.3), (c, 0.2, 0.3), (d, 0.6, 0.1)\}$
$F_1(e_2) = \{(a, 0.5, 0.3), (b, 0.3, 0.4), (c, 0.4, 0.3)\}$
$F_1(e_3) = \{(a, 0.3, 0.3), (b, 0.2, 0.4), (c, 0.4, 0.3)\}$
Now let (K_1, A) be an intuitionistic fuzzy soft set over E defined by
$K_1(e_1) = \{(ab, 0.3, 0.3), (bc, 0.2, 0.3), (bd, 0.2, 0.2)\}$
$K_1(e_2) = \{(ab, 0.3, 0.2), (bc, 0.3, 0.3)\}$
$K_1(e_3) = \{(ab, 0.2, 0.3), (bc, 0.2, 0.4)\}$

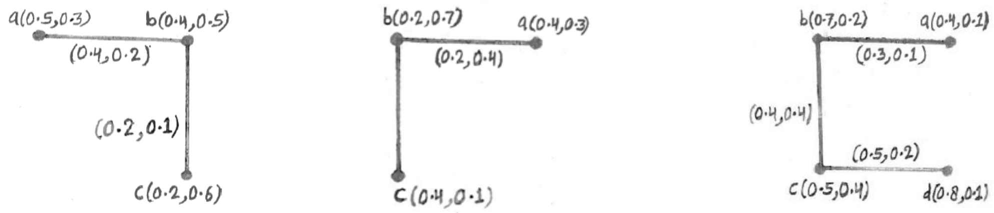
The intuitionistic fuzzy soft graph $G_1 = (G^*, F_1, K_1\ A)$ is shown below (Fig. 5)



(a) (b) (c)

Fig. 5: (a)G_1(e$_1$) corresponding to parameter e$_1$ (b) G_1(e$_2$) corresponding to parameter e$_1$ (c) G_1(e$_3$) corresponding to parameter e$_3$

Further, let $B = \{e_2, e_3, e_4\}$ be a parameter set and let (F_2, B) be an intuitionistic fuzzy soft set over V defined by
$F_2(e_2)$ = {(a, 0.5, 0.3), (b, 0.4, 0.5), (c, 0.2, 0.6)}
$F_2(e_3)$ = {(a, 0.4, 0.3), (b, 0.2, 0.7), (c, 0.4, 0.1)}
$F_2(e_4)$ = {(a, 0.4, 0.1), (b, 0.7, 0.2), (c, 0.5, 0.4), (d, 0.8, 0.1)}
Now let (K_2, A) be an intuitionistic fuzzy soft set over E defined by
$K_2(e_2)$ = {(ab, 0.4, 0.2), (bc, 0.2, 0.1)}
$K_2(e_3)$ = {(ab, 0.2, 0.4), (bc, 0.1, 0.2)}
$K_2(e_4)$ = {(ab, 0.3, 0.1), (bc, 0.4, 0.4), (cd, 0.5,0.2)}
The intuitionistic fuzzy soft graph $G_2 = (G^*, F_2, K_2, B)$ is show below (Fig. 6)



(a) (b) (c)

Fig. 6: (a)G_2(e$_2$) corresponding to parameter e$_2$ (b) G_2(e$_3$) corresponding to parameter e$_3$ (c) G_2(e$_4$) corresponding to parameter e$_4$

$F(e_2)$ = {(a, max (min(0.5, 0.3), min(0.3, 0.5)), min(max (0.3, 0.5), max(0.5, 0.3))),
(b, max(min(0.3, 0.5), min(0.4, 0.4)), min(max(0.4, 0.4), max(0.3, 0.5))),
(c, max(min(0.4, 0.6), min(0.3, 0.2)), min(max(0.3, 0.2),max(0.4, 0.6)))}
$F(e_2)$ = {(a, max(0.3, 0.3), min(0.5, 0.5)), (b, max(0.3, 0.4), min(0.4, 0.5)), (c, max(0.4, 0.2), min(0.3, 0.6)))}
$F(e_2)$ = {(a, 0.3, 0.5), (b, 0.4, 0.4), (c, 0.4, 0.3)}
$F(e_3)$ = {(a, max(min(0.3, 0.3), min(0.3, 0.4)), min(max(0.3, 0.4), max(0.3, 0.3))),
(b, max(min(0.2, 0.7), min(0.4, 0.2)), min(max(0.4, 0.2), max(0.2, 0.7))),
(c, max(min(0.4, 0.1), min(0.3, 0.4)), min(max(0.3, 0.4), max(0.4, 0.1)))}

$F(e_3)$ = {(a, max(0.3, 0.3), min(0.4, 0.3)), (b, max(0.2, 0.2), min(0.4, 0.7)),
(c, max(0.1, 0.3),min(0.4, 0.4)))}
$F(e_3)$ = {(a, 0.3, 0.3), (b, 0.2, 0.4), (c, 0.3, 0.4)}
and
$K(e_2)$ = {(ab, max (min(0.3, 0.2), min(0.2, 0.4)), min(max(0.2, 0.4), max(0.3, 0.2))), (bc, max (min(0.3, 0.1), min(0.3, 0.2)), min(max(0.3, 0.2), max(0.3, 0.1)))}
$K(e_2)$ = {(ab, max(0.2, 0.2), min(0.4, 0.3)), (bc, max(0.1, 0.2), min(0.3, 0.3)))}
$K(e_2)$ = {(ab, 0.2, 0.3), (bc, 0.2, 0.3)}
$K(e_3)$ = {(ab, max(min(0.2, 0.4), min(0.3, 0.2)), min(max(0.3, 0.2), max(0.2, 0.4))), (bc, max (min(0.2, 0.2), min(0.4, 0.1)), min (max(0.4, 0.1), max(0.2, 0.2)))}
$K(e_3)$ = {(ab, max(0.2, 0.2), min(0.3, 0.4)), (bc, max(0.2, 0.1), min(0.4, 0.2))}

$K(e_3)$ = {(ab, 0.2, 0.3), (bc, 0.2, 0.2)}
The intuitionistic fuzzy soft graph $H = (G^*, F, K, C)$ is shown below (Fig. 7)

(a) **(b)**

Fig.7: (a) $H(e_2)$ corresponding to the parameter e_2 (b) $H(e_3)$ corresponding to the parameter e_3

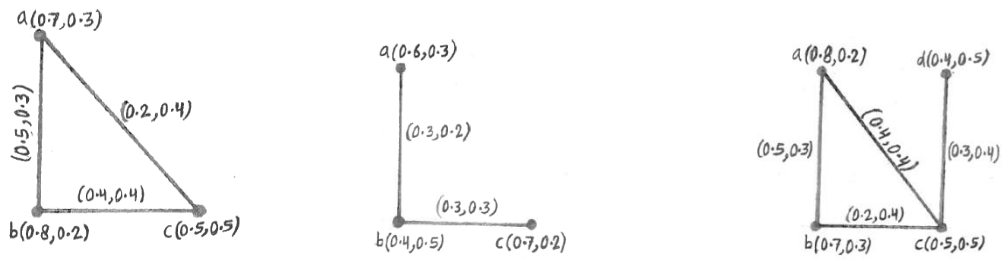
3.4. Difference of Intuitionistic Fuzzy Soft Graphs

Let $G_1 = (G^*, F_1, K_1\ A)$ and $G_2 = (G^*, F_2, K_2, B)$ be two intuitionistic fuzzy soft graphs over (V, P) and (E, P).We define the disjunctive sum of $G_1 = (G^*, F_1, K_1\ A)$ and $G_2 = (G^*, F_2, K_2, B)$ as the intuitionistic fuzzy soft graph $H = (G^*, F, K, C)$ over (V, P) and (E, P) written as $(G^*, F_1, K_1\ A) \ominus (G^*, F_2, K_2, B) = (G^*, F, K, C)$ such that

$\mu_{F(\varepsilon)}(x) = \min(\mu_{F1(\varepsilon)}(x), \nu_{F2(\varepsilon)}(x))$
$\nu_{F(\varepsilon)}(x) = \max(\nu_{F1(\varepsilon)}(x), \mu_{F2(\varepsilon)}(x))$
$\mu_{K(\varepsilon)}(y) = \min(\mu_{K1(\varepsilon)}(y), \nu_{K2(\varepsilon)}(y))$
$\nu_{K(\varepsilon)}(y) = \max(\nu_{K1(\varepsilon)}(y), \mu_{K2(\varepsilon)}(y))$

where $C = A \cap B \neq \phi$ and $\forall\ \varepsilon \in C, x \in V, y \in E$ and $A, B \subseteq P$. For an example

Let $G^* = (V, E)$ such that $V = \{a, b, c, d\}$, $E = \{ab, bc, cd, ac, ad, bd\}$ and $P = \{e_1, e_2, e_3, e_4, e_5\}$.
Let $A = \{e_1, e_2, e_3\}$ be a parameter set and let (F_1, A) be an intuitionistic fuzzy soft set over V defined by
$F_1(e_1)$ = {(a, 0.7, 0.3), (b, 0.8, 0.2), (c, 0.5, 0.5)}
$F_1(e_2)$ = {(a, 0.6, 0.3), (b, 0.4, 0.5), (c, 0.7, 0.2)}
$F_1(e_3)$ = {(a, 0.8, 0.2), (b, 0.7, 0.3), (c, 0.5, 0.5), (d, 0.4, 0.5)}
Now let (K_1, A) be an intuitionistic fuzzy soft set over E defined by
$K_1(e_1)$ = {(ab, 0.5, 0.3), (bc, 0.4, 0.4), (ac, 0.2, 0.4)}
$K_1(e_2)$ = {(ab, 0.3, 0.2), (bc, 0.3, 0.3)}
$K_1(e_3)$ = {(ab, 0.5, 0.3), (bc, 0.2, 0.4), (ac, 0.4, 0.4), (cd, 0.3, 0.4)}
The intuitionistic fuzzy soft graph $G_1 = (G^*, F_1, K_1\ A)$ is shown below (Fig.8)



(a) **(b)** **(c)**

Fig. 8: (a)$G_1(e_1)$ corresponding to parameter e_1 (b) $G_1(e_2)$ corresponding to parameter e_2 (c) $G_1(e_3)$ corresponding to parameter e_3 .

Again, let $B = \{e_1, e_3, e_4\}$ be a parameter set and let (F_2, B) be an intuitionistic fuzzy soft set over V defined as
$F_2(e_1)$ = {(a, 0.6, 0.3), (b, 0.4, 0.5), (c, 0.7, 0.2)}
$F_2(e_3)$ = {(a, 0.3, 0.5), (b, 0.2, 0.6), (c, 0.4, 0.5), (d, 0.6, 0.3)}
$F_2(e_4)$ = {(a, 0.4, 0.1), (b, 0.7, 0.2), (c, 0.5, 0.4)}
Now let (K_2, A) be an intuitionistic fuzzy soft set over E defined by
$K_2(e_1)$ = {(ab, 0.3, 0.2), (bc, 0.4, 0.2)}
$K_2(e_3)$ = {(ab, 0.2, 0.5), (ac, 0.3, 0.5), (cd, 0.4, 0.5)}
$K_2(e_4)$ = {(ab, 0.3, 0.1), (bc, 0.4, 0.4)}
The intuitionistic fuzzy soft graph $G_2 = (G^*, F_2, K_2, B)$ is shown below (Fig. 9).

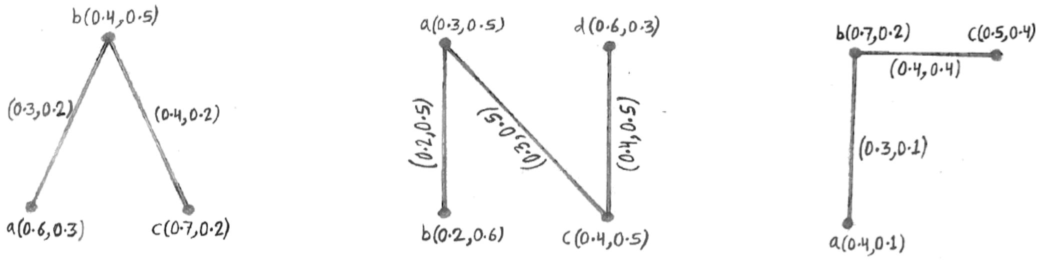


Fig. 9: (a)$G_2(e_1)$ corresponding to parameter e_1 (b) $G_2(e_2)$ corresponding to parameter e_2 (c) $G_2(e_3)$ corresponding to parameter e_3 .

Then we get
$F(e_1)$ = {(a, min(0.7, 0.3), max(0.3, 0.6)), (b, min(0.8, 0.5), max(0.2, 0.4)),
(c, min(0.5, 0.2), max(0.5, 0.7))}
$F(e_1)$ = {(a, 0.3, 0.6), (b, 0.5, 0.4), (c, 0.2, 0.7)}
$K(e_1)$ = {(ab, min(0.5, 0.2), max(0.3, 0.3)), (bc, min(0.4, 0.2), max(0.4, 0.4)),
(ac, min(0.2, 0.0), max(0.4, 0.0))}
$K(e_1)$ = {(ab, 0.2, 0.3), (bc, 0.2, 0.4), (ac, 0.0, 0.4)}
$F(e_3)$ = {(a, min(0.8, 0.5), max(0.2, 0.3)), (b, min(0.7, 0.6), max(0.3, 0.2)), (c, min(0.5, 0.5), max(0.5, 0.4)), (d, min(0.4, 0.3), max(0.5, 0.6))}
$F(e_3)$ = {(a, 0.5, 0.3), (b, 0.6, 0.3), (c, 0.5, 0.5), (d, 0.3, 0.6)}
$K(e_3)$ = {(ab, min(0.5, 0.5), max(0.3, 0.2)), (bc, min(0.2, 0.0), max(0.4, 0.0)), (ac, min (0.4, 0.5), max (0.4, 0.3)), (cd, min (0.3, 0.5), max (0.4, 0.4))}
$K(e_3)$ = {(ab, 0.5, 0.3), (bc, 0.0, 0.4), (ac, 0.4, 0.4), (cd, 0.3, 0.4)}
The intuitionistic fuzzy soft graph $H = (G^*, F, K, C)$ is shown below (Fig. 10)

(a) **(b)**

Fig.10: (a) $H(e_1)$ corresponding to the parameter e_1 (b) $H(e_3)$ corresponding to the parameter e_3

IV. CONCLUSION

In our work, we have put some new operations such as (α, β) cut of intuitionistic fuzzy soft graphs and strong (α, β) cut of intuitionistic fuzzy soft graphs. We also proposed some new terms like the disjunctive sum and difference of two intuitionistic fuzzy soft graphs with relevant example for each. It is worth to note that this work is not found in the literature till date.

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