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A STUDY ON INTUTIONISTIC FUZZY SOFT GRAPH

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Abstract:

In this paper, a novel framework for handling intuitionistic fuzzy soft information with combining the theory of intuitionistic fuzzy soft sets as graphs. We introduce all the notions of a certain types of intuitionistic fuzzy soft graphs including neighbourly edge regular intuitionistic fuzzy soft graphs and strongly edge irregular intuitionistic fuzzy soft graphs. We illustrate these are novel concepts to be several examples, and investigate some of their things related properties. We present an advice application of intuitionistic fuzzy soft graph in the decision-making problem also present our methods as an algorithm that is used in this application.

Key Words: Intuitionistic Fuzzy, Graph, Edge & Vertex.

Introduction:

This dissertation is an attempt to a study on intuitionistic fuzzy soft graph, strong intuitionistic fuzzy soft graph, complete intutionistic fuzzy soft graph in this paper. Also studied about union of two Intuitionistic fuzzy soft graph and proved that the collection of intuitionistic fuzzy soft graph is closed under finite union. Molodtsov[13] introduced the concept of soft set that can be seen as a new mathematical theory for dealing with uncertainties. Molodtsov applied this theory to several directions and then formulated the notions of Soft number, Soft derivative, Soft integral, etc. in. The soft set theory has been applied to many different fields with greatness. Maji[11] worked on theoretical study of soft sets in detail. Aktas and Cagman[2] introduced definition of soft graphs, and derived their basic properties. The most appreciate theory to deal with uncertainties is the theory of fuzzy sets, developed by Zadeh in 1965. But it has an inherent difficulty to set the membership function in each particular cases. In Zadeh's fuzzy set, the sum of membership degree and non-membership degree is equal to one. In Atanassov's intuitionistic fuzzy set the sum of membership degree and non- membership degree does not exeed one. Maji et al.[9] presented the concept of fuzzy soft sets by embedding ideas of fuzzy set in. There after many papers devoted to fuzzify the concept of soft set theory which leads to a series of mathematical models such as fuzzy soft set, generalized fuzzy soft set, possibility fuzzy soft set and so on. There after Maji and his co-author introduced the notion of intuitionistic fuzzy soft set which is based on a combination of intuitionistic fuzzy sets and soft set models. The first definition of fuzzy graphs was proposed by Kaffmann in 1973, from Zadeh's fuzzy relations.

Intuitionistic Fuzzy Soft Graph:

Definition: A fuzzy set ofa base set V = {v_1, v_2,…….,V_n} (non-empty set) is specified by its membership function σ ; where σ :→ [0, l] assigning to each $V_i \in$ V , the degree or grade to which V $\in \sigma$.

Definition: A fuzzy graph G = (σ,μ) is a pair of function : V → [0, l] and$\mu: V \times V \to [0,1]$ where for all v_i, $v_j \in V$ we have $\mu(v_i\ ,v_j) \leq \sigma(vi) \wedge \sigma(v_j)$ for each (V_i,v_j) ∈ V× V Here σ and μ are respectively called fuzzy vertex and fuzzy edge of the fuzzy graph G = (σ,μ).

Definition: Let $G_1 = (\sigma_1,\mu_1)$ and $G_2 = (\sigma_2,\mu_2)$ be two fuzzy graphs over the set V Then the Union of G_1 and G_2 is another fuzzy graph G_3 = (σ_3,μ_3) over the set V , where $\sigma_3 = \sigma_1 \vee \sigma_2 = \max\{\sigma_1(v_i), \sigma_2(v_i)\}$ for every and for every v_i,v_j ∈ V and i= 1,2...n

Definition: Let V be a non-empty set. An intuitionist fuzzy set A in V defined as A {(V, μ_A(v), γ A (v)) | v ∈V} which is characterized by a membership function μ_A: V → [0,1] and the non-membershipfunction γ_A: V → [0, l] and satisfying l. 0 ≤ μ_A(v) + γ_A(v) ≤ 1 for every v ∈ V .

0≤ μ_A (v), γ_A(v), π_A(v) ≤ 1forevery v ∈ V .

π_A(v) =1-μ_A(v) -γ_A(v)

where $\pi_A$is called the intuitionistic fuzzy index of the element v in A the value denotes the measure of non-determinacy. Obviously if π_A (v) = 0 foreveryv in V , then the intuitionistic fuzzy set A is just Zadeh's fuzzy set.

Definition: An intuitionist fuzzy graph is defined as G = (V, E, μ,γ) where 1. V ={$v_1, v_2, \ldots\ldots v_n$ } (non-empty set) such that μ_1: V → [0, 1] and γ_1 : V → [0, l] denote the degree of membership and non-membership of the element v_i∈ V respectively and 0≤ $\mu_1(v_i)$+ γ1 (V_i) ≤ 1 forevery vi ∈ V, i = 1,2…. n

E⊂:V×V where μ_2 :V×V→ [0,1] and γ_2: $V \times V$ are such that

(i) μ_2 (V_i,V_j)≤ min{$\mu_1(v_i)$, $\mu_1(v_i)$,}

(ii) $\gamma_2(v_i, v_j) \leq \max\{\gamma_1(v_i), \gamma_i(v_j)\}$ and

(iii) $0 \leq \mu_2(v_i, v_j) + \gamma_2(v_i, v_j) \leq 1, 0 \leq \mu_2(v_i, v_j), \pi(v_i, v_j) \leq 1$

where $\pi(v_i, v_j) = 1 - \mu_2(v_i, v_j) - \gamma_2(v_i, v_j)$ for every $(v_i, v_j) \in E, i, j = 1,2, \dots \dots, n$

Let U be an initial universal set, P be a set of parameters, P(U) be the power set of U and A⊆P.

Definition: A pair (F, A) is called a soft set over U if and only if F is a mapping of A into the set of all subsets of the set U.

Definition: A pair ($\bar{F}$, A) is called fuzzy soft set over U, where $\bar{F}$ is a mapping given by $\bar{F}$: A→ I^{U}; I^{U} denotes the collection of all fuzzy subsets of U; A ⊆ P.

Definition: A pair ($\breve{F}$, A) is called an intuitionistic fuzzy soft set over U, where $\breve{F}$ is a mapping given by $\breve{F}$: A→ $\mathrm{I}F^{\mathrm{U}}$; IF^{U} denotes the collection of all intuitionist fuzzy subsets of U; A ⊆ P.

Graphs in an Intuitionstic Fuzzy Soft Environment:

Definition: An intuitionistic fuzzy soft graph as on a non-empty set V is an ordered 3-tuple G = (Φ, Ψ, M) so such that

- M is a non-empty set of parameters,
- (Φ, M) is an intuitionistic fuzzy soft set over the places of V,
- (Ψ, M) is an intuitionistic fuzzy soft core set relation on that V, i.e., Ψ : M → P(V × V) where P(V × V) is intuitionistic fuzzy power set,
- (Φ (e), Ψ (e)) is always an intuitionistic unique fuzzy graph, for all e ∈ M.

That is, $\Psi_\mu(e)(uv) \le \min(\Phi_\mu(e)(u), \Phi_\mu(e)(v))$,

$\Psi_\nu(e)(uv) \le \max(\Phi_\nu(e)(u), \Phi_\nu(e)(v))$

Such that $\Psi_\mu(e)(uv) + \Psi_\nu(e)(uv) \le 1$, ∀ e ∈ M, u, v ∈ V.

Note that $\Psi_\mu(e)(uv) = \Psi_\nu(e)(uv) = 0$, ∀ uv ∈ V × V − E, e ∈ M.

(Φ, M) are called an intuitionistic fuzzy soft vertex and (Ψ, M) are called as an intuitionistic fuzzy soft edging. Thus, ((Φ, M), (Ψ, M)) are called as an intuitionistic fuzzy soft graph if

$\Psi_\mu(e)(uv) \le \min(\Phi_\mu(e)(u), \Phi_\mu(e)(v))$, $\Psi_\nu(e)(uv) \le \max(\Phi_\nu(e)(u), \Phi_\nu(e)(v))$

Such that $\Psi_\mu(e)(uv) + \Psi_\nu(e)(uv) \le 1$, ∀ e ∈ M, u, v ∈ V.

Definition: Let G = (Φ, Ψ, M) should be an intuitionistic fuzzy soft graph as of G^*. G is said to be a neighborly edge irregular intuitionistic fuzzy soft graph and set to be if H(e) is a neighborly edge an irregular intuitionistic fuzzy graph for all e ∈ A. Equivalently, always an intuitionistic fuzzy soft graph G are always called as a neighborly edge an irregular intuitionistic fuzzy soft graph if every two adjacent edges have distinct degrees in H(e) for all e ∈ M.

Definition: Let G = (Φ, Ψ, M) should be an intuitionistic fuzzy soft graph of G^*. G are said to be a neighbourly edging totally irregular intuitionistic fuzzy soft graph if H(e) is a neighbourly edge totally irregular intuitionistic fuzzy graph for all e ∈ A.

Example: Consider a crisp graph G = (V, E) such that V = {u_1, u_2, u_3, u_4} and E = {u_1u_2, u_2u_3, u_3u_1, u_1u_4, u_2u_4, u_3u_4}. Let P = {e_1, e_2, e_3, e_4} be a set of all parameters and M = {e_1, e_2, e_3} ⊂ P. Let (Φ, M) be an intuitionistic fuzzy soft set over the V with intuitionistic fuzzy approximation function setters

Φ : M → P (V) defined by

$\Phi(e_1)=\{(u_1,0.5,0.2),(u_2,0.6,0.4),(u_3,0.3,0.1),(u_4,0.5,0.2)\}$,

$\Phi(e_2)=\{(u_1,0.6,0.4),(u_2,0.7,0.2),(u_3,0.7,0.1),(u_4,0.5,0.4)\}$,

$\Phi(e_3)=\{(u_1,0.4,0.6),(u_2,0.3,0.1),(u_3,0.3,0.6),(u_4,0.4,0.1)\}$.

Let (Ψ, M) should be an intuitionistic fuzzy soft set over E with intuitionistic fuzzy approximation to the function Ψ : M → P (E)defined by

Edge Analysis in Intuitionistic Fuzzy Soft Graph and its Application in Decision Making Process:

Definition: A Fuzzy Set of a base set V = {v_1, v_2,..., v_n} (non-empty set) is specified by its membership function σ; where σ : V → [0,1] assigning to each v_i ∈ V , the degree or grade to which V ∈ σ

Definition: A Fuzzy graph G = (σ,μ) is a pair of function σ : V → [0,1] and μ : V ×V → [0,1], where for all v_i, v_j ∈ V we have μ(vi , v j) ≤ $\sigma(v_i)\wedge\sigma(v_j)$ for each (v_i, v_j) ∈ V ×V . Here σ and μ is respectively called as fuzzy vertex and fuzzy edge of the fuzzy graph G = (σ,μ).

Definition: Let $G_1 = (\sigma_1,\mu_1)$ and $G_2 = (\sigma_2,\mu_2)$ should be two fuzzy graphs over the set V. Then the Union of G_1 and G_2 is another fuzzy graph $G_3 = (\sigma_3,\mu_3)$ over the set V , where $\sigma_3 = \sigma_1 \vee \sigma_2 = \max\{\sigma_1(v_i),\sigma_2(v_i)\}$ for every vi ∈ V and i = 1,2...n and $\mu_3(v_i , v_j) = \max\{\mu_1(v_i,v_j), \mu_2(v_i , v_j)\}$ for every v_i , v_j ∈ V and i, j = 1,2...n

Definition: Let V be a non-empty set. An Intuitionistic Fuzzy Set A in V defined as

A = {(V,μA(v), γA(v))|v ∈ V} which is characterised by a membership function

μA : V → [0,1] and the non-membership function γA : V → [0,1] and satisfying

- 0 ≤ μA(v) +γA(v) ≤ 1 for every v ∈ V .
- 0 ≤ μA(v), γA(v),πA(v) ≤ 1 for every v ∈ V .
- πA(v) = 1− μA(v)−γA(v).

Where πA is called the intuitionistic fuzzy index of the element v in A; the value denotes the measure of non-determinancy. Obviously if $\pi_A(v) = 0$ for every v in V , then the intuitionistic fuzzy set A is just Zadeh's fuzzy set.

Definition:

- As an intuitionistic the Fuzzy Graph are defined as $G = (V,E,\mu, \gamma)$ where
- $V = \{v_1, v_2,..., v_n\}$ (non-empty set) such that $\mu_1 : V \to [0,1]$ and $\gamma_1 : V \to [0,1]$ denote the degree of membership and non-membership of the element $v_i \in V$ respectively and $0 \leq \mu_1(v_i) + \gamma_1(v_i) \leq 1$ for every $vi \in V$, $i = 1,2...n$
- $E \subseteq V \times V$ there are $\mu_2 : V \times V \to [0,1]$ and $\gamma_2 : V \times V \to [0,1]$ is such that
    - $\mu_2(v_i , v_j) \leq \min\{\mu_1(v_i),\mu_1(v_j)\}$
    - $\gamma_2(v_i , v_j) \leq \max\{\gamma_1(v_i), \gamma_1(v_j)\}$ and
    - $0 \leq \mu_2(v_i , v_j) + \gamma_2(v_i , v_j) \leq 1$,
    - $0 \leq \mu_2(v_i , v_j), \gamma_2(v_i , v_j), \pi(v_i , v_j) \leq 1$,
    - where $\pi(v_i , v_j) = 1-\mu_2(v_i , v_j)-\gamma_2(v_i , v_j)$ for every $(v_i , v_j) \in E$, $i, j = 1,2,...,n$
    - Let U be an initial universal set, P be a set of parameters, P(U) be the power set of U and $A \subseteq P$.

Edge Regular Intuitionistic Fuzzy Graph:

Definition: An intuitionistic fuzzy graph (IFG) of the form $G = V, E$ is said to be a *minmax IFG* if:
(i) $V = \{v_1, v_2, ..., vn\}$ such that $\mu_1 : V \to [0, 1]$ and $\nu_1 : V \to [0, 1]$
denote the degrees of membership and non-membership of the element $vi \in V$, respectively, and $0 \leq \mu_1(v_i) + \nu_1(v_i) \leq 1$ for every $vi \in V$ $(i = 1, 2, ..., n)$,
$\mu_2(v_i , v_j) \leq \min[\mu_1(v_i), \mu_1(v_j)]$, $\nu_2(v_i, v_j) \leq \max[\nu_1(v_i), \nu_1(v_j)]$ denote the degrees of membership and non-membership of the edge $(vi, v j) \in E$, respectively,
where $0 \leq \mu_2(vi, v j) + 2 (vi , v j) \leq 1$ for every $(vi , v j) \in E$.
For each intuitionistic fuzzy graph G, the degree of hesitance (hesitation degree) of the vertex $vi \in V$ in G is $\pi1(vi) = 1 - \mu_1(vi) - \nu_1(vi)$
$eij = (vi , v j) \in E$ in G is $\pi_2(eij) = 1 - \mu_2(eij) - \nu_2(eij)$.
Definition: An IFG, $G = (V, E)$ is said to be *complete IFG* if, $\mu_2(vi , v j) = \min(\mu_1(vi), \mu_1(v j))$ and $\nu_2(vi , v j) = \max(\nu_1(vi), \nu_1(v j))$ for every $vi , v j \in V$.
Definition: An IFG, $G = (V, E)$ is said to be *strong IFG* if $\mu_2(vi , v j)= \min(\mu_1(vi), \mu_1(v j))$ and $\nu_2(vi , v j) = \max(\nu_1(vi), \nu_1(v j))$ for every $(vi , v j) \in E$.
Definition: The *complement* of an IFG, $G = (V, E)$ is an IFG, $G = (V, E)$, where

- $V = V$,
- $\mu_1(vi) = \mu_1(vi)$ and $\nu_1(vi) = \nu_1(vi)$ for all $i = 1, 2, ..., n$,
- $\mu_2(vi , v j) = \min(\mu_1(vi), \mu_1(v j)) - \mu_2 (vi , v j)$ and $\nu_2 (vi , v j) = \max(\nu_1(vi), \nu_1(v j)) - \nu_2(vi , v j)$ for all $i, j = 1, 2, ..., n$.

Definition: The *neighborhood degree* of a vertex is defined as $dN (v) = (dN\mu(v), dN\nu (v))$,
Where,

$$d_{N\mu}(v) = \sum_{w \in N(v)} \mu_1(w) \quad \text{and} \quad d_{N\nu}(v) = \sum_{w \in N(v)} \nu_1(w).$$

Definition Then the degree of a vertex vi is defined by $d_G(vi) = (d_\mu(vi), d_\nu (vi)) = (K_1, K_2)$, where $K_1 =$

$$d_\mu(v_i) = \sum_{v_i \neq v_j} \mu_2(v_i, v_j) \text{ and } K_2 = d_\nu(v_i) = \sum_{v_i \neq v_j} \nu_2(v_i, v_j).$$

Definition: An intuitionistic fuzzy graph $G = (V, E)$ is said to be, a (K_1, K_2) *-regular* if $dG(v_i) = (K_1, K_2)$ for all $vi \in V$ and also G are called as a regular intuitionistic fuzzy graph of degree (K_1, K_2).
Definition: An intuitionistic fuzzy graph $G = (V, E)$ is said to be a *bipartite* if the vertex set V can be partitioned into two non-empty sets V_1 and V_2 such that

$\mu_2(v_i , v_j) = 0$ and $\nu_2 (v_i , v_j) = 0$ if $(v_i , v_j) \in V1$ or $(v_i , v_j) \in V_2$,
$\mu_2 (v_i , v_j) > 0$, $\nu_2(v_i , v_j) < 0$ if $v_i \in V_1$ or $v j \in V_2$ for some i and j (or)
$\mu_2(v_i , v_j) = 0$, $\nu_2(vi , v j) < 0$ if $v_i \in V_1$ or $v_j \in V_2$ for some i and j (or)
$\mu_2(v_i , v_j) > 0$, $\nu_2(v_i , v_j) = 0$ if $v_i \in V_1$ or $v j \in V_2$ for some i and j.

Definition: A bipartite intuitionistic fuzzy graph $G = (V, E)$ is said to be *complete* if $\mu_2(v_i , v_j) = \min(\mu_1(v_i), \mu_1(v_j))$ and $\nu_2(v_i ,v_j) = \max(\nu_1(vi), \nu_1(v_j))$ for all $v_i \in V_1$ and $v_j \in V_2$ and is denoted by . KV_1,V_2
Definition: Let $G^* = (V, E)$ be a crisp graph and let $e = viv j$ be an edge in G^*. Then the degree of an edge $e = v_i v_j \in E$ is defined as

$$d_{G^*}(v_iv_j) = d_{G^*}(v_i) + d_{G^*}(v_j) - 2.$$

Conclusion:

Graph theory has various applications in different areas including mathematics, science and technology, biochemistry (genomics), electrical engineering (communication networks and coding theory), computer science (algorithms and computation) and operations research (scheduling). Soft set of theories may plays a significant roles as a mathematical tools for mathematical modeling's, system's analysis and computing of decision making problems with uncertainty. An intuitionistic fuzzy soft model are generalization of they fuzzy soft model which gives more than precision, flexibility, and also compatibility to a system's when compared as like to be a fuzzy soft model. We're has been applied the concept of intuitionistic fuzzy soft sets to the graphs in this paper. We have presented certain types of the intuitionistic fuzzy soft graph's. In the future we intend to extend our research of fuzzification to (1) Interval-valued fuzzy soft graphs; (2) Bipolar fuzzy soft hypergraphs, (3) Fuzzy rough soft graphs, and (4) Applications of the intuitionistic fuzzy soft graphs in the decision support systems.

References:

1. B. Ahmad and A. Kharal, On fuzzy soft sets, Hindawi Publishing Corporation, Advances in fuzzy systems, Article ID 586507, (2009), 6 pages, doi: 10.1155/2009/ 86507.
2. S. Alkhazaleh, A. R. Salleh and N.Hassan, Possibility fuzzy soft set, Advances in Decision Sciences, 2011, Article ID 479756, doi:1 0.1155|2011|479756, 18 pages.
3. Kauffman, Introduction a la theorie des sous ensembles Flous, Massonet cie., vol. 1, (1973).
4. P. K. Maji, R. Biswas and A. R. Roy, Soft set theory, J. Compt. Math. Appl., 45 (2003) 555-562.