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Isomorphic Properties of Edge Irregular Intuitionistic Fuzzy Graphs

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ABSTRACT

In this paper, we discussed some properties of isomorphism, weak isomorphism and co-weak isomorphism of highly edge irregular and neighbourly edge irregular intuitionistic fuzzy graphs and its complement.

keywords: intuitionistic fuzzy graphs, neighbourly edge irregular, highly edge irregular, isomorphism, weak isomorphism co-weak isomorphism

AMS subject classification : 05C12, 03E72, 05C72.

I. INTRODUCTION

Graph theory has numerous applications to problems in computer science, electrical engineering, system analysis, operations research, economics, networking routing, transportation, etc. Rosenfeld[13] introduced the notion of fuzzy graph in 1975 and proposed another definition including paths, cycles, connectedness, etc. The complement of a fuzzy graphs was defined by Mordeson and Nair [6] and further studied by Sunitha and Kumar [14]. The concept of weak isomorphism, co-weak isomorphism and isomorphism between fuzzy graphs was introduced by Bhutani [3]. Nagoorgani and Chandrasekaran[7], defined μ -complement of a fuzzy graph.

Atanassov [2] introduced the concept of intuitionistic fuzzy (IF) relations and intuitionistic fuzzy graphs (IFGs). Research on the theory of intuitionistic fuzzy sets (IFSs) has been witnessing an exponential growth in Mathematics and its applications. This ranges from traditional Mathematics to Information Sciences. This leads to consider IFGs and their applications. R. Parvathy and M.G.Karunambigai[11] introduced the concept of IFG and analyzed its components. A.Nagoor Gani, R. Jahir Hussain and S. Yahya Mohamed[9] introduced irregular intuitionistic fuzzy graphs and discussed about its properties. S. Ravi Narayanan and S. Murugesan [12] discussed the properties of Edge Irregular Intuitionistic Fuzzy Graphs. These motivate us to discuss about some of the isomorphic properties of neighbourly(highly) edge irregular intuitionistic fuzzy graph. Throughout this paper we consider two intuitionistic fuzzy graphs $G_1 = ((\mu_{A1} , \gamma_{A1}), (\mu_{B1} , \gamma_{B1}))$ and $G_2 = ((\mu_{A2} , \gamma_{A2}), (\mu_{B2} , \gamma_{B2}))$.

II. PRELIMINARIES

We present some known definitions related to fuzzy graphs and intuitionistic fuzzy graphs for ready reference to go through the work presented in this paper.

Definition 2.1. [6] A fuzzy graph $G : (\sigma, \mu)$ is a pair of functions (σ, μ) , where $\sigma : V \rightarrow [0,1]$ is a fuzzy subset of a non empty set V and $\mu : V \times V \rightarrow [0, 1]$ is a symmetric fuzzy relation on σ such that for all u, v in V , the relation $\mu(u, v) \leq \sigma(u) \wedge \sigma(v)$ is satisfied. A fuzzy graph G is called complete fuzzy graph if the relation $\mu(u, v) = \sigma(u) \wedge \sigma(v)$ is satisfied.

Definition 2.2. [11] An intuitionistic fuzzy graph with an underlying set V is defined to be a pair $G = (V,E)$ where

(i) $V = \{v_1, v_2, v_3, . . . , v_n\}$ such that $\mu_1: V \rightarrow [0, 1]$ and $\gamma_1: V \rightarrow [0, 1]$ denote the degree of membership and non membership of the element $v_i \in V, (i = 1, 2, 3, . . . , n)$, such that $0 \leq \mu_1(v_i)+ \gamma_1(v_i) \leq 1$

(ii) $E \subseteq V\times V$ where $\mu_2: V \times V \rightarrow [0, 1]$ and $\gamma_2: V \times V \rightarrow [0, 1]$ are such that $\mu_2(v_i, v_j) \leq \min\{\mu_1(v_i), \mu_1(v_j)\}$ and $\gamma_2(v_i, v_j) \leq \max \{ \gamma_1(v_i) , \gamma_1(v_j) \}$ and $0\leq \mu_2(v_i, v_j)+ \gamma_2(v_i, v_j) \leq 1$, for every $(v_i, v_j) \in E, (i, j = 1, 2,. . . , n)$.

Definition 2.3. [10] Let G =< V,E > be an intuitionistic fuzzy graph. Then the degree of a vertex v is defined as $d(v) = (d_\mu(v), d_\gamma(v))$ where $d_\mu(v) = \sum\mu_2(u, v)$ and $d_\gamma(v) =\sum\gamma_2(u, v)$.

Definition 2.4. [4] Let G =< V,E > be an intuitionistic fuzzy graph. Then G is said to be constant intuitionistic fuzzy graph if all the vertices have the same degree.

Definition 2.5. [9] Let G =< V,E > be an intuitionistic fuzzy graph. Then, G is said to be neighbourly edge irregular intuitionistic fuzzy graph if every two adjacent edges in G have distinct degrees.

Definition 2.6. [9] Let G =< V,E > be an intuitionistic fuzzy graph. Then, G is said to be highly edge irregular intuitionistic fuzzy graph if every edge is adjacent to edges with distinct degrees.

Definition 2.7. [10] Let G =< V,E > be an intuitionistic fuzzy graph. The order of G is defined as $O(G) = (O\mu(G),O\gamma(G))$ where $O\mu(G) = \sum\mu1(v)$ and $O\gamma(G) =\sum\gamma1(v)$, for all $v\in V$.

Definition 2.8. [10] Let G =< V,E > be an intuitionistic fuzzy graph. The size of G is defined as $S(G) = (S\mu(G), S\gamma(G))$ where $S\mu(G) = \sum\mu2(uv)$ and $S\gamma(G) = \sum\gamma2(uv)$, for all $uv\in E$.

Definition 2.9. [5] Let G : (A,B) be an intuitionistic fuzzy graph and let $e_{ij} \in B$ be an edge of G. Then the degree of an edge e_{ij} is defined as $d_\mu(e_{ij}) = d_\mu(v_i) + d_\mu(v_j) - 2\mu_2(e_{ij})$ and $d_\gamma(e_{ij}) = d_\gamma(v_i) + d_\gamma(v_j) - 2\gamma_2(e_{ij})$ and the edge degree of G is $d(e_{ij}) = (d_\mu(e_{ij}), d_\gamma(e_{ij}))$.

Definition 2.10. [1] Let G =< A,B > be an intuitionistic fuzzy graph. The complement of G is defined as $\bar{G} =< \bar{A},\bar{B} >$ where $\bar{A} = (\overline{\mu_A}, \overline{\gamma_A})$ and $\bar{B} = (\overline{\mu_B}, \overline{\gamma_B})$ and $\overline{\mu_A}(x) =\mu_A(x)$ and $\overline{\gamma_A}(x) = \gamma_A(x)$.

$\overline{\mu_B}(xy)=\mu_A(x)\Lambda\mu_A(y) - \mu_B(xy)$ and $\overline{\gamma_B}(xy)=\gamma_A(x)\Lambda\gamma_A(y) - \gamma_B(xy)$

III. ISOMORPHISM ON EDGE IRREGULAR INTUITIONISTIC FUZZY GRAPHS

Definition 3.1. A homomorphism h of neighbourly edge irregular intuitionistic fuzzy graph(highly edge irregular intuitionistic fuzzy graph) G_1 and G_2 is a mapping $h: V_1 \rightarrow V_2$ which satisfies condition

(i) $\mu_{A1} (x) \leq \mu_{A2} (h(x))$ and $\gamma_{A1} (x) \geq \gamma_{A2} (h(x))$ (ii) $\mu_{B1} (xy) \leq \mu_{B2} (h(xy))$ and $\gamma_{B1} (xy) \geq \gamma_{B2} (h(xy))$

Example 3.2. Consider neighbourly edge irregular intuitionistic fuzzy graph on $G^*(V,E)$.

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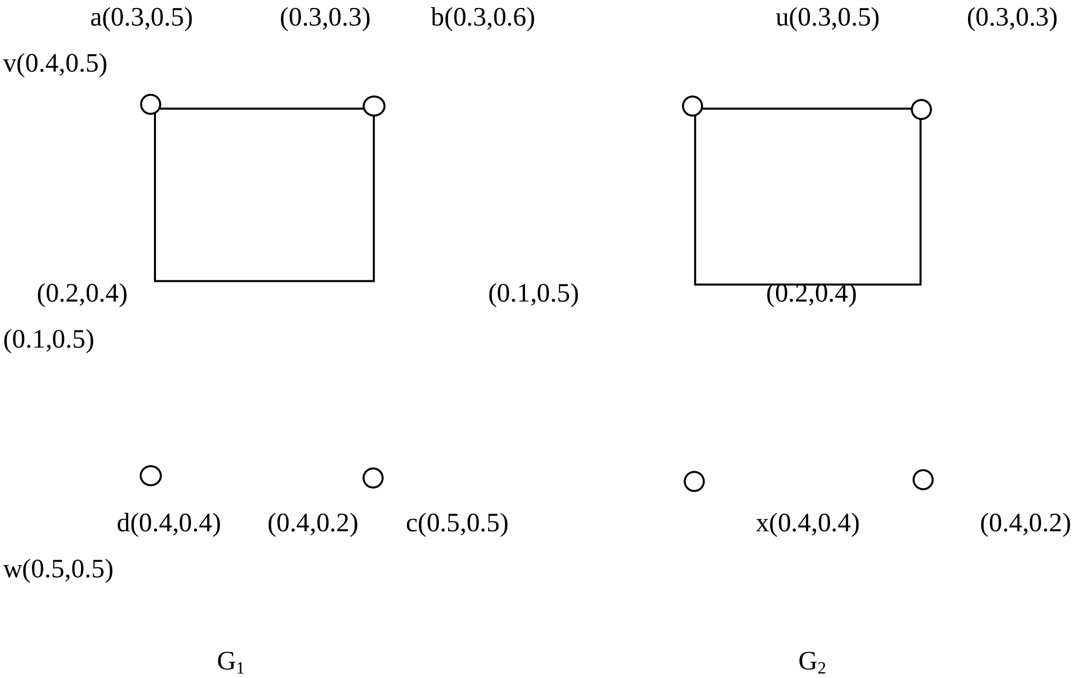
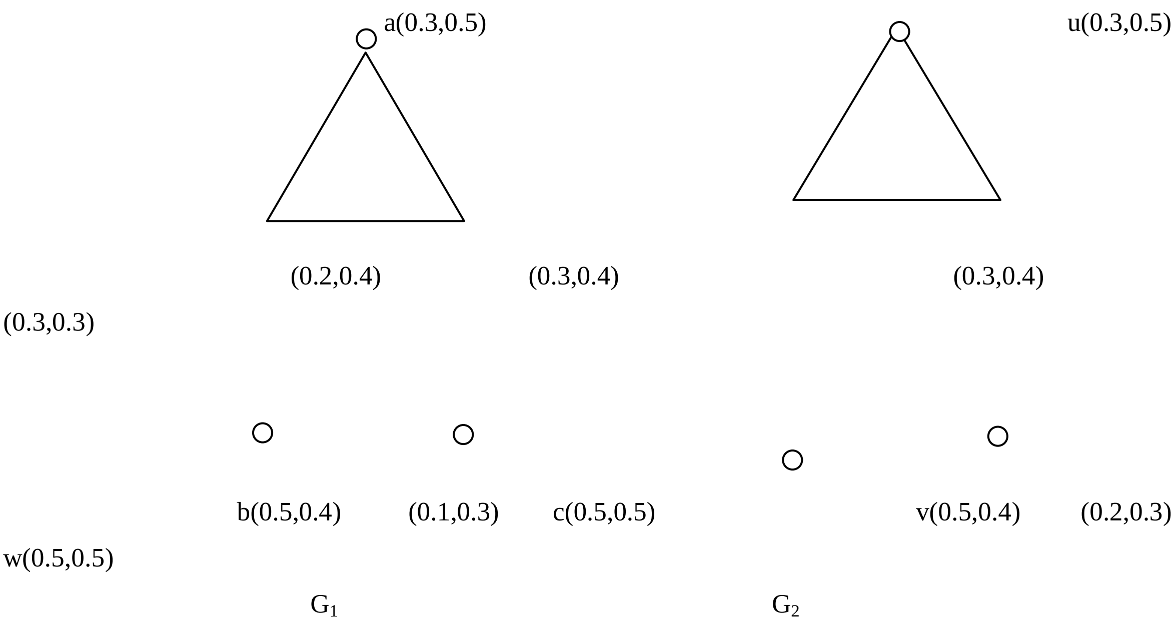


Definition 3.3. A weak isomorphism h of neighbourly edge irregular intuitionistic fuzzy graph (highly edge irregular intuitionistic fuzzy graph) G_1 and G_2 is a bijective mapping h : $V_1 \rightarrow V_2$ which satisfies the following conditions.

(i) h is homomorphism (ii) $\mu_{A1}(x) = \mu_{A2}(h(x))$, $\gamma_{A1}(x) = \gamma_{A2}(h(x))$

Example 3.4. Consider highly edge irregular intuitionistic fuzzy graph on $G^*(V,E)$.



There is a homomorphism h: $V_1 \rightarrow V_2$ such that h(a) = u , h(b) = v ,h(c) = w.

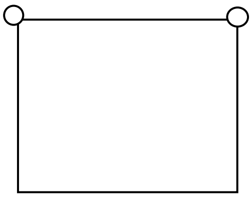
Definition 3.5. A co-weak isomorphism of neighbourly edge irregular intuitionistic fuzzy graph (highly edge irregular intuitionistic fuzzy graph) G_1 and G_2 is a bijective mapping h: $V_1 \rightarrow V_2$ which satisfies condition

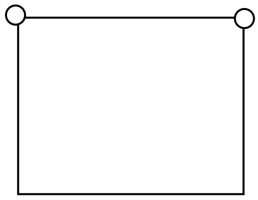
IJARSE
ISSN: 2319-8354

(i) h is homomorphism (ii) $\mu_{B1}(xy) = \mu_{B2}(h(xy))$ and $\gamma_{B1}(xy) = \gamma_{B2}(h(xy))$

Example 3.6. Consider neighbourly edge irregular intuitionistic fuzzy graph on $G^*(V, E)$.

a(0.5,0.4) (0.4,0.4) b(0.6,0.4) u(0.5,0.4) (0.4,0.4) v(0.7,0.3)





(0.5,0.3) (0.3,0.3) (0.5,0.3) (0.3,0.3)

d(0.5,0.5) (0.2,0.5) c(0.3,0.5) x(0.5,0.5) (0.2,0.5) w(0.4,0.6)

G_1 G_2

Definition 3.7. An isomorphism h of neighbourly edge irregular intuitionistic fuzzy graph (highly edge irregular intuitionistic fuzzy graph) G_1 and G_2 is a bijective mapping h: $V_1 \rightarrow V_2$ which satisfies condition

(i) $\mu_{A1}(x) = \mu_{A2}(h(x))$ and $\gamma_{A1}(x) = \gamma_{A2}(h(x))$ (ii) $\mu_{B1}(xy) = \mu_{B2}(h(x)h(y))$ and $\gamma_{B1}(xy) = \gamma_{B2}(h(xy))$

Theorem 3.8. If any two neighbourly edge irregular intuitionistic fuzzy graphs are isomorphic then their order and size are same.

Proof. If h: $G_1 \rightarrow G_2$ be an isomorphism between neighbourly edge irregular intuitionistic fuzzy graph then,

$\mu_{A1}(x) = \mu_{A2}(h(x))$, $\gamma_{A1}(x) = \gamma_{A2}(h(x))$ and $\mu_{B1}(xy) = \mu_{B2}(h(x)h(y))$ and $\gamma_{B1}(xy) = \gamma_{B2}(h(x)h(y))$

$O(G_1) = (\sum\mu_{A1}(u_1), \sum\gamma_{A1}(u_1)) = (\sum\mu_{A2}(h(u_1)), \sum\gamma_{A2}(h(u_1))) = (\sum\mu_{A2}(u_2), \sum\gamma_{A2}(u_2)) = O(G_2)$

$S(G_1) = (\sum\mu_{B1}(u_1v_1), \sum\gamma_{B1}(u_1v_1)) = (\sum\mu_{B2}(h(u_1)h(v_1)), \sum\gamma_{B2}(h(u_1)h(v_1))) = (\sum\mu_{B2}(u_2v_2),$

$\sum\gamma_{A2}(u_2v_2)) = S(G_2)$.

Remark 3.9. The above Theorem 3.8 is true for highly edge irregular intuitionistic fuzzy graph.

Remark 3.10. The converse of above Theorem 3.8 need not be true for both neighbourly edge irregular intuitionistic fuzzy graph and highly edge irregular intuitionistic fuzzy graph.

Example 3.11. Consider two neighbourly edge irregular intuitionistic fuzzy graphs.

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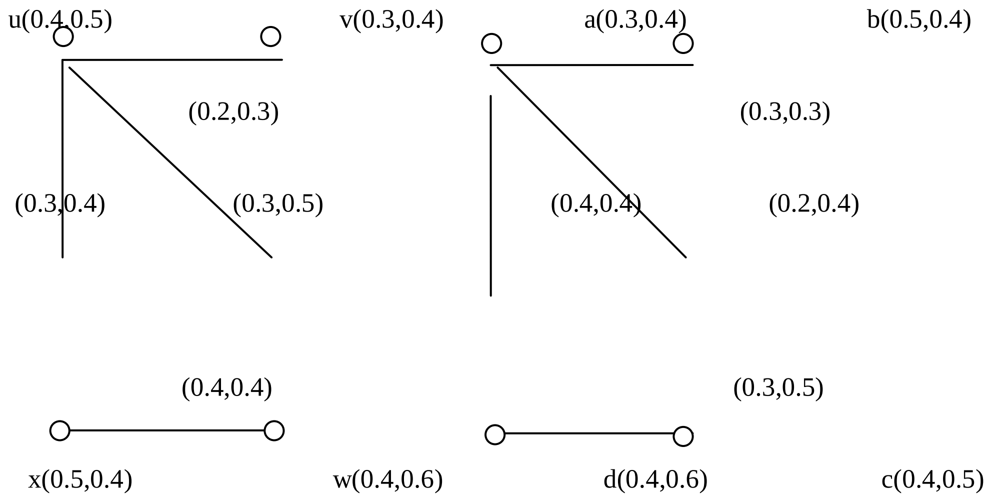
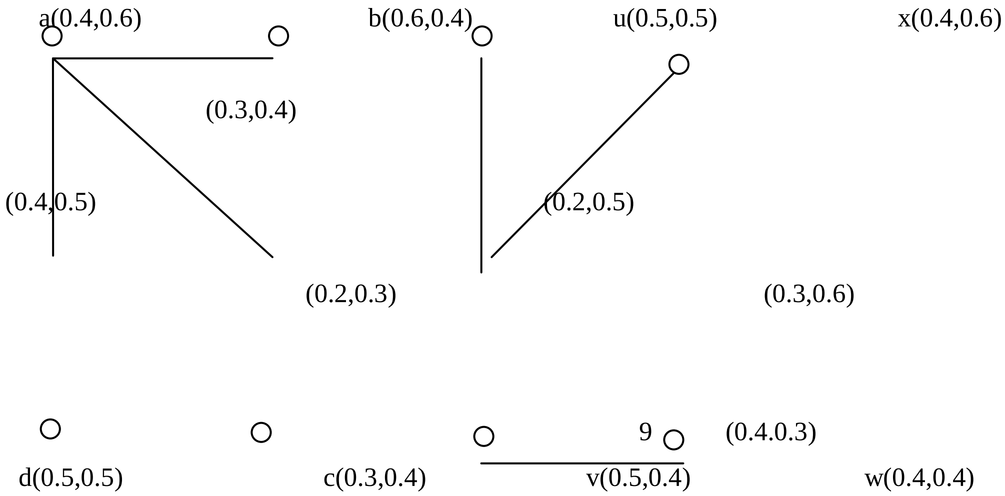


G_1 G_2

In both the graphs, $O(G_1) = O(G_2) = (1.6, 1.9)$ and $S(G_1) = S(G_2) = (1.2, 1.6)$. But G_1 is not isomorphic to G_2.

Theorem 3.12. If neighbourly edge irregular intuitionistic fuzzy graph(highly edge irregular intuitionistic fuzzy graph) are weak isomorphic then their order are same. But neighbourly edge irregular intuitionistic fuzzy graph(highly edge irregular intuitionistic fuzzy graph) of same order need not be weak isomorphic.

Example 3.13. Consider highly edge irregular intuitionistic fuzzy graph on $G^*(V,E)$.



G_1 G_2

Here, $O(G_1) = O(G_2) = (1.8, 1.9)$. But they are not weak isomorphic

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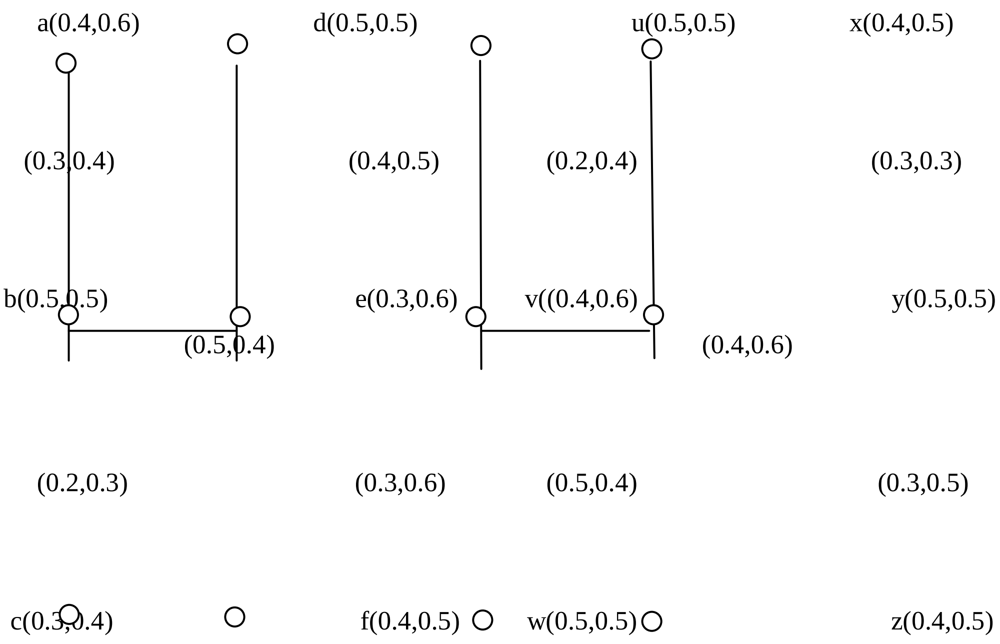
Theorem 3.14. If neighbourly edge irregular intuitionistic fuzzy graph(highly edge irregular intuitionistic fuzzy graph)are co-weak isomorphism their size are same. But neighbourly edge irregular intuitionistic fuzzy graph(highly edge irregular intuitionistic fuzzy graph) of same size need not be co-weak isomorphic.

Example 3.15. Consider highly edge irregular intuitionistic fuzzy graph on $G^*(V,E)$.



G_1 G_2

Theorem 3.16. If G_1 and G_2 are neighbourly edge irregular intuitionistic fuzzy graphs which are isomorphic then the degrees of corresponding vertices u and h(u) are preserved.

Proof. If $h: G_1 \rightarrow G_2$ is an isomorphism between neighbourly edge irregular intuitionistic fuzzy graph then

$\mu_{B1}(u_1v_1) = \mu_{B2}(h(u_1)h(v_1))$, $\gamma_{B1}(u_1v_1) = \gamma_{B2}(h(u_1)h(v_1))$

$d_\mu(u_1) = \sum \mu_{B1}(u_1v_1) = \sum\mu_{B2}(h(u_1)h(v_1)) = d_\mu(h(u_1))$, $d_\gamma(u_1) = \sum \gamma_{B1}(u_1v_1) = \sum \gamma_{B2}(h(u_1)h(v_1)) = d_\gamma(h(u_1))$

Thus the degrees of corresponding vertices of G_1 and G_2 are the same.

Remark 3.17. The above Theorem 3.16 holds true for highly edge irregular intuitionistic fuzzy graph.

Remark 3.18. The converse of Theorem 3.16 and Remark 3.17 need not be true.

International Journal of Advance Research in Science and Engineering
Volume No.06, Issue No. 10, October 2017
www.ijarse.com
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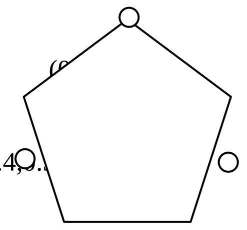
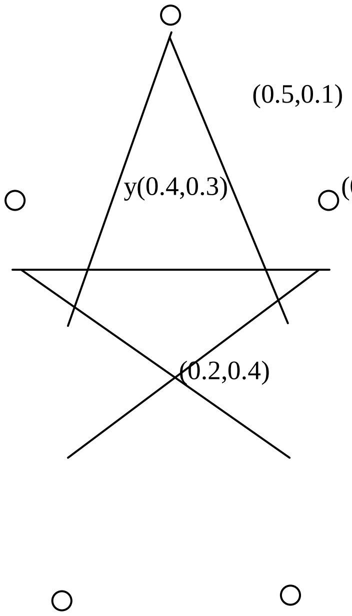
ISSN: 2319-8354

Example 3.19. Consider highly edge irregular intuitionistic fuzzy graph on $G^*(V,E)$.

a(0.5,0.5) u(0.5,0.5)





(0.1,0.5) (0.5,0.1) (0.1,0.5)

e(0.4,0... b(0.4,0.5) y(0.4,0.3) (0.3,0.3)

v(0.4,0.6)

(0.4,0.2) (0.2,0.4) (0.2,0.4)

(0.4,0.2)

d(0.5,0.4) c(0.4,0.4)

(0.3,0.3)

x(0.5,0.5)

w(0.3,0.4)

G_1 G_2

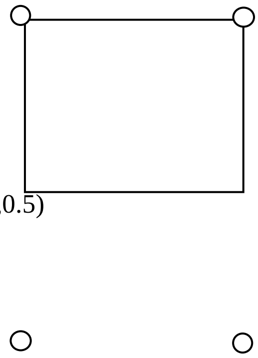
d(a) = d(u) = (0.6, 0.6) , d(b) = d(w) = (0.3, 0.9) , d(c) = d(y) = (0.5, 0.5) , d(d) = d(v) = (0.7, 0.5), d(e)=d(x)=(0.9,0.3)

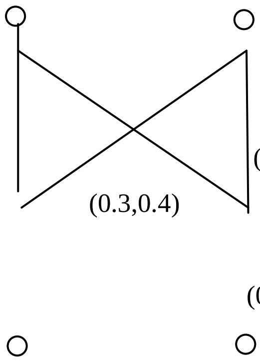
In G_1 and G_2 , the degrees of corresponding vertices are the same. But G_1 and G_2 are only co-weak isomorphic but not isomorphic.

Example 3.20. Consider two neighbourly edge irregular intuitionistic fuzzy Graphs.

a(0.4,0.5) (0.3,0.4) b(0.3,0.6) u(0.5,0.5)

v(0.6,0.4)





(0.4,0.5)

(0.4,0.5) (0.5,0.4) (0.3,0.4)

(0.4,0.4)

(0.5,0.4)

d(0.4,0.6) (0.4,0.4) c(0.5,0.5) x(0.5,0.4)

w(0.4,0.5)

G_1 G_2

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d(a) = d(u) = (0.7, 0.9) , d(b) = d(x) = (0.8, 0.8) , d(c) = d(v) = (0.9, 0.8) , d(d) = d(w) = (0.8, 0.9)

From above two graphs, it is clear that the degree of corresponding vertices are the same, But G_1 and G_2 are only co-weak isomorphic and not isomorphic.

Theorem 3.21. Let G_1 and G_2 be two highly edge irregular intuitionistic fuzzy graphs. G_1 and G_2 are isomorphic if and only if their complement are isomorphic. But the complement need not be highly edge irregular.

Proof. Assume that G_1 and G_2 are isomorphic. There exists a bijective map h: $V_1 \rightarrow V_2$ satisfying

$\mu_{A1}(x) = \mu_{A2}(h(x))$, $\gamma_{A1}(x) = \gamma_{A2}(h(x))$, for all $x \in V_1$

$\mu_{B1}(xy) = \mu_{B2}(h(x)h(y))$, $\gamma_{B1}(xy) = \gamma_{B2}(h(x)h(y))$, for all $xy \in E_1$

$$\bar{\mu}_{B_1}(xy) = \mu_{A1}(x) \wedge \mu_{A1}(y) - \mu_{B1}(xy)$$

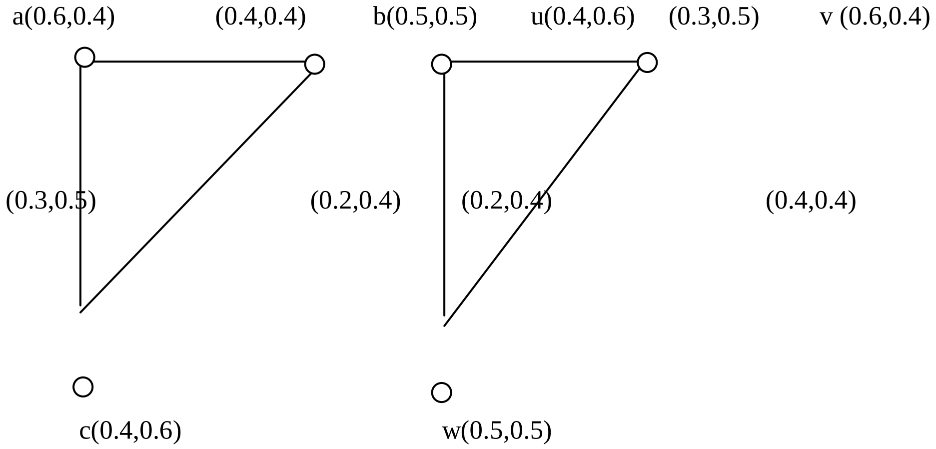
$$= \mu_{A2}(h(x)) \wedge \mu_{A2}(h(y)) - \mu_{B2}(h(x)h(y))$$

$$\bar{\gamma}_{B_1}(xy) = \gamma_{A1}(x) \vee \gamma_{A1}(y) - \gamma_{B1}(xy)$$

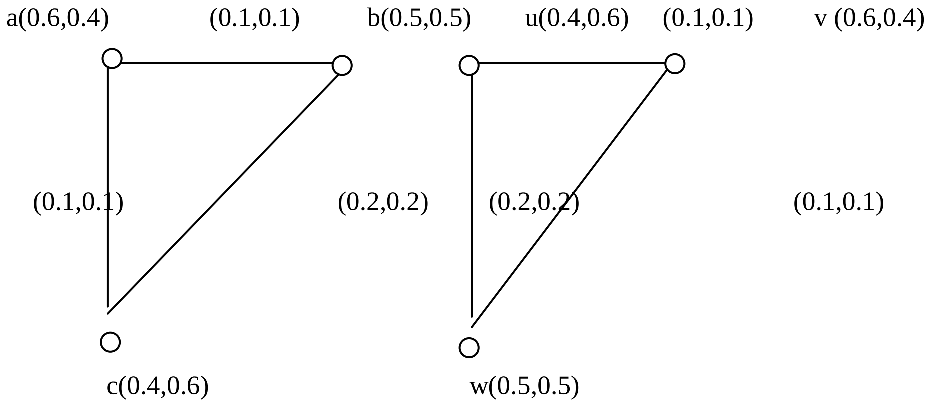
$$= \gamma_{A2}(h(x)) \vee \gamma_{A2}(h(y)) - \gamma_{B2}(h(x)h(y))$$

Hence $\overline{G_1} \cong \overline{G_2}$. The converse part is similar.

Example 3.22. Consider highly edge irregular intuitionistic fuzzy graph on $G^*(V,E)$.



G_1 G_2



$\overline{G_1}$ $\overline{G_2}$

There is an isomorphism $h: V_1 \rightarrow V_2$ such that $h(a) = u$, $h(b) = w$, $h(c) = v$.

Here, $G_1 \cong G_2$ and $\overline{G_1} \cong \overline{G_2}$. But the complements are not highly edge irregular intuitionistic fuzzy graphs.

Theorem 3.23. Let G_1 and G_2 be two highly edge irregular intuitionistic fuzzy graphs. If G_1 is weak isomorphism with G_2 , then $\overline{G_1}$ is weak isomorphic with $\overline{G_2}$.

Proof. If h is weak isomorphism between G_1 and G_2 then $h: V_1 \rightarrow V_2$ is a bijective function such that,

$\mu_{A1}(x) = \mu_{A2}(h(x))$, $\gamma_{A1}(x) = \gamma_{A2}(h(x))$ and $\mu_{B1}(xy) \leq \mu_{B2}(h(x)h(y))$, $\gamma_{B1}(xy) \leq \gamma_{B2}(h(x)h(y))$.

As, $h^{-1} : V_2 \rightarrow V_1$ is also bijective, for every x2 2 V2 , there exists $x_1 \in V_1$ such that $h^{-1}(x_2) = x_1$

$\mu_{A2}(x_2) = \mu_{A1}(h^{-1}(x_2))$, $\gamma_{A2}(x_2) = \gamma_{A1}(h^{-1}(x_2))$

$\bar{\mu}_{B_1}(x_1y_1) = \mu_{A1}(x_1) \wedge \mu_{A1}(y_1) - \mu_{B1}(x_1y_1)$

$\bar{\mu}_{B_1}(h^{-1}(x_2)\, h^{-1}(y_2)) \geq \mu_{A2}(h(x_1)) \wedge \mu_{A2}(h(y_1)) - \mu_{B2}(h(x_1)h(y_1))$

$= \mu_{A2}(x_2) \wedge \mu_{A2}(y_2) - \mu_{B2}(x_2y_2) = \bar{\mu}_{B_2}(x_2y_2$

Hence, $\bar{\mu}_{B_2}(x_2y_2) \leq \bar{\mu}_{B_1}(h^{-1}(x_2)\, h^{-1}(y_1))$

$\bar{\gamma}_{B_1}(x_1y_1) = \gamma_{A1}(x_1) \vee \gamma_{A1}(y_1) - \gamma_{B1}(x_1y_1)$

$\bar{\gamma}_{B_1}(h^{-1}(x_2)\, h^{-1}(y_2)) \leq \gamma_{A2}(h(x_1)) \vee \gamma_{A2}(h(y_1)) - \gamma_{B2}(h(x_1)h(y_1))$

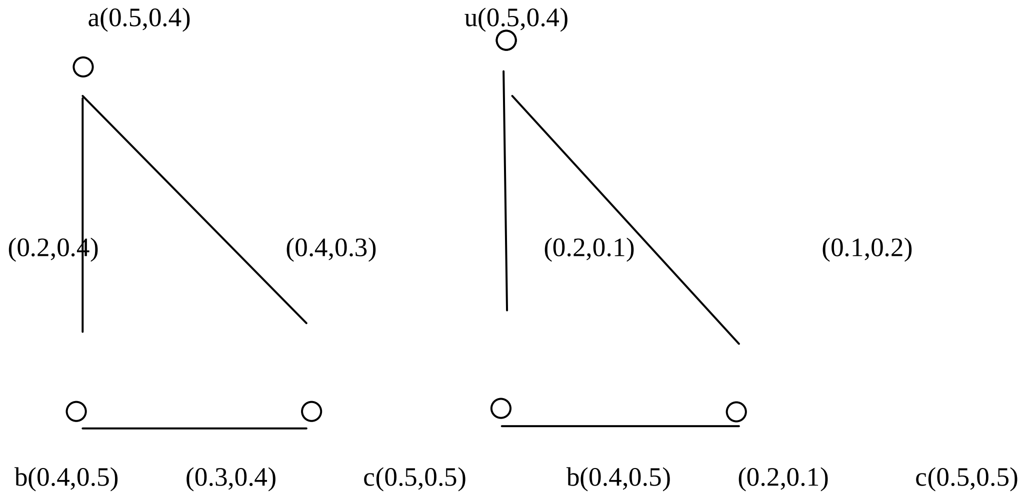
$= \gamma_{A2}(x_2) \vee \gamma_{A2}(y_2) - \gamma_{B2}(x_2y_2) = \bar{\gamma}_{B_2}(x_2y_2)$

$\bar{\gamma}_{B_2}(x_2y_2) \geq \bar{\gamma}_{B_1}(h^{-1}(x_2)\, h^{-1}(y_2))$. So, $h^{-1} : V_1 \rightarrow V_2$ is weak isomorphism between $\overline{G_1}$ and $\overline{G_2}$.

Remark 3.24. The above Theorem 3.23 is true for highly totally edge irregular intuitionistic fuzzy graphs

Remark 3.25. A neighbourly edge irregular intuitionistic fuzzy graph need not be self complementary.

Example 3.26. Consider an intuitionistic fuzzy graph on $G^*(V, E)$.



G $\qquad\qquad$ $\overline{G}$

Here G is neighbourly edge irregular intuitionistic fuzzy graph but G is not isomorphic to $\overline{G}$. Hence G is not self complementary

Theorem 3.27. Isomorphism between neighbourly edge irregular intuitionistic fuzzy graphs is an equivalence relation.

Proof.

Let $G_1 = (A_1, B_1)$, $G_2 = (A_2, B_2)$ and $G_3 = (A_3, B_3)$ be neighbourly edge irregular intuitionistic fuzzy graphs with vertex sets V_1 , V_2 and V_3 respectively.

Reflexive: (i.e) To prove $G \cong G$. Consider the identity map $h: V \rightarrow V$ such that $h(u) = u$ for all $u \in V$. Clearly h is a bijective map satisfying

$\mu_A(u) = \mu_A(h(u))$, $\gamma_A(u) = \gamma_A(h(u))$ and $\mu_B(uv) = \mu_B(h(u)h(v))$, $\gamma_B(uv) = \gamma_B(h(u)h(v))$

Therefore h is an isomorphism of the neighbourly edge irregular intuitionistic fuzzy graph to itself. Hence h satisfies reflexive relation.

Symmetric: To prove, if $G_1 \cong G_2$ then $G_2 \cong G_1$.

Assume $G_1 \cong G_2$. Let $h: V_1 \rightarrow V_2$ be an isomorphism from G_1 onto G_2 such that $h(u_1) = u_2$, for all $u_1 \in V_1$. This h is a bijective map satisfying $\mu_A(u_1) = \mu_A(h(u_1))$, $\gamma_A(u_1) = \gamma_A(h(u_1))$ and

$\mu_B(u_1v_1) = \mu_B(h(u_1)h(v_1))$, $\gamma_B(u_1v_1) = \gamma_B(h(u_1)h(v_1))$

Since h is bijective, inverse exists. So, $h^{-1}(u_2) = u_1$

$\mu_{A1}(h^{-1}(u_2)) = \mu_{A2}(u_2)$, $\gamma_{A1}(h^{-1}(u_2)) = \gamma_{A2}(u_2)$, for all $u_2 \in V_2$ and

$\mu_{B1}(h^{-1}(u_2)\, h^{-1}(v_2)) = \mu_{B2}(u_2v_2)$, $\gamma_{B1}(h^{-1}(u_2)h^{-1}(v_2)) = \gamma_{B2}(u_2v_2)$, for all $u_2, v_2 \in V_2$.

Thus, $h^{-1} : V_2 \rightarrow V_1$ is a 1-1, onto map which is an isomorphism from G_2 to G_1 .

Transitive: To Prove: if $G_1 \cong G_2$ and $G_2 \cong G_3$ then $G_1 \cong G_3$

Assume $G_1 \cong G_2$. Let $h: V_1 \rightarrow V_2$ be an isomorphism of G_1 onto G_2 such that $h(u_1) = u_2$ for all $u_1 \in V_1$ satisfying $\mu_{A1}(u_1) = \mu_{A2}(h(u_1))$, $\gamma_{A1}(u_1) = \gamma_{A2}(h(u_1))$, for all $u_1 \in V_1$

$\mu_{B1}(u_1v_1) = \mu_{B2}(h(u_1)h(v_1)) = \mu_{B2}(u_2v_2)$, $\gamma_{B1}(u_1v_1) = \gamma_{B2}(h(u_1)h(v_1)) = \gamma_{B2}(u_2v_2)$, for all $u_1v_1 \in E_1$

Assume $G_2 \cong G3$. Let $g : V_2 \rightarrow V_3$ be an isomorphism of G_2 onto G_3 such that $g(u_2) = u_3$ for all $u_2 \in V_2$ satisfying $\mu_{A2}(u_2) = \mu_{A3}(g(u_2)) = \mu_{A3}(u_3)$, $\gamma_{A2}(u_2) = \gamma_{A3}(g(u_2)) = \gamma_{A3}(u_3)$, for all $u_1 \in V_1$

$\mu_{B2}(u_2v_2) = \mu_{B3}(g(u_2)g(v_2)) = \mu_{B3}(u_3v_3)$, $\gamma_{B2}(u_2v_2) = \gamma_{B3}(g(u_2)g(v_2)) = \gamma_{B3}(u_3v_3)$, for all $u_2v_2 \in E_2$

Since $h: V_1 \rightarrow V_2$ and $g : V_2 \rightarrow V_3$ are isomorphism from G_1 onto G_2 and G_2 onto G_3 , then $g \circ h$ is 1-1, onto map from V_1 to V_3 . So, $g \circ h: : V_1 \rightarrow V_3$ where $(g \circ h)(u) = g(h(u))$

Now, $\mu_{A1}(u_1) = \mu_{A2}(h(u_1)) = \mu_{A2}(u_2) = \mu_{A3}(g(u_2)) = \mu_{A3}(g(h(u_1)))$

$\gamma_{A1}(u_1) = \gamma_{A2}(h(u_1)) = \gamma_{A2}(u_2) = \gamma_{A3}(g(u_2)) = \gamma_{A3}(g(h(u_1)))$

$\mu_{B1}(u_1v_1) = \mu_{B2}(h(u_1)h(v_1)) = \mu_{A2}(u_2v_2) = \mu_{A3}(g(u_2)g(v_2)) = \mu_{A3}(g(h(u_1)), g(h(v_1)))$

$\gamma_{B1}(u_1v_1) = \gamma_{B2}(h(u_1)h(v_1)) = \gamma_{A2}(u_2v_2) = \gamma_{A3}(g(u_2)g(v_2)) = \gamma_{A3}(g(h(u_1)), g(h(v_1)))$

Thus, $g \circ h$ is an isomorphism between G_1 and G_3 .

Hence isomorphism between neighbourly edge irregular intuitionistic fuzzy graphs is an equivalence relation.

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