Non Split Domination on Intuitionistic Fuzzy Graphs

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Abstract. A dominating set D of an IFG G = (V, E) is a non-split dominating set, if the
induced intuitionistic fuzzy subgraph \( \langle \mathcal{H} \rangle \) is connected. The Non-split domination
number \( \gamma_{ns}(G) \) of IFG G is the minimum cardinality of all Non-split dominating set. In
this paper we study some theorems in Non-split dominating sets of IFG and some results
of \( \gamma_{ns}(G) \) with other known parameters of IFG G.

Keywords: Non-Split domination number, path Non-split domination, cycle Non-split
domination, strong Non-split domination, global Non-split domination

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1. Introduction
In 1965, the notion of fuzzy sets was introduced by Zadeh [21] as a method of
representing uncertainty and vagueness. In 1986, Atanassov [1] introduced the concept of
IF sets as a generalization of fuzzy sets. The fuzzy relations between fuzzy sets were
concluded by Rosenfeld and he developed the structure of fuzzy graphs, obtaining
analog of several graph theoretical concepts. Bhattcharya [3] gave some remarks on
fuzzy graphs and some operations on fuzzy graphs were included by Mordeson and Peng
independent domination number in graphs. Somasundaram and Somasundaram [19]
presented more concepts of independent domination, connected domination in fuzzy
graphs. Parvathi and Karunambigai [15] gave a definition of IFG as a special case of
IFGS defined by Atanassov and Shannon [18]. Nagoor Gani and Begum [12] gave the
definition of order, degree and size in IFG. Later Parvathi and Thamizhendhi [16]
introduced dominating set, domination number, independent set, total dominating set and
total domination number in IFGs. In this Paper, non-split dominating sets in IFGs are
studied.

2. Preliminaries
In this section, some basic definitions relating to IFGS are given. Also the definition of
various non-split dominating sets and cardinality of non-split dominating sets in IFGs are
studied.
Note 1. When \( \mu_{2ij} = \gamma_{2ij} = 0 \) for some \( i \) and \( j \), then there is no edge between \( v_i \) and \( v_j \). Otherwise there exists an edge between \( v_i \) and \( v_j \).

**Definition 2.2.** [17] An IFG \( H = (V', E') \) is said to be an IF-subgraph (IFSG) of \( G = (V, E) \) if \( V' \subseteq V \) and \( E' \subseteq E \). That is \( \mu_{11} \leq \mu_{1ij} : V_{1i} \geq \gamma_{1i} \) and \( \mu_{2ij} \leq \mu_{2ij} : V_{2i} \geq \gamma_{2ij} \) for every \( i, j = 1, 2, 3 \ldots n \).

**Definition 2.3.** [17] Let \( G = (V, E) \) be an IFG. Then the cardinality of \( G \) is defined to be

\[
|G| = \sum_{v_i \in V} \frac{1 + \mu_1(v_i) - \gamma_1(v_i)}{2} + \sum_{v_i, v_j \in E} \frac{1 + \mu_2(v_i, v_j) - \gamma_2(v_i, v_j)}{2}
\]

**Definition 2.4.** [17] Let \( G = (V, E) \) be an IFG. Then the vertex cardinality of \( V \) defined by

\[
|V| = \sum_{v_i \in V} \frac{1 + \mu_1(v_i) - \gamma_1(v_i)}{2}; \quad \text{for all } v_i \in V.
\]

**Definition 2.5.** [17] Let \( G = (V, E) \) be an IFG. Then the edge cardinality of \( E \) defined by

\[
|E| = \sum_{v_i, v_j \in E} \frac{1 + \mu_2(v_i, v_j) - \gamma_2(v_i, v_j)}{2}; \quad \text{for all } (v_i, v_j) \in E.
\]

**Definition 2.6.** [12] The number of vertices is called the order of an IFG and is denoted by \( O(G) \). The number of edges is called size of an IFG and is denoted by \( S(G) \).

**Definition 2.7.** [14] The degree of a vertex \( v \) in an IFG, \( G = (V, E) \) is defined to be sum of the weights of the strong edges incident at \( v \). It is denoted by \( d_G(v) \).

The minimum degree of \( G \) is \( \delta(G) = \min\{ d_G(v) \mid v \in V \} \).

The maximum degree of \( G \) is \( \Delta(G) = \max\{ d_G(v) \mid v \in V \} \).

**Definition 2.8.** [14] Two vertices \( v_i \) and \( v_j \) are said to be neighbours in IFG, if either one of the following conditions hold

(i). \( \mu_2(v_i, v_j) > 0, \gamma_2(v_i, v_j) > 0 \),

(ii). \( \mu_2(v_i, v_j) = 0, \gamma_2(v_i, v_j) > 0 \),
such that either one of the following conditions is satisfied:

(i) $\mu_2(v_i,v_j) > 0, \gamma_2(v_i,v_j) > 0$, for some $i$ and $j$,

(ii) $\mu_2(v_i,v_j) = 0, \gamma_2(v_i,v_j) > 0$, for some $i$ and $j$,

(iii) $\mu_2(v_i,v_j) > 0, \gamma_2(v_i,v_j) = 0$, for some $i$ and $j$.

The length of a path $P = v_1, v_2, \ldots, v_{n+1}$ ($n > 0$) is $n$.

Definition 2.10. [14] Two vertices that are joined by a path is called connected.

Definition 2.11. [16] If $v_i, v_j$ are vertices in $G = (V, E)$ and if they are connected by means of a path then the strength of that path is defined as $(\min_{ij} \mu_{ij}, \max_{ij} \gamma_{2ij})$, where $\min_{ij} \mu_{ij}$ is the $\mu$-strength of the weakest arc and $\max_{ij} \gamma_{2ij}$ is the $\gamma$-strength of the strongest arc.

Definition 2.12. [16] If $v_i, v_j \in V \subseteq G$, then $\mu$-strength of connectedness between $v_i$ and $v_j$ is $\mu_2^c(v_i, v_j) = \sup_{k=1,2,..,n} \mu_k^c(v_i, v_j)$ and $\gamma_2^c(v_i, v_j) = \inf_{k=1,2,..,n} \gamma_k^c(v_i, v_j)$.

Definition 2.13. [16] An IFG, $G = (V, E)$ is said to be complete IFG if $\mu_{2ij} = \min\{\mu_{1i}, \mu_{i1}\}$ and $\gamma_{2ij} = \max\{\gamma_{1i}, \gamma_{i1}\}$ for every $v_i, v_j \in V$.

Definition 2.14. [21] The complement of an IFG, $\bar{G} = (\bar{V}, \bar{E})$ is an IFG, $\bar{G} = (\bar{V}, \bar{E})$, where

1) $\bar{V} = V$,
2) $\bar{\mu}_{ii} = \mu_{ii}$ and $\bar{\gamma}_{ii} = \gamma_{ii}$, for all $i=1,2,..,n$
3) $\bar{\mu}_{2ij} = \min(\mu_{1i}, \mu_{i1}) - \mu_{2ij}$ and $\bar{\gamma}_{2ij} = \max(\gamma_{1i}, \gamma_{i1}) - \gamma_{2ij}$, for all $i=1,2,..,n$

Definition 2.15. [14] An IFG, $G = (V, E)$ is said to bipartite if the vertex set $V$ can be partitioned into two non-empty sets $V_1$ and $V_2$ such that

i) $\mu_2(v_i, v_j) = 0$ and $\gamma_2(v_i, v_j) = 0$ if $v_i \in V_1$ (or) $v_j \in V_2$

ii) $\mu_2(v_i, v_j) > 0$ and $\gamma_2(v_i, v_j) > 0$ if $v_i \in V_1$ and $v_j \in V_2$ for some $i$ and $j$ (or)

$\mu_2(v_i, v_j) = 0$ and $\gamma_2(v_i, v_j) > 0$ if $v_i \in V_1$ and $v_j \in V_2$ for some $i$ and $j$ (or)

$\mu_2(v_i, v_j) > 0$ and $\gamma_2(v_i, v_j) = 0$ if $v_i \in V_1$ and $v_j \in V_2$ for some $i$ and $j$
**Definition 2.16.** [16] A bipartite IFG $G = (V, E)$ is said to be complete if $\mu_2(v_i, v_j) = \min(\mu_1(v_i), \mu_1(v_j))$ and $\gamma_2(v_i, v_j) = \max(\gamma_1(v_i), \gamma_1(v_j))$ for all $v_i \in V_1$ and $v_j \in V_2$. It is denoted by $K_{V_1V_2}$.

**Definition 2.17.** [17] Let $u$ be a vertex in an IFG $G = (V, E)$, then $N(u) = \{v \in V / (u, v)$ is a strong arc\}$ is called neighbourhood of $u$.

**Definition 2.18.** [17] A vertex $u \in V$ of an IFG $G = (V, E)$ is said to be an isolated vertext if $\mu_2(u, v) = 0$ and $\gamma_2(u, v) = 0$ for all $v \in V$. That is $N(u) = \emptyset$. Thus, an isolated vertex does not dominate any other vertex in $G$.

**Definition 2.19.** [17] An arc $(u, v)$ is said to be a strong arc, if $\mu_2(u, v) \geq \mu_2^o(u, v)$ and $\gamma_2(u, v) \geq \gamma_2^o(u, v)$

**Definition 2.20.** [17] Let $G = (V, E)$ be an IFG on $V$. Let $u, v \in V$, we say that $u$ dominates $v$ in $G$, if there exists a strong arc between them.

**Note 2.** If $\mu_2(u, v) < \mu_2^o(u, v)$ and $\gamma_2(u, v) < \gamma_2^o(u, v)$ for all $u, v \in V$, then the only dominating set of $G$ is $V$.

**Definition 2.21.** [17] A subset $S$ of $V$ is called a dominating set in $G$ if for every $v \in V \setminus S$, there exists $u \in S$ such that $u$ dominates $v$.

**Definition 2.22.** [17] A dominating set $S$ of an IFG is said to be minimal dominating set if no proper subset of $S$ is a dominating set.

**Definition 2.23.** [17] Minimum cardinality among all minimal dominating set is called lower-domination number of $G$, and is denoted by $d(G)$. Maximum cardinality among all minimal dominating set is called upper-domination number of $G$, and is denoted by $D(G)$.

**Definition 2.24.** [17] Two vertices in an IFG, $G = (V, E)$ are said to be independent if there is no strong arc between them.

**Definition 2.25.** [17] A subset $S$ of $V$ is said to be independent set of $G$. If $\mu_2(u, v) < \mu_2^o(u, v)$ and $\gamma_2(u, v) < \gamma_2^o(u, v)$ for all $u, v \in S$

**Definition 2.26.** [17] An independent set $S$ of $G$ in an IFG is said to be maximal independent, if for every vertex $v \in V \setminus S$, the set $S \cup \{v\}$ is not independent.

**Definition 2.27.** [17] The minimum cardinality among all maximal independent set is called lower independence number of $G$, and it is denoted by $i(G)$.

**Definition 2.28.** [17] The maximum cardinality among all maximal independent set is called upper independence number of $G$, and it is denoted by $I(G)$. 

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Definition 2.29. [7] A dominating set $D$ of a graph $G = (V, E)$ is a non-split dominating set, if the induced sub graph $(V - D)$ is connected. The non-split domination number $\gamma_{ns}(G)$ of graph $G$ is the minimum cardinality of a non-split dominating set.

Definition 2.30. [7] A dominating set $D$ of a connected graph $G$ is a path non-split dominating set if the induced sub graph $(V - D)$ is a path in $G$. The path non-split domination number $\gamma_{pns}(G)$ of $G$ is the minimum cardinality of a path non-split dominating set.

Definition 2.31. [7] A dominating set $D$ of a connected graph $G$ is a cycle non-split dominating set if the induced sub graph $(V - D)$ is a cycle in $G$. The cycle non-split domination number $\gamma_{cns}(G)$ of $G$ is the minimum cardinality of a cycle non-split dominating set.

Definition 2.32. [7] A dominating set $D$ of a graph $G = (V, E)$ is a strong non-split dominating set if the induced sub graph $(V - D)$ is complete. The strong non-split domination number $\gamma_{sns}(G)$ of $G$ is the minimum cardinality of a strong non-split dominating set.

Definition 2.33. [7] A dominating set $D$ of a connected graph $G$ is a global non-split dominating if $D$ is a non-split dominating set of both $G$ and $\overline{G}$. The global non-split domination number $\gamma_{gns}(G)$ of $G$ is the minimum cardinality of a global non-split dominating set of $G$.

Definition 2.34. [6] A vertex $v \in G$ is said to be end-vertex of IFG, if it has at most one strong neighbour in $G$.

Definition 2.35. [6] An edge $(v_i, v_j)$ is said to be a bridge in IFG $G$, if either $\mu_{2xy}^{\infty} < \mu_{2xy}^{\infty}$ and $\mu_{2xy}^{\infty} \geq \mu_{2xy}^{\infty}$ (or) $\mu_{2xy}^{\infty} \leq \mu_{2xy}^{\infty}$ and $\gamma_{2xy}^{\infty} > \mu_{2xy}^{\infty}$, for some $v_x, v_y \in V$.

Definition 2.36. [6] A vertex $v_i$ is said to be a cutvertex in IFG $G$ if deleting a vertex $v_i$ reduces the strength of the connectedness between some pair of vertices.

3. Non-split dominating set

Definition 3.1. A dominating set $D$ of an intuitionistic fuzzy graph $G = (V, E)$ is a non-split dominating set, if the induced intuitionistic fuzzy sub $(V - D)$ is connected. The non-split domination number $\gamma_{ns}(G)$ of intuitionistic fuzzy graph $G$ is the minimum cardinality of all non-split domination set.

Example 3.1. Consider the Figure 1
Here strong arcs are $e_2, e_5, e_6, e_7, $ and $e_9$. Let $D = \{v_2, v_6\}$ and $V - D = \{v_3, v_4, v_5\}$ is connected. Here $\gamma_{ns}(G) = v_2 + v_6 = 0.65$.

**Theorem 3.1.** A non-split dominating set $D$ of IFG $G$ is minimal if and only if for each vertex $v \in D$, one of the following conditions is satisfied.

i) There exists a vertex $u \in V - D$ such that $N(u) \cap D = \{v\}$.

ii) $v$ is an isolated vertex in $D$.

iii) $N(v) \cap (V - D) \neq \emptyset$

**Proof:** Let $D$ be a minimal dominating set of IFG $G$. Suppose for each node $v \in D$, the set $D' = D - \{v\}$ is not a dominating set. Thus there is a node $u \in V - D'$ which is not dominated by any node in $D'$. If $u \in V - D$ and $u$ is not dominated by $D'$, but is dominated by $D$ then $v$ is the strong neighbour of $u$. Hence $N(u) \cap D = \{v\}$. Also $v$ is an isolated vertex in $D$ and neighbourhood of each vertex in $D$ is a strong neighbour in $V - D$. This implies $N(v) \cap (V - D) \neq \emptyset$.

Conversely, Let $D$ be an non-split dominating set and each node $v \in D$, one of the following condition holds. Let us prove that $D$ is minimal. Suppose $D$ is not a minimal non-split dominating set. Then there exists a node $v \in D$ such that $D - \{v\}$ is a dominating set. Thus vis a strong neighbor to at least one node in $V - D$, which implies $v$ is not a strong neighbor of any node in $D$. Hence there is a node $u \in V - D$ such that $N(u) \cap D \neq v$. This implies one of the condition does not hold, which is a contradiction to our assumption. Hence $D$ is minimal. Hence the theorem.

**Theorem 3.2.** For any intuitionistic fuzzy graph $G$, $\gamma_{ns}(G) \leq \frac{O(G)}{\Delta_\mu(G)}$ where $\Delta_\mu(G)$ is the maximum degree of $G$.

**Proof:** Let $D$ be an non-split dominating set of IFG $G$ with $|D| = \gamma_{ns}(G)$. Since every vertex in $V - D$ is adjacent to some vertices in $D$, we have

$$|V - D| \leq \sum_{i=1}^{n} d(v_i) \leq \gamma_{ns}(G) \cdot \Delta_\mu(G)$$

$$\Rightarrow |V - D| + |D| \geq \gamma_{ns}(G) \cdot \Delta_\mu(G)$$

$$\Rightarrow O(G) - \gamma_{ns}(G) + \gamma_{ns}(G) \geq \gamma_{ns}(G) \cdot \Delta_\mu(G)$$

$$\Rightarrow O(G) \geq \gamma_{ns}(G) \cdot \Delta_\mu(G)$$

Thus, $\gamma_{ns}(G) \leq \frac{O(G)}{\Delta_\mu(G)}$. Hence the result.

**Example 3.2.** Consider the figure 2.
Here strong arcs are $e_1, e_4, e_5, e_7$ and $e_8$
Let $D = \{v_1, v_2\}$ and $V - D = \{v_3, v_4, v_5\}$, $0(G) = 6$.
Non-split domination number $\gamma_{ns}(G) = 1.3$

\[
\Delta_\mu(G) = V\{d_\mu(v_1)/ v \in V\} = 1.0
\]

\[
1.3 \leq \frac{6}{1.0} \Rightarrow 1.3 \leq 6.0
\]

\[
\gamma_{ns}(G) \leq \frac{0(G)}{\Delta_\mu(G)}
\]

**Definition 3.2.** Let $D$ be a minimum dominating set in IFG $G$. If the induced subgraph $(V - D)$ is a path in IFG $G$, then $D$ is called path non-split dominating set. The path non-split domination number $\gamma_{ns}(G)$ of $G$ is the minimum cardinality of all path non-split dominating set.

**Example 3.3.** Consider the figure 3.

Here strong arcs are $e_2, e_3$ and $e_5$
Let $D = \{v_2\}$ and $V - D = \{v_1, v_2, v_4\}$
Path non-split domination number $\gamma_{pns}(G) = 0.7$. 

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**Theorem 3.3.** Let G be an Intuitionistic fuzzy graph. If D is a path non-split dominating set, then there exists at least one adjacent vertex of each vertex \( v \in D \) in \( (V - D) \).

**Proof:** Let G be an Intuitionistic fuzzy graph. Let D be a path non-split dominating set. Suppose there is no adjacent vertex of each \( v \) in D occur in \( (V - D) \). Then these vertices occur in dominating set D. This implies for some \( u \in V - D \), there is \( v \in D \). Also path non-split dominating set is not minimum. Which contradicts the definition of path non-split dominating set. Hence there should be at least one adjacent vertex of each node \( v \in D \) in \( (V - D) \). Hence the proof.

**Example 3.4.** Consider the figure 4.

![Figure 4](image)

Here strong arcs are \( e_1, e_5, e_6, e_7, e_{10} \), and \( e_{11} \).

Let \( D = \{v_1, v_3, v_4\} \) and \( V - D = \{v_2, v_5, v_6, v_7\} \).

- \( v_3 \) is adjacent to \( v_2, v_5, v_6, \) and \( v_7 \).
- \( v_4 \) is adjacent to \( v_2 \) and \( v_5 \). One of the adjacent vertices of \( v_1, v_2, \) and \( v_3 \) occur in \( V - D \).

**Theorem 3.4.** If an intuitionistic fuzzy graph G with independent vertices then every independent vertex of G must be in path non-split dominating set D.

**Proof:** Let G be an Intuitionistic fuzzy graph with independent vertices. Let D be an non-split dominating set. Suppose an independent vertex \( v \in V - D \). Then there is no strong arc from \( v \) to any \( u \in D \) which contradicts the definition of dominating set. This leads D is not a path non-split dominating set. Therefore every independent vertex of IFG G should be in D. Hence the proof.

**Example 3.5.** Consider the figure 5.

![Figure 5](image)

Here strong arcs are \( e_3, e_6, e_7, e_8 \), and \( e_{10} \).

Let \( D = \{v_4, v_5, v_7\} \) and \( V - D = \{v_1, v_2, v_3, v_6\} \).
Theorem 3.5. Let G be an Intuitionistic fuzzy graph with end nodes. If D is a path non – split dominating set then maximum number of these end nodes occur in \((V - D)\).

**Proof:** Let G be an Intuitionistic fuzzy graph with end nodes. Let D be a path non-split domination set. Suppose D contains maximum number of end nodes. Then D is not minimum. Also for each \(v \in V - D\), there exists \(u \in D\). This results an non-split dominating set exists, which contradicts the assumption that D is a path non-split dominating set. Hence maximum number of end nodes should occur only in \((V - D)\). Hence the theorem.

Example 3.6. Consider the following figure,

Here strong arcs are \(e_1, e_2, e_3\) and \(e_5\)
Let \(D = \{v_1, v_4\}\) and \(V - D = \{v_2, v_3, v_5\}\)
The end nodes are \(v_2, v_3,\) and \(v_5\). These end nodes lie in \((V - D)\).

Definition 3.3. Let D be a minimum dominating set in IFG G. If the induced sub graph \((V - D)\) is a cycle in IFG G, then D is called cycle non-split dominating set. The cycle non-split domination number \(\gamma_{cns}(G)\) of G is the minimum cardinality of all cycle non-split dominating set.

Example 3.7. Consider a figure,
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Let $D = \{v_1, v_4, v_5\}$ and $V - D = \{v_2, v_3, v_6\}$

Here $D$ is called cycle non-split dominating set. The cycle non-split domination number $\gamma_{cns}(G) = 1.7$.

**Theorem 3.6.** If $G$ is an Intuitionistic fuzzy graph with degree of each node is equal. Then there exists a cycle non-split dominating set.

**Proof:** Let $G$ be an Intuitionistic fuzzy graph with all nodes of equal degree. Here at least one node has all its edges strong. Also adjacent vertices of this node have maximum number of strong arcs. This implies the IFG $G$ contains more cycles. Also for each $u \in V - D$ there exists $v \in D$ and $(V - D)$ is a connected cycle. By definition of domination, $D$ is a dominating set. Since $(V - D)$ is a cycle, $D$ is cycle non-split dominating set. Hence the proof.

**Example 3.8.** Consider a figure,

![Figure 8:](image)

Here strong arcs are $e_3, e_4, e_6, e_7$ and $e_8$

Let $D = \{v_4, v_6\}$ and $V - D = \{v_1, v_2, v_3, v_5, v_7, v_8\}$

Here $(V - D)$ is a cycle and $D$ is cycle non-split dominating set.

**Theorem 3.7.** Let $G$ be an Intuitionistic fuzzy graph. If $D$ is a cycle non-split dominating set, then there exists at least one strong arc in $D$.

**Proof:**

**Case (i):** Let $G$ be an Intuitionistic fuzzy graph with degree of each node is not equal. Let $D$ be a dominating set and the vertices of $D$ is isolated. Also $(V - D)$ is connected and form a cycle. Therefore $D$ is a cycle non-split dominating set.

**Case (ii):** Suppose $G$ is an IFG with degree of each node is equal. Then by theorem 3.15, $D$ is a cycle non-split dominating set and is connected. Since one adjacent vertex of each $v \in D$ occur in $(V - D)$, there exists at least one strong arc in $D$. Hence the theorem.

**Definition 3.4.** A dominating set $D$ of IFG $G$ is a strong Non-split dominating set if the induced subgraph $(V - D)$ is complete.

**Theorem 3.8.** Every complete intuitionistic fuzzy graph with vertices $P > 3$ contains strong non-split dominating set.

**Proof:** Let $G$ be complete IFG with vertices $P \leq 3$. Then for each $u \in V - D$ there exists a $v \in D$ such that $D$ is a path non-split dominating set or isolated vertex. This is a contradiction to the definition of strong non-split dominating set. Therefore, consider $P > 3$ since $G$ is complete, degree of each node is equal.
Also by definition, \( \mu_{2ij} = \min\{\mu_{ij}, \mu_{ij}\} \) and \( \gamma_{2ij} = \max\{\gamma_{ij}, \gamma_{ij}\} \) for every \( v_i, v_j \in V \). Hence there exists at least one strong arc in each node. This implies for each \( u \in V - D \) there exists \( v \in D \) and \( \langle V-D \rangle \) is complete. Hence \( D \) is strong non-split dominating set.

**Example 3.9.**

![Figure 9:](image)

Here strong arcs are \( e_1, e_2, e_3, e_5, e_6, e_7, e_9 \) and \( e_{10} \).

Let \( D = \{v_3, v_4\} \) and \( V - D = \{v_1, v_2, v_5\} \) is complete. Therefore \( D \) is a strong non-split dominating set.

**Definition 3.5.** A dominating set \( D \) of a connected IFG \( G \) is global non-split dominating set of both \( G \) and \( \overline{G} \).

**Example: 3.10.**

![Figure 10:](image)

Here strong arcs are \( e_1, e_3 \).

Let \( D = \{v_1\} \), \( V - D = \{v_2, v_3\} \). Let \( D = \{v_1\} \), \( V - D = \{v_2, v_3\} \).

Hence \( D \) is a global dominating set.

4. **Conclusion**

This paper identifies non-split domination number on intuitionistic fuzzy graph \( G \). We have defined different types of non-split dominating sets such as path non-split domination, cycle non-split domination, strong non-split domination and global non-split domination. Using these definitions we explore more theorems in future work.

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