SuperHyperDominating and SuperHyperResolving on Neutrosophic SuperHyperGraphs And Their Directions in Game Theory and Neutrosophic SuperHyperClasses

Henry Garrett

Independent Researcher

DrHenryGarrett@gmail.com

Twitter's ID: @DrHenryGarrett | ©DrHenryGarrett.wordpress.com

Abstract

In this research article, the notions of SuperHyperDominating and SuperHyperResolving are defined in the setting of neutrosophic SuperHyperGraphs. Some ideas are introduced on both notions of SuperHyperDominating and SuperHyperResolving, simultaneously and as the same with each other. Some neutrosophic SuperHyperClasses are defined based on the notion, SuperHyperResolving. The terms of duality, totality, perfectness, connectedness, and stable, are added to basic framework and initial notions, SuperHyperDominating and SuperHyperResolving but the concentration is on the "perfectness" to figure out what's going on when for all targeted SuperHyperVertices, there's only one SuperHyperVertex in the intended set. There are some instances and some clarifications to make sense about what's happened and what's done in the starting definitions. The key point is about the minimum sets. There are some questions and some problems to be taken as some avenues to pursue this study and this research. A basic familiarity with SuperHyperGraph theory and neutrosophic SuperHyperGraph theory are proposed.

Keywords: SuperHyperDominating, SuperHyperResolving, SuperHyperGraphs, Neutrosophic SuperHyperGraphs, Neutrosophic SuperHyperClasses
AMS Subject Classification: 05C17, 05C22, 05E45

1 Background

There are some studies covering the topic of this research. In what follows, there are some discussion and literature reviews about them.

First article is titled "properties of SuperHyperGraph and neutrosophic SuperHyperGraph" in **Ref.** [7] by Henry Garrett (2022). It's first step toward the study on neutrosophic SuperHyperGraphs. This research article is published on the journal "Neutrosophic Sets and Systems" in issue 49 and the pages 531-561. In this research article, different types of notions like dominating, resolving, coloring, Eulerian(Hamiltonian) neutrosophic path, n-Eulerian(Hamiltonian) neutrosophic path, zero forcing number, zero forcing neutrosophic- number, independent number, independent neutrosophic-number, clique number, clique neutrosophic-number, matching number, matching neutrosophic-number, girth, neutrosophic girth, 1-zero-forcing number, 1-zero- forcing neutrosophic-number, failed 1-zero-forcing number, failed 1-zero-forcing neutrosophic-number, global- offensive alliance, t-offensive alliance, t-defensive alliance, t-powerful alliance, and global-powerful alliance are defined in SuperHyperGraph and neutrosophic SuperHyperGraph. Some Classes of SuperHyperGraph and Neutrosophic SuperHyperGraph are cases of study. Some results are applied in family of SuperHyperGraph and neutrosophic SuperHyperGraph. Thus this research article has concentrated on the vast notions and introducing the majority of notions.

The seminal paper and groundbreaking article is titled "neutrosophic co-degree and neutrosophic degree alongside chromatic numbers in the setting of some classes related to neutrosophic hypergraphs" in **Ref.** [5] by Henry Garrett (2022). In this research article, a novel approach is implemented on SuperHyperGraph and neutrosophic SuperHyperGraph based on general forms without using neutrosophic classes of neutrosophic SuperHyperGraph. It's published in prestigious and fancy journal is entitled "Journal of Current Trends in Computer Science Research (JCTCSR)" with abbreviation "J Curr Trends Comp Sci Res" in volume 1 and issue 1 with pages 06-14. The research article studies deeply with choosing neutrosophic hypergraphs instead of neutrosophic SuperHyperGraph. It's the breakthrough toward independent results based on initial background.

In two articles are titled "Initial Material of Neutrosophic Preliminaries to Study Some Neutrosophic Notions Based on Neutrosophic SuperHyperEdge (NSHE) in Neutrosophic SuperHyperGraph (NSHG)" in **Ref.** [8] by Henry Garrett (2022) and "Basic Neutrosophic Notions Concerning SuperHyperDominating and Neutrosophic SuperHyperResolving in SuperHyperGraph" in **Ref.** [2] by Henry Garrett (2022) , there are some efforts to formalize the basic notions about neutrosophic SuperHyperGraph and SuperHyperGraph.

Some studies and researches about neutrosophic graphs, are proposed as book in **Ref.** [4] by Henry Garrett (2022) which is indexed by Google Scholar and has more than 1850 readers in Scribd. It's titled "Beyond Neutrosophic Graphs" and published by Ohio: E-publishing: Educational Publisher 1091 West 1st Ave Grandview Heights, Ohio 43212 United State. This research book covers different types of notions and settings in neutrosophic graph theory and neutrosophic SuperHyperGraph theory.

Also, some studies and researches about neutrosophic graphs, are proposed as book in **Ref.** [6] by Henry Garrett (2022) which is indexed by Google Scholar and has more than 2534 readers in Scribd. It's titled "Neutrosophic Duality" and published by Florida: GLOBAL KNOWLEDGE - Publishing House 848 Brickell Ave Ste 950 Miami, Florida 33131 United States. This research book presents different types of notions SuperHyperResolving and SuperHyperDominating in the setting of duality in neutrosophic graph theory and neutrosophic SuperHyperGraph theory. This research book has scrutiny on the complement of the intended set and the intended set, simultaneously. It's smart to consider a set but acting on its complement that what's done in this research book which is popular in the terms of high readers in Scribd.

1.1 Motivation and Contributions

In this study, there's an idea which could be considered as a motivation.

Question 1.1. *How to define a set of SuperHyperVertices such that its SuperHyperVertices either "connect" to all other SuperHyperVertices or "separate" all other couple of SuperHyperVertices?*

It's motivation to find notions to use in this dense model is titled "neutrosophic SuperHyperGraphs". The new notions, SuperHyperResolving and SuperHyperDominating, are applied in this setting. Different versions of these notions are introduced and studied like perfect, dual, connected, stable and total. How to figure out these notions leads us to get more results and to introduce neutrosophic classes of neutrosophic SuperHyperGraphs. The connections amid SuperHyperVertices motivates us to find minimum set such that this set only contains SuperHyperVertices and it has some elements connecting to other elements outside of this set. Another motivation is the key term "separation". Separating SuperHyperVertices from each other to distinguish amid them. It leads us to new measurement acting on the number of connections between SuperHyperVertices. Thus these ideas are the motivations to start this study. Minimum set concludes the discussion in every directions. Also, there are some avenues to extend these notions.

The framework of this study is as follows. In the beginning, I introduce basic definitions to clarify about preliminaries. In the subsection "Preliminaries", new notions of neutrosophic SuperHyperGraphs, perfect, dual, connected, stable, total, SuperHyperResolving, and SuperHyperDominating are defined for introduced results and used classes. In the section "The Setting of The Neutrosophic SuperHyperDominating", new notions are clarified and there are more instances to make more senses about the new ideas. In the section "The Setting of Maximum Number of The Neutrosophic Stable Perfect", the notion of stable is applied on the notion, perfect. The maximum number is the matter of minds and there are sufficient clarifications. In the section "The Setting of Maximum Number of The Neutrosophic Dual Perfect", the notion of dual is applied on the notion, perfect. The maximum number is intended and there are many examples and illustrations. There are other sections like "The Setting of Minimum Number of The Neutrosophic Notions", "The Setting of Minimum Number of The Neutrosophic Total Perfect", "The Setting of Minimum Number of The Neutrosophic ConnectedPerfect", "The Setting of The Neutrosophic SuperHyperResolving","Some Results on Neutrosophic Classes Via Minimum SuperHyperDominatingSet", "Minimum SuperHyperDominating Set and Minimum Perfect SuperHyperDominatingSet", "Applications in GameTheory", "Open Problems", "Conclusion and Closing Remarks". In the section "Applications in Game Theory", two applications are posed. In the section "Open Problems", some problems and questions for further studies are proposed. In the section "Conclusion and Closing Remarks", gentle discussion about results and applications is featured. In the section "Conclusion and Closing Remarks", a brief overview concerning advantages and limitations of this study alongside conclusions is formed.

1.2 Preliminaries

In this subsection, basic material which is used in this article, is presented. Also, new ideas and their clarifications are elicited.

Definition 1.2 (Neutrosophic Set)**.** (**Ref.** [3],Definition 2.1,p.87).

Let X be a space of points (objects) with generic elements in X denoted by x; then the **neutrosophic set** A (NS A) is an object having the form

$$A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$$

where the functions $T, I, F : X \to]^-0, 1^+[$ define respectively the a **truth-membership function**, an **indeterminacy-membership function**, and a **falsity-membership function** of the element $x \in X$ to the set A with the condition

$$^-0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3^+.$$

The functions $T_A(x), I_A(x)$ and $F_A(x)$ are real standard or nonstandard subsets of $]^-0, 1^+[$.

Definition 1.3 (Single Valued Neutrosophic Set)**.** (**Ref.** [11],Definition 6,p.2).

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Let X be a space of points (objects) with generic elements in X denoted by x. A **single valued neutrosophic set** A (SVNS A) is characterized by truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$, and a falsity-membership function $F_A(x)$. For each point x in X, $T_A(x), I_A(x), F_A(x) \in [0,1]$. A SVNS A can be written as

$$A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}.$$

Definition 1.4. The **degree of truth-membership**, **indeterminacy-membership** and **falsity-membership of the subset** $X \subset A$ of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$T_A(X) = \min[T_A(v_i), T_A(v_j)]_{v_i, v_j \in X},$$

$$I_A(X) = \min[I_A(v_i), I_A(v_j)]_{v_i, v_j \in X},$$

$$\text{and } F_A(X) = \min[F_A(v_i), F_A(v_j)]_{v_i, v_j \in X}.$$

Definition 1.5. The **support** of $X \subset A$ of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$supp(X) = \{x \in X : \ T_A(x), I_A(x), F_A(x) > 0\}.$$

Definition 1.6 (Neutrosophic SuperHyperGraph (NSHG))**.** (**Ref.** [10],Definition 3,p.291).

Assume V' is a given set. A **neutrosophic SuperHyperGraph** (NSHG) S is an ordered pair $S = (V, E)$, where

(i) $V = \{V_1, V_2, \ldots, V_n\}$ a finite set of finite single valued neutrosophic subsets of V';

(ii) $V = \{(V_i, T_{V'}(V_i), I_{V'}(V_i), F_{V'}(V_i)) : \ T_{V'}(V_i), I_{V'}(V_i), F_{V'}(V_i) \geq 0\}$, $(i = 1, 2, \ldots, n)$;

(iii) $E = \{E_1, E_2, \ldots, E_{n'}\}$ a finite set of finite single valued neutrosophic subsets of V;

(iv) $E = \{(E_{i'}, T'_V(E_{i'}), I'_V(E_{i'}), F'_V(E_{i'})) : \ T'_V(E_{i'}), I'_V(E_{i'}), F'_V(E_{i'}) \geq 0\}$, $(i' = 1, 2, \ldots, n')$;

(v) $V_i \neq \emptyset$, $(i = 1, 2, \ldots, n)$;

(vi) $E_{i'} \neq \emptyset$, $(i' = 1, 2, \ldots, n')$;

(vii) $\sum_i supp(V_i) = V$, $(i = 1, 2, \ldots, n)$;

$(viii)$ $\sum_{i'} supp(E_{i'}) = V$, $(i' = 1, 2, \ldots, n')$;

(ix) and the following conditions hold:

$$T'_V(E_{i'}) \leq \min[T_{V'}(V_i), T_{V'}(V_j)]_{V_i, V_j \in E_{i'}},$$

$$I'_V(E_{i'}) \leq \min[I_{V'}(V_i), I_{V'}(V_j)]_{V_i, V_j \in E_{i'}},$$

$$\text{and } F'_V(E_{i'}) \leq \min[F_{V'}(V_i), F_{V'}(V_j)]_{V_i, V_j \in E_{i'}}$$

where $i' = 1, 2, \ldots, n'$.

Here the neutrosophic SuperHyperEdges (NSHE) $E_{j'}$ and the neutrosophic SuperHyperVertices (NSHV) V_j are single valued neutrosophic sets. $T_{V'}(V_i), I_{V'}(V_i)$, and $F_{V'}(V_i)$ denote the degree of truth-membership, the degree of indeterminacy-membership and the degree of falsity-membership the neutrosophic SuperHyperVertex (NSHV) V_i to the neutrosophic SuperHyperVertex (NSHV) V.

$T'_V(E_{i'}), T'_V(E_{i'})$, and $T'_V(E_{i'})$ denote the degree of truth-membership, the degree of indeterminacy-membership and the degree of falsity-membership of the neutrosophic SuperHyperEdge (NSHE) $E_{i'}$ to the neutrosophic SuperHyperEdge (NSHE) E. Thus, the ii'th element of the **incidence matrix** of neutrosophic SuperHyperGraph (NSHG) are of the form $(V_i, T'_V(E_{i'}), I'_V(E_{i'}), F'_V(E_{i'}))$, the sets V and E are crisp sets.

Definition 1.7 (Characterization of the Neutrosophic SuperHyperGraph (NSHG))**.** (**Ref.** [10],Section 4,pp.291-292).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. The neutrosophic SuperHyperEdges (NSHE) $E_{i'}$ and the neutrosophic SuperHyperVertices (NSHV) V_i of neutrosophic SuperHyperGraph (NSHG) $S = (V, E)$ could be characterized as follow-up items.

(i) If $|V_i| = 1$, then V_i is called **vertex**;

(ii) if $|V_i| \geq 1$, then V_i is called **SuperVertex**;

(iii) if for all V_is are incident in $E_{i'}$, $|V_i| = 1$, and $|E_{i'}| = 2$, then $E_{i'}$ is called **edge**;

(iv) if for all V_is are incident in $E_{i'}$, $|V_i| = 1$, and $|E_{i'}| \geq 2$, then $E_{i'}$ is called **HyperEdge**;

(v) if there's a V_i is incident in $E_{i'}$ such that $|V_i| \geq 1$, and $|E_{i'}| = 2$, then $E_{i'}$ is called **SuperEdge**;

(vi) if there's a V_i is incident in $E_{i'}$ such that $|V_i| \geq 1$, and $|E_{i'}| \geq 2$, then $E_{i'}$ is called **SuperHyperEdge**.

If we choose different types of binary operations, then we could get hugely diverse types of general forms of neutrosophic SuperHyperGraph (NSHG).

Definition 1.8 (t-norm)**.** (**Ref.** [9], Definition 5.1.1, pp.82-83).

A binary operation $\otimes : [0,1] \times [0,1] \to [0,1]$ is a ***t*-norm** if it satisfies the following for $x, y, z, w \in [0,1]$:

(i) $1 \otimes x = x$;

(ii) $x \otimes y = y \otimes x$;

(iii) $x \otimes (y \otimes z) = (x \otimes y) \otimes z$;

(iv) If $w \leq x$ and $y \leq z$ then $w \otimes y \leq x \otimes z$.

Definition 1.9. The **degree of truth-membership**, **indeterminacy-membership** and **falsity-membership of the subset** $X \subset A$ of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$ (with respect to t-norm T_{norm}):

$$T_A(X) = T_{norm}[T_A(v_i), T_A(v_j)]_{v_i, v_j \in X},$$

$$I_A(X) = T_{norm}[I_A(v_i), I_A(v_j)]_{v_i, v_j \in X},$$

$$\text{and } F_A(X) = T_{norm}[F_A(v_i), F_A(v_j)]_{v_i, v_j \in X}.$$

Definition 1.10. The **support** of $X \subset A$ of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$supp(X) = \{x \in X : \ T_A(x), I_A(x), F_A(x) > 0\}.$$

Definition 1.11. (General Forms of Neutrosophic SuperHyperGraph (NSHG)).

Assume V' is a given set. A **neutrosophic SuperHyperGraph** (NSHG) S is an ordered pair $S = (V, E)$, where

(i) $V = \{V_1, V_2, \ldots, V_n\}$ a finite set of finite single valued neutrosophic subsets of V';

(ii) $V = \{(V_i, T_{V'}(V_i), I_{V'}(V_i), F_{V'}(V_i)) : \ T_{V'}(V_i), I_{V'}(V_i), F_{V'}(V_i) \geq 0\}, \ (i = 1, 2, \ldots, n)$;

(iii) $E = \{E_1, E_2, \ldots, E_{n'}\}$ a finite set of finite single valued neutrosophic subsets of V;

(iv) $E = \{(E_{i'}, T'_V(E_{i'}), I'_V(E_{i'}), F'_V(E_{i'})) : \ T'_V(E_{i'}), I'_V(E_{i'}), F'_V(E_{i'}) \geq 0\}, \ (i' = 1, 2, \ldots, n')$;

(v) $V_i \neq \emptyset, \ (i = 1, 2, \ldots, n)$;

(vi) $E_{i'} \neq \emptyset, \ (i' = 1, 2, \ldots, n')$;

(vii) $\sum_i supp(V_i) = V, \ (i = 1, 2, \ldots, n)$;

$(viii)$ $\sum_{i'} supp(E_{i'}) = V, \ (i' = 1, 2, \ldots, n')$.

Here the neutrosophic SuperHyperEdges (NSHE) $E_{j'}$ and the neutrosophic SuperHyperVertices (NSHV) V_j are single valued neutrosophic sets. $T_{V'}(V_i), I_{V'}(V_i)$, and $F_{V'}(V_i)$ denote the degree of truth-membership, the degree of indeterminacy-membership and the degree of falsity-membership the neutrosophic SuperHyperVertex (NSHV) V_i to the neutrosophic SuperHyperVertex (NSHV) V. $T'_V(E_{i'}), T'_V(E_{i'})$, and $T'_V(E_{i'})$ denote the degree of truth-membership, the degree of indeterminacy-membership and the degree of falsity-membership of the neutrosophic SuperHyperEdge (NSHE) $E_{i'}$ to the neutrosophic SuperHyperEdge (NSHE) E. Thus, the ii'th element of the **incidence matrix** of neutrosophic SuperHyperGraph (NSHG) are of the form $(V_i, T'_V(E_{i'}), I'_V(E_{i'}), F'_V(E_{i'}))$, the sets V and E are crisp sets.

Definition 1.12 (Characterization of the Neutrosophic SuperHyperGraph (NSHG))**.** (**Ref.** [10],Section 4,pp.291-292).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. The neutrosophic SuperHyperEdges (NSHE) $E_{i'}$ and the neutrosophic SuperHyperVertices (NSHV) V_i of neutrosophic SuperHyperGraph (NSHG) $S = (V, E)$ could be characterized as follow-up items.

(i) If $|V_i| = 1$, then V_i is called **vertex**;

(ii) if $|V_i| \geq 1$, then V_i is called **SuperVertex**;

(iii) if for all V_is are incident in $E_{i'}$, $|V_i| = 1$, and $|E_{i'}| = 2$, then $E_{i'}$ is called **edge**;

(iv) if for all V_is are incident in $E_{i'}$, $|V_i| = 1$, and $|E_{i'}| \geq 2$, then $E_{i'}$ is called **HyperEdge**;

(v) if there's a V_i is incident in $E_{i'}$ such that $|V_i| \geq 1$, and $|E_{i'}| = 2$, then $E_{i'}$ is called **SuperEdge**;

(vi) if there's a V_i is incident in $E_{i'}$ such that $|V_i| \geq 1$, and $|E_{i'}| \geq 2$, then $E_{i'}$ is called **SuperHyperEdge**.

Definition 1.13. (Neutrosophic SuperHyperDominating).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. Let D be a set of neutrosophic SuperHyperVertices (NSHV) [a SuperHyperVertex alongside triple pair of its values is called neutrosophic SuperHyperVertex (NSHV).]. If for every neutrosophic SuperHyperVertex (NSHV) N in $V \setminus D$, there's at least a neutrosophic SuperHyperVertex (NSHV) D_i in D such that N, D_i is in a neutrosophic SuperHyperEdge (NSHE) is neutrosophic then the set of neutrosophic SuperHyperVertices (NSHV) S is called **neutrosophic SuperHyperDominating**

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set. The minimum neutrosophic cardinality between all neutrosophic SuperHyperDominating sets is called **neutrosophic SuperHyperDominating number** and it's denoted by

$\mathcal{D}(NSHG)$ where **(neutrosophic cardinality** of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$|A|_T = \sum [T_A(v_i), T_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_I = \sum [I_A(v_i), I_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_F = \sum [F_A(v_i), F_A(v_j)]_{v_i, v_j \in A},$$

$$\text{and } |A| = \sum [|A|_T, |A|_I, |A|_F].$$

Definition 1.14. (Neutrosophic Dual SuperHyperDominating).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. Let D be a set of neutrosophic SuperHyperVertices (NSHV) [a SuperHyperVertex alongside triple pair of its values is called neutrosophic SuperHyperVertex (NSHV).]. If for every neutrosophic SuperHyperVertex (NSHV) D_i in D, there's at least a neutrosophic SuperHyperVertex (NSHV) N in $V \setminus D$, such that N, D_i is in a neutrosophic SuperHyperEdge (NSHE) is neutrosophic then the set of neutrosophic SuperHyperVertices (NSHV) S is called **neutrosophic dual SuperHyperDominating set**. The minimum neutrosophic cardinality between all neutrosophic SuperHyperDominating sets is called **neutrosophic dual SuperHyperDominating number** and it's denoted by $\mathcal{D}(NSHG)$ where **neutrosophic cardinality** of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$|A|_T = \sum [T_A(v_i), T_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_I = \sum [I_A(v_i), I_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_F = \sum [F_A(v_i), F_A(v_j)]_{v_i, v_j \in A},$$

$$\text{and } |A| = \sum [|A|_T, |A|_I, |A|_F].$$

Definition 1.15. (Neutrosophic Perfect SuperHyperDominating).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. Let D be a set of neutrosophic SuperHyperVertices (NSHV) [a SuperHyperVertex alongside triple pair of its values is called neutrosophic SuperHyperVertex (NSHV).]. If for every neutrosophic SuperHyperVertex (NSHV) N in $V \setminus D$, there's only one neutrosophic SuperHyperVertex (NSHV) D_i in D such that N, D_i is in a neutrosophic SuperHyperEdge (NSHE) is neutrosophic then the set of neutrosophic SuperHyperVertices (NSHV) S is called **neutrosophic perfect SuperHyperDominating set**. The minimum neutrosophic cardinality between all neutrosophic SuperHyperDominating sets is called **neutrosophic perfect SuperHyperDominating number** and it's denoted by $\mathcal{D}(NSHG)$ where **neutrosophic cardinality** of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$|A|_T = \sum [T_A(v_i), T_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_I = \sum [I_A(v_i), I_A(v_j)]_{v_i, v_j \in A},$$

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$$|A|_F = \sum [F_A(v_i), F_A(v_j)]_{v_i, v_j \in A},$$

$$\text{and } |A| = \sum [|A|_T, |A|_I, |A|_F].$$

Definition 1.16. (Neutrosophic Total SuperHyperDominating).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. Let D be a set of neutrosophic SuperHyperVertices (NSHV) [a SuperHyperVertex alongside triple pair of its values is called neutrosophic SuperHyperVertex (NSHV).]. If for every neutrosophic SuperHyperVertex (NSHV) N in V, there's at least a neutrosophic SuperHyperVertex (NSHV) D_i in D such that N, D_i is in a neutrosophic SuperHyperEdge (NSHE) is neutrosophic then the set of neutrosophic SuperHyperVertices (NSHV) S is called **neutrosophictotal SuperHyperDominating set**. The minimum neutrosophic cardinality between all neutrosophic SuperHyperDominating sets is called **neutrosophictotal SuperHyperDominating number** and it's denoted by $\mathcal{D}(NSHG)$ where **neutrosophic cardinality** of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$|A|_T = \sum [T_A(v_i), T_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_I = \sum [I_A(v_i), I_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_F = \sum [F_A(v_i), F_A(v_j)]_{v_i, v_j \in A},$$

$$\text{and } |A| = \sum [|A|_T, |A|_I, |A|_F].$$

Definition 1.17. (Neutrosophic SuperHyperResolving).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. Let R be a set of neutrosophic SuperHyperVertices (NSHV) [a SuperHyperVertex alongside triple pair of its values is called neutrosophic SuperHyperVertex (NSHV).]. If for every neutrosophic SuperHyperVertices (NSHV) N and N' in $V \setminus R$, there's at least a neutrosophic SuperHyperVertex (NSHV) R_i in R such that N and N' are neutrosophic resolved by R_i, then the set of neutrosophic SuperHyperVertices (NSHV) S is called **neutrosophicSuperHyperResolving set**. The minimum neutrosophic cardinality between all neutrosophic SuperHyperResolving sets is called neutrosophic **SuperHyperResolving number** and it's denoted by

$\mathcal{R}(NSHG)$ where neutrosophic cardinality of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$|A|_T = \sum [T_A(v_i), T_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_I = \sum [I_A(v_i), I_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_F = \sum [F_A(v_i), F_A(v_j)]_{v_i, v_j \in A},$$

$$\text{and } |A| = \sum [|A|_T, |A|_I, |A|_F].$$

Definition 1.18. (Neutrosophic Dual SuperHyperResolving).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. Let R be a set of neutrosophic SuperHyperVertices (NSHV) [a SuperHyperVertex alongside triple pair of its values is called neutrosophic SuperHyperVertex (NSHV).]. If for every neutrosophic SuperHyperVertices (NSHV) R_i and R_j in R, there's at least a neutrosophic SuperHyperVertex (NSHV) N in $V \setminus R$ such that R_i and R_j are neutrosophic resolved by R_i, then the set of neutrosophic SuperHyperVertices (NSHV)

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S is called **neutrosophic dual SuperHyperResolving set**. The minimum neutrosophic cardinality between all neutrosophic SuperHyperResolving sets is called **neutrosophicdual SuperHyperResolving number** and it's denoted by

$\mathcal{R}(NSHG)$ where neutrosophic cardinality of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$|A|_T = \sum [T_A(v_i), T_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_I = \sum [I_A(v_i), I_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_F = \sum [F_A(v_i), F_A(v_j)]_{v_i, v_j \in A},$$

$$\text{and } |A| = \sum [|A|_T, |A|_I, |A|_F].$$

Definition 1.19. (Neutrosophic Perfect SuperHyperResolving).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. Let R be a set of neutrosophic SuperHyperVertices (NSHV) [a SuperHyperVertex alongside triple pair of its values is called neutrosophic SuperHyperVertex (NSHV).]. If for every neutrosophic SuperHyperVertices (NSHV) N and N' in $V \setminus R$, there's only one neutrosophic SuperHyperVertex (NSHV) R_i in R such that N and N' are neutrosophic resolved by R_i, then the set of neutrosophic SuperHyperVertices (NSHV) S is called **neutrosophic perfect SuperHyperResolving set**. The minimum neutrosophic cardinality between all neutrosophic SuperHyperResolving sets is called neutrosophic **perfect SuperHyperResolving number** and it's denoted by $\mathcal{R}(NSHG)$ where **neutrosophic cardinality** of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$|A|_T = \sum [T_A(v_i), T_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_I = \sum [I_A(v_i), I_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_F = \sum [F_A(v_i), F_A(v_j)]_{v_i, v_j \in A},$$

$$\text{and } |A| = \sum [|A|_T, |A|_I, |A|_F].$$

Definition 1.20. (Neutrosophic Total SuperHyperResolving).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. Let R be a set of neutrosophic SuperHyperVertices (NSHV) [a SuperHyperVertex alongside triple pair of its values is called neutrosophic SuperHyperVertex (NSHV).]. If for every neutrosophic SuperHyperVertices (NSHV) N and N' in V, there's at least a neutrosophic SuperHyperVertex (NSHV) R_i in R such that N and N' are neutrosophic resolved by R_i, then the set of neutrosophic SuperHyperVertices (NSHV) S is called **neutrosophic total SuperHyperResolving set**. The minimum neutrosophic cardinality between all neutrosophic SuperHyperResolving sets is called **neutrosophic total SuperHyperResolving number** and it's denoted by

$\mathcal{R}(NSHG)$ where **neutrosophic cardinality** of the single valued neutrosophic set $A = \{< x : T_A(x), I_A(x), F_A(x) >, x \in X\}$:

$$|A|_T = \sum [T_A(v_i), T_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_I = \sum [I_A(v_i), I_A(v_j)]_{v_i, v_j \in A},$$

$$|A|_F = \sum [F_A(v_i), F_A(v_j)]_{v_i, v_j \in A},$$

$$\text{and } |A| = \sum [|A|_T, |A|_I, |A|_F].$$

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Definition 1.21. (Neutrosophic Stable and Neutrosophic Connected).

Assume a neutrosophic SuperHyperGraph (NSHG) S is an ordered pair $S = (V, E)$. Let Z be a set of neutrosophic SuperHyperVertices (NSHV) [a SuperHyperVertex alongside triple pair of its values is called neutrosophic SuperHyperVertex (NSHV).]. Then Z is called

(i) **stable** if for every two neutrosophic SuperHyperVertices (NSHV) in Z, there's no SuperHyperPaths amid them;

(ii) **connected** if for every two neutrosophic SuperHyperVertices (NSHV) in Z, there's at least one SuperHyperPath amid them.

Thus Z is called

(i) **stable (k-number/dual/perfect/total) (SuperHyperResolving/SuperHyperDominating) set** if Z is (k-number/dual/perfect/total) (SuperHyperResolving/SuperHyperDominating) set and stable;

(ii) **connected (k-number/dual/perfect/total) (SuperHyperResolving/SuperHyperDominating) set** if Z is (k-number/dual/perfect/total) (SuperHyperResolving/SuperHyperDominating) set and connected.

A number N is called

(i) **stable (k-number/dual/perfect/total) (SuperHyperResolving/SuperHyperDominating) number** if its corresponded set Z is (k-number/dual/perfect/total) (SuperHyperResolving/SuperHyperDominating) set and stable;

(ii) **connected (k-number/dual/perfect/total) (SuperHyperResolving/SuperHyperDominating) number** if its corresponded set Z is (k-number/dual/perfect/total) (SuperHyperResolving/SuperHyperDominating) set and connected.

Thus Z is called

(i) **(-/stable/connected) (-/dual/total) perfect (SuperHyperResolving/SuperHyperDominating) set** if Z is (-/stable/connected) (-/dual/total) perfect (SuperHyperResolving/SuperHyperDominating) set.

A number N is called

(i) **(-/stable/connected) (-/dual/total) perfect (SuperHyperResolving/SuperHyperDominating) number** if its corresponded set Z is -/stable/connected) (-/dual/total) perfect (SuperHyperResolving/SuperHyperDominating) set.

2 The Setting of The Neutrosophic SuperHyperDominating

The Definitions of the terms in this section are referred by the previous chapter.

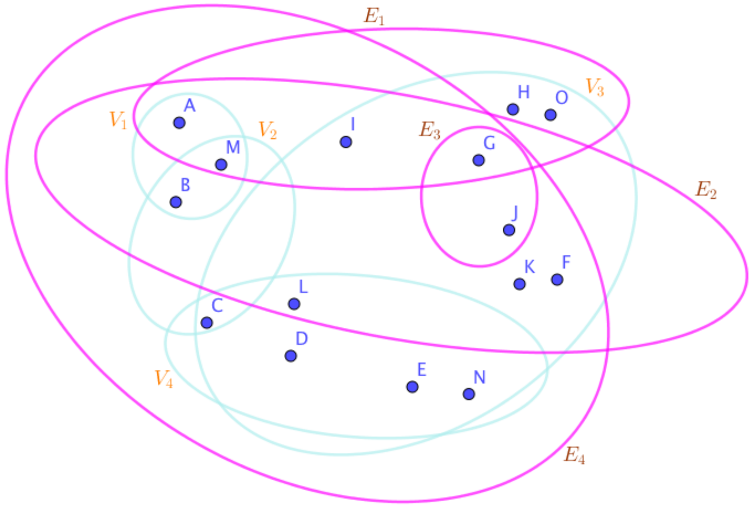

Figure 1. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (2.1)

Example 2.1. In Figure (1), the SuperHyperGraph is highlighted and featured. The sets, $\{A, B, C, D, E, F, G, H, I, J, K, L, M, N, O\}$, $\{V_1, V_2, V_3, V_4\}, \{E_3\}, \{E_1\}$, and $\{E_2, E_4\}$ are the sets of vertices, SuperVertices, edges, HyperEdges, and SuperHyperEdges, respectively. The SuperVertices V_1, V_2 and V_4 SuperHyperDominate each other by the SuperHyperEdge E_4. The SuperVertex V_3 doesn't SuperHyperDominate. The vertices G and J dominate each other by the edge E_3. The vertices $A, B, C, D, E, F, G, I, J, K, L, M,$ and N HyperDominate each other by the SuperHyperEdge E_4. The vertices H and O HyperDominate each other by the HyperEdge E_1. The set of vertices and SuperVertices, $\{A, H, V_1, V_3\}$ is minimal SuperHyperDominating set. The minimum SuperHyperDominating number is 17. The sets of vertices and SuperVertices, which are listed below, are the minimal SuperHyperDominating sets corresponded to the minimum SuperHyperDominating number which is 17.

$$\{A, H, V_1, V_3\}, \{M, H, V_1, V_3\}, \{B, H, V_1, V_3\}, \{C, H, V_1, V_3\}, \{L, H, V_1, V_3\},$$
$$\{D, H, V_1, V_3\}, \{E, H, V_1, V_3\}, \{N, H, V_1, V_3\}, \{A, H, V_2, V_3\}, \{M, H, V_2, V_3\},$$
$$\{B, H, V_2, V_3\}, \{C, H, V_2, V_3\}, \{L, H, V_2, V_3\}, \{D, H, V_2, V_3\}, \{E, H, V_2, V_3\},$$
$$\{N, H, V_2, V_3\}, \{A, O, V_1, V_3\}, \{M, O, V_1, V_3\}, \{B, O, V_1, V_3\}, \{C, O, V_1, V_3\},$$
$$\{L, O, V_1, V_3\}, \{D, O, V_1, V_3\}, \{E, O, V_1, V_3\}, \{N, O, V_1, V_3\}, \{A, O, V_2, V_3\},$$
$$\{M, O, V_2, V_3\}, \{B, O, V_2, V_3\}, \{C, O, V_2, V_3\}, \{L, O, V_2, V_3\}, \{D, O, V_2, V_3\},$$
$$\{E, O, V_2, V_3\}, \{N, O, V_2, V_3\}.$$

By using the Figure (2.1) and the Table (1), the neutrosophic SuperHyperGraph is obtained.

There are some points for the vertex A as follows.

(i) : The vertex A SuperHyperDominates M, I and G by using three SuperHyperEdges E_1, E_2, and E_4.

(ii) : The vertex A SuperHyperDominates B, J, K, L, and F by using two SuperHyperEdges E_2, and E_4.

Table 1. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (2.1)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

Table 2. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (2.2)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

(iii) : The vertex A SuperHyperDominates C, D, E, H, and N by using one SuperHyperEdge E_4.

There are some points for the vertex H as follows.

(i) : The vertex H SuperHyperDominates A, M, G, and O by using one SuperHyperEdge E_1.

There are some points for the SuperVertex V_1 as follows.

(i) : The SuperVertex V_1 SuperHyperDominates V_2, and V_4 by using one SuperHyperEdge E_4.

There are some points for the SuperVertex V_3 as follows.

(i) : The SuperVertex V_3 SuperHyperDominates no SuperVertex. It's an isolated SuperVertex.

In this case, there's no SuperHyperMatching.

With the exception of the isolated SuperVertex and the isolated vertex, the neutrosophic notion of perfect has no set here. In the upcoming section, a kind of a neutrosophic SuperHyperGraph will be featured. This kind is based on one kind of neutrosophic notions, perfect, total, global, connected, stable, k-number, dual, and the combinations of them.

Example 2.2. In Figure (2), the SuperHyperGraph is highlighted and featured. The sets, $\{A, B, C, D, E, F, G, H, I, J, K, L, M, N, O\}$, $\{V_1, V_2, V_3, V_4\}, \{E_3\}, \{E_1, E_2\}$, and $\{E_4\}$ are the sets of vertices, SuperVertices, edges, HyperEdges, and SuperHyperEdges, respectively. By using the Figure (2.2) and the Table (2), the neutrosophic SuperHyperGraph is obtained.

There are some points for the vertex A as follows.

(i) : The vertex A SuperHyperDominates $B, C, D, E, F, G, H, I, J, K, M, N$ and O by using one SuperHyperEdge E_4.

There are some points for the SuperVertex V_1 as follows.

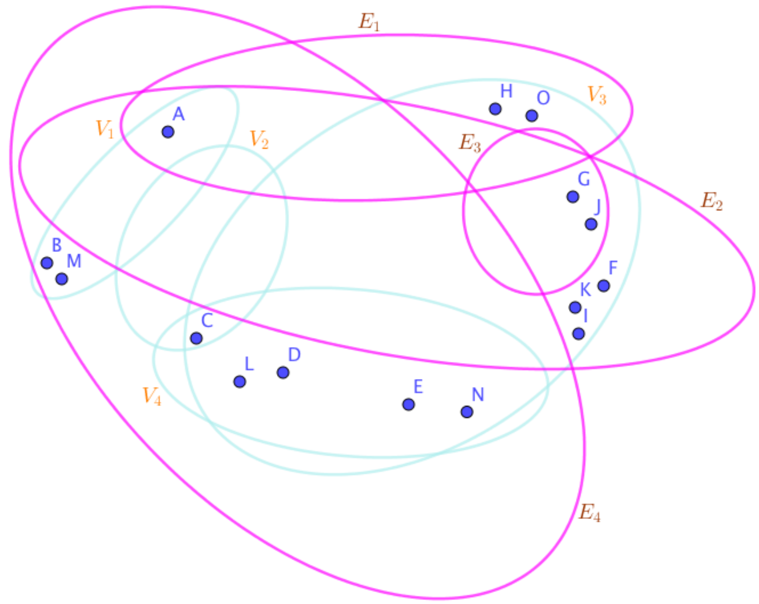

Figure 2. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (2.2)

(i) : The SuperVertex V_1 SuperHyperDominates V_2, and V_4 by using one SuperHyperEdge E_4.

There are some points for the SuperVertex V_3 as follows.

(i) : The SuperVertex V_3 SuperHyperDominates no SuperVertex. It's an isolated SuperVertex.

To sum them up, the set of SuperVertices and vertices $\{A, V_1, V_3\}$ is perfect SuperHyperDominating set. It's neither of connected, dual, total and stable SuperHyperDominating set. In this case, there's no SuperHyperMatching.

Proposition 2.3. *Consider a SuperHyperGraph. If a SuperHyperDominating set has either an isolated SuperVertex or an isolated vertex, then the set isn't connected, dual, and total.*

Proposition 2.4. *Consider a SuperHyperGraph. If a SuperHyperDominating set has either an isolated SuperVertex or an isolated vertex but neither all SuperVertices nor all vertices, then the set isn't connected, dual, total and stable.*

The Example (2.2), presents the obvious case in that, the set is perfect but neither of connected, dual, total and stable. The relation between the notion perfect and other notions, namely, connected, dual, total and stable are illustrated as follows.

Example 2.5. In Figure (3), the SuperHyperGraph is highlighted and featured. The sets, $\{A, B, C, D, E, F, H, I, K, L, M, N, O\}$, $\{V_1, V_2, V_3\}, \{E_2\}, \{E_3\}, \{E_1\}$, and $\{E_4\}$ are the sets of vertices, SuperVertices, loops, edges, HyperEdges, and SuperHyperEdges, respectively. By using the Figure (2.5) and the Table (3), the neutrosophic SuperHyperGraph is obtained.

There are some points for the vertex A as follows.

(i) : The vertex A SuperHyperDominates $B, C, D, E, F, H, I, K, L, M, N$ and O by using one SuperHyperEdge E_4.

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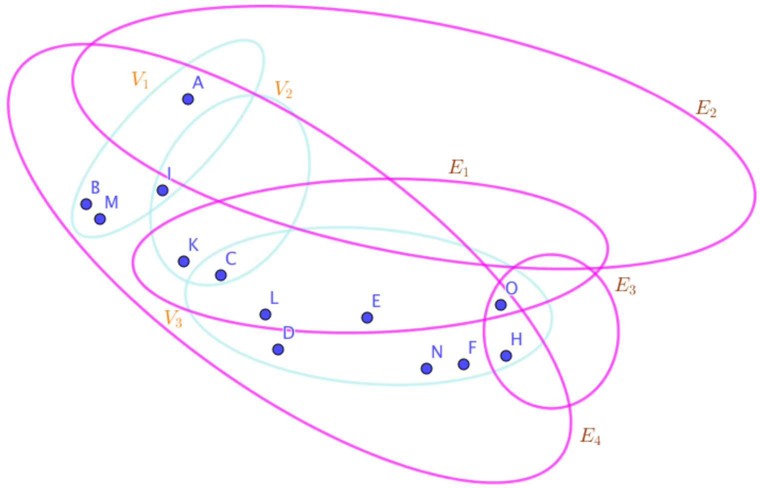

Figure 3. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (2.5)

Table 3. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (2.5)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

There are some points for the SuperVertex V_1 as follows.

(i) : The SuperVertex V_1 SuperHyperDominates V_2, and V_3 by using one SuperHyperEdge E_4.

To sum them up, the set of SuperVertices and vertices $\{A, V_1\}$ is perfect SuperHyperDominating set. It's either of connected, dual, and total SuperHyperDominating set but not stable SuperHyperDominating set. In this case, there's only one obvious SuperHyperMatching, namely, $\{E_4\}$.

Example 2.6. In Figure (4), the SuperHyperGraph is highlighted and featured. The sets, $\{A, B, C, D, E, F, H, I, K, L, M, N, O\}$, $\{V_1, V_2, V_3, V_4\}, \{E_3\}, \{E_1, E_2\}$, and $\{E_4, E_5\}$ are the sets of vertices, SuperVertices, loops, SuperEdges, HyperEdges, and SuperHyperEdges, respectively. By using the Figure (2.6) and the Table (4), the neutrosophic SuperHyperGraph is obtained.

In this case, there's a SuperHyperMatching, namely, $\{E_1, E_4, E_5, E_2\}$.

Table 4. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (2.6)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

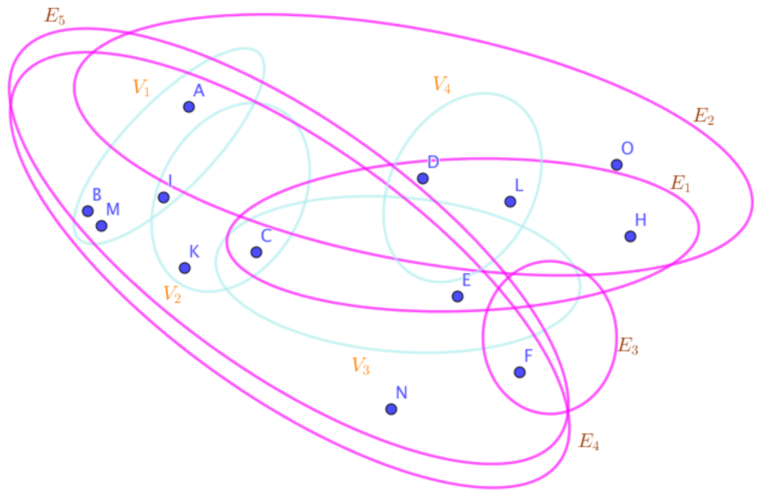

Figure 4. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (2.6)

In the Example (2.6), the SuperHyperMatching, namely, $\{E_1, E_4, E_5, E_2\}$, is proper. The term "proper" is referred to the case where edges, SuperEdges, HyperEdges, and SuperHyperEdges have no common endpoints with the exception in which the vertices and their SuperVertices could be endpoints for same SuperEdges, HyperEdges, and SuperHyperEdges.

Definition 2.7. Assume a neutrosophic SuperHyperGraph. Then

(i) : two vertices are **isolated** if there's no edge amid them;

(ii) : two vertices are **HyperIsolated** if there's no HyperEdge amid them;

(iii) : two vertices or SuperVertices are **SuperIsolated** if there's no SuperEdge amid them;

(iv) : two vertices or SuperVertices are **SuperHyperIsolated** if there's no SuperHyperEdge amid them;

(v) : a **notion** holds if the connections amid points are all edges;

(vi) : a **HyperNotion** holds if the set of connections amid points contains at least one HyperEdges;

(vii) : a **SuperNotion** holds if the connections amid points are all SuperEdges;

$(viii)$: a **SuperHyperNotion** holds if the set of connections amid points contains at least one SuperHyperEdges;

(ix) : If the connections amid vertices and the SuperVertices include them, count one time then the notion is **SuperHyperProper**;

Assume there's a point which connects to all other points and there's no connection more.

(x) : it's a **star** if the connections amid points are all edges;

(xi) : it's a **HyperStar** if the set of connections amid points contains at least one HyperEdges;

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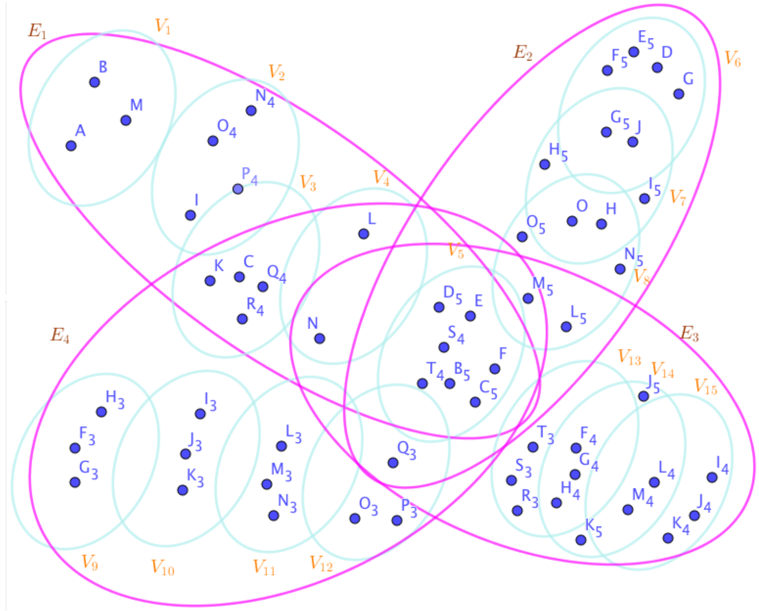

Figure 5. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (3.1)

Table 5. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (3.1)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

(xii) : it's a **SuperStar** if the connections amid points are all SuperEdges;

$(xiii)$: it's a **SuperHyperStar** if the set of connections amid points contains at least one SuperHyperEdges.

A SuperHyperStar is illustrated in the Example (3.1).

3 The Setting of Maximum Number of The Neutrosophic Stable Perfect

The natural extension is concerned to find minimum number of neutrosophic notions. Since the maximum number is always the number of vertices or neutrosophic number [which could be defined in different ways] of vertices.

Example 3.1. In Figure (5), the SuperHyperGraph is highlighted and featured. By using the Figure (3.1) and the Table (5), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperDominating, namely, $\{E, V_5\}$.

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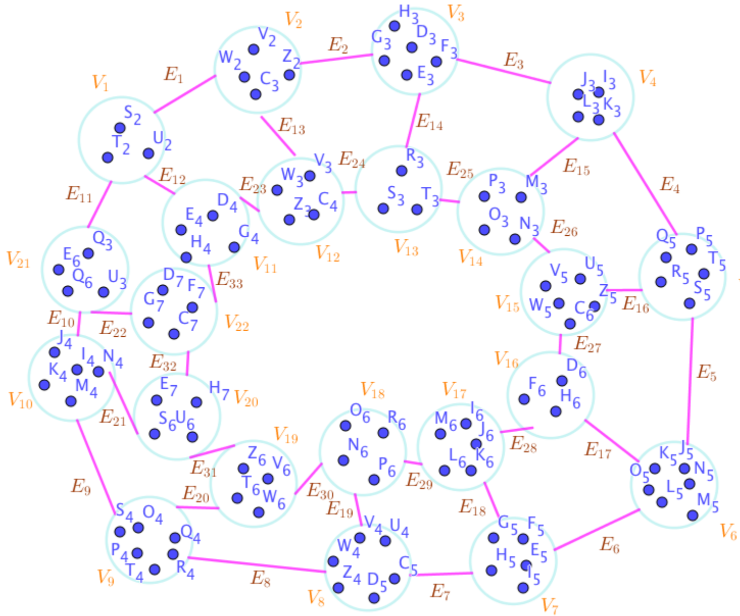

Figure 6. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (4.1)

Table 6. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (4.1)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

4 The Setting of Maximum Number of The Neutrosophic Dual Perfect

Example 4.1. In Figure (6), the SuperHyperGraph is highlighted and featured. By using the Figure (4.1) and the Table (6), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the maximum dual perfect SuperHyperDominating set, namely, $\{V_{11}, V_{12}, V_{13}, V_{14}, V_{15}, V_{16}, V_{17}, V_{18}, V_{19}, V_{20}, V_{22}\}$.

Example 4.2. In Figure (7), the SuperHyperGraph is highlighted and featured. By using the Figure (4.2) and the Table (7), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the maximum dual perfect SuperHyperDominating set, namely, $\{V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8, V_9, V_{10}, V_{11}\}$.

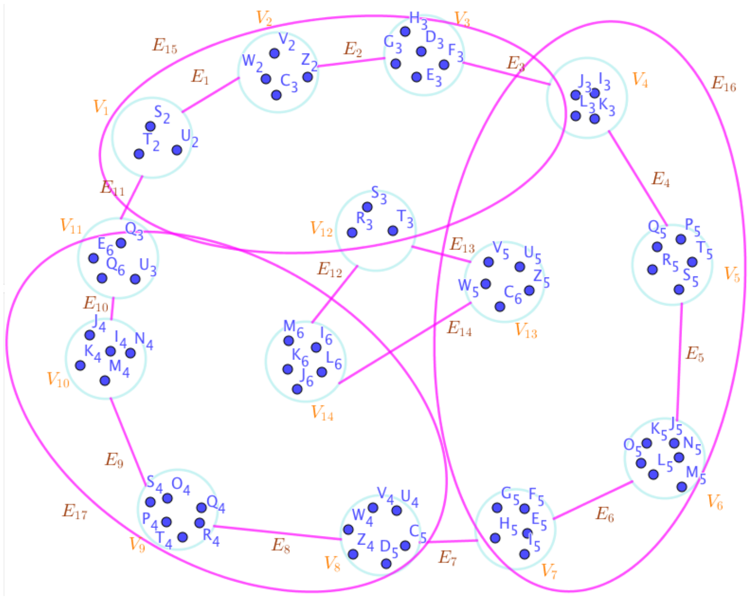

Figure 7. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (4.2)

Table 7. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (4.2)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

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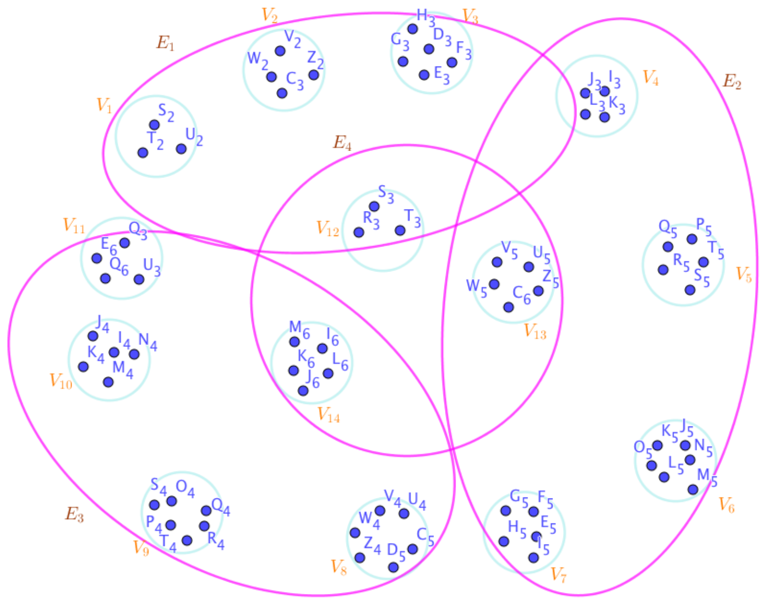

Figure 8. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (6.1)

Table 8. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (6.1)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

5 The Setting of Minimum Number of The Neutrosophic Notions

6 The Setting of Minimum Number of The Neutrosophic Total Perfect

Since there's a possibility to have an SuperHyperEdge contains multiple SuperVertices, instead of selecting a SuperVertex, the section of a SuperHyperEdge is substituted in the Definition of SuperHyperDominating. In the context of perfect, finding unique SuperHyperEdge is only matter.

Example 6.1. In Figure (8), the SuperHyperGraph is highlighted and featured. By using the Figure (6.1) and the Table (8), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum total perfect SuperHyperDominating set, namely, $\{V_{12}, V_{13}, V_{14}\}$.

Example 6.2. In Figure (9), the SuperHyperGraph is highlighted and featured. By using the Figure (6.2) and the Table (9), the neutrosophic SuperHyperGraph is obtained.

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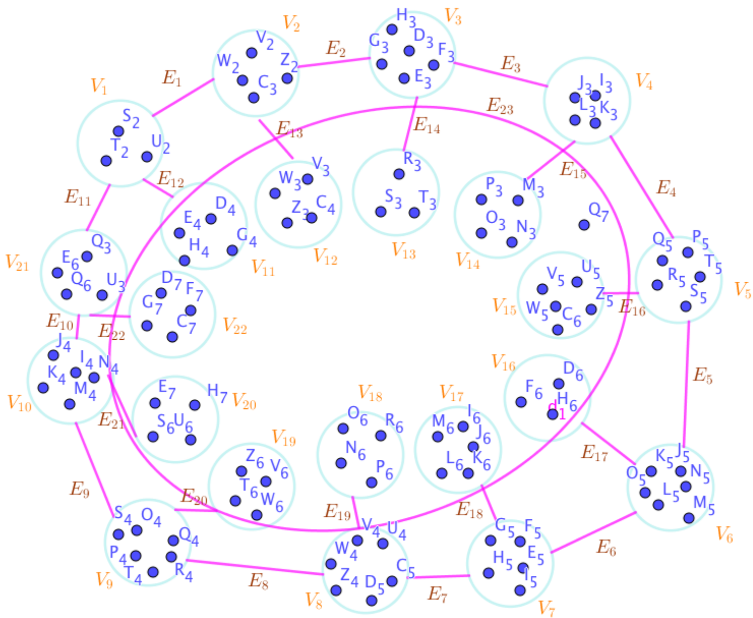

Figure 9. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (6.2)

Table 9. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (6.2)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

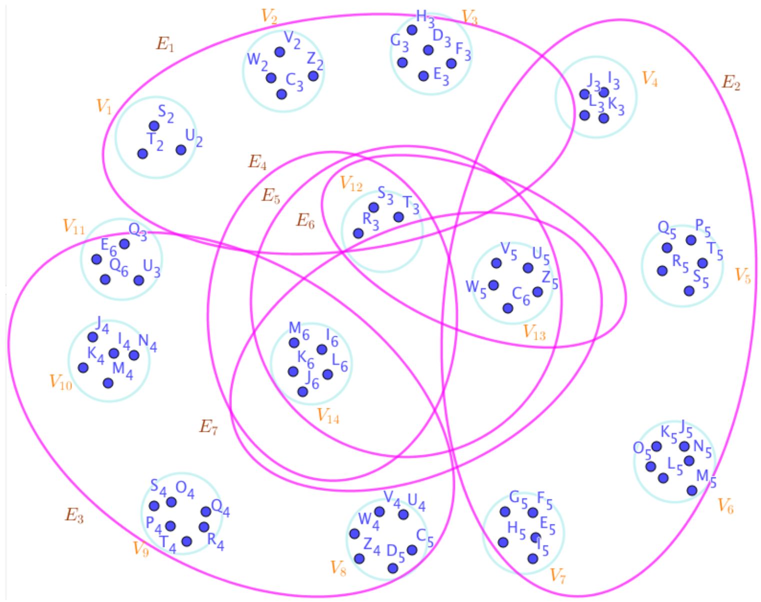

Figure 10. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating in the Example (7.1)

Table 10. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (7.1)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

In this case, there's the minimum total perfect SuperHyperDominating set, namely, $\{V_{11}, V_{12}, V_{13}, V_{14}, V_{15}, V_{16}, V_{17}, V_{18}, V_{19}, V_{20}, V_{22}\}$.

7 The Setting of Minimum Number of The Neutrosophic Connected Perfect

Example 7.1. In Figure (10), the SuperHyperGraph is highlighted and featured. By using the Figure (7.1) and the Table (10), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum connected perfect SuperHyperDominating set, namely, $\{V_{12}, V_{13}, V_{14}\}$ but neither of minimum total perfect SuperHyperDominating set, minimum dual perfect SuperHyperDominating set and minimum stable perfect SuperHyperDominating set.

8 The Setting of The Neutrosophic SuperHyperResolving

The Definitions of the terms in this section are referred by the previous chapter.

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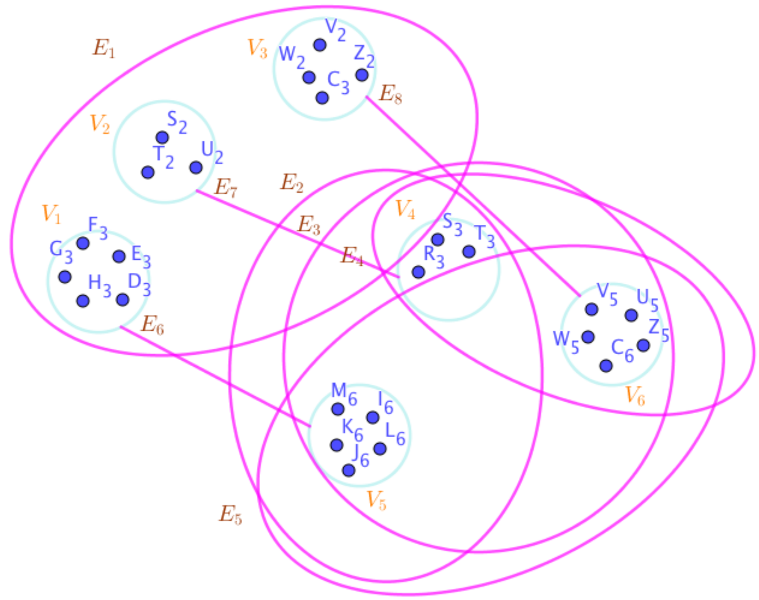

Figure 11. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.1)

Table 11. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.1)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

Example 8.1. In Figure (11), the SuperHyperGraph is highlighted and featured. By using the Figure (8.1) and the Table (11), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set, namely, $\{V_4, V_5, V_6\}$. It's also minimum perfect SuperHyperResolving set, minimum dual SuperHyperResolving set and minimum connected SuperHyperResolving set but not minimum stable SuperHyperResolving set.

Example 8.2. In Figure (12), the SuperHyperGraph is highlighted and featured. By using the Figure (8.2) and the Table (12), the neutrosophic SuperHyperGraph is obtained.

Table 12. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.2)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

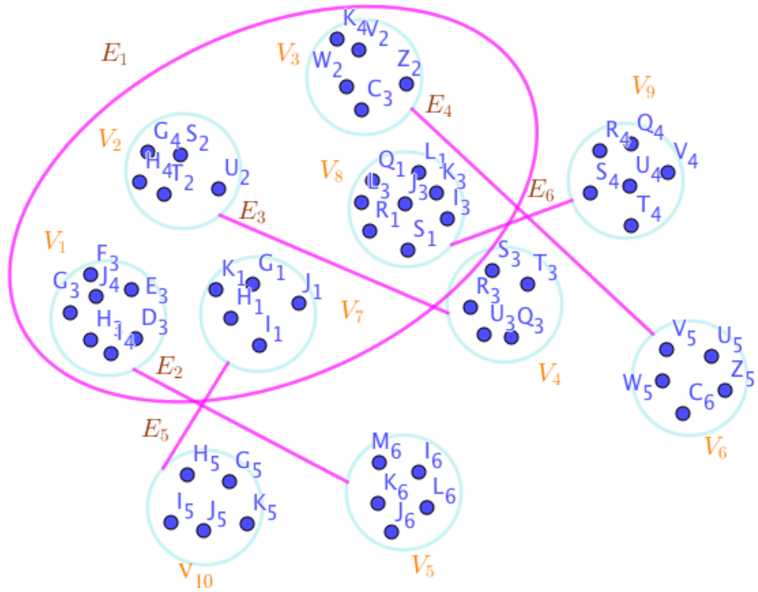

Figure 12. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.2)

Table 13. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.4)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

In this case, there's the minimum SuperHyperResolving set, namely, $\{V_4, V_5, V_6\}$. It's also minimum perfect SuperHyperResolving set and minimum stable SuperHyperResolving set.

Example 8.3.

Example 8.4. In Figure (13), the SuperHyperGraph is highlighted and featured. By using the Figure (8.4) and the Table (13), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set, namely, $\{V_4, V_5, V_6\}$. It's also minimum perfect SuperHyperResolving set and minimum total SuperHyperResolving set.

Example 8.5. In Figure (24), the SuperHyperGraph is highlighted and featured. By using the Figure (8.5) and the Table (24), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set, namely, $\{V_3\}$. It's also minimum perfect SuperHyperResolving set and minimum total SuperHyperResolving set. There's the minimum dual SuperHyperResolving set, namely, $\{V_1, V_2\}$.

Example 8.6. In Figure (15), the SuperHyperGraph is highlighted and featured. By using the Figure (8.6) and the Table (15), the neutrosophic SuperHyperGraph is obtained.

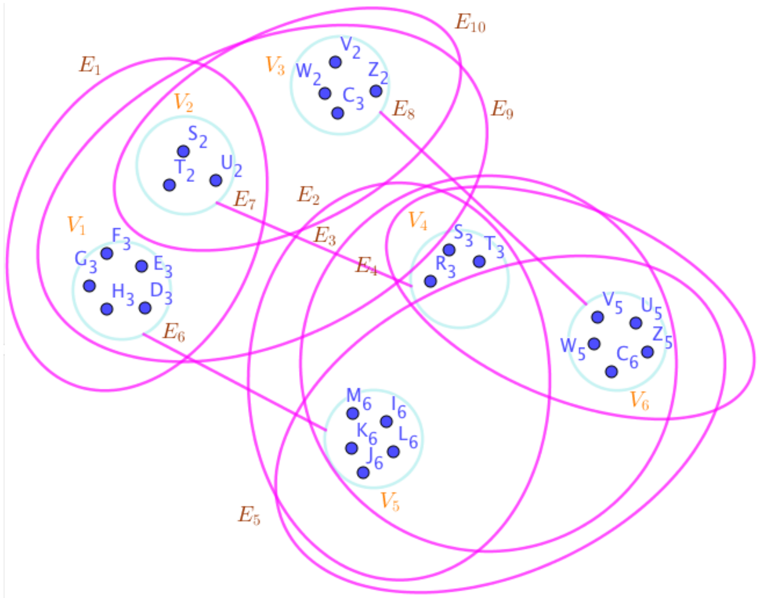

Figure 13. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.4)

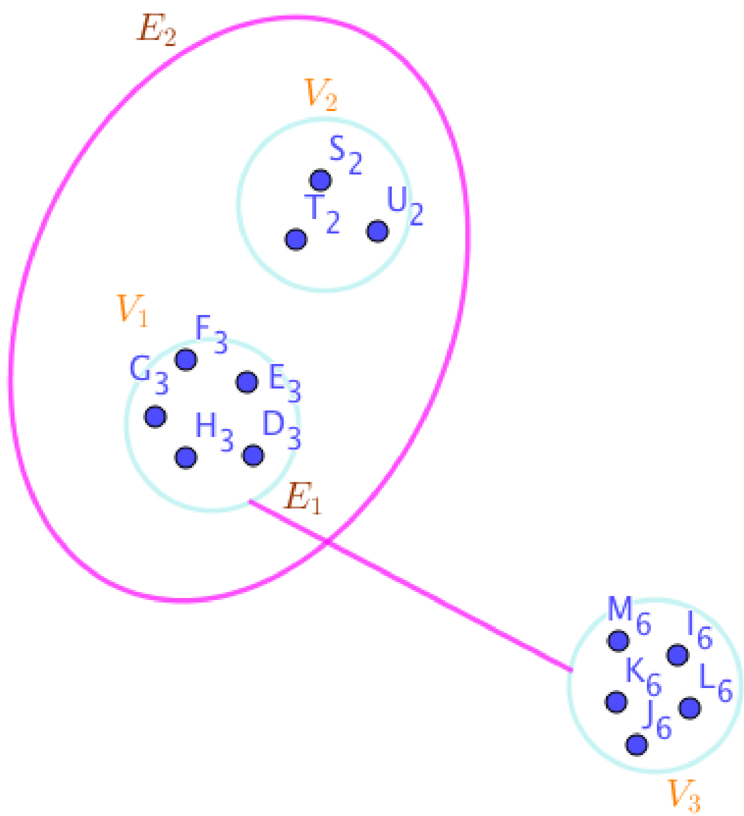

Figure 14. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.5)

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Table 14. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.5)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

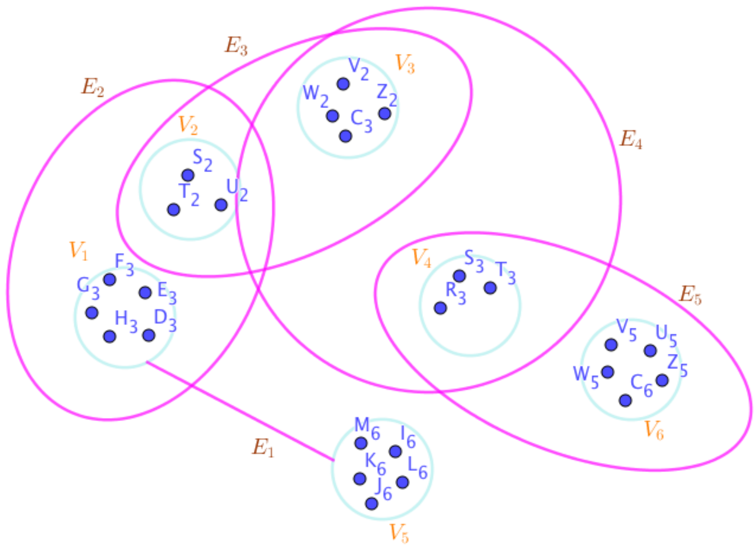

Figure 15. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.6)

Table 15. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.6)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

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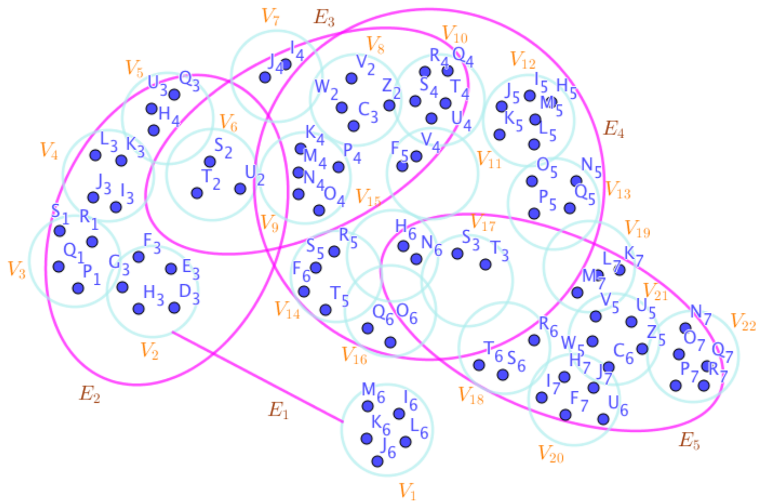

Figure 16. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.7)

Table 16. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.7)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

In this case, there's the minimum SuperHyperResolving set, namely, $\{V_5\}$. It's also minimum perfect SuperHyperResolving set and minimum total SuperHyperResolving set. There's the minimum dual SuperHyperResolving set, namely, $\{V_1, V_2, V_3, V_4\}$.

Example 8.7. In Figure (16), the SuperHyperGraph is highlighted and featured. By using the Figure (8.7) and the Table (16), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set, namely, $\{V_1, V_3, V_4, V_5, V_7, V_8, V_9, V_{10}, V_{12}, V_{13}, V_{14}, V_{15}, V_{16}, V_{18}, V_{19}, V_{20}, V_{21}\}$. It's also the minimum dual SuperHyperResolving set, namely, $\{V_2, V_6, V_{11}, V_{17}, V_{22}\}$.

Example 8.8. In Figure (17), the SuperHyperGraph is highlighted and featured. By using the Figure (8.8) and the Table (17), the neutrosophic SuperHyperGraph is obtained.

Table 17. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.8)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

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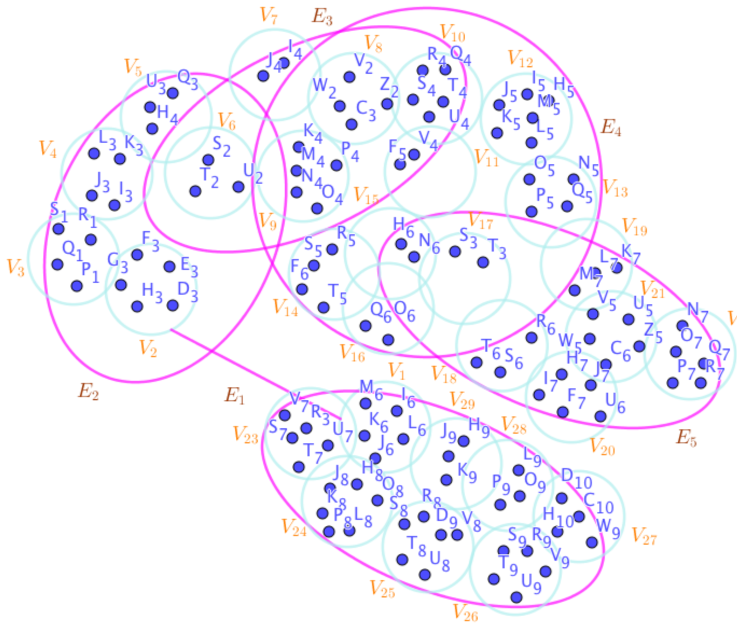

Figure 17. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.8)

Table 18. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.9)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

In this case, there's the minimum SuperHyperResolving set, namely,

$$\{V_{29}, V_3, V_4, V_5, V_7, V_8, V_9, V_{10}, V_{12}, V_{13}, V_{14}, V_{15}, V_{16}, V_{18},$$
$$V_{19}, V_{20}, V_{21}, V_{23}, V_{24}, V_{25}, V_{26}, V_{27}, V_{28}\}.$$

It's also the minimum dual SuperHyperResolving set, namely, $\{V_1, V_2, V_6, V_{11}, V_{17}, V_{22}\}$.

Example 8.9. In Figure (18), the SuperHyperGraph is highlighted and featured. By using the Figure (8.9) and the Table (18), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set, namely, $\{V_{29}, V_3, V_4, V_5, V_7, V_8, V_9, V_{10}, V_{12}, V_{13}, V_{14}, V_{15}, V_{16}, V_{18}, V_{19}, V_{20}, V_{21}, V_{23}, V_{24}, V_{25}, V_{26}, V_{27}, V_{28}\}$
It's also the ,minimum dual SuperHyperResolving set, namely, $\{V_1, V_2, V_6, V_{11}, V_{17}, V_{22}\}$.

Definition 8.10. Assume a neutrosophic SuperHyperGraph. In the terms of SuperHyperResolving, there's are some SuperHyperClasses as follows.

(i). it's **R-SuperHyperPath** if it's only one SuperVertex as intersection amid two given SuperHyperEdges with two exceptions as illustrated in the Example (8.9);

(ii). it's **R-SuperHyperCycle** if it's only one SuperVertex as intersection amid two given SuperHyperEdges as illustrated in the Example (8.11);

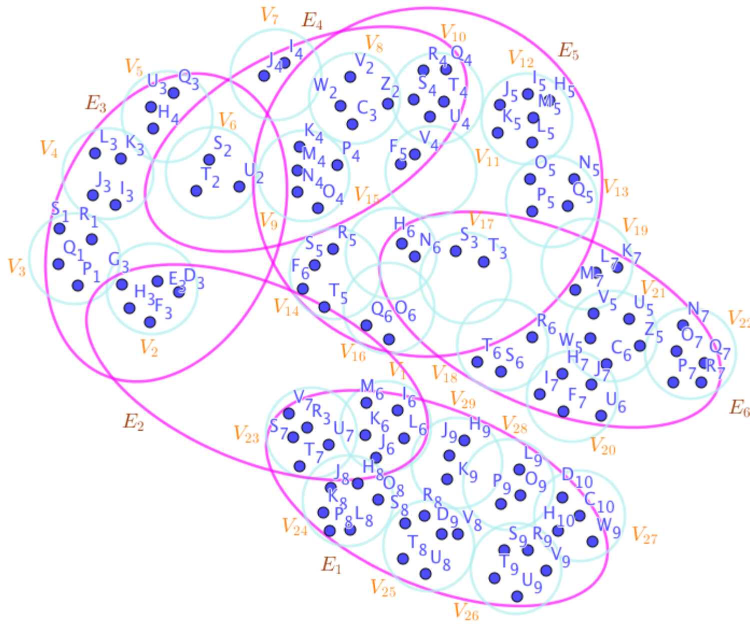

Figure 18. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.9)

Table 19. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.11)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

(iii). it's **R-SuperHyperStar** it's only one SuperVertex as intersection amid all SuperHyperEdges as illustrated in the Example (8.12);

(iv). it's **R-SuperHyperBipartite** it's only one SuperVertex as intersection amid two given SuperHyperEdges and these SuperVertices, forming two separate sets, has no SuperHyperEdge in common as illustrated in the Example (8.13);

(v). it's **R-SuperHyperMultiPartite** it's only one SuperVertex as intersection amid two given SuperHyperEdges and these SuperVertices, forming multi separate sets, has no SuperHyperEdge in common as illustrated in the Example (8.14);

(vi). it's **R-SuperHyperWheel** if it's only one SuperVertex as intersection amid two given SuperHyperEdges and one SuperVertex has one SuperHyperEdge with any common SuperVertex as illustrated in the Example (8.15);

Example 8.11. In Figure (19), the SuperHyperGraph is highlighted and featured. By using the Figure (8.11) and the Table (19), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set as illustrated in the Figure (19).

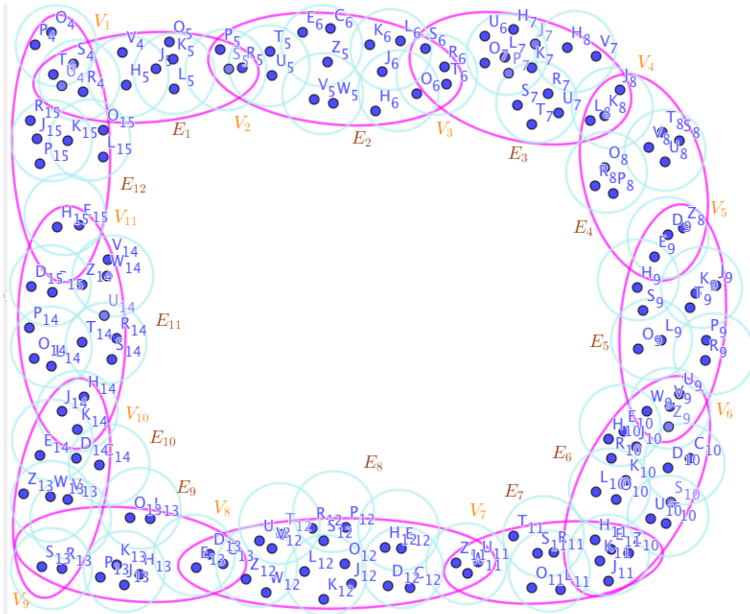

Figure 19. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.11)

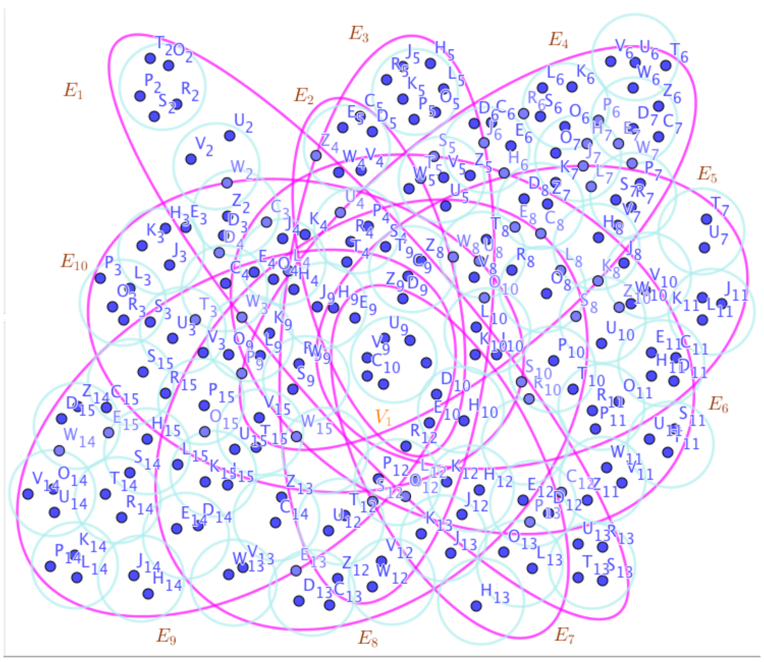

Figure 20. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.12)

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Table 20. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.12)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

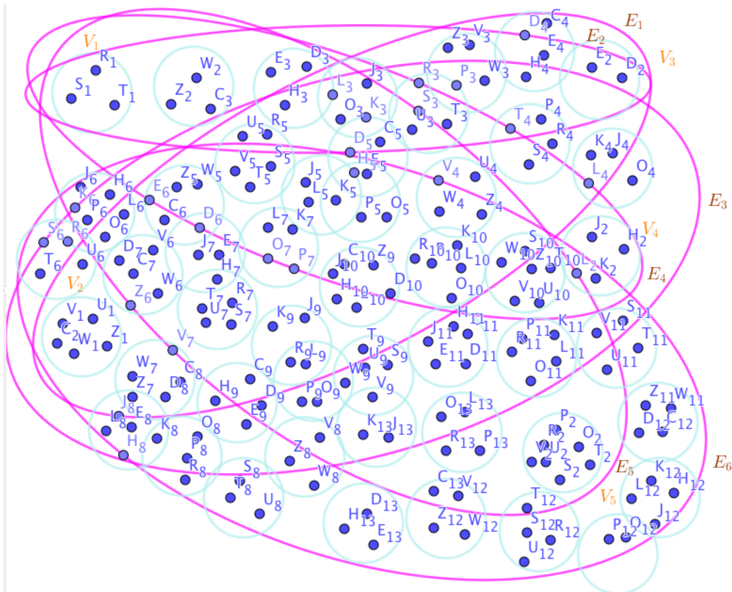

Figure 21. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.13)

Example 8.12. In Figure (20), the SuperHyperGraph is highlighted and featured. By using the Figure (8.12) and the Table (20), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set as illustrated in the Figure (20).

Example 8.13. In Figure (21), the SuperHyperGraph is highlighted and featured. By using the Figure (8.13) and the Table (21), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set as illustrated in the Figure (21).

Table 21. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.13)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

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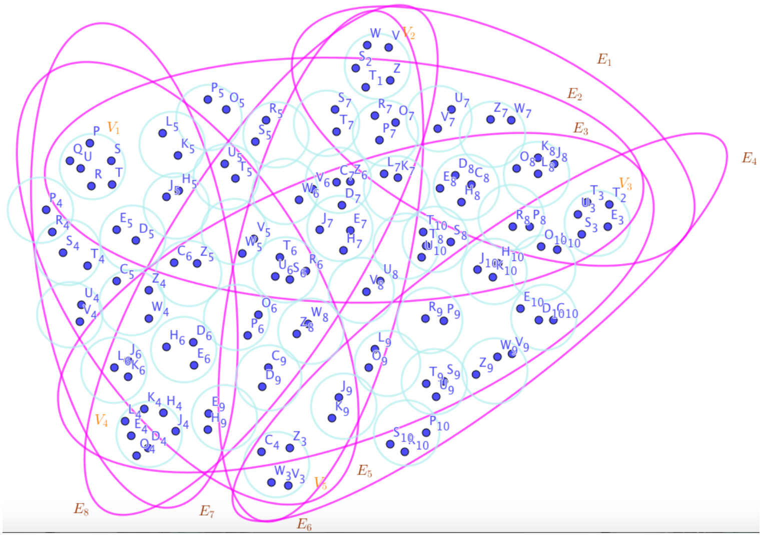

Figure 22. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.14)

Table 22. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.14)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

Example 8.14. In Figure (22), the SuperHyperGraph is highlighted and featured. By using the Figure (8.14) and the Table (22), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set as illustrated in the Figure (22).

Example 8.15. In the Figure (23), the SuperHyperGraph is highlighted and featured. By using the Figure (8.15) and the Table (23), the neutrosophic SuperHyperGraph is obtained.

In this case, there's the minimum SuperHyperResolving set as illustrated in the Figure (23).

Definition 8.16. Assume a neutrosophic SuperHyperGraph. An **interior SuperHyperVertex** is a SuperHyperVertex which is contained in only one

Table 23. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph Mentioned in the Example (8.15)

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

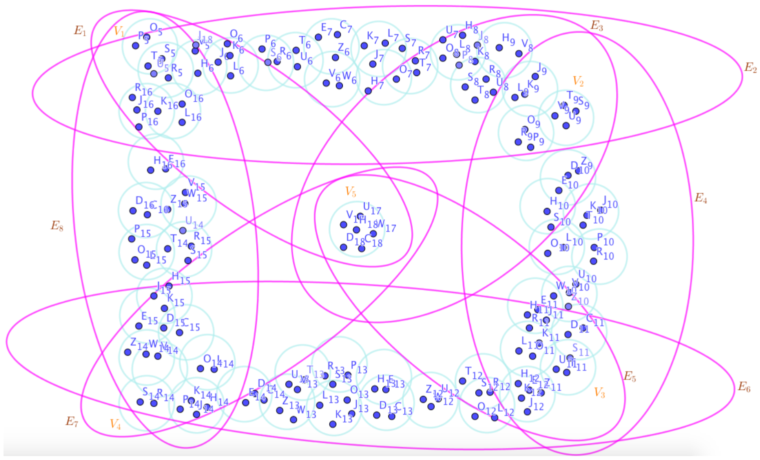

Figure 23. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving in the Example (8.15)

SuperHyperEdge.

Definition 8.17. Assume a neutrosophic SuperHyperGraph. An **exterior SuperHyperVertex** is a SuperHyperVertex which is contained in more than one SuperHyperEdge.

Definition 8.18. Assume a neutrosophic SuperHyperPath. A **SuperHyperLeaf** is a SuperHyperVertex which is contained in a SuperHyperEdge connects to only one SuperHyperEdge.

Definition 8.19. Assume a neutrosophic SuperHyperGraph. A **SuperHyperCenter** is a SuperHyperVertex which is contained in any SuperHyperEdge contains SuperHyperVertex.

Definition 8.20. Assume a SuperHyperGraph. If two SuperHyperVertices have same SuperHyperEdge, then these SuperHyperVertices are said to be **SuperHyperNeighbors**.

Definition 8.21. Assume a SuperHyperGraph. If two SuperHyperVertices have same SuperHyperNeighbors, then these SuperHyperVertices are said to be **SuperHyperTwins**.

Definition 8.22. Assume a SuperHyperGraph. The minimum number of SuperHyperEdges amid two SuperHyperVertices is said to be **SuperHyperDistance** amid them.

Proposition 8.23. *Assume a neutrosophic SuperHyperGraph. The minimum SuperHyperResolving set contains all interior SuperHyperVertices.*

Proof. Consider a neutrosophic SuperHyperGraph. All interior SuperHyperVertices with related exterior SuperHyperVertices have the SuperHyperDistance one. Thus one of them could only be out of the minimum SuperHyperResolving set. □

Proposition 8.24. *Assume a neutrosophic R-SuperHyperPath. The minimum SuperHyperResolving set contains only one of SuperHyperLeaves.*

Proof. Consider a neutrosophic R-SuperHyperPath. Assume A is a SuperHyperLeaf. Then there are new arrangements of SuperHyperVertices such that SuperHyperDistance amid them with SuperHyperLeaf is distinct where SuperHyperVertices are neither interior SuperHyperVertex nor exterior SuperHyperVertex more than one. □

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Definition 8.25. Assume a SuperHyperCycle. If two SuperHyperVertices have same SuperHyperDistance with any two given SuperHyperVertices, then these SuperHyperVertices are said to be **SuperHyperAntipodals**.

Proposition 8.26. *Assume a neutrosophic R-SuperHyperCycle. The minimum SuperHyperResolving set contains two exterior SuperHyperVertices have only one SuperHyperEdge in common [and not more].*

Proof. Assume a neutrosophic R-SuperHyperCycle. Two exterior SuperHyperVertices have only one SuperHyperEdge in common [and not more] aren't the SuperHyperAntipodals. Thus the SuperHyperVertices such that SuperHyperDistance amid them with at least one of these two exterior SuperHyperVertices is distinct where SuperHyperVertices are neither interior SuperHyperVertex nor exterior SuperHyperVertex more than one. □

Proposition 8.27. *Assume a neutrosophic R-SuperHyperStar. The minimum SuperHyperResolving set contains all exterior SuperHyperVertices excluding the SuperHyperCenter and another SuperHyperVertex.*

Proof. Assume a neutrosophic R-SuperHyperStar. All SuperHyperVertices are the SuperHyperTwins with the only exception the SuperHyperCenter. Thus one of SuperHyperTwins could be only out of minimum SuperHyperResolving set. Any given SuperHyperVertex in the minimum SuperHyperResolving set has the SuperHyperDistance one with the SuperHyperCenter and the SuperHyperDistance two with the latter SuperHyperVertex. □

Proposition 8.28. *Assume a neutrosophic R-SuperHyperBipartite. The minimum SuperHyperResolving set contains all exterior SuperHyperVertices excluding two SuperHyperVertices in different parts.*

Proof. Assume a neutrosophic R-SuperHyperBipartite. All SuperHyperVertices are the SuperHyperTwins in the same parts. Thus one of SuperHyperTwins could be only out of minimum SuperHyperResolving set. Any given SuperHyperVertex in the minimum SuperHyperResolving set has the SuperHyperDistance one with the SuperHyperVertex in different part and the SuperHyperDistance two with the SuperHyperVertex in same part. Thus the minimum SuperHyperResolving set contains all exterior SuperHyperVertices excluding two SuperHyperVertices in different parts. □

Proposition 8.29. *Assume a neutrosophic R-SuperHyperMultiPartite. The minimum SuperHyperResolving set contains all exterior SuperHyperVertices excluding two SuperHyperVertices in different parts.*

Proof. Assume a neutrosophic R-SuperHyperMultiPartite. All SuperHyperVertices are the SuperHyperTwins in the same parts. Thus one of SuperHyperTwins could be only out of minimum SuperHyperResolving set. Any given SuperHyperVertex in the minimum SuperHyperResolving set has the SuperHyperDistance one with the SuperHyperVertex in different part and the SuperHyperDistance two with the SuperHyperVertex in same part. Thus the minimum SuperHyperResolving set contains all exterior SuperHyperVertices excluding two SuperHyperVertices in different parts. □

Proposition 8.30. *Assume a neutrosophic R-SuperHyperWheel. The minimum SuperHyperResolving set contains all exterior SuperHyperVertices excluding three SuperHyperVertices, namely, two SuperHyperVertices have only one SuperHyperEdge in common [and not more] and the SuperHyperCenter.*

Proof. Assume a neutrosophic R-SuperHyperWheel. Any given SuperHyperVertex in the minimum SuperHyperResolving set has the SuperHyperDistance one with its SuperHyperNeighbors and the SuperHyperDistance two with the other SuperHyperVertex. Thus the minimum SuperHyperResolving set contains all exterior SuperHyperVertices excluding three SuperHyperVertices, namely, two SuperHyperVertices have only one SuperHyperEdge in common [and not more] and the SuperHyperCenter. □

9 Some Results on Neutrosophic Classes Via Minimum SuperHyperDominating Set

Proposition 9.1. *Assume a neutrosophic SuperHyperGraph. A SuperHyperVertex SuperHyperDominates if and only if it has SuperHyperDistance one.*

Proposition 9.2. *Assume a neutrosophic SuperHyperGraph. The minimum SuperHyperDominating set contains only SuperHyperVertices with SuperHyperDistances one from other SuperHyperVertices.*

Proposition 9.3. *Assume a neutrosophic R-SuperHyperPath. The minimum SuperHyperDominating set contains only SuperHyperVertices with SuperHyperDistances at least n over* 3.

Proof. Consider a neutrosophic R-SuperHyperPath. Any SuperHyperVertex has two SuperHyperNeighbors with the exceptions SuperHyperLeaves. Thus any SuperHyperVertex has two SuperHyperVertices with SuperHyperDistances one with the exceptions SuperHyperLeaves. SuperHyperVertices with SuperHyperDistances. The SuperHyperVertices are consecutive. Thus the minimum SuperHyperDominating set contains only SuperHyperVertices with SuperHyperDistances at least n over 3. □

Proposition 9.4. *Assume a neutrosophic R-SuperHyperCycle. The minimum SuperHyperDominating set contains only SuperHyperVertices with SuperHyperDistances at least n over* 3.

Proof. Assume a neutrosophic R-SuperHyperCycle. Any SuperHyperVertex has two SuperHyperNeighbors. Thus any SuperHyperVertex has two SuperHyperVertices with SuperHyperDistances one. SuperHyperVertices with SuperHyperDistances. The SuperHyperVertices are consecutive. Thus the minimum SuperHyperDominating set contains only SuperHyperVertices with SuperHyperDistances at least n over 3. □

Proposition 9.5. *Assume a neutrosophic R-SuperHyperStar. The minimum SuperHyperDominating set contains only the SuperHyperCenter.*

Proof. Assume a neutrosophic R-SuperHyperStar. The SuperHyperCenter is SuperHyperNeighbor with all SuperHyperVertices. Thus SuperHyperCenter with any SuperHyperVertex has SuperHyperDistances one. Thus the minimum SuperHyperDominating set contains only the SuperHyperCenter. □

Proposition 9.6. *Assume a neutrosophic R-SuperHyperBipartite. The minimum SuperHyperDominating set contains only two SuperHyperVertices in different parts.*

Proof. Assume a neutrosophic R-SuperHyperBipartite. The SuperHyperVertex is SuperHyperNeighbor with all SuperHyperVertices in opposite part. Thus SuperHyperVertex with SuperHyperVertex in opposite part has SuperHyperDistances one. The minimum SuperHyperDominating set contains only two SuperHyperVertices in different parts. □

Proposition 9.7. *Assume a neutrosophic R-SuperHyperMultiPartite. The minimum SuperHyperDominating set contains only two SuperHyperVertices in different parts.*

Proof. Assume a neutrosophic R-SuperHyperMultiPartite. The SuperHyperVertex is SuperHyperNeighbor with all SuperHyperVertices in opposite part. Thus SuperHyperVertex with SuperHyperVertex in opposite part has SuperHyperDistances one. The minimum SuperHyperDominating set contains only two SuperHyperVertices in different parts. □

Proposition 9.8. *Assume a neutrosophic R-SuperHyperWheel. The minimum SuperHyperDominating set contains only the SuperHyperCenter.*

Proof. Assume a neutrosophic R-SuperHyperWheel. The SuperHyperCenter is SuperHyperNeighbor with all SuperHyperVertices. Thus SuperHyperCenter with any SuperHyperVertex has SuperHyperDistances one. Thus the minimum SuperHyperDominating set contains only the SuperHyperCenter. □

10 Minimum SuperHyperDominating Set and Minimum Perfect SuperHyperDominating Set

Proposition 10.1. *Assume a neutrosophic R-SuperHyperStar. The minimum SuperHyperDominating set is minimum perfect SuperHyperDominating set.*

Proposition 10.2. *Assume a neutrosophic R-SuperHyperBipartite. The minimum SuperHyperDominating set is minimum perfect SuperHyperDominating set.*

Proposition 10.3. *Assume a neutrosophic R-SuperHyperMultiPartite. The minimum SuperHyperDominating set is minimum perfect SuperHyperDominating set.*

Proposition 10.4. *Assume a neutrosophic R-SuperHyperWheel. The minimum SuperHyperDominating set is minimum perfect SuperHyperDominating set.*

11 Applications in Game Theory

In this section, two applications are proposed for the minimum SuperHyperDominating set and the minimum SuperHyperResolving set in the field of game theory concerning multiple players using winning strategy to tackle each other.

Game theory is the vast section for study. The majority of approaches is about using the strategies to win the game.

Step 1. (Definition) There are some points and the connections between either them or group of them. This game is used in the multiple version of players. Multi players use this game-board. The game is about finding winning strategies to have proper set. The set with minimum number of elements which has special attributes. The set isn't unique thus it's possible to have many winners and even more there's a case in that, all players are winners and there's no loser. There are two different types of this game. Firstly, the set has the points which connect to all other vertices. Secondly, the set has the points which has different minimum number of connections amid any two given vertices from all other vertices.

Step 2. (Issue) In both versions of game, the issue is to find the optimal set. Every player tries to form the optimal set to win the game. The set isn't unique thus designing appropriate strategies to find the intended set is the matter.

Table 24. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph.

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

Step 3. (Model) The models uses different types of colors and lines to illustrate the situation. Sometimes naming the group of points and the connection, is rarely done since to have concentration on the specific elements. The number of points and groups of points in the connection isn't the matter. Thus it's possible to have some groups of points and some points in one connection.

11.1 Case 1: The Game Theory contains the Game-Board In the Terms of the minimum SuperHyperDominating set

Step 4. (Solution) The optimal set has 17 number of elements. Thus the players find these types of set. In what follows, all optimal sets are obtained. There 27 optimal sets. If one of them is chosen, the corresponded player is winner. In other viewpoint, If there are 27 players, then every player could be winner, if there are 28 players, then one player is loser and so on. In what follows, the mathematical terminologies and mathematical structures explains the ways in the strategies of winning are found in specific model.

In Figure (24), the SuperHyperGraph is highlighted and featured. The sets, $\{A, B, C, D, E, F, G, H, I, J, K, L, M, N, O\}$, $\{V_1, V_2, V_3, V_4\}, \{E_3\}, \{E_1\}$, and $\{E_2, E_4\}$ are the sets of vertices, SuperVertices, edges, HyperEdges, and SuperHyperEdges, respectively. The SuperVertices V_1, V_2 and V_4 SuperHyperDominate each other by the SuperHyperEdge E_4. The SuperVertex V_3 doesn't SuperHyperDominate. The vertices G and J dominate each other by the edge E_3. The vertices $A, B, C, D, E, F, G, I, J, K, L, M,$ and N HyperDominate each other by the SuperHyperEdge E_4. The vertices H and O HyperDominate each other by the HyperEdge E_1. The set of vertices and SuperVertices, $\{A, H, V_1, V_3\}$ is minimal SuperHyperDominating set. The minimum SuperHyperDominating number is 17. The sets of vertices and SuperVertices, which are listed below, are the minimal SuperHyperDominating sets corresponded to the minimum SuperHyperDominating number which is 17.

$$\{A, H, V_1, V_3\}, \{M, H, V_1, V_3\}, \{B, H, V_1, V_3\}, \{C, H, V_1, V_3\}, \{L, H, V_1, V_3\},$$
$$\{D, H, V_1, V_3\}, \{E, H, V_1, V_3\}, \{N, H, V_1, V_3\}, \{A, H, V_2, V_3\}, \{M, H, V_2, V_3\},$$
$$\{B, H, V_2, V_3\}, \{C, H, V_2, V_3\}, \{L, H, V_2, V_3\}, \{D, H, V_2, V_3\}, \{E, H, V_2, V_3\},$$
$$\{N, H, V_2, V_3\}, \{A, O, V_1, V_3\}, \{M, O, V_1, V_3\}, \{B, O, V_1, V_3\}, \{C, O, V_1, V_3\},$$
$$\{L, O, V_1, V_3\}, \{D, O, V_1, V_3\}, \{E, O, V_1, V_3\}, \{N, O, V_1, V_3\}, \{A, O, V_2, V_3\},$$
$$\{M, O, V_2, V_3\}, \{B, O, V_2, V_3\}, \{C, O, V_2, V_3\}, \{L, O, V_2, V_3\}, \{D, O, V_2, V_3\},$$
$$\{E, O, V_2, V_3\}, \{N, O, V_2, V_3\}.$$

By using the Figure (24) and the Table (24), the neutrosophic SuperHyperGraph is obtained.

There are some points for the vertex A as follows.

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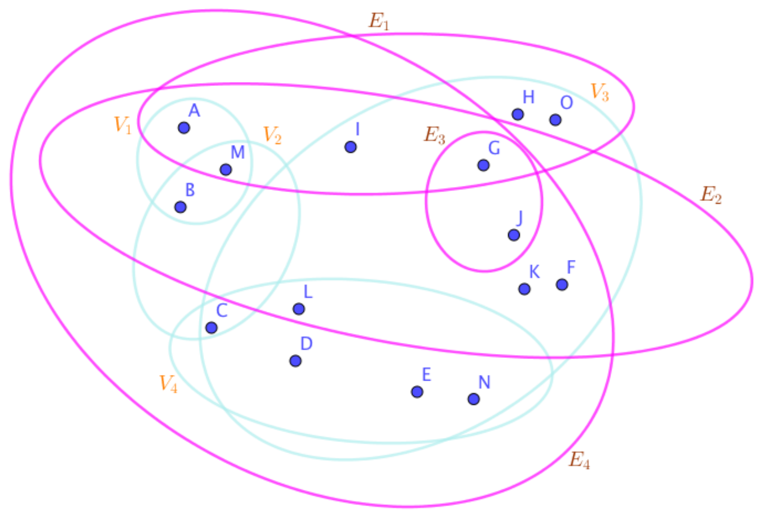

Figure 24. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperDominating.

(i) : The vertex A SuperHyperDominates M, I and G by using three SuperHyperEdges E_1, E_2, and E_4.

(ii) : The vertex A SuperHyperDominates B, J, K, L, and F by using two SuperHyperEdges E_2, and E_4.

(iii) : The vertex A SuperHyperDominates C, D, E, H, and N by using one SuperHyperEdge E_4.

There are some points for the vertex H as follows.

(i) : The vertex H SuperHyperDominates A, M, G, and O by using one SuperHyperEdge E_1.

There are some points for the SuperVertex V_1 as follows.

(i) : The SuperVertex V_1 SuperHyperDominates V_2, and V_4 by using one SuperHyperEdge E_4.

There are some points for the SuperVertex V_3 as follows.

(i) : The SuperVertex V_3 SuperHyperDominates no SuperVertex. It's an isolated SuperVertex.

11.2 Case 2: The Game Theory contains the Game-Board In the Terms of the minimum SuperHyperResolving set

Step 4. (Solution) The optimal set has twenty-three elements. One of winning set is featured as follows. The specific model of game-board is illustrated in the Figure (25). In what follows, the winning strategies are formed in the mathematical literatures. If the number of players exceeds from the number of optimal sets, then there's amount of losers which the difference amid the number of players and the number of optimal sets. If the number doesn't exceed, then there's a possibility to have no amount of losers. This game-board seems so hard since the winner has to find a specific set with twenty-three elements.

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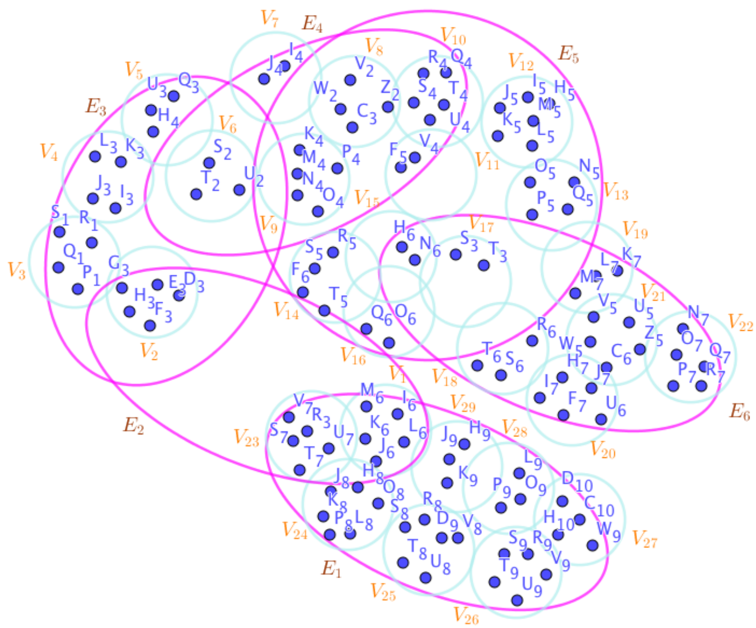

Figure 25. A Neutrosophic SuperHyperGraph Associated to the Notions of SuperHyperResolving.

Table 25. The Values of Vertices, SuperVertices, Edges, HyperEdges, and SuperHyperEdges Belong to The Neutrosophic SuperHyperGraph.

The Values of The Vertices	The Number of Position in Alphabet
The Values of The SuperVertices	The Minimum Values of Its Vertices
The Values of The Edges	The Minimum Values of Its Vertices
The Values of The HyperEdges	The Minimum Values of Its Vertices
The Values of The SuperHyperEdges	The Minimum Values of Its Endpoints

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In Figure (25), the SuperHyperGraph is highlighted and featured. By using the Figure (25) and the Table (25), the neutrosophic SuperHyperGraph is obtained. In this case, there's the minimum SuperHyperResolving set, namely,

$$\{V_{29}, V_3, V_4, V_5, V_7, V_8, V_9, V_{10}, V_{12}, V_{13}, V_{14}, V_{15}, V_{16}, V_{18}, V_{19}, V_{20}, V_{21}, V_{23}, V_{24}, V_{25}, V_{26}, V_{27}, V_{28}\}.$$

12 Open Problems

In this section, some questions and problems are proposed to give some avenues to pursue this study. The structures of the definitions and results give some ideas to make new settings which are eligible to extend and to create new study. The Neutrosophic SuperHyperGraphs facilitate the environment with the dense styles of objects thus the questions and the problems in this topic could open the ways to have new directions and more applications.

In this study, some notions are defined in the framework of neutrosophic SuperHyperGraphs. SuperHyperResolving and SuperHyperDominating are new ideas applying in neutrosophic SuperHyperGraphs. The keyword in this study is to find minimum set and the study highlights the results from minimum sets.

Question 12.1. *How to create some classes of neutrosophic SuperHyperGraphs alongside obtaining some results from them?*

Question 12.2. *How to characterize the number one for introduced classes of neutrosophic SuperHyperGraphs?*

Question 12.3. *How to characterize the number two for introduced classes of neutrosophic SuperHyperGraphs?*

Question 12.4. *How to characterize the number three for introduced classes of neutrosophic SuperHyperGraphs?*

Problem 12.5. *Is it possible to find the avenues to pursue this study in general form such that the results aren't about classes, in other words, beyond neutrosophic classes of neutrosophic SuperHyperGraphs?*

Problem 12.6. *Is it possible to find a real-world problem handling the situation such that introducing special neutrosophic classes of neutrosophic SuperHyperGraphs?*

Problem 12.7. *Is it possible to find a real-world problem to define new environment concerning specific behaviors of results?*

13 Conclusion and Closing Remarks

In this section, concluding remarks and closing remarks are represented. The drawbacks of this article are illustrated. Some benefits and advantages of this study are highlighted.

This study uses some approaches to make neutrosophic SuperHyperGraphs more understandable. In this way, some neutrosophic graphs are introduced. The notion of how much "close" leads us toward the ideas of direct connections and indirect connections. Direct connection is interpreted by SuperHyperEdges. When finding the minimum number of SuperHyperVertices such that they've SuperHyperEdges with others, is the matter, the notion of "SuperHyperDominating" is assigned. But when indirect connections separate any couple of SuperHyperVertices in the terms of direct connections forming indirect connections, the notion of "SuperHyperResolving" is sparked. Some notions are added to both settings of "SuperHyperDominating" and "SuperHyperResolving". These notions are duality, perfectness, totality, stable and connectedness. The existence of direct connections between the elements of intended set indicates the idea of "connectedness" but the lack of them points out the concept of "stable". Acting on itself by intended set introduces the term, totality but acting reversely is about the word, duality. In all the mentioned cases, if the intended set acts uniquely, then the prefix, perfect, is assigned to them. There are some results about these mentioned new notions. Sometimes some neutrosophic classes of neutrosophic SuperHyperGraphs based on one of the notions "SuperHyperDominating" or "SuperHyperResolving" is introduced to figure out what's happened to make neutrosophic SuperHyperGraphs more understandable and to make sense about what's going on in the terms of the directions. In the future research, the framework will be on the general forms of neutrosophic SuperHyperGraphs and in this endeavor, the upcoming research will be formed based on them. In the Table (26), some limitations

Table 26. A Brief Overview about Advantages and Limitations of this Study

Advantages	Limitations
1. Defining Different Versions	1. Defining SuperHyperDominating
2. Defining SuperHyperResolving	
3. Neutrosophic Classes	2. General Results
4. Duality, Totality, Connectedness	
5. Stable, Perfect	3. Connections Amid Nnotions

and advantages of this study are pointed out.

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