Identifying Internet Streaming Services using Max Product of Complement in Neutrosophic Graphs

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Abstract

The complement of the highest result of multiplication of two neutrosophic graphs is determined in this study. In the complement of the maximum product of a neutrosophic graph, the degree of a vertex is investigated. The complement of the maximum product of two normal neutrosophic graphs has several results that are presented and proven. Finally, we have offered a neutrosophic graph application for locating an online streaming service using normalized Hamming distance.

Keywords: Neutrosophic Graphs; Max Product Neutrosophic Graph; Complement Neutrosophic Graph.

1 Introduction

Graphs are commonly understood to be essentially representations of relations. A good tool for expressing information about item connections is a graph. Edges describe relationships, whereas vertices represent things. The objects and the relationships between them are represented, re- sportively, by the vertices and edges of the graph. The information that describes the conditions might become ambiguous when it comes to global challenges. In a variety of disciplines, including topology, optimization, network, and environmental science, neutrosophic models are useful mathematical instruments for solving combinatorial issues. Neutrosophic models are more sophisticated than straightforward graphical models due to the inherent vagueness and ambiguity they include. When neutrosophic set theory was originally applied, it was utilized to solve several intricate problems for which there was insufficient information.When it comes to applying graph theory to dealing with real-life circumstances, it is seen to be crucial. The use of fuzzy set theory has no bounds; hence the fuzzy graph theory has unique relevance. Rosenfeld[14] presented the notion of fuzzy graphs in 1975, while independently Yeh and Bang also introduced the concept of fuzzy graphs.[22] Fuzzy graphs are quite different from traditional graphs and are excellent for representing interactions that deal with ambiguity. Numerous issues in the fields of computer science, electrical engineering, system modeling, transportation, finance, etc. can be treated by using them.The concept of intuitionistic fuzzy sets (IFS), introduced by Atanassov,[1] and represents an extension of fuzzy sets that effectively handle ambiguous conditions. Unlike traditional fuzzy sets, IFS structures are not confined solely to membership grades, allowing for improved handling of uncertainty. The concept of IFS has witnessed significant utilization across various domains. In 1994, Shannon and Atanassov[17] made a notable contribution by introducing the concept of intuitionistic fuzzy graphs (IFG), further enhancing the applicability and importance of this mathematical framework. The concept of IFG that was initially introduced by Atanassov and Shannon was further elucidated by Parvathi and Karunambigai.[11]

https://doi.org/10.54216/IJNS.230123

Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

Madhumangal Pal and Sankar Sahoo[15] classified IFG products into three categories: Strong, semi-strong, and direct. Additionally, Yaqoob et al.,[21] extensively investigated the four fundamental operations of complex IFG, including the cartesian product, join, union, and composition. Yahya Mohamed and Mohamed Ali developed the terms modular, complement, and maximum product on IFG [[7,9,19]]. The neutrosophic sets were suggested by Smarandache.[18] Using imprecise, ambiguous, and inconsistent data in practical applications calls for a sophisticated mathematical approach. IFS and interval-valued IFS are both included in this category of fuzzy set theory[3] and [[4,12,13,16]]. The truth, indeterminacy, and falsity membership values (T, I, and F), which are independent and fall inside the real standard or non-standard unit interval [0, 1], are used to describe Neutrosophic sets. The subclass of neutrosophic sets called single-valued neutrosophic sets (SVNS) was introduced by Haibin Wang with the purpose of facilitating practical implementation in real-world applications. In order to create SVNS, IFS with independent membership values between [0, 1] were generalised. SVNS are a subset of Neutrosophic sets, which simplifies the utilization of Neutrosophic sets in practical situations. One may find similar research on the growth of the single-valued Neutrosophic network in [[?,2,5,6,23]]. Yahya et al., created the maximum product of two.[20] Kaviyarasu M[8] explained the concept of regularity in neutrosophic graph theory. According to the aforementioned literature, the product's classical, fuzzy, and intuitionistic fuzzy forms are employed in a number of industries and provide practical answers to the problems. The max product and their complement in neutrosophic graphs have also not been employed in the present study. The proposed method can also be used to discover the online streaming service.

1.1 Motivation

Numerous uses of neutrosophic graphs and their expansions have been found recently in study [In the studies cited in the literature]. In the field of applied mathematics, research on the combination of neutrosophic graphs and their products is expanding. In this study, the maximum product of the complement of the neutrosophic graph is used as the context. The following is a description of the study's rationale:

1. The max product and complement notions are foundational ideas in graph theory with numerous applications in diverse disciplines.
2. These ideas expand the options for conveying uncertainty when used in the context of neurotsophic graphs
3. These ideas expand the options for conveying uncertainty when used in the context of neurotsophic graphs
4. More ambiguous information cannot be captured using this method.
5. When used in the neurotsophic graph setting, it could produce a useful result.
6. Additionally, there are issues with finding an online streaming provider.

It should be emphasized that earlier researches have not addressed these challenges, which fact inspired us to offer a workable alternative. As a result, this article discusses these problems and suggests creative solutions. The goal of the current study is to contribute significantly to society by accomplishing this.

1.2 Novelties

The notions of the maximum product of neutrosophic groups are defined in this work. A fresh definition of the neutrosophic graph complement is also offered.

1. The notions of the maximum product of neurotsophic groups are defined in this work.
2. To offer a fresh definition of the neurotsophic graph complement.
3. This study also teaches the notions of the neurotsophic graph's maximum product of complement.
4. To increase the amount of uncertainty that decision-making issues may represent, a Max product of complement of neurotsophic graph is used.

1.3 Structure of the paper

Graphs produced by neutrosophic are characterized by the degree of their vertex and the complement of the maximum product of two neutrosophic graphs is applied in this study to handle decision-making concerns and identify the internet streaming service. In the "preliminaries" section, we have discussed a few basic neutrosophic graph concepts. The term "complement of max product of neutrosophic graphs" has been defined along with its degree in "Neutrosophic Graph Complement of Max Product." Neutrosophic graphs are employed in the "Application" to locate the supplier of online streaming by using normalized Hamming distance. We have considered the signals of other users and selected the fundamental signal that most accurately reflects their choice of streaming service. This approach has allowed us to determine the type of service each user chooses based on how closely their symptoms resemble those of the offered solutions.

2 Preliminary

Definition 2.1. [8]

1. A neutrosophic graph denoted as $G = ((T\sigma_1, I\sigma_2, F\sigma_3), (T\mu_1, I\mu_2, F\mu_3))$ is represented by $G^* = (V, E)$, where V is the set of vertices, and E is the set of edges. The functions $T\sigma_1, I\sigma_2$, and $F\sigma_3$ are mappings from V to the closed interval $[0, 1]$, signifying the degrees of true , intermediate and false membership, respectively, for each element $x_i \in V$. It holds that $0 \leq T\sigma_1(x_i)+I\sigma_2(x_i)+F\sigma_3(x_i) \leq 3$ for all $x_i \in V$.
2. Moreover, in the context of G^*, the functions T_{μ_1}, I_{μ_2}, and F_{μ_3} are mappings from $V \times V$ to the closed interval [0, 1], representing the degrees of true , intermediate, and false membership, respectively, for each edge $(x_i, x_j) \in E$.

$$\begin{gathered} T\mu_1(x_i, x_j) \leq T\sigma_1(x_i) \wedge T\sigma_1(x_j), \\ I\mu_1(x_i, x_j) \leq I\sigma_1(x_i) \wedge I\sigma_1(x_j), \\ F\mu_1(x_i, x_j) \geq F\sigma_1(x_i) \wedge F\sigma_1(x_j), \end{gathered}$$

$0 \leq T\sigma_1(x_i, x_j) + I\sigma_2(x_i, x_j) + F\sigma_3(x_i, x_j) \leq 3.$

Definition 2.2. [8] A neurotsophic graph $G = ((T\sigma_1, I\sigma_2, F\sigma_3), (T\mu_1, I\mu_2, F\mu_3))$ is called strong neurotsophic graph if

1. $T\mu_1(x_i, x_j) \leq T\sigma_1(x_i) \wedge T\sigma_1(x_j)$,
2. $I\mu_1(x_i, x_j) \leq I\sigma_1(x_i) \wedge I\sigma_1(x_j)$,
3. $F\mu_1(x_i, x_j) \geq F\sigma_1(x_i) \wedge F\sigma_1(x_j)$,

for all $x_i, x_j \in E_i \neq j$.

Definition 2.3. [8] A neurotsophic graph $G = ((T\sigma_1, I\sigma_2, F\sigma_3), (T\mu_1, I\mu_2, F\mu_3))$ is considered complete if

1. $T\mu_1(x_i, x_j) \leq T\sigma_1(x_i) \wedge T\sigma_1(x_j)$,
2. $I\mu_1(x_i, x_j) \leq I\sigma_1(x_i) \wedge I\sigma_1(x_j)$,
3. $F\mu_1(x_i, x_j) \geq F\sigma_1(x_i) \wedge F\sigma_1(x_j)$,

for all $x_i, x_j \in V_i \neq j$.

Definition 2.4. [21] A neurotsophic graph $G = ((T\sigma_1, I\sigma_2, F\sigma_3), (T\mu_1, I\mu_2, F\mu_3))$. The order of G denoted as $O(G)$ is defined as follows $O(G) = (O_{T\sigma_1}(G), O_{I\sigma_1}(G), O_{F\sigma_1}(G))$, where $O_{T\sigma_1}(G) = \Sigma_{x\in V} T\sigma_1(x), O_{I\sigma_2}(G) = \Sigma_{x\in V} I\sigma_2(x)$ and $O_{F\sigma_3}(G) = \Sigma_{x\in V} F\sigma_3(x)$.

Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

Definition 2.5. [21] A neurotsophic graph $G = ((T\sigma_1, I\sigma_2, F\sigma_3), (T\mu_1, I\mu_2, F\mu_3))$. The size of G The size of G , denoted as $S(G)$, is defined as follows $S(G) = (S_{T\mu_1}(G), S_{I\mu_1}(G), S_{F\mu_1}(G))$, where $S_{T\mu_1}(G) = \Sigma_{xy\in E} T\mu_1(xy), S_{I\mu_2}(G) = \Sigma_{xy\in E} I\mu_2(xy)$ and $S_{F\mu_3}(G) = \Sigma_{xy\in E} F\mu_3(xy)$.

Definition 2.6. [8] A neurotsophic graph $G = ((T_{\sigma_1}, I_{\sigma_2}, F_{\sigma_3}), (T_{\mu_1}, I_{\mu_2}, F_{\mu_3}))$. The degree of a vertex x in G is denoted by $d_G(x) = (Td_1^G(x), Id_2^G(x), Fd_3^G(x))$ and can be calculated as follows

$$Td_1^G(x) = \sum_{x\neq y} T\mu_1^G(xy) = \sum_{xy\in E} T\mu_1^G(xy) \tag{1}$$

$$Id_2^G(x) = \sum_{x\neq y} I\mu_2^G(xy) = \sum_{xy\in E} I\mu_2^G(xy) \tag{2}$$

$$Fd_3^G(x) = \sum_{x\neq y} F\mu_2^G(xy) = \sum_{xy\in E} F\mu_2^G(xy) \tag{3}$$

Where $Td_1^G(x)$ represents the total of type membership scores of the edges connected to vertex x, $Id_2^G(x)$ represents the total of intermediate membership scores of the edges connected to vertex x and $Fd_3^G(x)$ represents the sum of false membership scores of the edges connected to vertex x.

3 Neutrosophic Graphs' Complement of the Maximum Product

Definition 3.1. The complement of a neutrosophic graph $G = (V, E)$ is a neutrosophic graph $\overline{G} = (\overline{(T_{\sigma_1}, I_{\sigma_2}, F_{\sigma_3})}, \overline{(T_{\mu_1}, I_{\mu_2}, F_{\mu_3})})$ where $\overline{(T_{\sigma_1}, I_{\sigma_2}, F_{\sigma_3})} = \overline{(T_{\sigma_1})}, \overline{(I_{\sigma_2})}, \overline{(F_{\sigma_3})}$ and $\overline{(T_{\mu_1}, I_{\mu_2}, F_{\mu_3})} = \overline{(T_{\mu_1})}, \overline{(I_{\mu_2})}, \overline{(F_{\mu_3})}$,where $\overline{T_{\mu_1}}(x,y) = T_{\sigma_1}(xy) - T_{\sigma 1}(y) \wedge T_{\sigma_1}(xy), \overline{I_{\mu_2}}(x,y) = I_{\sigma_2}(xy) - I_{\sigma 2}(y) \wedge I_{\sigma_2}(xy)$ and $\overline{F_{\mu_3}}(x,y) = F_{\sigma_3}(xy) - F_{\sigma 3}(y) \wedge F_{\sigma_3}(xy)$.

Definition 3.2. Let $G_1 = ((T\sigma_1^{G_1}, I\sigma_2^{G_1}, F\sigma_3^{G_1}), (T\mu_1^{G_1}, I\mu_2^{G_1}, F\mu_3^{G_1}))$ and $G_2 = ((T\sigma_1^{G_2}, I\sigma_2^{G_2}, F\sigma_3^{G_2}), (T\mu_1^{G_2}, I\mu_2^{G_2}, F\mu_3^{G_2}))$ be two neutrosophic graphs the maxium product of G_1 and G_2 is defined $G_1 \times_m G_2 = (V_1 \times_m V_2, E_1 \times_m E_2), E_1 \times_m E_2 = \{(x_1, y_1), (x_2, y_2)/x_1 = x_2, y_1, y_2 \in E_2$ or $y_1 = y_2, x_1, x_2 \in E_1\}$.

$$T\sigma^{G_1\times_m G_2}(x_1, y_2) = T\sigma_1^{G_1}(x_1) \wedge T\sigma_1^{G_2}(y_1) \tag{4}$$

$$I\sigma^{G_1\times_m G_2}(x_1, y_2) = I\sigma_1^{G_1}(x_1) \wedge I\sigma_1^{G_2}(y_1) \tag{5}$$

$$F\sigma^{G_1\times_m G_2}(x_1, y_2) = F\sigma_1^{G_1}(x_1) \vee F\sigma_1^{G_2}(y_1) \tag{6}$$

$$T\mu_1^{G_1\times_m G_2}((x_1, y_1), (x_2, y_2)) = \begin{cases} T\sigma_1^{G_1}(x_1) \wedge T\mu_1^{G_2}(y_1, y_2) if x_1 = x_2, y_1, y_2 \in E_2 \\ T\mu_1^{G_1}(x_1, x_2) \wedge T\sigma_1^{G_2}(y_1) if y_1 = y_2, x_1, x_2 \in E_1 \end{cases} \tag{7}$$

$$I\mu_2^{G_1\times_m G_2}((x_1, y_1), (x_2, y_2)) = \begin{cases} I\sigma_2^{G_1}(x_1) \wedge I\mu_2^{G_2}(y_1, y_2) if x_1 = x_2, y_1, y_2 \in E_2 \\ I\mu_2^{G_1}(x_1, x_2) \wedge I\sigma_2^{G_2}(y_1) if y_1 = y_2, x_1, x_2 \in E_1 \end{cases} \tag{8}$$

$$F\mu_3^{G_1\times_m G_2}((x_1, y_1), (x_2, y_2)) = \begin{cases} F\sigma_3^{G_1}(x_1) \vee F\mu_3^{G_2}(y_1, y_2) if x_1 = x_2, y_1, y_2 \in E_2 \\ F\mu_3^{G_1}(x_1, x_2) \vee F\sigma_3^{G_2}(y_1) if y_1 = y_2, x_1, x_2 \in E_1 \end{cases} \tag{9}$$

Example 3.3. Let $G_1^* = (V_1, E_1)$ and $G_2^* = (V_2, E_2)$ be two crisp graphs, such that $V_1 = \{u_1, u_2, u_3\}$ and $V_2 = \{v_1, v_2\}, E_1 = \{u_1u_3, u_2u_3\}$ & $E_2 = \{v_1v_2\}$. Take two neurotsophic graphs as consideration $G_1 = (T\sigma_1^{G_1}, I\sigma_2^{G_1}, F\sigma_3^{G_1}), (T\mu_1^{G_1}, I\mu_2^{G_1}, F\mu_3^{G_1})$ and $G_2 = (T\sigma_1^{G_2}, I\sigma_2^{G_2}, F\sigma_3^{G_2}), (T\mu_1^{G_1}, I\mu_2^{G_1}, F\mu_3^{G_1})$ & $G_1 \times_m G_2$

$V_1 \times_m V_2$	u_1v_1	u_2v_1	u_3v_1	u_1v_2	u_2v_2	u_3v_2
$T\sigma_1^{G_1} \times T\sigma_1^{G_2}$	0.7	0.7	0.8	0.7	0.7	0.7
$I\sigma_2^{G_1} \times I\sigma_2^{G_2}$	0.7	0.6	0.7	0.6	0.6	0.6
$F\sigma_3^{G_1} \times F\sigma_3^{G_2}$	0.5	0.5	0.5	0.5	0.5	0.4

Table 1: Product of two vertex sets

Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

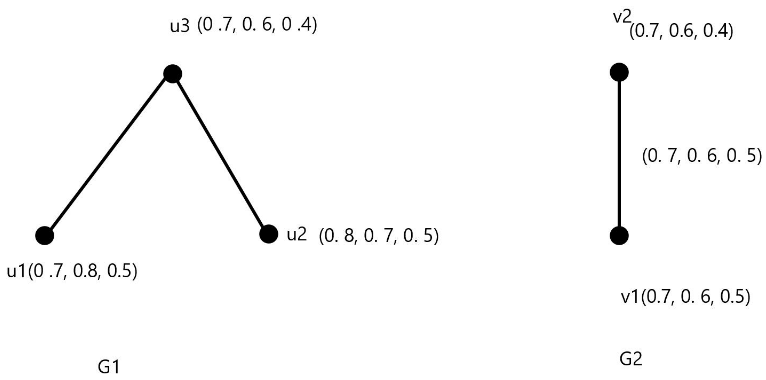

Figure 1: Neutrosophic Graphs

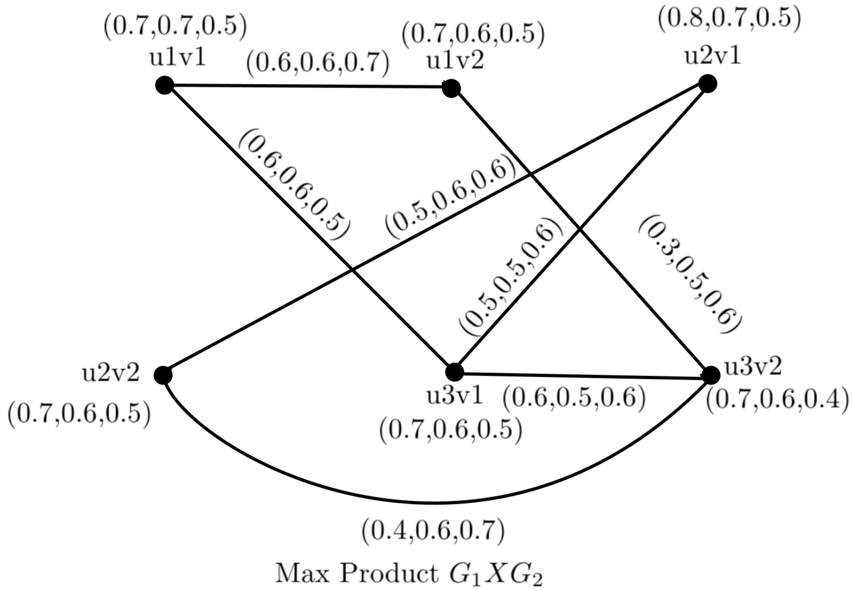

Figure 2: Max Product of Neutrosophic Graph

$E_1 \times_m E_2$	u_1v_1, u_3v_1	u_2v_1, u_3v_1	u_3v_1, u_3v_2	u_1v_2, u_3v_2	u_2v_2, u_3v_2	u_2v_2, u_2v_1	u_1v_1, u_1v_2
$T\mu_1^{G_1} \times T\mu_1^{G_2}$	0.8	0.8	0.7	0.7	0.7	0.8	0.7
$I\mu_2^{G_1} \times I\mu_2^{G_2}$	0.7	0.7	0.6	0.6	0.6	0.7	0.8
$F\mu_3^{G_1} \times F\mu_3^{G_2}$	0.5	0.5	0.4	0.4	0.4	0.5	0.5

Table 2: Product of two Edge sets

Definition 3.4. The maximum of two neurotsophic graphs' products in complement $G_1 = ((T\sigma_1^{G_1}, I\sigma_2^{G_1}, F\sigma_3^{G_1}), (T\mu_1^{G_1}, I\mu_2^{G_1}, F\mu_3^{G_1}))$ and $G_2 = ((T\sigma_1^{G_2}, I\sigma_2^{G_2}, F\sigma_3^{G_2}), (T\mu_1^{G_2}, I\mu_2^{G_2}, F\mu_3^{G_2}))$ is a neurotsophic graphs $\overline{G_1 \times_m G_2} = ((\overline{T\sigma_1^{G_1} \times_m T\sigma_1^{G_2}}), (\overline{I\sigma_2^{G_1} \times_m I\sigma_2^{G_2}}), (\overline{I\sigma_3^{G_1} \times_m I\sigma_3^{G_2}})),$ $((\overline{T\mu_1^{G_1} \times_m T\mu_1^{G_2}}), (\overline{I\mu_2^{G_1} \times_m I\mu_2^{G_2}}), (\overline{I\mu_3^{G_1} \times_m I\mu_3^{G_2}}))$ on $G^* = (V, E)$.

$$E_1 \times_m E_2 = \begin{cases} x_1 = x_2, y_1\, y_2 \in E_2 \;\; or \;\; y_1 = y_2, x_1x_2 \in E_1 \;\; or \\ (x_1, y_1)(x_2, y_2)|x_1x_2 \in E_1, y_1y_2 \notin E_2 \;\; or \;\; x_1x_2 \notin E_1, y_1y_2 \in E_2 \;\; or \\ x_1x_2 \in E_1, y_1y_2 \in E_2 \;\; or \;\; x_1x_2 \notin E_1, y_1y_2 \notin E_2 \end{cases}$$

$$(\overline{T\sigma_1^{G_1} \times_m T\sigma_1^{G_2}})(x_1, y_2) = (T\sigma_1^{G_1} \times_m T\sigma_1^{G_2})(x_1, y_1) = T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1) \quad (10)$$

$$(\overline{I\sigma_2^{G_1} \times_m I\sigma_2^{G_2}})(x_1, y_2) = (I\sigma_2^{G_1} \times_m I\sigma_2^{G_2})(x_1, y_1) = I\sigma_2^{G_1}(x_1) \vee I\sigma_2^{G_2}(y_1) \quad (11)$$

$$(\overline{F\sigma_3^{G_1} \times_m F\sigma_3^{G_2}})(x_1, y_2) = (F\sigma_3^{G_1} \times_m F\sigma_3^{G_2})(x_1, y_1) = F\sigma_3^{G_1}(x_1) \wedge F\sigma_3^{G_2}(y_1) \quad (12)$$

Where $x_1 \in V_1$ *and* $y_1 \in V_2$

$\overline{(T\mu_1^{G_1} \times_m T\mu_1^{G_2})}((x_1, y_1), (x_2, y_2))$

$$= \begin{cases} (T\sigma_1^{G_1} \times_m T\sigma_1^{G_2})(x_1, y_1) \wedge (T\sigma_1^{G_1} \times_m T\sigma_1^{G_2})(x_2, y_2) - (T\mu_1^{G_1} \times_m T\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \text{ if } x_1 = x_2, y_1y_2 \in E_2 \\ (T\sigma_1^{G_1} \times_m T\sigma_1^{G_2})(x_1, y_1) \wedge (T\sigma_1^{G_1} \times_m T\sigma_1^{G_2})(x_2, y_2) - (T\mu_1^{G_1} \times_m T\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \text{ if } y_1 = y_2, x_1x_2 \in E_1 \\ (T\sigma_1^{G_1} \times_m T\sigma_1^{G_2})(x_1, y_1) \wedge (T\sigma_1^{G_1} \times_m T\sigma_1^{G_2})(x_2, y_2) \; otherwise \end{cases}$$

$\overline{(I\mu_1^{G_1} \times_m I\mu_1^{G_2})}((x_1, y_1), (x_2, y_2))$

$$= \begin{cases} (I\sigma_1^{G_1} \times_m I\sigma_1^{G_2})(x_1, y_1) \wedge (I\sigma_1^{G_1} \times_m I\sigma_1^{G_2})(x_2, y_2) - (I\mu_1^{G_1} \times_m I\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \text{ if } x_1 = x_2, y_1y_2 \in E_2 \\ (I\sigma_1^{G_1} \times_m I\sigma_1^{G_2})(x_1, y_1) \wedge (I\sigma_1^{G_1} \times_m I\sigma_1^{G_2})(x_2, y_2) - (I\mu_1^{G_1} \times_m I\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \text{ if } y_1 = y_2, x_1x_2 \in E_1 \\ (I\sigma_1^{G_1} \times_m I\sigma_1^{G_2})(x_1, y_1) \wedge (I\sigma_1^{G_1} \times_m I\sigma_1^{G_2})(x_2, y_2) \; otherwise \end{cases}$$

$\overline{(F\mu_1^{G_1} \times_m F\mu_1^{G_2})}((x_1, y_1), (x_2, y_2))$

$$= \begin{cases} (F\sigma_1^{G_1} \times_m F\sigma_1^{G_2})(x_1, y_1) \vee (F\sigma_1^{G_1} \times_m F\sigma_1^{G_2})(x_2, y_2) - (F\mu_1^{G_1} \times_m F\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \text{ if } x_1 = x_2, y_1y_2 \in E_2 \\ (F\sigma_1^{G_1} \times_m F\sigma_1^{G_2})(x_1, y_1) \vee (F\sigma_1^{G_1} \times_m F\sigma_1^{G_2})(x_2, y_2) - (F\mu_1^{G_1} \times_m F\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \text{ if } y_1 = y_2, x_1x_2 \in E_1 \\ (F\sigma_1^{G_1} \times_m F\sigma_1^{G_2})(x_1, y_1) \vee (F\sigma_1^{G_1} \times_m F\sigma_1^{G_2})(x_2, y_2) \; otherwise \end{cases}$$

Example 3.5. Examine the two neutrosophic diagrams as depicted in Fig 1 and their respective maximum product $G_1 \times_m G_2$ illustrated in Fig 2. Subsequently, the complement of the maximum product of G_1 and G_2 is displayed in Fig 3.

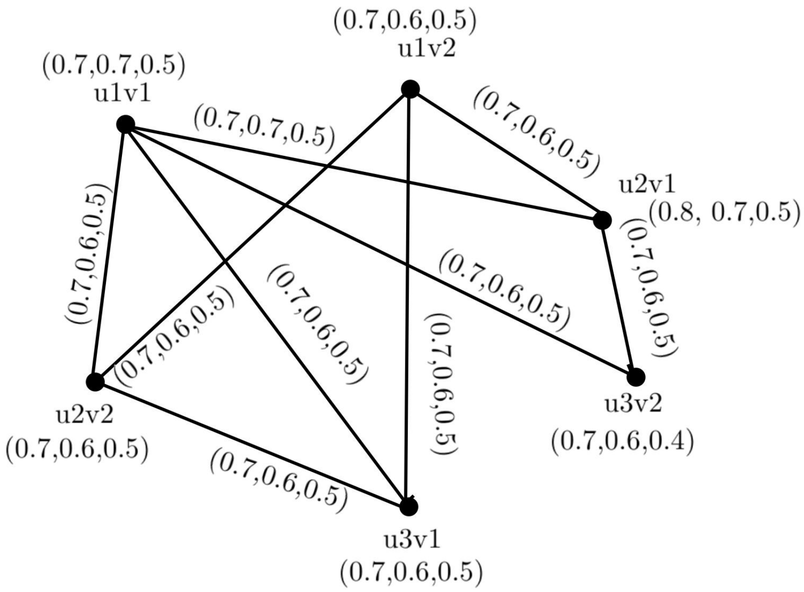

Figure 3: Complement of Max Product $\overline{G_1 \times_m G_2}$

Theorem 3.6. *Let G_1 and G_2 be a two regular neurotsophic graphs of underlying crip graph G_1^* and G_2^* are complete graphs and $T\sigma_1^{G_1}, I\sigma_2^{G_1}, F\sigma_3^{G_1}, T\sigma_1^{G_2}, I\sigma_2^{G_2}, F\sigma_3^{G_2}$ are constants which satisfy $T\sigma_1^{G_1} \geq T\mu_1^{G_2}, I\sigma_2^{G_1} \geq I\mu_2^{G_2}, F\sigma_3^{G_1} \leq T\mu_3^{G_2}, T\sigma_1^{G_2} \geq T\mu_1^{G_1}, I\sigma_2^{G_2} \geq I\mu_2^{G_1}, F\sigma_3^{G_2} \leq T\mu_3^{G_1}, T\sigma_1^{G_1} > T\mu_1^{G_1}, I\sigma_2^{G_1} > I\mu_2^{G_1}, F\sigma_3^{G_1} < T\mu_3^{G_1}, T\sigma_1^{G_2} > T\mu_1^{G_2}, I\sigma_2^{G_2} > I\mu_2^{G_2}, F\sigma_3^{G_2} < T\mu_3^{G_2}$ of max product of two neurotsophic graph G_1 and G_2 is regular neurotsophic graphs.*

Proof. Let G_1 and G_2 be two regular neurotsophic graphs. The underlying crisp graphs and G_1^* and G_2^* are complete graphs of degree d_1 and d_2 for every vertices of V_1 and V_2. Given that $T\sigma_1^{G_1}, I\sigma_2^{G_1}, F\sigma_3^{G_1}$ and $T\sigma_1^{G_2}, I\sigma_2^{G_2}, F\sigma_3^{G_2}$ are constants, say $T\sigma_1^{G_1}(x) = C_1, I\sigma_2^{G_1}(x) = C_2, F\sigma_3^{G_1}(x) = C_3 \; \forall x \in V_1, T\sigma_1^{G_2}(y) = C_4, I\sigma_2^{G_2}(y) = C_5, F\sigma_3^{G_2}(y) = C_6 \; \forall y \in V_2$ and $T\sigma_1^{G_1} \geq T\mu_1^{G_2}, I\sigma_2^{G_1} \geq I\mu_2^{G_2}, F\sigma_3^{G_1} \leq T\mu_3^{G_2}, T\sigma_1^{G_2} \geq T\mu_1^{G_1}, I\sigma_2^{G_2} \geq I\mu_2^{G_1}, F\sigma_3^{G_2} \leq T\mu_3^{G_1}$. By theorem man product of two neurotsophic graphs is regular neurot-

https://doi.org/10.54216/IJNS.230123

Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

sophic graphs. Consider $(x_1, y_2) \in (\overline{T\sigma^{G_1} \times_m T\sigma^{G_2}})$.

$$\begin{aligned}
d_1^{(\overline{T\sigma^{G_1}\times_m T\sigma^{G_2}})}(x_1,y_1) &= \sum_{(x_1,y_1)(x_2,y_2)\in E} (\overline{T\sigma^{G_1}\times_m T\sigma^{G_2}})((x_1,y_1)(x_2,y_2)) \\
&= \sum_{x_1=x_2,y_1y_2\in E_1} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2) \\
&- (T\mu_1^{G_1}\times_m T\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big) \\
&+ \sum_{y_1=y_2,x_1x_2\in E_1} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2) \\
&- (T\mu_1^{G_1}\times_m T\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big) \\
&+ \sum_{x_1x_2\in E_1,y_1y_2\notin E_2} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2)\Big) \\
&+ \sum_{x_1x_2\notin E_1,y_1y_2\in E_2} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2)\Big) \\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2)\Big) \\
&+ \sum_{x_1x_2\notin E_1,y_1y_2\notin E_2} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2)\Big)
\end{aligned}$$

Since G_1^* and G_2^* are complete graphs, then

$$\begin{aligned}
d_1^{(\overline{G_1\times_m G_2})}(x_1,y_1) &= \sum_{x_1=x_2,y_1y_2\in E_2} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2) \\
&- (T\mu_1^{G_1}\times_m T\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big) \\
&+ \sum_{y_1=y_2,x_1x_2\in E_1} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2) \\
&- (T\mu_1^{G_1}\times_m T\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big) \\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2) \\
&- (T\mu_1^{G_1}\times_m T\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big) \\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2} \Big((T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_1,y_1)\wedge(T\sigma_1^{G_1}\times_m T\sigma_1^{G_2})(x_2,y_2)\Big) \\
d_2^{(\overline{G_1\times_m G_2})}(x_1,y_1) &= \sum_{x_1=x_2,y_1y_2\in E_2} \Big((I\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_1,y_1)\wedge(I\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_2,y_2) \\
&- (I\mu_1^{G_1}\times_m I\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big) \\
&+ \sum_{y_1=y_2,x_1x_2\in E_1} \Big((I\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_1,y_1)\wedge(I\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_2,y_2) \\
&- (I\mu_1^{G_1}\times_m I\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big) \\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2} \Big((I\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_1,y_1)\wedge(I\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_2,y_2) \\
&- (I\mu_1^{G_1}\times_m I\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big) \\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2} \Big((I\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_1,y_1)\wedge(I\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_2,y_2)\Big)
\end{aligned}$$

https://doi.org/10.54216/IJNS.230123

Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

Similarity

$$\begin{aligned}
d_3^{\overline{(G_1\times_m G_2)}}(x_1,y_1) &= \sum_{x_1=x_2,y_1y_2\in E_2}\Big((F\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_1,y_1)\wedge(F\sigma_1^{G_1}\times_m F\sigma_1^{G_2})(x_2,y_2)\\
&- (F\mu_1^{G_1}\times_m F\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big)\\
&+ \sum_{y_1=y_2,x_1x_2\in E_1}\Big((F\sigma_1^{G_1}\times_m F\sigma_1^{G_2})(x_1,y_1)\wedge(F\sigma_1^{G_1}\times_m F\sigma_1^{G_2})(x_2,y_2)\\
&- (F\mu_1^{G_1}\times_m F\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big)\\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2}\Big((I\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_1,y_1)\wedge(F\sigma_1^{G_1}\times_m I\sigma_1^{G_2})(x_2,y_2)\\
&- (F\mu_1^{G_1}\times_m F\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big)\\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2}\Big((F\sigma_1^{G_1}\times_m F\sigma_1^{G_2})(x_1,y_1)\wedge(F\sigma_1^{G_1}\times_m F\sigma_1^{G_2})(x_2,y_2)\Big)
\end{aligned}$$

Case 1 If $T\sigma_1^{G_1}(x)\leq T\sigma_1^{G_2}(y), I\sigma_1^{G_1}(x)\leq I\sigma_1^{G_2}(y)$ and $F\sigma_1^{G_1}(x)\geq F\sigma_1^{G_2}(y)$ for all $x\in V_1$ and $y\in V_2$. Eq (5)

$$\begin{aligned}
Td_1^{\overline{G_1\times G_2}}(x_1,y_1) &= \sum_{x_1=x_2,y_1y_2\in E_2}\Big((T\sigma_1^{G_1}(x_1)\wedge T\sigma_1^{G_2}(y_1))\wedge(T\sigma_1^{G_1}(x_2)\wedge T\sigma_1^{G_2})(y_2)\\
&- (T\mu_1^{G_1}\times_m T\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big)\\
&+ \sum_{y_1=y_2,x_1x_2\in E_1}\Big((T\sigma_1^{G_1}(x_1)\wedge T\sigma_1^{G_2}(y_1))\wedge(T\sigma_1^{G_1}(x_2)\wedge T\sigma_1^{G_2}(y_2))\\
&- (T\mu_1^{G_1}\times_m T\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big)\\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2}\Big((T\sigma_1^{G_1}(x_1)\wedge T\sigma_1^{G_2}(y_1))\wedge(T\sigma_1^{G_1}(x_2)\wedge T\sigma_1^{G_2}(y_2))\Big)\\
&+ \sum_{x_1=x_2,y_1y_2\in E_2}\Big((T\sigma_1^{G_1}(x_1)\wedge T\sigma_1^{G_2}(y_1))\wedge(T\sigma_1^{G_1}(x_2)\wedge T\sigma_1^{G_2}(y_2))\Big)\\
Id_2^{\overline{G_1\times G_2}}(x_1,y_1) &= \sum_{x_1=x_2,y_1y_2\in E_2}\Big((I\sigma_1^{G_1}(x_1)\wedge T\sigma_1^{G_2}(y_1))\wedge(I\sigma_1^{G_1}(x_2)\wedge I\sigma_1^{G_2})(y_2)\\
&- (I\mu_1^{G_1}\times_m I\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big)\\
&+ \sum_{y_1=y_2,x_1x_2\in E_1}\Big((I\sigma_1^{G_1}(x_1)\wedge I\sigma_1^{G_2}(y_1))\wedge(I\sigma_1^{G_1}(x_2)\wedge I\sigma_1^{G_2}(y_2))\\
&- (I\mu_1^{G_1}\times_m I\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big)\\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2}\Big((I\sigma_1^{G_1}(x_1)\wedge I\sigma_1^{G_2}(y_1))\wedge(I\sigma_1^{G_1}(x_2)\wedge I\sigma_1^{G_2}(y_2))\Big)\\
&+ \sum_{x_1=x_2,y_1y_2\in E_2}\Big((I\sigma_1^{G_1}(x_1)\wedge I\sigma_1^{G_2}(y_1))\wedge(I\sigma_1^{G_1}(x_2)\wedge I\sigma_1^{G_2}(y_2))\Big)
\end{aligned}$$

https://doi.org/10.54216/IJNS.230123

Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

$$\begin{aligned}
Fd_3^{\overline{G_1\times G_2}}(x_1,y_1) &= \sum_{x_1=x_2,y_1y_2\in E_2}\Big((F\sigma_1^{G_1}(x_1)\vee F\sigma_1^{G_2}(y_1))\vee(F\sigma_1^{G_1}(x_2)\vee F\sigma_1^{G_2})(y_2)\\
&- (F\mu_1^{G_1}\times_m F\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big)\\
&+ \sum_{y_1=y_2,x_1x_2\in E_1}\Big((F\sigma_1^{G_1}(x_1)\vee F\sigma_1^{G_2}(y_1))\wedge(F\sigma_1^{G_1}(x_2)\vee F\sigma_1^{G_2}(y_2))\\
&- (F\mu_1^{G_1}\times_m F\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\Big)\\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2}\Big((F\sigma_1^{G_1}(x_1)\vee F\sigma_1^{G_2}(y_1))\vee(F\sigma_1^{G_1}(x_2)\vee F\sigma_1^{G_2}(y_2))\Big)\\
&+ \sum_{x_1=x_2,y_1y_2\in E_2}\Big((F\sigma_1^{G_1}(x_1)\vee F\sigma_1^{G_2}(y_1))\vee(F\sigma_1^{G_1}(x_2)\vee F\sigma_1^{G_2}(y_2))\Big)
\end{aligned}$$

Since by the definition of project of two neutrosophic graphs,

$$\begin{aligned}
Td_1^{\overline{G_1\times G_2}}(x_1,y_1) &= \sum_{x_1=x_2,y_1y_2\in E_2} T\sigma_1^{G_2}(y_1)-(T\mu_1^{G_1}\times_m T\mu_1^{G_2})((x_1,y_1),(x_2,y_2))\\
&+ \sum_{y_1=y_2,x_1x_2\in E_1} T\sigma_1^{G_2}(y_1)-(\overline{T\mu_1^{G_1}\times_m T\mu_1^{G_2}})((x_1,y_1),(x_2,y_2))+\sum_{x_1,x_2\in E_1y_1y_2\in E_2} C_3\\
&= \sum_{x_1=x_2,y_1y_2\in E_2} T\sigma_1^{G_2}(y_1)-T\sigma_1^{G_2}(x_1)\wedge T\mu_1^{G_2}(y_1,y_2)\\
&+ \sum_{y_1=y_2,x_1x_2\in E_1} T\sigma_1^{G_2}(y_1)-T\mu_1^{G_1}(x_1,x_2)\vee T\sigma_1^{G_2}(y_1)+\sum_{x_1,x_2\in E_1y_1y_2\in E_2} C_3\\
&= \sum_{x_1=x_2,y_1y_2\in E_2} C_3-T\sigma_1^{G_1}(x_1)+\sum_{y_1=y_2,x_1x_2\in E_1} C_3-T\sigma_1^{G_2}(y_1)+C_3d^*_{G_2}(y_1)d^*_{G_1}(x_1).\\
Td_1^{\overline{G_1\times G_2}}(x_1,y_1) &= (C_3-C_1)d_2+C_3d_1d_2,
\end{aligned}$$

Similarly we can find

$$\begin{aligned}
Id_1^{\overline{G_1\times_m G_2}}(x_1,y_1) &= (C_3-C_1)d_2+C_3d_1d_2,\\
Fd_1^{\overline{G_1\times_m G_2}}(x_1,y_1) &= (C_4-C_1)d_2+C_4d_1d_2,
\end{aligned}$$

Since G_1 and G_2 are two regular neurotsophic graphs, G_1^* and G_2^* represent complete graphs, with membership functions denoted by $\mu_1^{G_1}$ and $\mu_1^{G_2}$. These membership functions are constants, namely, (C_1,C_2) for $\mu_1^{G_1}$ and (C_3,C_4) for $\mu_1^{G_2}$.

Case 2 If $T\sigma_1^{G_1}(x)\geq T\sigma_1^{G_2}(y), I\sigma_1^{G_1}(x)\geq I\sigma_1^{G_2}(y)$ and $F\sigma_1^{G_1}(x)\leq F\sigma_1^{G_2}(y)$ for all $x\in V_1$ and $y\in V_2$.

$$\begin{aligned}
Td_1^{\overline{G_1\times_m G_2}}(x_1,y_1) &= \sum_{x_1=x_2,y_1y_2\in E_2}\Big(T\sigma_1^{G_1}(x_1)-\{(T\sigma_1^{G_1}(x_1)\vee T\mu_1^{G_2}(y_1,y_2)\}\Big)\\
&+ \sum_{y_1=y_2,x_1x_2\in E_1}\Big(T\sigma_1^{G_1}(y_1)-\{(T\sigma_1^{G_1}(y_1)\vee T\mu_1^{G_2}(x_1,x_2)\}\Big)\\
&+ \sum_{x_1x_2\in E_1,y_1y_2\in E_2} T\sigma_1^{G_1}(x_1)\\
&= \sum_{x_1=x_2,y_1y_2\in E_2} C_1-(T\sigma_1^{G_1}(x_1))+\sum_{y_1=y_2,x_1x_2\in E_1} C_1-(T\sigma_1^{G_1}(y_1))\\
&+ C_1d^*_{G_2}(y_1)d^*_{G_2}(x_1)\\
Td_1^{\overline{G_1\times_m G_2}}(x_1,y_1) &= (C_1-C_3)d_2+C_3d_1d_2,
\end{aligned}$$

Similarly we can find

$$\begin{aligned}
Id_1^{\overline{G_1\times_m G_2}}(x_1,y_1) &= (C_1-C_3)d_2+C_3d_1d_2\\
Fd_1^{\overline{G_1\times_m G_2}}(x_1,y_1) &= (C_4-C_2)d_1+C_4d_1d_2
\end{aligned}$$

https://doi.org/10.54216/IJNS.230123

Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

Because of this, normal neurotsophic graphs have a regular complement of their maximum product. □

Theorem 3.7. *Let G_1 and G_2 be a pair of regular neurotsophic graphs derived from the underlying crip graph G_1^* and G_2^* respectively. The vertex sets and edges sets of G_1 and G_2 are complete graphs, and the regular netrosphic graphs are associated with them. If $T\sigma_1^{G_1} > T\mu_1^{G_2}, I\sigma_2^{G_1} > I\mu_2^{G_2}, F\sigma_3^{G_1} < T\mu_3^{G_2}, T\sigma_1^{G_2} > T\mu_1^{G_1}, I\sigma_2^{G_2} > I\mu_2^{G_1}, F\sigma_3^{G_2} < F\mu_3^{G_1}, T\sigma_1^{G_1} > T\mu_1^{G_1}, I\sigma_2^{G_1} > I\mu_2^{G_1}, F\sigma_3^{G_1} < F\mu_3^{G_1}$ and $T\sigma_1^{G_2} < T\mu_1^{G_2}, I\sigma_2^{G_2} < I\mu_2^{G_2}, F\sigma_3^{G_2} > F\mu_3^{G_2}$, a complement graph is a regular neurotsophic graph when it's the maximum product of two regular netrosophic graphs.*

Proof. The underlying crisp graphs G_1^* and G_2^* are regular graphs, with every vertex in V_1 and V_2 having degrees g_1 and g_2, respectively. Given that $T\sigma^{G_1}, I\sigma^{G_1}, F\sigma^{G_1}, T\mu^{G_2}, I\mu^{G_2}$ and $F\mu^{G_2}$ and are constants say $T\sigma_1^{G_1}(x) = C_1, I\sigma_2^{G_1}(x) = C_2, F\sigma_3^{G_1}(x) = C_3 \forall x \in V_1, T\sigma_1^{G_2}(x) = C_4, I\sigma_2^{G_2}(x) = C_5, F\sigma_3^{G_2}(x) = C_6 \forall y \in V_2, T\mu_1^{G_1}(x_1, y_1) = e_1, I\mu_2^{e_1}(x_1, y_1) = e_2, F\mu_3^{G_1}(x_1, y_1) = e_3, T\mu_1^{G_2}(x_1 y_1) = e_4, I\mu_2^{G_2}(x_1, y_1) = e_5, F\mu_3^{G_2}(x_1, y_1) = e_6$ and $T\sigma_1^{G_1} > T\mu_1^{G_2}, I\sigma_2^{G_1} > I\mu_2^{G_2}, F\sigma_3^{G_1} < F\mu_3^{G_2}; T\sigma_1^{G_2} > T\mu_1^{G_1}, I\sigma_2^{G_2} > I\mu_2^{G_1}, F\sigma_3^{G_2} < F\mu_3^{G_1}$.
Consider $(x_1, y_2)\epsilon\overline{(T\sigma_1^{G_1} \times T\sigma_1^{G_2})}$

Case 1: If $T\sigma_1^{G_1}(x) \leq T\sigma_1^{G_2}(y), I\sigma_1^{G_1}(x) \leq I\sigma_1^{G_2}(y)$ and $F\sigma_1^{G_2}(x) \geq F\sigma_3^{G_2}(y) \forall x \in V_1$ and $y \in V_2$.

$$\begin{aligned}
Td_1^{\overline{G_1 \times G_2}}(x_1, y_1) &= \sum_{x_1 = x_2, y_1 y_2 \in E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2}(y_2)) \\
&- (T\mu_1^{G_1} \times_m T\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \Big) \\
&+ \sum_{y_1 = y_2, x_1 x_2 \in E_1} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2}(y_2)) \\
&- (T\mu_1^{G_1} \times_m T\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \Big) \\
&+ \sum_{x_1, x_2 \in E_1, y_1 y_2 \notin E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2})(y_2) \\
&+ \sum_{x_1, x_2 \notin E_1, y_1 y_2 \in E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2})(y_2) \\
&+ \sum_{x_1, x_2 \notin E_1, y_1 y_2 \notin E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2})(y_2) \\
&+ \sum_{x_1, x_2 \in E_1, y_1 y_2 \in E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2})(y_2) \\
&= \sum_{x_1 = x_2, y_1 y_2 \in E_2} T\sigma_1^{G_2}(y_1) - \{T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1, y_2)\} \\
&+ \sum_{y_1 = y_2, x_1 x_2 \in E_1} T\sigma_1^{G_2}(y_1) - \{T\sigma_1^{G_2}(x_2) \vee T\sigma_1^{G_2}(x_1, x_2)\} \\
&+ \sum_{x_1 x_2 \in E_1, y_1 y_2 \notin E_2} C_4 + \sum_{x_1 x_2 \notin E_1, y_1 y_2 \in E_2} C_4 + \sum_{x_1 x_2 \notin E_1, y_1 y_2 \notin E_2} C_4 + \sum_{x_1 x_2 \in E_1, y_1 y_2 \in E_2} C_4 \\
&= (C_4 - C_1) g_2 + (C_1 - C_1) g_1 + C_4 d_{G_1^*}(x_1) + |\overline{E_2}| + C_3 |\overline{E_1}| d_{G_2^*}(y_1) + C_4 |\overline{E_1}| |\overline{E_2}| \\
&+ C_4 d_{G_2^*}(x_2) d_{G_1^*}(y_4).
\end{aligned}$$

Where $|\overline{E_1}| and |\overline{E_2}|$ are the degree of vertex of complement graphs G_1^* and G_2^*.

$$\begin{aligned}
Td_1^{\overline{G_1 \times G_2}}(x_1, y_1) &= (C_4 - C_1) g_2 + C_4 g_1 |\overline{E_2}| + C_4 g_2 |\overline{E_1}| + C_4 |\overline{E_1}| |\overline{E_2}| + C_1 g_1 g_2. \\
Id_2^{\overline{G_1 \times G_2}}(x_1, y_1) &= (C_4 - C_1) g_2 + C_4 g_1 |\overline{E_2}| + C_4 g_2 |\overline{E_1}| + C_4 |\overline{E_1}| |\overline{E_2}| + C_1 g_1 g_2. \\
Fd_3^{\overline{G_1 \times G_2}}(x_1, y_1) &= (C_5 - C_2) g_2 + C_5 g_1 |\overline{E_2}| + C_5 g_2 |\overline{E_1}| + C_5 |\overline{E_1}| |\overline{E_2}| + C_2 g_1 g_2.
\end{aligned}$$

For all vertices, this is accurate $\overline{V_1 \times_m V_2}$.

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Case 2 If $T\sigma_1^{G_2}(x) \leq T\sigma_1^{G_1}(y), I\sigma_1^{G_2}(x) \leq I\sigma_1^{G_1}(y)$ and $F\sigma_1^{G_2}(x) \geq F\sigma_3^{G_1}(y) \forall x \in V_1$ and $y \in V_2$.

$$\begin{aligned}
Td_1^{\overline{G_1 \times G_2}}(x_1, y_1) &= \sum_{x_1=x_2, y_1y_2 \in E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2}(y_2)) \\
&- (T\mu_1^{G_1} \times_m T\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \Big) \\
&+ \sum_{y_1=y_2, x_1x_2 \in E_1} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2}(y_2)) \\
&- (T\mu_1^{G_1} \times_m T\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \Big) \\
&+ \sum_{x_1x_2 \in E_1, y_1y_2 \notin E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2}(y_2) \Big) \\
&+ \sum_{x_1x_2 \notin E_1, y_1y_2 \notin E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2}(y_2)) \\
&- (T\mu_1^{G_1} \times_m T\mu_1^{G_2})((x_1, y_1), (x_2, y_2)) \Big) \\
&+ \sum_{x_1x_2 \notin E_1, y_1y_2 \notin E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2}(y_2) \Big) \\
&+ \sum_{x_1x_2 \in E_1, y_1y_2 \in E_2} \Big((T\sigma_1^{G_1}(x_1) \vee T\sigma_1^{G_2}(y_1)) \wedge (T\sigma_1^{G_1}(x_2) \vee T\sigma_1^{G_2}(y_2) \Big) \\
Td_1^{\overline{G_1 \times G_2}}(x_1, y_1) &= \sum_{x_1=x_2, y_1y_2 \in E_2} (T\sigma_1^{G_1}(x_2) - T\sigma_1^{G_1}(x_1)) + \sum_{y_1=y_2, x_1x_2 \in E_2} (T\sigma_1^{G_1}(x_2) - T\sigma_1^{G_2}(y_1)) \\
&+ \sum_{x_1x_2 \in E_1, y_1y_2 \notin E_2} T\sigma_1^{G_2}(x_1) + \sum_{x_1x_2 \notin E_1, y_1y_2 \notin E_2} T\sigma_1^{G_2}(x_1) \\
&+ \sum_{x_1x_2 \notin E_1, y_1y_2 \notin E_2} T\sigma_1^{G_2}(x_1) + \sum_{x_1x_2 \in E_1, y_1y_2 \in E_2} T\sigma_1^{G_2}(x_1)
\end{aligned}$$

Where E_1 & E_2 are the degrees of the vertices of complement graphs G_1^* & G_2^*, respectively.

$$\begin{aligned}
Td_1^{\overline{G_1 \times G_2}}(x_1, y_1) &= (C_1 - C_1)g_1 + (C_1 - C_4)g_2 + C_1g_1|\overline{E_2}| + C_1g_2|\overline{E_1}| + C_1|\overline{E_1}||\overline{E_2}| + C_1g_1g_2. \\
&= (C_1 - C_3)g_2 + C_1g_1|\overline{E_2}| + C_1g_2|\overline{E_1}| + C_1|\overline{E_1}||\overline{E_2}| + C_1g_1g_2. \\
Similarly & \\
Id_2^{\overline{G_1 \times G_2}}(x_1, y_1) &= (C_1 - C_3)g_2 + C_1g_1|\overline{E_2}| + C_1g_2|\overline{E_1}| + C_1|\overline{E_1}||\overline{E_2}| + C_1g_1g_2. \\
Fd_3^{\overline{G_1 \times G_2}}(x_1, y_1) &= (C_2 - C_4)g_2 + C_2g_1|\overline{E_2}| + C_2g_2|\overline{E_1}| + C_2|\overline{E_1}||\overline{E_2}| + C_2g_1g_2.
\end{aligned}$$

For all vertices, this is accurate $\overline{V_1 \times_m V_2}$. As a result, the complement of the modular product of two regular neurotsophic graphs is also regular. □

4 Applications

We want to identify the internet streaming service that particular demographic favors based on their usage trends. We will examine the streaming behaviors of our eight users,$U = \{u_1, u_2, u_3, u_4, u_5, u_6, u_7, u_8\}$(Depicted Fig 4) utilizing a series of symptoms or indicators, I = { Video and picture quality, Content variety, User interface, Price, Device compatibility }. Every individual may have distinct encounters and inclinations, and our goal is to ascertain the fundamental factor that sets apart their choice of streaming service from a selection of well-known platforms, P = {Netflix, Amazon Prime Video, Hulu, Disney+, HBO Max }(Depicted Fig 5). By utilizing the neutrosophic normalized Hamming distance, we can evaluate the resemblance between every user's inclinations and the accessible streaming platforms. The metric with the minimum distance for each user can subsequently be regarded as the fundamental indication or preference that has the greatest impact

https://doi.org/10.54216/IJNS.230123
Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

on their selection of streaming service. For example, suppose user u_1 encounters the subsequent indications: excellent video quality, extensive range of content, easy-to-use interface, cost-effective pricing, and support for numerous devices. By contrasting their indications with the characteristics of various streaming services, we can establish that the primary factor for u_1 is "Content variety" as it closely corresponds with the offerings of platforms such as Netflix or Amazon Prime Video. Likewise, In (Table3, Table4, and Fig 6) we can examine the signs of other users and identify the fundamental sign that most accurately reflects their streaming service inclination. This method enables us to make inferences about the type of service each user favors by considering their symptom resemblances to the accessible choices. For this purpose we need two kinds of observations:

1. The multiple indicators found in each streaming
2. The type of indications found for each stream in a typical given circumcision. Both of these facts are noted in a neutrosophic set, which includes descriptions of the membership, indeterminacy, and non-membership functions μ, σ, and δ, among other things.

To find the core attribute by utilizing neutrosophic normalized Hamming distance formula (Table5) for every indicators of i^{th} stream from k^{th} platform is:

$$LNH(S(P_i), d_k) = \frac{1}{2}\sum_{j=1}^{n} max\{|\mu_j(p_i) - \mu_j(d_k)|, |\mu_j(p_i) - \mu_j(d_k)|, |\mu_j(p_i) - \mu_j(d_k)|\}$$

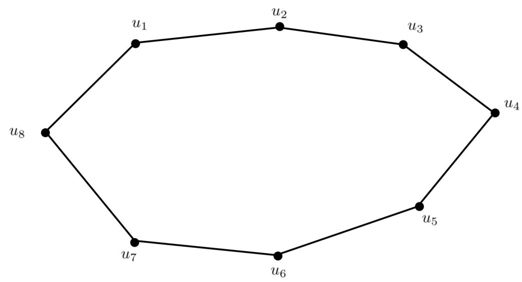

Figure 4: Neuturosophic Graph G_1

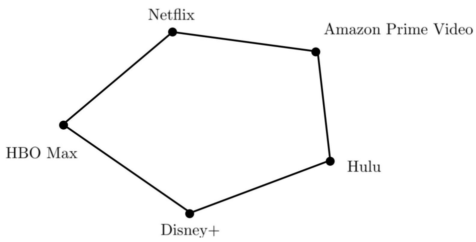

Figure 5: Neuturosophic Graph G_2

https://doi.org/10.54216/IJNS.230123
Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

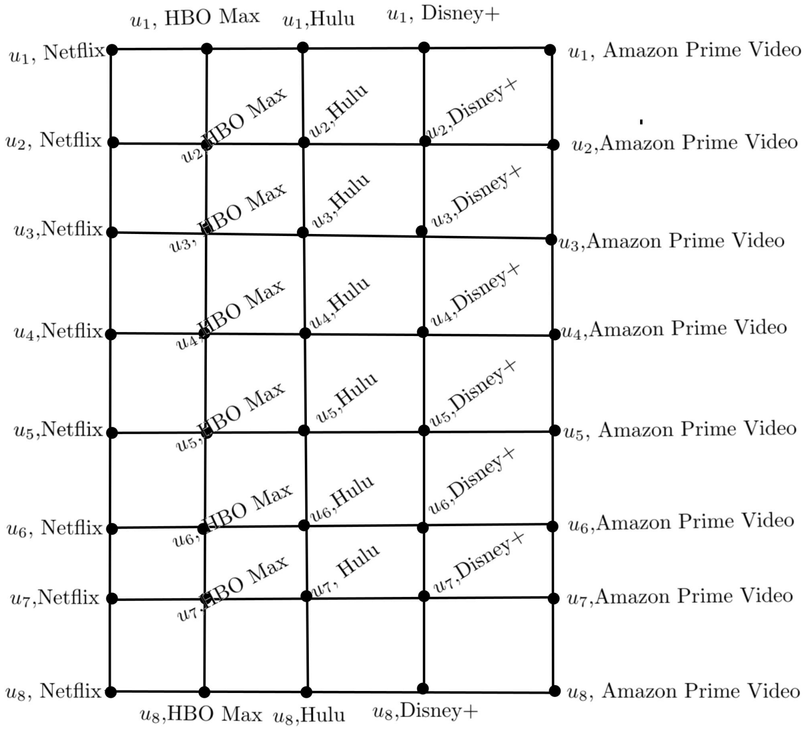

Figure 6: Neuturosophic Graph $G_1 \times_m G_2$

	Video quality	Content variety	User interface	Price	Device compatibility
u_1	(0.5, 0.4, 0.4)	(0.4, 0.3, 0.3)	(0.4, 0.5, 0.3)	(0.5, 0.5, 0.5)	(0.4, 0.5, 0.6)
u_2	(0.2, 0.7, 0.3)	(0.5, 0.7, 0.4)	(0.4, 0.6, 0.5)	(0.4, 0.6, 0.5)	(0.4, 0.5, 0.6)
u_3	(0.5, 0.4, 0.2)	(0.7, 0.3, 0.5)	(0.5, 0.6, 0.6)	(0.4, 0.6, 0.5)	(0.3, 0.5, 0.4)
u_4	(0.6, 0.5, 0.3)	(0.5, 0.5, 0.5)	(0.3, 0.5, 0.6)	(0.6, 0.3, 0.5)	(0.5, 0.6, 0.8)
u_5	(0.3, 0.5, 0.7)	(0.3, 0.7, 0.1)	(0.8, 0.5, 0.2)	(0.3, 0.5, 0.8)	(0.4, 0.3, 0.8)
u_6	(0.4, 0.5, 0.6)	(0.7, 0.5, 0.4)	(0.7, 0.4, 0.2)	(0.6, 0.5, 0.8)	(0.7, 0.6, 0.5)
u_7	(0.3, 0.6, 0.3)	(0.5, 0.6, 0.5)	(0.2, 0.8, 0.3)	(0.5, 0.5, 0.6)	(0.7, 0.6, 0.4)
u_8	(0.2, 0.5, 0.6)	(0.3, 0.6, 0.4)	(0.2, 0.5, 0.6)	(0.2, 0.6, 0.5)	(0.6, 0.3, 0.4)

Table 3: User Encounters the Subsequent Indications

	Netflix	HBO Max	Hulu	Disney+	Amazon Prime Video
Video quality	(0.7, 0.4, 0.4)	(0.3, 0.6, 0.4)	(0.3, 0.7, 0.5)	(0.2, 0.6, 0.7)	(0.2, 0.7,0.3)
Content Variety	(0.5, 0.6, 0.4)	(0.3, 0.7, 0.5)	(0.3, 0.6, 0.5)	(0.3, 0.5, 0.7)	(0.2, 0.7, 0.5)
User interface	(0.2, 0.7, 0.4)	(0.1, 0.7, 0.5)	(0.4, 0.6, 0.7)	(0.8, 0.4, 0.4)	(0.2, 0.8, 0.2)
Price	(0.4, 0.4, 0.5)	(0.5, 0.2, 0.6)	(0.4, 0.6, 0.7)	(0. 2, 0.6, 0.5)	(0.5,0.6, 0.5)
Device compatibility	(0.2, 0.6, 0.5)	(0.2, 0.7, 0.4)	(0.0, 0.7, 0.5)	(0. 2, 0.6, 0.5)	(0.6, 0.3, 0.3)

Table 4: Contrasting Indications with the Characteristic of Various Streaming Service

5 Result Analysis

The neutrosophic extended Hausdorff normalized Hamming distance program has been run for each stream, and the results show that streams u_1, u_3, and u_6 have the lowest values in the Netflix column. We draw the conclusion that these streams are most likely connected to Netflix using the least distance approach. We anticipate that streams u_2 and u_8 will be on Hulu, stream u_5 will be connected to Disney+, and streams u_7 and u_8 are likely to be connected to Amazon Prime Video based on this pattern (Fig 7). Additionally, we believe

https://doi.org/10.54216/IJNS.230123

Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

	Netflix	HBO Max	Hulu	Disney+	Amazon Prime Video
u_1	**0.2000**	0.2600	0.2800	0.3200	0.2800
u_2	0.2600	0.2800	**0.2200**	0.3000	0.2400
u_3	**0.1600**	0.1800	0.2200	0.3400	0.3000
u_4	**0.1800**	0.2400	0.2400	0.3600	0.3200
u_5	0.3800	0.4200	0.3200	**0.3000**	0.4400
u_6	**0.2000**	0.2800	0.2800	0.3400	0.2800
u_7	0.2400	0.2600	0.2600	0.4000	**0.1800**
u_8	0.3000	0.3000	**0.2200**	0.2800	**0.2200**

Table 5: The Shortest Distance

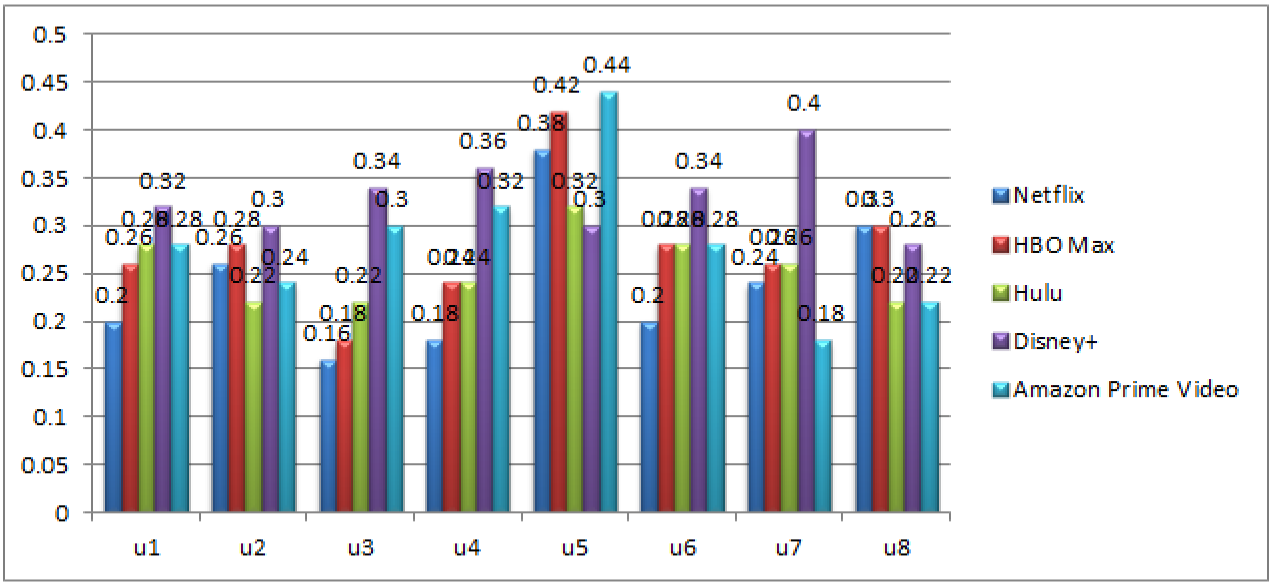

Figure 7: Neutrosophic Graphs

that our application will open the door for a lot of additional future researches that will be very beneficial to the general population.

6 Conclusion

Graph theory has proved to be a valuable tool in addressing a wide range of networking problems across various fields, including signal processing, transportation, and error codes. A prominent combinatorial optimization problem in graph theory involves finding the shortest path. In handling ambiguous information that arises in real-world scenarios, the neutrosophic graph model has gained popularity for providing true membership, indeterminacy membership, and false membership. The concept of the maximum product of two neutrosophic graphs' complement has been introduced in this paper, offering a powerful means to combine different structural models effectively. The regularity in the complement of two neutrosophic graphs has attracted significant attention due to its numerous applications in building reliable communications and network systems. Moreover, neutrosophic graphs play a vital role in decision-making processes, as they can be used to compare and choose between various internet streaming services, enabling users to make informed and relevant choices.

6.1 Future Work

We are going to extend our work

https://doi.org/10.54216/IJNS.230123

Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023

1. Different type product of complement Neutrosophic graph.
2. Product of Neutrosophic graph and its applications on medical flied
3. Product of Neutrosophic graph and its applications on textile industry
4. Neutrosophic coloring graph and their applications.

Funding: Not applicable.
Data Availability Statement: Not applicable
Conflicts of Interest: The authors declare no conflict of interest.

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https://doi.org/10.54216/IJNS.230123
Received: May 18, 2023 Revised: August 18, 2023 Accepted: November 30, 2023