

# C# Application to Deal with Neutrosophic $g\alpha$ -Closed Sets in Neutrosophic Topology

<sup>1</sup>Saranya. S, <sup>2</sup>Vigneshwaran. M and <sup>3</sup>Jafari. S

<sup>1,2</sup>PG and Research Department of Mathematics,  
Kongunadu Arts and Science College,  
Coimbatore - 641 029,  
India.

<sup>1</sup>[saranyamaths1107@gmail.com](mailto:saranyamaths1107@gmail.com)  
<sup>2</sup>[vignesh.mat@gmail.com](mailto:vignesh.mat@gmail.com)

<sup>3</sup>Department of Mathematics,  
College of Vestsjaelland South,  
Herrestraede 11, 4200 Slagelse,  
Denmark.

<sup>3</sup>[jafaripersia@gmail.com](mailto:jafaripersia@gmail.com)

## Abstract

In this paper, we have developed a C# application for finding the values of the complement, union, intersection and the inclusion of any two neutrosophic sets in the neutrosophic field by using .NET Framework, Microsoft Visual Studio and C# Programming Language. In addition to this, the system can find neutrosophic topology ( $\tau$ ), neutrosophic  $\alpha$ -closed sets and neutrosophic  $g\alpha$ -closed sets in each resultant screens. Also this computer based application produces the complement values of each neutrosophic closed sets.

**Keywords:** .NET framework; Microsoft Visual Studio; C# Application; Neutrosophic Set Operations; Neutrosophic Topology ( $\tau$ ); Neutrosophic  $\alpha$ -Closed Set; Neutrosophic  $g\alpha$ -Closed Set.

**MSC 2010 No.:** 03E72, 03F55, 54A40, 68W99, 68U99

## 1. Introduction

Smarandache [12] introduced neutrosophic sets in 1998. By using the concept of neutrosophic set Salama and Alblowi [4] were introduced neutrosophic topological spaces in 2012. In 2014, Salama et al., [6] have developed some software programs for dealing with neutrosophic sets. Salama et al., [7] have designed and implemented a neutrosophic data operation by using object oriented programming in 2014. Arokiarani et al., [2] were introduced neutrosophic  $\alpha$ -closed sets in neutrosophic topological spaces in 2017. In 2018, Vigneshwaran and Saranya [14] have introduced  $b^*g\alpha$ -closed sets in topological spaces. Recently, Saranya and Vigneshwaran have introduced neutrosophic  $g\alpha$ -closed sets, neutrosophic  $*g\alpha$ -closed sets and neutrosophic  $b^*g\alpha$ -closed sets in neutrosophic topological spaces in [9] and also developed a new C# application to deal with neutrosophic  $\alpha$ -closed sets in neutrosophic topology [10].

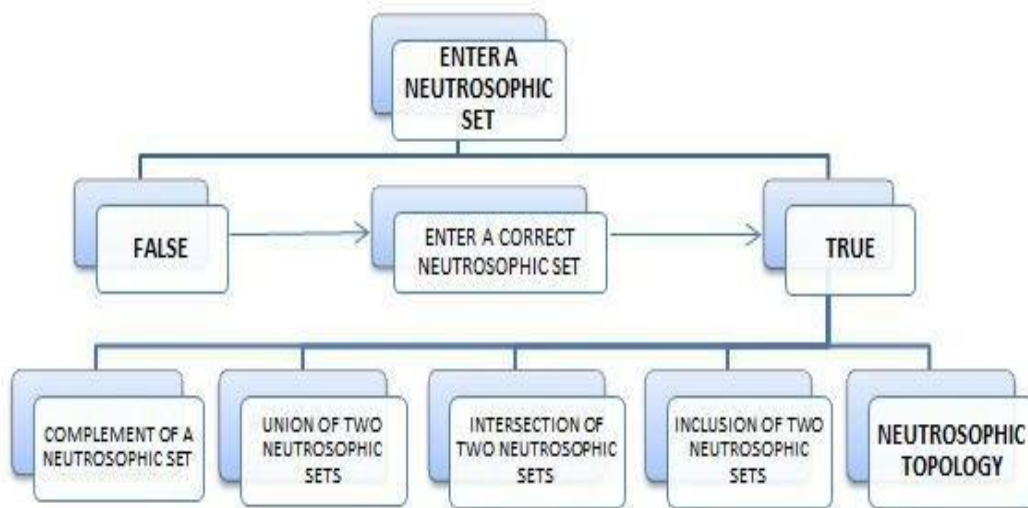
The present study introduces, the C# application to reduce the manual calculations for finding the values of the complement, union, intersection and the inclusion of two neutrosophic sets in a neutrosophic field. We have developed a C# application by using .NET Framework, Microsoft Visual Studio and C# Programming Language. In this application the user can calculate the values of neutrosophic topology, neutrosophic  $\alpha$ -closed set and neutrosophic  $g\alpha$ -closed set values in each resultant screens. Also it generates the values of the complement sets.

## 2. Preliminaries

In this section, we recollect some of the basic definitions, which has been used in [1, 3, 5, 8, 11 and 13] and all of the basic definitions from “Neutrosophic  $b^*g\alpha$ -Closed Sets [9]” paper are used to write the coding in C# application for this current research work.

## 3. Results on Neutrosophic $g\alpha$ -Closed Sets via C# Application

In this section we have shown the working process of C# application for finding the values of the complement, union, intersection and the inclusion of any two neutrosophic sets. Also it produces the values of neutrosophic topology ( $\tau$ ), neutrosophic  $\alpha$ -closed set and neutrosophic  $g\alpha$ -closed set values in neutrosophic topological spaces. The complements of neutrosophic  $\alpha$ -closed set and neutrosophic  $g\alpha$ -closed set values will be displayed at the end of the results of each sets.



“Figure 1: Neutrosophic Topology - Flow Chart”

### Algorithm: Neutrosophic Topology

input	$0_N, 1_N, L, M$
output	complement of $L$ and $M$ ; union of $L$ and $M$ ; intersection of $L$ and $M$ ; inclusion of $L$ and $M$ ; neutrosophic Topology

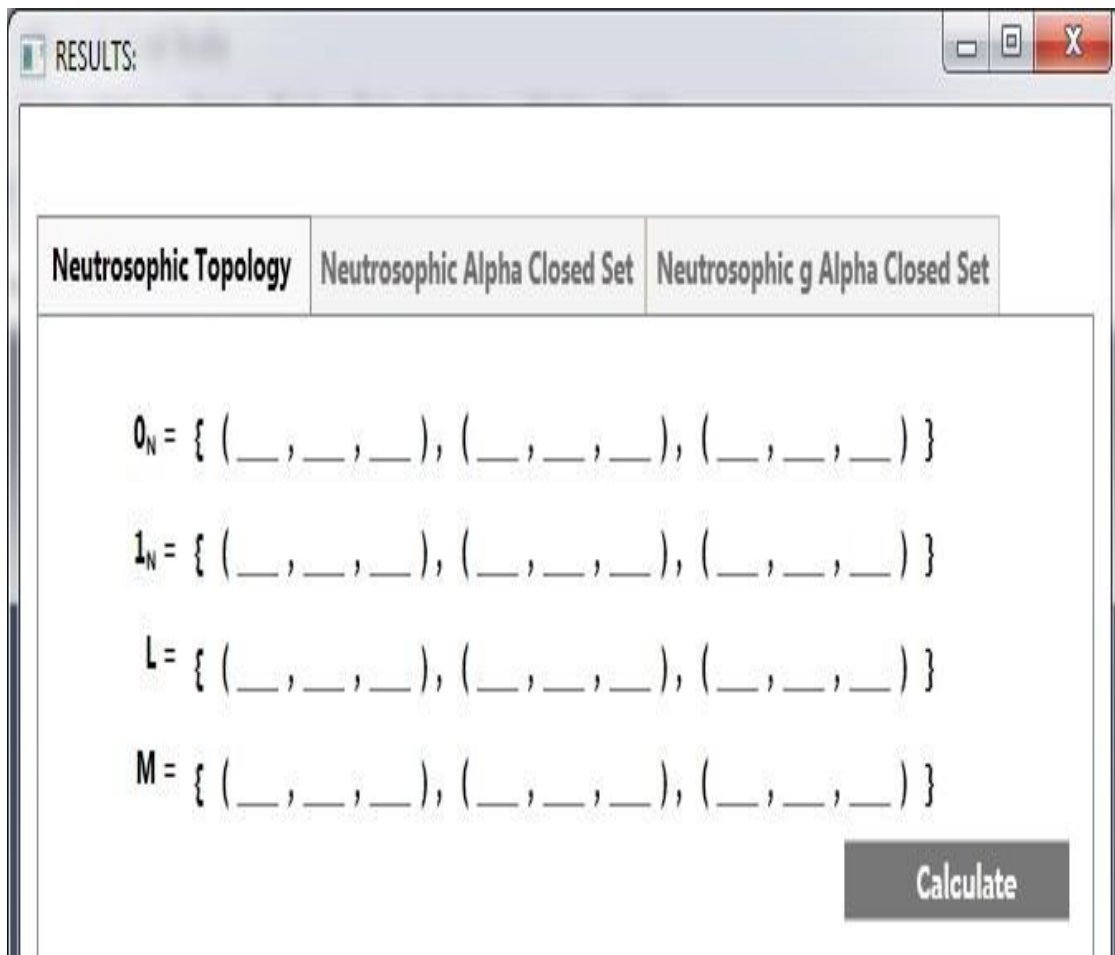
### STEPS:

- step-1: check  $0_N$  and  $1_N$  is valid
- step-2:  $L$  and  $M$  should be a neutrosophic set
- step-3: calculate the complement of  $L$  and  $M$

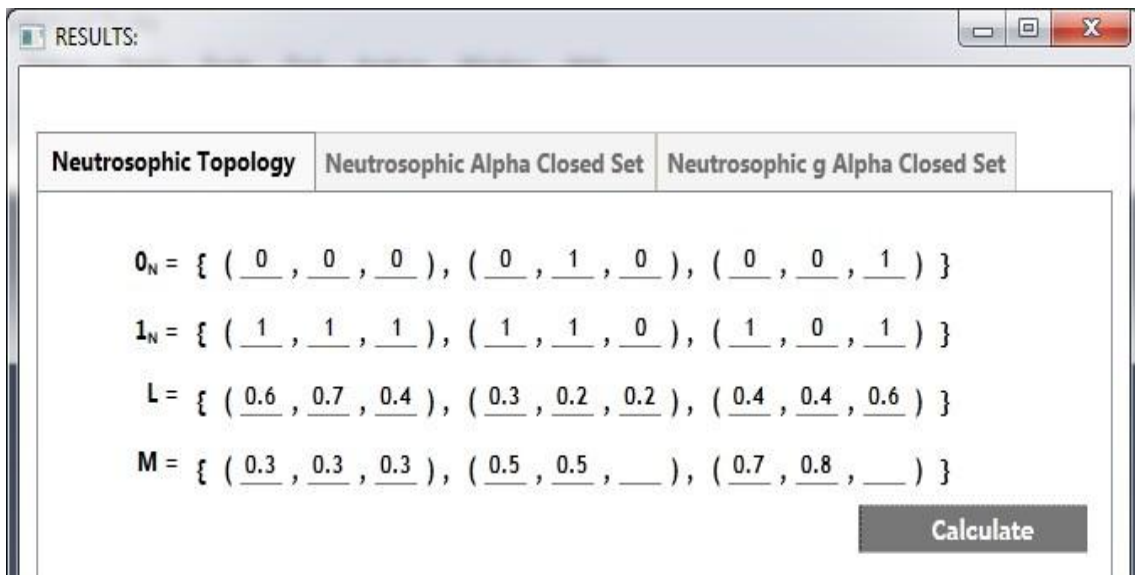
- step-4: calculate the union of  $L$  and  $M$
- step-5 calculate the intersection of  $L$  and  $M$
- step-6: check the inclusion of  $L$  and  $M$
- step-7: if the union and the intersection conditions satisfied then goto step-8 or else repeat step-2
- step-8: compute the neutrosophic topology for the assigned data.

**Note:** Follow the below conditions to enter  $0_N$ ,  $1_N$ ,  $L$  and  $M$  values in the initial resultant screen:

- i.  $0_N$  and  $1_N$  values should be any three values of Definition 9 in [5],
- ii.  $L$  and  $M$  values should be based on Definition 2.1 and Remark 2.2 in [12].

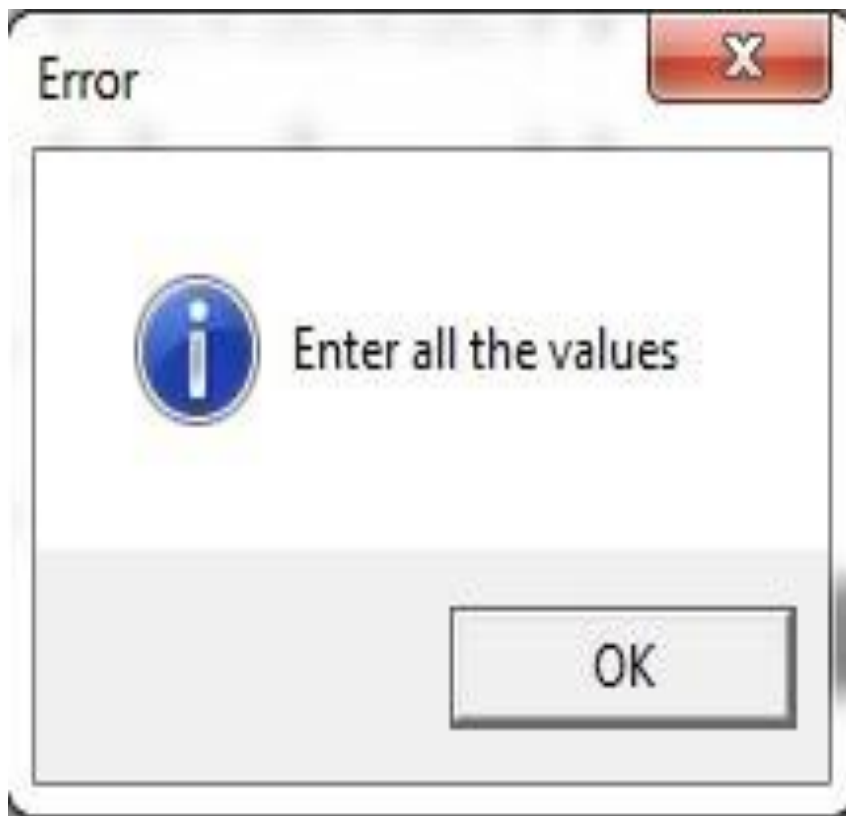


“Figure 2: Initial Resultant Screen / User Screen”

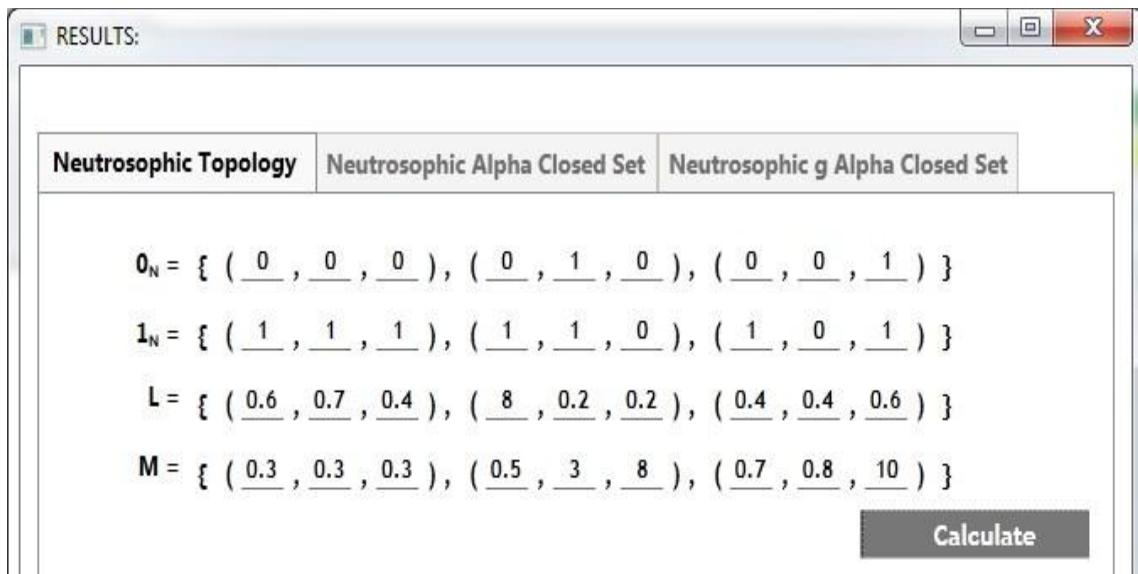


“Figure 3: Screenshot of Incomplete Data in the Resultant Screen”

The above figure shows the entered values of the initial resultant screen. In this, some of the values are not entered by the user. For this incomplete data the following dialog box intimate the user to enter all the values.

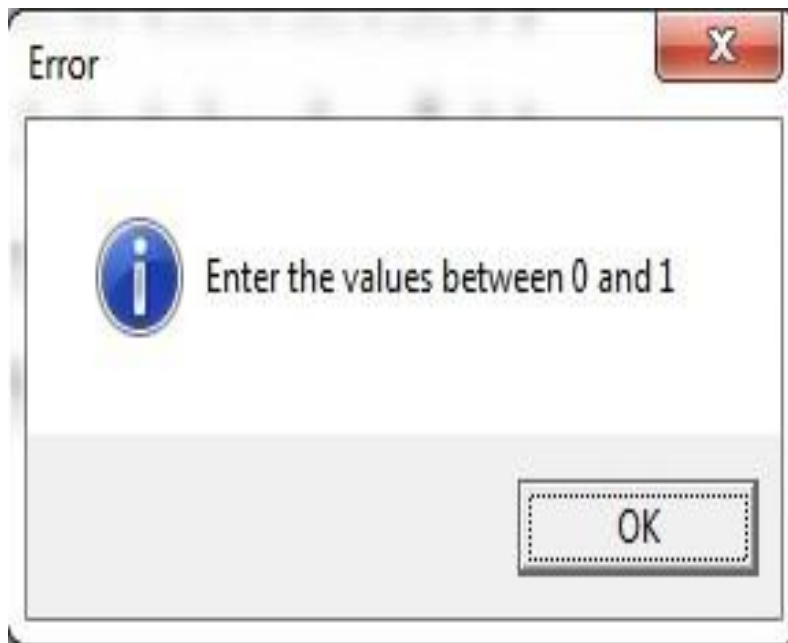


“Figure 4: Screenshot of Dialog Box-1”



“Figure 5: Screenshot of Incorrect Data in the Resultant Screen”

The above figure shows that the entered values of the initial resultant screen. Here some of the values are not properly entered by the user. For this incorrect data, the following dialog box intimates the user to enter the values in the non- standard unit interval 0 and 1. In this the user not followed the conditions to enter  $L$  and  $M$ . Both  $L$  and  $M$  should be a neutrosophic values.



“Figure 6: Screenshot of Dialog Box-2”

The following figure shows the results of the complement of two neutrosophic sets, that is  $L'$  and  $M'$ , union of two neutrosophic sets  $[L \cup M]$ , intersection of two neutrosophic sets  $[L \cap M]$  and the inclusion of two neutrosophic sets  $[L \subseteq M]$ . Also it shows the result of neutrosophic topology  $[\tau]$ .

The screenshot shows a window titled "RESULTS:" with three tabs: "Neutrosophic Topology", "Neutrosophic Alpha Closed Set", and "Neutrosophic g Alpha Closed Set". The "Neutrosophic Topology" tab is active. The window displays the following mathematical expressions:

$$0_N = \{ (\underline{0}, \underline{0}, \underline{0}), (\underline{0}, \underline{0}, \underline{0}), (\underline{0}, \underline{1}, \underline{0}) \}$$

$$1_N = \{ (\underline{1}, \underline{1}, \underline{0}), (\underline{1}, \underline{1}, \underline{1}), (\underline{1}, \underline{0}, \underline{1}) \}$$

$$L = \{ (\underline{0.3}, \underline{0.2}, \underline{0.3}), (\underline{0.1}, \underline{0.1}, \underline{0}), (\underline{0.5}, \underline{0.5}, \underline{0.5}) \}$$

$$M = \{ (\underline{0.5}, \underline{0.5}, \underline{0.5}), (\underline{0.1}, \underline{0.1}, \underline{0}), (\underline{0.3}, \underline{0.4}, \underline{0.3}) \}$$

A "Calculate" button is located to the right of these expressions. Below the button, the results of the calculations are displayed:

$$L' = \{(0.5, 0.5, 0.5), (0.9, 0.9, 1), (0.3, 0.2, 0.3)\}$$

$$M' = \{(0.3, 0.4, 0.3), (0.9, 0.9, 1), (0.5, 0.5, 0.5)\}$$

$$L \text{ Union } M = \{(0.5, 0.5, 0.5), (0.1, 0.1, 0), (0.3, 0.4, 0.3)\}$$

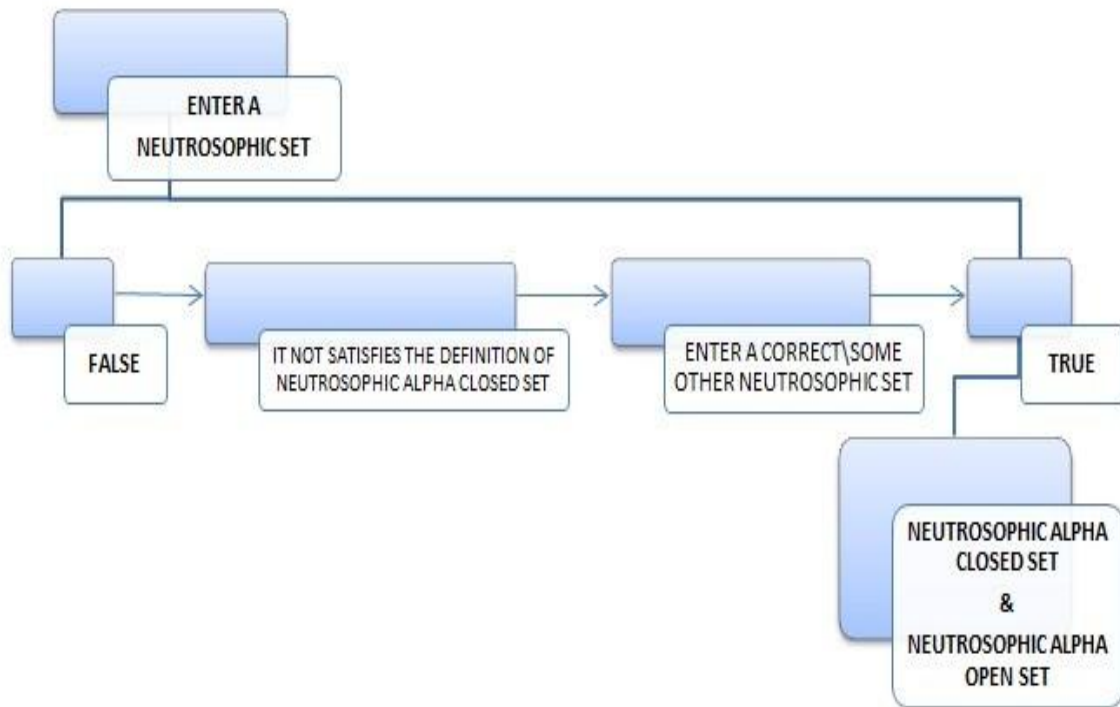
$$L \text{ Intersection } M = \{(0.3, 0.2, 0.3), (0.1, 0.1, 0), (0.5, 0.5, 0.5)\}$$

L Contained in M = True

**Neutrosophic Topology :**

$$\tau = \{0_N, L, M, L \text{ Union } M, L \text{ Intersection } M, 1_N\}$$

“Figure 7: Existence of Neutrosophic Topology via C# Application”



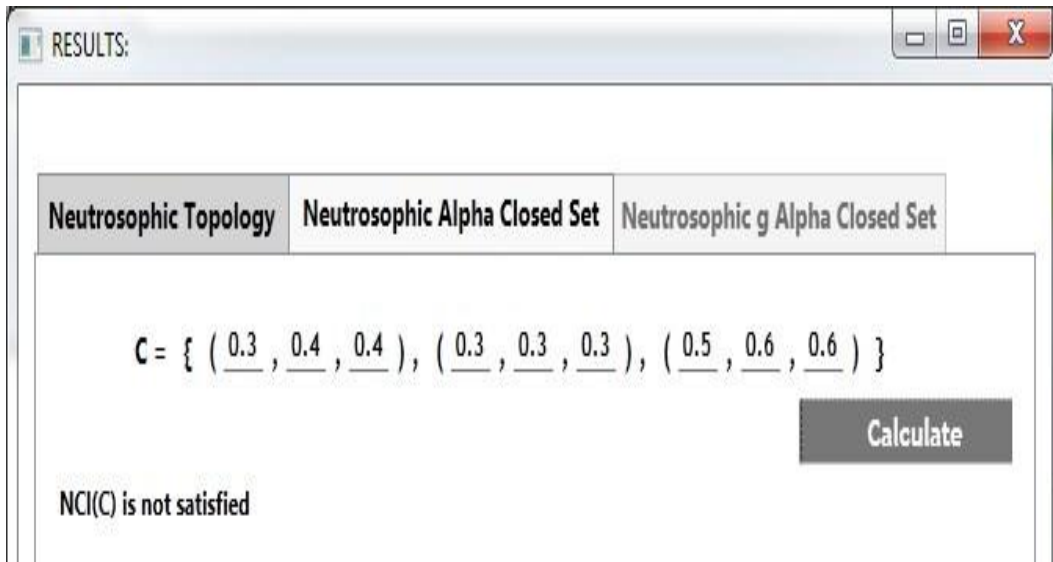
“Figure 8: Neutrosophic  $\alpha$  Closed Set - Flow Chart [N $\alpha$ CS - FC]”

**Algorithm: Neutrosophic  $\alpha$ -Closed Set**

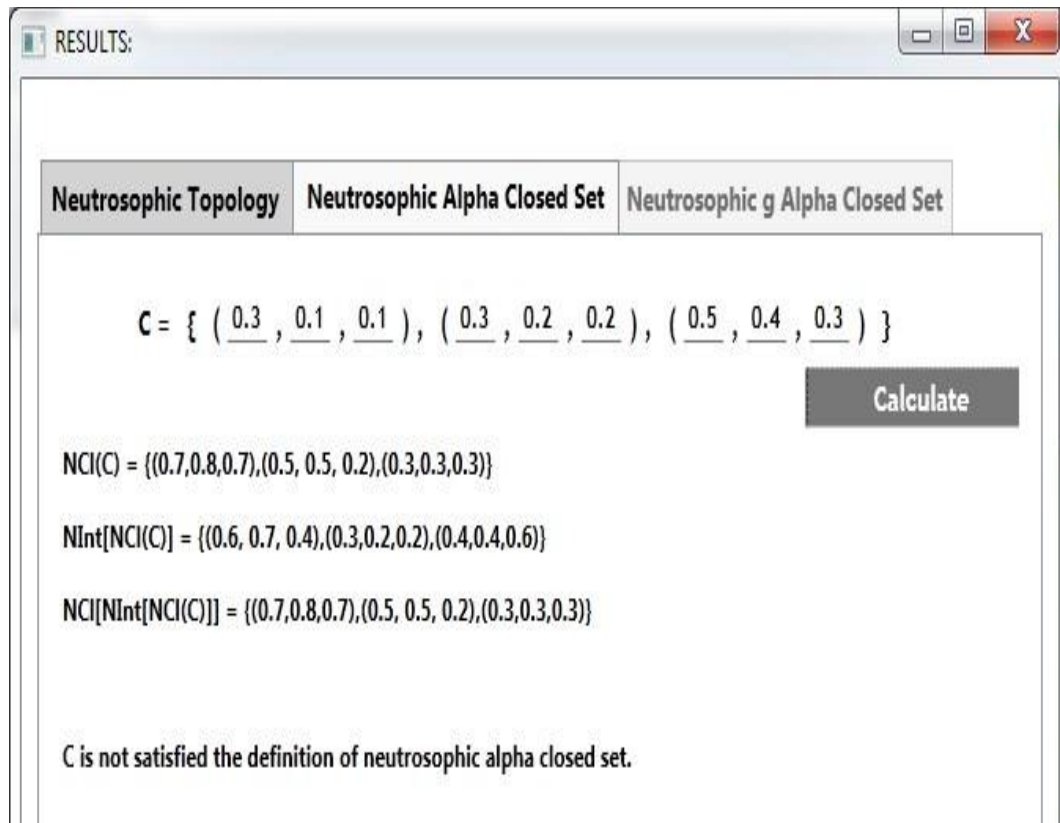
input	neutrosophic set $C$
output	neutrosophic $\alpha$ -closed set; neutrosophic $\alpha$ -open set[ $D$ ]

**STEPS:**

- step-1: check  $C$  is valid
- step-2: find  $Ncl(C)$ , if  $Ncl(C)$  satisfies the neutrosophic closure condition then goto step-3 or else repeat step-1
- step-3: find  $Nint[Ncl[C]]$ , if  $Nint[Ncl[C]]$  satisfies the neutrosophic interior of neutrosophic closure condition then goto step-4 or else repeat step-1
- step-4: find  $Ncl[Nint[Ncl[C]]]$ , if  $Ncl[Nint[Ncl[C]]]$  satisfies the neutrosophic closure of neutrosophic interior of neutrosophic closure condition then goto step-5 or else repeat step-1
- step-5: if  $Nacl[C] = C$  then produce neutrosophic  $\alpha$ -closed set or else repeat step-1
- step-6: compute the neutrosophic  $\alpha$ -open set[ $D$ ] for the assigned data.



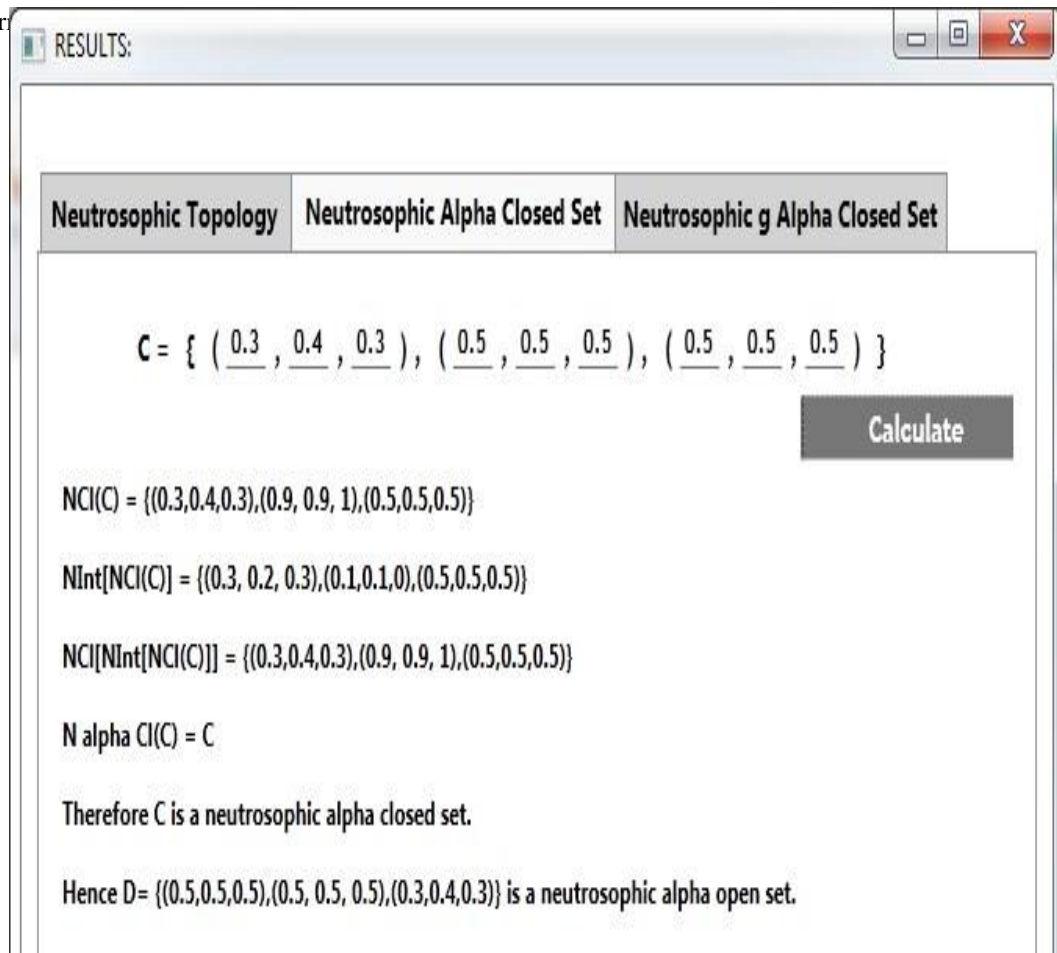
“**Figure 9:** Screenshot of Not Satisfies the Neutrosophic Closure Condition”



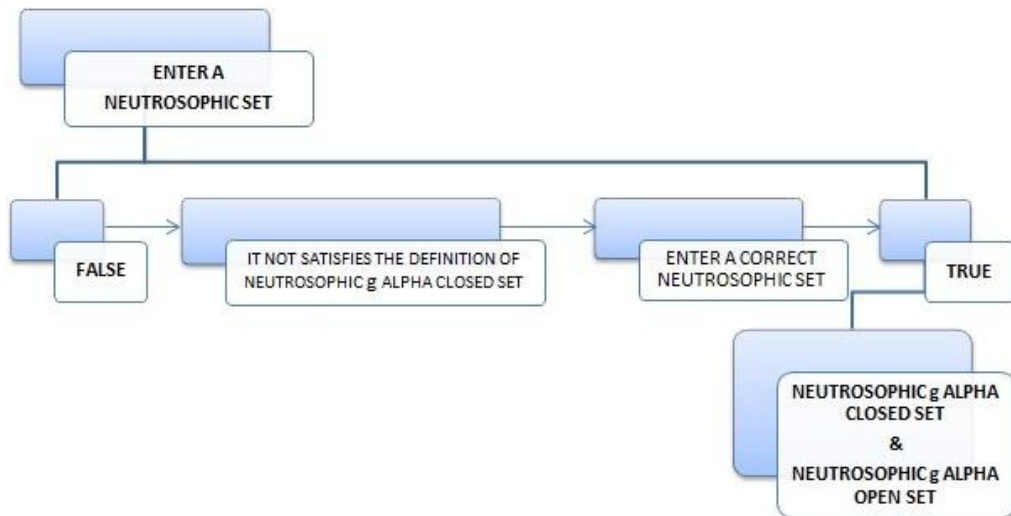
“**Figure 10:** Screenshot of Not Satisfies the Definition of Neutrosophic  $\alpha$ -Closed Set”

Figure 9 & 10 shows the entered data set  $C$  is not satisfies the definition of neutrosophic  $\alpha$ -closed sets. For this, the user has to enter some other neutrosophic set  $C$ .





“Figure 11: Existence of Neutrosophic  $\alpha$  Closed Set [ $N\alpha CS$ ] via C# Application”



“Figure 12: Neutrosophic  $g\alpha$  Closed Set - Flow Chart [ $Ng\alpha CS - FC$ ]”

**Algorithm: Neutrosophic  $g\alpha$ -Closed Set**

input	neutrosophic set $E$
output	neutrosophic $g\alpha$ -closed set; neutrosophic $g\alpha$ -open set[ $F$ ]

**STEPS:**

step-1: check  $E$  is valid

step-2: check  $E \subseteq D$  then goto step-3 otherwise repeat step-1

step-3: find  $Ncl(E)$ , if  $Ncl(E)$  satisfies the neutrosophic closure condition then goto step-4 or else repeat step-1

step-4: find  $Nint[Ncl[E]]$ , if  $Nint[Ncl[E]]$  satisfies the neutrosophic interior of neutrosophic closure condition then goto step-5 or else repeat step-1

step-5: find  $Ncl[Nint[Ncl[E]]]$ , if  $Ncl[Nint[Ncl[E]]]$  satisfies the neutrosophic closure of neutrosophic interior of neutrosophic closure condition then goto step-6 or else repeat step-1

step-6: calculate  $Nacl[E]$

step-7: if  $Nacl[E] \subseteq D$  then produce neutrosophic  $g\alpha$ -closed set else repeat step- 1

step-8: compute the neutrosophic  $g\alpha$ -open set[ $F$ ] for the assigned data.

RESULTS:

Neutrosophic Topology	Neutrosophic Alpha Closed Set	Neutrosophic g Alpha Closed Set
$E = \{ ( \underline{0.3}, \underline{0.2}, \underline{0.3} ), ( \underline{0.1}, \underline{0.1}, \underline{0} ), ( \underline{0.6}, \underline{0.6}, \underline{0.5} ) \}$		
$NCl(E) = \{(0.3,0.4,0.3),(0.9, 0.9, 1),(0.5,0.5,0.5)\}$		
$NInt[NCl(E)] = \{(0.3, 0.2, 0.3),(0.1,0.1,0),(0.5,0.5,0.5)\}$		
$NCl[NInt[NCl(E)]] = \{(0.3,0.4,0.3),(0.9, 0.9, 1),(0.5,0.5,0.5)\}$		
$N \alpha Cl(E) = \{(0.3,0.4,0.3),(0.1, 0.1, 0),(0.5,0.5,0.5)\}$		
Therefore E is a neutrosophic g alpha closed set.		
Hence $F = \{(0.6,0.6,0.5),(0.9, 0.9, 1),(0.3,0.2,0.3)\}$ is a neutrosophic g alpha open set.		

Calculate

“**Figure 13:** Existence of Neutrosophic  $g\alpha$  Closed Set [ $Ng\alpha$ CS] via C# Application”

## 4. Conclusion

In this paper, the new C# application has been introduced and discussed its working process via .NET Framework, Microsoft Visual Studio and C# Programming Language in the neutrosophic field. Also the existence of the complement of a neutrosophic set, union of two neutrosophic sets, intersection of two neutrosophic sets, the inclusion of two neutrosophic sets, neutrosophic topology, neutrosophic  $\alpha$ -closed set and neutrosophic  $g\alpha$ -closed set in neutrosophic topological spaces has been presented in each figure.

## References

1. Alblowi, S.A. Salama, A.A. and Eisa, M. (2013). New Concepts of Neutrosophic sets, International Journal of Mathematics and Computer Applications Research(IJMCAR), Vol. 3, No. 4, pp. 95-102.
2. Arokiarani, I. Dhavaseelan, R. Jafari. S. and Parimala, M. (2017). On Some New Notions and Functions in Neutrosophic Topological Spaces, Neutrosophic Sets and Systems, Vol. 16, pp. 16-19.
3. Dhavaseelan, R. and Jafari, S. (2017). Generalized Neutrosophic Closed sets, New Trends in Neutrosophic Theory and Applications, Vol. 2, pp. 261-273.
4. Salama, A.A. and Alblowi, S.A. (2012). Neutrosophic set and Neutrosophic Topological Spaces, IOSR-Journal of Mathematics, Vol. 3, No. 4, pp. 31-35.
5. Salama, A.A. and Alblowi, S.A. (2012). Generalized Neutrosophic set and Generalized Neutrosophic Topological Spaces, Journal of Computer Science and Engineering, Vol. 2, No. 7, pp. 29-32.
6. Salama, A.A. El-Ghareeb, H.A. Manie, A.M. and Smarandache, F. (2014). Introduction to Develop Some Software Programs for Dealing with Neutrosophic Sets, Neutrosophic Sets and Systems, Vol. 4, pp. 53-54.
7. Salama, A.A. Mohamed Abdelfattah, El-Ghareeb, H.A. and Manie, A.M. (2014). Design and Implementation of Neutrosophic Data Operations Using Object Oriented Programming, International Journal of Computer Application, Vol. 4, No. 5, pp. 163-175.
8. Salama, A.A. Smarandache, F. and Valeri, K. (2014). Neutrosophic closed set and Neutrosophic Continuous Functions, Neutrosophic Sets and Systems, Vol. 4, pp. 4-8.
9. Saranya, S. and Vigneshwaran, M. (2019). Neutrosophic  $b^*g\alpha$ -Closed Sets, Neutrosophic Sets and Systems, Vol. 24, pp. 90-99.
10. Saranya, S. and Vigneshwaran, M. (2019). C# Application to Deal with Neutrosophic  $\alpha$ -Closed Sets, Journal of Advanced Research in Dynamical and Control Systems, 11, 01-Special Issue, pp.1347- 1355.
11. Saranya, S. and Vigneshwaran, M. (2019). Design and Development of .NET Framework to Deal with Neutrosophic  $*g\alpha$  Sets, International Journal of Recent Technology and Engineering, (Accepted for Publication).

12. Smarandache, F. (1998). Neutrosophy, Neutrosophic Probability, Set and Logic, Ann Arbor, Michigan, USA, 105 p.
13. Smarandache, F. (2005). Neutrosophic Set - A Generalization of the Intuitionistic Fuzzy Set, International Journal of Pure and Applied Mathematics, Vol. 24, No. 3, pp. 287-297.
14. Vigneshwaran, M. and Saranya, S. (2018). Applications of  $b^*g\alpha$ -Closed Sets and  $b^*g\alpha$ -Functions in Topological Spaces, International Journal of Innovative Research Explorer, Vol. 3, No. 5, pp. 172-183.