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Structural coregraph of triple layered fuzzy graph

B Gayathri[1], D Gnanavel[2]
[1] Research Scholar, Department of Maths, Prist University, Puducherry, India
[2] Assistant Professor of Maths, Department of Maths, Prist University, Puducherry, India

Abstract
In this dissertation we discussed the basic concepts of double layered fuzzy graph, triple layered fuzzy graph, fuzzy distance, and spanning tree.
Fuzzy graph theory was introduced by Ariel Rosenfeld in 1975. Though it is very Young, it has been growing fast and has numerous applications in various fields. During the same time Yeh and Bang have also introduced various concepts of connectedness in fuzzy graphs.
The degree of a vertex in fuzzy graphs which are obtained from two given fuzzy graphs using operations were discussed by Nagoor Gani and Radha. Radha and Kumaravelintroduced the concept of degree of an edge and total degree of an edge in fuzzy graphs.
We study the degree of an edge in fuzzy graphs which are obtained from two given fuzzy graphs using the operations of union and join. In general, the degree of an edge in union and join of two fuzzy graphs G_1 and G_2 cannot be expressed in terms of these in G_1 and G_2.

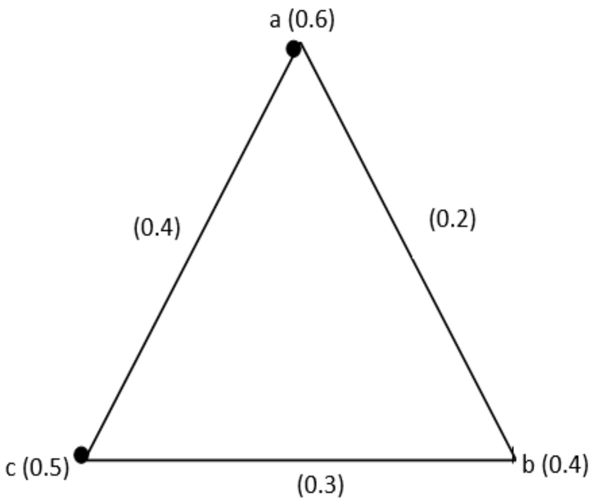
Keywords: fuzzy graphs, by Nagoor Gani, degree of an edge, core graph

Introduction
Fuzzy graph theory was introduced by Rosenfeld in 1975 [5]. The degree of a vertex in some fuzzy graphs was discussed by Nagoorgani and Radha [7]. Nagoorgani and Malarvizhi have defined different types of fuzzy graphs and discussed its relationships with isomerism in fuzzy graphs [3]. The double layered fuzzy graph was introduced by Pathinathan and Jesintha Rosline, they have examined some of the properties of DLFG [4].
In this paper, Mrs. L. Jethruth Emelda Mary and P. Amutha introduced the structural core graph of Triple Layered Fuzzy Graph Using new algorithm.

3.2: Structural Core Graph
In this section, we have introduced new algorithm to construct a structural core graph of Triple Layered Fuzzy Graph. (i.e) To obtain a spanning tree for the given Triple Layered Fuzzy Graph.

Algorithm 3.3
1. Construct a TLFG with 3n vertices and 5n edges where n is the number of vertex in the base graph whose crisp graph is cycle.
2. Calculate face values using the formulae. Min $\frac{\mu(a,b)}{\sigma(a)\wedge\sigma(b)}$ where μ (a, b) is the weight of the edge (a, b) and $\sigma(a)$&$\sigma(b)$ are membership value of vertices and b in TLFG.
3. Select a face with least value. If two (or) more faces are there with least value, choose aface with least order value.
4. Choose a vertex with least value in the selected face.
5. Select the smallest fuzzy distance, fuzzy distance edge from the selected vertex and include that in T. If two (or) more edges are there with the same value choose an edge with least adjacent vertex value, where T is a tree of TLFG.
6. If two (or) more vertices are there with same value then choose the edge with least intersecting face value.
7. Repeat this procedure till we cover all the vertices of TLFG.
8. Stop, when T becomes Spanning tree of TLFG.

Example 3.4
Consider a fuzzy graph G: (σ, μ) with n=3 vertices whose crisp graph is a cycle C_3.



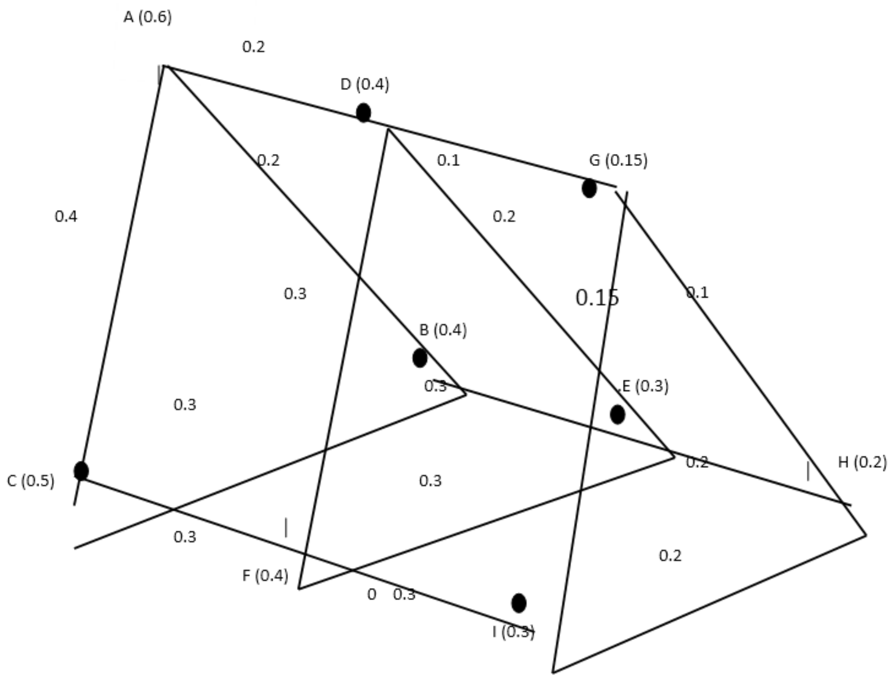


Fig 2: TLEG of n=3 vertices.

Face value calculation

F_1 (a b c) → min {0.5, 0.75, 0.8) = 0.5

F_2 (a c d f) → min {0.8, 0.5, 0.5, 0.75} = 0.5

F_3 (d e f) → min {0.67, 1, 0.5} = 0.5

F_4 (a b e d) → min {0.5, 1, 0.67, 0.5} = 0.5

F_5 (g h i) → min {1, 1, 1} = 1

F_6 (d e g h) → min {0.67, 1, 0.67, 1} = 0.67

F_7 (d g f i) → min {0.5, 0.5, 0.65, 1} = 0.5

F_8 (c d e f) → min {0.75, 1, 1, 0.75} = 0.75

F_9 (e f i h) → min {1, 1, 1, 0 75} = 0.75

Table 1

Reached node	Edge	Membership Value	Iteration
e	ed	0.2	1
ed	dg	0.1	2
edg	gh	0.5	3
edgh	he (form Cycle)	-	No
edgh	hi	0.2	4
edghi	ig (form Cycle)	-	No
edghi	if	0.3	5
edghif	fe (form Cycle)	-	No
edghif	fc	0.3	6
edghifc	cb	0.3	7
edghifcb	ba	0.2	8

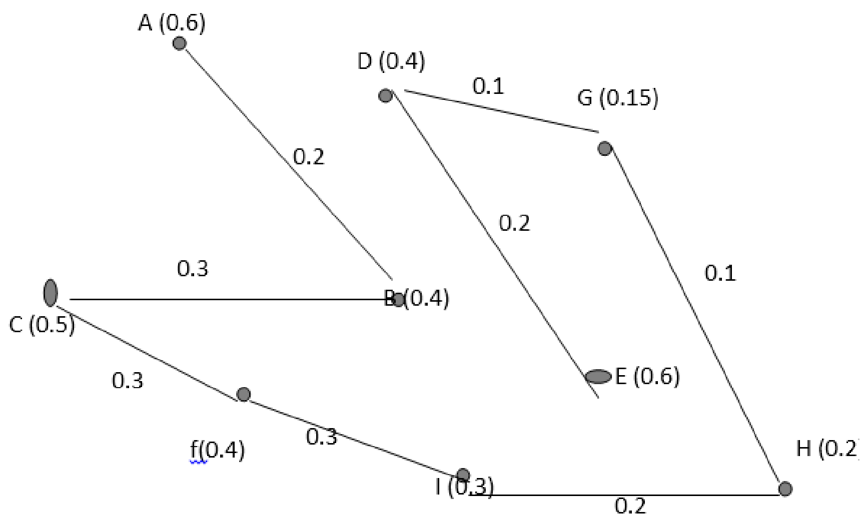


Fig 3: Structural core graph of TLFG of n=3 vertices

Example: 3.5

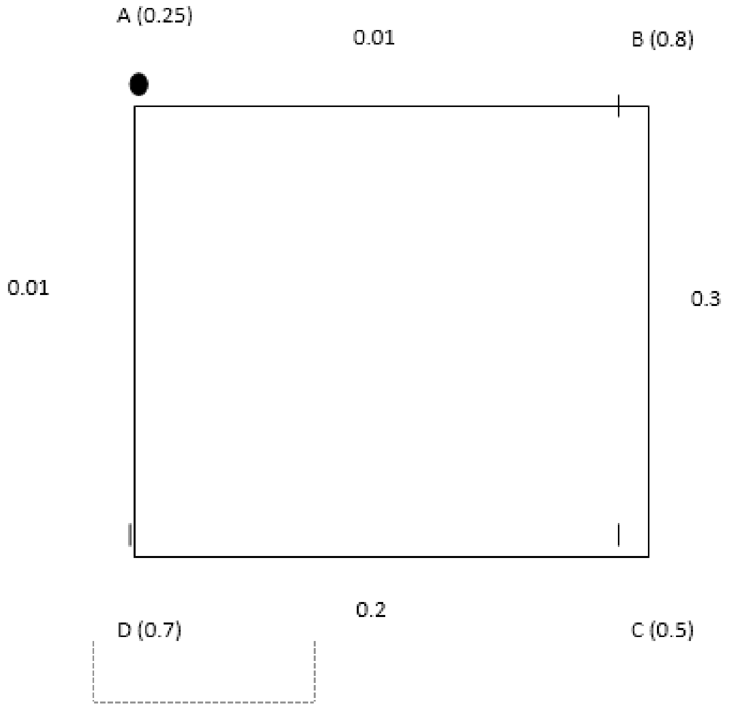


Fig 4: Fuzzy graph (C_4)

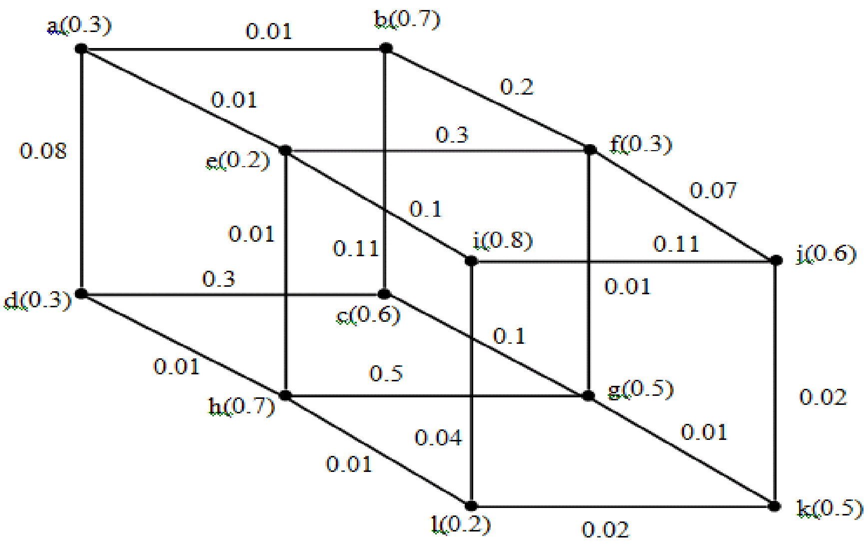


Fig 5: TLFG of n = 4 vertices

Facevaluecalculation

F_1 (a b c d) → min {0.03, 0.18, 1, 0.26} = 0.03
F_2 (e f g h) → min {1, 0.03, 1, 0.02} = 0.02
F_3(l i j k) → min {0.2, 0.18, 0.04, 0.02} = 0.04
F_4(a e h d) → min {0.03, 0.02, 0.03, 0.26} = 0.02
F_5(a e f b) → min {0.03, 1, 0.66, 0.03} = 0.03
F_6(f j l g) → min {1, 0.4, 1, 0.33} = 0.33
F_7(h g k l) → min {1, 0.02, 0.25, 0.1} = 0.02
F_8(a b f e) → min {0.03, 0.66, 1, 0.33} = 0.03
F_9(e f j i) → min {1, 0.23, 0.18, 0.14} = 0.14
F_{10}(b c g f) → min {0.18, 0.4, 0.03, 0.66} = 0.03
F_{11}(f j k g) → min {0.23, 0.04, 0.03, 0.03} = 0.03

Table 2

Reached node	Edge	Membership Value	Iteration
L	Lk	0.05	1
lk	kg	0.01	2
lkg	gh	0.01	3
lkgh	hl(form cycle)	_	No
lkgh	hd	0.01	4

lkghd	dc	0.3	5
lkghdc	cg(form cycle)	_	No
lkghdc	cb	0.11	6
lkghdcb	bf	0.2	7
lkghdcbf	fg(form cycle)	_	No
lkghdcbf	fe(form cycle)	_	No
lkghbcdfe	ei	0.3	8
lkghdcbfei	ij	0.1	9
lkghdcbfeij	jf(form cycle)	_	No
lkghdcbfeij	jk(form cycle)	_	No
lkghdcbfeij	Ji	0.11	10
lkghdcbfeiji	il(form cycle)	_	No
lkghdcbfeiji	Ie	0.1	11
lkghdcbfeijie	eh(form cycle)	_	No
lkghdcbfeijie	ea	0.01	12
lkghdcbfeiliea	ad(form cycle)	_	No
lkghdcbfeijiea	ab	0.01	13
lkghdcbfeijieab	bf(form cycle)	_	No
lkghdcbfeijieab	fe(form cycle)	_	No
lkghdcbfeijieab	bc	0.11	14

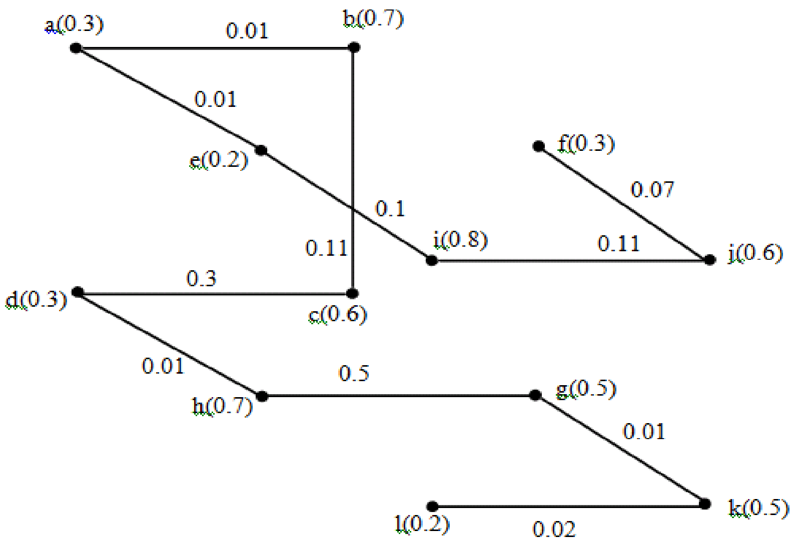


Fig 6: Sructural core graph of TLFG of n=4 vertices

Example 3.6

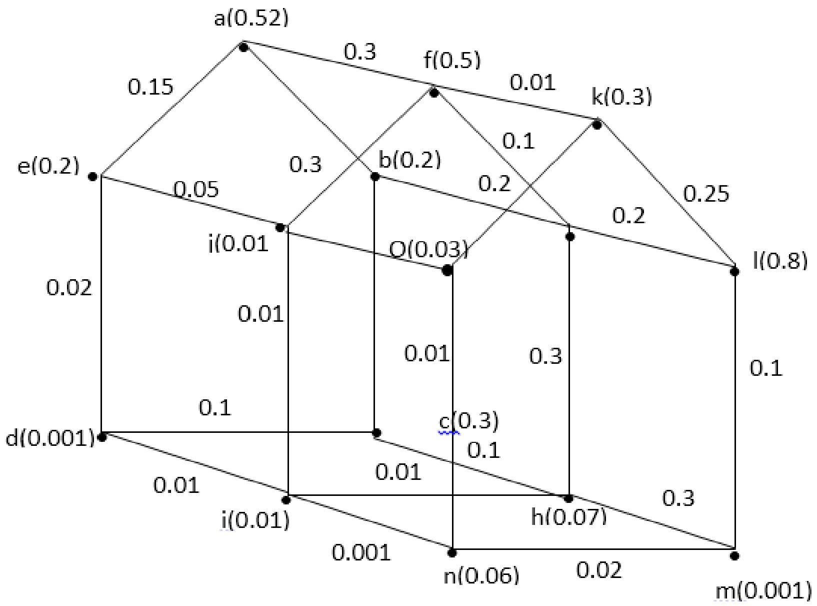


Fig 7: TLFG of order n=5 vertices

Facevaluecalculation

F_1 (a b c d e) → min {0.576, 1, 0.33, 0.1, 0.75} = 0.33
F_2 (f g h I j) → min {0.2, 0.75, 1, 1, 1} = 0.2
F_3 (k l m n o) → min {0.833, 0.2, 0.33, 0.16, 1} = 0.16
F_4 (a f j e) → min {0.6, 1, 0.25, 0.75, 0.6} = 0.25
F_5 (f k o j) → min {0.3, 1, 0.66, 1,} = 0.03
F_6 (e j I d) → min {0.25, 1, 1, 0.1} = 0.1
F_7 (j o n i) → min {0.66, 0.16, 0.1, 1} = 0.1
F_8 (b g h c) → min {1, 0.75, 0.33, 1} = 0.33
F_9 (g l m h) → min {0.28, 0.2, 0.75, 0.75} = 0.2
F_{11} (a f g b) → min {0.6, 0.2, 1, 0.5} = 0.2
F_{12} (f k l g) → min {0.33, 0.83, 0.28, 0.2} = 0.2

Table 3

Reached node	Edge	Membership Value	Iteration
I	In	0.001	1
in	nm	0.02	2
inm	mh	0.3	3
inmh	hi(form Cycle)	_	No
inmh	hc	0.1	4
inmhc	cd	0.1	5
inmhcd	di (Form Cycle)	_	No
inmhcdi	ij	0.01	6
inmhcdij	je	0.05	7
inmhcdije	ed(form cycle)	_	No
inmhcdije	ea	0.15	8
inmhcdijea	ab	0.1	9
inmkcdijeab	bc(form cycle)	_	No
inmhcdijeab	bg	0.2	10
inmhcdijeabg	gh(form cycle)	_	No
Inmhcdijeabg	gi	0.2	11
Inmhcdijeabgi	Im(form cycle)	_	No
Inmhcdijeabgi	Ik	0.25	12
Inmhcdijeabgi	Kf	0.01	13
Inmhcdijeabgik	fg(form cycle)	_	No
Inmhcdijeabgikf	fa	0.3	14
Inmhcdijeabgikf	ab(form cycle)	_	No
Inmhcdijeabgikfa	fk(form cycle)	_	No
Inmhcdijeabgikfaf	fj	0.3	15

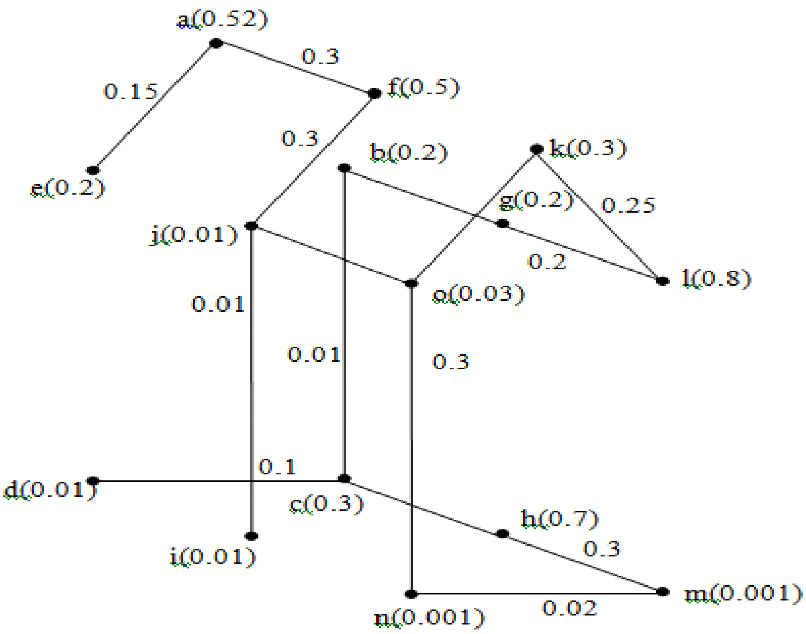


Fig 8: Structural core graph of TLFG of order n=5 vertices.

For different values of n, we will get different TLFG and when we apply the algorithm we will get different structures for each graph.

4. Theoretical Concepts

Consider the TLFG from example 3.4 with different labeling

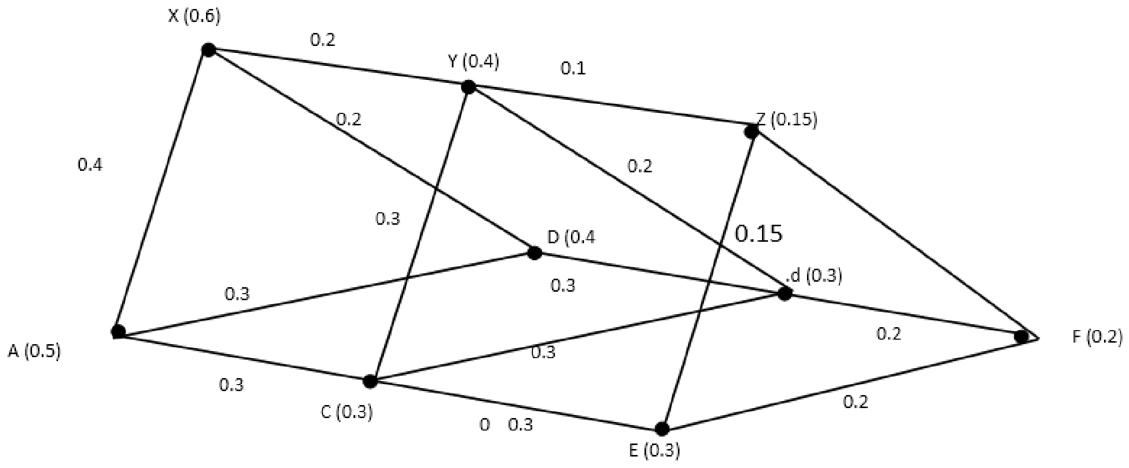


Fig 9: TL (G_1)

Consider the TLFG from Example 3.5with different labeling

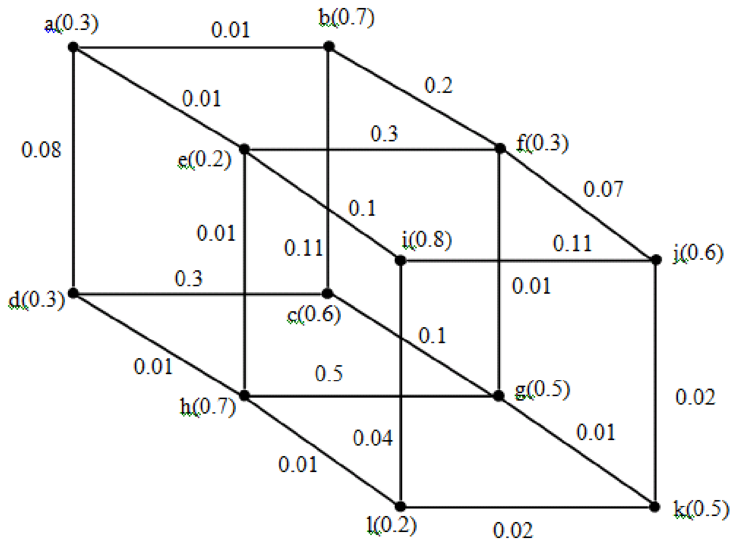


Fig 10: TL (G_2)

The union of G_1 and G_2 graph is shown in figure.

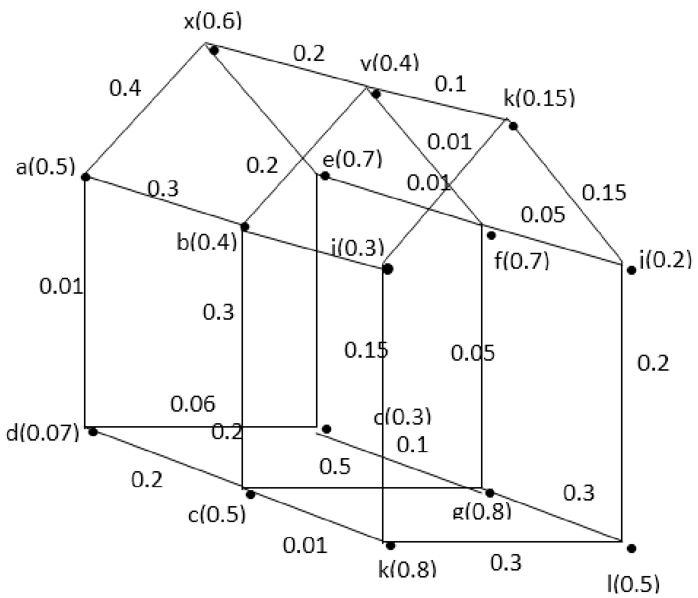


Fig 11: TL (G_1) U

Then the core graph is given by

Face value calculation

F_1(a b c d) → min {0.75, 0.6, 0.4, 0.02} = 0.02
F_2(a x y b) → min {0.8, 0.5, 0.5, 0.75} = 0.5
F_3(b I k c) → min {0.33, 0.5, 0.02, 0.75} = 0.02
F_4(b y z i) → min {0.4, 0.66, 0.66, 0.33} = 0.33
F_5(x a d h e) → min {0.8, 0.02, 0.3, 1, 0.33} = 0.02
F_6(y f g c b) → min {0.1, 0.5, 1, 0.75, 0.5} = 0.1
F_7(z j l k i) → min {1, 1, 0.6, 0.5, 0.66} = 0.5
F_8(e f g h) → min {0.1, 0.5, 0.75, 1} = 0.5
F_9(f j l g) → min {0.5, 1, 0.6, 0.5} = 0.5
F_{10}(d h g c) → min {0.3, 0.75, 1, 0.4} = 0.3
F_{11}(c g l k) → min {1, 0.6, 0.6, 0.02} = 0.02

Table 4

Reached node	Edge	Membership Value	Iteration
I	In	0.001	1
in	nm	0.02	2
inm	mh	0.3	3
inmh	hi(form Cycle)	_	No
inmh	hc	0.1	4
inmhc	cd	0.1	5
inmhcd	di (Form Cycle)	_	No
inmhcdi	ij	0.01	6
inmhcdij	je	0.05	7
inmhcdije	ed(form cycle)	_	No
inmhcdije	ea	0.15	8
inmhcdijea	ab	0.1	9
inmkcdijeab	bc(form cycle)	_	No
inmhcdijeab	bg	0.2	10
inmhcdijeabg	gh(form cycle)	_	No
Inmhcdijeabg	gi	0.2	11
Inmhcdijeabgi	Im(form cycle)	_	No
Inmhcdijeabgi	Ik	0.25	12
Inmhcdijeabgi	Kf	0.01	13
Inmhcdijeabgik	fg(form cycle)	_	No
Inmhcdijeabgikf	fa	0.3	14
Inmhcdijeabgikf	ab(form cycle)	_	No
Inmhcdijeabgikfa	fk(form cycle)	_	No
Inmhcdijeabgikfaf	fj	0.3	15

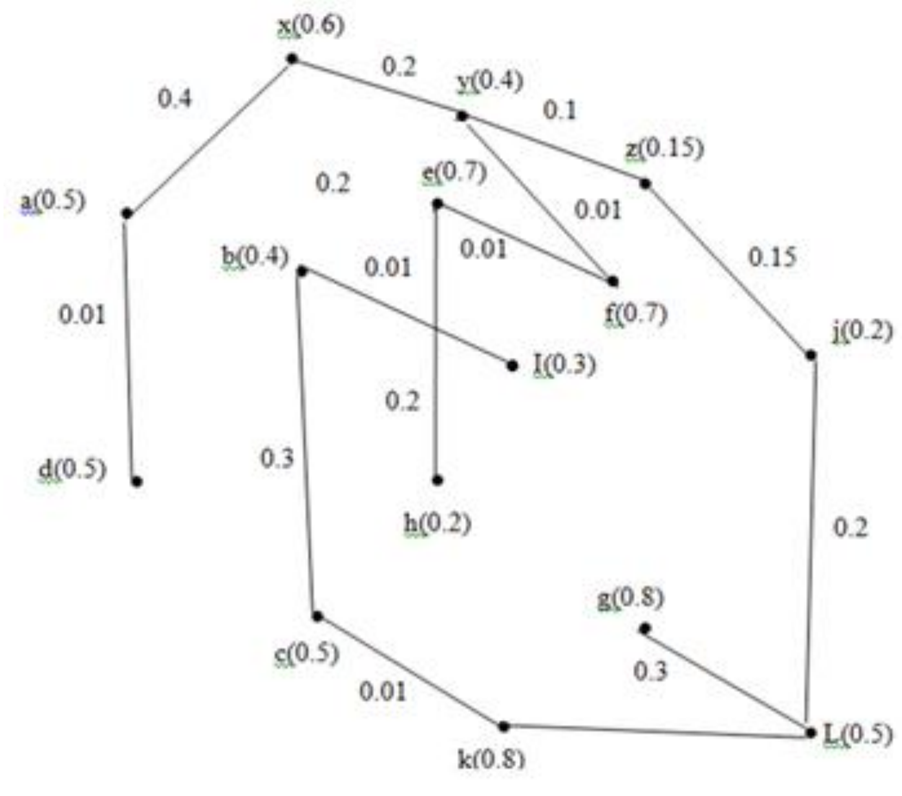


Fig 12: Structural core graph of TL (G_1) ∪TL (G_2)

Conclusion

In this dissertation we discussed the concept of "Thestructural core graph of triple layered fuzzy graph" we obtained the optimal tree for the triple layered fuzzy graph

of order n= 3,4,5,6,7,& 8 using the concept of structural core graph of triple layered fuzzy graph.
This work can be entered other different layered fuzzy graph using structural core graph.

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