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SHORTEST PATH ALGORITHMS W.R.T. SINGLE VALUED NEUTROSOPHIC GRAPHS

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ABSTRACT. The minimal spanning tree (MST) algorithms by using the edges weights are elderly presented mainly by Prim's and Kruskal's algorithms. In this article we use the triplet weights for the neutrosophic edges by using the different score functions we angry with the new model algorithms namely neutrosophic Prim's algorithm and neutrosophic kruskal's algorithm. Further, we use the different score functions we get the satisfied results based on the algorithms.

1. INTRODUCTION

The idea of Neutrosophic technique was derived by Smarandache [17]. These can abduction the ordinary circumstance of both deception as well as ambiguity that endure in genuine existence plot.The concept of the triplet was derived by using fuzzy set and intuitionistic fuzzy set. The triplet contains truth, indeterminacy and false numbers lies between 0 and 1. By using Fuzzy of type 1, intuitionistic fuzzy and conventional set is NS. In NS there are three components called truth assign number indicate T and indeterminate assign number I, false assign number indicate F, separately. Furthermore, in real life problems we can apply NSs for the reference see [18]. Next they got idea of SVNS. By using this SVNSs properties described by Wang et al. [25]. In order to deal with uncertainty, fuzzy concept

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proposed by Zadeh [28]. A rank method on IVIFSs with rank method studied by Nayagam et al. [12] and Mitchell [8]. The generalizations of score function on IVFSs introduced by Garg [3]. The weighted accuracy function and score function in IVIFSs studied by Xu [26] and Liu and Xie [7] the IVIFSs. There different types of algorithms for finding the minimal sapping tree see the reference [14], in that mainly Prim's algorithm and Kruskal's algorithm. The number of types of spanning tree problems contain to residential through a lot of researchers with assign the weights to edges are not accurate in that an uncertainty is there for that see the references [2,4,5,6,9,10,11,13,14,23,24,27].

In this manuscript the main aim is to find minimal spanning tree from NSCWG by using algorithms like Prim's and Kruskal's with different score functions.

2. Preliminaries

The authors are research down by the some results based on the neutrosophic theory [1,15,16,17,19,20,21,22].

Definition 2.1. *Neutrosophic set contains the triplet numbers which are lies between the 0 and 1. The summation of these three values present between the 0 and 3.*

Example 1. $\langle 0.2, 0.5, 0.6\rangle$ *is the neutrosophic set and the sum also shows* $0 \leq 1.3 \leq 3$.

Definition 2.2. *The single valued neutrosophic sets is denoted as following* $A =< T, I, F >$ *and defined as the functions* $0 \leq T \leq 1$ *is the truth number* $0 \leq I \leq 1$ *is the indeterminacy number and* $0 \leq F \leq 1$ *falsity number. The*T, I *and* F*satisfies the condition*$0 \leq T + I + F \leq 3$.

Definition 2.3. *A single valued neutrosophic graph (SVN-graph) with* N_V*is explained by to be a two of a kind* (P, Q) *everywhere* $[0, 1]$ *indicate the interval B. The functions* $T_P : N_V \to B, I_P : N_V \to B$ *and* $F_P : N_V \to B$ *and* $0 \leq T_P + I_P + F_P \leq 3$ *for all vertices in* N_V. *Further, The functions* $T_Q : N_V \times N_V \to B, I_Q : N_V \times N_V \to B$ *and* $F_Q : N_V \times N_V \to B$ *are explained by* $T_Q(a_i, a_j) \leq \min[T_Q(a_i), T_Q(a_j)], I_Q(a_i, a_j) \geq \max[I_Q(a_i), I_Q(a_j)]$ *and* $F_Q(a_i, a_j) \geq \max[F_Q(a_i), F_Q(a_j)]$ *with the condition* $0 \leq T_B(a_i, a_j) + I_B(a_i, a_j) + F_B(a_i, a_j) \leq 3$ *for all* $(a_i, a_j) \in E$.

Definition 2.4. *Let* $A = (T, I, F)$*be a SVNs. Then a score function S is explained by* $S_{ZHANG}(A) = \frac{(2+T-I-F)}{3}$, *where* T, I*and* F *corresponds to the truth number, indeterminacy number and falsity number lies between 0 and 1.*

3. MST ALGORITHM OF NEUTROSOPHIC WEIGHTED GRAPHS

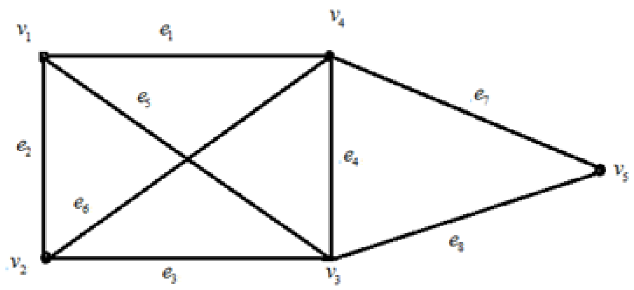
This segment, an innovative description of minimum spanning tree algorithms come within reach of new technique presented by using neutrosophic graph theory with edge weight. In the subsequent, we put forward MST algorithm, with step by steps process given below:

We discus all neutrosophic graphs are connected with n vertices.

Minimal spanning tree by using Primes algorithm:

Input: Neutrosophic weighted graph.
Output: MST from the given neutrosophic weighted graph.
Neutrosophic Prim's algorithms:
Step:1 Compute the Adjacency matrix of the given neutrosophic graph.
Step:2 With help of the score function change the adjacency matrix to assign the scores of the each edge.
Step:3 Staring from any arbitrary vertex v_i, $(i \neq j = 1, 2, \cdots n)$ and connect it to its nearest neighbor vertex (that is to be vertex which has the smallest weight) say, v_j $(i \neq j = 1, 2, \cdots n)$. Now consider the edge $\{v_i, v_j\}$ and connect it to its closest neighbor (that is to a vertex other than v_i and v_j , that has the smallest weight among all entities) without forming loop. Let this vertex be v_k say.
Step:4 start from the vertex v_k and repeat the process of step:3. Terminate the process after all n vertices connected with n-1 edges. These n-1 edges forms a minimal neutrosophic spanning tree.

Numerical example:
The following graph is the given neutrosophic connected weighted graph G.



Weights of the given NCWG are given in the table form,

Edges	End vertices	weight of the edges
e_1	v_1v_4	$(0.4, 0.5, 0.8)$
e_2	v_1v_2	$(0.2, 0.4, 0.6)$
e_3	v_2v_3	$(0.2, 0.4, 0.3)$
e_4	v_3v_4	$(0.2, 0.7, 0.9)$
e_5	v_1v_3	$(0.7, 0.2, 0.4)$
e_6	v_2v_4	$(0.6, 0.3, 0.4)$
e_7	v_4v_5	$(0.8, 0.1, 0.2)$
e_8	v_3v_5	$(0.5, 0.3, 0.4)$

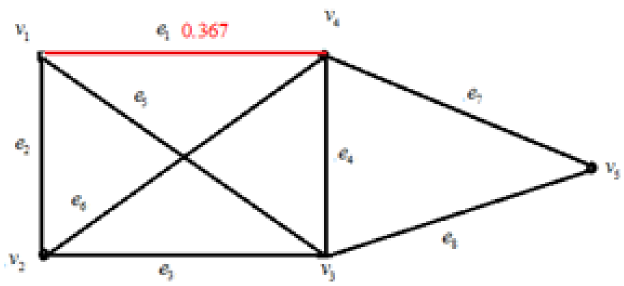
Now according to the step 1 process we construct the adjacency matrix of the given NSCWG. The adjacency matrix of the given neutrosophic connected weighted graph is

$$\begin{bmatrix} 0 & (0.2,0.4,0.6) & (0.7,0.2,0.4) & (0.4,0.5,0.8) & 0 \\ (0.2,0.4,0.6) & 0 & (0.2,0.4,0.3) & (0.6,0.3,0.4) & 0 \\ (0.7,0.2,0.4) & (0.2,0.4,0.3) & 0 & (0.2,0.7,0.9) & (0.5,0.3,0.4) \\ (0.4,0.5,0.8) & (0.6,0.3,0.4) & (0.2,0.7,0.9) & 0 & (0.8,0.1,0.2) \\ 0 & 0 & (0.5,0.3,0.4) & (0.8,0.1,0.2) & 0 \end{bmatrix}$$

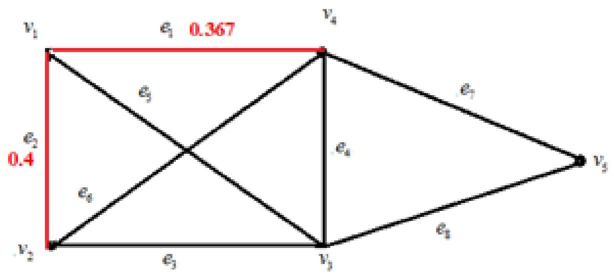
According to the Step 2 the score matrix as follows: By using the score function, the adjacency matrix is converting to the following matrix

$$\begin{bmatrix} 0 & 0.4 & 0.7 & 0.367 & 0 \\ 0.4 & 0 & 0.5 & 0.633 & 0 \\ 0.7 & 0.5 & 0 & 0.2 & 0.6 \\ 0.367 & 0.633 & 0.2 & 0 & 0.833 \\ 0 & 0 & 0.6 & 0.833 & 0 \end{bmatrix}$$

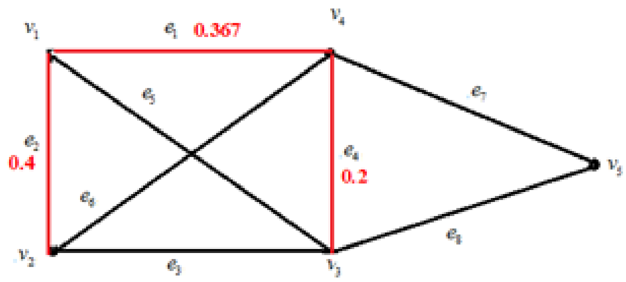
Now, consider step 3 the arbitrary vertex is v_1 and connect it to its nearest neighbor vertex which has smallest weight is v_4 with the weight 0.367.



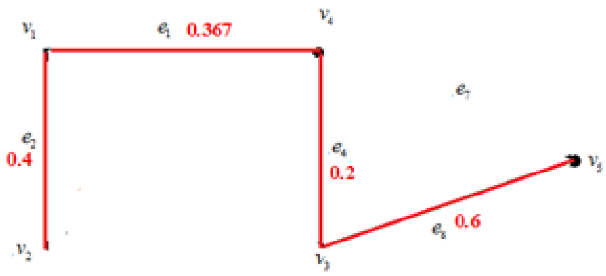
Next, consider the two end vertices on the edge $\{v_1, v_4\}$and the nearest neighbor vertex is $v_2$add to the edge $\{v_1, v_2\}$at v_1.



Now, consider the vertices $\{v_1, v_2, v_4\}$, the nearest vertex with the small weight is v_3 add the vertex to the vertex sets and edge $\{v_4, v_3\}$the new vertex set contains 4 vertices, i.e., $\{v_1, v_2, v_3, v_4\}$.



We have 4 vertices now we consider the vertex set $\{v_1, v_2, v_3, v_4\}$, repeat the same process we get nearest vertex having smallest weight is not visited already is v_5, the new vertex set is $\{v_1, v_2, v_3, v_4, v_5\}$. Then stop the process because all the vertices are appeared. Now, the required sapping tree is $v_1 - v_2 - v_3 - v_4 - v_5$. The minimal



weight is $0.4 + 0.367 + 0.2 + 0.6 = 1.567$. This minimal spanning tree is comparing with different than Prim's, namely Kruskal's algorithm.

Minimal spanning tree by using Kruskal's algorithm:

Input: Neutrosophic weighted graph.
Output: MST of the given neutrosophic weighted graph with n-1 edges.

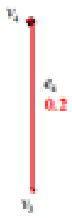
Neutrosophic Kruskal's algorithm:

Step:1 Compute the Adjacency matrix of the given neutrosophic weighted graph.
Step:2 With help of the score function of NCWG, change the adjacency matrix to scores matrix by replacing edge weight with its score value.
Step: 3 List the edges of NCWG in the order of non decreeing weights
Step: 4 Start with a small weighted edge, proceed sequentially by selecting one edge at a time such that no cyclic is formed.
Step: 5 Stop the process of step:4 when n-1 edges are selected.
These n-1 edges make up a minimal neutrosophic spanning tree of neutrosophic weighted graph G.

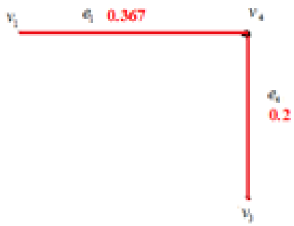
Remark: The process of step: 4 is called greedy process.

By using the same numerical example, we consider the adjacency matrix and also score function both are same. (ref. above example)

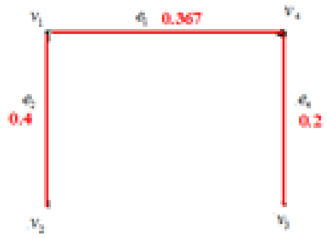
Now, according to the Kruskal's algorithm, we chose minimum weight edge first, the edge is $\{v_3, v_4\}$ with minimum weight is 2.



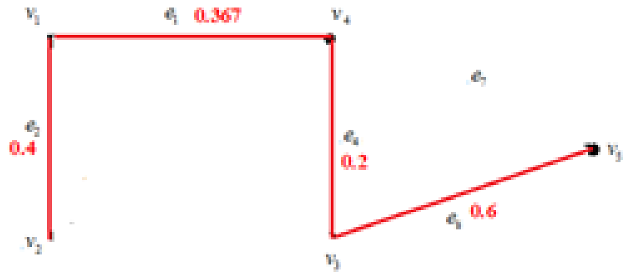
After that, we consider the next smallest weight edge is $\{v_1, v_4\}$with weight 0.367.



Next, we repeat this processor we get the smallest weight is 0.4 add the edge $\{v_1, v_2\}$.



After that, we consider the smallest weight edge is 0.5 $\{v_2, v_3\}$ but we add this edge we form a loop, so that we does not consider that edge. Further, we go to the edge $\{v_3, v_5\}$with minimum weight is 0.6 .Therefore the required sapping tree is



The minimal weight is $0.4 + 0.367 + 0.2 + 0.6 = 1.567$.

3.1. Comparative Study.

References	Score functions	Minimal weight(Prim's and Kruskal's)
29	$S_{ZHANG}(A) = \frac{2+T-I-F}{3}$	1.567
11	$S_{ZHANG}(A) = \frac{1+(1+T-2I-F)(2-T-F)}{2}$	1.345
10	$S_{ZHANG}(A) = \frac{1+T-2I-F}{2}$	-0.6

4. Conclusion

This study indicates the extension of the neutrosophic theory. Hear we thought that the minimal spanning algorithms extended to neutrosophic graphs. In particularly by using different three score functions we derive the different minimal weights but by using Prim′s and Kruskal′s we get the equal minimal weights which satisfies that Prim′s and Kruskal′s satisfies in neutrosophic theory also.

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