Computation of Shortest Path Problem in a Network with SV-Triangular Neutrosophic Numbers

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***Abstract*— In this article, we present an algorithm method for finding the shortest path length between a paired nodes on a network where the edge weights are characterized by single valued triangular neutrosophic numbers. The proposed algorithm gives the shortest path length from source node to destination node based on a ranking method. Finally, a numerical example is also presented to illustrate the efficiency of the proposed approach.**

Keywords— single valued triangular neutrosophic number; score function; network; shortest path problem.

I. INTRODUCTION

In 1995, the concept of the neutrosophic sets (NS for short) and neutrosophic logic were introduced by Smarandache in [1, 2] in order to efficiently handle the indeterminate and inconsistent information which exist in real world. Unlike fuzzy sets which associate to each member of the set a degree of membership T and intuitionistic fussy sets which associate a degree of membership T and a degree of non-membership F, T, F $\in$ [0, 1], Neutrosophic sets characterize each member x of the set with a truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$ and a falsity- membership function $F_A(x)$ each of which belongs to the non-standard unit interval $]^-0, 1^+[$. Thus, although in some case intuitionistic fuzzy sets consider a particular indeterminacy or hesitation margin, $\pi = 1 - T - F$. Neutrosophic set has the ability of handling uncertainty in a better way since in case of neutrosophic set indeterminacy is taken care of separately. Neutrosophic sets is a generalization of the theory of fuzzy set [3], intuitionistic fuzzy sets [4], interval-valued fuzzy sets [5] and interval-valued intuitionistic fuzzy sets [6]. However, the neutrosophic theory is difficult to be directly applied in real scientific and engineering areas. To easily use it in science and engineering areas, in 2005, Wang et al. [7] proposed the concept of SVNS, which differ from neutrosophic sets only in the fact that in the former's case, the of truth, indeterminacy and falsity membership functions belongs to [0, 1]. Recent research works on neutrosophic set theory and its applications in various fields are progressing rapidly [8,30-37]. Very recently Subas et al.[9] presented the concept of triangular and trapezoidal neutrosophic numbers and applied to multiple-attribute decision making problems. Then, Biswas et al. [10] presented a special case of trapezoidal neutrosophic numbers including triangular fuzzy numbers neutrosophic sets and applied to multiple-attribute decision making problems by introducing the cosine similarity measure. Deli and Subas [11] presented the single valued triangular neutrosophic numbers (SVN-numbers) as a generalization of the intuitionistic triangular fuzzy numbers and proposed a methodology for solving multiple-attribute decision making problems with SVN-numbers.

The shortest path problem (SPP) which concentrates on finding a shortest path from a source node to other node, is a fundamental network optimization problem that has been appeared in many domain including, road networks application, transportation, routing in communication channels and scheduling problems and various fields. The main objective of the shortest path problem is to find a path with minimum length between starting node and terminal node which exist in a given network. The edge (arc) length (weight) of the network may represent the real life quantities such as, cost, time, etc. In conventional shortest path, the distances of the edge between different nodes of a network are assumed to be certain. In the literature, many algorithms have been developed with the weights on edges on network being fuzzy numbers, intuitionistic fuzzy numbers, type-2 fuzzy numbers vague numbers [12-17].

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In more recent times, Broumi et al. [18-24] presented the concept of neutrosophic graphs, interval valued neutrosophic graphs and bipolar single valued neutrosophic graphs and studied some of their related properties. Also, Smarandache [25-26] proposed another variant of neutrosophic graphs based on literal indeterminacy. Up to date, few papers dealing with shortest path problem in neutrosophic environment have been developed. The paper proposed by Broumi et al. [27] is one of the first on this subject. The authors proposed an algorithm for solving neutrosophic shortest path problem based on score function. The same authors [28] proposed another algorithm for solving shortest path problem in a bipolar neutrosophic environment. Also, in [29] they proposed the shortest path algorithm in a network with its edge lengths as interval valued neutrosophic numbers. However, till now, single valued triangular neutrosophic numbers have not been applied to shortest path problem. The main objective of this paper is to propose an approach for solving shortest path problem in a network where the edge weights are represented by single valued triangular neutrosophic numbers.

In order to do, the paper is organized as follows: In Section 2, we firstly review some basic concepts about neutrosophic sets, single valued neutrosophic sets and single valued triangular neutrosophic sets. In Section 3, we propose some modified operations of single valued triangular neutrosophic numbers. In Section 5, we propose an algorithm for finding the shortest path and shortest distance in single valued triangular neutrosophic graph. In Section 6, we presented an hypothetical example which is solved by the proposed algorithm. Finally, some concluding remarks are presented in Section 7.

II. Preliminaries

In this section, some basic concepts and definitions on neutrosophic sets, single valued neutrosophic sets and single valued triangular neutrosophic sets are reviewed from the literature.

Definition 2.1 [1]. 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 ∈ X}, where the functions T, I, F: X→]$^-0,1^+$[define respectively the truth-membership function, an indeterminacy-membership function, and a falsity-membership function of the element x ∈ X to the set A with the condition:

$$^-0 \le T_A(x) + I_A(x) + F_A(x) \le 3^+. \qquad (1)$$

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

Since it is difficult to apply NSs to practical problems, Wang et al. [7] introduced the concept of a SVNS, which is an instance of a NS and can be used in real scientific and engineering applications.

Definition 2.2 [7]. 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

$$A = \{< x: T_A(x), I_A(x), F_A(x) >, x \in X\} \qquad (2)$$

Definition 2.3 [11]. A single valued triangular neutrosophic number (SVTrN-number) $\tilde{a} =< (a_1, b_1, c_1); T_a, I_a, F_a >$ is a special neutrosophic set on the real number set *R*, whose truth membership, indeterminacy-membership, and a falsity-membership are given as follows

$$T_a(x) = \begin{cases} (x-a_1)T_a / (b_1-a_1) & (a_1 \le x \le b_1) \\ T_a & (x = b_1) \\ (c_1-x)T_a / (c_1-b_1) & (b_1 \le x \le c_1) \\ 0 & otherwise \end{cases} \qquad (3)$$

$$I_a(x) = \begin{cases} (b_1 - x + I_a(x-a_1)) / (b_1-a_1) & (a_1 \le x \le b_1) \\ I_a & (x = b_1) \\ (x - b_1 + I_a(c_1-x)) / (c_1-b_1) & (b_1 \le x \le c_1) \\ 1 & otherwise \end{cases} \qquad (4)$$

$$F_a(x) = \begin{cases} (b_1 - x + F_a(x-a_1)) / (b_1-a_1) & (a_1 \le x \le b_1) \\ F_a & (x = b_1) \\ (x - c_1 + F_a(c_1-x)) / (c_1-b_1) & (b_1 \le x \le c_1) \\ 1 & otherwise \end{cases} \qquad (5)$$

Where $0 \le T_a \le 1$; $0 \le I_a \le 1$; $0 \le F_a \le 1$ and

$0 \le T_a + I_a + F_a \le 3$; $a_1, b_1, c_1 \in R$

Definition 2.4 [11]. Let $\tilde{A}_1 =< (a_1, a_2, a_3); T_1, I_1, F_1 >$ and $\tilde{A}_2 =< (b_1, b_2, b_3); T_2, I_2, F_2 >$ be two single valued triangular neutrosophic numbers. Then, the operations for SVTrN-numbers are defined as follows.

(i)

$$\tilde{A}_1 \oplus \tilde{A}_2 =< (a_1+b_1, a_2+b_2, a_3+b_3); \min(T_1, T_2), \max(I_1, I_2), \max(F_1, F_2) > \qquad (6)$$

(ii)

$$\tilde{A}_1 \otimes \tilde{A}_2 =< (a_1 b_1, a_2 b_2, a_3 b_3); \min(T_1, T_2), \max(I_1, I_2), \max(F_1, F_2)) \qquad (7)$$

(iii)

$$\lambda \tilde{A}_1 =< (\lambda a_1, \lambda a_2, \lambda a_3); \min(T_1, T_2), \max(I_1, I_2), \max(F_1, F_2) > \qquad (8)$$

A convenient method for comparing two single valued triangular neutrosophic numbers is by using of score function and accuracy function.

Definition 2.5[11]. Let $\tilde{A}_1 = \langle (a_1, a_2, a_3); T_1, I_1, F_1 \rangle$ be a single valued triangular neutrosophic number. Then, the score function $s(\tilde{A}_1)$ and accuracy function $a(\tilde{A}_1)$ of a SVTrN-numbers are defined as follows:

(i) $s(\tilde{A}_1) = \left(\frac{1}{12}\right)\left[a_1 + 2a_2 + a_3\right] \times \left[2 + T_1 - I_1 - F_1\right]$ (9)

(ii) $a(\tilde{A}_1) = \left(\frac{1}{12}\right)\left[a_1 + 2a_2 + a_3\right] \times \left[2 + T_1 - I_1 + F_1\right]$ (10)

Definition 2.6 [11]. Let $\tilde{A}_1$ and $\tilde{A}_2$ be two SVTrN-numbers the ranking of $\tilde{A}_1$ and $\tilde{A}_2$ by score function and accuracy function are defined as follows :

(i) If $s(\tilde{A}_1) \prec s(\tilde{A}_2)$ then $\tilde{A}_1 \prec \tilde{A}_2$

(ii) If $s(\tilde{A}_1) = s(\tilde{A}_2)$ and if

(1) $a(\tilde{A}_1) \prec a(\tilde{A}_2)$ then $\tilde{A}_1 \prec \tilde{A}_2$

(2) $a(\tilde{A}_1) \succ a(\tilde{A}_2)$ then $\tilde{A}_1 \succ \tilde{A}_2$

(3) $a(\tilde{A}_1) = a(\tilde{A}_2)$ then $\tilde{A}_1 = \tilde{A}_2$

III. ARITHMETIC OPERATIONS BETWEEN TWO SV-TRIANGULAR NEUTROSOPHIC NUMBERS

In this subsection, a slight modification has been made on some operations between two single valued triangular neutrosophic numbers proposed by Deli and Subas [11], required for the proposed algorithm.

Let $\tilde{A}_1 = \langle (a_1, a_2, a_3); T_1, I_1, F_1 \rangle$ and $\tilde{A}_2 = \langle (b_1, b_2, b_3); T_2, I_2, F_2 \rangle$ are two single valued triangular neutrosophic numbers,. Then the operations for SVTrNNs are defined ad below:

(i) $\tilde{A}_1 \oplus \tilde{A}_2 = \langle (a_1 + b_1, a_2 + b_2, a_3 + b_3); T_1 + T_2 - T_1T_2, I_1I_2, F_1F_2 \rangle$ (11)

(ii) $\tilde{A}_1 \otimes \tilde{A}_2 = \langle (a_1 b_1, a_2 b_2, a_3 b_3); T_1T_2, I_1 + I_2 - I_1I_2, F_1 + F_2 - F_1F_2) \rangle$ (12)

(iii) $\lambda\tilde{A}_1 = \langle (\lambda a_1, \lambda a_2, \lambda a_3); 1 - (1 - T_1)^{\lambda}), I_1^{\lambda}, F_1^{\lambda}) \rangle$ (13)

IV. NETWORK TERMINOLOGY

Consider a directed network G = (V, E) consisting of a finite set of nodes V={1, 2,…,n} and a set of m directed edges E $\subseteq$ V x V. Each edge is denoted by an ordered pair (i, j) where i, j $\in$ V and $i \neq j$. In this network, we specify two nodes, denoted by s and t, which are the source node and the destination node, respectively. We define a path P_{ij} ={i= i_1, (i_1, i_2), i_2,…, i_{l-1}, (i_{l-1}, i_l), i_l =j}as sequence that joins two nodes of edges. The existence of at least one path P_{si} in G (V, E) is assumed for every i $\in$ V-{s}.

d_{ij} denotes a single valued triangular neutrosophic number associated with the edge (i ,j), corresponding to the length necessary to traverse (i, j) from i to j. In real problems, the lengths correspond to the cost, the time, the distance, etc. Then, neutrosophic distance along the path P is denoted as d(P) is defined as

$$d(P) = \sum_{(i,j \in P)} d_{ij} \quad (14)$$

Remark1 : A node i is said to be predecessor node of node j if

(i) Node i is directly connected to node j.

(ii) The direction of path connecting node i and j from i to j.

V . SINGLE VALUED TRIANGULAR NEUTROSOPHIC PATH PROBLEM

In this section, motivated by the work of Kumar [15], an algorithm is presented for finding the shortest path between the source node (i) and the destination node (j) in a network where the edges weight are characterized by a single valued triangular neutrosophic numbers.

The steps of the algorithm are:

Step1: Assume $\tilde{d}_1 = \langle (0,0,0); 0,1,1 \rangle$ and label the source node (say node1) as [$\tilde{d}_1 = \langle (0,0,0); 0,1,1 \rangle$,-]. The label indicating that the node has no predecessor.

Step 2: Find $\tilde{d}_j$ = minimum{ $\tilde{d}_i \oplus \tilde{d}_{ij}$ };j=2,3,…,n.

Step 3: If minimum occurs corresponding to unique value of i i.e., i= r then label node j as [$\tilde{d}_j$, r]. If minimum occurs corresponding to more than one values of i then it represents that there are more than one single valued triangular neutrosophic path between source node and node j but single valued triangular neutrosophic distance along path is $\tilde{d}_j$, so choose any value of i.

Step 4: Let the destination node (node n) be labeled as [$\tilde{d}_n$, l], then the single valued triangular neutrosophic shortest distance between source node and destination node is $\tilde{d}_n$.

Step 5: Since destination node is labeled as [$\tilde{d}_n$,l], to find the single valued triangular neutrosophic shortest path between source node and destination node, check the label of node l. Let it be [$\tilde{d}_l$, p], now check the label of node p and so on. Repeat the same procedure until node 1 is obtained.

Step 6: Now the single valued triangular neutrosophic shortest path can be obtained by combining all the nodes obtained by the step 5.

Remark 5.1 Let $\tilde{A}_i$; i =1, 2,…, n be a set of single valued triangular neutrosophic numbers, if S($\tilde{A}_k$) < S($\tilde{A}_i$), for all i, the single valued triangular neutrosophic number is the minimum of $\tilde{A}_k$.

After describing the proposed algorithm, in next section, an hypothetical example is presented and the proposed method is explained completely.

IV. ILLUSTRATIVE EXAMPLE

In this section an hypothetical example is introduced to verify the proposed. Consider the network shown in Fig. 1; we want to obtain the shortest path from node 1 to node 6 where edges have a single valued triangular neutrosophic numbers. Let us now apply the proposed algorithm to the network given in Fig.1.

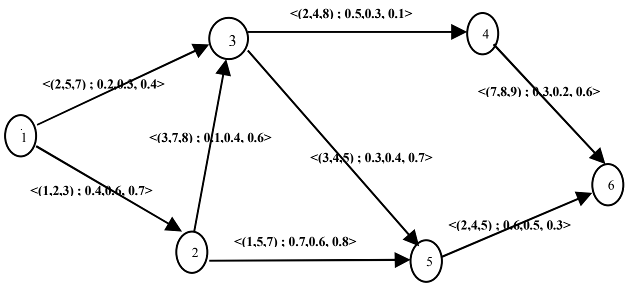

Fig. 1. A Network with single valued triangular neutrosophic edges.

In this network each edge have been assigned to single valued triangular neutrosophic number as follows:

Table 1. Weights of the graphs

Edges	Single Valued Triangular Neutrosophic Distance
1-2	<(1, 2,3);0.4,0.6,0.7>
1-3	<(2,5,7);0.2,0.3,0.4>
2-3	<(3,7,8);0.1,0.4,0.6>
2-5	<(1,5,7);0.7,0.6,0.8>
3-4	<(2,4,8);0.5,0.3,0.1>
3-5	<(3, 4,5);0.3,0.4,0.7>
4-6	<(7, 8,9);0.3,0.2,0.6>
5-6	<(2,4,5);0.6,0.5,0.3>

The calculations for this problem are as follows:
Node 6 is assumed to be the destination node,n= 6.
Assume $\tilde{d}_1 = <(0,\ 0,\ 0);\ 0,\ 1,\ 1>$ and label the source node (say node 1) as [$<(0,\ 0,\ 0);\ 0,\ 1,\ 1>$,-], the value of $\tilde{d}_j$; j= 2, 3, 4, 5 ,6 can be obtained as follows:

Iteration1: Since only node 1 is the predecessor node of node 2, so putting i=1 and j= 2 in step of the proposed algorithm, the value of $\tilde{d}_2$ is

$\tilde{d}_2$ = min{ $\tilde{d}_1 \oplus \tilde{d}_{12}$ }=min{<(0, 0, 0); 0, 1, 1> $\oplus$ <(1, 2, 3); 0.4, 0.6, 0.7>= <(1, 2, 3); 0.4, 0.6, 0.7>
Since minimum occurs corresponding to i=1, so label node 2 as [<(1, 2, 3); 0.4, 0.6, 0.7>, 1]
$\tilde{d}_2$ = <(1, 2, 3); 0.4, 0.6, 0.7>

Iteration 2: The predecessor node of node 3 are node 1 and node 2, so putting i= 1, 2 and j= 3 in step 2 of the proposed algorithm, the value of $\tilde{d}_3$ is

$\tilde{d}_3$=min{ $\tilde{d}_1 \oplus \tilde{d}_{13}, \tilde{d}_2 \oplus \tilde{d}_{23}$ }=min{<(0, 0, 0); 0, 1, 1> $\oplus$ <(2, 5, 7); 0.2, 0.3, 0.4>, <(1, 2, 3); 0.4, 0.6, 0.7> $\oplus$ <(3, 7, 8); 0.1, 0.4, 0.6>}= min<(2, 5, 7); 0.2, 0.3, 0.4> , <(4, 9, 11); 0.46, 0.24, 0.42>}
Using Eq.9, we have
S ({<(2, 5, 7); 0.2, 0.3, 0.4>)

$$=\left(\frac{1}{12}\right)\left[a_1+2a_2+a_3\right]\times\left[2+T_1-I_1-F_1\right]=2.38$$

S (<(4, 9, 11); 0.46, 0.24, 0.42>) =4.95
Since S ({<(2, 5, 7); 0.2, 0.3, 0.4>) $<$ S (<(4, 9, 11); 0.46, 0.24, 0.42>)
So min{<(2, 5, 7); 0.2, 0.3, 0.4> , <(4, 9, 11); 0.46, 0.24, 0.42>} = <(2, 5, 7); 0.2, 0.3, 0.4>
Since minimum occurs corresponding to i=1, so label node 3 as [<(2, 5, 7); 0.2, 0.3, 0.4>, 1]
$\tilde{d}_3$=<(2, 5, 7); 0.2, 0.3, 0.4>

Iteration 3: The predecessor node of node 4 is node 3, so putting i= 3 and j= 4 in step 2 of the proposed algorithm, the value of $\tilde{d}_4$ is $\tilde{d}_4$=min { $\tilde{d}_3 \oplus \tilde{d}_{34}$ }=min{<(2, 5, 7); 0.2, 0.3, 0.4>, $\oplus$ <(2, 4, 8); 0.5, 0.3, 0.1> }=<(4, 9, 15,); 0.6, 0.09, 0.04>
So min {<(2, 5, 7); 0.2, 0.3, 0.4>, $\oplus$ <(2, 4, 8); 0.5, 0.3, 0.1> }= <(4, 9, 15); 0.6, 0.09, 0.04>
Since minimum occurs corresponding to i=3, so label node 4 as [<(4, 9, 15); 0.6, 0.09, 0.04>,3]
$\tilde{d}_4$ =<(4, 9, 15); 0.6, 0.09, 0.04>

Iteration 4: The predecessor node of node 5 are node 2 and node 3, so putting i= 2, 3and j= 5 in step 2 of the proposed algorithm, the value of $\tilde{d}_5$ is

$\tilde{d}_5$ =min{ $\tilde{d}_2 \oplus \tilde{d}_{25}, \tilde{d}_3 \oplus \tilde{d}_{35}$ }=min{<(1, 2, 3); 0.4, 0.6, 0.7> $\oplus$ <(1, 5, 7); 0.7, 0.6, 0.8>, <(2, 5, 7); 0.2, 0.3, 0.4> $\oplus$ <(3, 4, 5); 0.3, 0.4, 0.7>}=
min{<(2, 7, 10); 0.82, 0.36, 0.56>, <(5, 9, 12); 0.44, 0.12, 0.28>}
Using Eq.9, we have
S (<(2, 7, 10); 0.82, 0.36, 0.56>) =4.12
S (<(5, 9, 12); 0.44, 0.12, 0.28>) =5.13
Since S (<(2, 7, 10); 0.82, 0.36, 0.56>) $<$ S (<(5, 9, 12); 0.44, 0.12, 0.28>)
minimum{<(2, 7, 10); 0.82, 0.36, 0.56>, <(5, 9, 12); 0.44, 0.12, 0.28>}
= <(2, 7, 10); 0.82, 0.36, 0.56>
$\tilde{d}_5$ = <(2, 7, 10); 0.82, 0.36, 0.56>
Since minimum occurs corresponding to i=2, so label node 5 as [<(2, 7, 10); 0.82, 0.36, 0.56>, 2]

Iteration 5: The predecessor node of node 6 are node 4 and node 5, so putting i= 4, 5and j= 6 in step 2 of the proposed algorithm, the value of $\tilde{d}_6$ is

$\tilde{d}_6$ =min{ $\tilde{d}_4 \oplus \tilde{d}_{46}, \tilde{d}_5 \oplus \tilde{d}_{56}$ }=min{<(4, 9, 15); 0.6, 0.09, 0.04> $\oplus$ <(7, 8, 9); 0.3, 0.2, 0.6>, <(2, 7, 10); 0.82, 0.36, 0.56> $\oplus$ <(2, 4, 5); 0.6, 0.5, 0.3>}= min{<(11, 17, 24); 0.72, 0.018, 0.024>, <(4, 11, 15); 0.93, 0.18, 0.17>}
Using Eq.9, we have
S (<(11, 17, 24); 0.72, 0.018, 0.024>) =15.40
S (<(4, 11, 15); 0.93, 0.18, 0.17>) =8.82

Since S (<(4, 11, 15); 0.93, 0.18, 0.17>) < S (<(11, 17, 24); 0.72, 0.018, 0.024>)

So min{<(11, 17, 24); 0.72, 0.018, 0.024>, <(4, 11, 15); 0.93, 0.18, 0.17>}

= <(4, 11, 15); 0.93, 0.18, 0.17>

$\tilde{d}_6$ =<(4, 11, 15); 0.93, 0.18, 0.17>

Since minimum occurs corresponding to i= 5, so label node 6 as [<(4, 11, 15); 0.93, 0.18, 0.17>, 5]

Since node 6 is the destination node of the given network, so the single valued triangular neutrosophic shortest distance between node 1 and node 6 is <(4, 11, 15); 0.93, 0.18, 0.17>.

Now the single valued triangular neutrosophic shortest path between node 1 and node 6 can be founded by using the following procedure:

Since node 6 is labeled by [<(4, 11, 15); 0.93, 0.18, 0.17>, 5], which represents that we are coming from node 5. Node 5 is labeled by [<(2, 7, 10); 0.82, 0.36, 0.56>, 2], which represent that we are coming from node 2. Node 2 is labeled by [<(1, 2, 3); 0.4, 0.6, 0.7>, 1], which represents that we are coming from node 1. Now the single valued triangular neutrosophic shortest path between node 1 and node 6 is obtaining by joining all the obtained nodes. Hence the single valued triangular neutrosophic shortest path $1 \to 2 \to 5 \to 6$.

The single valued triangular neutrosophic shortest distance and the single valued triangular neutrosophic shortest path of all nodes from node 1 is depicted in the table 2 and the labeling of each node is shown in Fig.2.

TABLE 2. Tabular representation of different single valued triangular neutrosophic shortest paths

Node No.(j)	$\tilde{d}_i$	Single Valued Triangular Neutrosophic Shortest Path Between jth and 1st node
2	<(1, 2, 3); 0.4, 0.6, 0.7>	$1 \to 2$
3	<(2, 5, 7); 0.2, 0.3, 0.4>	$1 \to 3$
4	<(4, 9, 15); 0.6, 0.09, 0.04>	$1 \to 3 \to 4$
5	<(2, 7, 10); 0.82, 0.36, 0.56>	$1 \to 2 \to 5$
6	<(4, 11, 15); 0.93, 0.18, 0.17>	$1 \to 2 \to 5 \to 6$

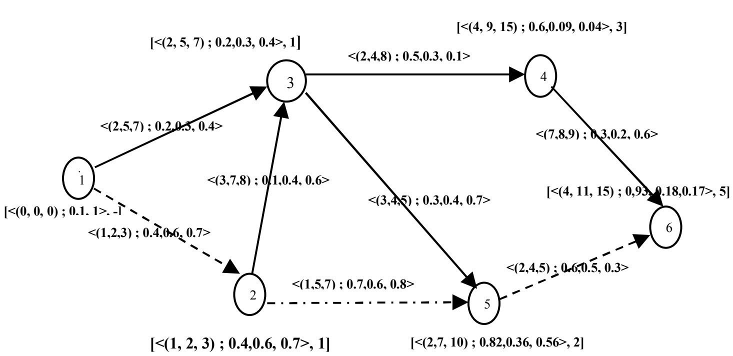

Fig.2.Network with single valued triangular neutrosophic shortest distance of each node from node 1

VI. Conclusion

In this article, an algorithm has been developed for solving the shortest path problem on a network where the edges weight are characterized by a neutrosophic numbers called single valued triangular neutrosophic numbers. To show the performance of the proposed methodology for the shortest path problem, an hypothetical example was introduced. In future works, we studied the shortest path problem in a single valued trapezoidal neutrosophic environment and we will research the application of this algorithm.

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