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Travelling Salesman Problem Generalized Interval Arithmetic

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Abstract: The travelling salesman problem is one of the famous combinatorial optimization problem and has been intensively studied in the last decades. We present a new extension of the basics problem, where travel times are specified as a range of possible values.
Keywords: Fuzzy sets, Arithmetic operation on interval, least common method, travelling salesman problem.

I. INTRODUCTION

Given the cost of travel between each pair of a finite number of cities, the travelling salesman problem (TSP) is to find the cheapest tour passing through all of the cities and returning to the point of departure. Here we investigate a more realistic problem ,namely interval –valued fuzzy travelling salesman problem & restriction in assignment problem using new arithmetic operations and proposed a new method which was verified by means of numerical examples.

II. FUZZY SETS

Fuzzy sets is fully defined by its membership functions. Member function is a function in [0,1] that represents the degree of belonging.
Example: Words like young ,tall, good, or high are fuzzy.

III. ARITHMETIC OPERATION ON INTERVAL

Arithmetic operation is a branch of mathematics ,that involves the study of numbers, operation of numbers that are useful in all the other branches of mathematics.

It basically comprises operations such as **ADDITION, SUBTRACTION, MULTIPLICATION and DIVISION.**

ADDITION :A (+) B

$$\mu_{A(+)B}(z) = \bigvee_{z=x+y} (\mu_A(x) \wedge \mu_B(y))$$

SUBTRACTION :A (-) B

$$\mu_{A(-)B}(z) = \bigvee_{z=x-y} (\mu_A(x) \wedge \mu_B(y))$$

MULITIPLICATION :A (•) B

$$\mu_{A(\bullet)B}(z) = \bigvee_{z=x\bullet y} (\mu_A(x) \wedge \mu_B(y))$$

DIVISION:A (/) B

$$\mu_{A()B}(z) = \bigvee_{z=x/y} (\mu_A(x) \wedge \mu_B(y))$$

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IV. LEAST COMMON METHOD

The least common multiple of two numbers is the **"smallest non zero common number "**Which is a multiple of both the numbers.
The different methods to find least common multiple of 2 or more numbers are :
Using Prime fraction and using repeated Function
Example LCM of 4 and 6 is 12.

V. TRAVELLING SALES MAN PROBLEM

A Territory with several terms linked with reads. The job is to visit each town exactly once so that the total distance travelled is minimum.

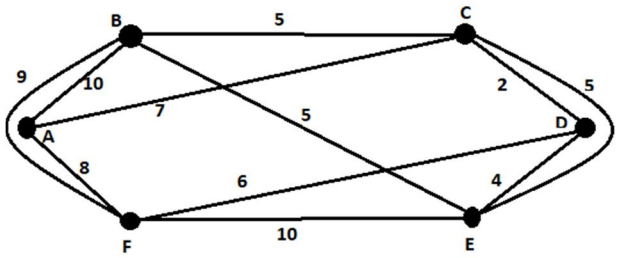
- Can be solved by listing all possible hamiltion circuit and then selecting the one with minimum cost
- For completing Graph with n vertices Hamilton circuit **S** = $\frac{(n-1)!}{2}$

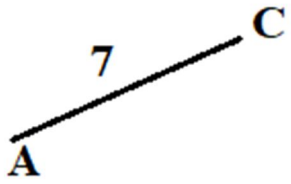
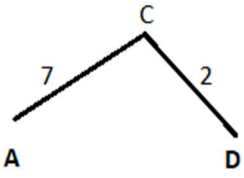
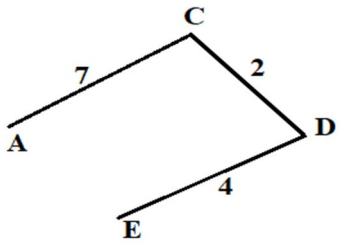
Travelling Salesman problem can be solved in two different ways. They are

- Nearest Neighbor Algorithm
- The Closet Insection Algorithm

A. Nearest Neighbor Algorithm

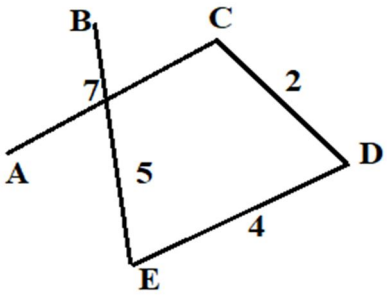
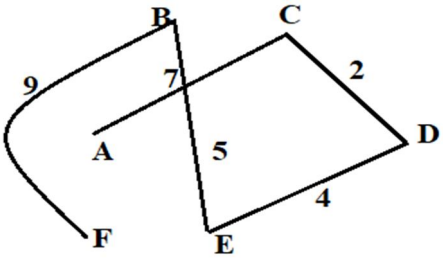
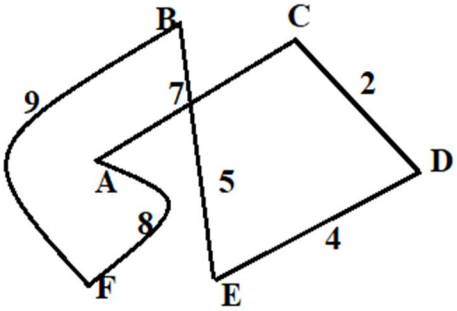
Start from any random point



Current vertex	Next vertex table visited (nearest)	path	
A	C	AC	
C	D	ACD	
D	E	ACDE	

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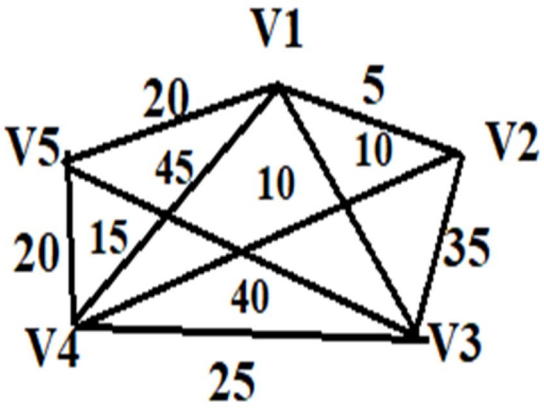
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E	B	ACDEB	
B	F	ACDEHF	
F	A	ACDEBFA	

B. Closed Insection Algorithm

Start with a cycle and keeps adding more and more vertices to the cycle until all the vertices are added.

\



Start with V_1, V_2 is nearest.

Cycle $C_2 = V_1\ V_2\ V_1 = 0$

$V_1\ V_2\ V_3\ V_1 = 5 + 35 + 10 = 50$

$C_3 = V_1\ V_2\ V_3\ V_1$

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From C_3 path V_4 Is nearest

$V_1 V_2 V_3 V_4 V_1 = 5 + 35 + 25 + 15 = 80$

$V_1 V_4 V_3 V_2 V_1 = 5 + 15 + 25 + 55 = 80$

$V_1 V_4 V_2 V_3 V_1 = 15 + 40 + 35 + 10 = 100$

$C_4 = V_1 V_2 V_3 V_4 V_1$

$V_1 V_2 V_3 V_4 V_5 V_1 = 5 + 35 + 25 + 20 + 20 = 105$

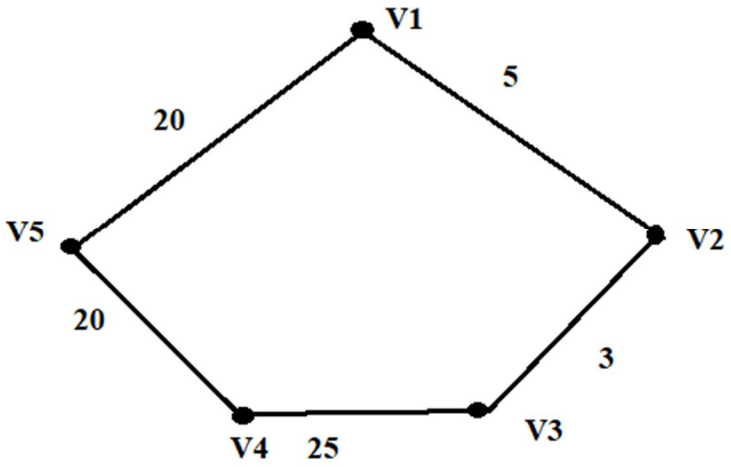
$V_1 V_5 V_3 V_4 V_2 V_1 = 20 + 30 + 25 + 40 + 5 = 100$

$V_1 V_3 V_2 V_4 V_5 V_1 = 10 + 35 + 40 + 20 + 20 = 125$

$V_1 V_5 V_2 V_3 V_4 V_1 = 20 + 45 + 35 + 25 + 15 = 140$

$C_5 = V_1 V_2 V_3 V_4 V_5 V_1 = 105$

Cycle with length 105 is shorest

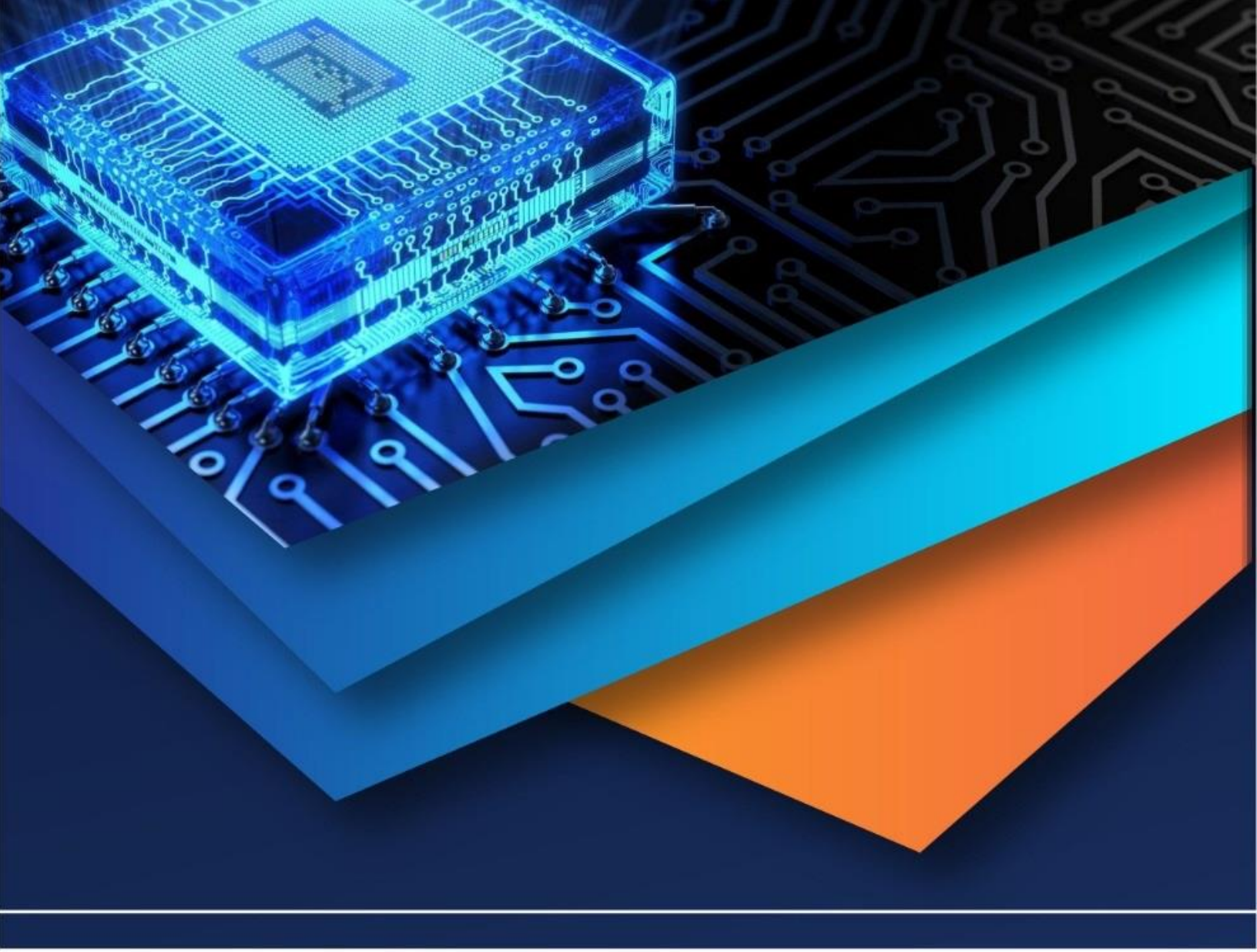


VI. CONCLUSION

In this paper, a new approach to solve the travelling salesman problem, It depands very much on the way the problem is encoded and which crossover and mutation methods are used . Better quality of solution and cost as well as solution times.

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