

## Comparison of Different Prim's Algorithm Techniques

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**Abstract-** The spanning tree is a combination of edges and vertices in such a way so that graph does not hold any cycle. For one graph G, it is possible to have more than one spanning trees. The minimum spanning tree in a graph is a subgroup of same graph that associates all vertices with absolute possible maximum edge weight. Different algorithms are used for generating the minimum spanning tree and one such algorithm is prim's algorithm. The main objective in this paper is to show the comparisons of different methods that are used with prim's algorithm for solving the problem of minimum spanning tree in various real world applications. This paper includes the concept of Prim technique for finding the maximum edge weight and the comparison of its different variants with respect to various usage applications.

**Keywords-** Prim's algorithm, Fuzzy Environment, LAN networks, Comparisons

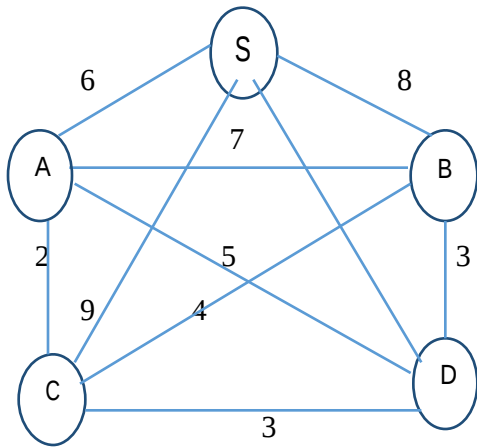
### I. INTRODUCTION

The word spanning tree is commonly used in the traversal of the graphs, which means for a graph G having vertices V and edges E will not create any loop while traversing the vertices of the graph G along with the coverage of all the vertices present in the graph G. While traversing all the vertices of the graph, it will create a tree like structure called spanning tree and out of those n spanning trees, which will have less cost is called minimum spanning tree (MST). Many researchers have used various techniques for finding lower valued spanning tree. Out of which Prim's algorithm is mostly used in various application for lower valued minimum spanning tree. The concept of Prim's algorithm revolves around the greedy algorithm. It finds minimum spanning tree of the graph and represented by undirected arrow. This means that there are number of edges in a tree form and every edge is connected with a vertex. Each edge is having some value with it. The below is mentioned the pseudo code of the prim's algorithm and Table 1 shows the example of finding MST through prim's technique.

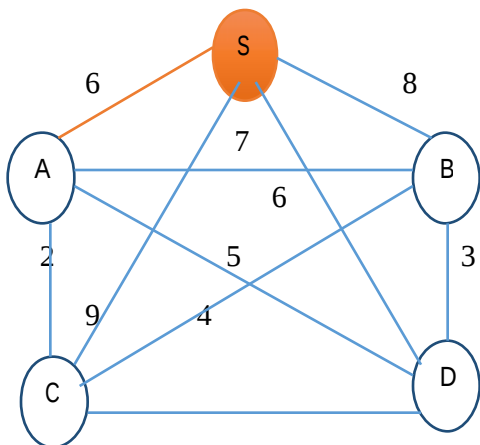
**1.1 Pseudocode:** The following are the certain steps that are to be followed to find out the minimum spanning tree.

1. To find out whether there is any parallel edge or loop in the graph, if yes then remove it.
2. Take any vertex as the starting node and label it as 0, the distance and all rest of the vertices as  $\infty$ .
3. Find out all the vertices that are connected with starting vertex and calculate the distance of each edge.
4. The minimum distance edge is considered and considered it as visited edge. If one vertex is visited then it will not be considered again.
5. Repeat step 2-4 again and stop when all the vertices visited.

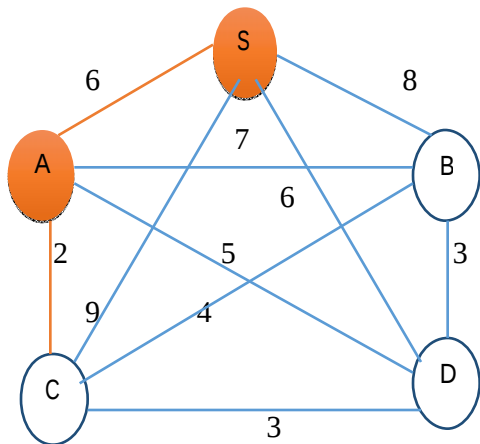
## 1.2 EXAMPLE



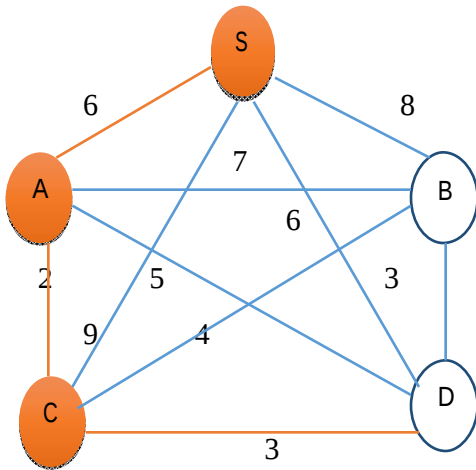
Step 1: Choose the vertex S as starting node and consider it as first vertex.



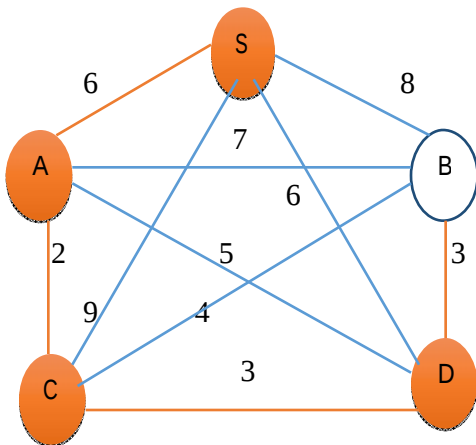
Step 2: Starting vertex is S. Calculate the distance of S with all consecutive nodes. In figure the minimum weight is 6. So A is considered.



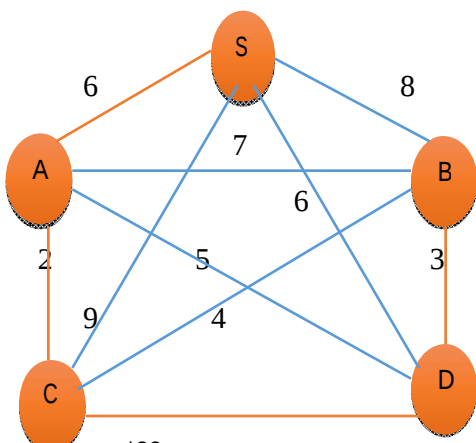
Step 3: After A, Calculate the distance of A and S with all consecutive nodes and from the figure C has the minimum value.



Step 4: In above figure, From C calculate the minimum weighted edge that is C, so it is considered.



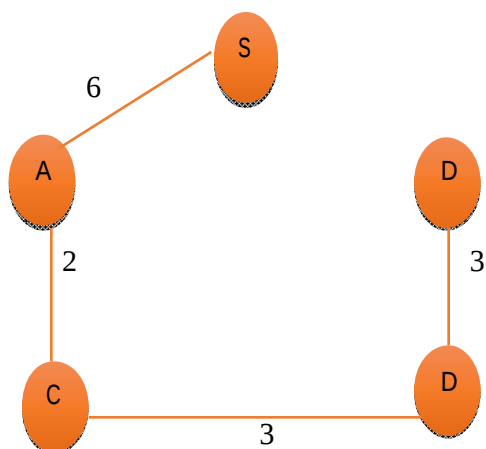
Step 5: After D, B is considered as minimum weighted vertex after calculating all the distances.



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Total sum is  $6+2+3+3=14$

So, final MST using prim's algorithm is given below.



The various researchers presented many different ways and having their own pros and cons as described below in Table. Every improved Algorithm is having different complexity and it plays an important role in Path Search Algorithm.

### 1.3 FUZZY ENVIRONMENT

It also works in Fuzzy environment. It is one of the most fundamental and also well-known optimization methods. The MST is an effective and reliable way to multicast the data. Two different challenges are projected in context of mapping of fuzzy values with the edge values and adding additional vertices in fuzzy system. For this FMST (Fuzzy Minimum Spanning tree) involves in ranking FMST is having addition operation between fuzzy numbers that is very different from conventional method and only involves real numbers in fuzzy.

### 1.4 MODIFIED PRIM TECHNIQUE

Modified prim's technique is another variant of prim's technique in which minimum weighted vertex is picked and then create the entire tree taking that vertex as root node. Modified prim technique is implemented in various applications such as parallel machines, broadcasting the signals and many such applications. The big advantage of having the modified prim technique is that it will not increase the time and space complexity and choosing the minimum vertex will give the chance to reduce the computational cost for finding the minimum spanning tree.

### 1.5 OPEN-MP

There is also an improvement in prim's technique for implementation in MST. In this work, they have presented shared memory-based parallel implementations, and it is applied in Prim's method. In this case, two most often used methods of program shared memory parallel machines are given below:

- 1) Hand-coded parallel threads

2) Using serial code with compiler directives.

Today Open-MP is the most widely used framework for the parallelization of the serial code. Thread-pool model results in significantly less overhead, it reduces overhead during execution of a program which is parallel. Researchers have also improved it with the usage of hardware and software implementation. Their main objective is to implement multi threading for open multiprocessing.

## 1.6 LAN NETWORKS

Prim's algorithm is used in selection of various LAN topologies for calculating their installation cost in context of moving the data from source to destination. Most of the universities and colleges around the globe use this method for installing fiber optics in their campus. The main advantage of using this technique is that it will compare the different structures that are used to install fiber optics and give the optimized structure for the installation. With Prim's algorithm, assurance has been made that implementation will be done using minimum cost.

## II. LITERATURE REVIEW

The below table 1 demonstrates the comparison of various prim's algorithms in terms of adopted method, complexity, pros and cons by adapting those methods.

**TABLE-1**  
**COMPARISON OF VARIOUS PRIM'S ALGORITHMS**

| Sr No. | Authors                     | Method                     | Complexity   | Advantages                                                                                      | Disadvantages                            |
|--------|-----------------------------|----------------------------|--------------|-------------------------------------------------------------------------------------------------|------------------------------------------|
| 1      | Arindam Dey et al. [1]      | Graded mean representation | $O( V ^2)$   | Applicable on arcs having fuzzy numbers.                                                        | -                                        |
| 2      | Arogundade O. T. et al. [2] | Prim's algorithm           |              | It reduces the cost of fuel and time for transportation of passengers from one town to another. | -                                        |
| 3      | Thomas H. Cormen et al. [3] | Updated Prim's technique   | $O(E \lg V)$ | Identifies the graph's minimum weight edge and renders a single node as a root node.            | Not much efficient due to its complexity |
| 4      | Badri Munier et al. [4]     | OpenMP                     |              | Proposed technique avoids any                                                                   | -                                        |

|   |                                    |                                                                                   |              |                                                                                                                                                             |                          |
|---|------------------------------------|-----------------------------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
|   |                                    |                                                                                   |              | blocking or non-blocking synchronization.                                                                                                                   |                          |
| 5 | Artur Mariano et al. [5]           | Optimized implementation of Prim's algorithm on a 24MHz Xilinx FPGA Spartan-class |              | Compared to simple multi-threaded implementations, the Open MP-based implementation of both algorithms demonstrated excellent performance and scalability.  | -                        |
| 6 | Charles K. Gitonga [6]             | Prim's algorithm                                                                  |              | - With the help of this algorithm in network we save the cost and also more people are connected with each other at minimum cost.<br>-It is useful for LAN. | It is not useful for WAN |
| 7 | Dairina, Salmawaty Arif et al. [7] | Kruskal's and Prim's technique                                                    | $D^2 \log n$ | Minimum weight check of the entire broadcast graph without giving priority to the time unit                                                                 | -                        |
| 8 | Santiago Manen et al. [8]          | Randomized Prim's (RP) algorithm                                                  |              | Performance is improved by maximizing the probability that the sampled groups of super pixels remain within the same object.                                | -                        |
| 9 | C. J. Alpert et al. [9]            | Direct combination of the algorithm                                               |              | Depending on interconnecting infrastructure and                                                                                                             | -                        |

|    |                               |                                                                             |                               |                                                                                                                                                                        |                                                                                  |
|----|-------------------------------|-----------------------------------------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
|    |                               | of prim and the algorithm of dijkstra with indirect "shallow-light" methods |                               | net size, it can trade off costs and distance.                                                                                                                         |                                                                                  |
| 10 | ZuhriRam adhan et al. [10]    | Prim's algorithm and Floyd-warshall algorithm                               |                               | It finds shortest path and minimum spanning tree                                                                                                                       | -                                                                                |
| 11 | Yanmei Yan et al. [11]        | Improved prim's algorithm using euler's graph                               |                               | This technique find out the minimum distance using euler's theoram                                                                                                     | After visiting the tourist sites, we cannot start and finish on a defined vertex |
| 12 | R.S. BARR et al. [12]         | Parallization of prim's and sollin's algorithm                              |                               | It solves problem of minimum spanning tree on sequential machine.                                                                                                      | -                                                                                |
| 13 | Nirav J. Patelet al. [13]     | Prim's algorithm, kruskal's algorithm, modified prim's algorithm            |                               | We can find minimum spanning tree.                                                                                                                                     | Methods work only on undirected graph                                            |
| 14 | Hong Zhao, a et al. [14]      | Prim algorithm                                                              |                               | Primary algorithm for solving the road design paved in the road construction project will reduce project costs and the conflict between road construction and ecology. | -                                                                                |
| 15 | Shreekant V. Jere et al. [15] | Prim's method                                                               | The running time of algorithm | For different number of nodes, we evaluated our algorithm and                                                                                                          | Running time is more                                                             |

|  |  |  |                                                                  |                                  |  |
|--|--|--|------------------------------------------------------------------|----------------------------------|--|
|  |  |  | is<br>approximat<br>ely in a<br>(almost 2<br>logV V)<br>version. | measured the time<br>complexity. |  |
|--|--|--|------------------------------------------------------------------|----------------------------------|--|

### III. CONCLUSION

The time complexity of Prim's technique is acceptable for finding the minimum spanning tree in terms of its overall performance. But the modified prim's algorithm was used in this analysis and this improved prim technique determines the graph's minimum weighted edge by having its one node as a root node. Table-1 has demonstrated the various methods adopted by various researchers and having their own advantages and disadvantages. The main advantage found was the reduction in time complexity and makes algorithm efficient for dense graph for travel or to find minimum path and the major disadvantage was  $D^2 \log n$  complexity.

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