# PARALLELIZATION OF PRIM’S ALGORITHM TO FIND THE MST

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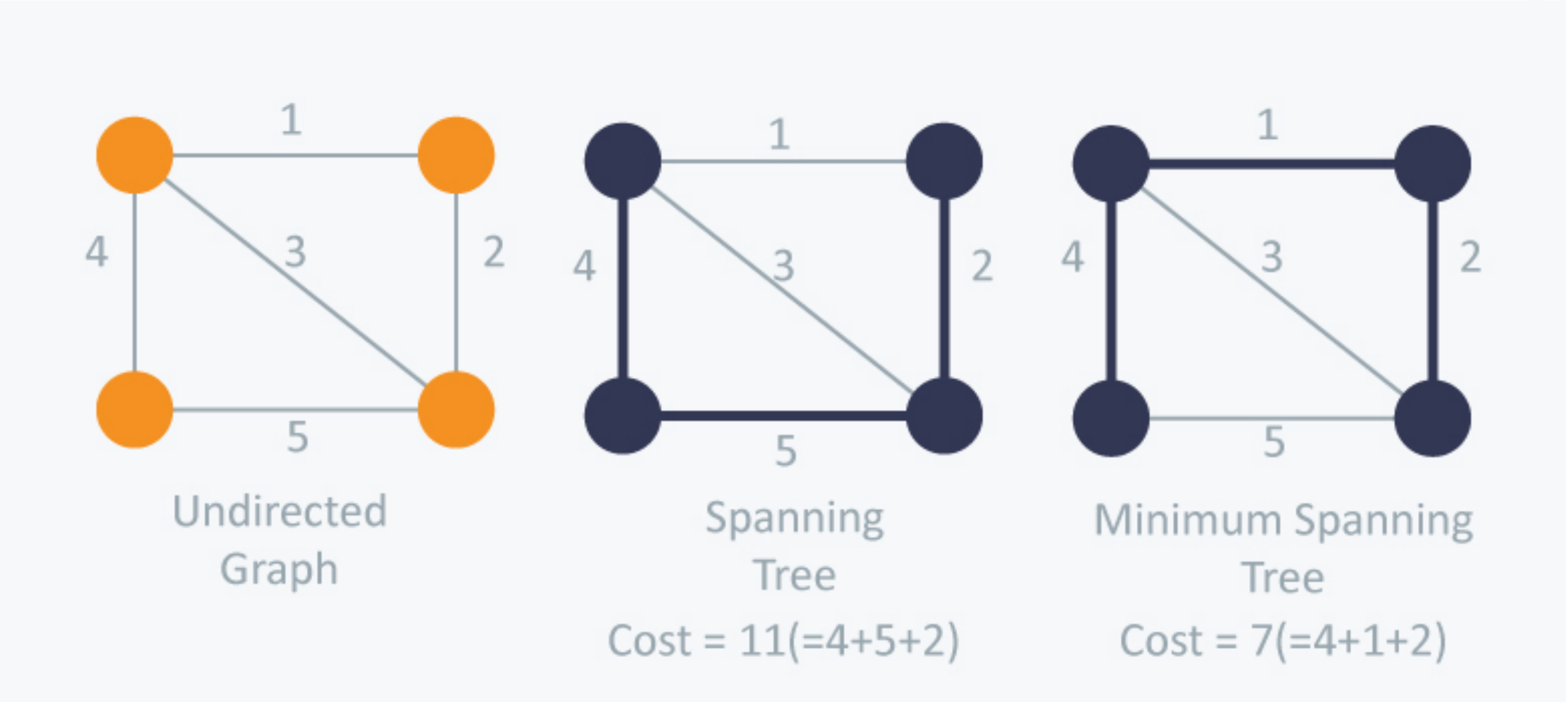
# Minimum Spanning Tree (MST) of a graph

- A spanning tree (a tree with all the nodes in the graph) where the sum of the edges is the least possible.



# Applications of MST

- Design of cost-effective Networks and efficient Circuits
- Transportation Planning:  to determine the most cost-effective routes for building roads, railways, or other transportation networks.
- Image Processing: used in Image Segmentation

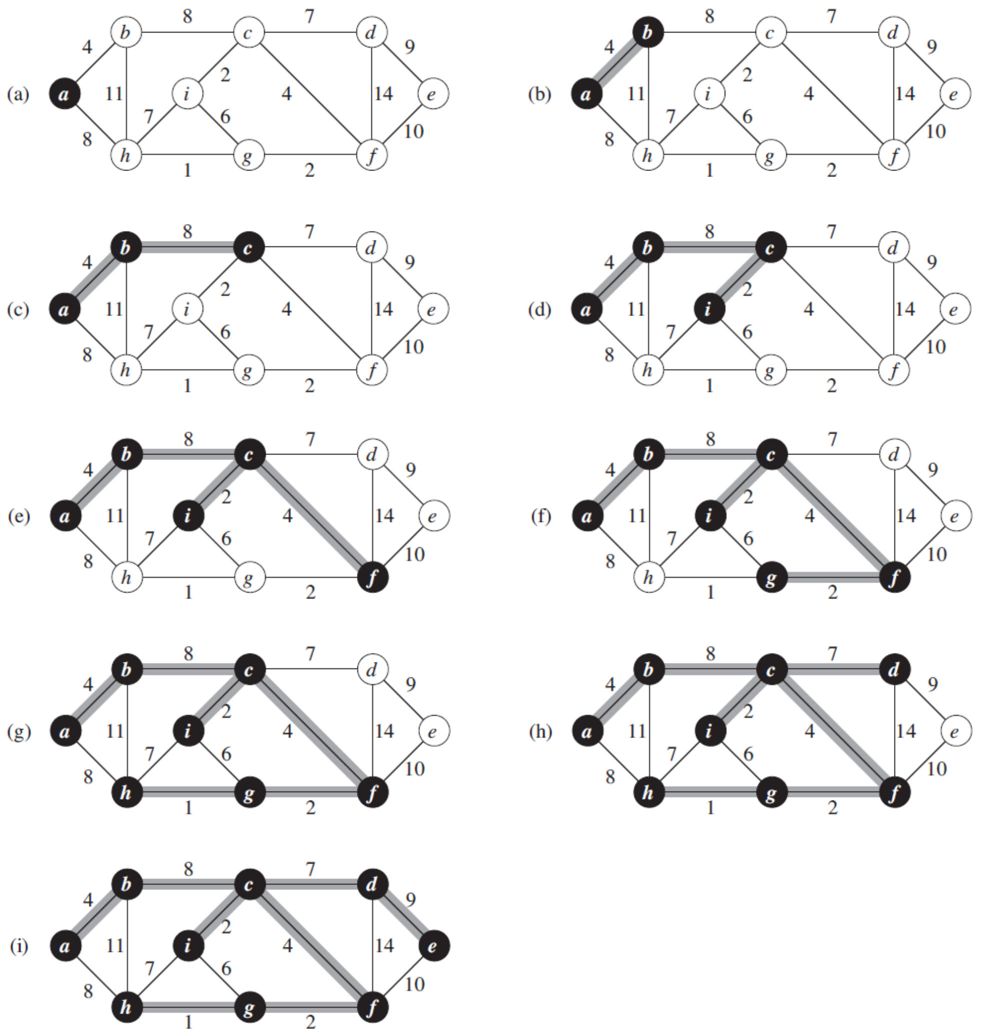
# Prim’s Algorithm (Sequential):

1. Initialize a tree with a single vertex, chosen arbitrarily from the graph.

2. Grow the tree by one edge: Of the edges that connect the tree to vertices not yet in the tree, find the minimum-weight edge, and transfer it to the tree.

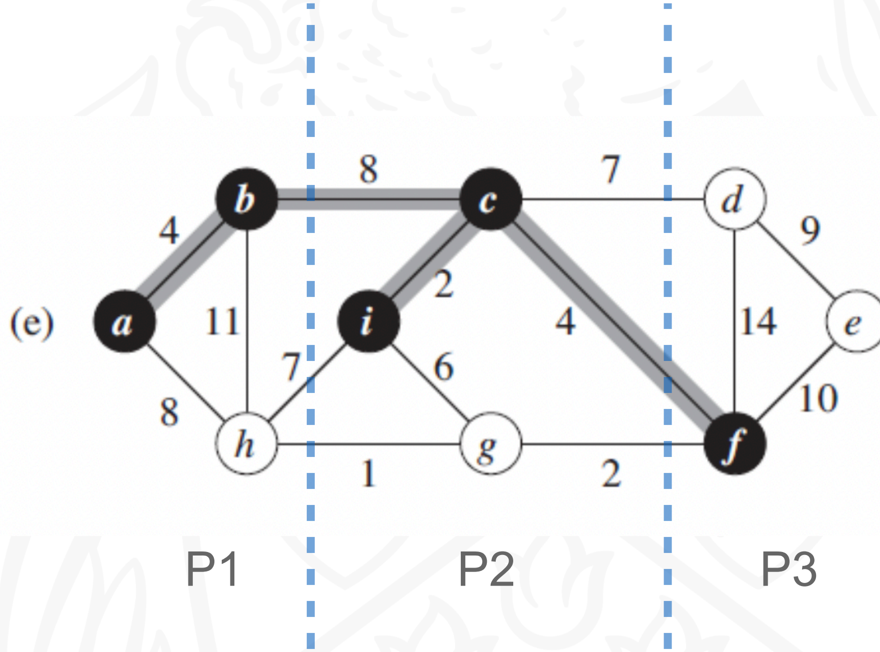
3. Repeat step 2 (until all vertices are in the tree)

4. Time = O(n^2)

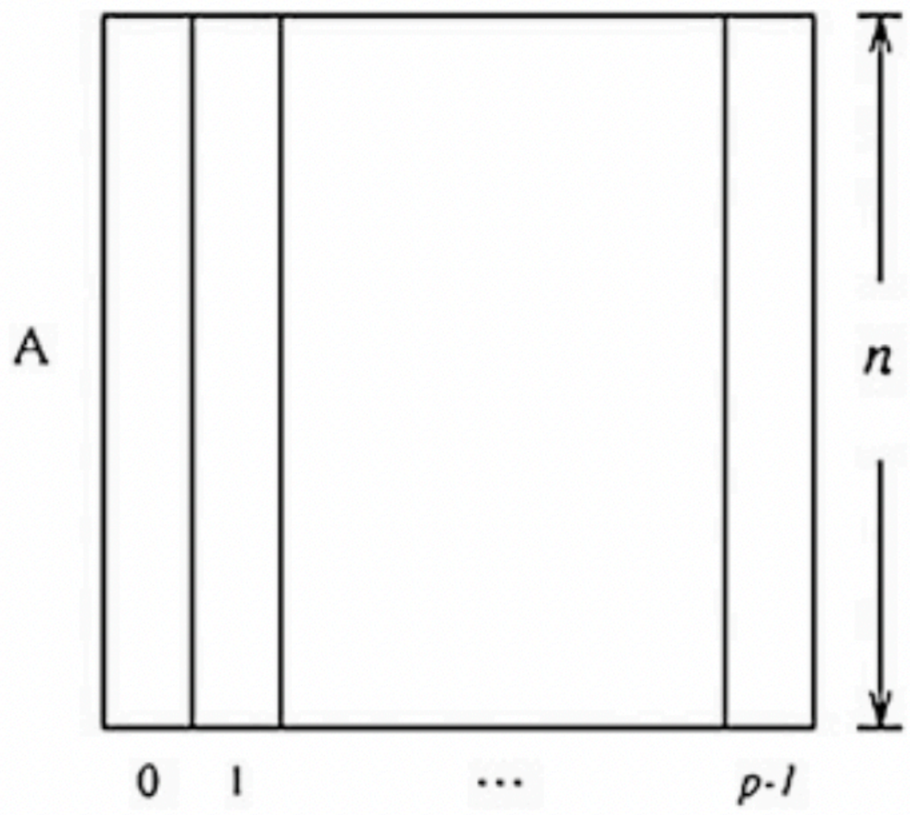


# Pseudo code for Parallel approach

- Initialization:
- Divide the set of vertices V into p subsets $V_1$, $V_2$, ..., $V_p$
- Assign each subset to a different process
- While vertices_in_MST is not equal to V:
- For each process pi:
  - Find the minimum-weight edge $e_i$ (candidate) connecting MST to vertices in Vi
  - Send $e_i$ to the root process using MPI_Reduce to find the global minimum-weight edge $e_{min}$
- If rank of current process is root:
  - Select the minimum-weight edge $e_{min}$ from the received edges
  - Add $e_{min}$ to MST
- Broadcast $e_{min}$ to all processes
- Continue this till all the vertices are in the MST
- Time = O(n^2/p) + O(nlogp)

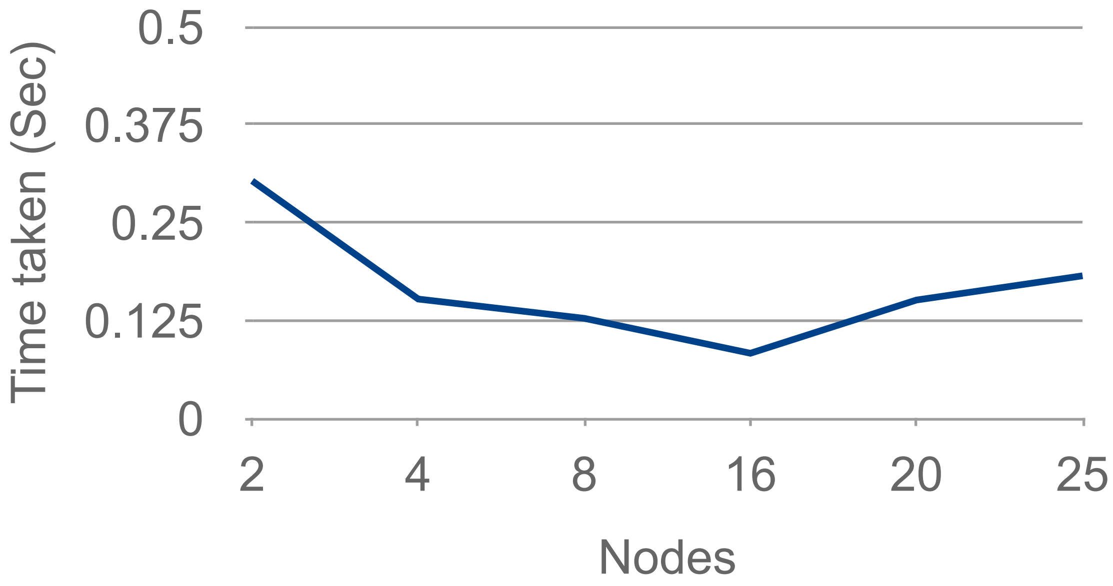


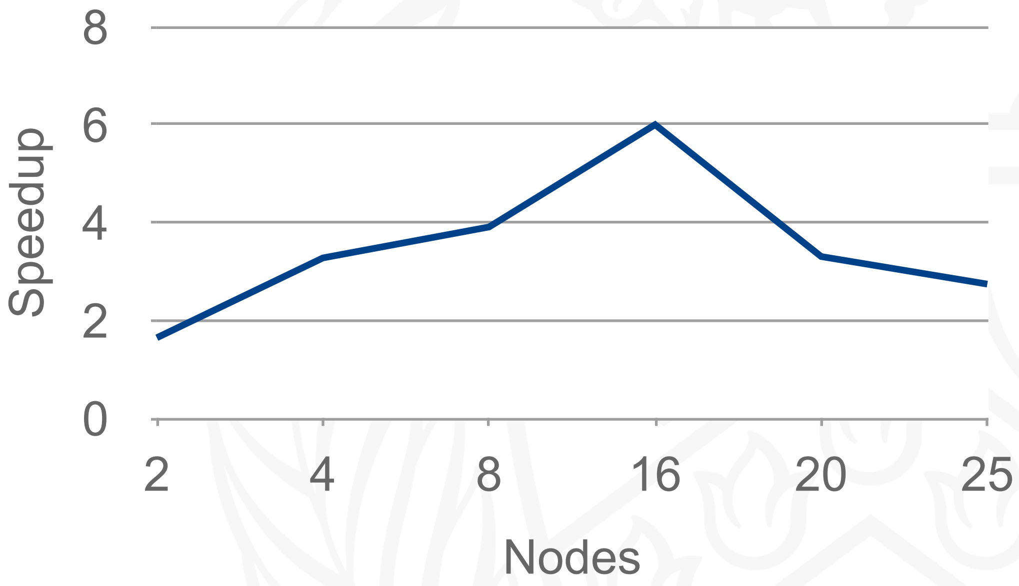
- Partitioning of adjacency matrix among ‘p’ processors:



# Results

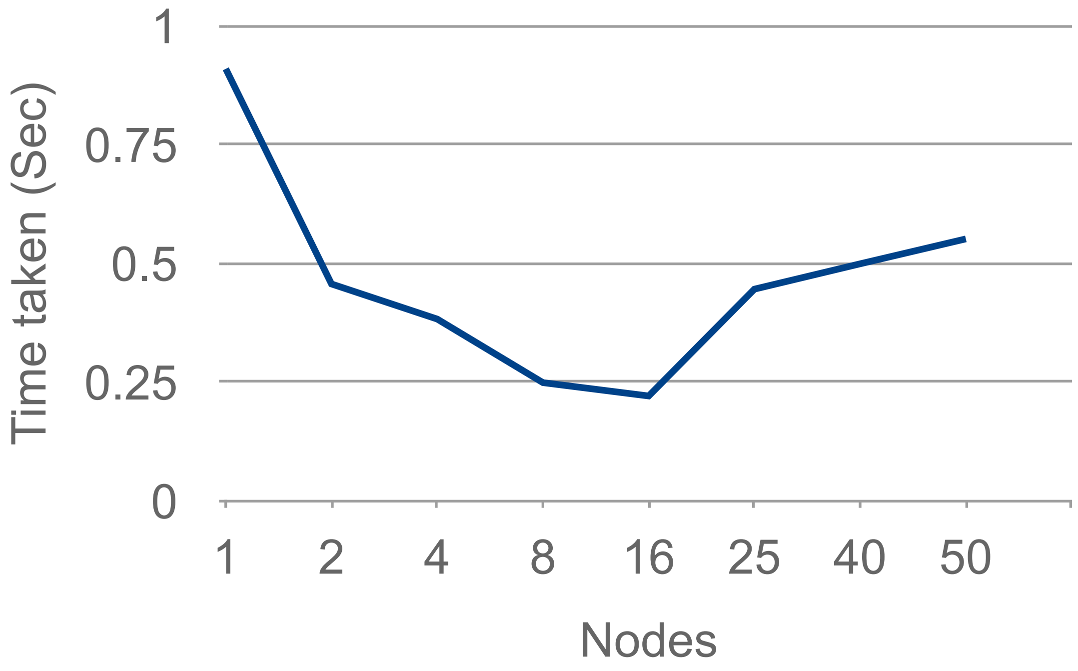
- Input graph: 10000 nodes (5% density)

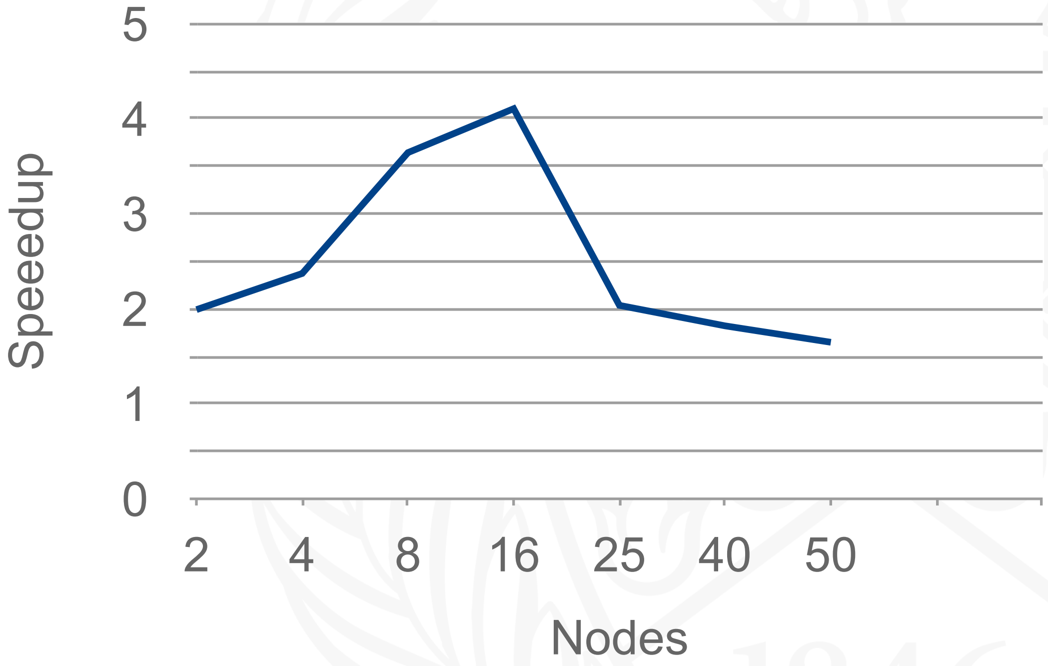


# Results

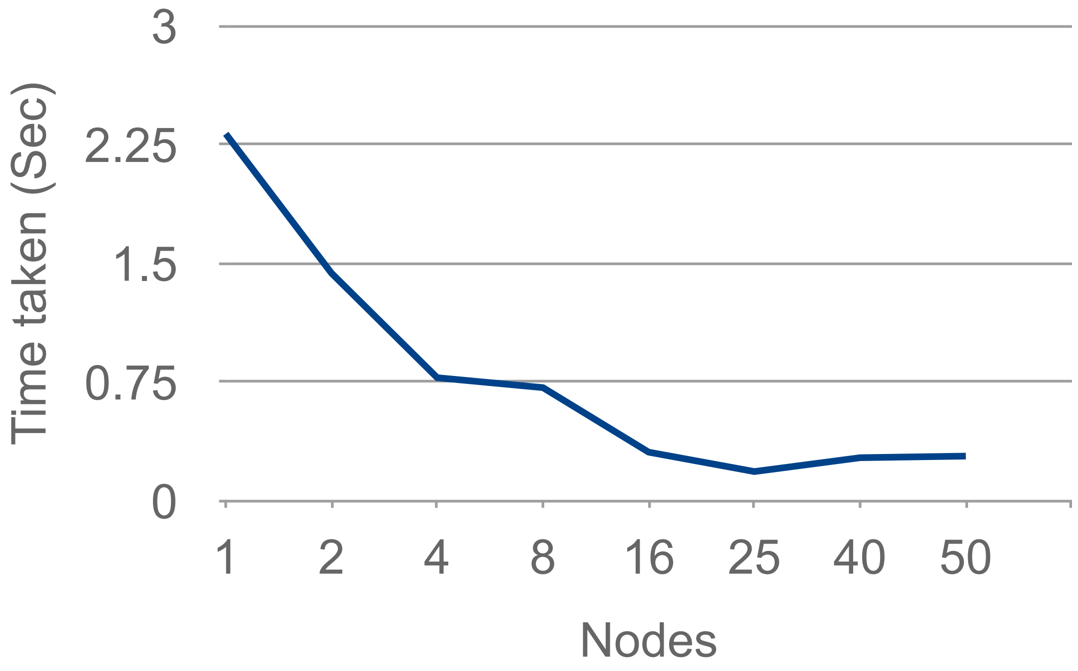
- Input graph: 10000 nodes (10% density)

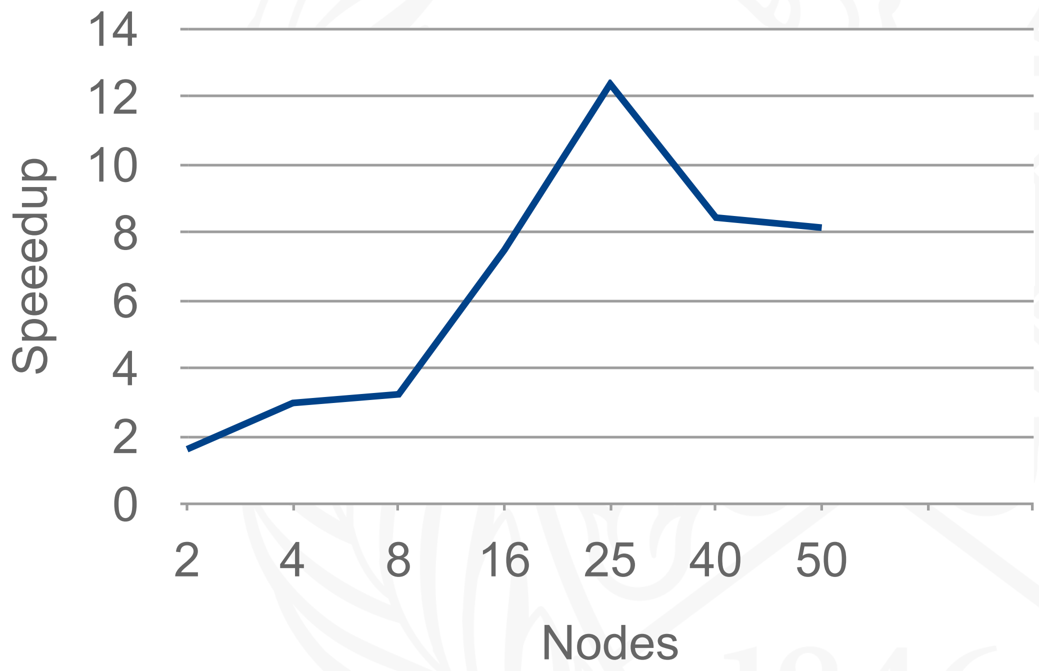


# Results

- Input graph: 10000 nodes (20% density)



# Observations

- This algorithm works best with larger datasets by gaining considerable speedups.
- Also, higher density graphs are better suited for this as we are using an adjacency matrix to store the graph.

# References

- Parallelization of Minimum Spanning Tree Algorithms Using Distributed Memory Architectures http://www.scl.rs/papers/Loncar-TET-Springer.pdf

# THANK YOU

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