COP5615 - PROJECT 2 (GOSSIP ALGORITHM) PROJECT REPORT

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Implementation:

Gossip Algorithm:

As per the project statement, a node is terminated (achieves convergence) when it receives a rumor 10 times. The node still continues transmitting but can no longer receive messages. The algorithm completes once all nodes achieve convergence. The start time, end time, and total time is taken to achieve convergence are calculated at this point.

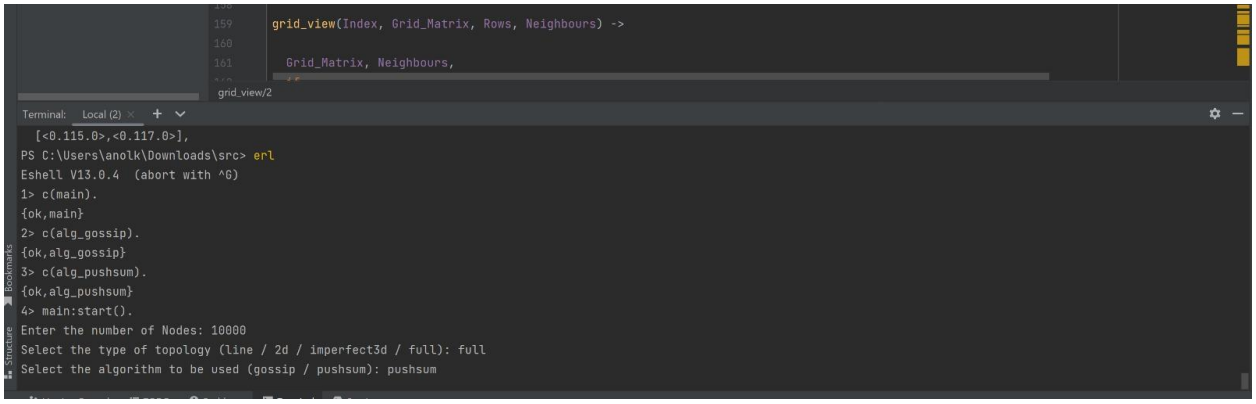
Push-Sum Algorithm:

In the push-sum implementation, every node has an index and a weight. The node achieves convergence when the ratio of the index to the weight (S/W) does not change by more than 10^{-10} for three consecutive messages received. The values of S and W are halved each time a message is sent. The network should be terminated once all nodes in it achieve convergence.

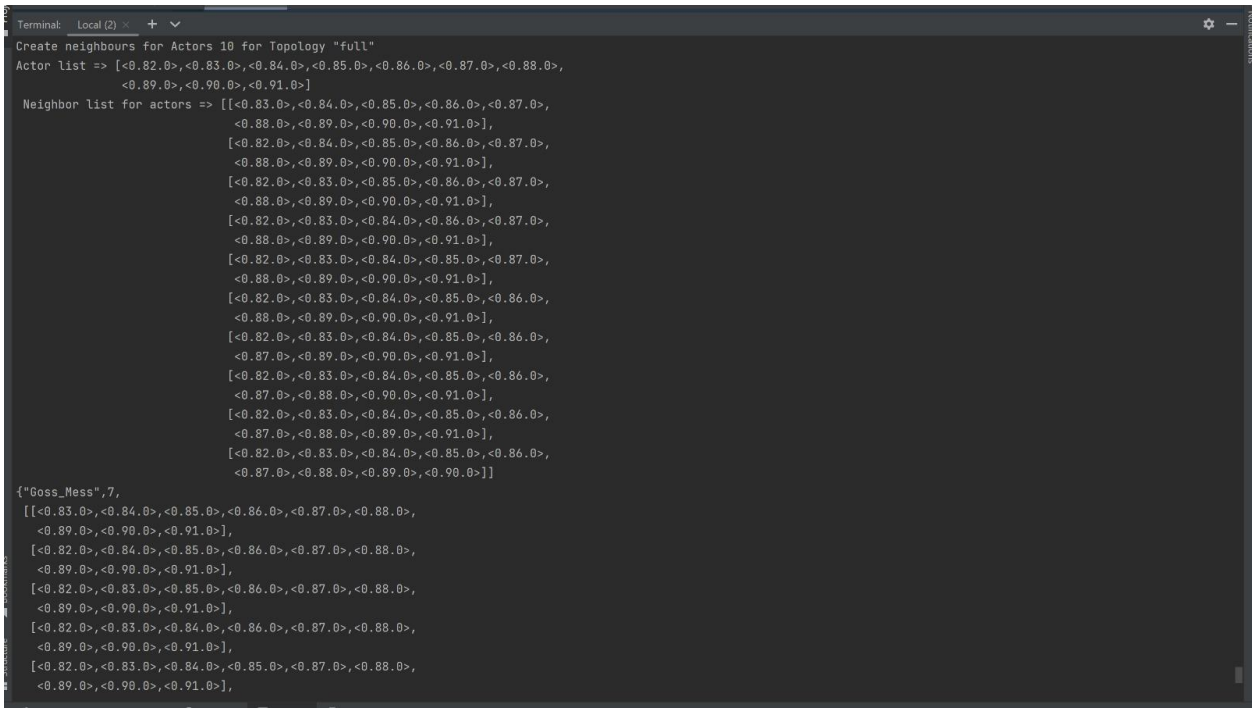
Topologies used:

Line: Actors are arranged in a line and each actor will have only two neighbors with the exception of the first and last actors.
Full Network: Every actor is a neighbor of all other actors.
2D Grid: The actors form a grid structure where each actor will have its adjacent and diagonal actors as its neighbors.
Imperfect 3D: It follows the 2D Grid pattern with the addition of one random neighbor to the list of neighbors for each actor.

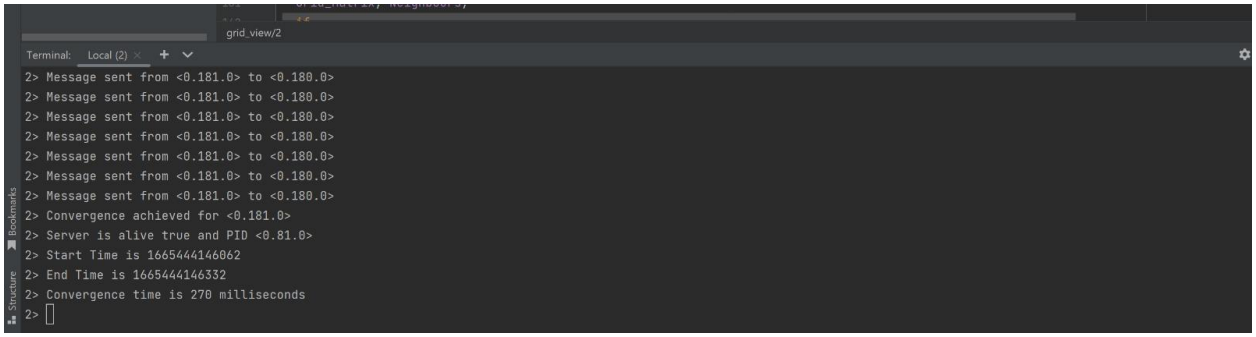
RESULT SCREENSHOTS



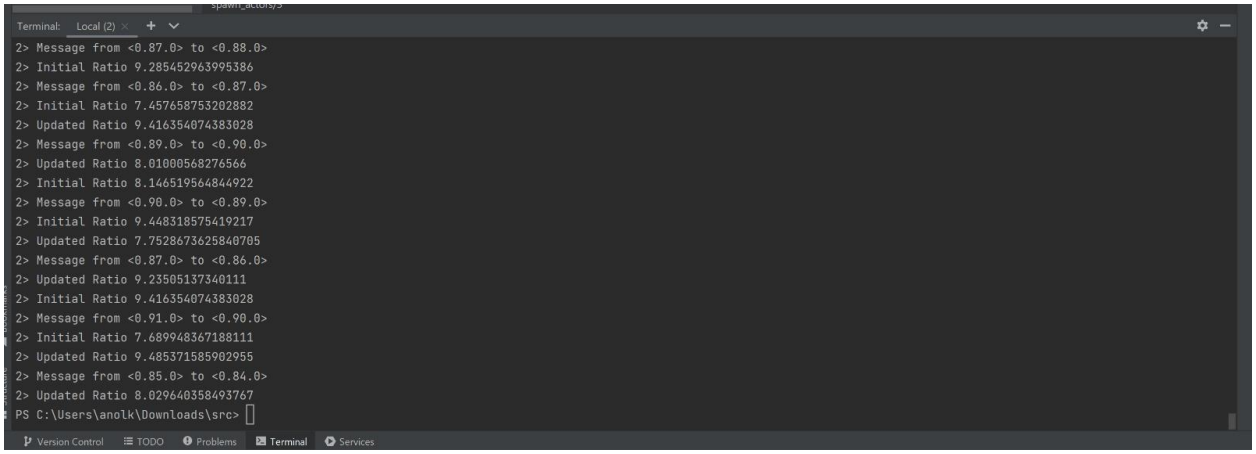
The above figure shows the input taken for the program(node count, topology and algorithm)



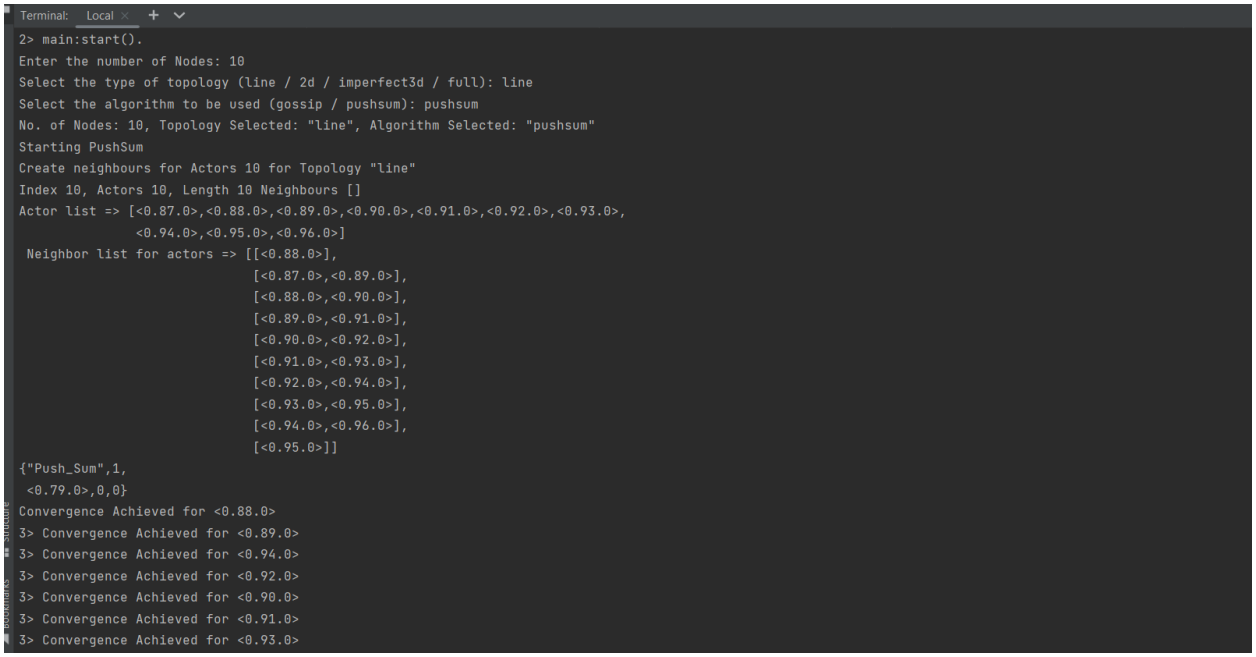
The above figure shows the neighbor list for a full topology



The above figure shows algorithm convergence



The above figure shows the ratio being updated for push-sum algorithm.



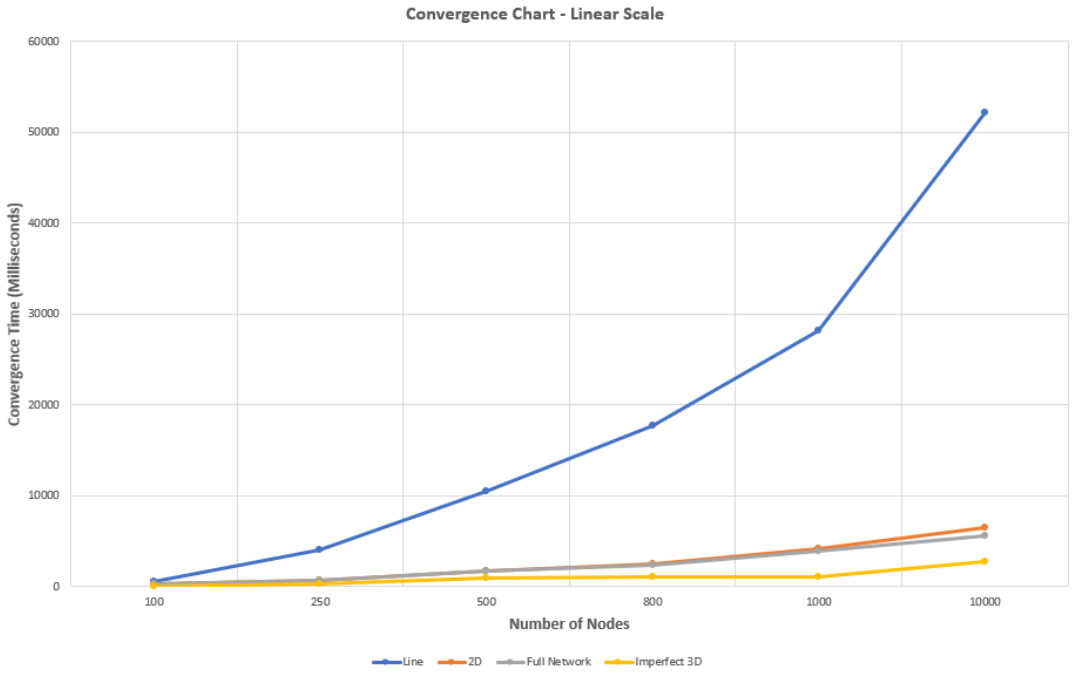
The above figure shows convergence in the push-sum algorithm

Largest Network:

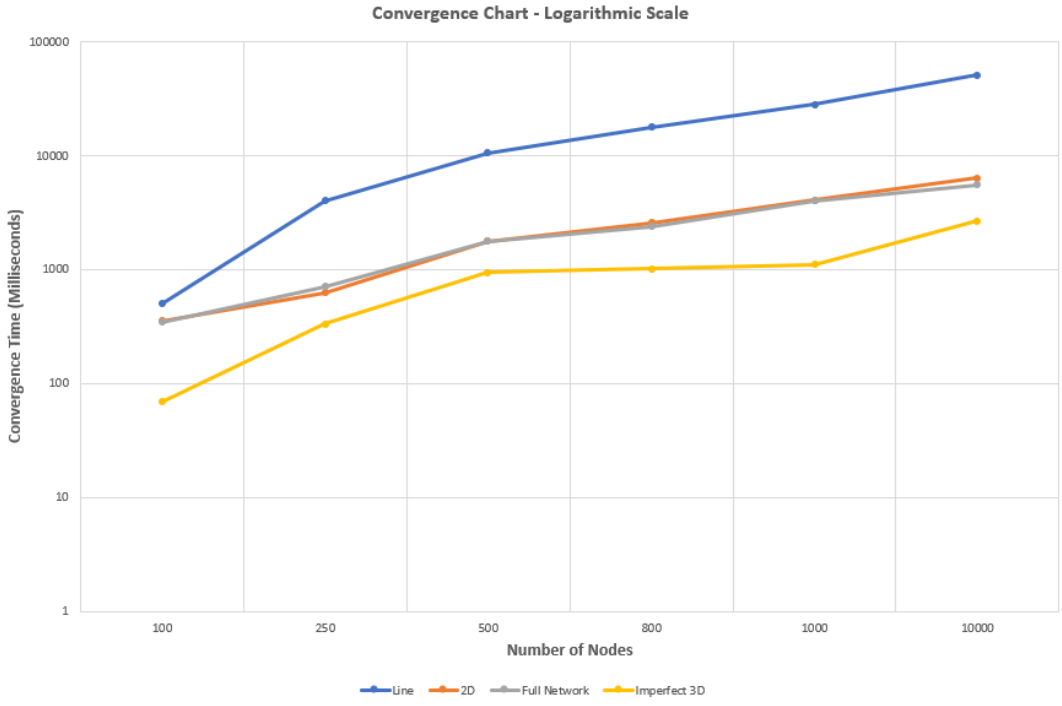
The largest network achieved was with 10000 nodes for all topologies with both algorithms.

Convergence Time vs Size of the Network Graphs:

Gossip Algorithm:

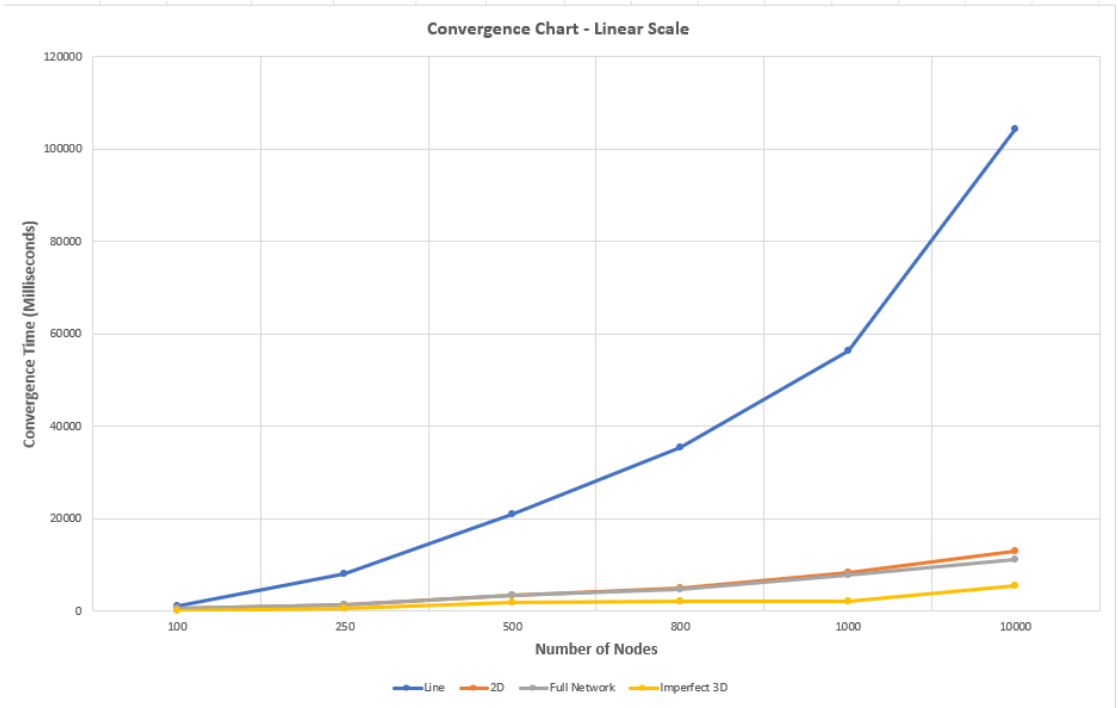


The graph above shows how the gossip algorithm's convergence times vary with the number of nodes for various topologies.

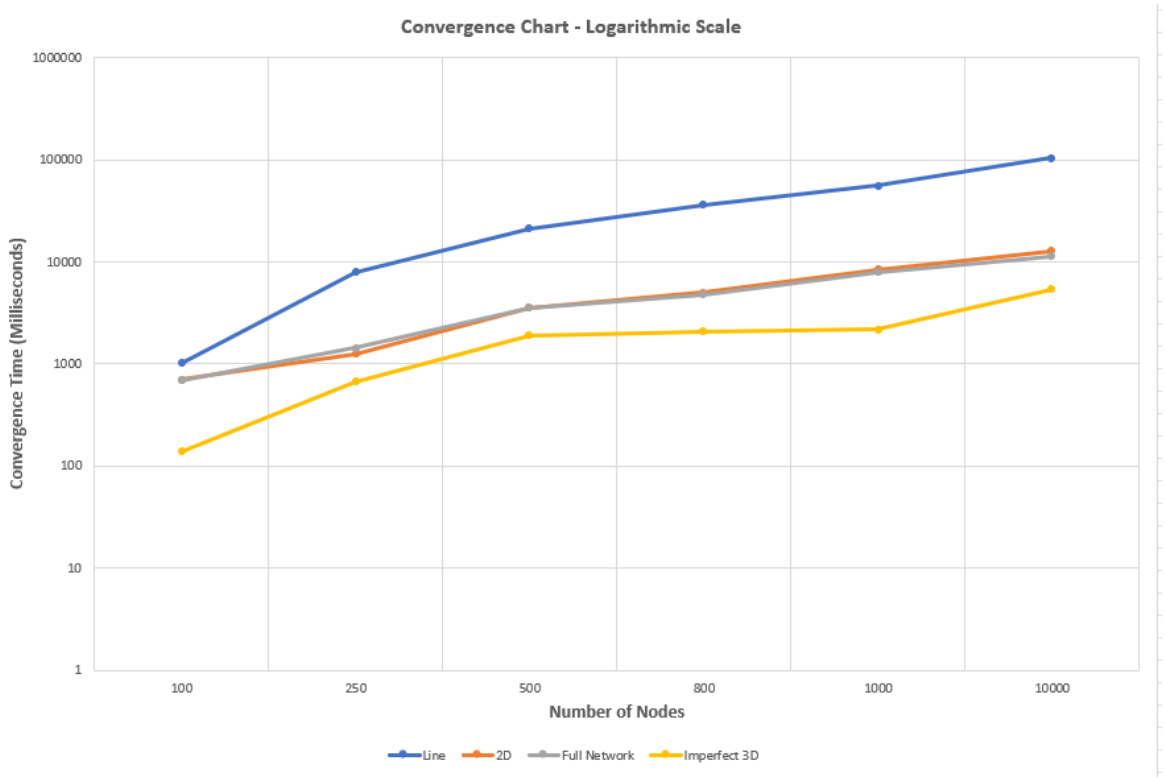


The above graph shows how the gossip algorithm's log of convergence times varies with the number of nodes for various topologies.

Push-Sum Algorithm:



The graph above shows how the push-sum algorithm's convergence times vary with the number of nodes for various topologies.



The above graph shows how the push-sum algorithm's log of convergence times varies with the number of nodes for various topologies.

Findings:

1. Imperfect 3D showed the fastest convergence. This could be because adding the random neighbor node adds an additional source of origin that starts transmitting messages creating new cluster origins so it ends up being faster than the 2d grid.
2. Line topology took the longest time to converge since each node can have a maximum of only 2 neighbors. Each node takes time to receive 10 messages in order to converge.
3. 2d grid topology does not create random origins and hence is comparatively slower than imperfect 3d. Full network topology was faster than the line topology since every node is connected to every neighbor.
4. The gossip algorithm reached convergence a lot faster than push-sum. This could be because 10^{-10} is a very small value and the updated weights took a long time to reach this value.
5. In case no neighbor is available to transmit (if all neighbors have reached convergence), a situation arises where one or more nodes will never attain convergence. This is avoided by ensuring that nodes that have already attained convergence continue transmitting till the algorithm is complete.
6. Both 2d and full network topologies showed almost identical convergence times despite full network nodes having more neighbors per node.