Project Report

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Group Members:

1. Raghav Ravishankar, UFID: 1995874, raghav29@ufl.edu
2. Suhas Kumar Bharadwaj, UFID: 16120229, suhaskb@ufl.edu

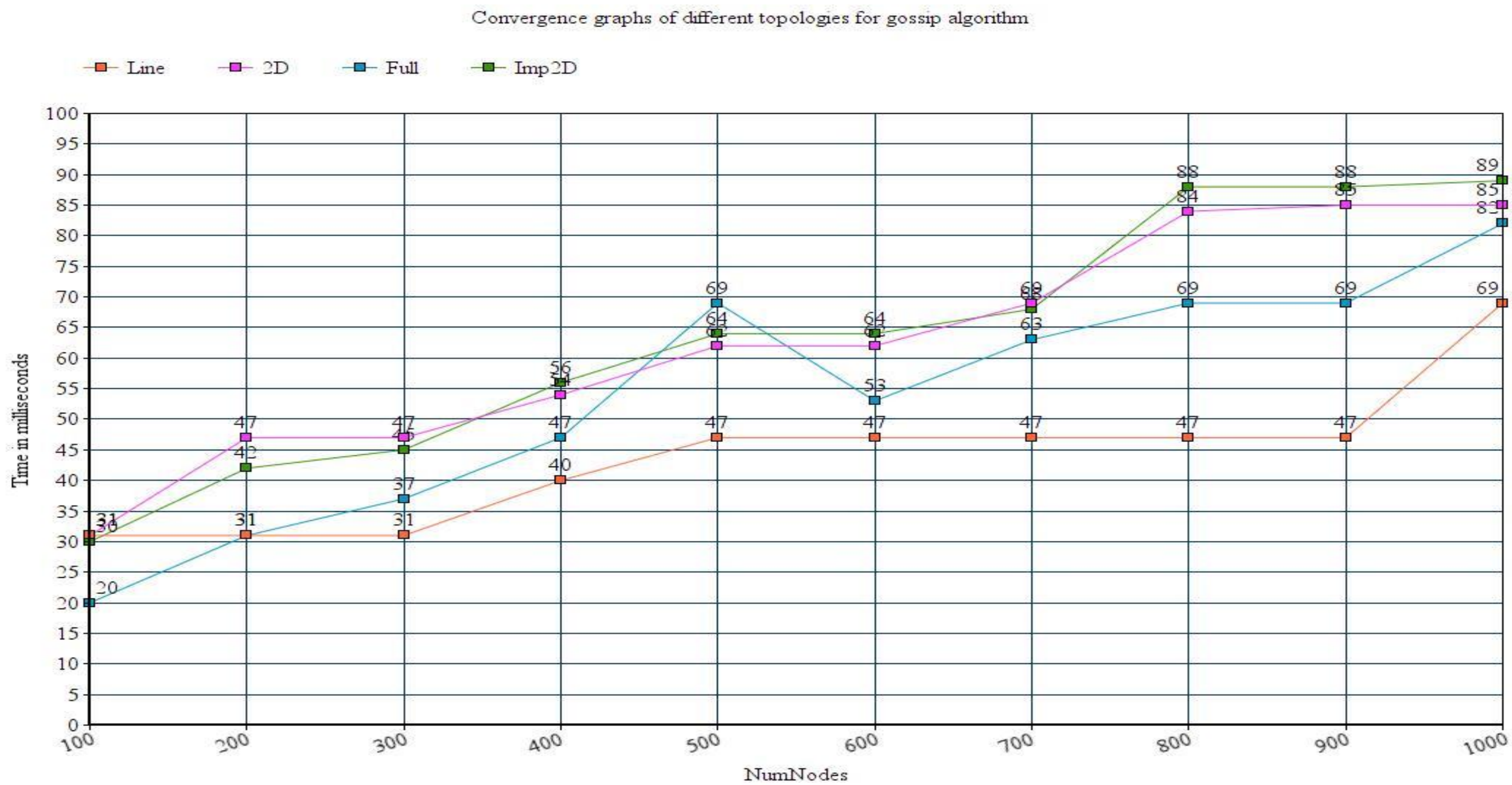
Implementation Details:

The assumption is that the convergence of the Gossip algorithm occurs when 90% of the nodes in the network have heard the rumor. We terminate the algorithm once the convergence has been achieved and measure the time taken for it to happen so. In our implementation we stop transmitting the rumor once a node has received a rumor 10 times.

The push-sum algorithm assumes that the convergence has been achieved once the average estimate (S/W value) does not change more than 10^{-10} when the message has been received in three consecutive rounds. We terminate the algorithm once all the nodes in the network achieve convergence.

This program takes as input, the number of Nodes, topology and the algorithm. Once the input is obtained, the server is initialized. If the number of nodes are not perfect squares for 2D and imperfect 2D, the nearest square is taken as input for the number of nodes. Depending on the algorithm, gossip and push-sum nodes are initialized with their respective information. All the nodes are then arranged according to their respective topologies and their neighbors are determined according to the project specification. Once the topologies are constructed, gossip begins. If the required topology is a full topology, if the number of nodes are greater than 2, a random number of iterations are chosen and random number of nodes are chosen for those many number of iterations and a rumor is sent to them else a single node is chosen randomly and a rumor is sent to the node. If the neighbor list has a single entity, the message is sent to the neighbor. If the neighbor list consists of 2 neighbors, it sends the rumor to both the neighbors. For all the other cases, random number of iterations are chosen between 3 and the length of the neighbor list and the rumors are sent to that many number of nodes.

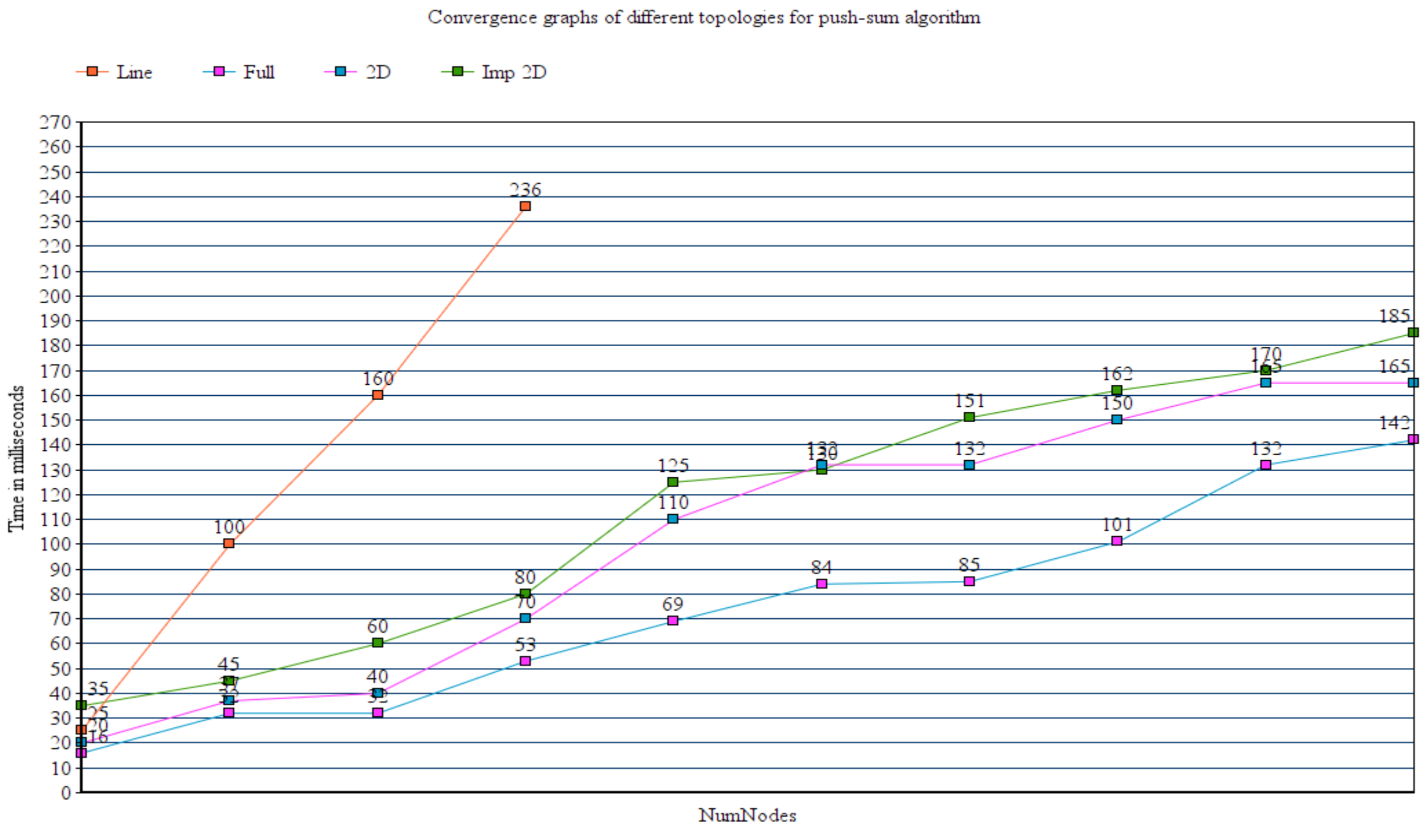
Gossip Protocol:



Graph plotting the convergence time vs size of the network for different topologies for the Gossip Protocol

The graph above plots the convergence time in milliseconds vs the size of the network (Number of Nodes) for all the topologies using the gossip algorithm.

<u>Push-sum Algorithm:</u>



Analysis:

Full topology has the maximum convergence time when compared to all the topologies. Even on smaller network sizes, the convergence time of the topology appears to increase exponentially with the number of nodes.

For both gossip and push-sum algorithms, the graphs show similar characteristics. This is because push-sum can be thought of as an extension of the gossip algorithm, where the nodes should receive multiple messages for convergence.

Observations:

When the push-sum algorithm was run for a large sized network of over 1 million nodes, the obtained values indicated that the computed average by the algorithm varied from the actual average by a significant factor.

For the line topology implementation, the rumor is being sent to both the neighbors to make sure that line topology converges.