Project 2: Gossip Protocol

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This report presents the convergence time analysis of Gossip and Push-Sum algorithms across various topologies. The experiments were conducted using a Gleam-based actor simulator.

Key Observations:

• Gossip converges quicker than Push-Sum for all the topologies that were tested.
• The convergence to the consensus is the fastest in the full topology because each node is able to communicate directly with every other node.
• Line topology is consistently the slowest due to its sequential neighbor communication.
• Imperfect 3D topology improves convergence compared to standard 3D by introducing a random neighbor.

Experimental Plots:

The following plots show convergence time vs. number of nodes for both algorithms.

Graph 1: Gossip Algorithm Convergence Time vs Network Size

The first graph shows convergence time for the Gossip algorithm across four topologies:
- Full Network (blue line): Fastest convergence, scales from 247ms to 472ms
- Imperfect 3D Grid (red line): Second best performance, scales from 387ms to 870ms
- 3D Grid (orange line): Moderate performance, scales from 517ms to 1390ms
- Line (green line): Slowest convergence, scales from 772ms to 2079ms
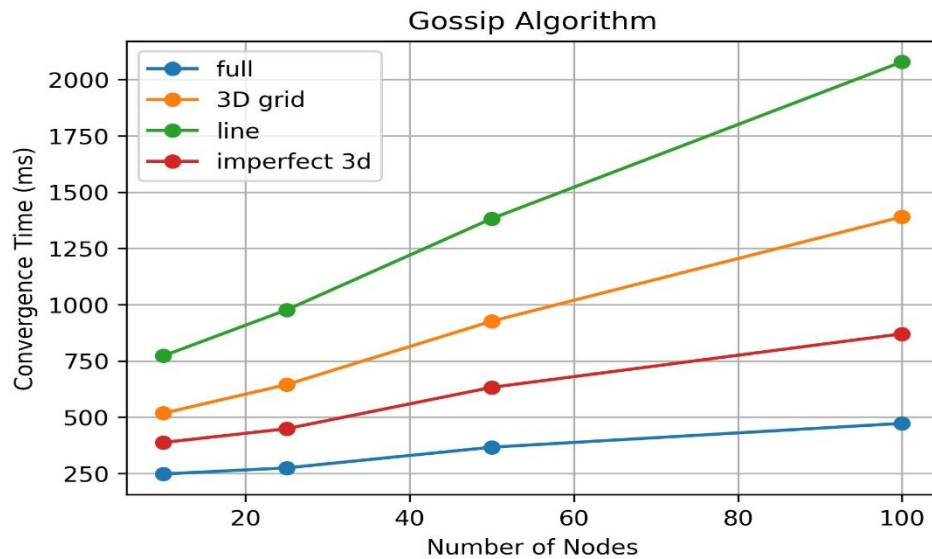
Graph 2: Push-Sum Algorithm Convergence Time vs Network Size
The second graph shows convergence time for the Push-Sum algorithm across the same topologies:

- Full Network (blue line): Best performance, scales from 508ms to 1282ms
- Imperfect 3D Grid (red line): Good performance, scales from 847ms to 1973ms
- 3D Grid (orange line): Moderate performance, scales from 1328ms to 3167ms
- Line (green line): Slowest performance, scales from 1919ms to 4671ms