

Distributed Operating System Principles

Gossip Simulator

Team 9

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What is working

The ability to execute various algorithms (line, full, 2D, Imp3D) in combination with either gossip or push-sum protocols is supported. In the gossip protocol, convergence occurs when all nodes have reached a state of convergence. A node is considered converged after receiving the message for the 10th time. Once converged, a node ceases to transmit the message to its neighbors. Upon achieving network-wide convergence, meaning all nodes have converged, the total convergence time is outputted.

How to run your program?

```
dotnet run <numNodes> <topology> <algorithm>
```

What is the largest network you managed to deal with for each type of topology and algorithm?

For Gossip Algorithm

Topology	Largest Network Size
Full	1500
2D	1500
Line	1500
Imperfect 3D	1500

For Pushsum Algorithm

Topology	Largest Network Size
Full	1500
2D	1500
Line	1500
Imperfect 3D	1500

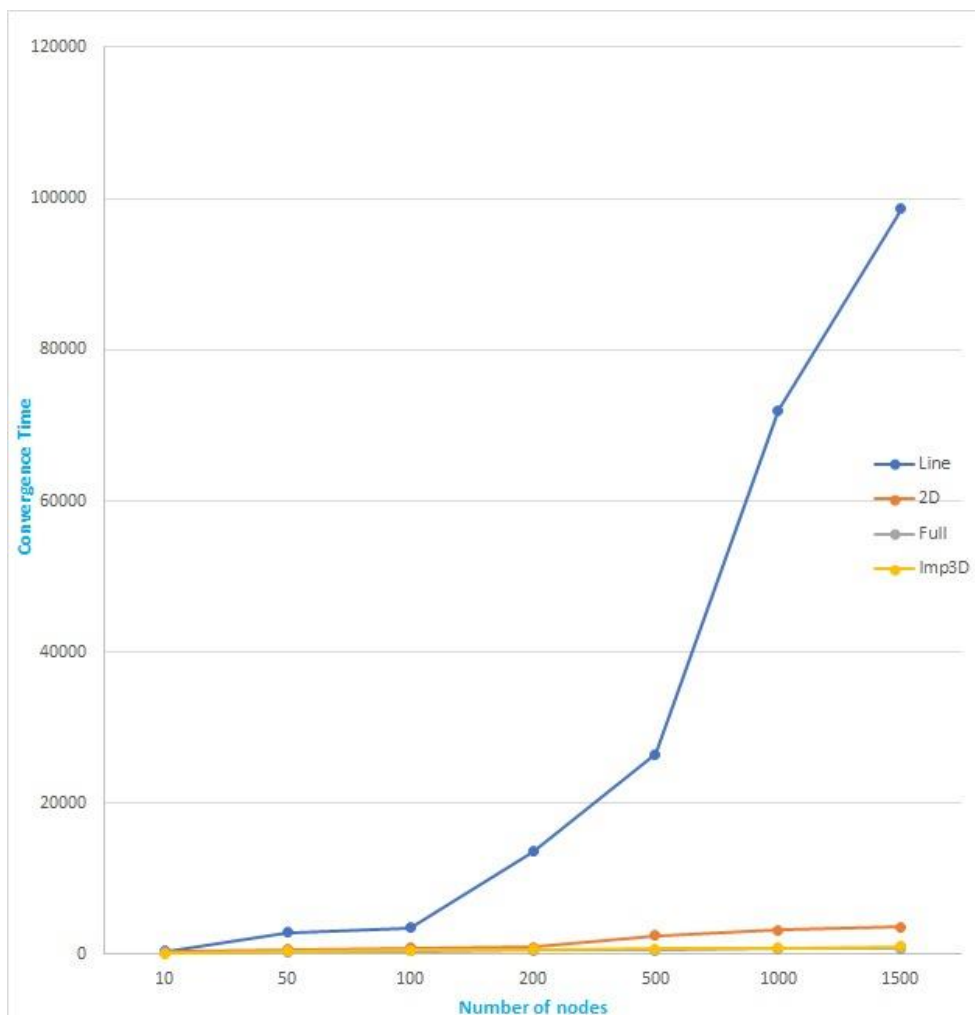
Gossip Algorithm

Since each node in the system only communicates with two neighbors, convergence in a line topology is slower and takes longer to reach a synchronized or converged state.

As anticipated, both 2D and imperfect 3D topologies demonstrate convergence times that fall between the line and full topologies. Imperfect 3D topology exhibits slightly better or equal performance compared to 2D topology.

During various runs, it was observed that not all nodes were reaching convergence; typically, the convergence rate of the topology ranged from 80% to 90%. This issue arises because the structure breaks during convergence, rendering some nodes unreachable. To address this challenge, a strategy was implemented to monitor nodes that haven't converged. A random non-converged node is selected, and messages are continuously sent until the entire topology achieves convergence.

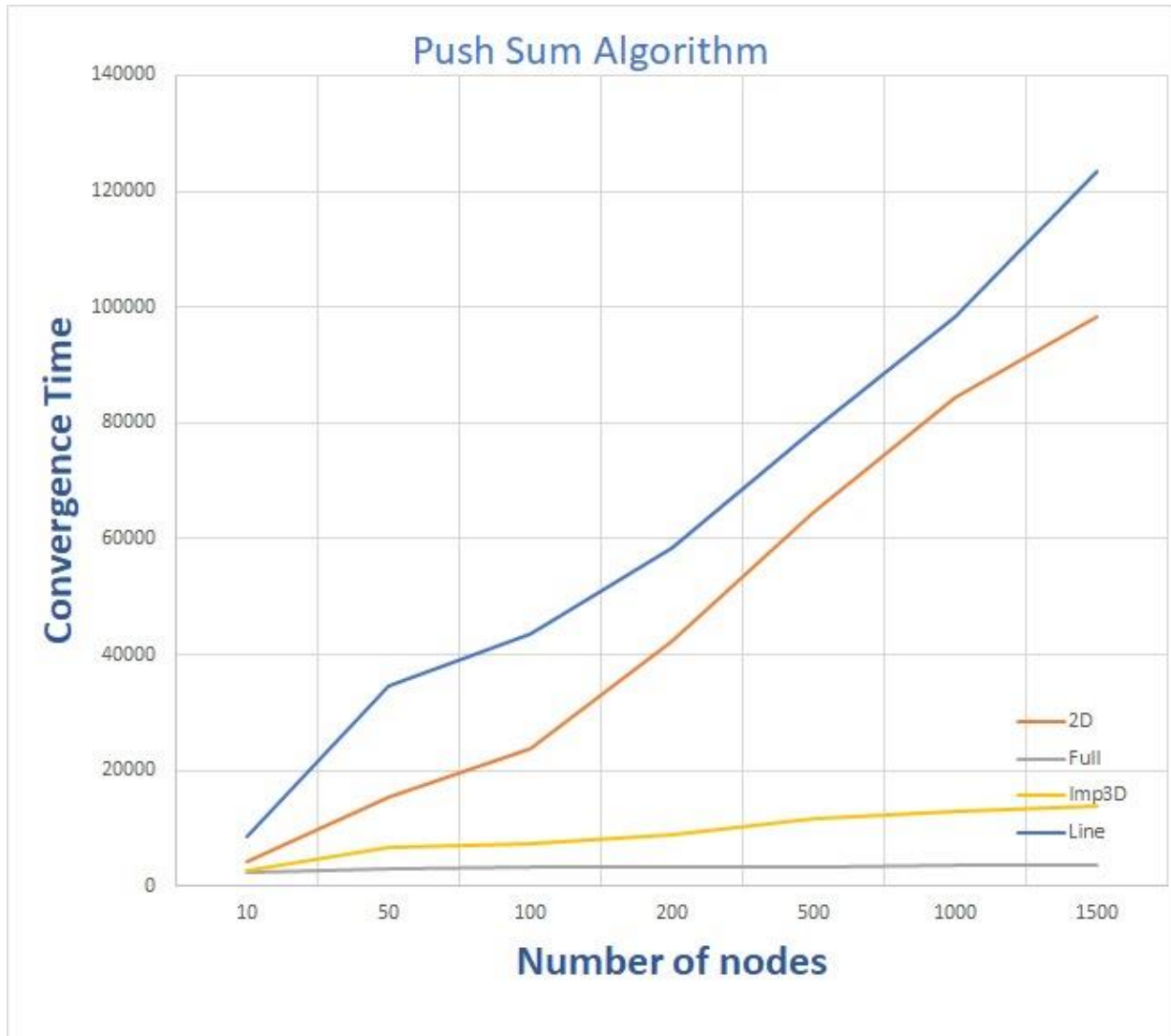
Convergence time as a function of the size of the network for Gossip Algorithm



PushSum Algorithm

The PushSum network operates by transmitting messages with parameters s and w to an actor. The initial value of s is set to the index of the actor, and w is initialized to 1. The propagation concludes when the s/w ratio of an actor remains unchanged for three consecutive iterations, indicating that it stays within the limit of 10^{-10} .

Convergence time as a function of the size of the network



Observations

The convergence rate was identical in both Gossip and Push-Sum algorithms, ranging from the fastest to the slowest

Full > Imp3D > 2D > Line

In any given situation, the full topology demonstrates the quickest convergence. This is attributed to its connectivity with all nodes, facilitating a faster attainment of convergence in this configuration.

It was observed that the number of nodes directly relates to the convergence speed of both algorithms. The software takes longer to converge as the number of nodes rises.