

# COP 5615 - Fall 2020

## Project 2 - Gossip Simulator

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### Introduction

The goal of this project is to implement gossip and push-sum algorithms for information propagation. These algorithms are implemented in different topologies like full, line, 2D and imp2D.

- The gossip algorithm works such that, we start by sending a rumour to one of the nodes in the network and that is when the rumour forwarding starts and the entire network receives the rumour by forwarding it. The convergence condition in our case is that every node will listen to a rumor at most 10 times and converge after that.
- For push-sum a pair( $s, w$ ) is the message that is passed around by nodes. Here,  $s$  = actor number and  $w = 1$  for each node. The point of convergence is met when the ratio  $s/w$  does not change more than  $10^{-10}$  three times in a row.

### Topologies

We are using 4 kinds of topologies for both of our algorithms which are as follows:

- Full: In this topology where each node is connected to every other node in the network
- Line: Here each node is connected to two nodes, one on the right and the other on the left except the first and the last nodes. Represents a line drawn through a number of points.
- 2D: This topology resembles a 2D matrix where the nodes are arranged in rows and columns.
- Imp2D: In Imp2D each node is arranged in the same fashion as 2D but here there is an advantage of an extra random neighbor other than the matrix neighbors.

### Results

For both the Gossip and Push-sum algorithms, the topologies have similarities wrt the time taken by the topology to converge all the nodes.

The time taken by topologies is in the following order  $\text{full} < \text{imp2d} < \text{2d} < \text{line}$ .

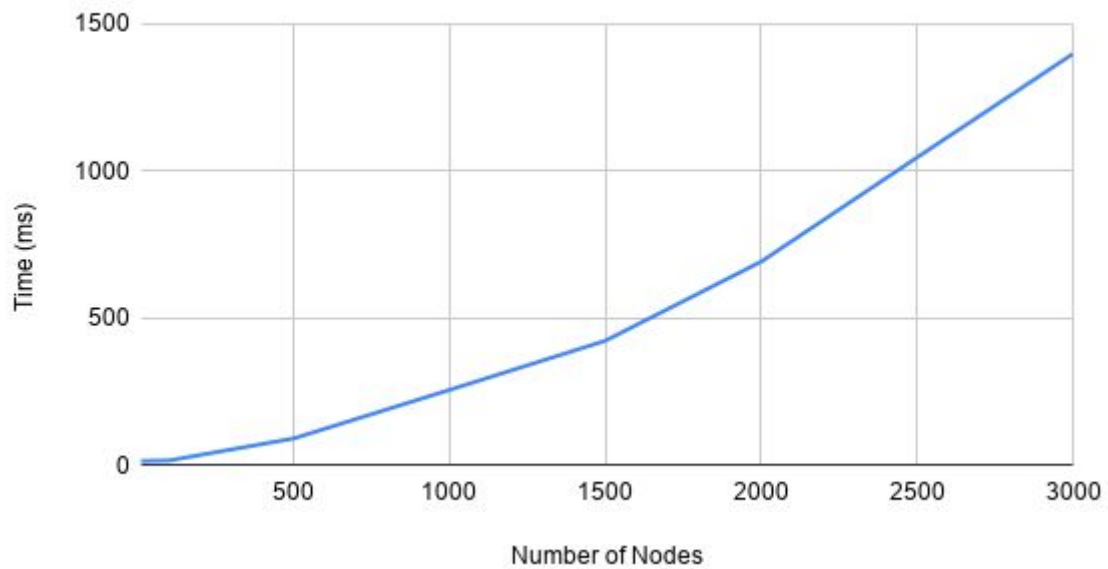
There are instances where imp2D and full have the same time but that depends on the number of processes currently running. In ideal conditions where the CPU is not involved in a large number of tasks, the full topology will take less time than imp2D.

Line topology is very time consuming for both pushsum and gossip algorithms. It takes a large amount of time for nodes in line topology to converge

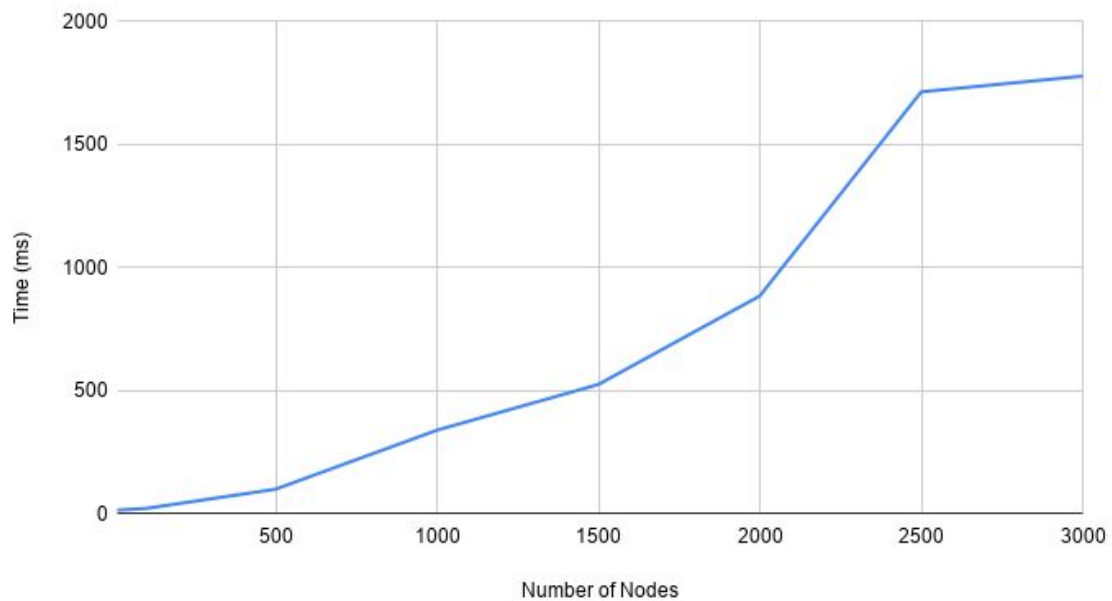
The number of nodes vs time taken is plotted for all topologies for both the algorithms

Following are the plots for Gossip algorithm and all the topologies:

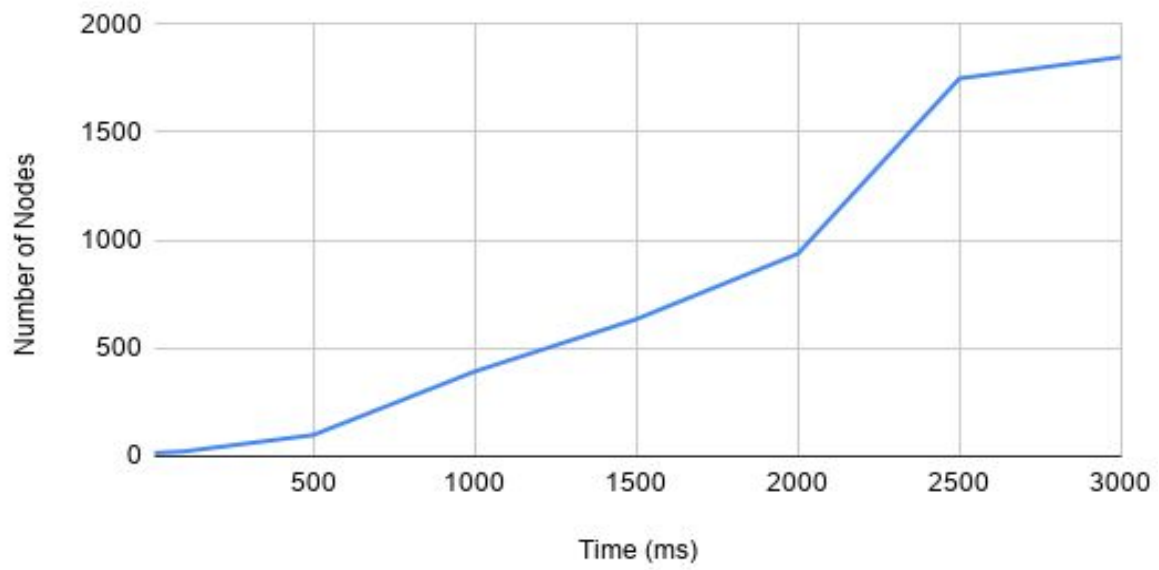
Gossip for Full



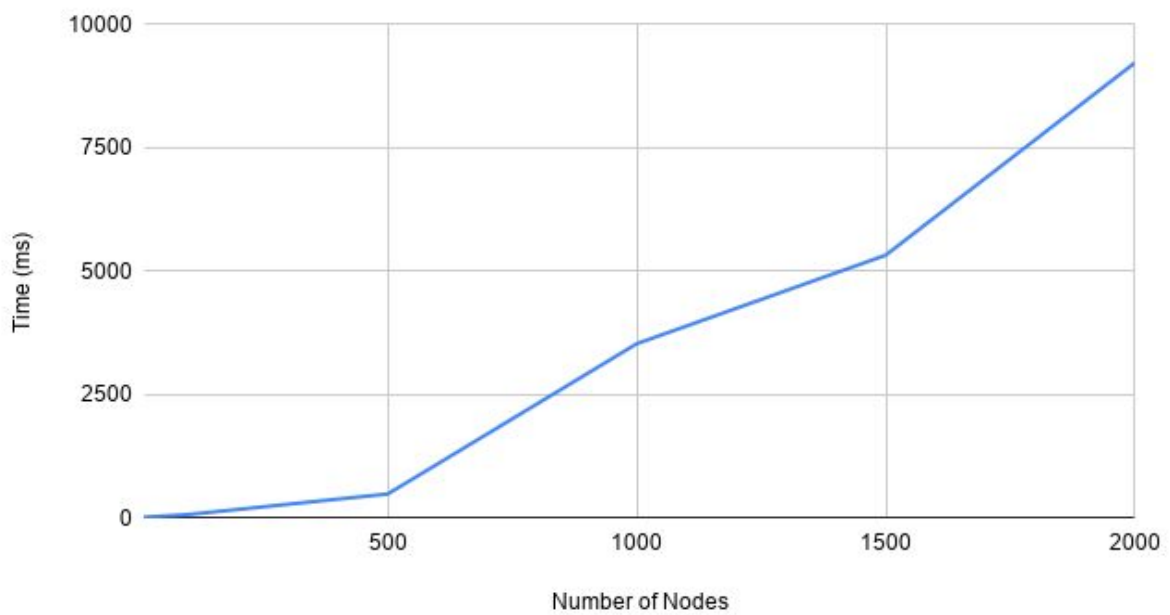
Gossip for Imp2d



## Gossip for 2D



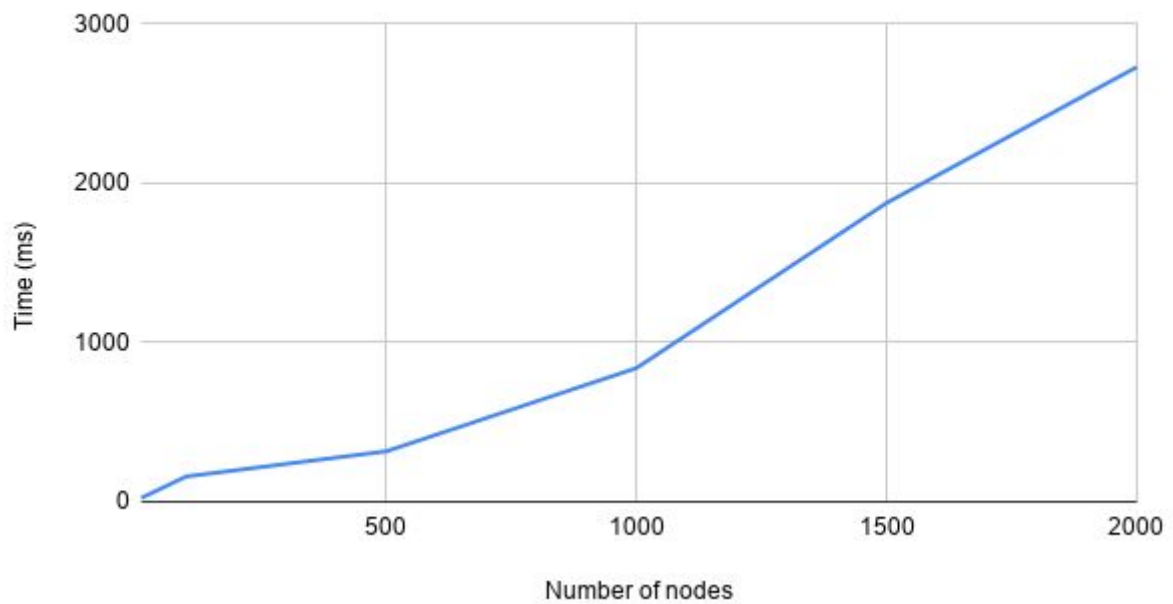
## Gossip for line



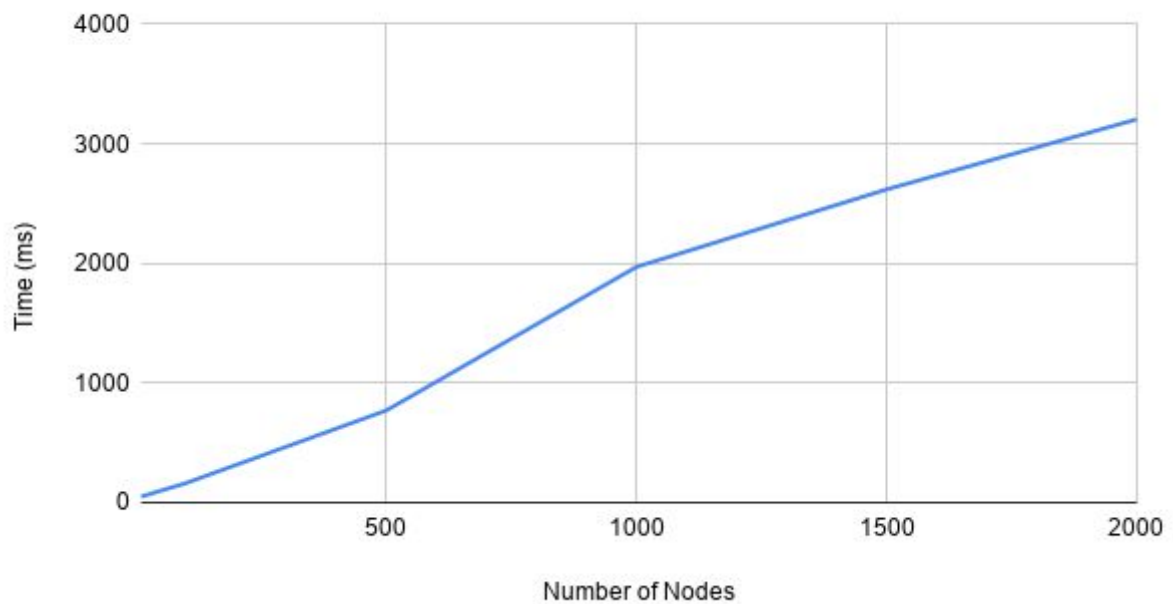
As we can see here, full < Imp2D < 2D < line

The plots for Push-sum algorithm for all the topologies are shown below:

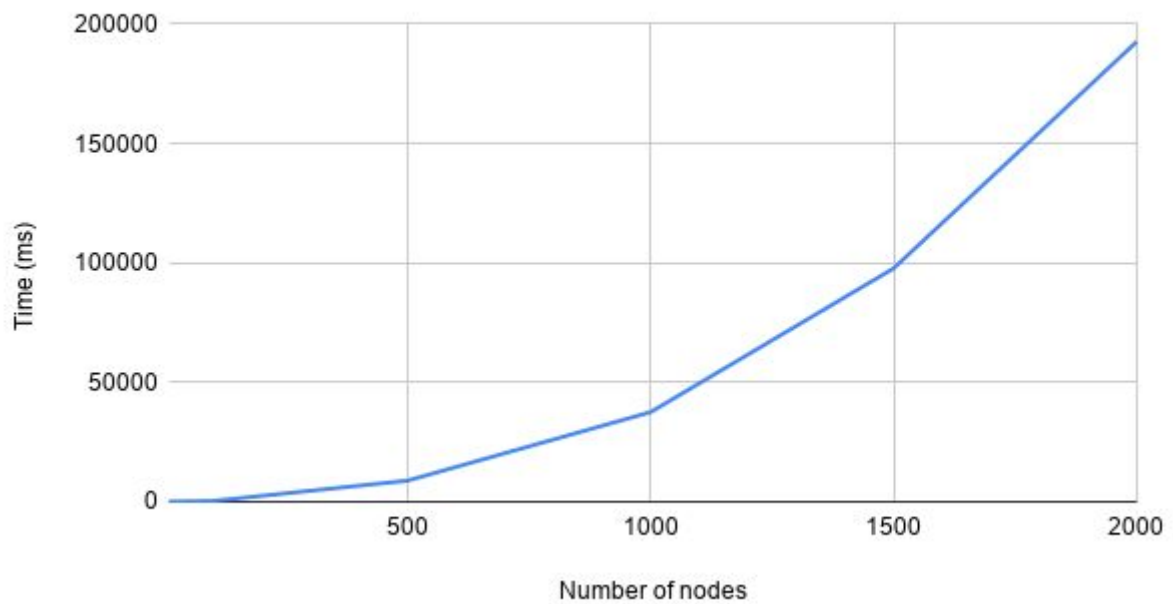
Push-sum for Full



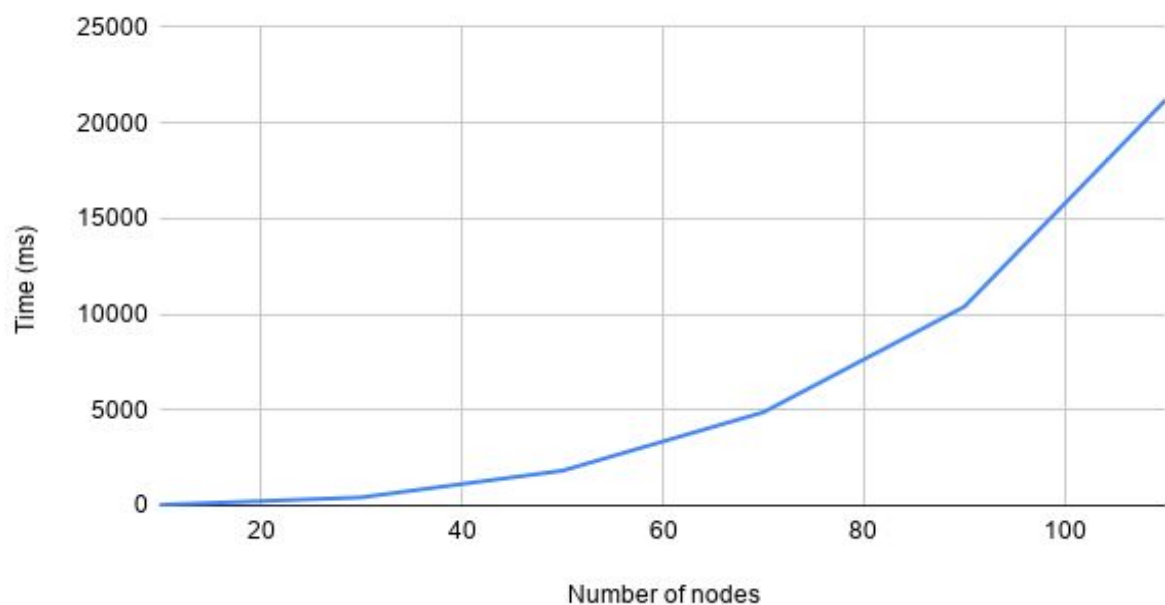
Push-sum for Imp2D



## 2Dps



## Push-sum for Line



As we see here again time for  $\text{full} < \text{imp2d} < 2d < \text{line}$

While experimenting, we found out that when the system was under load, nodes in the imp2D network would take less time to converge compared to the full network.

The most number of nodes for line topology that we could achieve a convergence for is 110. Something to be noted is that the gossip algorithm takes less time in order for all nodes to converge. On the other hand, in push-sum, the nodes take relatively more time since the

sum has to travel from one end of the network to another end which is not possible when the network is too large.

The maximum number of nodes will always vary from system to system which in our case was 10K. Also the maximum number of nodes also vary with respect to the topology and the algorithm.

Line topology is the slowest to converge because there aren't enough neighbors to propagate rumors with high frequency.