Distributed Operating System Principles (COP5615): Project - 2

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Problem Statement:

Algorithms of the gossip kind can be utilized for both group communication and aggregate computing. This project's objective is to use a simulator built on F# actors to determine the convergence of such algorithms. Because actors in F# are entirely asynchronous, the Asynchronous Gossip is used.

System Prerequisites:

- Installed the.NET SDK
- Multicore System
- Installed the F# language server for.NET
- If you're using Visual Studio Code, use the Ionide extension for F Sharp.

How to Run?
The zip file contains the following:

- **ReadMe file**
- **Gossip.fsx**

In order to execute in terminal or cmd use the following command
dotnet fsi gossip.fsx <nodeNum> <topology> <protocol>
Here, nodeNum - number of nodes
Topology - line/ full/3D / imp3D
Protocol - push-sum / gossip
Example:
Dotnet fsi gossip.fsx 1000 imp3D gossip

What is Working?

- We can use any combination of gossip and push-sum protocol with all line, full, 3D, and Imp3D. When all of the nodes in the Gossip protocol have converged, the protocol is said to be converged.
- When a node listens to the message for the tenth time, it is considered converged.
- The node stops relaying the message to its neighbor after convergence.
- The total time for convergence is reported once the network has converged, i.e., all nodes have converged.

- **Observation:** When compared to gossip, push-sum took significantly longer to converge since the sum from one end of the network had to reach the other end of the network, which was not always possible.

The Gossip Algorithm Involves the following:

- A participant(actor) it told/sent a rumor(fact) by the main process
- Each actor chooses a random neighbor to inform about the rumor
- Each actor keeps note of rumors and the number of times they've heard them. Once it has heard the rumor ten times, it stops disseminating.

Nodes	Line	Full	3D	Imp3D
100	66.25	16.25	20.4	18.08
200	258.75	25	25.2	31.64
300	478.75	57.5	103.2	57.63
400	622.5	61.25	110.4	100.57
500	605	77.5	114	110.74
600	896.25	77.5	116.4	123.17
700	1682.5	86.25	147.6	132.21
800	1706.25	78.75	177.6	158.2
900	4722.5	105	200.4	201.14
1000	9088.75	120	278.4	193.23

Figure 1: Tabular Data of Gossip Protocol

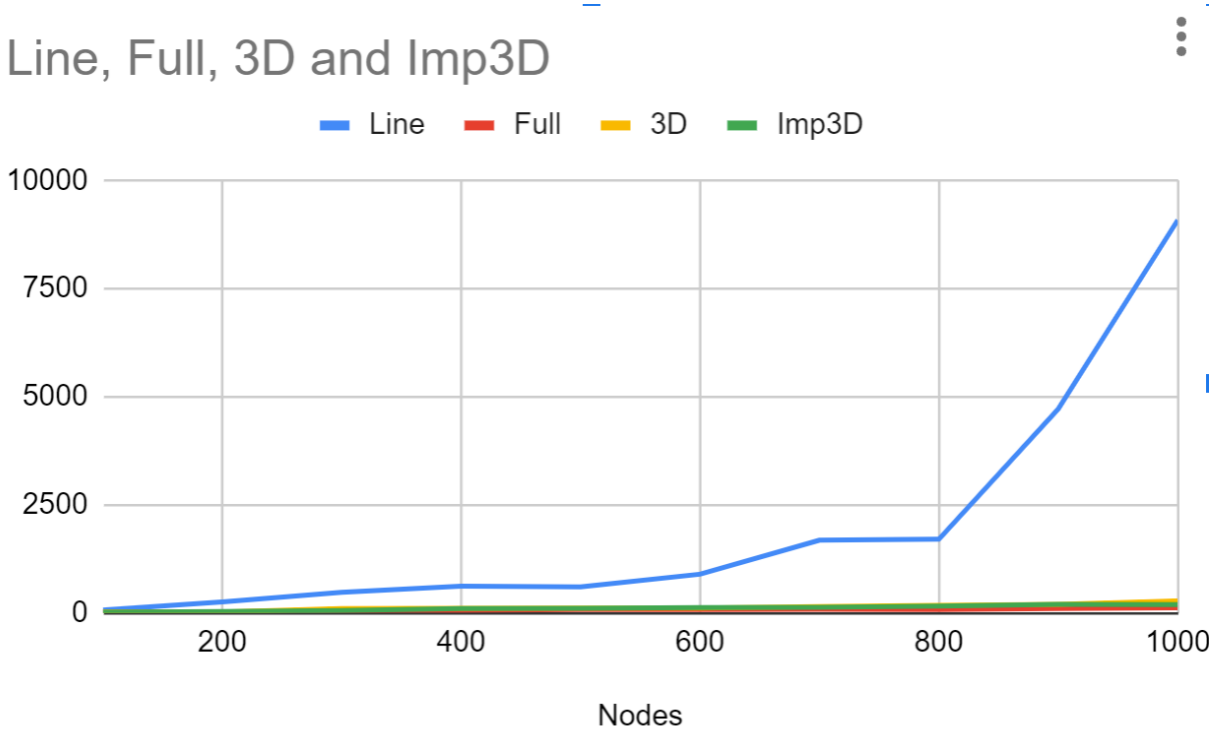

Figure 2: Line Graph for Gossip Protocol

Number of Node	Full	3D	Imp3D	Line
100	31.5	110.4	44.88	978.48
200	55.5	315.6	98.94	4450.68
300	105	516	238.68	10749.24
400	115.5	883.2	281.52	10695.24
500	147	1171.2	243.78	19828.8
600	169.5	1510.8	421.26	24973.92
700	202.5	1893.6	355.98	29792.88
800	235.5	2160	425.34	51598.08
900	264	2236.8	455.94	35184.24
1000	358.5	2672.4	545.7	39508.56

Figure 3: Tabular Data of Push-Sum

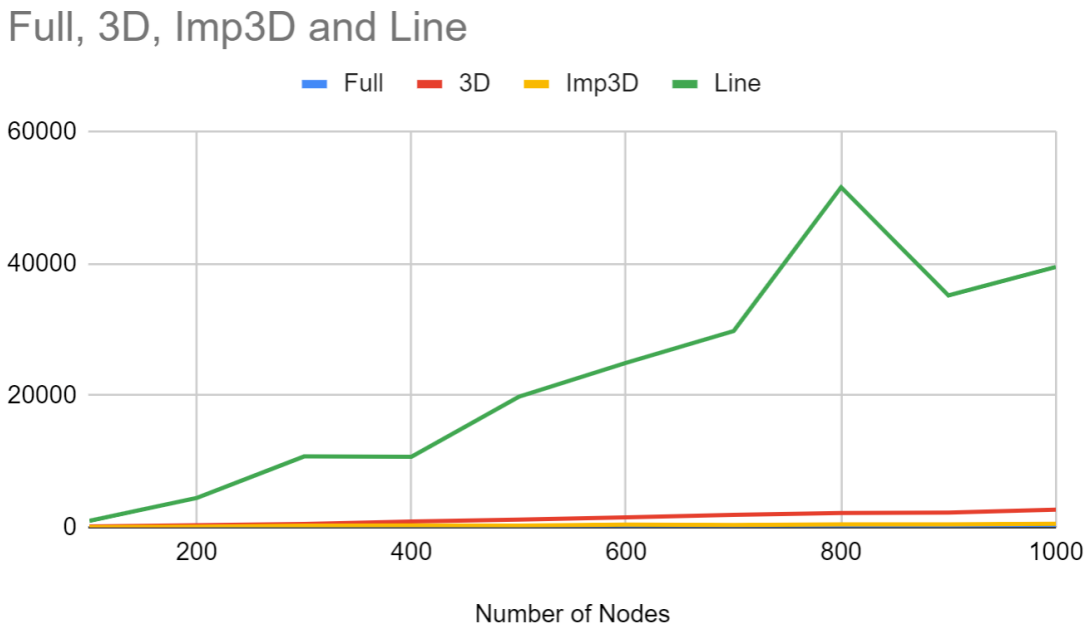

Figure 4: Line Graph for Push-Sum

Observations:

- **Full Topology** is the fastest convergence rate in both cases (Push-Sum and Gossip).
- **Line Topology** as expected took a longer time than other topologies with an average of O(N^2)
- **3D and Imperfect 3D** are faster then linear and but slower then full topology. Thus, we can say that more the number on neighbours the faster the convergence rate.

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

- For each topology and technique, the largest network that we have been able to solve is 15k nodes.

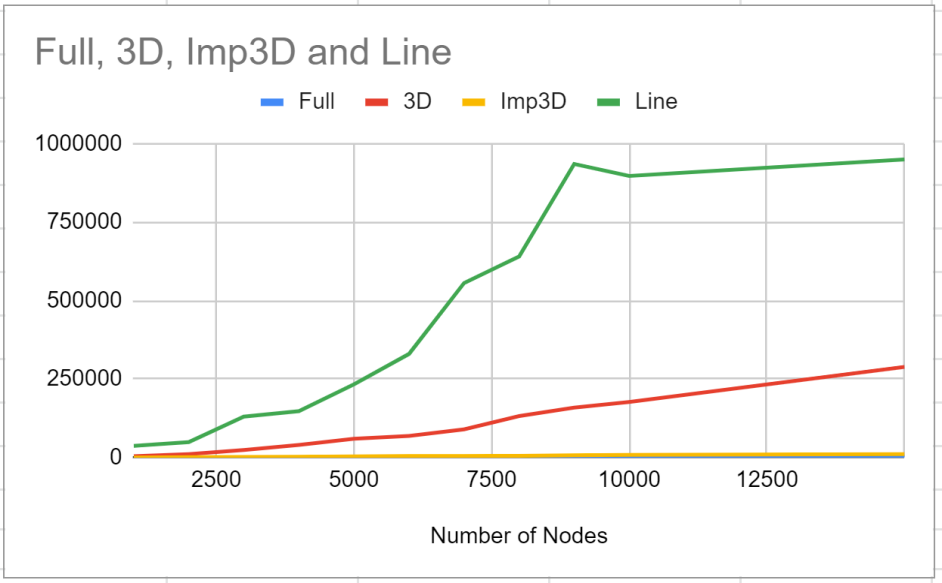

Figure 5: Push-Sum in 1000's

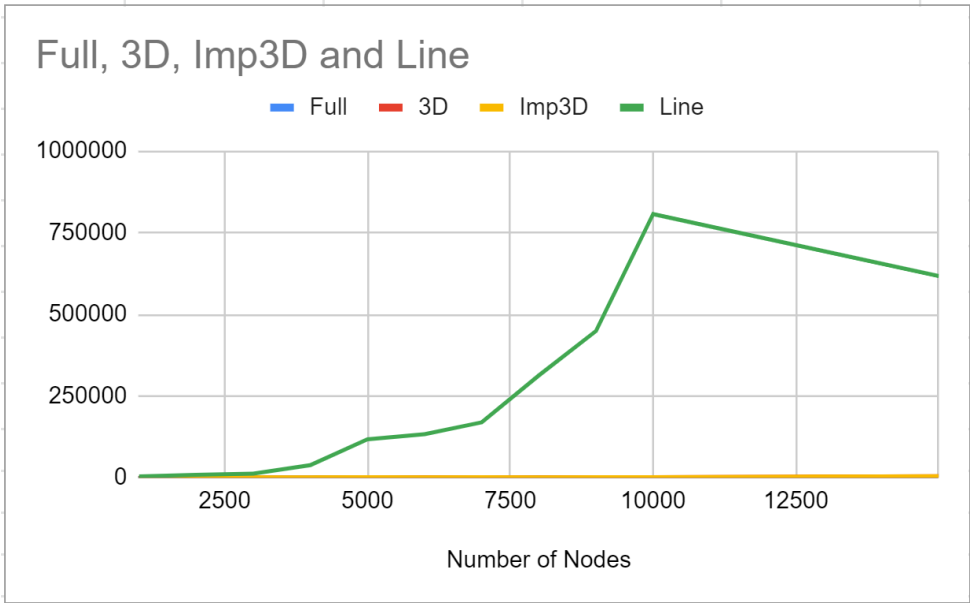

Figure 6: Gossip Protocol in 1000's