

Distributed Operating Systems Principles - Gossip and Push Sum

Team Members:

- Simran Sunil Kukreja (UFID: 72070369, s.kukreja@ufl.edu)
- Rachana Nitinkumar Gugale (UFID: 63532454, rgugale@ufl.edu)

Execution Steps:

- Navigate to the program folder i.e., Project2
- .beam files have been attached in the Project2 folder [To compile, execute c(filename). in the erl shell]
- To run the program, use the command:
`main:start(NumOfNodes,"Topology","Algorithm").`
["Topology" can be provided as "Line", "Full", "2D", or "3D"; "Algorithm" can be provided as "Gossip" or "PushSum"]

Note: For constructing the 2D Grid topology, we are rounding the square root value obtained to a perfect square and constructing a 2D Grid out of the perfect square number of nodes.

What is working:

- Gossip and Push Sum algorithms have been implemented for Line, Full Network, 2D, and Imperfect 3D topologies.
- We have used the Erlang actor model to implement the algorithms and are analyzing their convergence times.

Interesting Observations:

- We noticed the following order of the convergence times with respect to the size of the network: Full Network < Imperfect 3D < 2D < Line
- Hence, for both the algorithms, Gossip, and Push Sum, Full Network topology had the best convergence time, and Line Topology had the worst convergence time.

Largest network size considered for Gossip:

Full Network	3000
Imperfect 3D	1000
2D	1000
Line	600

Largest network size considered for Push Sum:

Full Network	1000
Imperfect 3D	800
2D	800
Line	300

Gossip Execution results:

For 500 Nodes, the Full Network Topology converged as shown in the following screenshot.

```
<0.4703.0> received rumour "Full_Rumor"
<0.4430.0> received rumour "Full_Rumor"
<0.4845.0> received rumour "Full_Rumor"
<0.4632.0> received rumour "Full_Rumor"
<0.4514.0> received rumour "Full_Rumor"
<0.4616.0> received rumour "Full_Rumor"
<0.4395.0> received rumour "Full_Rumor"
<0.4869.0> received rumour "Full_Rumor"
<0.4617.0> received rumour "Full_Rumor"
<0.4670.0> received rumour "Full_Rumor"
<0.4677.0> received rumour "Full_Rumor"
<0.4449.0> received rumour "Full_Rumor"
<0.4746.0> received rumour "Full_Rumor"
<0.4841.0> received rumour "Full_Rumor"
<0.4742.0> received rumour "Full_Rumor"
<0.4446.0> received rumour "Full_Rumor"
<0.4876.0> received rumour "Full_Rumor"
<0.4719.0> received rumour "Full_Rumor"
<0.4729.0> received rumour "Full_Rumor"
<0.4611.0> received rumour "Full_Rumor"
<0.4634.0> received rumour "Full_Rumor"
<0.4403.0> received rumour "Full_Rumor"
<0.4846.0> received rumour "Full_Rumor"
<0.4649.0> received rumour "Full_Rumor"
<0.4680.0> received rumour "Full_Rumor"
<0.4601.0> received rumour "Full_Rumor"
<0.4503.0> received rumour "Full_Rumor"
<0.4417.0> received rumour "Full_Rumor"
<0.4563.0> received rumour "Full_Rumor"
<0.4457.0> received rumour "Full_Rumor"
<0.4795.0> received rumour "Full_Rumor"
<0.4680.0> received rumour "Full_Rumor"
<0.4387.0> received rumour "Full_Rumor"
<0.4583.0> received rumour "Full_Rumor"
<0.4768.0> received rumour "Full_Rumor"

Convergence Time: 33330
```

Ln 56, Col 31 Spaces: 4 UTF-8 LF Erlang ⌂ ⌂

For 500 Nodes, the Imperfect 3D Grid Topology converged as shown in the following screenshot.

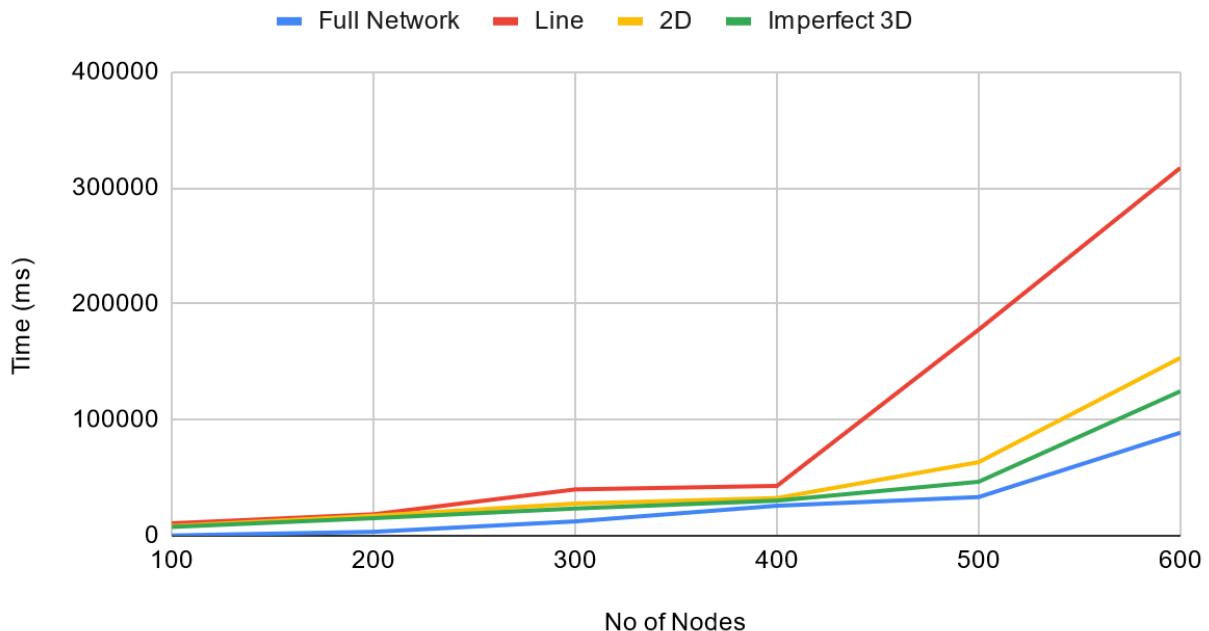
```
<0.3648.0> received rumour "Imp_3D_Rumor"
<0.3640.0> received rumour "Imp_3D_Rumor"
<0.3714.0> received rumour "Imp_3D_Rumor"
<0.3722.0> received rumour "Imp_3D_Rumor"
<0.3578.0> received rumour "Imp_3D_Rumor"
<0.3514.0> received rumour "Imp_3D_Rumor"
<0.3450.0> received rumour "Imp_3D_Rumor"
<0.3613.0> received rumour "Imp_3D_Rumor"
<0.3549.0> received rumour "Imp_3D_Rumor"
<0.3548.0> received rumour "Imp_3D_Rumor"
<0.3540.0> received rumour "Imp_3D_Rumor"
<0.3532.0> received rumour "Imp_3D_Rumor"
<0.3531.0> received rumour "Imp_3D_Rumor"
<0.3539.0> received rumour "Imp_3D_Rumor"
<0.3617.0> received rumour "Imp_3D_Rumor"
<0.3625.0> received rumour "Imp_3D_Rumor"
<0.3633.0> received rumour "Imp_3D_Rumor"
<0.3448.0> received rumour "Imp_3D_Rumor"
<0.3447.0> received rumour "Imp_3D_Rumor"
<0.3446.0> received rumour "Imp_3D_Rumor"
<0.3447.0> received rumour "Imp_3D_Rumor"
<0.3842.0> received rumour "Imp_3D_Rumor"
<0.3651.0> received rumour "Imp_3D_Rumor"
<0.3441.0> received rumour "Imp_3D_Rumor"
<0.3449.0> received rumour "Imp_3D_Rumor"
<0.3441.0> received rumour "Imp_3D_Rumor"
<0.3433.0> received rumour "Imp_3D_Rumor"
<0.3502.0> received rumour "Imp_3D_Rumor"
<0.3503.0> received rumour "Imp_3D_Rumor"
<0.3567.0> received rumour "Imp_3D_Rumor"
<0.3793.0> received rumour "Imp_3D_Rumor"
<0.3450.0> received rumour "Imp_3D_Rumor"
<0.3613.0> received rumour "Imp_3D_Rumor"
<0.3677.0> received rumour "Imp_3D_Rumor"
<0.3613.0> received rumour "Imp_3D_Rumor"

Convergence Time: 46526
```

Ln 56, Col 31 Spaces: 4 UTF-8 LF Erlang ⌂ ⌂

Gossip Convergence Graph:

Full Network, Line, 2D and Imperfect 3D



	100	200	300	400	500	600
Full Network	172	3347	12331	25825	33330	88855
Line	10662	18452	39921	42937	177728	317269
2D	8278	17219	27698	32460	63436	153358
Imperfect 3D	7550	15105	23455	30211	46526	124555

As seen from the plotted graph above, Full Network topology is converging the fastest, for the given network size.

Also, line topology takes the maximum amount of time to converge among all the topologies with respect to the network size considered.

Push Sum Execution results:

For 500 Nodes, the Full Network Topology converged as shown in the following screenshot:

```
<0.745.0>: Sending rumor to process: <0.741.0>
<0.741.0>: Sending rumor to process: <0.749.0>
<0.749.0>: Sending rumor to process: <0.813.0>
<0.813.0>: Sending rumor to process: <0.877.0>
<0.877.0>: Sending rumor to process: <0.813.0>
<0.813.0>: Sending rumor to process: <0.821.0>
<0.821.0>: Sending rumor to process: <0.829.0>
<0.829.0>: Sending rumor to process: <0.837.0>
<0.837.0>: Sending rumor to process: <0.829.0>
<0.829.0>: Sending rumor to process: <0.837.0>
<0.837.0>: Sending rumor to process: <0.1118.0>
<0.1118.0>: Sending rumor to process: <0.1117.0>
<0.1117.0>: Sending rumor to process: <0.1181.0>
<0.1181.0>: Sending rumor to process: <0.1117.0>
<0.1117.0>: Sending rumor to process: <0.1109.0>
<0.1109.0>: Sending rumor to process: <0.1101.0>
<0.1101.0>: Sending rumor to process: <0.1109.0>
<0.1109.0>: Sending rumor to process: <0.1173.0>
<0.1173.0>: Sending rumor to process: <0.1165.0>
<0.1165.0>: Sending rumor to process: <0.1101.0>
<0.1101.0>: Sending rumor to process: <0.1186.0>
<0.1186.0>: Sending rumor to process: <0.1194.0>
<0.1194.0>: Sending rumor to process: <0.1093.0>
<0.1093.0>: Sending rumor to process: <0.1157.0>
<0.1157.0>: Sending rumor to process: <0.1149.0>
<0.1149.0>: Sending rumor to process: <0.1213.0>
<0.1213.0>: Sending rumor to process: <0.1214.0>
<0.1214.0>: Sending rumor to process: <0.1222.0>
<0.1222.0>: Sending rumor to process: <0.1214.0>
<0.1214.0>: Sending rumor to process: <0.916.0>
<0.916.0>: Sending rumor to process: <0.924.0>
<0.924.0>: Sending rumor to process: <0.923.0>
<0.923.0>: Sending rumor to process: <0.922.0>
<0.922.0>: Sending rumor to process: <0.930.0>
<0.930.0>: Sending rumor to process: <0.994.0>

Convergence Time: 4425
```

Ln 36, Col 15 Spaces: 4 UTF-8 CRLF Erlang ⌂ ⌂

For 500 Nodes, the 3D Topology converged as shown in the following screenshot:

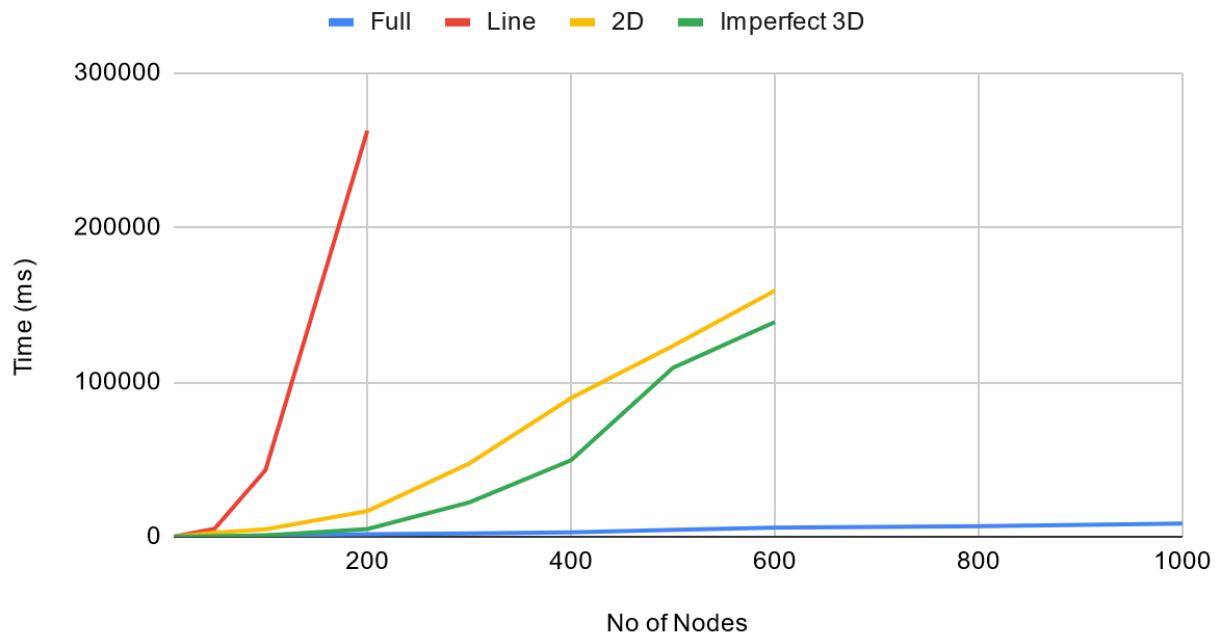
```
<0.1371.0>: Sending rumor to process: <0.1392.0>
<0.1392.0>: Sending rumor to process: <0.1502.0>
<0.1502.0>: Sending rumor to process: <0.1400.0>
<0.1400.0>: Sending rumor to process: <0.1522.0>
<0.1522.0>: Sending rumor to process: <0.1592.0>
<0.1592.0>: Sending rumor to process: <0.1389.0>
<0.1389.0>: Sending rumor to process: <0.1309.0>
<0.1309.0>: Sending rumor to process: <0.1593.0>
<0.1593.0>: Sending rumor to process: <0.1473.0>
<0.1473.0>: Sending rumor to process: <0.1610.0>
<0.1610.0>: Sending rumor to process: <0.1289.0>
<0.1289.0>: Sending rumor to process: <0.1567.0>
<0.1567.0>: Sending rumor to process: <0.1492.0>
<0.1492.0>: Sending rumor to process: <0.1697.0>
<0.1697.0>: Sending rumor to process: <0.1690.0>
<0.1690.0>: Sending rumor to process: <0.1699.0>
<0.1699.0>: Sending rumor to process: <0.1721.0>
<0.1721.0>: Sending rumor to process: <0.1480.0>
<0.1480.0>: Sending rumor to process: <0.1645.0>
<0.1645.0>: Sending rumor to process: <0.1394.0>
<0.1394.0>: Sending rumor to process: <0.1461.0>
<0.1461.0>: Sending rumor to process: <0.1276.0>
<0.1276.0>: Sending rumor to process: <0.1497.0>
<0.1497.0>: Sending rumor to process: <0.1546.0>
<0.1546.0>: Sending rumor to process: <0.1703.0>
<0.1703.0>: Sending rumor to process: <0.1451.0>
<0.1451.0>: Sending rumor to process: <0.1614.0>
<0.1614.0>: Sending rumor to process: <0.1563.0>
<0.1563.0>: Sending rumor to process: <0.1254.0>
<0.1254.0>: Sending rumor to process: <0.1709.0>
<0.1709.0>: Sending rumor to process: <0.1337.0>
<0.1337.0>: Sending rumor to process: <0.1714.0>
<0.1714.0>: Sending rumor to process: <0.1473.0>
<0.1473.0>: Sending rumor to process: <0.1711.0>
<0.1711.0>: Sending rumor to process: <0.1592.0>

Convergence Time: 109259
```

Ln 36, Col 15 Spaces: 4 UTF-8 CRLF Erlang ⌂ ⌂

Push Sum Convergence Graph:

PushSum - Full, Line, 2D and Imperfect 3D



	10	50	100	200	300	400	500	600	800	1000
Full	18	149	809	1594	2109	2819	4425	5865	6778	8497
Line	19	5146	43070	262687	Crashed					
2D	3	2598	4770	16573	47346	89699	123464	159174	Crashed	
Imperfect 3D	18	331	821	4943	22190	49474	109259	138862	Crashed	

The same trend in terms of convergence time, as noticed in Gossip can be observed for Push Sum protocol from the plotted graph above.