

COP5615 Distributed Operating System Principals: Project - 1

Gossip Simulator

Submitted By:

Rachit Rathi, UFID: 8089-6039

Rishabh Das, UFID: 8045-9065

Background:

In this project we have used the Gossip and Push Sum algorithm and applied it to different topologies such as Line, Full Network, 3D Grid and Imperfect 3D Grid. In this the convergence of both the algorithms are determined by using actors and a graph is created by running the program for different node sizes on different topologies for each algorithm. For Gossip if a rumour is heard 10 times by every actor then it terminates. In Push-Sum s/w ratio does not change by more than 10^{-10} times in 3 rounds then actor terminates

Steps to run:

1. The name of the project is **project2.fsx**
2. To run the program, extract the zip file "Project2" and open Gossip.fsx. To run type **"dotnet run <numberOfNodes> <topology{full, line, 3D, imp3D}> <algorithm{gossip, push-sum}>"** on the terminal (make sure dotnet.exe path is defined on \$PATH)
3. Include the **gossip.fsproj** project file in the same folder as the **project2.fsx**

Observations and Output:

```
PS C:\Users\rachi\OneDrive\Desktop\DOSP\dosp\Project2> dotnet run 50 line gossip
[DEBUG][10/11/2021 10:22:12 PM][Thread 0001][EventStream] StandardOutLogger started
[DEBUG][10/11/2021 10:22:12 PM][Thread 0001][EventStream(nodeConfig)] Logger log1-DefaultLogger [DefaultLogger] started
[DEBUG][10/11/2021 10:22:12 PM][Thread 0001][EventStream(nodeConfig)] StandardOutLogger being removed
Time taken: 4351
```

a) Sample Gossip Output

```
PS C:\Users\rachi\OneDrive\Desktop\DOSP\dosp\Project2> dotnet run 100 3D push-sum
[DEBUG][10/11/2021 10:27:37 PM][Thread 0001][EventStream] StandardOutLogger started
[DEBUG][10/11/2021 10:27:37 PM][Thread 0001][EventStream(nodeConfig)] Logger log1-DefaultLogger [DefaultLogger] started
[DEBUG][10/11/2021 10:27:37 PM][Thread 0001][EventStream(nodeConfig)] StandardOutLogger being removed
Time taken: 2002, Ratio:63.9929677828
```

b) Sample PushSum Output

Gossip & Full

NumNodes	T1	T2	T3	T4	T5	Avg (in ms)
50	992	992	899	994	897	954
100	1194	1193	1094	1093	1294	1173
300	1592	1497	1399	1598	1397	1496
500	1603	1601	1699	1799	1800	1700

Gossip & Line

NumNodes	T1	T2	T3	T4	T5	Avg
50	4546	4895	5196	4446	5096	4835
100	11246	9597	9446	10447	9896	10126
300	30346	28796	30247	28997	27648	29206
500	48099	49699	50400	50897	48348	49488

Gossip & 3D

NumNodes	T1	T2	T3	T4	T5	Avg
50	1994	2492	1895	2138	1965	2096
100	2295	2096	1894	2194	2192	2134
300	3093	3395	3292	2996	3395	3234
500	3296	2998	3392	2894	3097	3135

Gossip & Imp3D

NumNodes	T1	T2	T3	T4	T5	Avg
50	1495	1647	1997	1199	1912	1650
100	1422	1753	1917	1590	2294	1795
300	2011	2153	2157	2199	1919	2087
500	2197	2072	2488	2408	2099	2252

Push-sum & Full

N	T1	R1	T2	R2	T3	R3	T4	R4	T5	R5	Avg T (in ms)	Avg R	Ideal R
50	1296	25.5	1197	25.57	1196	25.4	1396	25.6	1196	25.6	1256	25.5	32
100	1198	50.5	1197	50.57	1197	50.6	1146	50.3	1246	50.5	1197	50.5	62.5
300	1197	150.6	1196	151.1	1247	150.7	1199	150.8	1129	150.3	1207	150.7	171.5
500	1398	250.3	1197	250.9	1248	251.2	1249	250.4	1250	250.1	1268	250.6	256

Push-sum & Line

N	T1	R1	T2	R2	T3	R3	T4	R4	T5	R5	Avg T	Avg R	Ideal R
50	1947	44.16	2196	31.5	1796	13.9	1596	35.4	2047	27.8	1916	30.5	32
100	1996	50.2	1947	61.7	1746	70.3	2096	73.5	1897	54.2	1936	61.9	62.5
300	2398	123.7	2248	251.2	2397	105.9	2948	227.7	2298	182.7	2457	178.2	171.5
500	2398	165.8	2100	177.3	2798	384.5	2798	187.6	3199	376.1	2658	258.3	256

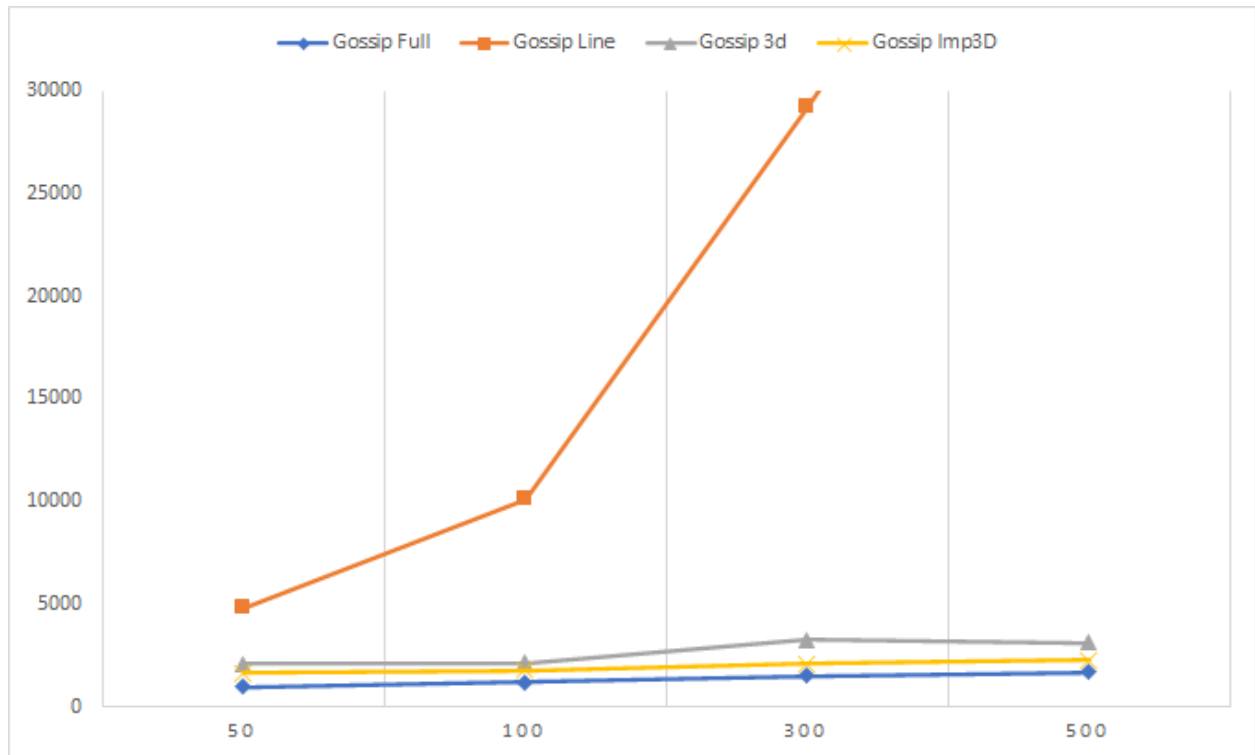
Push-sum & 3D

N	T1	R1	T2	R2	T3	R3	T4	R4	T5	R5	Avg T	Avg R	Ideal R
50	1796	47.6	1596	26.7	1397	22.1	1797	30.6	1546	34.4	1626	32.3	32
100	1746	64.6	1496	66.6	1497	77.7	1545	62.5	1597	87.1	1576	71.7	62.5
300	1697	116.9	1848	283.1	1748	196.7	1600	235.4	1848	125.7	1748	191.6	171.5
500	2099	369.4	2049	245.5	2149	183.7	1650	194.2	1849	35.1	1959	270.1	256

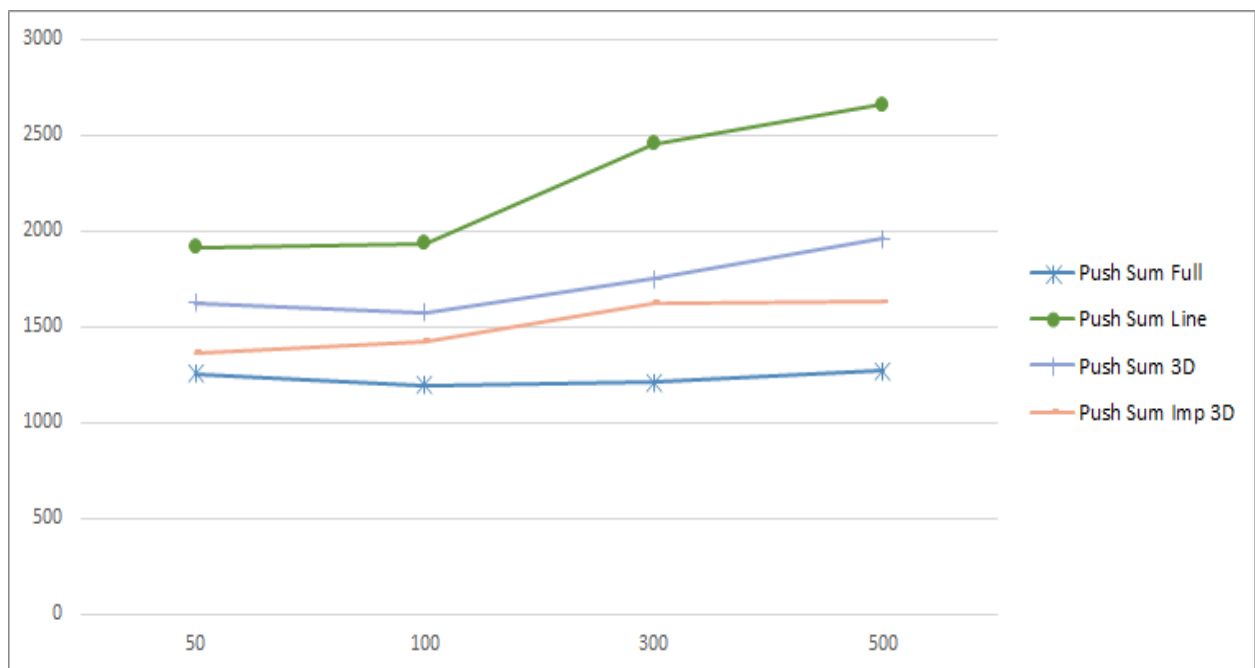
Push-sum & Imperfect3D

N	T1	R1	T2	R2	T3	R3	T4	R4	T5	R5	Avg T	Avg R	Ideal R
50	1936	31.8	1445	27.7	1247	30.7	1396	32.8	1345	42.4	1365	33.1	32
100	1497	58.8	1396	55.9	1297	69.9	1295	70.2	1647	65.1	1426	63.9	62.5
300	1548	122.7	1747	186.5	1647	211.5	1742	213.2	1449	197.7	1626	186.3	171.5
500	1498	282.1	1801	283.9	1600	245.8	1749	252.4	1449	268.3	1629	266.5	256

Graph for Gossip:



Graph for Push Sum:



Findings and Conclusion:

For Gossip Algorithm:

- We have taken an average of five time values noted for different sets of nodes ranging from 50 to 500. The graph above shows the output with X-Axis having the nodes and Y-Axis with time in milliseconds.
- The observation is that for the Line topology in gossip, time for convergence increases drastically as the nodes increase while for other topologies (Full Network 3D and imperfect 3D) the convergence time is almost in the same range. Here we have executed the program upto 5000 nodes and it runs efficiently.

For Push Sum Algorithm:

- We have taken the average of five time values of execution and the ratio obtained during each run to get a better estimation of the actual output. The rumours sent are propagated asynchronously. For push sum the s/w ratio should ideally be the next closest perfect cube after the $(\text{number of nodes} + 1) / 2$.
- From the graph above for push sum we find that the convergence time for Line Topology increases gradually as compared to other topologies when the number of nodes increases. The full topology provides the best ratio estimation followed by Line, Imperfect 3D and 3D. This is because in full topology information is spread fast among the nodes. Also one extra neighbor in Imperfect 3D provides a better estimation on the s/w ratio of imperfect 3D as compared to 3D Grid.