Project2 Report

In this project, we implemented 6 different topologies: full network, 3D grid, random 2D grid, torus, line and imperfect line, to test how fast gossip and push-sum can work on these different topologies.

In gossip, each actor selects a random neighbor and tells it the rumor, each actor keep track of rumors and how many times it has heard the rumor. It stops transmitting once it has heard the rumors 50 times

In push-sum, node send out its quantities s and w only when receiving other node's s and w, algorithm converge when sum estimation s/w did not change more than 1.0e-10 in 3 consecutive rounds.

When measuring time to converge, we do it 3 times and calculate the average (plot using average). It is acknowledged to know from the figure 1, for Gossip Algorithm, the line topology is always slower than any other topologies (except random 2D grid). The graph also shows that full network topology is kind of quicker than Torus, line, imperfect line and full topologies except the 3D's first node choosing. Actually, 3D's first node represents the situation contains 8 nodes in topology and second not represents the situation contains 27 nodes in topology. And we can see that full topology is quicker than 3D in the large number of nodes condition. Finally, there is no random 2D topology statistics found in the graph, it is due to the situation some nodes may not have neighbors near within the distances (0.1), so the process would fail and last long time until forced termination.

In Figure 2, pushsum algorithm, line topology is almost horizontal and is the quickest, while full topology is the slowest.
But all the topologies except random 2D are all almost the same time at the small number nodes.
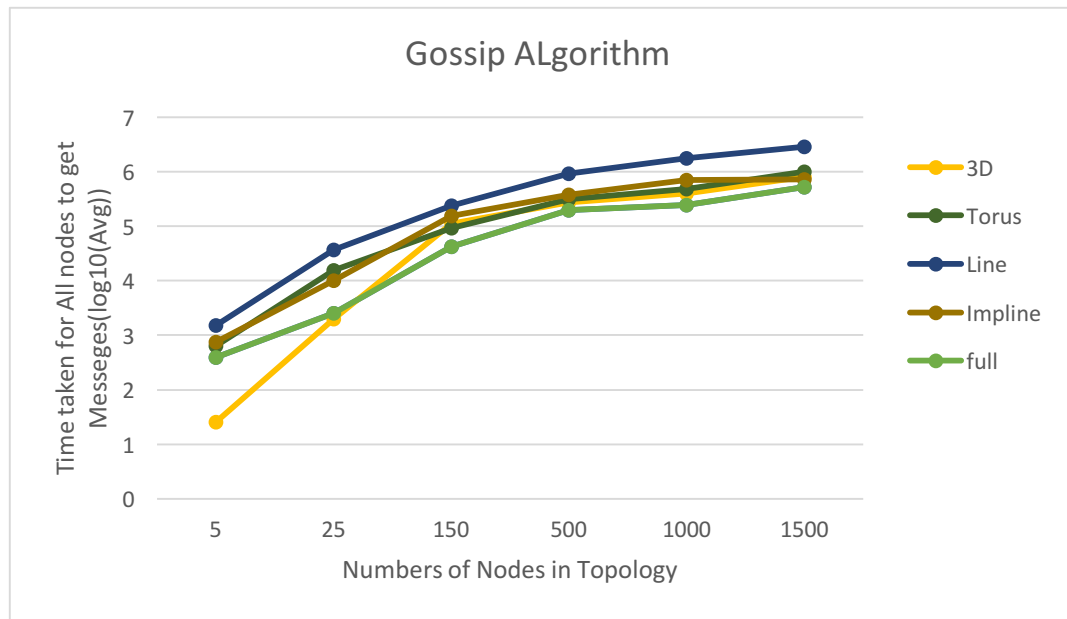
Figure 1 Convergence time for gossip on 3D, Torus, Line, Impline and full topology
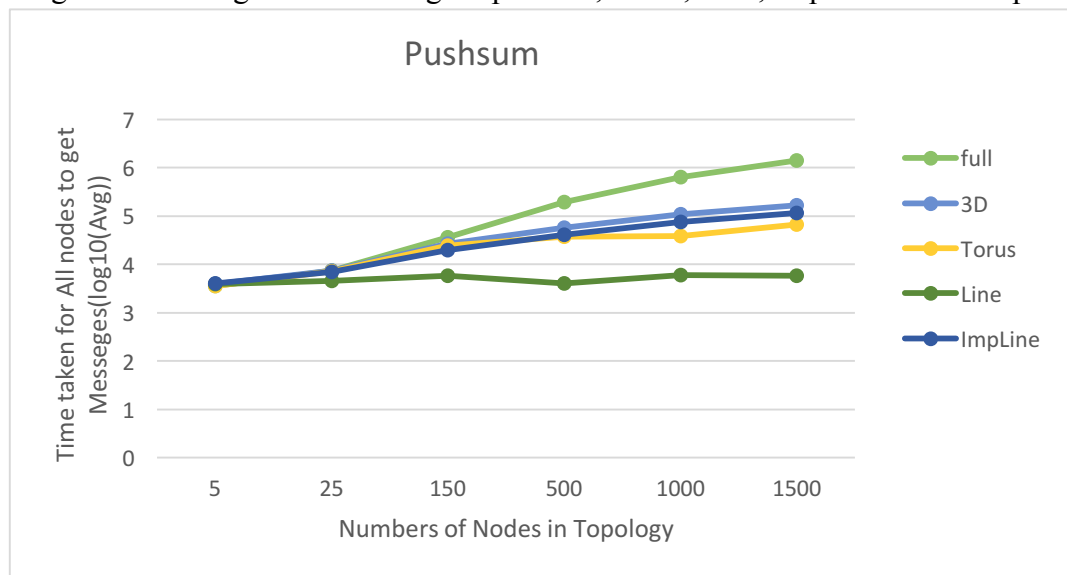

Figure 2 Convergence time for pushsum on 3D, Torus, Line, Impline and full topology

In gossip:

1.Basically full quicker than3D, Torus, line and imperfect line topologies. It is easy to understand that every node can connect to each other, which is a large chance to be more faster infect other nodes.

2.Line is slower than any other topologies, this is because it can only influence other before and after it, when number of nodes increasing, the convergence time changes exponentially.

3.The increasing rate changes largely when number of nodes is below 500, and when nodes go over 500, it does not grow that much.

4.Random 2D is not included in this graph because of its failure situation, in which time is hard to count.

5.The convergence time of 3D, torus and imperfect line is almost the same with the increasing number, that is because they both can only influence limited number of nodes.

In push-sum:

1.line topology is quicker than any other topology and its time almost doesn't increase with the increasing of number of nodes, that is because, its nodes can only influence before and after it, when nodes go over a center number, s/w would not change largely and would terminate.

2.full topology is the slowest because it has to influence every other node, while those nodes's value is increasing with the sequence, so when the number of nodes increases, the time also has to increase exponentially.

3. Random 2D is not included in this graph because of its failure situation, in which time is hard to count.

4. The convergence time of 3D, torus and imperfect line is almost the same with the increasing number, that is because they both can only influence limited number of nodes.

APPENDIX: Original data measured for the plots

Without failure model

Gossip-Full Network

Times numNodes	5	25	150	500	1000	1500
1	383us	3430us	22951us	218818us	239468us	644988us
2	368us	2550us	60943us	160350us	237586us	440209us
3	423us	1723us	42685us	222902us	252429us	471677us
Avg	391us	2568us	42193us	200690us	243161us	518958us
Log10(Avg)	2.59	3.41	4.63	5.30	5.39	5.72

Gossip-3D Grid

Times \ numNodes	5	25	150	500	1000	1500
1	30us	1967us	110159us	247529us	369959us	759196us
2	24us	2273us	143808us	315974us	402758us	975306us
3	24us	1756us	80631us	267240us	411453us	713873us
Avg	26us	2002us	111533us	276914us	394723us	816125us
Log10(Avg)	1.41	3.30	5.05	5.44	5.60	5.91

Considering some nodes would not have neighbors between and then would last forever until forced termination, so in the without-failure-model, their time is not included.

Gossip-Random 2D Grid

Times \ numNodes	5	25	150	500	1000	1500
1						
2						
3						
Avg						

Gossip-Torus

Time \ numNodes	5	25	150	500	1000	1500
1	668us	18933us	94328us	302904us	522725us	1085977us
2	692us	13041us	78284us	314962us	459643us	859460us
3	571us	14900us	110213us	309084us	450899us	1024760us
Avg	644us	15625us	94275us	308983us	477756us	990066us
Log10(Avg)	2.81	4.19	4.97	5.49	5.68	6.00

Gossip-Line

Times \ numNodes	5	25	150	500	1000	1500
1	1271us	35369us	242911us	988895us	1792492us	2716757us
2	1301us	34942us	272258us	850160us	1631390us	3118122us
3	1942us	42142us	206244us	967665us	1903678us	2813137us
Avg	1505us	37484us	240471us	935573us	1775853us	2882672us
Log10(Avg)	3.18	4.57	5.38	5.97	6.25	6.46

Gossip-Imperfect Line

Times　　　numNodes	5	25	150	500	1000	1500
1	735us	10472us	155779us	389313us	704218us	690482us
2	785us	8917us	149206us	340430us	716041us	754377us
3	807us	10453us	162221us	410987us	720904us	720904us
Avg	767us	9947us	155735us	380243us	713721us	721921us
Log10(Avg)	2.88	4.00	5.19	5.58	5.85	5.86

Pushsum-Full network

Times　　　numNodes	5	25	150	500	1000	1500
1	4053us	8835us	39521us	186042us	626201us	1374513us
2	3648us	7180us	35722us	199019us	592758us	1522594us
3	3000us	6393us	34114us	202946us	653943us	1386698us
Avg	3567us	7469us	36452us	196002us	624301us	1427935us
Log10(Avg)	3.55	3.87	4.56	5.29	5.80	6.15

The minimum number should be 8, or otherwise it would be meaningless with only one node.

Pushsum-3D Grid

Times　　　numNodes	8	27	150	500	1000	1500
1	4142us	7619us	26657us	43413us	109228us	185391us
2	3573us	6270us	23822us	44850us	129355us	133850us
3	3886us	8547us	30183us	86168us	93634us	179882us
Avg	3867us	7479us	26887us	58144us	110739us	166374us
Log10(Avg)	3.59	3.87	4.43	4.76	5.04	5.22

Considering some nodes would not have neighbors between and then would last forever until forced termination, so in the without-failure-model, their time is not included.

Pushsum-Random 2D

Times　　　numNodes	5	25	150	500	1000	1500
1						
2						
3						
Avg						

Pushsum-Torus

Times numNodes	5	25	150	500	1000	1500
1	4303us	6649us	20433us	41695us	34513us	66129us
2	3121us	6641us	24664us	38113us	44334us	56958us
3	3490us	8658us	29325us	35196us	37345us	75233us
Avg	3638us	7316us	24807us	38335us	38731us	66107us
Log10(Avg)	3.56	3.86	4.39	4.58	4.59	4.82

Pushsum-Line

Times numNodes	5	25	150	500	1000	1500
1	4020us	4779us	6686us	3663us	5327us	6027us
2	3341us	4620us	6707us	4155us	6918us	5650us
3	4242us	4374us	4376us	4306us	5852us	5852us
Avg	3868us	4591us	5923us	4041us	6032us	5843us
Log10(Avg)	3.59	3.66	3.77	3.61	3.78	3.77

Pushsum-Imperfect Line

Times numNodes	5	25	150	500	1000	1500
1	4278us	6621us	16675us	39602us	72121us	112348us
2	3830us	7040us	20502us	39119us	73121us	122050us
3	4110us	6998us	21224us	43562us	82152us	108715us
Avg	4073us	6886us	19467us	40761us	75798us	114371us
Log10(Avg)	3.61	3.84	4.29	4.61	4.88	5.06