Report

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Graphs and analysis:

For analysis, we have taken data for both the algorithms for every topology, giving different number of nodes.

For data-collection we have run the gossip and push-sum algorithm from 100 to 1000 nodes in 100 node intervals for every topology. The below table depicts the collected data and for smoother graph plot we have taken the logarithm values of collected data.

All the time values are collected in milliseconds

- **Gossip Algorithm:**

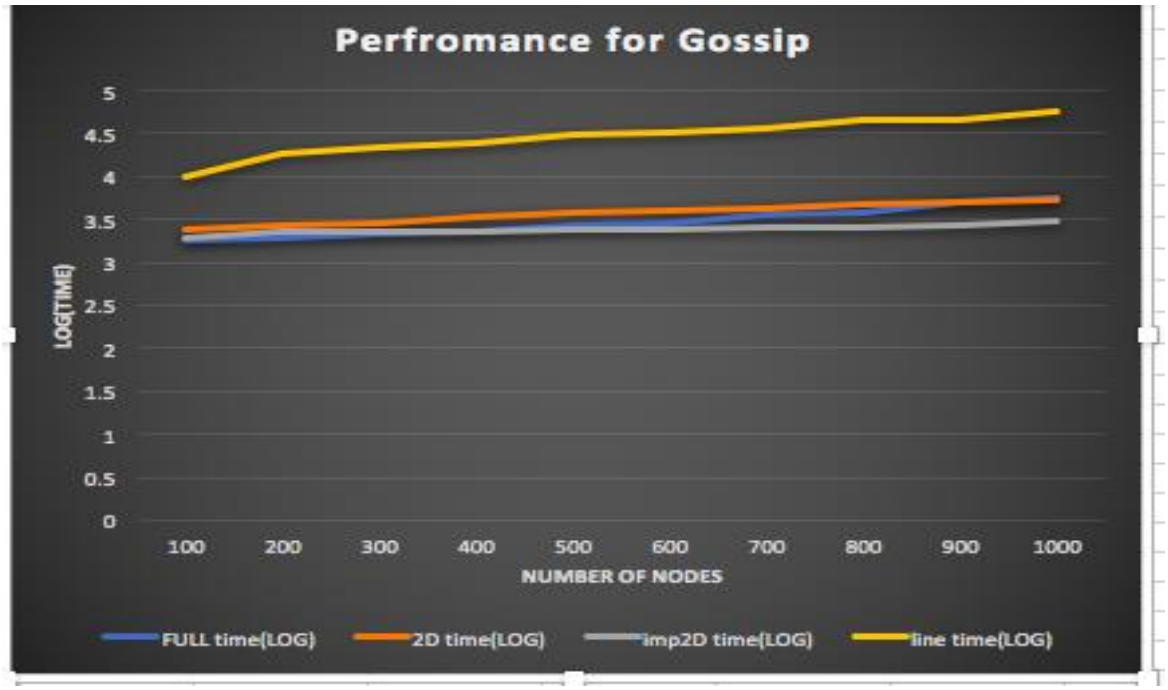
	Full	2D	**imp2D**	line
Number of Nodes/Time	Time	Time	Time	Time
100	1848	2453	1960	10040
200	1891	2701	2260	18135
300	2114	2833	2340	21742
400	2287	3302	2343	25006
500	2701	3717	2408	30575
600	2814	4015	2425	32836
700	3535	4240	2530	36152
800	3702	4631	2542	45143
900	4948	5059	2651	45309
1000	5510	5201	3096	55944

Logarithm values of above data:

	FULL	2D	**imp2D**	line
Number of Nodes/Time	time(LOG)	time(LOG)	time(LOG)	time(LOG)
100	3.266701967	3.389697548	3.292256071	4.001733713
200	3.276691529	3.431524584	3.354108439	4.25851756
300	3.325104983	3.452246575	3.369215857	4.337299491
400	3.359266165	3.518777069	3.369772289	4.398044227
500	3.431524584	3.570192561	3.381656483	4.485366466

600	3.449324093	3.60368555	3.384711743	4.516350247
700	3.548389418	3.627365857	3.403120521	4.558132328
800	3.568436414	3.665674781	3.405175546	4.654590417
900	3.694429691	3.704064679	3.423409728	4.656184477
1000	3.741151599	3.716086854	3.490800952	4.747753515

Graph for gossip:



From the plot it is clear that, the relationship between the number of nodes and time taken to converge is logarithmic

- when the number of nodes are small, the performance ordering is as follows:

Full<imp2D<2D<line

The full is having the best performance that is it is having least time of convergence, this is because every node is connected to every other node and it is easier converge but for other topologies, they have limited sets of neighbor.

- For larger number of nodes, the performance ordering gets slightly changed as noticed below

imp2D< Full <2D<line

This is happening because in full topology some actors reach their threshold value sooner and other actors while sending message may check the converged nodes to send message which is like an overhead time which adds to the overall performance of the full topology. As an imp2D has structure stability and randomness factor, it has the best performance for larger number of nodes

Interesting Fact

- The interesting fact observed here is that line has at most two neighbors so it takes too long time to get converged as compared to other topologies that is the more the node is connected the better its performance will be.
- By looking at the slope of plots, we can conclude that performance of topologies has less dependency in number of nodes. This is because the gossip is asynchronous .

➢ **Push-Sum**

	Full	2D	**imp2D**	line
Number of Nodes/Time	Time	Time	Time	Time
100	2947	14700	3206	256000
200	6709	69642	10263	1190302
300	10841	145602	12852	2504561
400	16838	235575	14847	2517116
500	21210	408828	21219	7572136
600	28029	553330	26553	12341234
700	34128	725702	30595	18123412
800	42382	951061	36242	21543265
900	50519	1067600	60647	25433245
1000	61072	1526352	58589	31234234

Logarithm values of above data:

	Full	2D	**imp2D**	line
Number of Nodes/Time	Time	Time	Time	Time
100	3.469380136	4.167317335	3.505963518	5.408239965
200	3.826657792	4.842871235	4.011274329	6.075657163
300	4.035069344	5.163167341	4.108970717	6.398731614
400	4.226290505	5.3721292	4.171638709	6.40090323
500	4.326540669	5.611540632	4.326724913	6.879218406
600	4.447607604	5.742984217	4.424113595	7.091358587
700	4.533110838	5.86075832	4.485650458	7.258239963
800	4.627181447	5.978208373	4.559212156	7.333311524
900	4.703454745	6.028408565	4.782809323	7.405401775
1000	4.785842143	6.1836547	4.767816086	7.49463086

Graph:

From the plot it is clear that, the relationship between the number of nodes and time taken to converge is logarithmic. The performance ordering is as follows

Full~imp2D<2D<line

From the graph we can conclude that the performance of full and 2D are almost similar because of better connectivity and stability in the structure while the line has highest convergence time, this is because

Interesting Fact

- The convergence rate for all topologies in push-sum is higher than that of gossip, this is because of the way we are calculating the aggregates (in sequential manner).
- Higher the connectivity of the nodes, better is the performance. This can be easily observed from the graph.