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**Project Description:**

The focus of the project is to implement gossip and push-sum algorithms for four network topologies namely Line, 2D, imp2D and Full. These algorithms are simulated to find the time of convergence for each of the network topologies. The time of convergence is plotted against the number of nodes and results are inferred.

Algorithms:

Gossip: A rumor is sent to a random neighbor and the number of times each node hears the rumor is kept track off. The termination of the algorithm occurs when  $N = 10$ . The convergence happens when a node listens to the rumor for 10 times.

Push Sum: The messages are sent and received as pairs  $(s, w)$   $S$  ranges from 1 to maximum number of Actors,  $w$  is initialized to 1 for each of the actors. When a message is passed to another actor, half of  $s$  and  $w$  is kept, and the other half is added in the message. The algorithm reaches convergence when the  $s/w$  ratio does not change by a margin more than  $10^{-10}$  in 3 consecutive rounds of receiving messages. The output is the time until convergence for each of the algorithms.

Input format: dotnet fsi --langversion:preview project2.fsx 'number of nodes' 'topology' 'algorithm'

Network topologies:

Full: Every actor is a neighbor of every other actor. Each actor can directly talk to another actor.

Line: Actors are arranged in a line which implies that the actor has only two neighbors unless you are on the extreme ends of the line.

2D: Actors form a 2D grid. The actors can talk to only the grid neighbors.

Imperfect 2D: Grid arrangement but one random neighbor is selected from the list of actors.

Observations:

X axis for the plots is number of nodes and the Y axis is time for convergence (in ms) for each of the topologies and both the algorithms. Along the x axis, we have taken number of nodes from 10 to 1000.

From the graphs above, we can observe that the convergence times are

Gossip: Full<Imp2D<2D<line

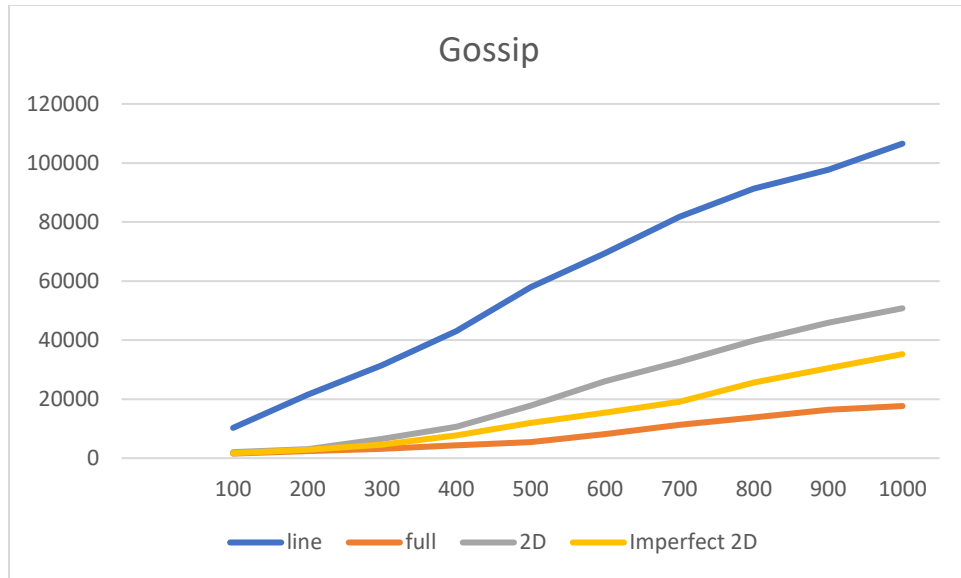


Fig 1: Time convergence v/s number of nodes

Num of nodes	line	full	2D	Imperfect 2D
100	10255	1534	2031	1687
200	21421	2367	3002	2789
300	31456	3165	6513	4525
400	43082	4390	10612	7666
500	57892	5465	17818	11936
600	69435	8106	26007	15432
700	81765	11271	32666	19076
800	91321	13747	39821	25543
900	97652	16345	45912	30435
1000	106543	17650	50763	35231

Push Sum: Imp2D<full<2D<line

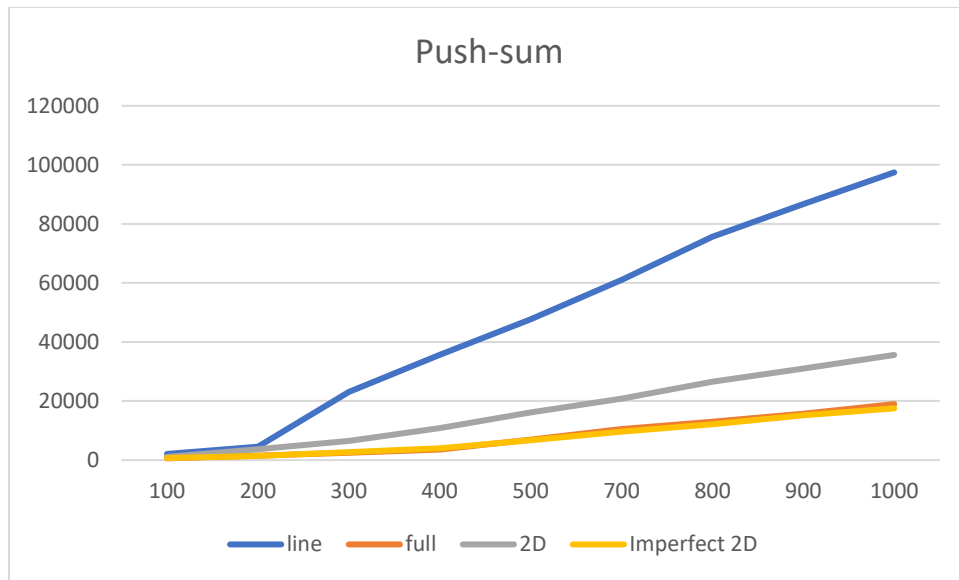


Fig 2: Time convergence v/s number of nodes

	line	full	2D	Imperfect 2D
100	2072	610	1071	703
200	4507	1499	3674	1345
300	23098	2501	6445	2709
400	35675	3609	10848	4022
500	47657	6892	16093	6743
700	61023	10536	20828	9678
800	75672	13023	26512	12125
900	86722	15672	30987	15129
1000	97456	18956	35607	17523

The gossip and push-sum algorithm plot suggests that the line topology takes the longest to converge. 2D is the next highest. Imp2D and Full are the fastest as the algorithms involve randomization. Randomization is thus a key factor which decides the implementation and working of the algorithm.