Project Report

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Implementation Scheme

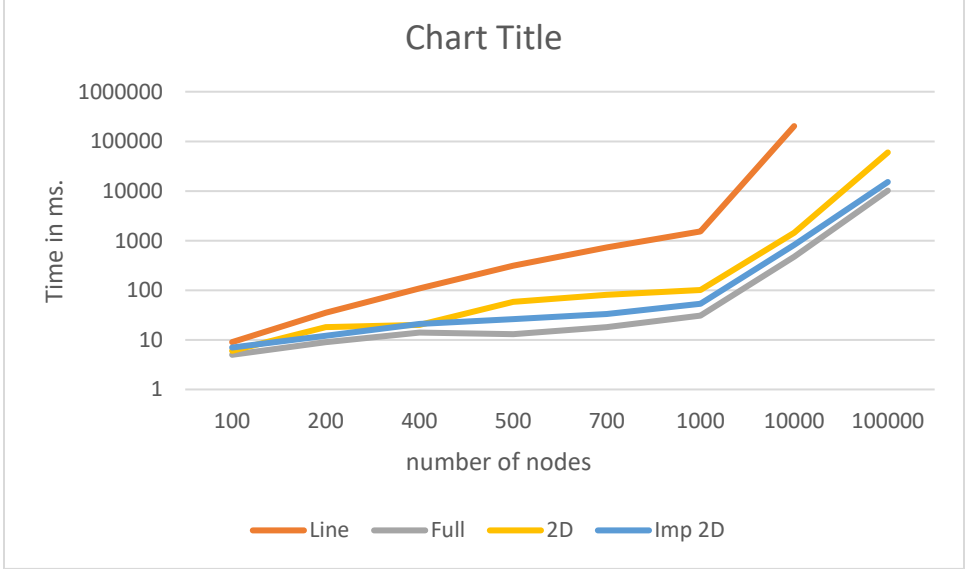
We have implemented gossip and push-sum algorithm for line, full, 2D and imperfect 2D network. In our implementation, we are sending message to a random neighbor in each topology and stopping the code when convergence is achieved.

Convergence in gossip algorithm: we are concluding that if the spread is 100%, that is, is all the nodes have been infected at least once when the convergence is achieved.
We have taken a state variable which we are defining as **state = number of nodes * 5**. We are stopping the transmission of the messages from a node when it has received (number of nodes * 5) number of messages. We are keeping this number high, in order to achieve 100% spread. We are allowing the actors more time to reach the saturation level so that 100% convergence can be achieved.

Convergence in push-sum algorithm: Convergence in push-sum algorithm is achieved when the s/w ratio for all the actors do not change more than 10^{-10} in three consecutive rounds.
As per our observation, when convergence is reached, the final values of S is number of nodes /2 and W is close to one. The value of W does not seem to change and remains 1 at the end as well.

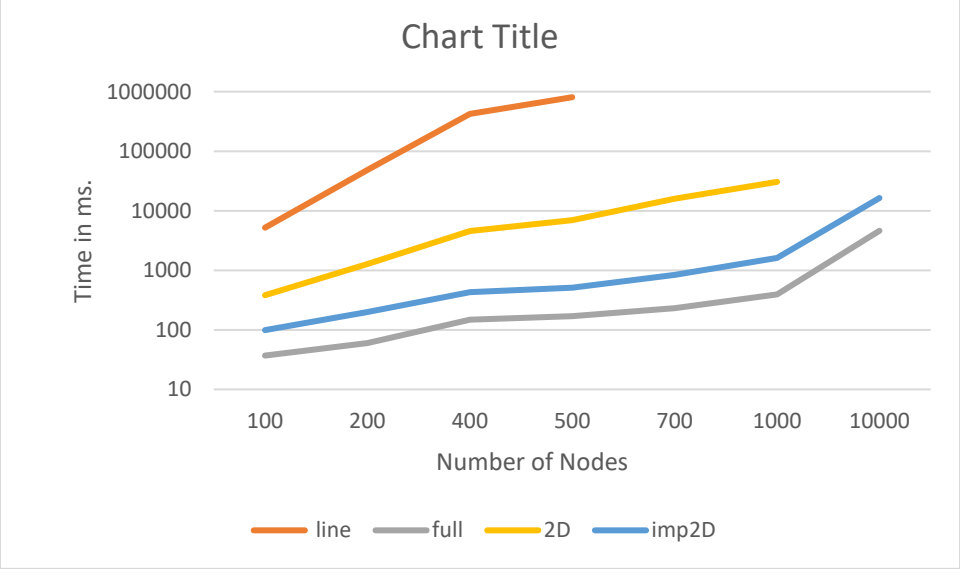
Graphs: convergence time as a function of the size of the network

Gossip algorithm:



Number of Nodes	Line Network Time (ms)	Full Network Time (ms.)	2D Network Time (ms.)	Imperfect 2D grid Time (ms.)
100	9	5	6	7
200	35	9	18	12
400	109	14	20	21
500	313	13	58	26
700	724	18	81	33
1000	1540	31	101	53
10000	202899	470	1449	824
100000		10176	59797	15171

Push-Sum Algorithm:



Number of Nodes	Line Network Time (ms)	Full Network Time (ms.)	2D Network Time (ms.)	Imperfect 2D grid Time (ms.)
100	5203	37	382	99
200	48492	60	1271	200
400	423562	149	4576	432
500	807023	169	6918	513
700	*	230	15976	843
1000	*	394	30556	1620
10000	*	4617		16368

Interesting observations:

- According to our observation, line topology is taking the maximum time to converge for both the gossip and push-sum algorithms. The probable reason for this is the limited number of neighbors.
- Full topology is taking minimum time to converge for both the topologies.

- We observed that, gossip algorithm is working for Full, 2D and Imperfect 2D for nodes up to 100000. However, while running for these many number of nodes for line topology system is hitting limits and time is increases exponentially.
- From the results, we observed that deadlocks are encountered while running push sum for line topology and large number of nodes and convergence is not achieved.
- Push Sum and gossip algorithm showed similar trends in graph.
- **In push-sum, as per out observation, when convergence is reached, the final values of *S* is**

  S = (Number of Nodes) /2 **and,**

  ***W* = 1 (approx.)**

  The value of W does not seem to change and remains 1 at the end as well.

* Line topology is taking time to reach convergence as the number of nodes increases. Due this the time for number of nodes greater than 500 is more than 10 minutes and increases exponentially.

References

[1] https://www.cs.cornell.edu/johannes/papers/2003/focs2003-gossip.pdf