

# Report

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This project report contains two parts. First part is results for gossip algorithm. Second is results for push-sum algorithm. Report for bonus part is in Report-Bonus.pdf.

In my program, situation where each node ends is the same as that described in Proj2.pdf.

Node in my program will send one message to its neighbors during each interval. The interval I choose for node in gossip algorithm is 500ms, and that in path-sum is 200ms (to speed up convergence). The reason I set an interval between sending two messages is full network topology will cause sending of enormous messages at the beginning and will cause CPU usage reach 100%. This will introduce large process delay and will cause result different from real network situation.

In both parts, I measured the finish time, which is from the sending of first message to the finish of last node. I used it to measure the convergence time for each topology. I tested the finish time in different numbers of nodes.

I can run 5000 nodes by using full network topology in both gossip and push-sum. More nodes will cause memory problem.

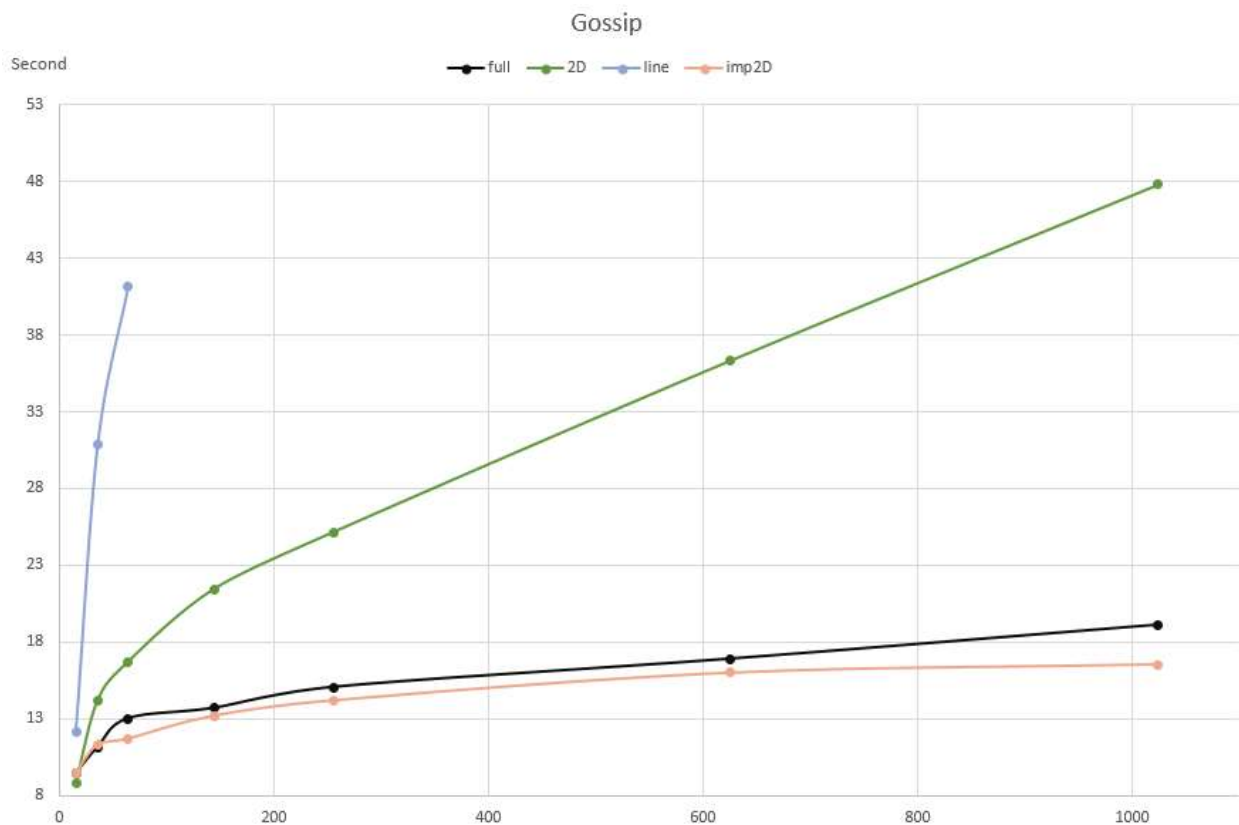
After shortening the interval between sending two messages to 50ms, I can run more than 20000 nodes in my computer by using 2D and imp2D network topology in both gossip and push-sum. Time for 20000 nodes by using imp2D topology and gossip algorithm takes only 4.3s.

I can only get a result from 100 nodes by using Line topology because using line topology has a high probability that message transfer ends somewhere and other nodes cannot even receive one message. But after increasing the stop condition for each node to 30, I can get result from 10000 nodes using my computer.

## 1. Gossip

The numbers of nodes I chose to test in gossip algorithm are 16, 36, 64, 144, 256, 625, 1024, 2025. Following graph is drawn based on the test data. There are several conclusions we can find from it.

- Convergence time of two topologies, which are full and imperfect 2D grid, is in logarithm relation with input number of nodes.
- Convergence time of two topologies, which are line and 2D grid, is in polynomial relation with input number of nodes. When the number of network nodes becomes large, it will take a long time for system to converge.
- In my implementation, some nodes will not converge because all their neighbors are finished. From the test, the ratios of finished nodes to total nodes for full, imp2D, 2D, line are respectively 98.80, 74.65, 70.63, 63.79.



## 2. Push-Sum

The numbers of nodes I chose to test in gossip algorithm are 16, 36, 64, 144, 256, 625, 1024. Following graph is drawn based on the test data.

- Convergence times of four topologies have same behavior as them in gossip algorithm. Convergence times of full and imperfect 2D grid show logarithm relation with number of nodes and those of line and 2D grid show polynomial relation with input number of nodes.
- The ratios of finished nodes to total nodes for full, imp2D, 2D, line, are respectively 98.47, 69.48, 64.52, 64.19.
- Compare to gossip algorithm, node of push-sum algorithm will stop when its  $s/w$  value doesn't change instead of receiving certain number of messages. Thus, messages each node receives before finishing is different. And we can see grid topology is not good for this situation. It becomes slowed and the finished ratio decreases, while the other two doesn't change too much.

