

COP5615 Project 2: Gossip Algorithm Documentation

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Problem Statement

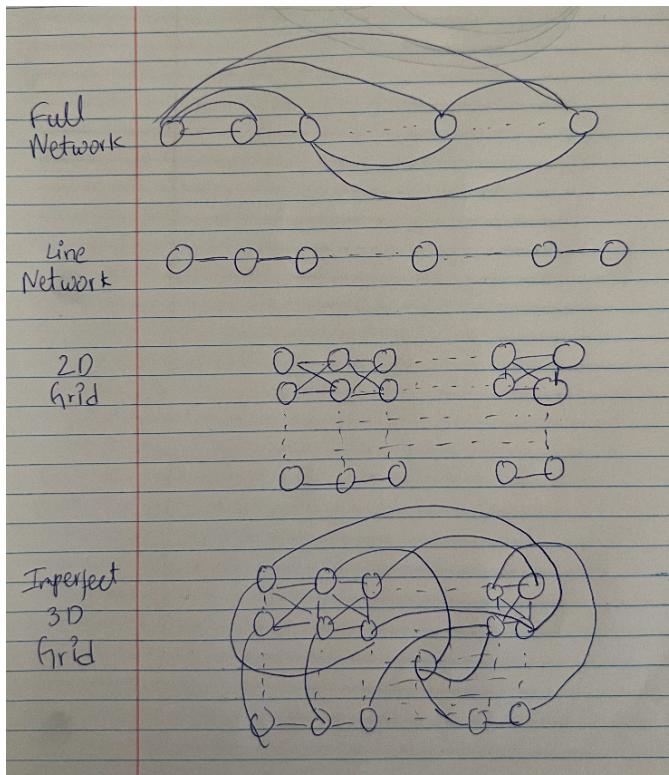
Implementation of gossip algorithm for group communication and for computing aggregate computation and understanding the convergence of these two algorithms as a function of size of the network for different topologies.

Implementation

The implementation of the gossip algorithm using actor model In Erlang is done by defining a network of actors over 4 topologies and understanding the convergence time each topologies as a function of the network size. The topologies are

- * Full Network
- * Line Network
- * 2-D grid network
- * Imperfect 3-D grid

Topologies



Run Instructions

- > Move to src folder
- > Start erlang compiler by entering erl
- > for gossip run the following commands
 - > c(gossip).
 - > gossip:process(N,[],Gossip).(Where N is size of network, Gossip is the gossip to spread).
- > for push sum run the following commands
 - > c(pushsum).
 - > pushsum:process(N,[]).(Where N is size of network).

Algorithms

Group Communication

- * Initiate the network with desired topology
- * Randomly select an actor and start sending the rumor/gossip to one of its connected actor selected randomly
- * Upon receiving a gossip, increment the counter and send the rumor
- * **Termination Step** : When the counter reaches 10.

Push Sum

- * Initiate the network with desired topology
- * Initiate S,W with 0, I for Ith actor.
- * Randomly select an actor and start sending the rumor/gossip to one of its connected actor selected randomly
- * Upon receiving a gossip, increment the counter and send the rumor
- * **Termination Step** : When S/W didn't change not more than 10^{-10} for 3 consecutive times.

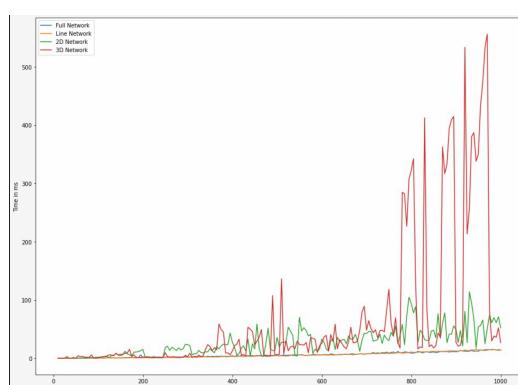
Actor Communication at each step

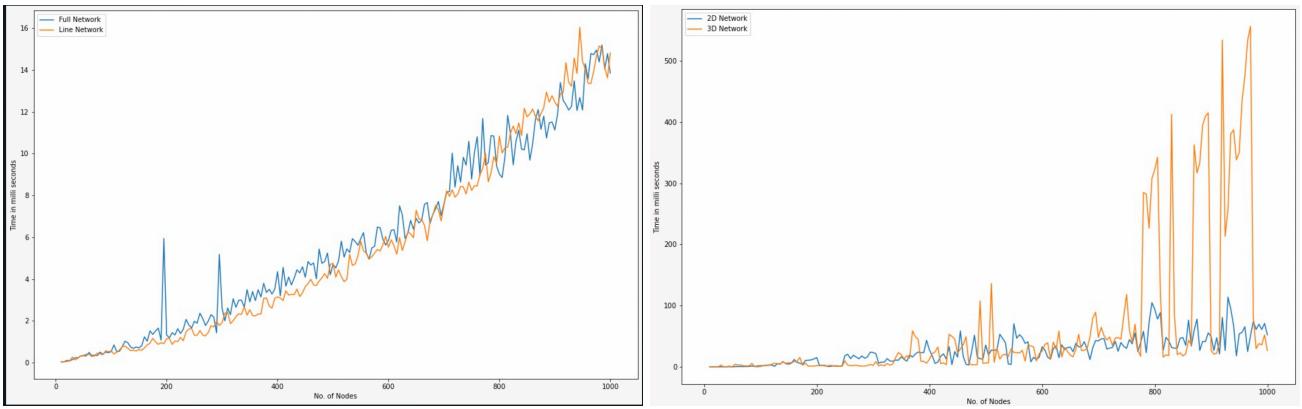
- * Full Network : An actor will randomly select any other actor from the entire network.
- * Line Network : An actor will randomly select the actor which is left or right to it. Actor I can communicate with $I+1, I-1$.
- * 2D Grid Network : An actor will randomly select the actor which is directly connected to the network.
i.e actor at (I,j) can communicate with $(I+1,j), (I-1,j), (I,j+1), (I,j-1), (I+1,j+1), (I+1,j-1), (I-1,j-1), (I-1,j+1)$.
- * Imperfect 3D Grid Network : An actor will randomly select the actor which is directly connected to the network and another random actor.

Results

Group Communication

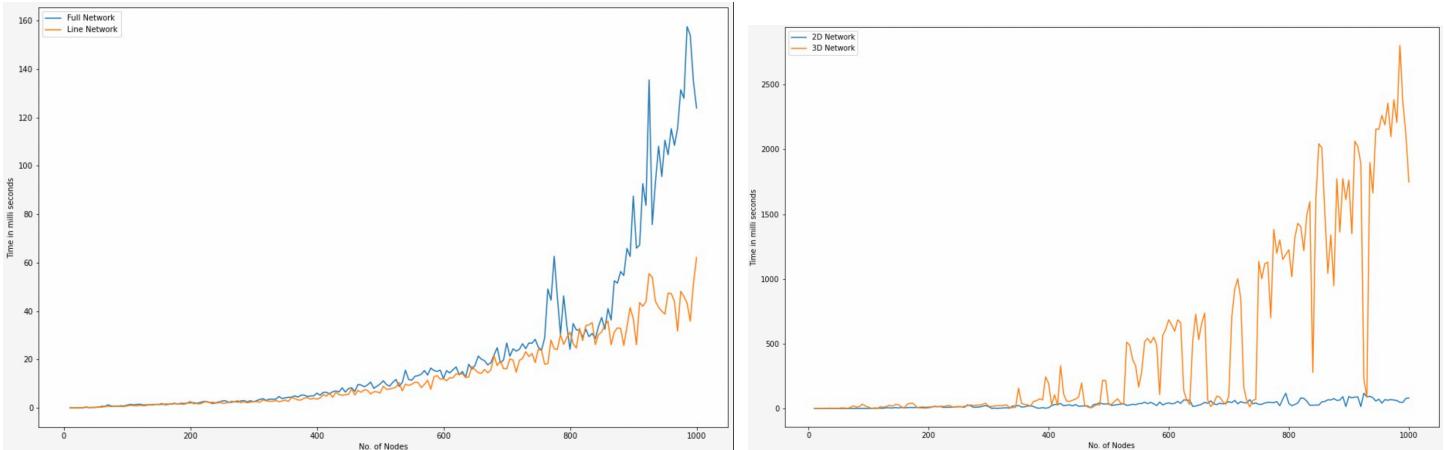
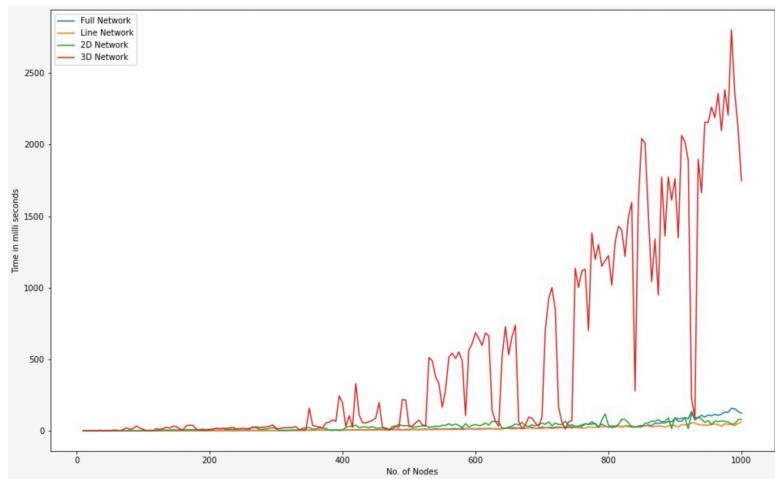
The network size has been increased from 5 to 1000 with the step size as 5. The results are as below. Size of network vs time of convergence.





Push Sum

The network size has been increased from 5 to 1000 with the step size as 5. The results are as below. Size of network vs time of convergence.



Observations

For group communication, the full network and line topology almost gave the same efficacy than 2D and 3D. The time of convergence of 3D network is fluctuating a lot which is probably because of the randomization of the network. The 2D network has been consistent in both the algorithms. The average convergence time is low for line network. The line and full network convergence time are comparable. For small networks, the line topology is better whereas for large networks, the 2D network provides consistent results.

Largest Network we could work with for all the topologies.

For all the topologies the process is killed after network size **85,000**. The time taken to converge for network size 10000 is around 6 mins for full network and line network.

Conclusion

The working on distributed implementation of gossip algorithm simulator using distributed Erlang using actor model has been compared with different topologies. 2 algorithms, group communication and push sum have been discussed and implemented and extracted a correlation between the size of network and time of convergence. The different topologies are

- * Full Network
- * Line Network
- * 2D grid Network
- * Imperfect 3D Network

For network of small sizes, the line network is very efficient for larger networks, 2D grid network yield more consistent time.