DOS PROJECT 2 REPORT

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Aim:

The aim of this project is to implement the Gossip Algorithm and the Push-Sum protocol for the following topologies:

- Full Network
- Line Network
- Random 2D Grid
- 3D Torus Grid
- Honeycomb Network
- Random Honeycomb Network

Implementation details:

Gossip: In this algorithm, every actor selects another actor at random and the message is being passed to it. The actor becomes inactive if it receives the message 10 times. Every actor updates it's list of neighbors whenever an actor checks its neighbors list for a random node and finds out that this node is dead. Also, the actor becomes dormant if the neighbors list for an actor becomes empty.

The motive of this Gossip protocol is to disseminate a message without having centralized authority. The efficiency of this protocol is determined by the time it takes for the rumor to be heard by every node. Hence, convergence occurs when every actor has received/ heard the message at least once.
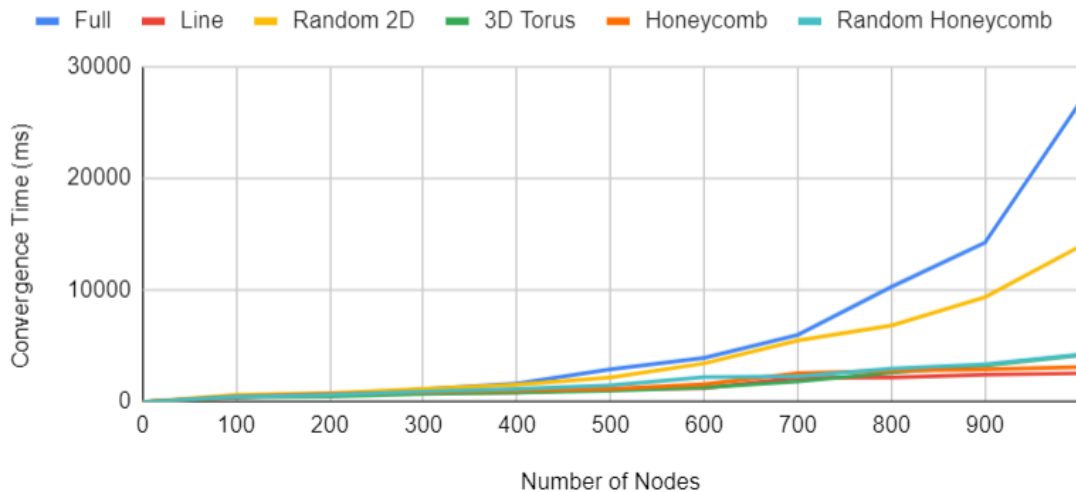
Push Sum: Every actor randomly selects another actor and sends it s/2 and w/2 values. It updates its s and w values as s/2 and w/2. The actor converges if and only if the change in its s/w value is less than 10^{-10} 3 times. When all the actors reach convergence, the algorithm converges. Each node receives the message 3 times to ensure fault tolerance of the network.

The following are the **interesting observations** for convergence times across all topologies for **Gossip Protocol**:

- Full Network takes the longest time to converge.
- Full Network and Random 2D Network surprisingly take longer than the remaining topologies, despite having more number of neighbors which we initially thought would span better decreasing the convergence time.
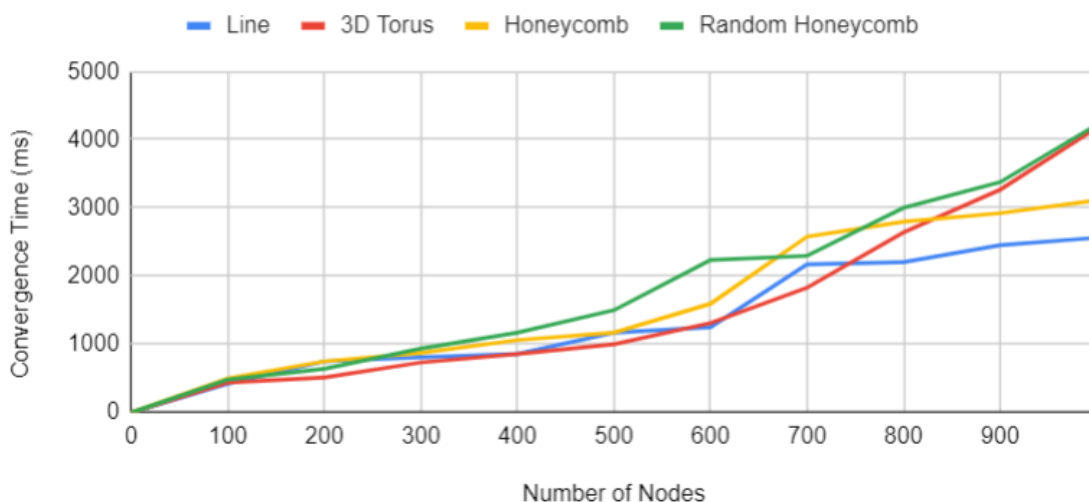

- Line Network takes the shortest time to converge.
- 3D Torus Network was initially the fastest of all but later it's convergence time increased as the number of nodes increases.

The following are the **interesting observations** for convergence times across all topologies for **Push-Sum protocol**:

- Line Network performs the worst of all topologies. The convergence time for this network increases exponentially and it behaves differently than the other topologies.
- Honeycomb network, after Line network takes the longest time to converge.


Push Sum Algorithm
Number of Nodes vs Convergence Time
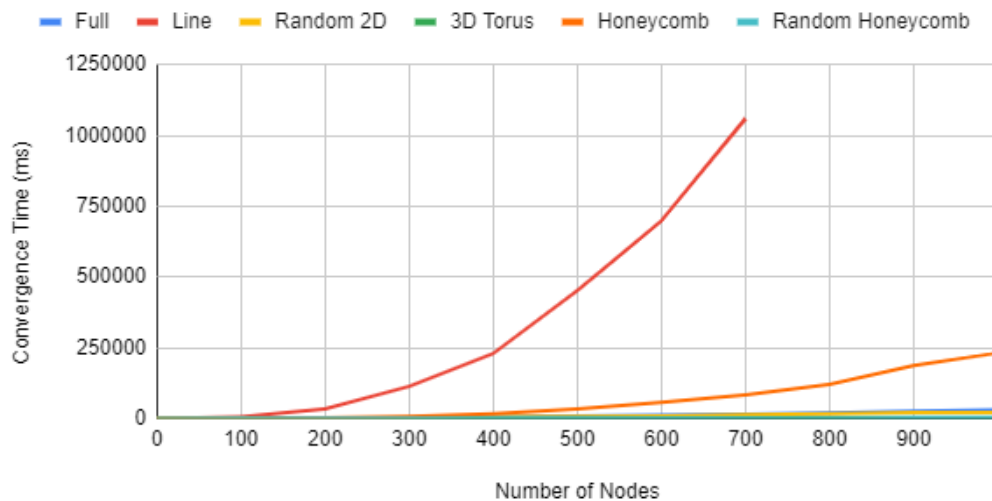
- 3D Torus and Random Honeycomb networks perform better than the remaining topologies.
- Random Honeycomb performs the best of all topologies.
- Upto first 400 nodes, Full network and Random 2D grid perform almost the same which is also the case with 3D Torus and Random Honeycomb.

Push Sum Algorithm
Without Line Network and Honeycomb Network
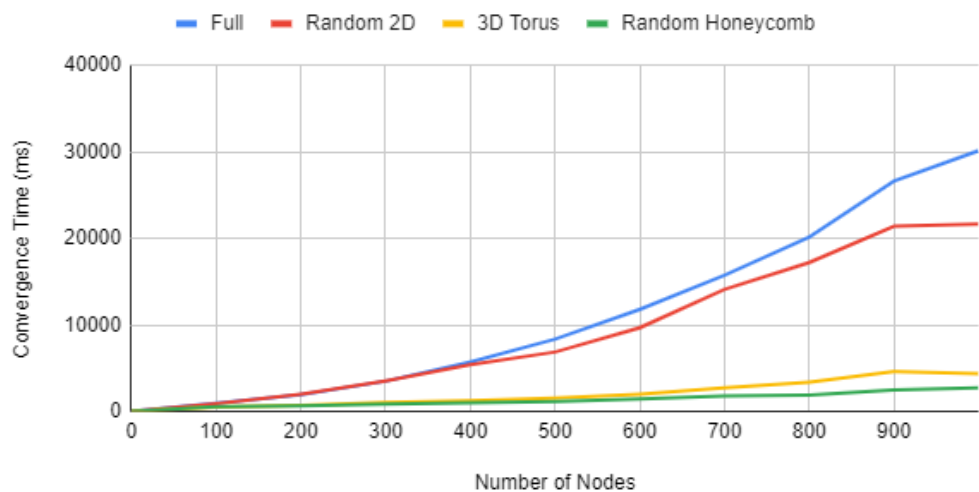
The maximum possible network capacity for each topology for the given constraints is as follows:

Gossip:

Topology	Maximum Nodes	Convergence Time
Full	5000	194237
Line	5000	170359
Random 2D	5000	337297
3D Torus	5000	143422
Honeycomb	5000	160756
Random Honeycomb	5000	188406

Push Sum:

Topology	Maximum Nodes	Convergence Time
Full	5000	217852
Line	700	1059579
Random 2D	5000	240658
3D Torus	5000	172610
Honeycomb	2000	515266
Random Honeycomb	5000	61766

Measuring Time:
We have measured the time taken to setup the network as t1. Then we start the clock again to measure the convergence time taken as t2.