

COP5615 – Fall 2019

PROJECT - 2

1. Group Members

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Steps to run:

1. Unzip the file and navigate inside the folder
2. Open Terminal (with elixir installed)
3. For running:
Executable file supported : `./gossip_protocol <numNodes> <topology> <algorithm>`
example: `./gossip_protocol 100 full gossip`

Otherwise, build mix project using `mix escript.build` and follow the above steps

What is working

Topologies	Gossip	Push-Sum
Full (full)	Working	Working
Line (line)	Working	Working
3D Torus (3Dtorus)	Working	Working
Random 2D (rand2D)	Working	Working
HoneyComb (honeycomb)	Working	Working
Random Honeycomb (randhoneycomb)	Working	Working

To Run Topology : (instead of topology)

1. Full - full
2. Line - line
3. 3D Torus - 3Dtorus
4. Random 2D - rand2D
5. Honeycomb - honeycomb
6. Random HoneyComb - randhoneycomb

To Run Algorithm : (instead of algorithm)

1. Gossip - gossip
2. PushSum - push-sum

What is the largest network you managed to deal with for each type of topology and algorithm

Due to system constraint could not run for bigger values, it runs but very slow but tried and tested for below:

Topologies	Gossip	Push-Sum
Full	10000	5000
Line	10000	5000
Random 2D	10000	5000
3D torus	50000	10000
Honey Comb	20000	10000
Random HoneyComb	50000	10000

Topology Properties:

1. Full:

In this network, each node is connected to every other node in the network except itself. This algorithm has chances to converge faster if every node receives equal opportunity to receive a rumour, but if that fails then takes more time to converge.

2. Line:

In line Topology, Each node is connected to before and after node except the first and the last node which is connected to only one node either before the node or after the node.

3. Random 2D:

In Random 2D we place the coordinates of a node as x and y parameter and they have neighbours which are at a distance of 0.1. Similar to Line and Full, if the node is connected to many nodes then the chance of convergence increases on node failure of its neighbor, but in some cases it keeps waiting for rumour to be heard until its picked up by the neighbor.

4. 3D Torus:

In 3D Torus, the network is connected to 6 neighbors which can be represented as x^+ , x^- , y^+ , y^- , z^+ , z^- . The network performs well as they converge faster because probability of rumour heard is $\frac{1}{6}$, therefore they converge faster as compared to other nodes.

5. HoneyComb:

HoneyComb networks have a maximum of 3 neighbors and can have 1 or 2 neighbors as well. The built network converges faster but not that relative to random honeycomb and 3D torus. Because it is connected in a sequential flow the time taken for a rumor to initially reach a node is more for honeycomb.

6. Random HoneyComb:

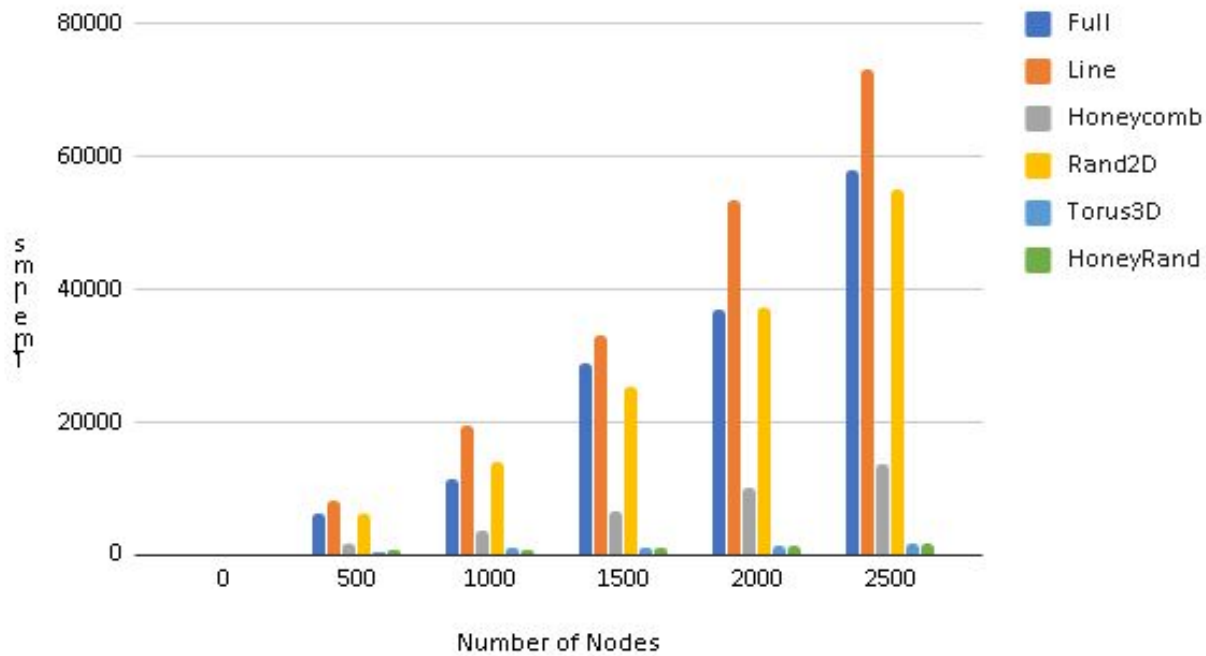
Like honeyComb network random honeycomb is connected to at most 3 neighbors and has an extra 1 neighbor which is randomly picked from the network other than itself or the ones who are already a neighbor. Random

HoneyComb performs on par with 3Dtorus sometimes even better, because the chances of failure nodes all to fail at one time is not that frequent.

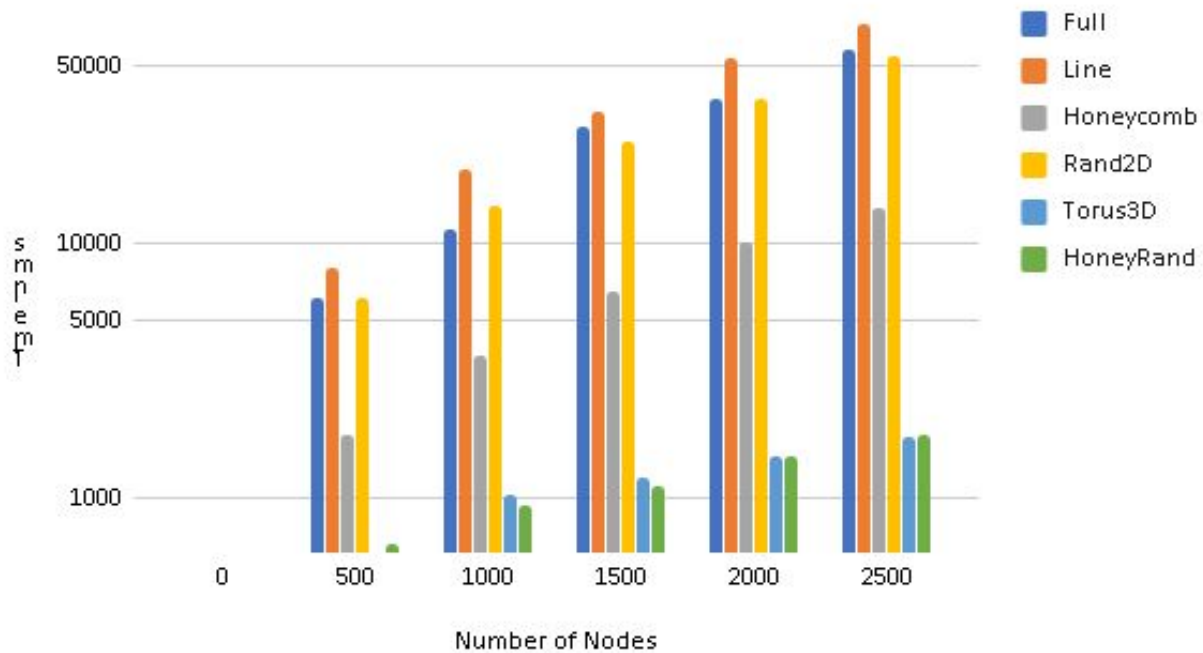
Charts for Observation:

Gossip

Gossip Algorithm



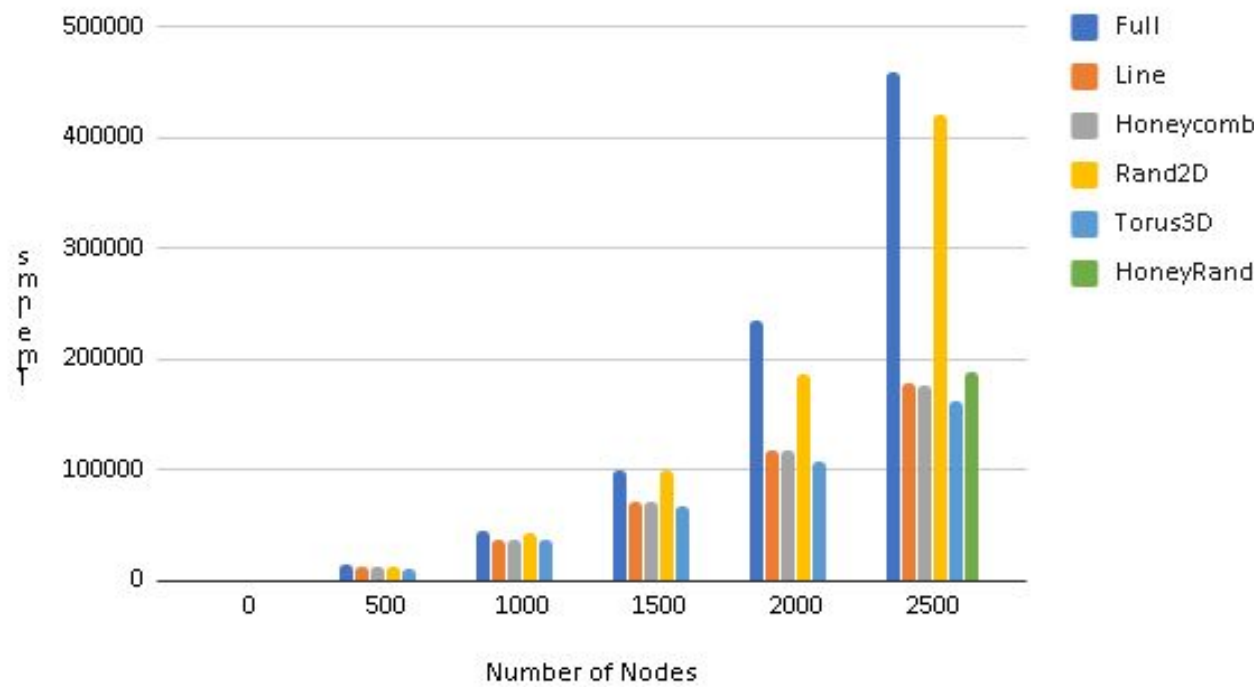
Gossip Algorithm



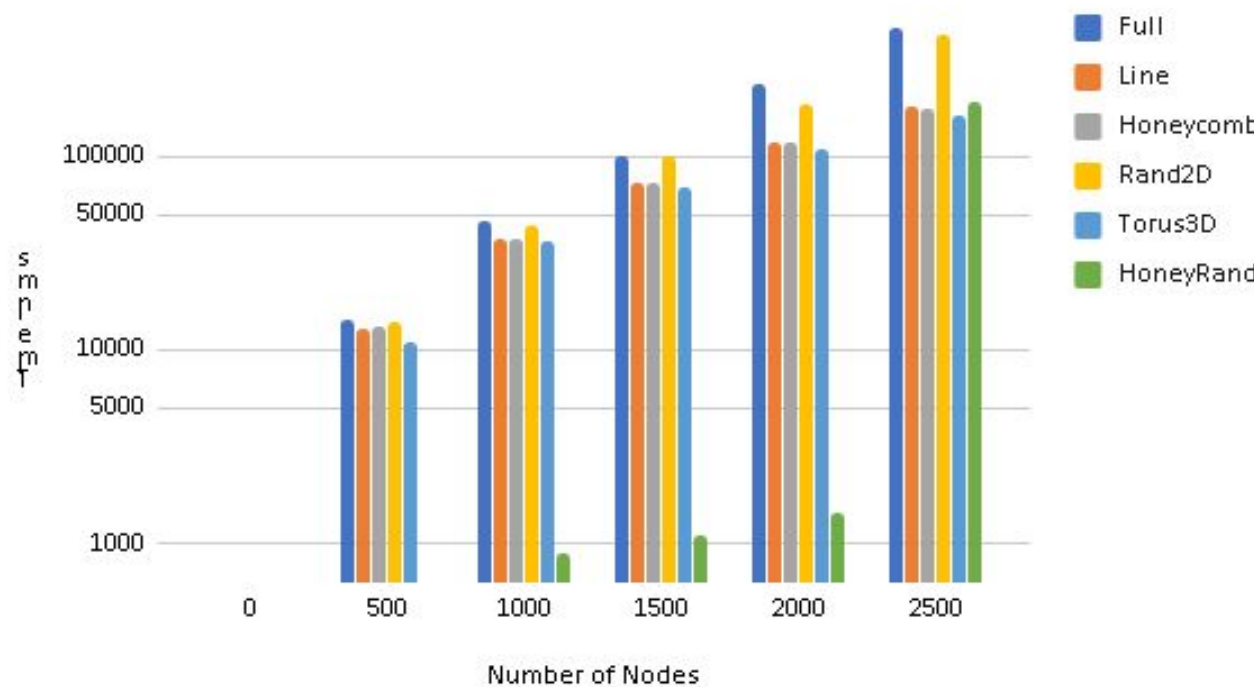
Logarithmic Scale

Push-Sum

Push-Sum Algorithm



Push-Sum Algorithm



Logarithmic Scale

Topology Properties:

1. Gossip Algorithm:
Gossip Algorithm which is used to propagate information on a network. Implemented convergence of nodes when the number of times rumor is heard is 10.
2. Push-Sum Algorithm:
Push-Sum was designed using the fact that if the average sum/weight ratio of a node is not changed (10^{-10}) for more than 3 times then it converges.

How it was designed

1. Convergence Parameter:
Convergence is achieved if the condition such as for gossip protocol when count > 10 or for push-sum when the difference in $s/w < (10^{-10})$ is three times. Also the algorithm is designed to inform it's neighbor that it would not be active anymore, hence if its neighbors are dead, the node is terminated.
2. Convergence Time:
Convergence time is calculated by the difference of the start of node time to that of its end when it is converged in milliseconds.

Interesting Observations made:

1. Gossip propagation takes less time to propagate as number of nodes increases for even Line topology which takes more time as compared to others as compared to push-sum.
2. HoneyComb Random has the highest probability of converging at a faster rate, followed by 3D torus and HoneyComb topology.
3. Line Topology failure is mainly because that the neighbors of a particular node are deleted quickly as they are in sequential order, which results in failing to converge at a faster time
4. For gossip as number of nodes increase, Line Topology takes more time as compared to others.
5. For Push-sum algorithm, line topology is on par with honeycomb topology and Full topology takes the most time.
6. Since we used the concept of node to terminate if its neighbor node is not active the converging was achieved faster, rather than waiting for all nodes to converge.
7. Gossip convergence time sequence Random HoneyComb $<$ 3D Torus $<$ HoneyComb $<$ Random 2D $<$ Full $<$ Line.
8. Push-Sum convergence time sequence Random HoneyComb $<$ 3D Torus $<$ HoneyComb $<$ Line $<$ Random 2D $<$ Full .

Data Used for Chart preparation

Gossip

Gossip						
	Full	Line	Honeycomb	Rand2D	Torus3D	HoneyRand
0	0	0	0	0	0	0
500	6173	8078	1770	6153	609	661
1000	11342	19672	3658	14035	1033	935
1500	28960	32951	6533	25410	1217	1113
2000	36933	53401	10118	37355	1461	1472
2500	57866	73171	13846	55169	1736	1764
3000	74928	102025	18543	73985	2180	1982
3500	104194	129311	24656	99412	2577	2346
4000	115899	167044	31210	122185	2592	2605
4500	144190	207391	41390	151621	3134	2859
5000	171841	255199	48473	178067	3880	3206

Push-Sum

		pushsum				
	Full	Line	Honeycomb	Rand2D	Torus3D	HoneyRand
0	0	0	0	0	0	0
100	1465	1431	1350	1371	1234	354
200	3644	3451	3201	3265	2834	444
400	9349	9071	8148	8636	7546	529
500	14267	12855	13218	14028	11036	625
800	28986	24846	23566	27726	22200	753
1000	45670	37441	37382	43546	36552	896
1500	99217	72480	72301	99887	68183	1118
2000	235920	118308	117631	186427	108477	1440
2500	458710	179476	175924	420527	163132	188490
3000	738323	249273	259100	713187	228260	258641
3500	335270	336977	356006	1085938	320188	340044

Screenshots:

```
Generated escript gossip_protocol with MIX_ENV=dev
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 full gossip
Gossip algorithm
full topology
Convergence Time: 18388 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 line gossip
Gossip algorithm
line topology
Convergence Time: 20541 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 random2D gossip
Gossip algorithm
Wrong topology
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 rand2D gossip
Gossip algorithm
Random 2D topology
Convergence Time: 14717 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 3Dtorus gossip
Gossip algorithm
3D torus topology
Convergence Time: 1101 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 honeycomb gossip
Gossip algorithm
Honeycomb topology
Convergence Time: 4752 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 randhoneycomb gossip
Gossip algorithm
Random Honeycomb topology
Convergence Time: 1015 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 randhoneycomb push-sum
Push-Sum algorithm
```

```
Honeycomb topology
Convergence Time: 4752 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 randhoneycomb gossip
Gossip algorithm
Random Honeycomb topology
Convergence Time: 1015 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 randhoneycomb push-sum
Push-Sum algorithm
Random Honeycomb topology
Convergence Time: 43360 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 honeycomb push-sum
Push-Sum algorithm
Honeycomb topology
Convergence Time: 43699 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 3Dtorus push-sum
Push-Sum algorithm
3D torus topology
Convergence Time: 44011 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 rand2D push-sum
Push-Sum algorithm
Random 2D topology
Convergence Time: 57549 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 line push-sum
Push-Sum algorithm
line topology
Convergence Time: 43558 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $ ./gossip_protocol 1000 full push-sum
Push-Sum algorithm
full topology
Convergence Time: 58456 ms
floura@floura-Inspiron-N5050 ~/Downloads/Nadarsaxeena/NadarSaxeena $
```