PROJECT 2 - BONUS REPORT

Group Members:

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Topologies implemented are:

• Line Topology
• Full topology
• Imperfect Line Topology
• Torus Topology
• Random 2D Topology
• 3D Topology

Algorithms Implemented are:

• Gossip Protocol
• Push-Sum Algorithm

Failure Model for Algorithms:

We are taking a fourth parameter as the number of nodes to kill from the user.

$ escript project2_bonus <No. of Nodes> <Topology> <Algorithm> <No. of Nodes to Kill>

The given number of nodes will be killed, and the convergence time will then be calculated, as the time it takes for the remaining nodes to reach convergence. The nodes to kill will be randomly selected by a function.

Experiments Performed:

We are varying the number of failed nodes and keeping the number of nodes fixed for a given topology and algorithm. We are plotting graphs for both the algorithms for all the topologies. On x-axis we have the number of nodes killed and on y-axis we have time taken to reach convergence. We are keeping the number of nodes equal to 200 nodes. For Analysis, we observed the convergence time for different values of <Number of nodes to kill>. We kept killing the nodes with an increase of 20 nodes. (e.g. 20 -> 40 -> 60 and so on till 100). As the number of neighbors gets decreased, the network becomes less dense and hence more time is required to converge.

Failure Model for Gossip Protocol: Convergence Times

FULL

No. of Nodes	Time for Convergence (milliseconds)
0	2458
20	2607
40	3156
60	4249
80	4999
100	8002

3D

No. of Nodes	Time for Convergence (milliseconds)
0	2521
20	2734
40	4287
60	5614
80	7672
100	9650

TORUS

No. of Nodes	Time for Convergence (milliseconds)
0	1957
20	2629
40	3666
60	4838
80	7344
100	10870

IMPERFECT LINE

No. of Nodes	Time for Convergence (milliseconds)
0	3390
20	3460
40	4936
60	5600
80	6412
100	8080 +

LINE

No. of Nodes	Time for Convergence (milliseconds)
0	10124
20	12588 +
40	12788 +
60	13929 +
80	14011 +
100	15002 +

RANDOM 2D

No. of Nodes	Time for Convergence (milliseconds)
0	5407
20	4460
40	4265
60	6578
80	7780
100	9980

+ → indicates failure to converge, value reported after multiple attempts
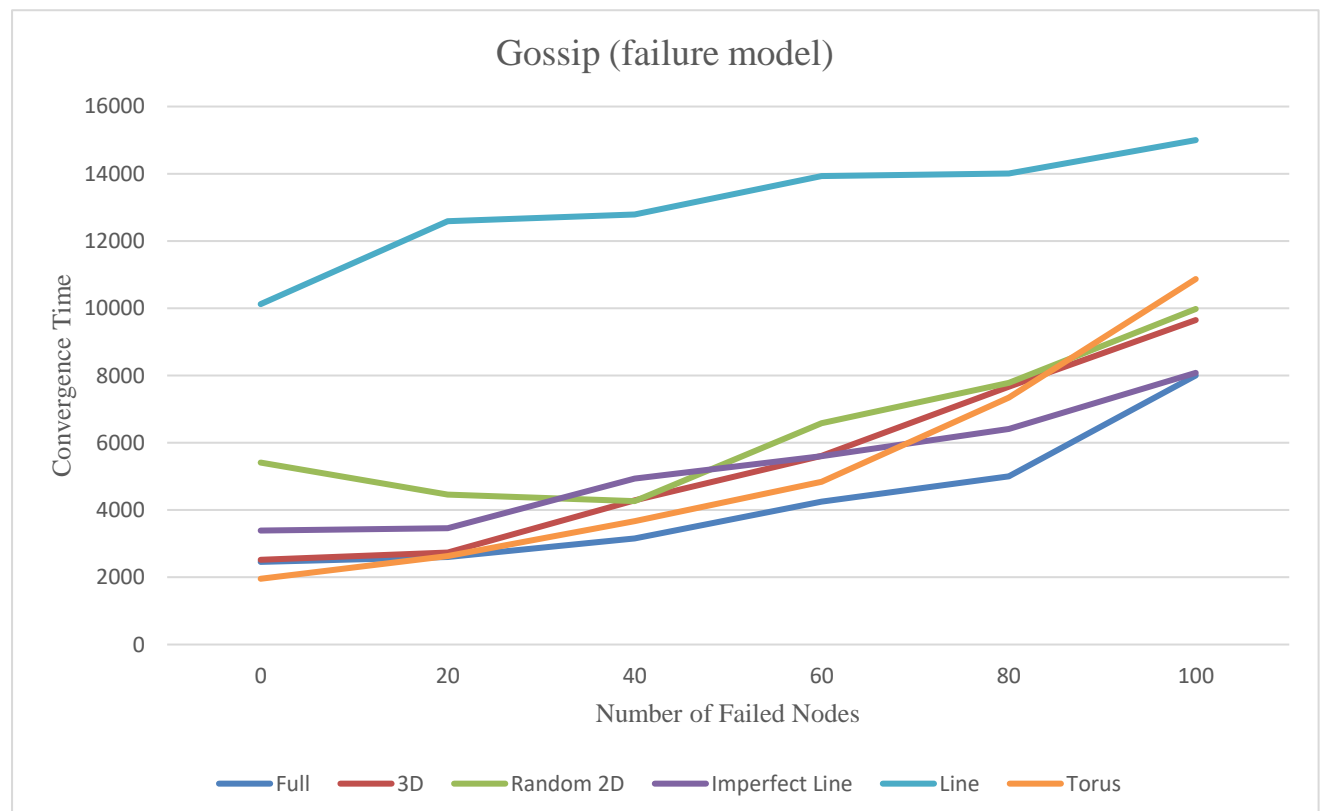
Interesting Observations:

- Full, 3D, Random 2D and Torus topologies showed successful convergence even with 50% nodes failure, whereas Imperfect line topology took multiple attempts to converge as 50% of the nodes were killed. And Line topology failed to converge even with small number of failed nodes.
- In Line topology, killing only a single node also causes the network to fail to converge. We tested it by giving different values for number of nodes to kill.
- Full topology came out to be the most fault tolerant taking least time to converge.

Failure Model for Push-Sum Protocol: Convergence Times

FULL

No. of Nodes	Time for Convergence (milliseconds)
0	864
20	2087
40	3556
60	4897
80	6779
100	8020

3D

No. of Nodes	Time for Convergence (milliseconds)
0	9757
20	10498
40	10669
60	11221
80	10026
100	14007

TORUS

No. of Nodes	Time for Convergence (milliseconds)
0	2625
20	3172
40	5260
60	7436
80	9060 +
100	11088 +

IMPERFECT LINE

No. of Nodes	Time for Convergence (milliseconds)
0	2306
20	3169
40	5935
60	7562 +
80	8220 +
100	8560 +

LINE

No. of Nodes	Time for Convergence (milliseconds)
0	2462
20	5040 +
40	6502 +
60	8200 +
80	12052 +
100	15850 +

RANDOM-2D

No. of Nodes	Time for Convergence (milliseconds)
0	6092
20	3488
40	4156
60	6656
80	7569
100	9786

+ → indicates failure to converge, value reported after multiple attempts

Push-Sum (failure model)
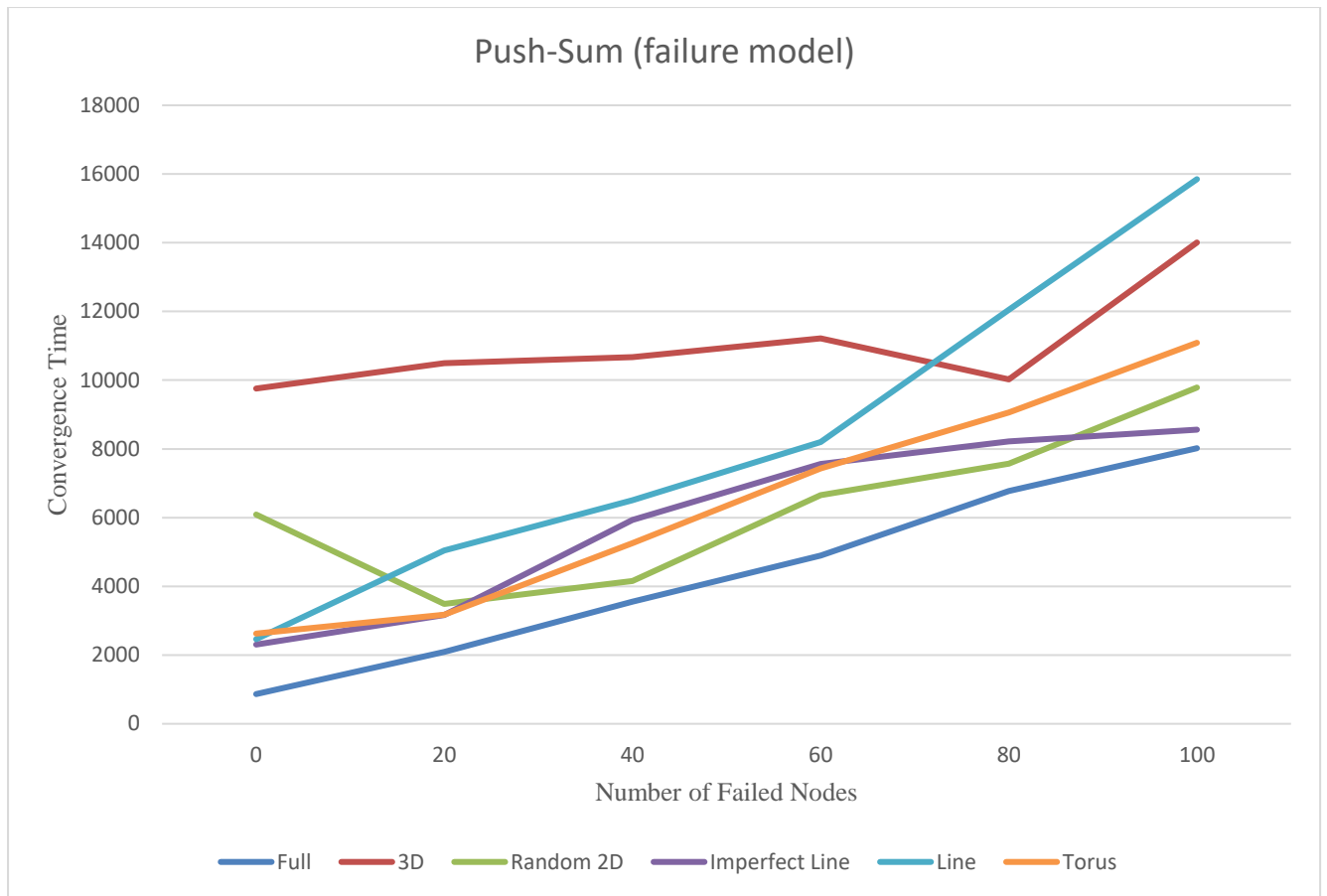
Interesting Observations:

- Full, 3D, Random 2D topologies showed successful convergence even with 50% nodes failure, whereas Imperfect line topology took multiple attempts to converge as 30% and more percentage of the nodes were killed. Torus topology also struggled to converge as 40% and more percentage of the nodes were killed. And Line topology failed to converge even with small number of failed nodes.
- Full topology was still the most fault tolerant having least convergence times.