Project 2 - Understanding gossip protocol and pushsum algorithms

COP5615 Distributed Operating Systems at the University of Florida.

Contribution

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How to run

enter into erl mode compile the code by doing c(algo). Run the alogorithm by directing the command algo:start(number of nodes, topology, type of algorithm)

What is Working

With the `gossip` or `push-sum` protocol, we are able to run all `line` , `2D` , `complete` and `Imp2D` operations. The convergence in Gossip protocol is achieved when all the nodes have converged. A node is set to be converged when it listens to the message for the 10th time. After convergence, the node stops communicating with its neighbor. The total time for convergence is reported out once the network has converged, or when all nodes have converged.

Gossip

Normal Scale

- We have observed the following facts from this project
- The `slowest` to converge is line topology. This is as a result of the fact that it only has access to two neighbors. (left and right node).
- In every circumstance that is possible, full topology converges the `fastest` . This is because it is connected to all the nodes, making convergence in this situation faster to accomplish.
- As intended, 2D and imperfect 2D will reach the convergence time between the line and full, with imperfect 2D performing slightly better or equivalent to 2D performance.

Note: All nodes weren't converging, on multiple runs we would notice that the convergence rate of topology would be 80-90%. This is because of the fact that the structure breaks while converging and some nodes are unreachable. In order to tackle this problem, we keep a track of all nodes that aren't converged, select one non converged node at random and keep sending messages till the time topology doesn't achieve the convergence.

PushSum

The PushSum network works by sending message `s` and `w` as parameter to an actor. The intial value of `s` is equal to the index of the actor and `w = 1`. The propagation stops when an actor's `s/w` ratio does not change for 3 times in a row (i.e stays within limit of 10^-10)

Note: Unlike gossip algorithms, the push sum algorithm is able to converge in all topologies. We believe this is due to the fact we try to reduce the value s/w ratio till it does stop changing the ratio for consecutive three times. This allows in more messages being transmitted compared to the gossip algorithm allowing the network to converge. This also causes an increase in convergence time.

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

For each topology and technique, we have been able to solve networks with up to 10,000 nodes. In order to compare the network, we chose to set the cap at 10,000 nodes. Notice that other topologies (full, 2D, and imp2D) could run on larger nodes within a reasonable time frame.

The outcomes of executing the topologies in various combinations are listed below.

Interesting finds

- Since every node is connected to every other node in a full topology network, the likelihood of receiving messages from other nodes rises dramatically, outperforming all other topologies for the Gossip algorithm. With comprehensive topology, there is hardly any blindspot (nodes that never converge). Thus, it is the optimum topology for spreading the rumor.
- In the case of PushSum, if we reduce the gradient of s/w (i.e. `delta`) 10^-10 to 10^-5, the topology convergence time is also reduced to half.
- Since the neighbor's number is the smallest, the line algorithm (topology) will perform badly, increasing the likelihood of failure.