

DISTRIBUTED ALGORITHMS (IN4150)

LAB 3 REPORT

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December 23, 2022

1 Algorithm Implemented

Afek's and Gafni's algorithm for election in an asynchronous complete network

2 Test Cases

Scenario 1: Only One Candidate

In this simplest scenario we constructed a complete network of 4 nodes, and let node 0 to initiate the election at the beginning. In this case, node 0 consecutively captures all nodes and becomes the leader.

- **number of messages:**

Capture: 3

Kill: 0

Acknowledgement: 3

- **maximum level reached:**

Only node 0 reaches level 3, as he captures everybody else. Other nodes are has level 0, 1, 2, respectively, according to the order they were captured by node 0.

- **time of captures:**

Node 0 is captured 0 times, since he is the only capturer. The other nodes are captured once by Node 0.

Scenario 2: Two Candidates Starting at Nearly the Same Time

For simplicity and clearness, we still consider a scenario with 4 nodes. Node 0 and Node 1 both starts the election at the beginning, while Node 0 sends a capture to Node 2, and Node 1 sends to Node 3.

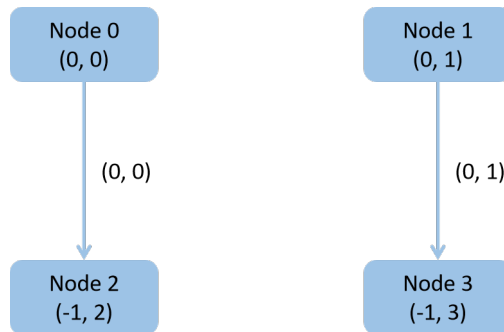


Figure 1: Phase 1

Node 2 and 3 is then captured, sending back their acknowledgements. Node 0 and Node 1 thus has a higher level.

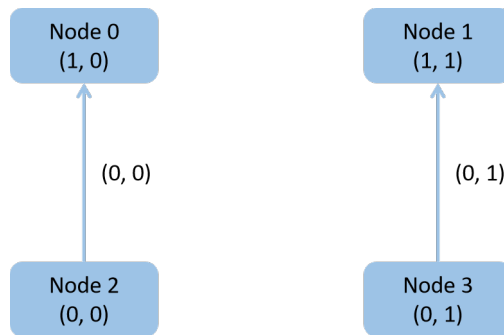


Figure 2: Phase 2

Node 0 then tries to capture Node 3, and Node 1 tries to capture Node 2. Node 2 and Node 3 both sends to their original parents a kill message. Because Node 1 has a higher ID, Node 0 is killed and Node 1 is not. Node 0 then sends the OK message to Node 2, Node 2 sends the ACK to Node 1. making Node 1 capturing node 2.

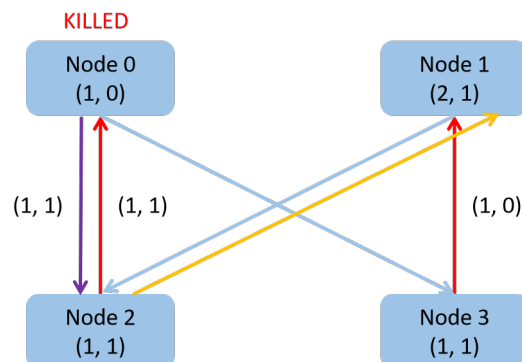


Figure 3: Phase 3

Finally, Node 1 sends a CAPTURE to Node 0 to capture the final victim, and succeeded.

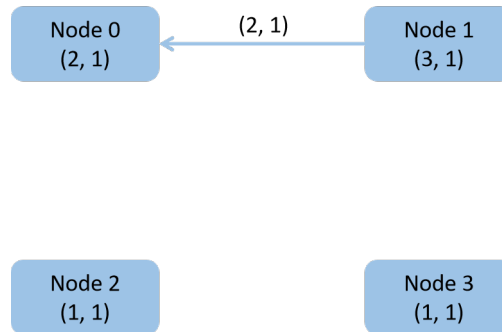


Figure 4: Phase 4

- **number of messages:**
 Capture: 5. 3 by Node 1, 2 by Node 0. And 1 eventually ignored by Node 3.
 Kill: 2. Kill attempt from Node 2 to Node 1 succeeded. Kill attempt from Node 3 to Node 0 failed.
 Acknowledgement: 4.
- **maximum level reached:**
 Only Node 3 reaches level 3, as he captures everybody else. Node 2 has max level 2 because of being captured by Node 3. However, by himself, he reached level 1. The other has level 1.
- **time of captures:**
 Node 0 is captured 1 time. Node 2 is captured 2 times. Node 3 is captured 1 time.

Scenario 3: Four Candidates Starting at Nearly the Same Time

In this situation, we let all of the nodes to start together, making the situation chaotic. Eventually, the algorithm terminated. Because we chose to randomly send Captures to untraversed links, and has random delay time, the process is hard to explain. However, we documented the stats.

- **number of messages:**
 Capture: 7.
 Kill: 1.
 Acknowledgement: 4.
- **maximum level reached:**
 Only Node 3 reaches level 3, as he captures everybody else. Node 2 has max level 2 because of being captured by Node 3. However, by himself, he reached level 1. The other has level 1.
- **time of captures:**
 Node 0 is captured 1 time. Node 2 is captured 2 times. Node 3 is captured 1 time.

Scenario 4: Network with 30 nodes

In this situation, we increased the amount of nodes to 30 to test the robustness of the algorithm. We set a 0.25 probability for a node to become a candidate. And if a node will be a candidate, we randomly set its election starting time according to an exponential distribution with $\lambda = 0.1$. The statistics are as follows:

- **number of messages:**

Capture: 86.

Kill: 3.

Acknowledgement: 54.

- **maximum level reached:**

Node 16 reaches level 30, as he captures everybody else. Node 28 reached level 8 and was killed because of Node 16.

- **time of captures:**

Total number of capture is 54, mainly due to captures by Node 16 and Node 28.