Exercise Solution Sheet 2 - Group 06

- Group Members
1. RaviPrasad Marike Ramesh 387219
2. Darshan Hingu 380584
3. Swamy, Seema Narasimha 384418
4. Yuchun Chen 387275

Exercise 1.1: Bully Algorithm

i) Describe the Bully Algorithm
Answer: Many distributed systems needs one process to act as leader or coordinator. The bully algorithm is one of the basic algorithms for leader election. It assumes that all nodes are given a unique ID that imposes a total ordering of the nodes. The current leader at any time is the node with the highest id participating in the cluster. The idea behind Bully Algorithm:

- Each process wakes up, either as initiator or at the latest when it receives a message from its neighbor node
- Each waking up starts a complete ring circulation
- At the end of its circulation, each node receives a message with its own identity and the ID of the node with the largest ID within the ring
- If both IDs are identical, the node has won the election; otherwise it has lost
- Highest of all nodes wins the election

ii) How many messages are passed for a leader election with the bully algorithm
Answer: For unidirectional Bully algorithm, n to power of 2 messages are required and n complete circulations.

iii) The Bully Algorithm is an example for a leader election. Give examples of applications that need a unique leader.
Answer: Some of the applications of Bully Algorithm:

a) No SQL Database systems
b) Mobile information systems

Exercise 1.2: Election

i)Best Case:
Trial 1: 11+ 6

ii) Average case:
Trial 1: 13+6
Trial 2: 15+6
Trial 3: 17+6

iii) Worst case:

Trial 1: 21+6

ii) There is a precondition for the algorithm of Chang and Roberts that all node IDs have to be unique (no duplicate IDs). Assume, we drop this precondition and allow multiple nodes to have the same ID.

1. Does the algorithm still work properly? Please provide a reasonable answer

Answer: **Yes** the algorithm will work properly, When a current node receives the id of incoming node, the current node then compares the incoming node's id with itself, if current node id is same as the incoming node's id, the current node will make itself the Leader and it sends an announcement around the ring and termination of election happens.

2. In which cases does the algorithm still deliver a proper result? Explain at least two cases.

Answer:

Case 1: If there is only 1 initiator the algorithm will still deliver a proper result.

Exercise 1.3: Process MeshAlgorithm (Maekawa)

i) What is the advantage of the Maekawa algorithm against the Broadcast Algorithm

Answer:

It requires less messages per access and query less amount of nodes.
It does not include the involvement of all process in each coordination.
It does not require the permission from each process.

ii) The Meakawa Algorithm is not deadlock free. Give an example of a deadlock situation

Answer:

Maekawa's algorithm can deadlock because a site is exclusively locked by other sites and requests are not prioritized by their timestamps.

Assume three sites Si , Sj , and Sk simultaneously invoke mutual exclusion.
Suppose Ri ∩ Rj= {Sij}, Rj ∩ Rk= {Sjk}, and Rk ∩ Ri= {Ski}.
Consider the following scenario:

- Sij has been locked by Si (forcing Sj to wait at Sij).
- Sjk has been locked by Sj (forcing Sk to wait at Sjk).
- Ski has been locked by Sk (forcing Si to wait at Ski).

This state represents a deadlock involving sites Si , Sj , and Sk .