PS Algorithms for distributed systems

Exercise Sheet 2

https://avs.cs.sbg.ac.at/

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Exercise 2.1

Given a synchronous, anonymous, uniform network with n nodes for which the graph of the network is connected and does not contain cycles, prove that a leader can be elected in this network by using a randomised algorithm which runs in $O(n)$ rounds using $O(n)$ messages in expectation.

Hint: In case of multiple potential leader candidates, perform the tiebreaking as simple as possible.

Exercise 2.2

Given a synchronous, anonymous, non-uniform ring with n nodes, let $L \cup V$ with $|L| \geq 1$ where each node $v \in V$ knows if it belongs to L itself or not. Prove that in the end, all nodes can verify if L is a valid set of leaders ($|L| = 1$) in $O(n)$ rounds using $O(n)$ messages. Can the verification algorithm also be formulated for asynchronous rings? What is the difference?

Exercise 2.3

Consider the following zero-round (randomized) leader election algorithm. Each node declares itself the leader with probability p. The algorithm is successful if there is exactly one leader. For what choice of p is the algorithms success probability the highest? Prove your choice. What is the lower bound for the success probability of the algorithm in this case?