UV Distributed Algorithms

Exercise Sheet 1

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

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Exercise 1.1

In the lecture we assumed that given a synchronous, uniform ring with unique identifiers, for the Clockwise algorithm, each node has a designated clockwise and counterclockwise port. Prove that even if the two neighbors are indistinguishable (i.e., a message can only be sent to both neighbors and upon receiving a message it is not know from which neighbor it was sent), we can still appoint a leader in $O(n)$ rounds using $O(n^2)$ messages.

Exercise 1.2

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?

The following exercises are not available for a presentation slot.

Exercise 1.3

Given a synchronous, non-anonymous ring with n nodes, prove that there exists configurations of IDs for which the Clockwise algorithm from the lecture runs using $\Theta(n)$ and $\Theta(n^2)$ messages respectively.

Exercise 1.4

Given a synchronous, anonymous, uniform ring with n nodes where a leader has already been elected, prove that we can assign unique IDs to each node in $O(n)$ rounds.