



## Principles of Distributed Computing

### Exercise 2: Sample Solution

#### 1 Leader Election in an “Almost Anonymous” Ring

- a) Yes, it is possible:

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**Algorithm 1** Leader Election (all but one nodes have the same ID)

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```
1: send IDs two hops around the ring
2: if the same ID has been received twice AND the received ID differs from the own ID then
3:   I am the leader
4: end if
```

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#### 2 Distributed Computation of the AND

- a) Because the size of the ring is not known to the nodes, the case where all nodes have a one as input and the case where all but one nodes have a one as input cannot be distinguished.
- b) All input values have to be sent all around the ring. In order to detect the returning of the own message, we add a hop counter to each message. If the message has made  $n$  hops, it has arrived where it started.
- c) The following algorithm calculates the AND in a synchronous, non-uniform ring:

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**Algorithm 2** AND in the Ring: asynchronous, non-uniform ( $n$  is the number of nodes)

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```
1: if input bit = 0 then
2:   send 0 to the neighbor in the ring
3: end if;
4: for  $i := 2$  to  $n$  do
5:   if received a 0 and have not already sent a 0 then
6:     send 0 to the neighbor in the ring
7:   end if
8: end for;
9: if received at least one 0 then
10:  result := 0
11: else
12:  result := 1
13: end if;
```

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If the result is 1, no message is sent, otherwise there is exactly one message over each link. Thus, time and message complexity are both  $n$ .