1 Leader Election with Failures

Consider the leader election problem on a complete graph in the synchronous message passing model. That is, every node has a unique ID and at end of the algorithm, every node that did not crash has to output the ID of the leader node.

Explain how to adapt the \((f+1)\)-round lower bound proof for consensus from the lecture to show that if at most \(f \leq n - 2\) processes may fail during the protocol, at least \(f + 1\) rounds are needed to solve leader election.

2 \(k\)-set agreement

A generalization of consensus is the \(k\)-set agreement problem: Every node has an input value and at the end every node has to output a value such that the following properties are fulfilled:

1. Agreement: There must not be more than \(k\) different output values.

2. Validity: Every node must output a value which was input of some node.

Show that on a complete graph in the synchronous message passing model with at most \(f\) node failures, the \(k\)-set agreement problem is solvable in \(\lceil f/k \rceil + 1\) rounds.