

Exercise 4

1 Perfect Failure Detectors

For this question, assume that every processing step takes no time, i.e., $\Phi = 0$.

- a) Assume that a bound Δ on message delay is known and holds always. Design a *perfect* failure detector $\mathcal{D} \in \mathcal{P}$.
- b) According to the eventual synchrony model, assume that a bound Δ on message delay exists, but is not known to the protocol designer, and furthermore, that the bound holds only after the global stabilization time t_S . Design an *eventually perfect* failure detector $\mathcal{D} \in \diamond\mathcal{P}$.

2 Leader Election

Leader election is the problem of choosing one server among the group that has not failed. A protocol for leader election outputs the index ℓ of a newly elected leader at every server, under the following two conditions:

Completeness: Unless all servers have crashed, some correct server is eventually elected as the leader.

Safety: If some server is elected as the leader, then all previously elected leaders have crashed.

The second condition implies that the protocol must never elect two different servers as the leader while both are correct.

- a) Given a perfect failure detector $\mathcal{D} \in \mathcal{P}$, design a protocol for leader election.
- b) (*bonus question) Explain why a protocol for leader election cannot be implemented from an eventually perfect failure detector $\mathcal{D} \in \diamond\mathcal{P}$, by describing an execution of any such protocol that violates the safety property.