Session 5: Exercises

M2 MOSIG: Large-Scale Data Management and Distributed Systems

Thomas Ropars

2023

1 About the consensus problem

Question 1.1: *Show that each of the consensus properties (validity, uniform agreement, termination) is necessary to make the problem non-trivial (i.e., omitting one of the properties makes the problem trivial to solve even if processes may crash). Give the pseudo-code for the three solutions.*

2 Consensus in a synchronous system

Question 2.2: *Prove that the FloodSet consensus algorithm (Algorithm 4 in the lecture notes) satisfies uniform agreement.* Hint: *Adapt the proof of Algorithm 2.*

Question 2.3: *Consider the FloodSet consensus algorithm, and replace the condition $r == f + 1$ by $r == f$. Show that the modified algorithm is incorrect for $f \leq n - 2$.*

Question 2.4: *Consider the FloodSet consensus algorithm, and replace the condition $r == f + 1$ by $r == n - 1$. Prove that the modified algorithm satisfies uniform agreement.*

Question 2.5: *Consensus has been defined in the crash-stop model (processes do not recover after a crash). Consider instead the crash-recovery model, in which processes may recover after a crash. In this model processes have access to a local stable storage (e.g., disk) that survives a crash. In the context of consensus, for every process p_i, the initial value of p_i is stored on disk. A process has decided once its decision value is written to stable storage.*

Assume that processes always recover after a crash, and eventually stop crashing. Consider fair channels and an asynchronous system.

Give an algorithm that solves consensus under these assumptions.