Grenoble INP / UJF – Academic year 2015-2016
MOSIG2 – PDES
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Distributed Systems
Final examination

Duration: 3 hours
All paper documents allowed, no electronic devices

PART 2 (12 points):

Question 4

Let us assume that 3 machines execute the Paxos protocol. The machines are named P1, P2 et P3.

- Machine P1 uses the following set of sequence numbers: {1, 4, 7, 10, …} and would like to propose value V1.
- Machine P2 uses the following set of sequence numbers: {2, 5, 8, 11, …} and would like to propose value V2.
- Machine P3 uses the following set of sequence numbers: {3, 6, 9, 12, …} and would like to propose value V3.

For each of the following states, answer the following questions:

- Can the system reach that state?
    - If yes, propose a sequence of PREPARE and ACCEPT messages (together with the answers to these messages) that lead to that state.
- Is the outcome of the consensus known?
    - If yes, what is the outcome?
    - If no, what are the possible outcomes?

State S1: P1 accepted (3, V3), P2 accepted (1, V1), P3 accepted (3, V3)
State S2: P1 accepted (1, V1), P2 accepted (2, V2), P3 accepted (3, V3)
State S3: P1 accepted (1, V1), P2 accepted (2, V2), P3 accepted (3, V1)
State S4: P1 accepted (1, V1), P2 accepted (2, V2), P1 accepted (1, V1)

Question 5

Which modifications would you make to the Paxos protocol if processes had access to a perfect failure detector? Motivate your choice (i.e. explain why you would make this (or these) change(s)).

Question 6

During the lectures, we have studied the uniform reliable broadcast abstraction (URB).

A) Propose an algorithm implementing URB under the following assumptions:

- Known number of processes (N)
- Reliable channels
- Crash faults
- Perfect failure detector

<u>Note:</u> You must explain the algorithm that is executed when process crashes occur.

B) Prove that your algorithm ensures validity despite process crashes.

C) Prove that your algorithm ensures uniform agreement despite process crashes.