

# Session 2: Exercises

M2 MOSIG: Large-Scale Data Management and Distributed Systems

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## 1 Lamport clocks

**Question 1.1:** Show through an example that Lamport Clocks cannot be used to decide whether a cut is consistent.

## 2 Vector Clocks

**Question 2.2:** Consider an execution in which the events are time stamped using vector clocks. Define a function  $\mathcal{F}$  which takes the vector clock of an event  $e$  and convert it to a scalar value  $SC$ , so that  $e \rightarrow e' \Rightarrow SC(e) < SC(e')$ . Prove that your function  $\mathcal{F}$  ensures the targeted property.

**Question 2.3:** Let  $C$  be a consistent cut defined by the tuple  $(c_1, c_2, \dots, c_n)$ . Let  $VC(e_i^{c_i})$  be the vector clock of event  $e_i^{c_i}$ . What condition, expressed in terms of  $VC(e_i^{c_i})$ , ensures that  $C$  is consistent?

## 3 Back to Chandy-Lamport algorithm

**Question 3.4:** Recall that the Chandy-Lamport snapshot algorithm requires FIFO-channels to work. Modify the algorithm to also work without that assumption. **NB** Consider only a single instance of the algorithm.

Propose an algorithm that only computes a consistent global state (it does not save the state of the channels).

Note : Do not implement FIFO order of messages.

Hint: Use piggybacking (piggyback the adequate information on application messages).

**Question 3.5:** Extend your algorithm to also record the state of the channels.