

CSCI 351 - Spring 2023

11-Final Review Exercises

Edward Talmage

May 1, 2023

Problem 1. Prove the consensus number of a *Fetch&Add* Object.

Problem 2. Consider a 3-process execution. If message delays are

- p_0 to p_1 : $d - 2u/3$
- p_0 to p_2 : $d - 4u/7$
- All others: $d - u/10$

- (a) What are the message delays resulting from shifting the execution by the vector $\langle u/2, 0, u/3 \rangle$?
- (b) Is the shifted execution from (a) admissible?
- (c) Give a different (non-trivial) shift vector that yields an admissible execution.

Problem 3. Describe an execution in which Lamport Logical Clocks overspecify relationships between events. That is, demonstrate that the timestamps specify relationships beyond the happens-before relationship. Give vector clock values for each event and discuss how the partial ordering of vector clocks is relevant.

Problem 4. Give an algorithm to elect a leader in a synchronous ring where each node is also connected to that directly across from itself (only applies to even n). That is, each p_i is connected to p_{i-1} , p_{i+1} , and $p_{i+n/2}$, all subscripts modulo n .

Problem 5. Restate the guarantees of the quasi-perfect failure detector Q . Give an algorithm to solve mutual exclusion using Q .

Problem 6. Prove the largest lower bound you can on the bias of the following common coin algorithm: Each process flips a fair local coin three times, then broadcasts the maximum value it sees. Assume asynchronous, reliable communication with no faults.