

# Distributed Computing: Spring 2024

## Theory Assignment 3

**Submission Date:** 10th April 2024, 13:00 hrs

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**Question 1: Early-stopping algorithm for Consensus under Crash Failures:** Modify the Consensus Algorithm for Crash Failures (synchronous system) to terminate within  $f + 1$  rounds when the actual number of stop-failures ( $f_a$ ) is lower than  $f$ .

The Algorithm (14.1 from Book: Distributed Computing by Ajay Kshemkalyani and Mukesh Singhal) gives a consensus algorithm for  $n$  processes, where up to  $f$  processes, where  $f < n$ , may fail in the fail-stop model. Here, the consensus variable  $x$  is integer-valued. Each process has an initial value  $x_i$ . If up to  $f$  failures are to be tolerated, then the algorithm has  $f + 1$  rounds. Modify this algorithm to include an early stopping mechanism where the algorithm terminated when the actual number of stop failures  $f_a$  is less than  $f$ .

**Question 2: Generalizing the Consensus Problem with binary inputs to work with multi-valued inputs:** Assume that you have a solution to the Consensus Problem problem that works with binary inputs. Can you use this to solve the Consensus Problem to work with multi-valued inputs.

Please submit the assignment by the above mentioned deadline.