Assignment 6

Q27: Logical Clocks
a. What is causal ordering of messages?

b. Explain the principle approach to obtaining logical timestamps for events using Lamport time (LT), Vector time (VT), and Matrix time (MT).

c. Try to find an example illustrating the benefits of MT over VT over LT. Where does MT (VT) convey more information than VT (LT)?

Q28: Global State
a. What is a consistent global state?

b. How does Chandy/Lamport’s algorithm obtain a consistent snapshot?

Q29: Mutual Exclusion
a. Distinguish critical sections from critical regions.

b. Enumerate 6 requirements for a valid solution to mutual exclusion in a distributed system.

Q30: Lock Managers
a. Describe the protocol used to ensure mutual exclusion via a centralized lock manager (CLM).

b. What are the minimum, maximum, and average delays before a process may enter a critical section controlled by a CLM?

c. Explain how the decentralized algorithm proposed by Lin et al. works. What are its major problems? How can these problems be avoided?

d. How can mutual exclusion be guaranteed in a logical ring?

e. Outline the general approach of Ricart/Agrawala’s algorithm. To what extent is this algorithm an improvement over a CLM?

f. What is the key improvement of Maekawa’s algorithm over Ricart/Agrawala’s?

Q31: Failure Tolerance
a. Having detected (or suspected) a crash of a central instance, how can the nodes in a virtual ring autonomously agree on a new coordinator?

b. How can a crash of a coordinating process be detected?

c. Describe an algorithm suitable for electing a new coordinator in general networks.

d. Compare the original ring-based election algorithm, the improved ring-based election algorithm, and the bully algorithm: How do node crashes during a running election affect correctness of the algorithm?
Q32: Deadlocks

a. Describe the conceptual difference between deadlock avoidance and deadlock prevention.

b. Create a deadlocked system with ≈ 4 nodes and detect the deadlock using (1) a hierarchical and (2) a distributed deadlock detection algorithm.