Due: Nov. 15, 2 p.m.

Problem 1

Suppose that we want to build a synchronous system of n nodes that can achieve Byzantine agreement in the presence of f Byzantine failure and t crash failure.

1. What is the minimum number of nodes required to achieve Byzantine agreement? Explain your answer.
2. Assume $f = 1$ and $t = 1$. Explain why at least 3 rounds are necessary to achieve Byzantine agreement in this case.

Problem 2

State true or false with an explanation: If a sequentially consistent shared memory contains only 1 variable, then it is also a linearizable shared memory.

Problem 3

(Question 18.13 from the textbook-5th edition) In a gossip system, a front end has a timestamp (3,5,7) representing the data it has received from members of a group of three replica managers. The tree replica managers have vector timestamps (4,2,8), (4,5,6) and (4,5,8), respectively. Which replica managers could immediately satisfy a query from the front end, and what would the resultant timestamp of the front end be? Which could incorporate an update from the front end immediately?

Problem 4

Why Gossip-based system is not appropriate for updating replicas in near-real time? Provide an alternative approach.

Problem 5

In a replication system, the total number of servers is 4. 2 servers have an independent probability $p = 0.3$ of failing each, the $3rd$ server has $p = 0.5$ and the last one has $p = 1$. What is the availability of an object stored at each of these servers?