

# CSE 552: Distributed and Parallel Systems

## Problem Set 2

**Due: November 15, 5pm**

1. A Paxos system has three acceptors: A1, A2, A3. The following is their state represented as highest proposal number prepared, highest-numbered proposal accepted:

A1: 3, (1,1)

A2: 3, (2,2)

A3: 3, null

- a. Give a sequence of events that could lead to this state.
- b. What value or values are safe to propose for proposal number 3?

2. In the Facebook memcache paper, Figure 11 implies that a key cached in a replica region will have a 0.1% chance of being out of date, even after an entire day has elapsed since the key was updated. Give an example sequence of events that would leave cached data for a key in a replica region being out of date for an extended period of time. (Note: you may invoke a network partition only if that is the only way for the cached data to be out of date.)

3. Define the term 'soft state'.

4. For a system with N nodes where every node can communicate with every other node, give the minimum and maximum number of messages required to complete the Chandy-Lamport snapshot algorithm. Assume the monitor that initiates the snapshot and collects the responses runs on one of the N nodes, e.g., by taking a local snapshot first and then invoking the algorithm.

5. For the Viewstamped Replication algorithm described in the reading list, outline five ways that a byzantine node would be able to cause correctness or liveness to be violated.