Homework 2

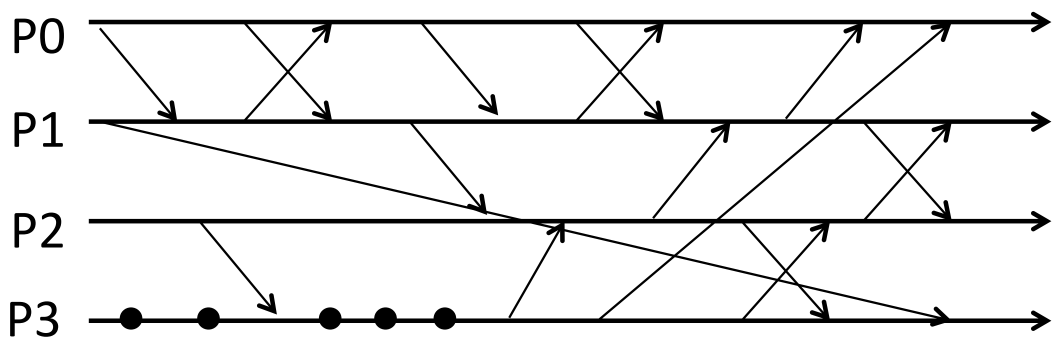
Due: October 20th, 2015 23:59:59pm

Please typewrite your answer to the homework problems, save your file in `.pdf` format, name your file as "your BU email id"-homework2.pdf (e.g., jdoe-homework2.pdf), and submit it to Blackboard before deadline. Late homework will not be accepted.

Problem 1. (Chapter 14 Problem 4 in Cbook) (10 pts) A client attempts to synchronize with a time server. It records the round-trip times and timestamps returned by the server in the table below. Which of these times should it use to set its clock? To what time should it set it? Estimate the accuracy of the setting with respect to the server's clock. If it is known that the time between sending and receiving a message in the system concerned is at least 8 ms, do your answers change?

Round-trip (ms)	Time (hr:min:sec)
22	10:54:23.674
25	10:54:25.450
20	10:54:28.342

Problem 2. (20 pts) In the following figure, both processes, p_0, p_1, and p_2, start with sequence numbers or vector timestamps (as applicable) containing all zeroes. Arrows between processes denote message transmission. List the Lamport timestamps of all events.



Problem 3. (20pts) Repeat Problem 2 for vector timestamps instead of Lamport timestamps (List the vector timestamps of all events).

Problem 4. (10 pts) Someone has built a modified version of the Ricart-Agrawala's algorithm that they claim is faster. It is faster because it does not require each process to wait for N-1 replies. Instead, it waits for only N/2 +1 replies before entering the critical section. The reasoning is that since this is a majority of processes, it is not possible that more than one process has received a majority of replies. The rest of the algorithm remains unchanged. Does this algorithm guarantee mutual exclusion?

Problem 5. (10 pts) Assume that there are 9 nodes in a distributed system numbered 1, 2, ..., 9 and that Maekawa's algorithm is used to enforce mutual exclusion. Show an example situation where deadlock may occur.

Problem 6. (10 pts) Suppose there are 10 processes, p1 through p10. The process with the highest id should always be the leader. Initially, p10 is the leader. However, after a power outage, all even numbered processes (p2, p4, ...) fail. The failure of leader p10 is only detected by p5. How many messages are exchanged in order to elect the new leader using the bully algorithm? You can assume that no further process failure happens during the bully algorithm run.

Problem 7. (20 pts) In the figure below, a-e are regular application messages, with S(a) denoting the send event of a and R(a) denoting its receipt event. Markers shown as dotted lines. Note that Markers don't count as events. Use the Chandy-Lamport global snapshots algorithm to mark the entire global snapshot collected.