SUGGESTED EXERCISES on Paxos (No credit assigned)

1. Consider a particular execution of Paxos. In this execution, learner 1 learns that value v is chosen. Is it possible for another learner to learn that a different value w is chosen? Explain your answer. Recall that a learner learns that a value v is chosen only after v is accepted by a majority (i.e., quorum) of acceptors.

   Solution: Another learner cannot learn a different value. The first learner can only learn value v when a majority of acceptors have accepted v. This ensures that, subsequently, no proposer will propose any value other than v in its Phase 2.

2. Acceptor A1 has already responded to a *prepare* message from proposer P1 with proposal number 10, and also responded to *accept* message from P1 containing proposal number 10 with value 3. Assume that A1 has not received any *prepare* or *accept* message with proposal number greater than 10 yet. In each case below, determine whether A1 will respond if it now receives the specified message, and is so, what would be the contents of its response:

   (i) A1 receives a prepare message containing proposal number 8 and value 5.
   (ii) A1 receives a prepare message containing proposal number 11 and value

   Solution:
   (i) A1 will not respond since the proposal number 8 is smaller than 10.
   (ii) A1 will respond with the message (11,(10,3)), where 11 is the sequence number of the prepar message it is responding to, and (10,3) is the largest numbered proposal it has accepted so far.

3. Suppose that proposer P1 sends a *prepare* message with proposal number 25 and value 9, and receives responses from a quorum (majority) of acceptors. Acceptor A1's response to P1 contains a proposal with sequence number 22 and value 17; Acceptor A2's response to P1 contains a proposal with sequence number 23 and value 6; remaining responses do not contain a proposal.

   Which proposal number and value would P1 include in its *accept* messages?

   Solution: accept(25,6), because 25 is the sequence number chosen by P1, and 6 is the value of the proposal with largest sequence number that it has received in responses from the acceptors.