Quiz 4 – ECE 526 Distributed Algorithms – Fall 2016 – Duration 25 minutes -- 30 points

1. (6 points) FLP impossibility result:

   Consider an asynchronous system in which up to f processes may suffer crash failure. When any process P crashes, assume that each non-faulty process received, within a bounded interval of duration T, a message informing that P has crashed. Is it possible to achieve exact consensus in this system?

   Briefly explain why.

   Yes. The f+1 synchronous algorithm for consensus can be simulated. In each round, each process Pi can wait until it receives a message from each process Pj, or an indication that Pj has crashed.

2. (8 points) Full link reversal algorithm:

   (a) Suppose that, when a node reverses its links, we consider it to have performed 1 unit of work. Given is a graph with reversal distance 10. State true or false:

       i. The total amount of work performed will be at least 10 __**False**_____
       ii. The total amount of work performed will be at most 10 __**True**_____

   (b) In Figure 1, suppose that node D is the destination. Determine the "reversal distance" of node A, and the reversal distance of the graph.

       reversal distance of A = rd(A) =   **1**
       reversal distance of the graph rd =   **2**

   (b) Show the directions of the links after one round of link reversals starting with the graph in Figure 1. You may draw the new graph below, or on the next page.

   There is only one sink in the graph that is not the destination. That sink reverses both its incoming links.

3. (8 points) Suppose that the vector clock associated with an event e is denoted as V(e) and the Lamport clock associated with an event e is denoted as L(e).

State **true or false**:

(a) For events a and b, if V(a) < V(b) then L(a) < L(b)

True

(b) For events a and b, if L(a) = L(b) then a and b are ~~not~~ concurrent event.

True

Would the answer change if the cut is given as consistent?

(c) For events a and b, if V(a) < V(b), and event b is included in cut C, then a is also included in cut C.

False

(d) For events a and b, if L(a) < L(b), and event b is included in cut C, then a is also included in cut C.

False

4. (8 points) Consider the execution in Figure 2. Is it possible to assign vector timestamp T(e) to each event e *in this execution* with the following two properties? (i) for any events a and b, T(a) < T(b) if and only if a → b, and (ii) each vector timestamp contains 2 integer elements.

If you answer no, explain briefly. If you answer yes, show the timestamps for all the events.

Note that the < operation on vectors above is identical to that used in vector timestamps discussed in the class (however, for the vector timestamps discussed in the class, number elements in the vector equals the number of processes).

Note that the question is NOT asking you to suggest an algorithm for computing the timestamps with the above properties. It is only asking whether such timestamps exist.

yes

There are many possible answers.
One answer is obtained by noting that p0 has only one event,
and calculating the timestamps as if that event is the first event
at p1