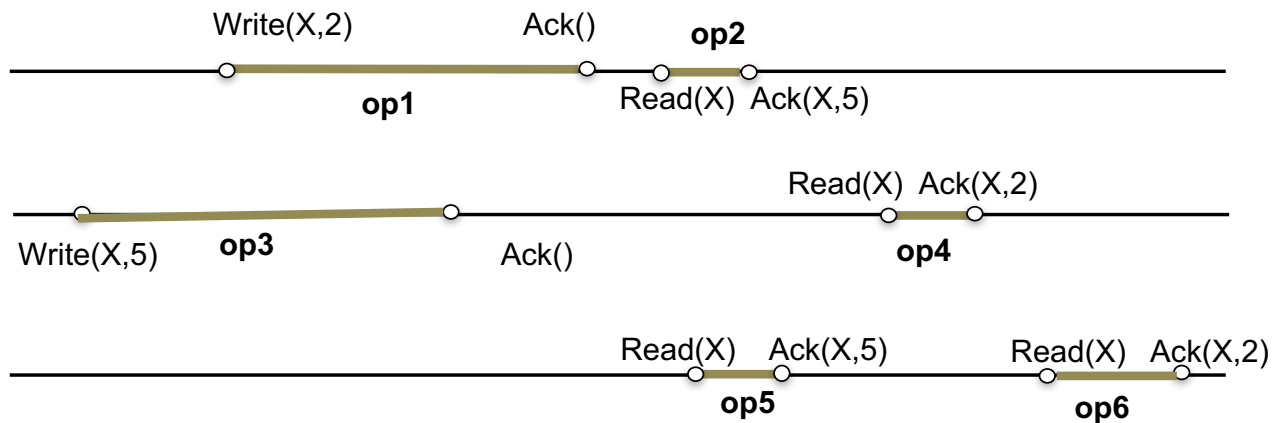


## Quiz 2 – ECE 526 Distributed Algorithms – Fall 2016 – Duration 25 minutes -- 35 points (5 points/question)

1. Does the execution below satisfy causal consistency? \_\_\_\_Yes\_\_\_\_\_  
 If you answer No, explain why.

**X is 0 initially**



2. Does the execution above satisfy sequential consistency? \_\_\_\_No\_\_\_\_\_  
 If you answer No, explain why.

No valid (legal) permutation of the operations exists. In fact, no such permutation for the operations of just the first two processes exists.

3. In the above execution, determine all the operations that *happened-before* operation **op6**.

op5 – due to program order  
 op1, op3 – due to read-from relation

4. What is the consensus number of the *atomic snapshot object*? \_\_\_\_\_1\_\_\_\_\_
- Briefly explain why.**

Read/write registers can simulate atomic snapshot object

5. In a **synchronous** system, is it possible to use only read/write registers to achieve consensus despite crash failures? **Explain briefly.**

Yes. Read/write registers can be used to simulate message passing, and then use message passing algorithm. Other solutions can be designed as well.

6. Considers processes  $p_0$  and  $p_1$ . Suppose that message delay from  $p_0$  to  $p_1$  is in the range [10 ms, 20 ms], and the message delay from  $p_1$  to  $p_0$  is in the range [10 ms, 20 ms]. Given this information, what is the least possible worst case skew achievable? **Explain briefly.**

Uncertainty is 10 ms in each direction. Hence  $u/2 = 5$  ms skew in the worst-case.

7. **State true or false:**

(a) When simulating a *multi-valued* single-reader single-write register using *binary* single-reader single-write registers, the reader must perform a low-level write when performing a high-level Read.

\_\_\_\_\_False\_\_\_\_\_

(b) Consider processes  $p_0$  and  $p_1$ . If the message delay between  $p_0$  and  $p_1$  (in each direction) is uniformly distributed in  $[d-u, d]$ , then in every execution of any clock synchronization algorithm the skew must be at least  $u/2$ . \_\_\_\_\_False\_\_\_\_\_