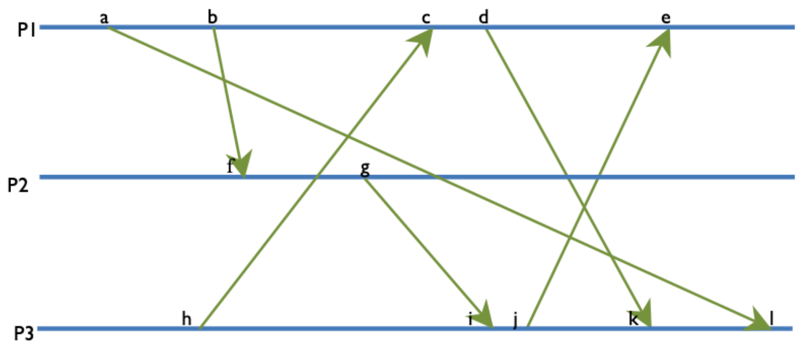
SOLUTIONS ACTIVITIES UNIT 9 --> Activities 10 to 16

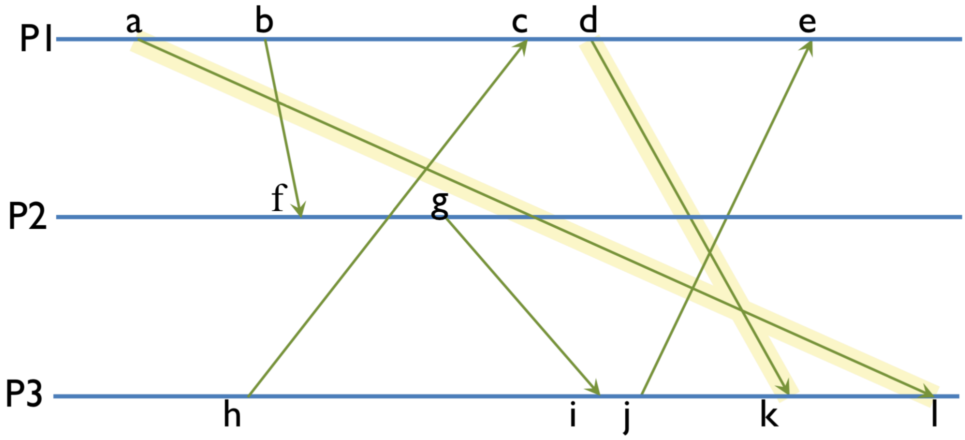
Activity 10

Discuss whether Chandy-Lamport algorithm can be used in the system presented in activity 5

The system presented in activity 5 was:

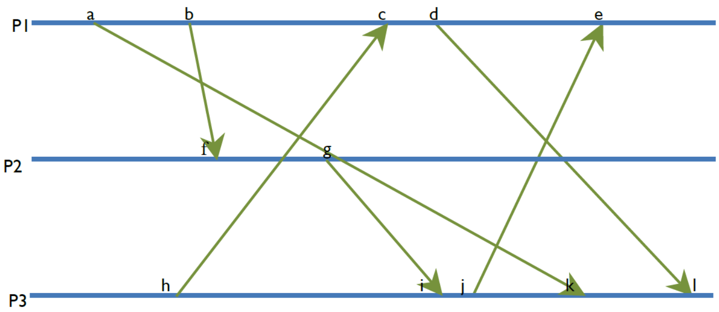


To be able to apply the Chandy-Lamport algorithm we need FIFO channels between nodes.

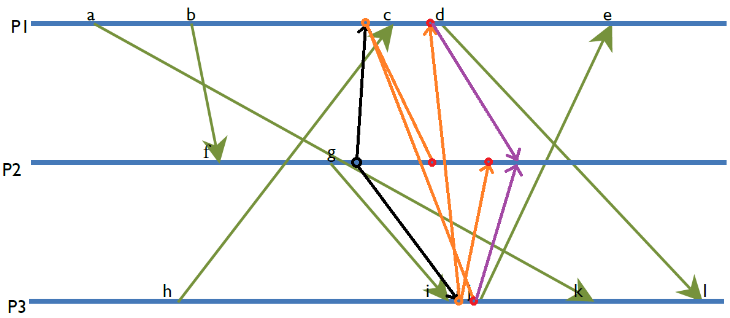


The remarked messages are not in order FIFO. Notice that in P1 we send first a message (M1) at event 'a' to node P3, so this message goes through channel (P1,P3). Later, at event "d", P1 sends another message to node P3 (lets call it M2). So M1 is sent before M2. However, at node P3, message M2 was received BEFORE message M1, and thus we can say that channel (P1,P3) is not FIFO. So Chandy-Lamport cannot be applied here.

Activity 11. Given the following trace of a system formed by three processes:



Assume that process P2 starts the execution of Chandy & Lamport algorithm immediately after generating event “g” and that the MARK message that broadcasts is delivered to P1 and P3 just before their events “c” and “j”, respectively, thus generating broadcastings of new MARK messages before events “d” and “j”, respectively. Explain which trace will follow this Chandy & Lamport algorithm and what messages in transit (i.e. messages sent and not yet delivered) are stored in each channel.

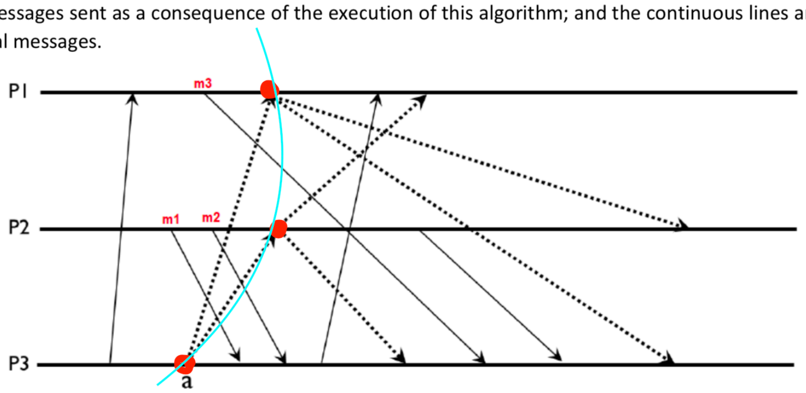


Channel state	Value
P1, P2	*Empty*
P1, P3	a
P2, P1	*Empty*
P2, P3	*Empty*
P3, P1	h
P3, P2	*Empty*

Local state	Step	Value
P1	2	St. P1
P2	1	St. P2
P3	3	St. P3

And the consistent cut will be through steps 1, 2 and 3. Two messages in transit: the message that goes a-->k, and the message that goes h-->c

Activity 12. Let us suppose that P3 starts the Chandy-Lamport algorithm at event a, being the broken lines the messages sent as a consequence of the execution of this algorithm; and the continuous lines are the normal messages.



When the algorithm finishes, please indicate how many messages are registered in these channels:

- In channel (P3, P1): **∅**
- In channel (P2, P3): **m1, m2**
- In channel (P1, P3): **m3**

The blue line indicates the consistent cut that we will obtain with the Chandy-Lamport algorithm.

ACTIVITY 13.- Given the following sentences, modify them as needed to make all them TRUE.

1. A snapshot is inconsistent if it includes messages **receiving but not its sending**.
2. The Chandy-Lamport's algorithm requires total connectivity: between each pair of nodes a,b there must be unidirectional channels (a,b) and (b,a).
3**. Every node** sends MARK messages.
4. Whenever a process receives a MARK message, it must store its local state **if it has not stored it yet**.
5. The Chandy-Lamport algorithm **creates a consistent snapshot of the global state of a DS**

Activity 14

1. The Bully algorithm fails if two or more nodes start the algorithm simultaneously (i.e. when there is more than one initiator). **Justification:** The Bully algorithm always chooses the node with the highest identifier as leader, so if more than one node starts the algorithm simultaneously, they will all choose the same leader.	**F**
2. The leader election algorithm for rings fails if two or more nodes start the algorithm simultaneously (i.e. when there is more than one initiator). **Justification:** The leader election algorithm for rings always chooses the node with the highest identifier as leader, so if more than one node starts the algorithm simultaneously, they will all choose the same leader.	**F**
3. The centralized mutual exclusion algorithm seen at classroom restricts the scalability and fault tolerance because the coordinator is a bottleneck and a single fail point. **Justification:** The coordinator is a single point of failure, the entire system may go down if it crashes, and in a large system, a single centralized coordinator can become a performance bottleneck.	**T**
4. The distributed mutual exclusion algorithm seen at classroom employs logical clocks to order some entry requests to the critical section. **Justification:** The distributed mutual exclusion algorithm uses Lamport logical clocks with their nodes identifiers	**T**
5. The Berkeley algorithm is one of the most efficient mutual exclusion algorithms. **Justification:** The Berkeley algorithm is not a mutual exclusion algorithm	**F**
6. The distributed mutual exclusion algorithm does not need any action in its output protocol. **Justification:** It needs to send OK to all processes that sent messages retained in its queue.	**F**
7. The Cristian algorithm is a very efficient leader election algorithm. **Justification:** The Cristian algorithm is not a leader election algorithm.	**F**

Activity 15

1. In leader election algorithm for rings, if any node receives an ELECTION message with the content (5, 5, 3), this message indicates: **that the initiator of the leader election was the node with identifier 5 and that so far the ELECTION message has propagated through the nodes with identifiers 5 and 3**

2. If the Bully algorithm is used for leader election, if the N_7 node sends an ELECTION message, this indicates that: **that node wants to start an election and there is a node with an identifier higher than its own (in this case N_8).**

3. For the leader election, if node N_1 initiates the Bully algorithm, then it will send an ELECTION message to nodes: **that have a higher identifier than its own (in this case from N_2 to N_8).**

4. If node N_5 initiates the leader election algorithm for rings, at some moment it will receive a message of type ELECTION with the following content: **(5, {5, 7, 1, 3})**

Activity 16. Given the following sentences, justify whether they are True or False:

1. The Chandy-Lamport algorithm requires the channels not to lose nor disorder messages. ***Justification***: *It requires all the channels to transmit their messages in FIFO order.*	**T**
2. It is usually problematic to make a computer clock go backwards. ***Justification***: *If the computer clocks go backwards, the order of execution of different events could be wrongly registered.*	**T**
3. The Berkeley algorithm does not assume a node with a precise clock. ***Justification***: *This algorithm does not aim to synchronize all the clocks with the "real" instant, but to reach an agreement between the nodes.*	**T**
4. The Berkeley algorithm synchronized clocks of nodes of a distributed system without taking into account the divergence of these clocks and the real official clock. ***Justification***: *The objective of that algorithm is not to synchronize the local clocks with the "real" time, but to reach an agreement between all the nodes.*	**T**
5. The Cristian algorithm is used to manage logical clocks. ***Justification***: *It is used to manage clock synchronization.*	**F**
6. The Cristian algorithm provides the basis to implement any decentralized algorithm. ***Justification***: *As each node has its own clock, and the only important time reference is the order in which the events happen, there is no need to synchronize the physical clocks (which is the objective of the Cristian algorithm), because that order of events can be established by using logical clocks.*	**F**
7. Chandy & Lamport algorithm requires FIFO communication channels. ***Justification***: *The algorithm needs all its channels to transmit their messages in FIFO order.*	**T**
8. Cristian algorithm allows identifying the messages in transit in each of the communication channels of a distributed system. ***Justification***: *The Chandy-Lamport algorithm can identify the messages in transit if the identifier of the initiator node is added to the MARK message.*	**F**