IN5020 - Distributed Systems Group Session

Topic 4 – Time and Coordination in Distributed Systems

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Question 1 -
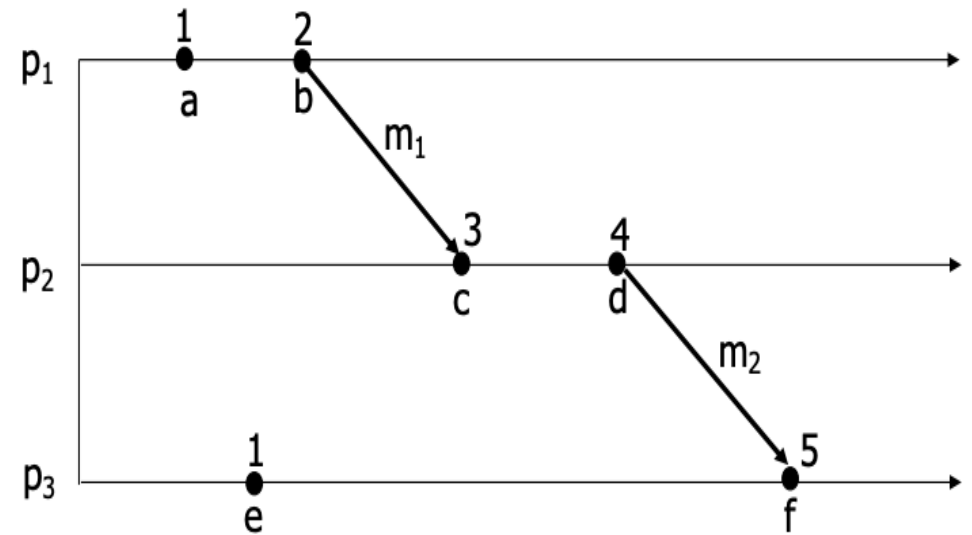what is the advantage of vector clocks over logical clocks?

Short comings of logical clocks

Logical clocks operate on the principle of
Counters. The values of the counters are used
To determine the order of event.

But it doesn't detect concurrent event

- For example

L(b) > L(e) but b || e ('b' and 'e' are concurrent events. They don't have happened-before relationship
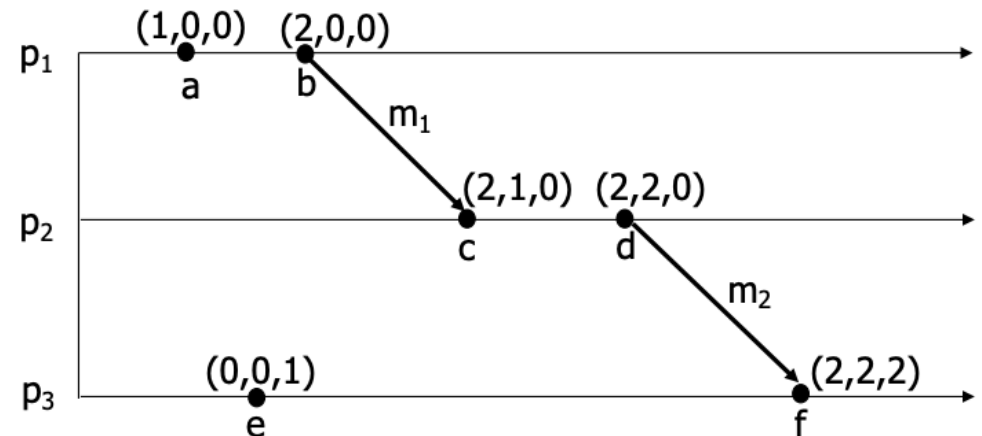
Advantages of vector clocks

Vector clocks identify concurrent events

Vector clocks compare the vectors instead of

Single counter

- For example

Neither V(b) >= V(e) nor V(b) <= V(e). So we can conclude that 'e' and 'b' are concurrent events
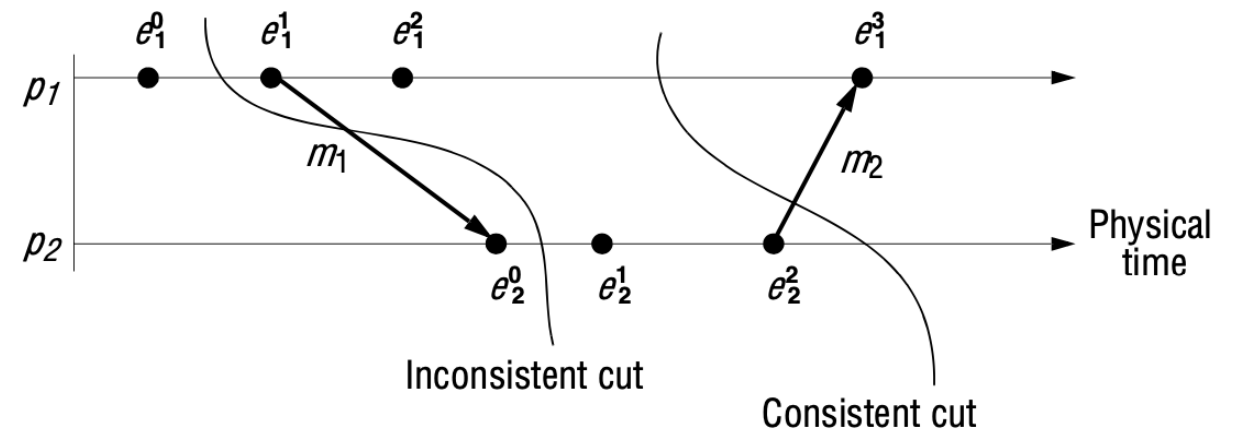
Question 2 -
What is consistent cut?

Consistent Cut

History of process 'i' - set of events that occur at the process

Cut – union of prefixes of process

histories

Consistent cut – for each event it contains,

It also contains all the events that happened before the event (captures the happened-before relationship)

Question 3 -
What is the ordering property in the mutual exclusion problem and how do the 3 algorithms handle it?

Mutal Exclusion problem and ordering property

Mutal Exclusion problem:

If a collection of processes share a resource or collection of resources, then often mutual exclusion is required to prevent interference and ensure consistency when accessing the resources.

The processes access common resources in a critical section.

Safety property: At most one process may execute in the critical section (CS) at a time.

Liveness property: Requests to enter and exit the critical section eventually succeed.

Ordering property: If a process request to enter the critical section (CS) before other process then that process should get access to the CS before other process.

Ordering property - three algorithms

Central Server Algorithm:

- Server implements queue and gives permission to the processes. The server is not restricted to use FIFO queue or anything like that. So the property is not satisfied.

Ring Algorithm:

- Process can access CS if it has token. Tokens are passed in the ring topology. But it doesn't satisfy ordering. Because multiple processes can send requests at a time.

Ricart and Agrawala algorithm:

- It uses multicast and replies to get access to CS. It uses timestamps and when multiple processes wants to access, the request with lowest timestamp is chosen. It satisfies the property.

Question 4 -
How is the fault tolerance of different mutual exclusion algorithms evaluated? Name the type of failure that cannot be tolerated by the ring-based algorithm

Mutual Exclusion algorithms - fault tolerance

Evaluate the algorithms on the following aspects:

1.   What happens when messages are lost?

2.   What happens when a process crashes?

The ring-based algorithm cannot tolerate:

- The loss of message.

- Any single process crashes.

Thank You