Assignment 3

Team G3T2

- Vishnudatha Kanjur (3250569)
- Julian Hörz (3316908)

Solutions:

1. a)
   i) False, synchronization depends on time t. Further that clocks has to be accurate and the clock has to be synchronized with the correct clock.
   As per the lecture, synchronizing physical clocks means: Limiting the difference between the clock values (i.e., skew) to a sufficiently low amount and not to zero.
   ii) Lamport's algorithm will work only for the left process system.

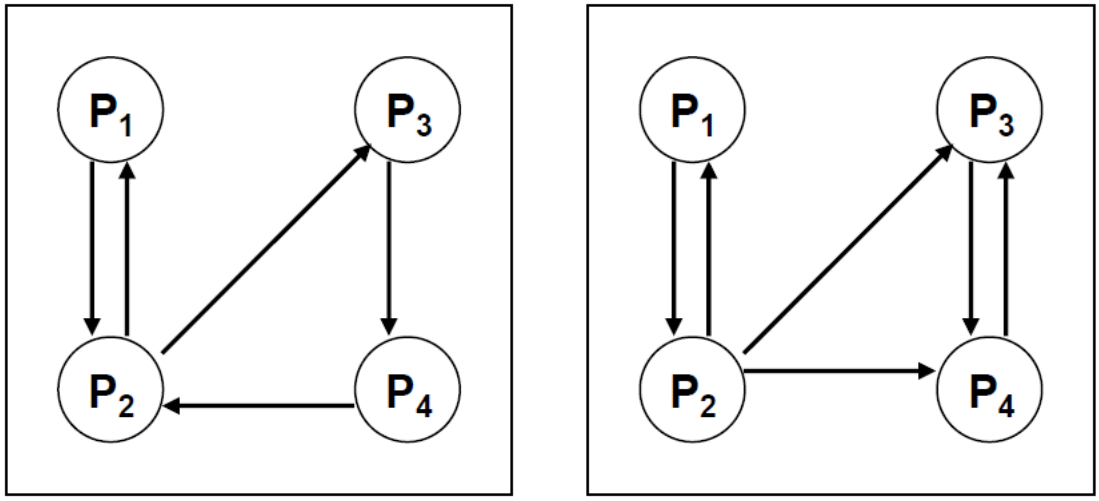
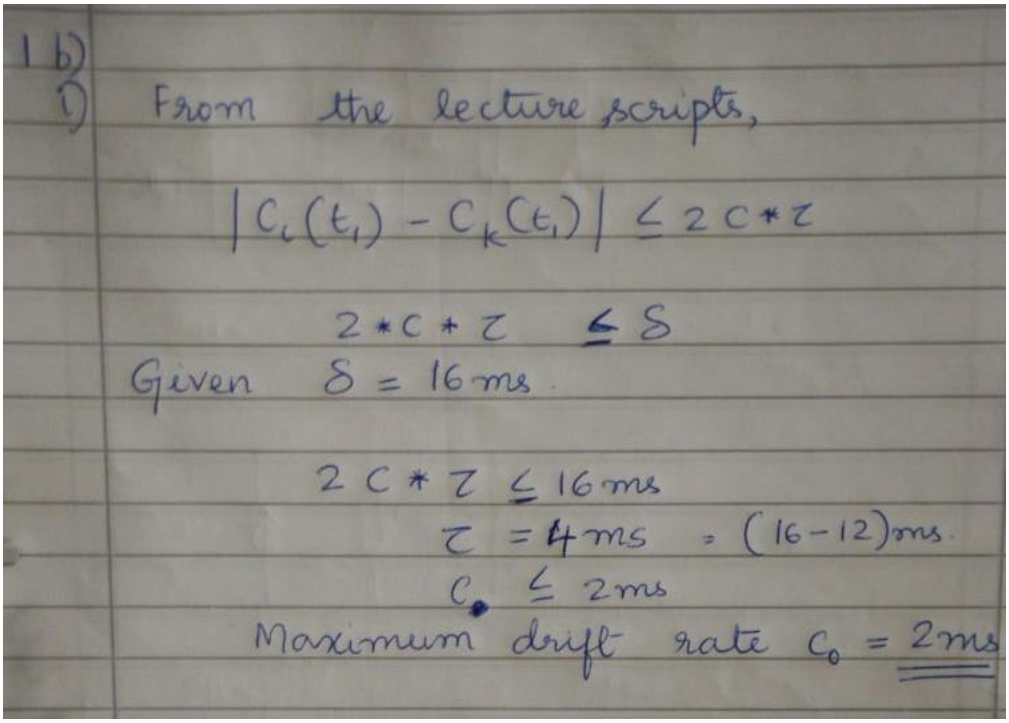


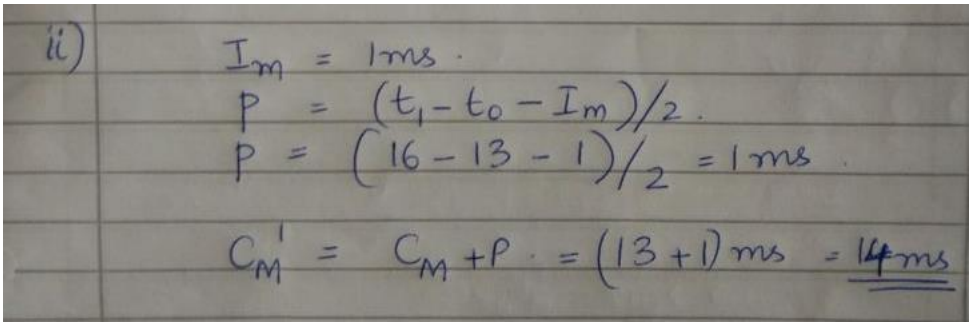
Figure 1: Two process systems

The right process system violates the assumption that there exists a directed graph of processes(Chapter 5 Slide 23). It violates it because two edges are going from P2 to P3 and P4. Therefore the graph is not directed. P3 and P4 are not connected to P1 and P2 to send messages for synchronization.

b) i)



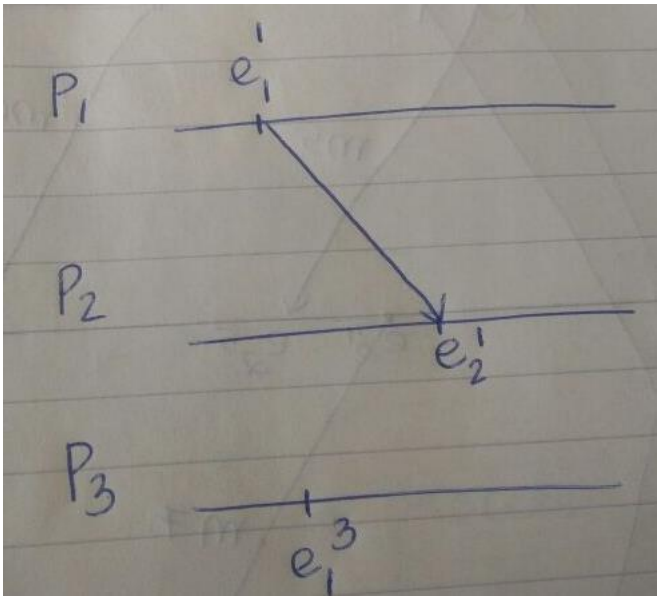
ii)



iii) The slave C_s has to slow down until the time is corrected(ie until C_M has caught up) by letting some interrupts pass without incrementing the time. So t_1 will be t_u,

t_1=16ms.

2. a) i) Concurrent relation is non transitive.
   Assume P1,P2,P3 be three processes as per the below diagram and e_1^1,e_2^1,e_3^1 be three states as in the below diagram. $e_1^1 || e_3^1$,$e_2^1 || e_3^1$ but $e_1^1 || e_2^1$ doesn't hold as $e_1^1 \rightarrow e_2^1$



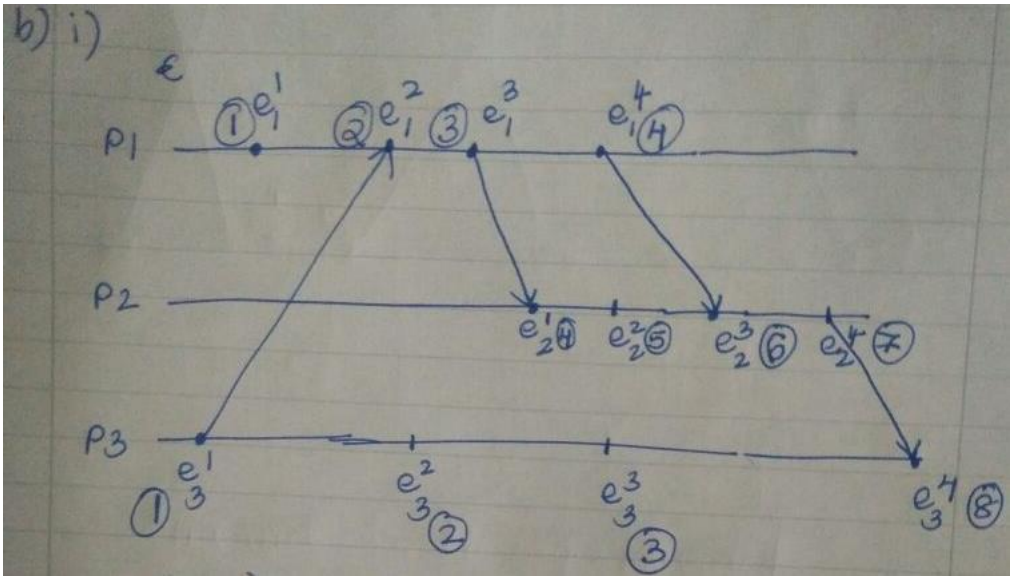
ii)

Statement true false	**true false**
At least one send-event must have occurred between *t*1 and *t*2	false
At least two events occurred between *t*2 and *t*3	true
At least six events occurred between *t*2 and *t*3	false
At least two receive-events occurred between *t*1 and *t*3	false
At least one receive-event occurred between *t*2 and t3	true
At least one send event occurred between *t*2 and *t*3	false

b) i)

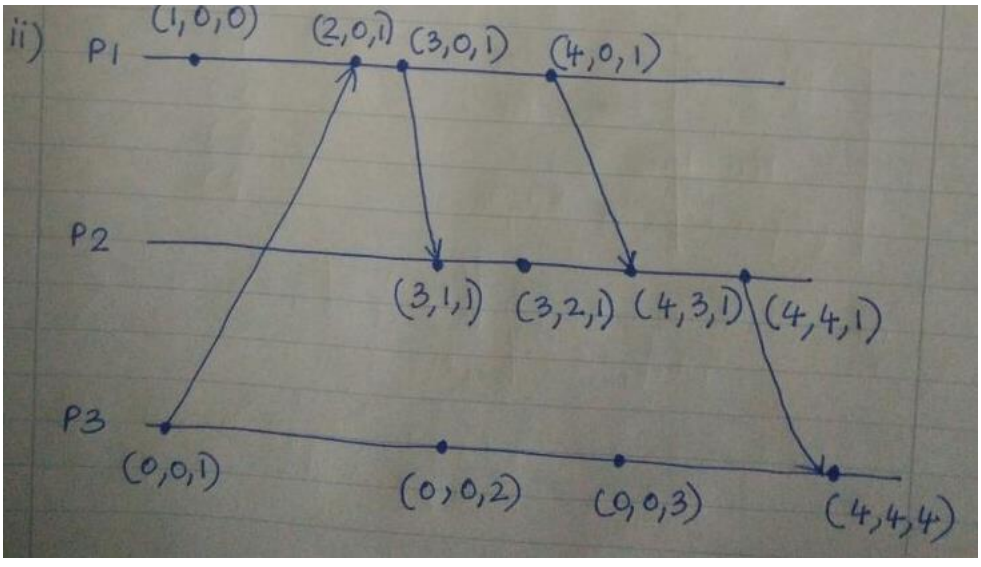
State e_i^j	$C(e_i^j)$
e_1^1	1
e_1^2	2
e_1^3	3
e_1^4	4
e_2^1	4
e_2^2	5
e_2^3	6
e_2^4	7
e_3^1	1
e_3^2	2
e_3^3	3
e_3^4	8

b) i)

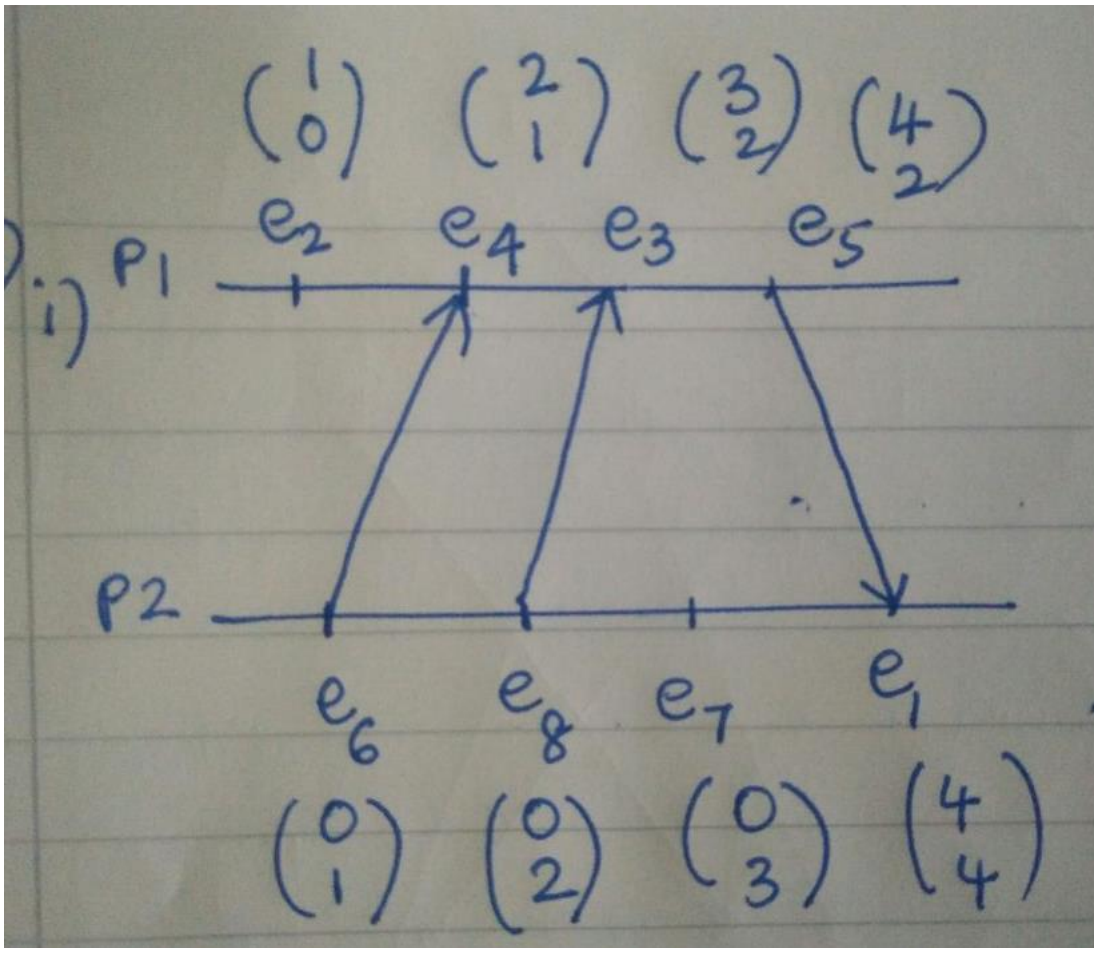


ii)

State e_i^j	VC(e_i^j)
e_1^1	(1,0,0)
e_1^2	(2,0,1)
e_1^3	(3,0,1)
e_1^4	(4,0,1)
e_2^1	(3,1,1)
e_2^2	(3,2,1)
e_2^3	(4,3,1)
e_2^4	(4,4,1)
e_3^1	(0,0,1)
e_3^2	(0,0,2)
e_3^3	(0,0,3)
e_3^4	(4,4,4)



c)

i) 

The events that belong to P1 -e2,e4,e3,e5

The events that belong to P2-e6,e8,e7,e1

ii) Local event: e2,e7

Send event: e6,e8,e5

Receive event: e4,e3,e1

3.

a) i) No. This is not a valid linearization of H as the e_1^2 is causally dependent on e_2^1

$$\langle e_1^1, \boxed{e_1^2, e_2^1}, e_1^3, e_2^2, e_1^4, e_2^3, e_1^5 \rangle$$

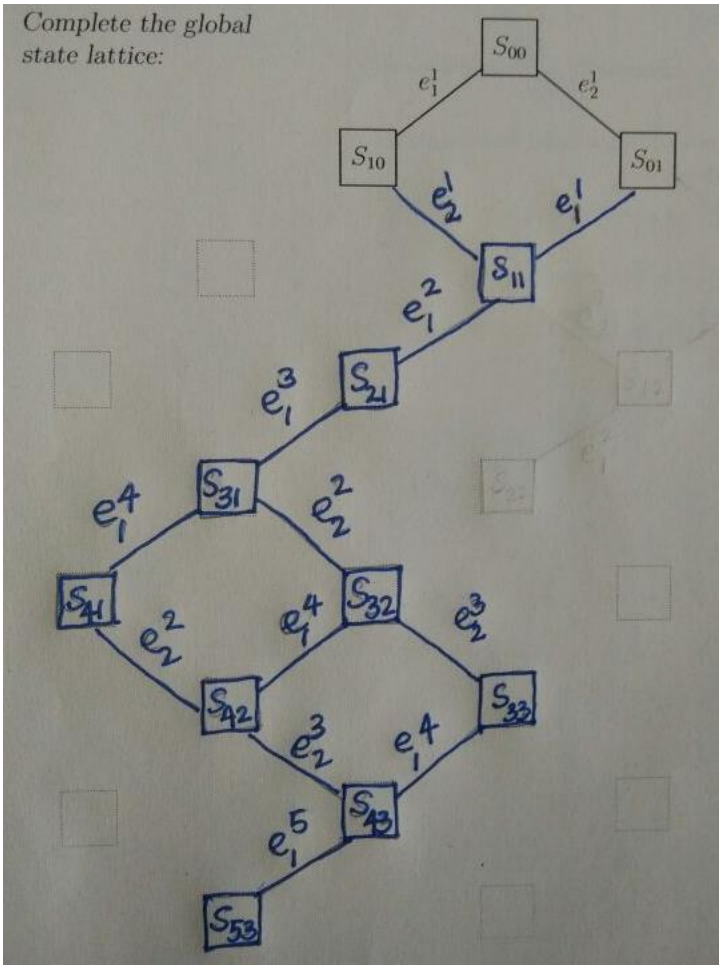
ii) No. This is not a valid linearization of H as the e_2^2 is causally dependent on e_1^3

$$\langle e_1^1, e_2^1, e_1^2, \boxed{e_2^2, e_1^3}, e_1^4, e_2^3, e_1^5 \rangle$$

iii) Yes. This is a valid linearization of H as all the dependencies are captured accurately.

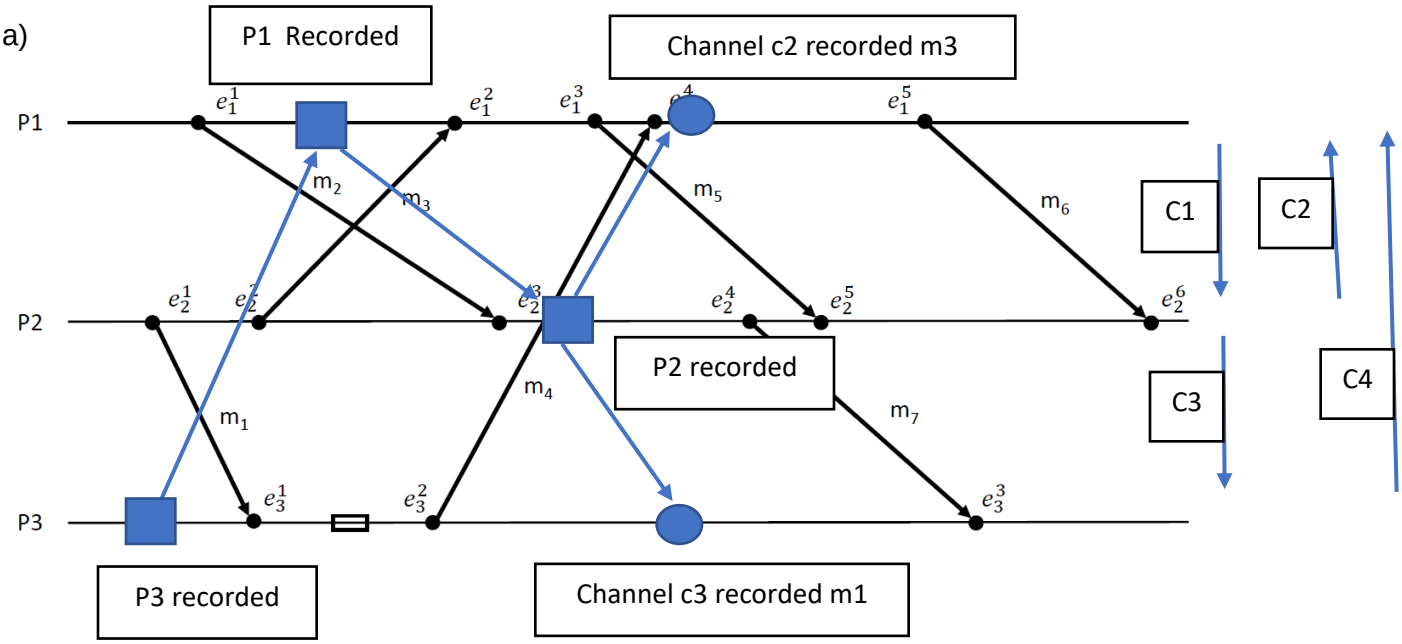
$$\langle e_1^1, e_2^1, e_1^2, e_1^3, e_1^4, e_2^2, e_2^3, e_1^5 \rangle$$

b)



4.

a)


P1 Recorded
Channel c2 recorded m3
P1
P2
P3
e_1^1
e_1^2
e_1^3
e_1^4
e_1^5
e_2^1
e_2^2
e_2^3
e_2^4
e_2^5
e_2^6
e_3^1
e_3^2
e_3^3
m1
m2
m3
m4
m5
m6
m7
C1
C2
C3
C4
P2 recorded
P3 recorded
Channel c3 recorded m1

b)

Channel	Message recorded
C1	empty
C2	m3
C3	m1
C4	empty