

HW 6

①

$$M = \begin{bmatrix} 2 & 5 & 3 & 3 & 2 \\ 3 & 5 & 8 & 8 & 1 \\ 4 & 8 & 4 & 8 & 2 \\ 6 & 1 & 4 & 3 & 5 \\ 1 & 2 & 3 & 4 & 5 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & 5 & 3 & 1 & 1 \\ 0 & 2 & 1 & 1 & 1 \\ 0 & 7 & 1 & 2 & 1 \\ 2 & 1 & 1 & 1 & 0 \\ 1 & 2 & 3 & 2 & 1 \end{bmatrix}$$

$$\text{Need} = \begin{bmatrix} p_1 & p_2 & p_3 & p_4 & p_5 \\ 1 & 0 & 0 & 2 & 1 \\ 3 & 3 & 7 & 8 & 0 \\ 4 & 2 & 3 & 7 & 1 \\ 3 & 0 & 3 & 4 & 5 \\ 0 & 0 & 0 & 2 & 4 \end{bmatrix} (M - A)$$

$n = 5$ processes
 $m = 5$ resource types
 $t = (6, 17, 9, 8, 7)$

$$\begin{cases} \text{avail} = \text{total} - \text{column}(\text{Alloc}) = (6, 17, 9, 8, 7) - \\ - (5, 17, 9, 7, 4) = (1, 0, 0, 2, 3) \\ \text{ready} = \text{filtered}(\text{need}, \text{avail}) = \\ = p_1; \Rightarrow \text{SAFE STATE} \end{cases}$$

②

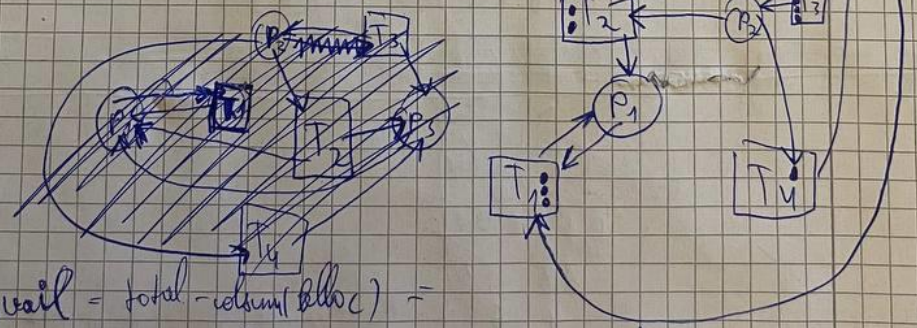
$n = 3$

$m = 4$

$$A = \begin{bmatrix} p_1 & p_2 & p_3 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

$$N = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

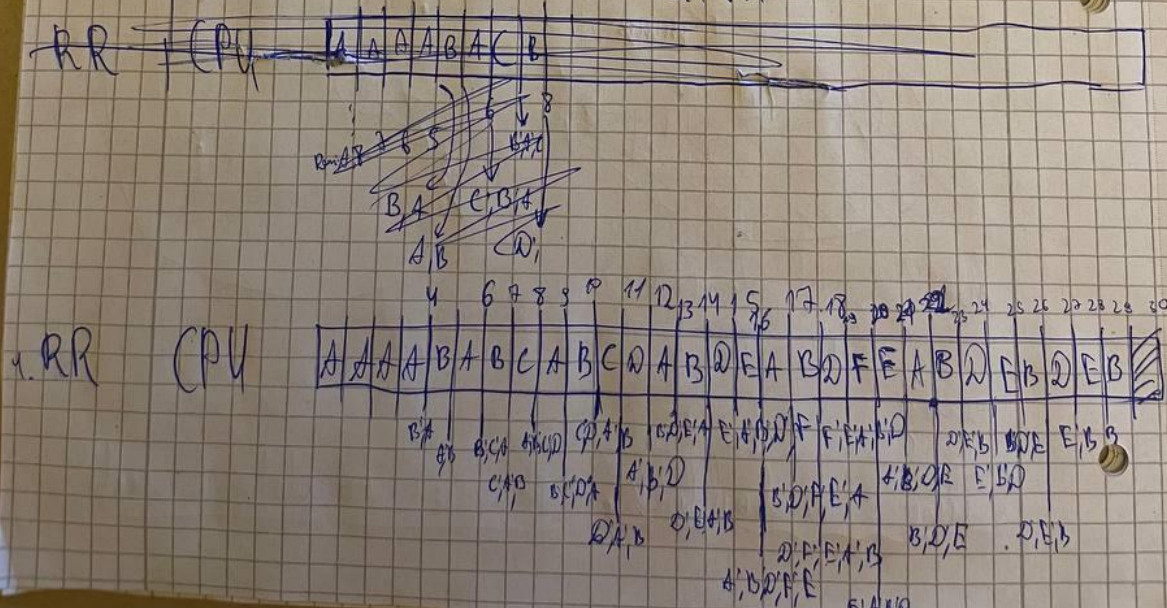
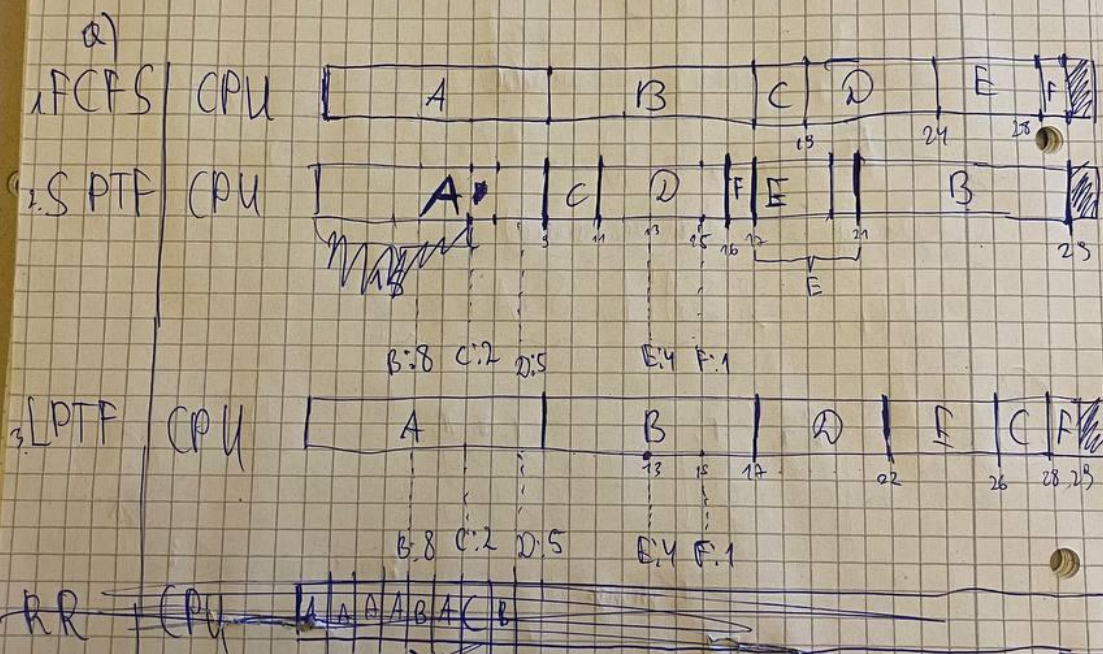
$t = (3, 2, 3, 1)$



$$\begin{aligned} \text{avail} &= \text{total} - \text{column}(\text{Alloc}) = \\ &= (3, 2, 3, 1) - (1, 2, 2, 1) = (2, 0, 1, 0) \end{aligned}$$

$$\text{ready} = p_1, p_2$$

There is no deadlock. No cycles + computational proof



8)

	1	2	3	4	5	6
1. $f =$	9	13	13	16	15	14
$\bar{f} =$	9	13	13	16	15	14
$\bar{w} =$	0	5	11	11	11	13
2. $f =$	8	28	5	8	8	2
$\bar{f} =$	8	28	5	8	8	2
$\bar{w} =$	0	17	3	3	4	1
3. $f =$	9	13	22	14	13	14
$\bar{f} =$	9	13	22	14	13	14
$\bar{w} =$	0	5	20	9	8	13
4. $f =$	22	25	5	19	15	5
$\bar{f} =$	22	25	5	19	15	5
$\bar{w} =$	13	17	3	14	11	4

$f = (9 + 13 + 13 + 16 + 15 + 14) / 6 \approx 13,33$
 $\bar{f} = (9 + 13 + 13 + 16 + 15 + 14) / 6 \approx 13,33$
 $\bar{w} = (0 + 5 + 11 + 11 + 11 + 13) / 6 \approx 9,5$
 $f = (8 + 28 + 5 + 8 + 8 + 2) / 6 \approx 9,5$
 $\bar{f} = (8 + 28 + 5 + 8 + 8 + 2) / 6 \approx 9,5$
 $\bar{w} = (0 + 17 + 3 + 3 + 4 + 1) / 6 \approx 4,66$
 $f = (9 + 13 + 22 + 14 + 13 + 14) / 6 \approx 14,66$
 $\bar{f} = (9 + 13 + 22 + 14 + 13 + 14) / 6 \approx 14,66$
 $\bar{w} = (0 + 5 + 20 + 9 + 8 + 13) / 6 \approx 9,33$
 $f = (22 + 25 + 5 + 19 + 15 + 5) / 6 \approx 15,166$
 $\bar{f} = (22 + 25 + 5 + 19 + 15 + 5) / 6 \approx 15,166$
 $\bar{w} = (13 + 17 + 3 + 14 + 11 + 4) / 6 \approx 10,33$