Date Operating Systems Bilal Wahaich.

Problem 6.1)

$n = 5$, $m = 5$, $t = (6, 17, 9, 10, 7)$

- Banker's Algorithm:

Available resources (V) =

Sum of allocation matrix = $(0+0+0+3+1,\ 5+2+7+1+2,\ 3+1+1+1+3,\ 1+1+1+1+2,\ 1+1+1+1)$

$= (4, 17, 9, 7, 4)$

So, V = ~~Sum of~~ Available resources − Sum of A

$(6, 17, 9, 10, 7) - (4, 17, 9, 7, 4)$

$= (2, 0, 0, 3, 3)$

~~Step2:~~

Need Matrix (N) = N = M − A

$$= \begin{bmatrix} 2 & 5 & 3 & 3 & 2 \\ 3 & 5 & 8 & 10 & 1 \\ 4 & 12 & 4 & 9 & 2 \\ 6 & 1 & 4 & 5 & 5 \\ 1 & 2 & 3 & 4 & 5 \end{bmatrix} - \begin{bmatrix} 0 & 5 & 3 & 1 & 1 \\ 0 & 2 & 1 & 1 & 1 \\ 0 & 7 & 1 & 2 & 1 \\ 3 & 1 & 1 & 1 & 0 \\ 1 & 2 & 3 & 2 & 1 \end{bmatrix}$$

$$N = \begin{bmatrix} 2 & 0 & 0 & 2 & 1 \\ 3 & 3 & 7 & 9 & 0 \\ 4 & 5 & 3 & 7 & 1 \\ 3 & 0 & 3 & 4 & 5 \\ 0 & 0 & 0 & 2 & 4 \end{bmatrix}$$

Step 3: Date

$$N = \begin{bmatrix} 2\,0\,0\,2\,1 \\ 3\,3\,7\,9\,0 \\ 4\,5\,3\,7\,1 \\ 3\,0\,3\,4\,5 \\ 0\,0\,0\,2\,4 \end{bmatrix}$$

$Need_0 = (2,0,0,2,1)$

Since $(2,0,0,2,1) \leq (2,0,0,3,3)$, can be satisfied

hence, available resources after process 0.

$= (2,0,0,3,3) + (0,5,3,1,1)$

$V_{updated} = (2,5,3,4,4)$

$$N = \begin{bmatrix} \sout{2\,0\,0\,2\,1} \\ 3\,3\,7\,9\,0 \\ 4\,5\,3\,7\,1 \\ 3\,0\,3\,4\,5 \\ 0\,0\,0\,2\,4 \end{bmatrix}$$

$Need_4 = (0,0,0,2,4) \leq (2,5,3,4,4)$ satisfies process 4

$= (2,5,3,4,4) + (1,2,3,2,1)$

$V_{updated} = (3,7,6,6,5)$

$Need_3 = (3,0,3,4,5)$ satisfies process 3

$= (3,7,6,6,5) + (3,1,1,1,0)$

$V_{updated} = (6,8,7,7,6)$

~~$Need_1 = 3,3,7,9,0$~~

$Need_2 = (4,5,3,7,1)$ satisfies

$Need_1 = (3,3,7,9,0)$ satisfies

So, $(6,15,8,9,7) + (0,2,1,1,1)$

$= (6,17,9,10,8)$

So,

$V_{updated} = (6,8,7,7,6) + (0,7,1,2,1)$

$= (6,15,8,9,7)$

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Safe Sequence : $P_0 \rightarrow P_4 \rightarrow P_3 \rightarrow P_2 \rightarrow P_1$

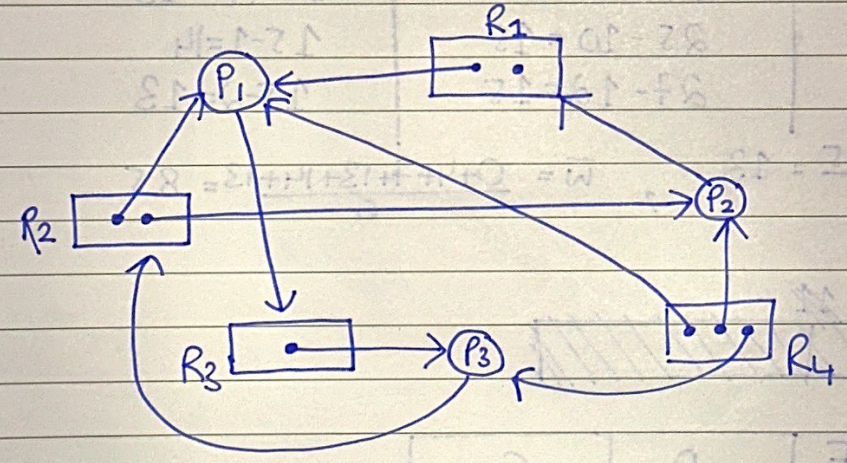
Hence it is in a safe state with this order of process.

Problem 6.2:

$n = 3$, $m = 4$, $t = 2, 2, 1, 3$

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

a)



b) available = total − allocated

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

$= (1,0,0,0)$

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

$V_0 = (1,0,0,0)$

$V_1 = (1,1,0,1)$

$V_2 = (1,1,1,2)$

$V_3 = (2,2,1,3)$

$P_1 \rightarrow P_2 \rightarrow P_0$

The system is not deadlocked.

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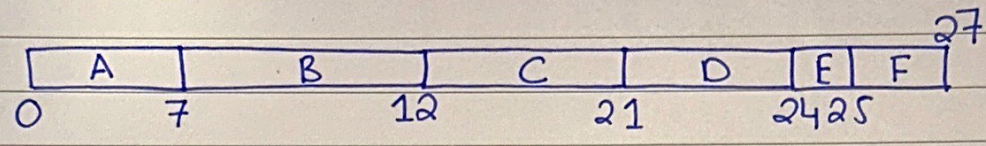
Problem 6.3:

a) FCFS:

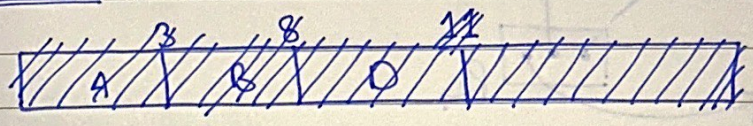


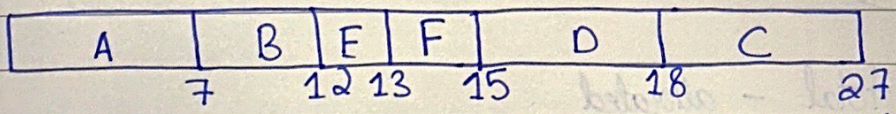
b)

Process	Completion Time	Turnaround Time T_i	Waiting Time W_i
A	7	7 - 0 = 7	7 - 7 = 0
B	12	12 - 3 = 9	9 - 5 = 4
C	21	21 - 5 = 16	16 - 9 = 7
D	24	24 - 8 = 16	16 - 3 = 13
E	25	25 - 10 = 15	15 - 1 = 14
F	27	27 - 12 = 15	15 - 2 = 13

$\bar{t} = \frac{7+9+16+16+15+15}{6} = 13$, $\bar{w} = \frac{0+4+7+13+14+13}{6} = 8.5$

SPTF:





Process	Completion time	Turnaround time	Waiting time
A	7	7 - 0 = 7	7 - 7 = 0
B	12	12 - 3 = 9	9 - 5 = 4
C	27	27 - 5 = 22	22 - 9 = 13
D	18	18 - 8 = 10	10 - 3 = 7
E	13	13 - 10 = 3	3 - 1 = 2
F	15	15 - 12 = 3	3 - 2 = 1

$\bar{T} = \frac{7+9+22+10+3+3}{6} = 8.83$, $\bar{W} = \frac{0+4+13+7+2+1}{6} = 4.5$

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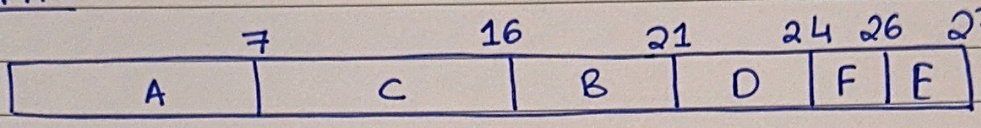
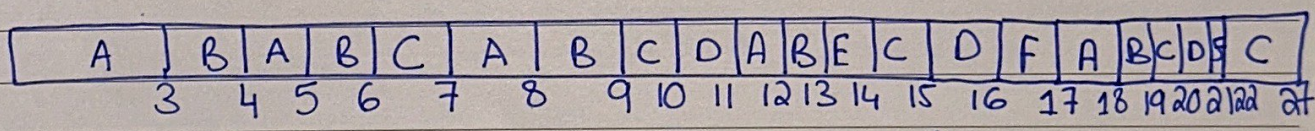
LPTF:



Process	Completion Time	Turnarand Time	Waiting Time
A	7	7-0=7	7-7=0
B	21	21-3=18	18-5=13
C	16	16-5=11	11-9=2
D	24	24-8=16	16-3=13
F	27	27-10=17	17-1=16
F	26	26-12=14	14-2=12.

$\bar{t} = \frac{7+18+11+16+17+14}{6} = 13.83$, $\bar{w} = \frac{0+2+13+13+16+12}{6} = 9.33.$

Round Robin:



Process	Completion Time	Turnarond Time	Waiting Time
A	18	18-0 = 18	18-7= 11
B	19	19-3 = 16	16-5=11
C	27	27-5 = 22	22-9=13
D	21	21-8 = 13	13-3=10
F	14	14-10 = 4	4-1=3
F	22	22-12=10	10-2=8

$\bar{t} = \frac{18+16+22+13+4+10}{6} = 13.8$ units

$\bar{w} = \frac{11+11+13+10+3+8}{6} = 9.3$ units.