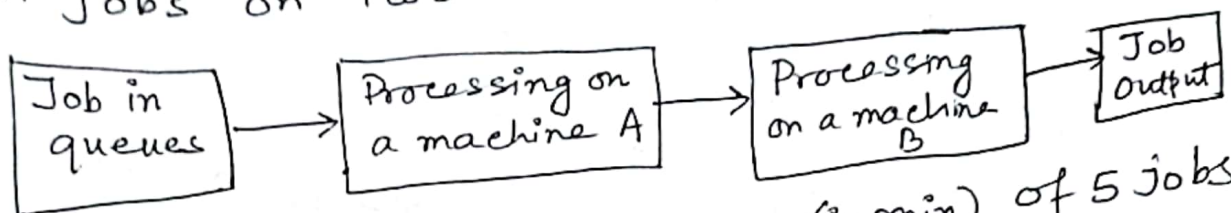


Sequencing problem:

Types of problem

- ① n jobs on a single machine.
- ② n jobs on a two machine
- ③ n jobs on three machine
- ④ n jobs on m machine
- ⑤ Two jobs through m machine.

- ① n jobs on two machine (Johnson's rule)

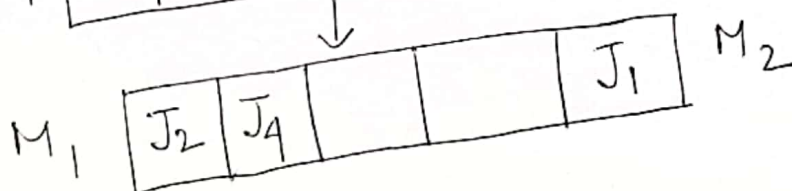
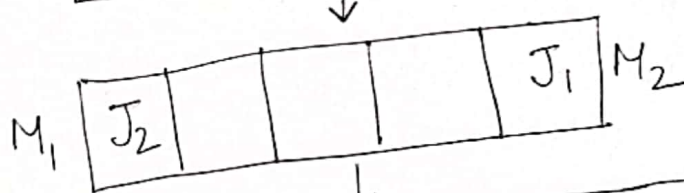


Ex. Consider the processing time (in min) of 5 jobs each of which must go through the two machine M_1 & M_2 in order M_1, M_2 .

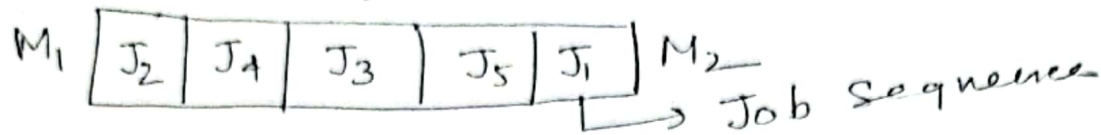
Job	J_1	J_2	J_3	J_4	J_5
M_1	5	1	9	3	10
M_2	2	6	7	8	4

Find sequence for job that minimize the total elapsed time. Also find the idle time for each machine.

Ans →



Job	M_1	M_2
J_1	5	②
J_2	①	6
J_3	9	7
J_4	③	8
J_5	10	④



Sequence	M_1 In-out	M_2 In-out
J_2	0 - 1	① 1 - 7
J_4	1 - 4	7 - 15
J_3	4 - 13	15 - 22 ①
J_5	13 - 23	23 - 27 ①
J_1	23 - 28	28 - 30

Total time of $M_1 = 5 + 1 + 9 + 3 + 10 = 28 \text{ min}$
 " " $M_2 = 2 + 6 + 7 + 8 + 4 = 27 \text{ min}$

Total elapsed Time = 30 min

Idle time for $M_1 = 30 - 28 = 2 \text{ min}$

Idle time for $M_2 = 30 - 27 = 3 \text{ min}$

n Jobs on m machine

Ex. 4 Jobs processed on 5 machines — A, B, C, D, and E in the order A, B, C, D, E. The processing times are given as below. Find the optimum sequence of Jobs, minimum elapsed time and idle time of all machines.

Machines \ Jobs	Jobs			
	1	2	3	4
A	8	7	6	9
B	6	7	5	4
C	3	5	6	4
D	4	6	7	3
E	10	11	9	7

Conditions

- 1) $\min(A_i) \geq \max(B_i, C_i, D_i)$ $6 \neq 7$ ✗
- 2) $\min(E_i) \geq \max(B_i, C_i, D_i)$ $7 \geq 7$ ✓

$$\min(A) = 6 \quad \max(B, C, D) = 7$$

$$\min(E) = 7$$

Since the second condition is satisfied, we can convert this into an equivalent N jobs 2 machines problem with 4 Jobs as follows:

$$X_i = (A_i + B_i + C_i + D_i)$$

$$Y_i = (B_i + C_i + D_i + E_i)$$

M \ J	1	2	3	4
X_i	21	25	24	20
Y_i	23	29	27	18

Job sequence

X_i	1	3	2	4
Y_i				

Job Sequence	A			B			C			D			E		
	In	Out	Idle	In	Out	Idle	In	Out	Idle	In	Out	Idle	In	Out	Idle
1	0	8	0	8	14	8	14	17	14	17	21	17	21	31	21
3	8	14	0	14	19	0	19	25	2	25	32	4	32	41	1
2	14	21	0	21	28	2	28	33	3	33	39	1	41	52	0
4	21	30	0	30	34	2	34	38	1	39	42	0	52	59	0

Idle time for machine A : $59 - 30 = 29$
 Idle time for machine B : $59 - 34 + 12 = 37$
 Idle time for machine C : $59 - 38 + 20 = 41$
 Idle time for machine D : $59 - 42 + 22 = 39$
 Idle Time for " E : 22
 Total elapsed time = 59 hours.