

TOPIC 10: SCHEDULING AND PLANNING

Solutions to Practice Problems

1.

Car	Labor Time Remaining	Due Date	$CR = \frac{\text{Due date} - \text{Today's Date}}{\text{Work time remaining}}$
A	5	5	$(5-1)/5 = 0.8$
B	10	18	1.7
C	1	12	11
D	3	15	4.67

Job sequence: A-B-D-C

2.

Job	Process Time	Flow Time	Lateness
B	1	1	$\text{Max}\{0, 9 + 1 - 11\} = 0$
D	5	6	$\text{Max}\{0, 9 + 6 - 13\} = 2$
A	8	14	$\text{Max}\{0, 9 + 14 - 16\} = 7$
C	20	34	$\text{Max}\{0, 9 + 34 - 21\} = 22$
E	3	37	$\text{Max}\{0, 9 + 37 - 32\} = 14$
F	4	41	$\text{Max}\{0, 9 + 41 - 40\} = 10$
SUM	41	133	55

Average completion time = $133/6 = 22.17$ days

Average job lateness = $55/6 = 9.17$ days

3. a. The sequences are:

- (i) FCFS: E C B F D A
- (ii) EDD: E F B D A C or E B F D A C
- (iii) LPT: C B D A E F
- (iv) SPT: F E A D B C

b. SPT:

Job	Process Time	Flow Time	Due Date	Lateness
F	2	2	9	2
E	3	5	6	8
A	5	10	19	0
D	6	16	15	10
B	7	23	9	23
C	15	38	25	22

SUM	38	94		65
------------	-----------	-----------	--	-----------

Average completion time = $94/6 = 15.7$ days

Average job lateness = $65/6 = 10.83$ days

EDD (E F B D A C):

Job	Process Time	Flow Time	Due Date	Lateness
E	3	3	6	6
F	2	5	9	5
B	7	12	9	12
D	6	18	15	12
A	5	23	19	13
C	15	38	25	22
SUM	38	99		70

Average completion time = $99/6 = 16.5$ days

Average job lateness = $70/6 = 11.67$ days

EDD (E B F D A C):

Job	Process Time	Flow Time	Due Date	Lateness
E	3	3	6	6
B	7	10	9	10
F	2	12	9	12
D	6	18	15	12
A	5	23	19	13
C	15	38	25	22
SUM	38	104		75

Average completion time = $104/6 = 17.33$ days

Average job lateness = $75/6 = 12.5$ days

c. SPT is better than EDD since its average completion time and average job lateness are lower than EDD's.

4. *Step 1*: smallest time = 1, 1st machine, job 3 → Schedule job 3 as early as possible. Cross out job 3.

Step 2: smallest time = 2, 2nd machine, job 2 → Schedule job 2 as late as possible. Cross out job 2.

Step 3: smallest time = 3, 2nd machine, job 7 → Schedule job 7 as late as possible (before job 2). Cross out job 7.

Step 4: smallest time = 4, 1st machine, job 4 → Schedule job 4 as early as possible (after job 3). Cross out job 4.

Step 5: smallest time = 6, 1st machine, job 1 → Schedule job 1 as early as possible (after job 4). Cross out job 1.

Step 6: smallest time = 7, 1st machine, job 6 → Schedule job 6 as early as possible (after job 1). Cross out job 6.

Step 7: only job 5 is left, put it after job 6, before job 7.

The final job sequence is: 3-4-1-6-5-7-2

5. First we need to calculate A' ($A' = A + B$) and B' ($B' = B + C$) as follows:

<u>Job</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>A'</u>	<u>B'</u>
1	6	30	7	36	37
2	23	2	5	25	7
3	1	7	10	8	17
4	4	3	1	7	4
5	8	8	2	16	10

Based on the numbers in the A' and B' columns, the jobs should be sequenced as follows:

Step 1: smallest time = 4, 2nd machine, job 4 → Schedule job 4 as late as possible. Cross out job 4.

Step 2: smallest time = 7, 2nd machine, job 2 → Schedule job 2 as late as possible (before job 4). Cross out job 2.

Step 3: smallest time = 8, 1st machine, job 3 → Schedule job 3 as early as possible. Cross out job 3.

Step 4: smallest time = 10, 2nd machine, job 5 → Schedule job 5 as late as possible (before job 2). Cross out job 5.

Step 5: only job 1 is left, put it after job 2, before job 5.

The final job sequence is: 3 1 5 2 4

6. Use Moore's Algorithm:

Step 1:

<u>Job</u>	<u>Process Time</u>	<u>Flow Time</u>	<u>Due Date</u>	<u>Late?</u>
D	2	2	5	NO
B	5	7	12	NO
C	9	16	17	YES
A	3	19	18	YES
F	8	27	19	YES
E	7	34	21	YES

Step 2: C is the first one late.

Step 3: Consider D, B and C.

Reject C, because C has the longest process time.

Go to Step 2.

Step 2:

<u>Job</u>	<u>Process Time</u>	<u>Flow Time</u>	<u>Due Date</u>	<u>Late?</u>
D	2	2	5	NO
B	5	7	12	NO
A	3	10	18	NO
F	8	18	19	YES
E	7	25	21	YES

F is the first one late.

Step 3: **Reject F**, because F has the longest process time.

Go to Step 2.

Step 2:

<u>Job</u>	<u>Process Time</u>	<u>Flow Time</u>	<u>Due Date</u>	<u>Late?</u>
D	2	2	5	NO
B	5	7	12	NO
A	3	10	18	NO
E	7	17	21	NO

No more late jobs. Go to Step 4.

Step 4: Optimal Sequence = **D-B-A-E-C-F or D-B-A-E-F-C**

2 jobs are late.

7. Use Moore's Algorithm:

Step 1:

<u>Job</u>	<u>Process Time</u>	<u>Flow Time</u>	<u>Due Date</u>	<u>Late?</u>
A	9	9	47	NO
D	14	23	55	NO
C	12	35	59	YES
B	5	40	68	YES
E	11	51	76	YES

Step 2: C is the first one late.

Step 3: Consider A, D and C.

Reject D, because D has the longest process time.

Go to Step 2.

Step 2:

<u>Job</u>	<u>Process Time</u>	<u>Flow Time</u>	<u>Due Date</u>	<u>Late?</u>
A	9	9	47	NO
C	12	21	59	NO
B	5	26	68	NO
E	11	37	76	NO

No more late jobs. Go to Step 4.

Step 4: Optimal Sequence = **A-C-B-E-D**

1 job is late.