

## Job Sequencing with Deadlines

Job-1

The sequencing of jobs on a single processor with deadline constraints is called as Job Sequencing with Deadlines.

Here,

- You are given a set of jobs
- Each Job has a defined deadline and some profit associated with it.
- The profit of Job is given only when that Job is completed within its deadline
- Only one processor is available for processing all its jobs.
- Processor takes one unit of time to complete a job.

"How can the total Profit be maximized if only one job can be completed at a time?"



## Approach to Solution

Job-2

- A Feasible solution would be a subset of jobs where each job of the subset gets completed within its deadline.
- Value of ~~the~~ the feasible solution would be the sum of profit of all the jobs contained in the subset.
- An Optimal Solution of the problem would be feasible solution which gives the maximum profit.

Step 1: Sort all the given jobs in decreasing order of their profit.

Step 2: → Check the value of Maximum deadline  
→ Draw the Gantt chart where maximum time on Gantt chart is the value of maximum deadline

Step 3: → Pick up the jobs one by one  
→ Put the job on Gantt chart as far as possible from 0 ensuring the jobs gets completed before its deadline.

## Algorithm

Job-3

- 1- Sort all jobs in decreasing order of profit
- 2- Iterate on jobs in decreasing order of profit.

For each job, do the following:

- (a) Find a time slot  $i$ , such that slot is empty and  $i < \text{deadline}$  and  $i$  is greatest.

Put the job in this slot and mark this slot filled

- (b) If no such  $i$  exists, then ignore the job.

Question-1 Given the jobs, their deadlines and associated profits as shown:

Jobs	J1	J2	J3	J4	J5	J6
Deadlines	5	3	3	2	4	2
Profits	200	180	190	300	120	100

Answer the following Questions:

- 1- Write the optimal schedule that gives maximum profit?
2. Are all jobs completed in the optimal schedule?
- 3- What is the maximum earned profit?



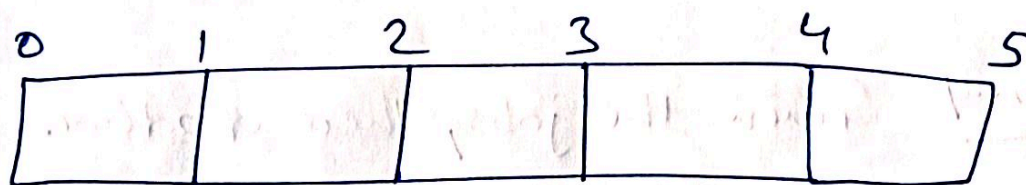
Solution: Step-1:

Sort all the given jobs in decreasing order of their profit:

Jobs	J4	J1	J3	J2	J5	J6
Deadlines	2	5	3	3	4	2
Profits	300	200	190	180	120	100

Step 2: Value of maximum Deadline = 5

So, draw a Gantt chart with maximum time on Gantt chart = 5 units as shown below -



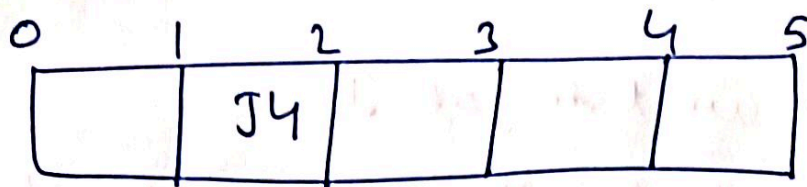
Gantt chart

Now,

- we take each job one by one in the order they appear in step-1.
- We place the job on Gantt chart as far as possible from 0.

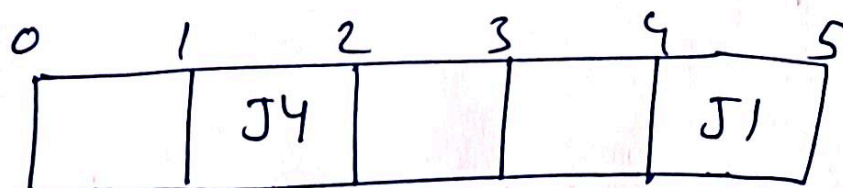
Step-3: → We take job J4

- Since its deadline is 2, so we place it in the First empty cell before deadline 2



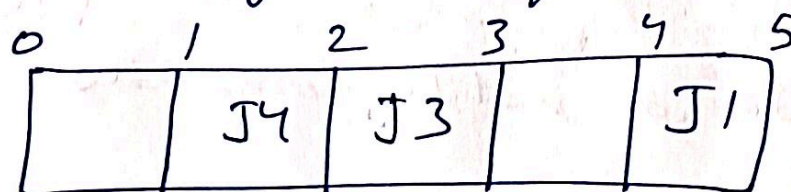
Step 4: → We take job J1

→ Since its deadline is 5, so we place it in the first empty cell before deadline 5 as-



Step 5: → we take job J3

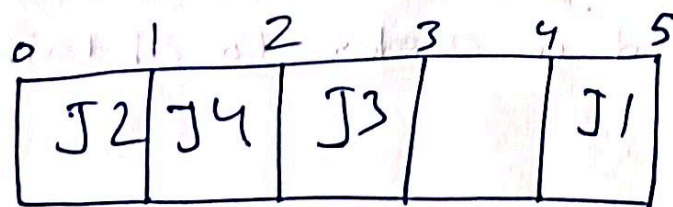
→ Since deadline is 3, so we place it in the first empty cell before deadline 3 as-



Step 6: → we take Job J2

→ Since its deadline is 3, so, we place it in first empty cell before deadline 3

→ Since the second and third cells are already filled, so we place job J2 in the first cell





Step 7: → Now, we take job J5.

→ Since its deadline is 4, so we place it in first empty cell before deadline 4 as.

0	1	2	3	4	5
J2	J4	J3	J5	J1	

Now,

→ The only job left is Job J6 whose deadline is 2.

→ All the ~~jobs~~ slots before deadline 2 are already occupied.

→ Thus job J6 can not be completed.

Now, the given questions may be answered as

Part-1 : The optimal schedule is-

J2, J4, J3, J5, J1

This is the required order in which the jobs must be completed in order to obtain the maximum profit.

Part-2:

- All the jobs are not completed in Optimal schedule.
- This is because job J6 could not be completed within its deadline.

Part-3: Maximum earned profit:

$$\begin{aligned} &= \text{Sum of profit of all the jobs in optimal schedule} \\ &= \text{profit of job J2} + \text{profit of Job J4} + \text{J3} + \text{J5} + \text{J1} \\ &= 180 + 300 + 190 + 120 + 300 \\ &= 990 \text{ units} \end{aligned}$$

Time Complexity  $O(n^2)$