Job Sequencing With Deadlines

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- 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 a job is given only when that job is completed within its deadline.
  - Only one processor is available for processing all the jobs.
  - Processor takes one unit of time to complete a job.

- **The problem states-**

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

Approach to Solution-

- A feasible solution would be a subset of jobs where each job of the subset gets completed within its deadline.
- Value of 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 a feasible solution which gives the maximum profit.

Greedy Algorithm-

- Greedy Algorithm is adopted to determine how the next job is selected for an optimal solution.
- The greedy algorithm described below always gives an optimal solution to the job sequencing problem-

Step-01:

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

Step-02:

- Check the value of maximum deadline.
- Draw a Gantt chart where maximum time on Gantt chart is the value of maximum deadline.

Step-03:

- Pick up the jobs one by one.
- Put the job on Gantt chart as far as possible from 0 ensuring that the job gets completed before its deadline.

PRACTICE PROBLEM BASED ON JOB SEQUENCING WITH DEADLINES-

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

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

Answer the following questions-

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

Solution

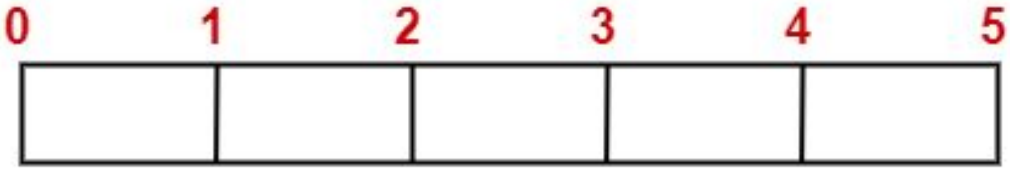
Step-01:

- 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-02:

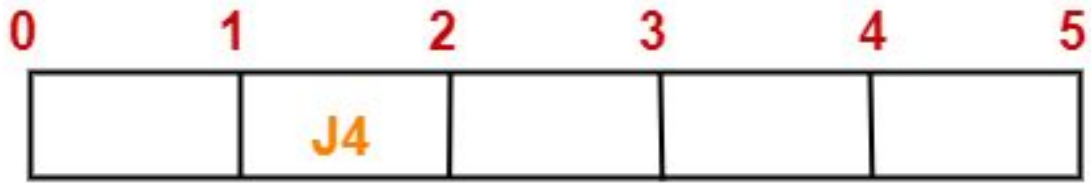
- Value of maximum deadline = 5.
- So, draw a Gantt chart with maximum time on Gantt chart = units as shown-
- Now, We take each job one by one in the order they appear in Step-01.
- We place the job on Gantt chart as far as possible from 0.



Gantt Chart

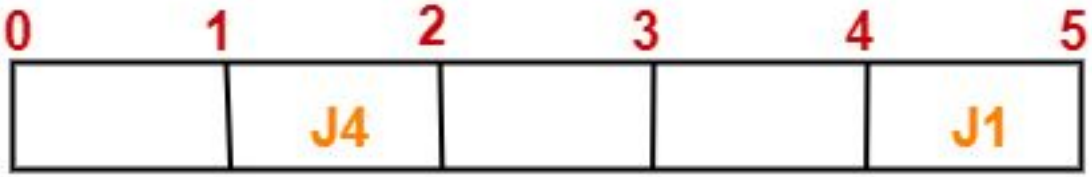
Step-03:

- We take job J4.
- Since its deadline is 2, so we place it in the first empty cell before deadline 2 as-



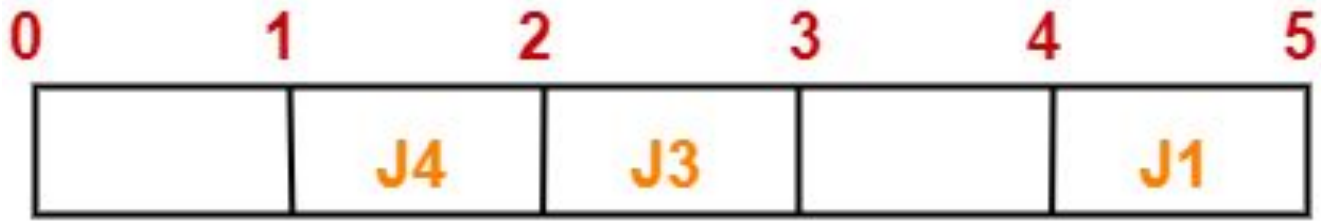
Step-04:

- We take job J1.
- Since its deadline is 5, so we place it in the first empty cell before deadline 5 as-



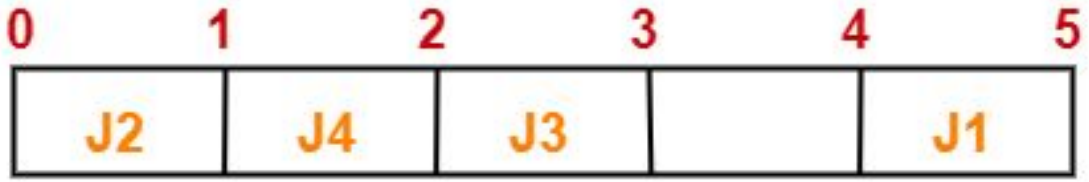
Step-05:

- We take job J3.
- Since its deadline is 3, so we place it in the first empty cell before deadline 3 as-



Step-06:

- We take job J2.
- Since its deadline is 3, so we place it in the first empty cell before deadline 3.
- Since the second and third cells are already filled, so we place job J2 in the first cell as-



Step-07:

- Now, we take job J5.
- Since its deadline is 4, so we place it in the first empty cell before deadline 4 as-

- Now, The only job left is job whose deadline is 2.
- All the slots before deadline 2 are already occupied.
- Thus, job J6 can not be completed.

Final Solution

Part-01:

- 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-02:

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

Part-03:

- Maximum earned profit
- = Sum of profit of all the jobs in optimal schedule
- = Profit of job J2 + Profit of job J4 + Profit of job J3 + Profit of job J5 + Profit of job J1
- = 180 + 300 + 190 + 120 + 200= 990 units

Problem

- Find the optimal schedule

Job	J_1	J_2	J_3	J_4	J_5
Deadline	2	1	3	2	1
Profit	60	100	20	40	20