AMRITA VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY UNDER SECTION 3 OF UGC ACT, 1956

SCHOOL OF COMPUTING

# DESIGN AND ANALYSIS OF ALGORITHMS

# LAB WORKBOOK

# WEEK - 7

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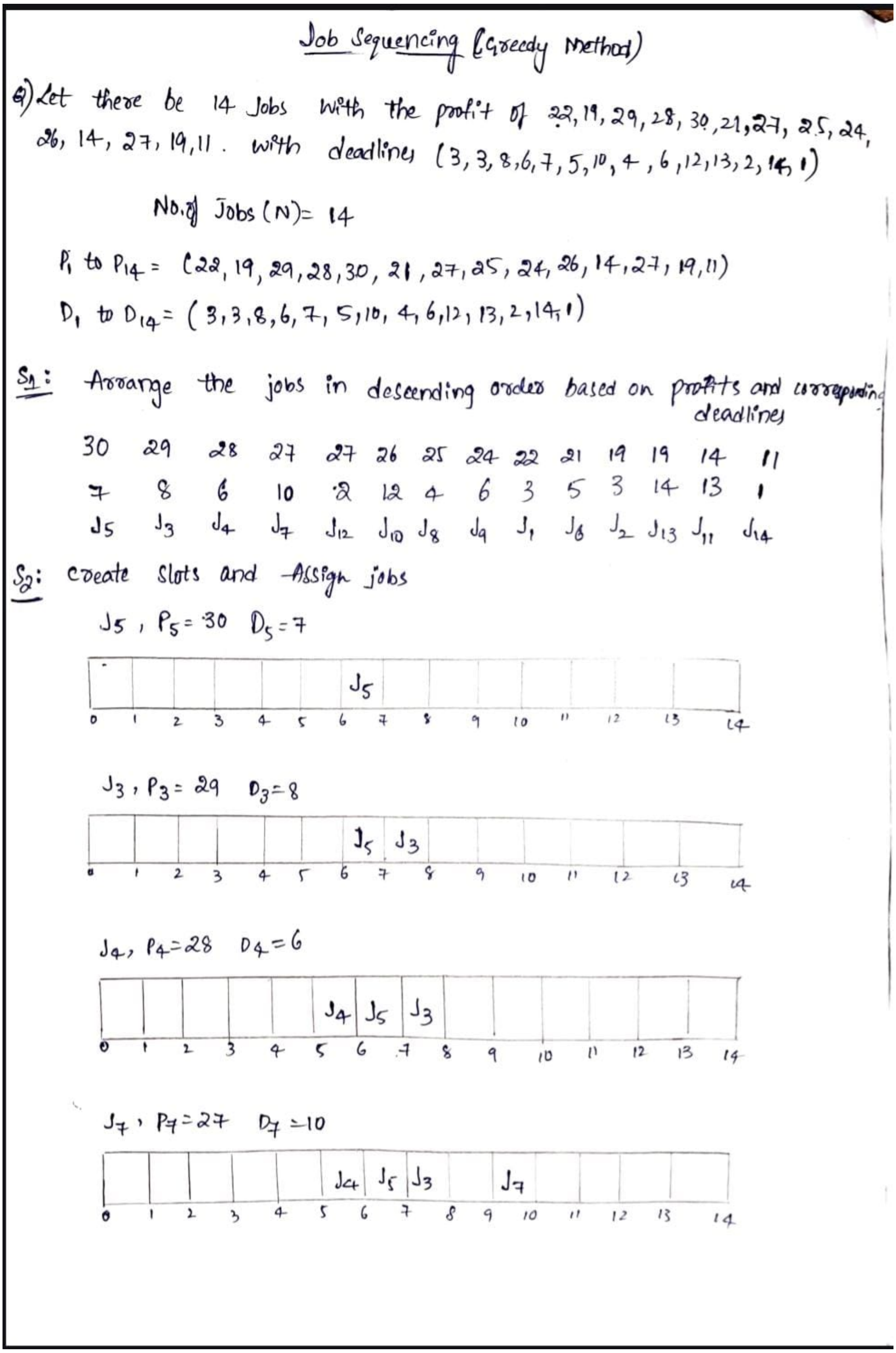
**ROLL NO : CH.SC.U4CSE24128**

**CLASS : CSE-B**

**Question 1:** Let there be 14 jobs with the profit of 22,19,29,28,30,21,27,25,24,26,14,27,19,11 with deadlines 3,3,8,6,7,5,10,4,6,12,13,2,14,1

Implement the greedy algorithm for the Job Sequencing with Deadlines and determine the optimal sequence of jobs that maximizes total profit.



## Job Sequencing (Greedy Method)

Q) Let there be 14 Jobs with the profit of 22, 19, 29, 28, 30, 21, 27, 25, 24, 26, 14, 27, 19, 11. with deadlines (3, 3, 8, 6, 7, 5, 10, 4, 6, 12, 13, 2, 14, 1)

No. of Jobs (N) = 14

$P_1$ to $P_{14}$ = (22, 19, 29, 28, 30, 21, 27, 25, 24, 26, 14, 27, 19, 11)

$D_1$ to $D_{14}$ = (3, 3, 8, 6, 7, 5, 10, 4, 6, 12, 13, 2, 14, 1)

$S_1$: Arrange the jobs in descending order based on profits and corresponding deadlines

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 29 | 28 | 27 | 27 | 26 | 25 | 24 | 22 | 21 | 19 | 19 | 14 | 11 |
| 7 | 8 | 6 | 10 | 2 | 12 | 4 | 6 | 3 | 5 | 3 | 14 | 13 | 1 |
| $J_5$ | $J_3$ | $J_4$ | $J_7$ | $J_{12}$ | $J_{10}$ | $J_8$ | $J_9$ | $J_1$ | $J_6$ | $J_2$ | $J_{13}$ | $J_{11}$ | $J_{14}$ |

$S_2$: create slots and Assign jobs

$J_5$, $P_5$ = 30 $D_5$ = 7

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $J_5$ | | | | | | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_3$, $P_3$ = 29 $D_3$ = 8

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $J_5$ | $J_3$ | | | | | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_4$, $P_4$ = 28 $D_4$ = 6

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $J_4$ | $J_5$ | $J_3$ | | | | | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_7$, $P_7$ = 27 $D_7$ = 10

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_{12}$ , $P_{12} = 27$ $D_{12} = 2$

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $J_{12}$ | | | | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_{10}$ , $P_{10} = 26$ , $D_{10} = 12$

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $J_{12}$ | | | | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | $J_{10}$ | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_8$ , $P_8 = 25$ , $D_8 = 4$

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $J_{12}$ | | $J_8$. | | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | $J_{10}$ | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_9$ , $P_9 = 24$ , $D_9 = 6$

As 6th slot is filled check for [4-5] , if it is empty assign the value to it

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $J_{12}$ | | $J_8$ | $J_9$ | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | $J_{10}$ | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_1$ , $P_1 = 22$ , $D_1 = 3$

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $J_{12}$ | $J_1$ | $J_8$ | $J_9$ | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | $J_{10}$ | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_6$ , $P_6 = 21$ $D_6 = 5$

As 5th slot is filled check poevious slots, only [0-1] slot is empty So assign the value to it

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $J_6$ | $J_{12}$ | $J_1$ | $J_8$ | $J_9$ | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | $J_{10}$ | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_2$ , $P_2 = 19$ $D_2 = 3$

3od slot is filled and previous slots are also filled. so, no slot is free for $J_2$

So, Reject $J_2$

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $J_6$ | $J_{12}$ | $J_1$ | $J_8$ | $J_9$ | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | $J_{10}$ | | |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_{13}$, $P_{13}=19$ , $D_{13}=14$

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $J_6$ | $J_{12}$ | $J_1$ | $J_8$ | $J_9$ | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | $J_{10}$ | | $J_{13}$ |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_4$, $P_{11}=14$, $D_{11}=13$

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $J_6$ | $J_{12}$ | $J_1$ | $J_8$ | $J_9$ | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | $J_{10}$ | $J_{11}$ | $J_{13}$ |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

$J_{14}$, $P_{14}=11$, $D_{14}=1$

Deadline is 1

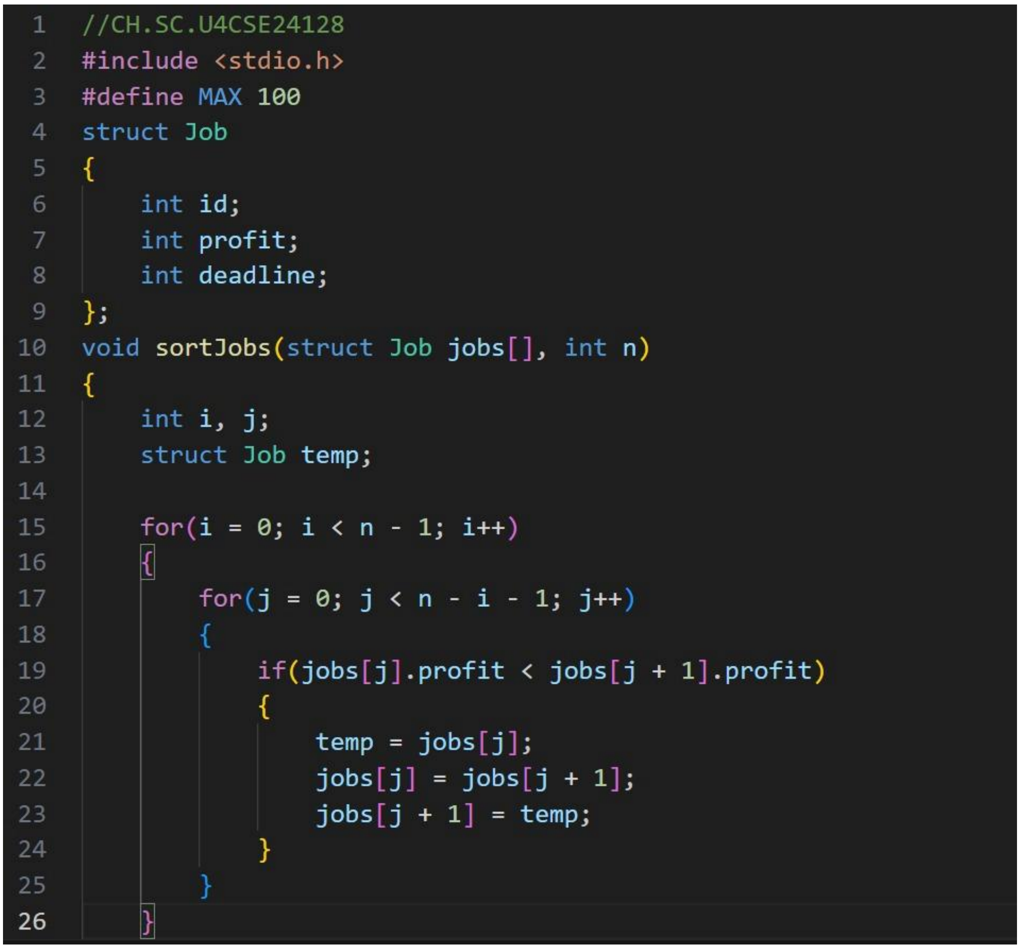
1st slot is filled . there is no slot free to assign this value.
So , Reject $J_{14}$

Final Job sequence:
$\{J_5, J_3, J_4, J_7, J_{12}, J_{10}, J_8, J_9, J_1, J_6, J_{13}, J_{11}\}$

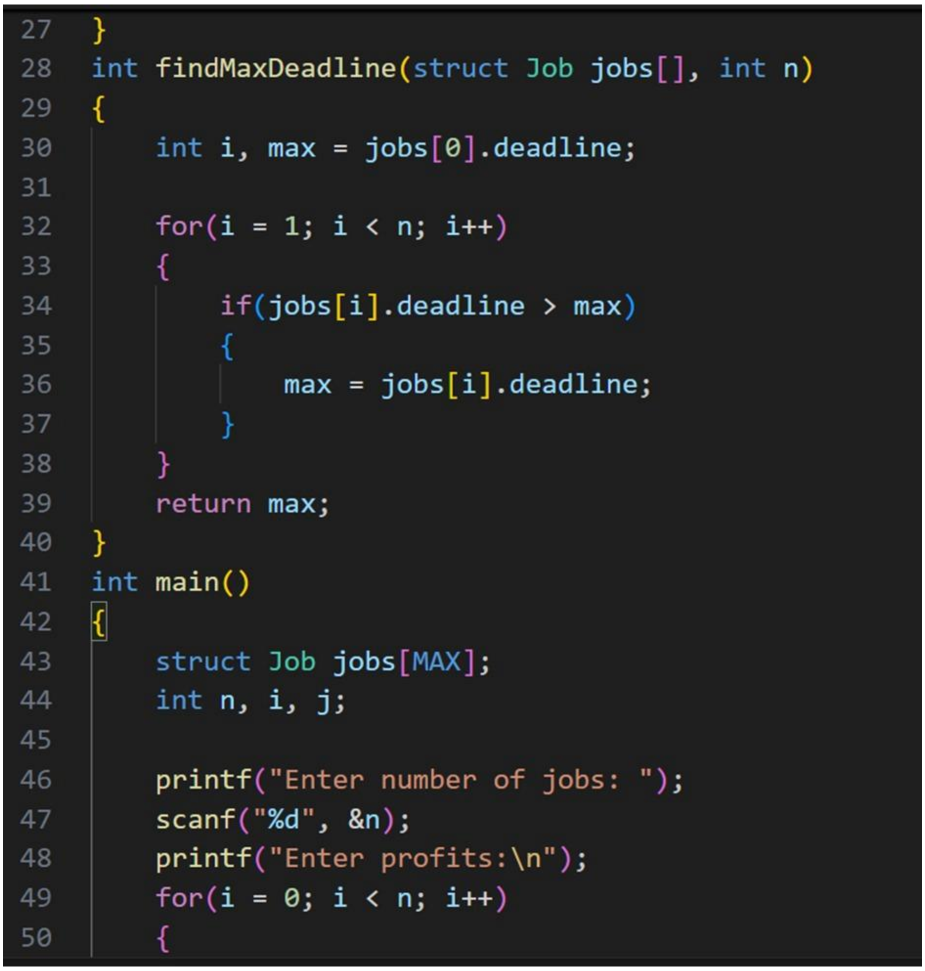
| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $J_6$ | $J_{12}$ | $J_1$ | $J_8$ | $J_9$ | $J_4$ | $J_5$ | $J_3$ | | $J_7$ | | $J_{10}$ | $J_{11}$ | $J_{13}$ |

Total profit: $21+27+22+25+24+28+30+29+27+26+14+19$
$292$

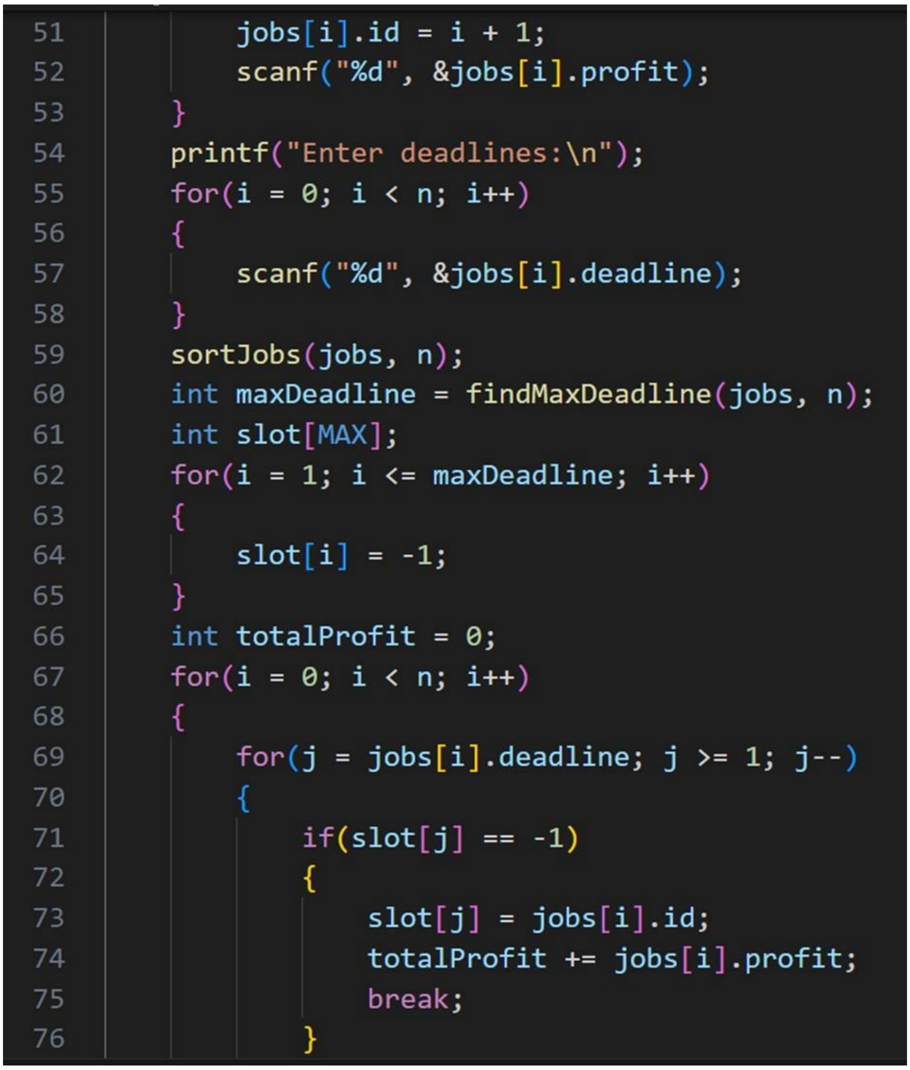
**CODE:**



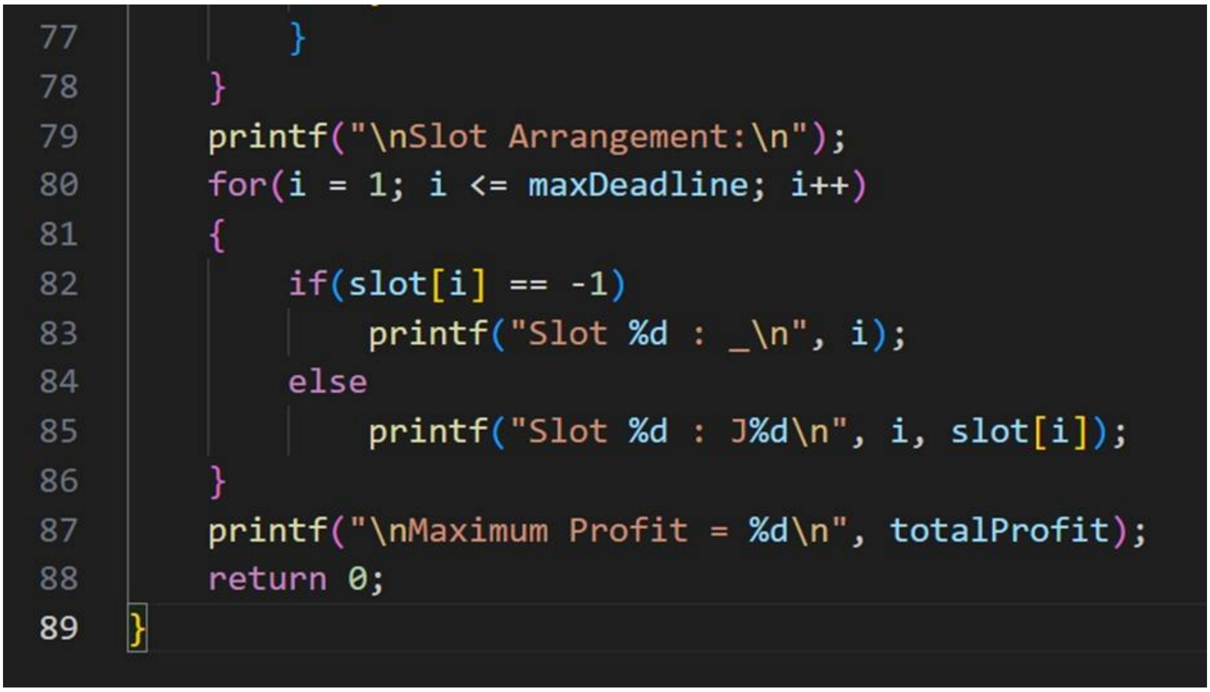
```c
//CH.SC.U4CSE24128
#include <stdio.h>
#define MAX 100
struct Job
{
    int id;
    int profit;
    int deadline;
};
void sortJobs(struct Job jobs[], int n)
{
    int i, j;
    struct Job temp;

    for(i = 0; i < n - 1; i++)
    {
        for(j = 0; j < n - i - 1; j++)
        {
            if(jobs[j].profit < jobs[j + 1].profit)
            {
                temp = jobs[j];
                jobs[j] = jobs[j + 1];
                jobs[j + 1] = temp;
            }
        }
    }
```



```c
}
int findMaxDeadline(struct Job jobs[], int n)
{
    int i, max = jobs[0].deadline;

    for(i = 1; i < n; i++)
    {
        if(jobs[i].deadline > max)
        {
            max = jobs[i].deadline;
        }
    }
    return max;
}
int main()
{
    struct Job jobs[MAX];
    int n, i, j;

    printf("Enter number of jobs: ");
    scanf("%d", &n);
    printf("Enter profits:\n");
    for(i = 0; i < n; i++)
    {
```

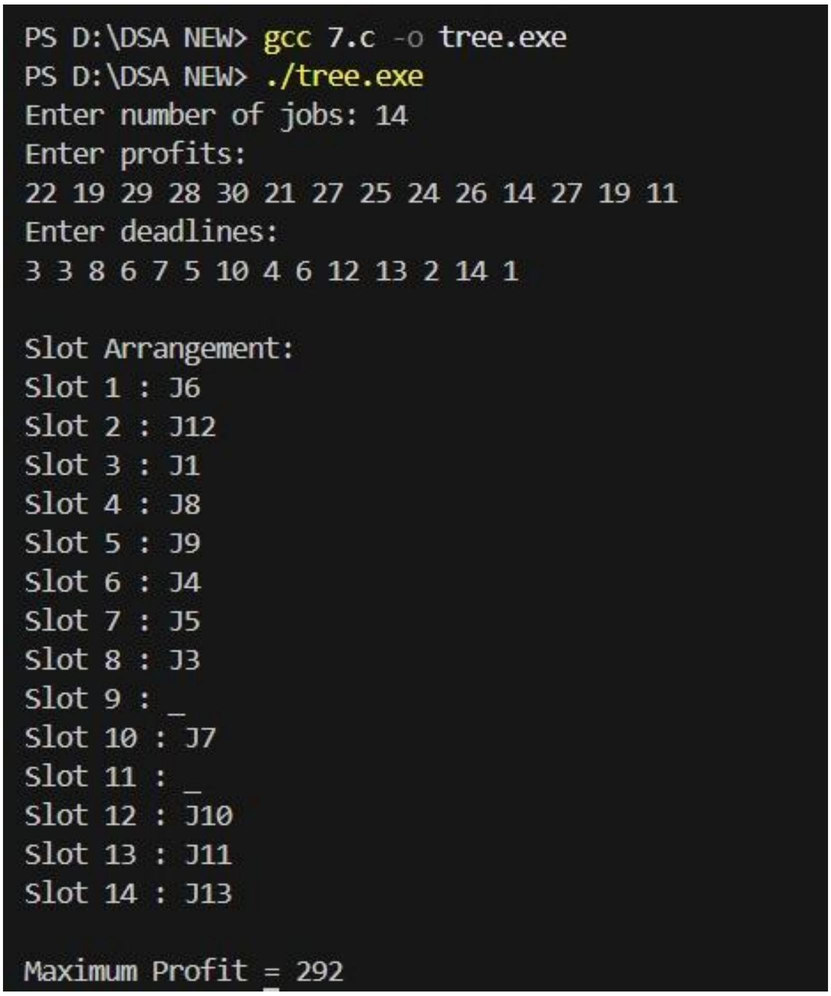


```c
        jobs[i].id = i + 1;
        scanf("%d", &jobs[i].profit);
    }
    printf("Enter deadlines:\n");
    for(i = 0; i < n; i++)
    {
        scanf("%d", &jobs[i].deadline);
    }
    sortJobs(jobs, n);
    int maxDeadline = findMaxDeadline(jobs, n);
    int slot[MAX];
    for(i = 1; i <= maxDeadline; i++)
    {
        slot[i] = -1;
    }
    int totalProfit = 0;
    for(i = 0; i < n; i++)
    {
        for(j = jobs[i].deadline; j >= 1; j--)
        {
            if(slot[j] == -1)
            {
                slot[j] = jobs[i].id;
                totalProfit += jobs[i].profit;
                break;
            }
```



```c
        }
    }
    printf("\nSlot Arrangement:\n");
    for(i = 1; i <= maxDeadline; i++)
    {
        if(slot[i] == -1)
            printf("Slot %d : _\n", i);
        else
            printf("Slot %d : J%d\n", i, slot[i]);
    }
    printf("\nMaximum Profit = %d\n", totalProfit);
    return 0;
}
```

**OUTPUT:**



```
PS D:\DSA NEW> gcc 7.c -o tree.exe
PS D:\DSA NEW> ./tree.exe
Enter number of jobs: 14
Enter profits:
22 19 29 28 30 21 27 25 24 26 14 27 19 11
Enter deadlines:
3 3 8 6 7 5 10 4 6 12 13 2 14 1

Slot Arrangement:
Slot 1 : J6
Slot 2 : J12
Slot 3 : J1
Slot 4 : J8
Slot 5 : J9
Slot 6 : J4
Slot 7 : J5
Slot 8 : J3
Slot 9 : _
Slot 10 : J7
Slot 11 : _
Slot 12 : J10
Slot 13 : J11
Slot 14 : J13

Maximum Profit = 292
```

**Time Complexity:**

**1. Sorting the jobs by profit**

We used Bubble Sort in the program.

Time complexity:$O(n^2)$

**2. Finding maximum deadline**

We check all jobs once.

Time complexity:$O(n)$

**3. Assigning jobs to slots**

For each job, we may check up to d slots.$O(n^2)$

**Total Time Complexity**

$\mathbf{O(n^2) + O(n) + O(n^2)} $**=** $\mathbf{O(n^2)}$

**Space Complexity**

We use:

- Job array → O(n)
- Slot array → O(d)

Total Space: O(n)