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

NAME : MADDU RAAHITHYA YADAV

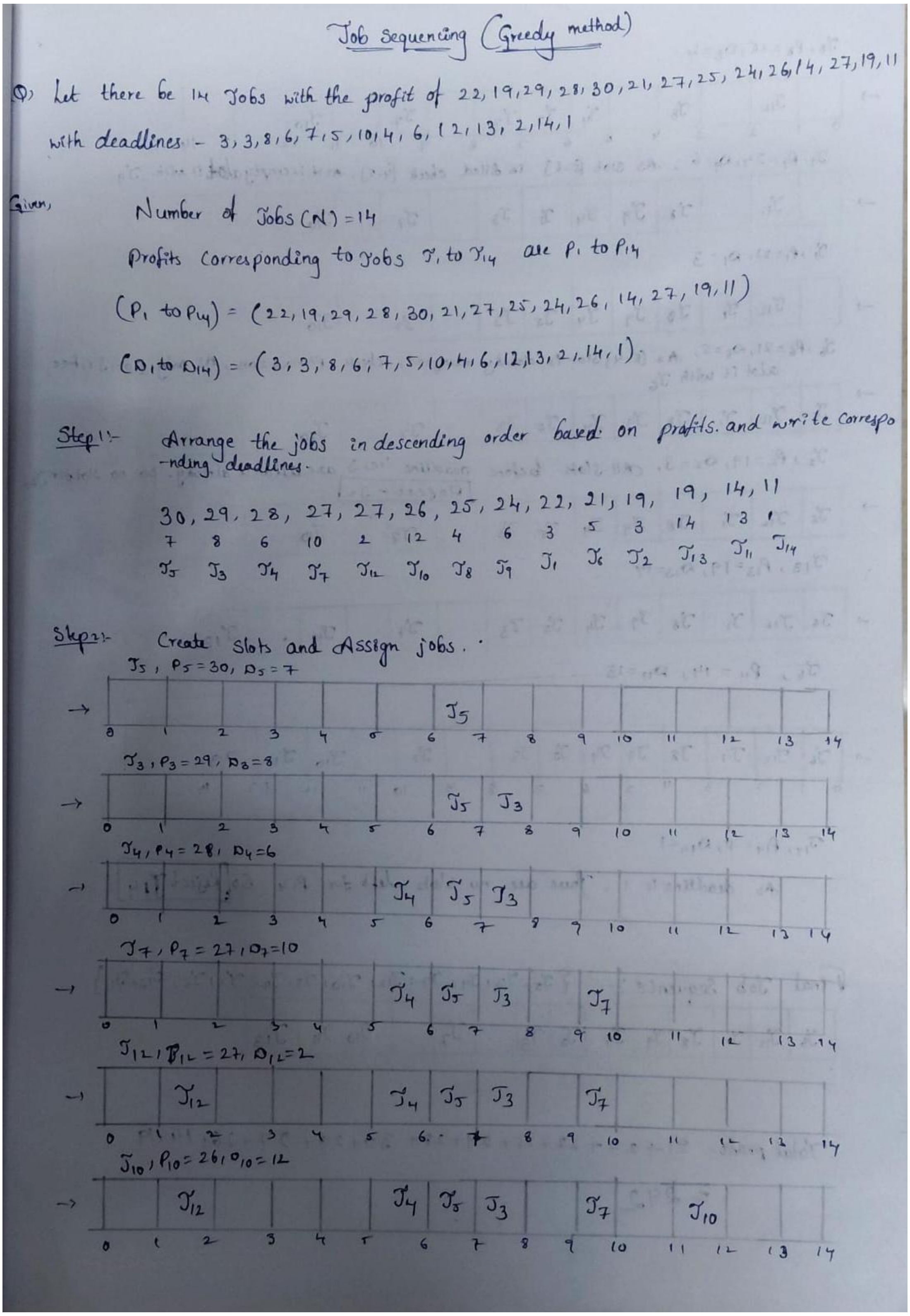
ROLL NUMBER : CH.SC.U4CSE24124

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.

WORKING:



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

Given,

Number of Jobs (N) = 14

Profits corresponding to Jobs J_1 to J_{14} are P_1 to P_{14}

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

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

Step 1:- Arrange the jobs in descending order based on profits and write 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}

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

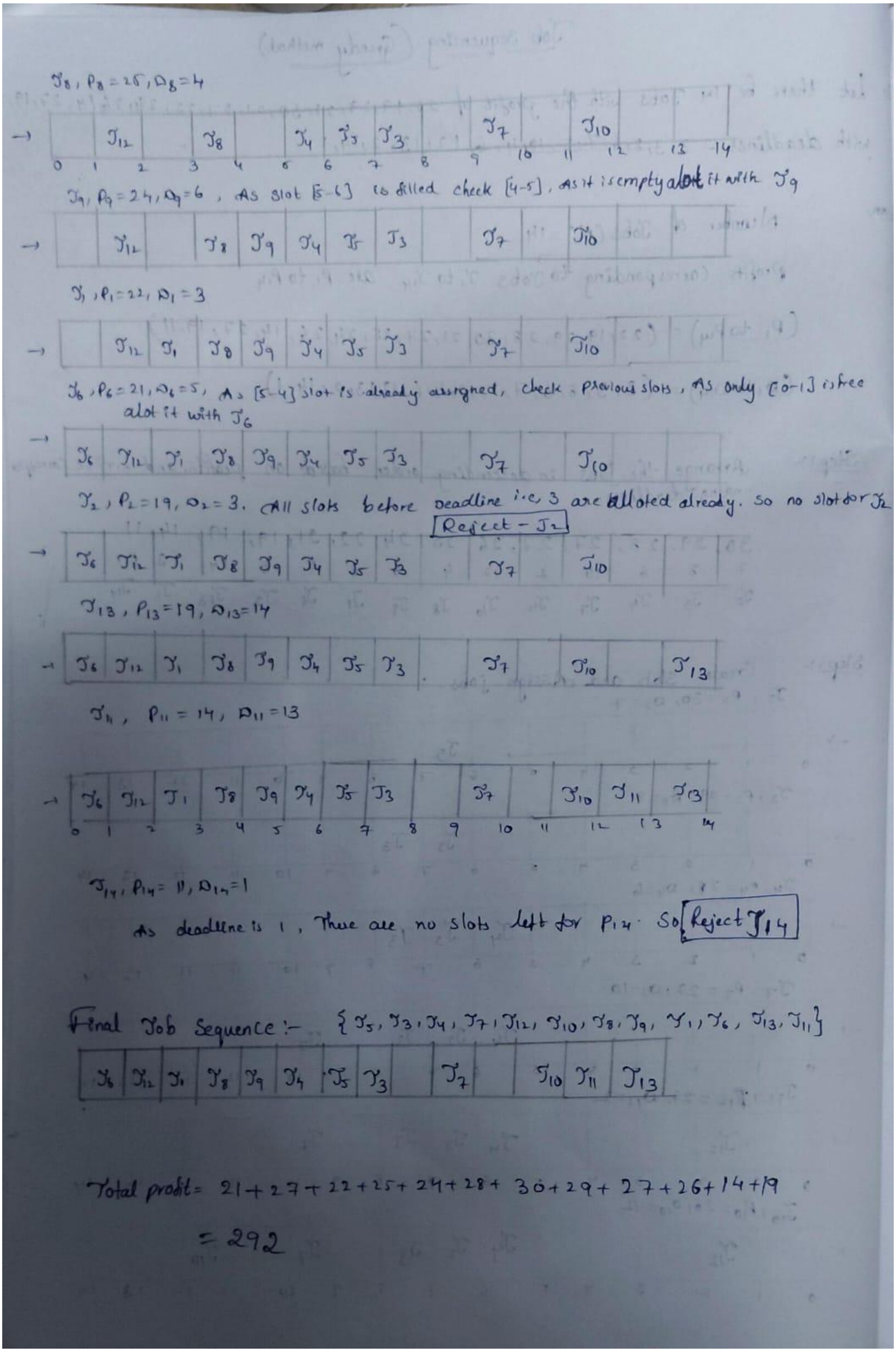
	J_{12}				J_4	J_5	J_3		J_7				

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 slot [5-6] is filled check [4-5], As it is empty alot it with J_9

→

	J_{12}		J_8	J_9	J_4	J_5	J_3		J_7		J_{10}		

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}		

J_6, $P_6 = 21$, $D_6 = 5$, As [5-4] slot is already assigned, check previous slots, As only [0-1] is free alot it with J_6

→

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

J_2, $P_2 = 19$, $D_2 = 3$. All slots before Deadline i.e, 3 are alloted already. So no slot for J_2 $\boxed{\text{Reject} - J_2}$

→

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

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}

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

→

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

As deadline is 1, There are no slots left for P_{14}. So $\boxed{\text{Reject } J_{14}}$

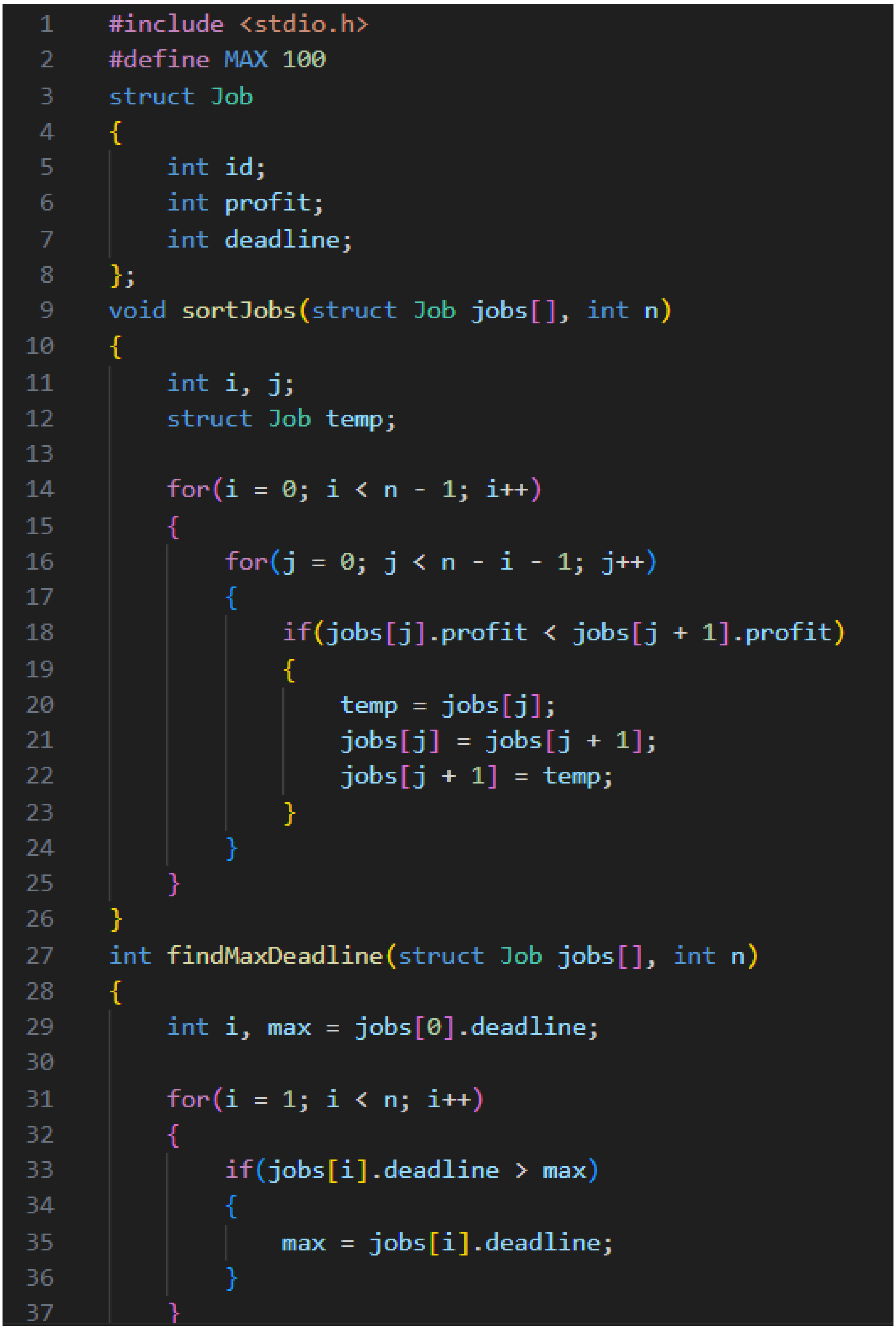
Final Job Sequence :- $\{J_5, J_3, J_4, J_7, J_{12}, J_{10}, J_8, J_9, J_1, J_6, J_{13}, J_{11}\}$

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

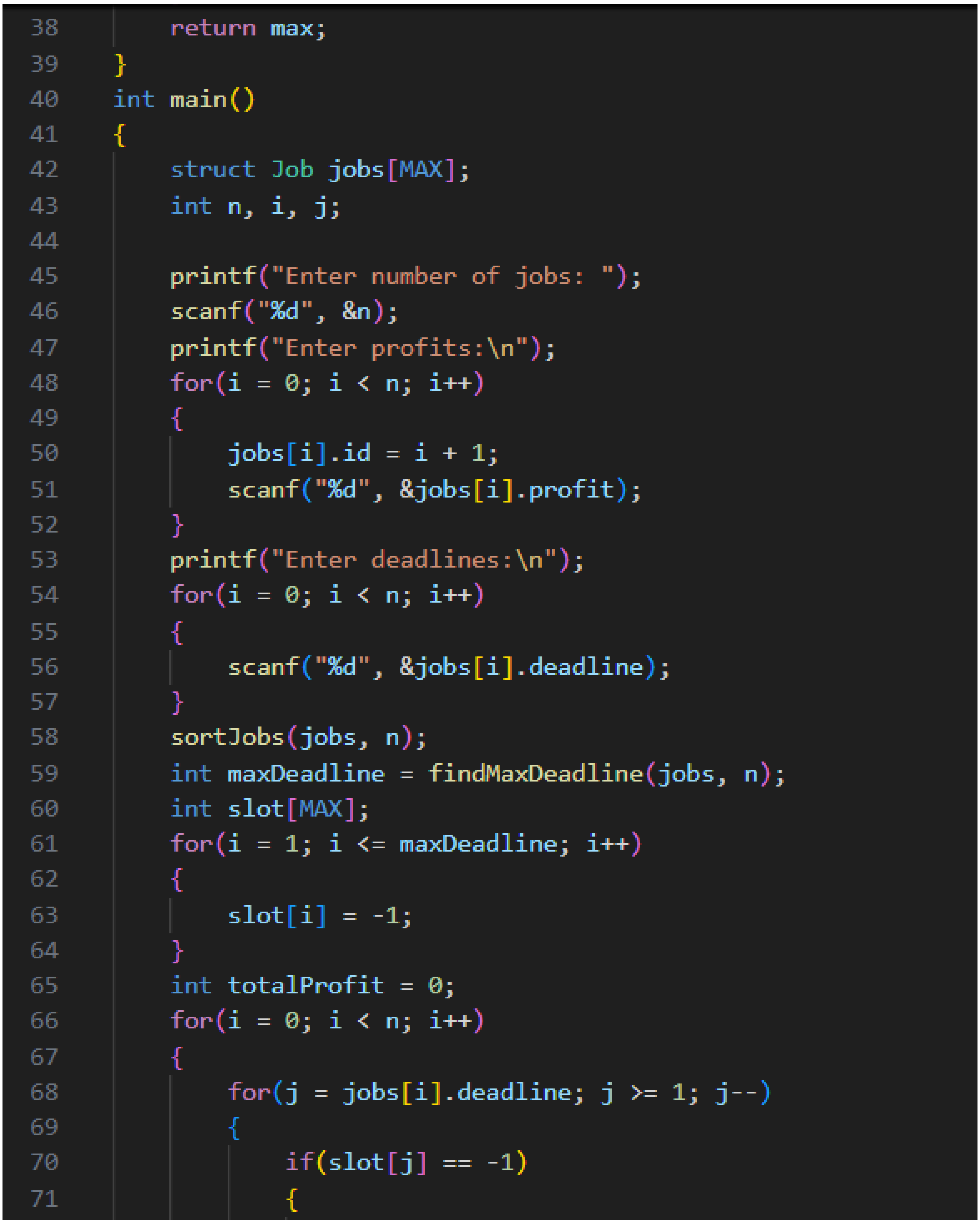
Total profit = $21 + 27 + 22 + 25 + 24 + 28 + 30 + 29 + 27 + 26 + 14 + 19$

$= 292$

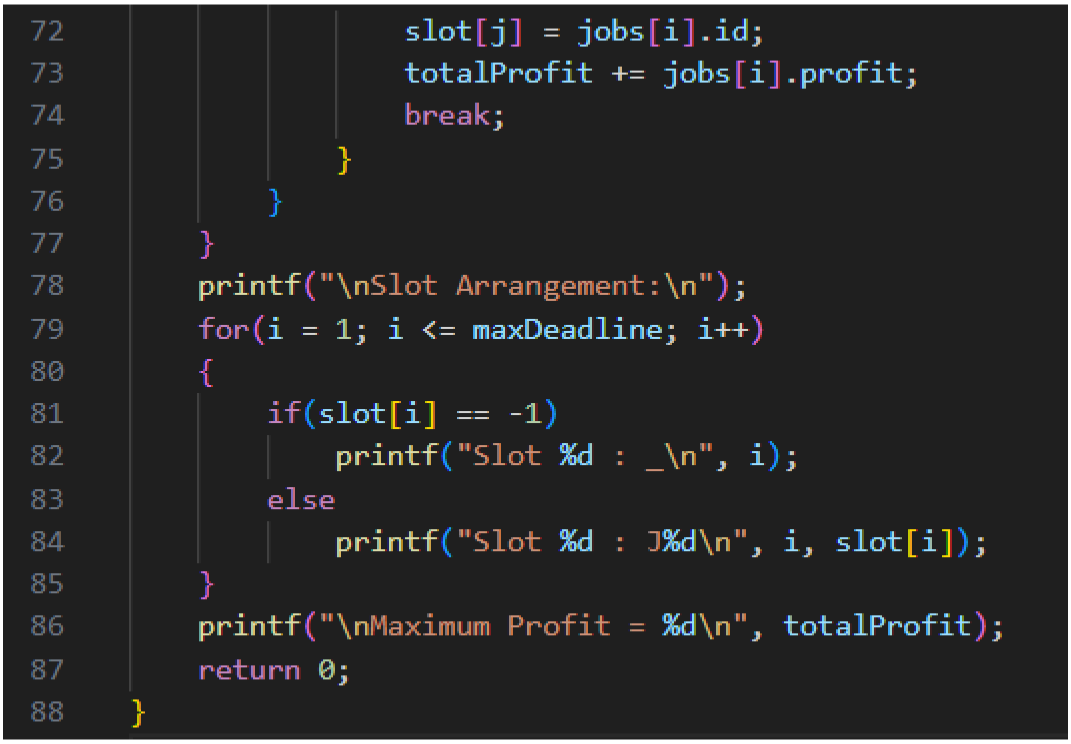
CODE:



```c
#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;
            }
        }
    }
}
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;
        }
    }
```

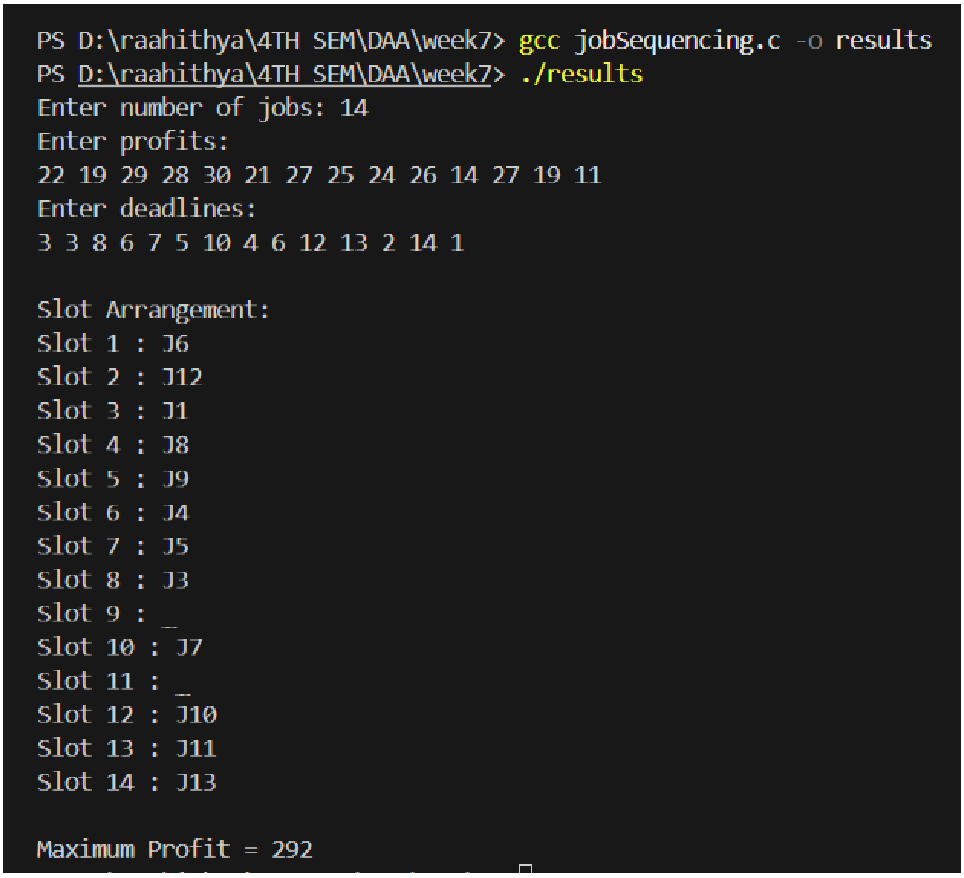


```
    return max;
}
int main()
{
    struct Job jobs[MAX];
    int n, i, j;

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



```c
                slot[j] = jobs[i].id;
                totalProfit += jobs[i].profit;
                break;
            }
        }
    }
    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:\raahithya\4TH SEM\DAA\week7> gcc jobSequencing.c -o results
PS D:\raahithya\4TH SEM\DAA\week7> ./results
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

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

Space Complexity

We use:

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

Total Space: O(n)