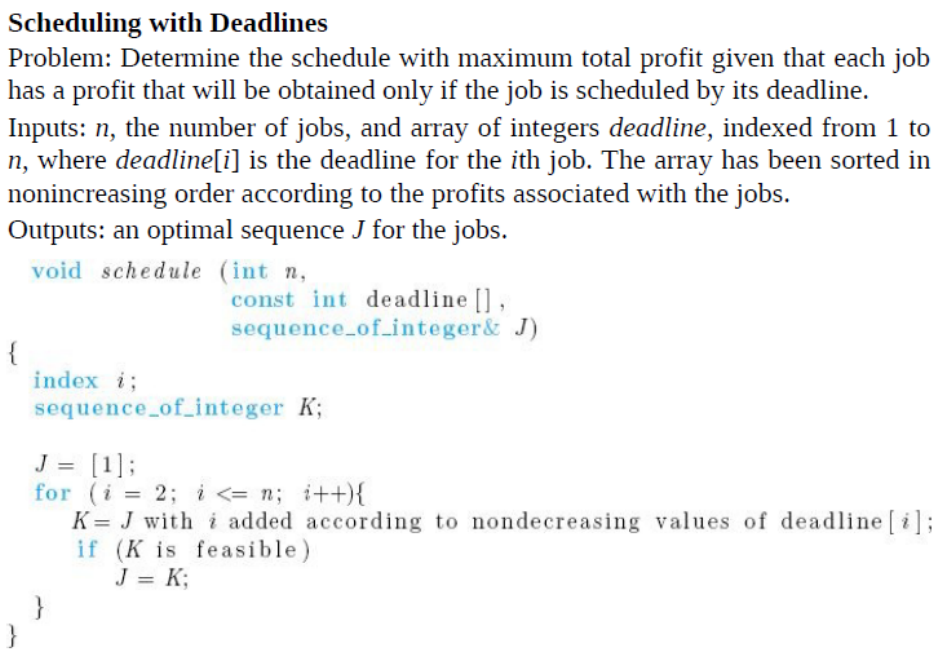
AZA - Practical implementation and analysis of an algorithm (30%) – deadline 6/12/2024 – 5PM

Tasks:

1. **Design and implement an algorithm to solve a problem for scheduling with deadlines (Algorithm 4.4).**



Scheduling with Deadlines

Problem: Determine the schedule with maximum total profit given that each job has a profit that will be obtained only if the job is scheduled by its deadline.

Inputs: n, the number of jobs, and array of integers *deadline*, indexed from 1 to n, where *deadline*[i] is the deadline for the ith job. The array has been sorted in nonincreasing order according to the profits associated with the jobs.

Outputs: an optimal sequence J for the jobs.

```
  void schedule (int n,
                 const int deadline[],
                 sequence_of_integer& J)
{
  index i;
  sequence_of_integer K;

  J = [1];
  for (i = 2; i <= n; i++){
     K = J with i added according to nondecreasing values of deadline[i];
     if (K is feasible)
        J = K;
  }
}
```

Table 1.1. Consider the following jobs, deadlines, and profits, and use the scheduling with deadlines algorithm to maximize the total profit. Show the optimal sequence of jobs with max profit on the screen.

Job	Deadline	Profit
1	2	40
2	4	15
3	3	60
4	2	20
5	3	10
6	1	45
7	1	55

2. **Consider the procedure schedule in the Scheduling with Deadlines algorithm (Algorithm 4.4). Let d be the maximum of the deadlines for n jobs. Modify the procedure so that it adds a job as late as possible to the schedule being built, but no later than its deadline. Do this by initializing d+1 disjoint sets, containing the integers 0, 1, ..., d. Let small(S) be the smallest member of set S. When a job is scheduled, find the set S containing the minimum of its deadline and n. If small(S) = 0, reject the job. Otherwise, schedule it at time small(S), and merge S with the set containing small(S)−1. Assuming we use Disjoint Set Data**

Structure III in Appendix C, show that this version is θ(nlgm), where m is the minimum of d and n.

3. **Use a greedy approach to write an algorithm that minimises the number of record moves in the problem of merging n files. Use a two-way merge pattern. (Two files are merged during each merge step.)**

    a. Show two different inputs for your implementation and analyse each step of your algorithm.
    b. Analyse your algorithm and show the results using order notation.

4. **Without constructing a Huffman tree, generate Huffman code for a given set of characters.**

Character	**Frequency**
A	45
B	13
C	12
D	16
E	9
F	5

    a. Use Canonical Huffman Coding
    b. Use Frequency-Based Approximation
    c. Show examples of coding and decoding and analyse both approaches using order notation.

What you should hand in

Single ZIP file via AIS system. Name convention for the ZIP file:

FirstName_ LastName _ AZA_practical.ZIP

ZIP file should include four CPP files and a single PDF document with your complexity analysis. No other format, such as Word or Open Office, should be included.

Note 1: Any use of an AI assistant must be referenced; otherwise, it will be considered plagiarism.

Note 2: Late submission, missing files, or ZIP files that cannot be opened and expanded will cost you zero marks for the assignment.

Note 3: It is individual work. Two or more identical submissions will be investigated as plagiarism.

Submission Deadline: 6th December 2024 at 5 PM

Marking table

1. Scheduling with deadline algorithm implementation	3
Correct output on a screen based on input from the table 1.1	1
2. Algorithm Modification – code description	3
Use of Disjoint Set Data Structure III	2
Implementation of the modification	3
Correct output on a screen based on input from the table 1.1	1
Modified algorithm analysis	3
3. Greedy Algorithm Description	3
Two different inputs	2
Algorithm analysis	2
4. Canonical Huffman Coding – calculation of code lengths	2
Frequency-Based Approximation - calculation of code lengths	2
Examples of coding and decoding	1
Analysis of both approaches using order notation	2
	30