**Indian Institute of Technology, Jodhpur**

**Bridge Course on DSA**

**(Session: 2022-23)**

**Assignment 4**

**Instructions:**
- The score points are assigned to the respective question
- You are required to attempt all the questions
- Answers need to be succinct and in your own words
- Verbosity is undesirable
- Please submit the solution within the provided deadline
- Plagiarism will not be tolerated. Zero marks will be awarded for the entire assignment if plagiarism is detected.

**Section 1**

1. Find the least number of platforms necessary to prevent delays in any train's arrival given a schedule of the arrival and departure times of trains at a station.
   Example:
   Arrival   = { 2.05, 2.10, 3.10, 3.20, 3.50, 5.10 }
   Departure = { 2.35, 3.40, 3.25, 4.30, 4.10, 5.40 }
   The minimum number of platforms needed = 2

2. Find the lowest product among all triplet combinations found in an integer array.
   Example:
   Input:  { 4, -1, 4, 5, 9 }
   Output: -45

3. Find the maximum number of tasks that one person can complete at once, assuming that each task can only be performed one at a time, where the set of tasks and their beginning and ending times are already given.
   Example:
   Input:
   {1, 4}, {3, 5}, {0, 6}, {5, 7}, {3, 8}, {5, 9}, {6, 10}, {8, 11}, {8, 12}, {2, 13}, {12, 14}
   Output:
   {1, 4}, {5, 7}, {8, 11}, {12, 14}

Section 2:

1. One day, Benny was walking and realized that her life was boring. Everything was grey. Even the roads in the best park were grey. Therefore, she decided to make the roads a little bit brighter. She knows that every road in the park is a segment laying on the X axis with coordinates Xl, Xr (Xl ≤ Xr). Roads may intersect or overlap. She chooses any subset of roads and paints them in red. After that, she wants to get one continuous red segment. As she really likes number L the length of this segment has to be equal to L. Your task is to determine if it is possible to choose some subset of roads and paint them to get one red segment with a length equal to L? If it's possible, print in a single line "Yes"(without quotes), otherwise print "No" (without quotes).

   Input format
   The first line contains one integer T - the number of test cases. Each test case starts with two integers, N and L, denoting the number of roads and Benny's favorite number, L. The next N lines contain two integers, Xl, Xr, denoting the left and right borders of the road.

   Output format
   For every test case, output "Yes" if it is possible to paint some roads and "No" otherwise.

2. Two friends decided to play a very exciting online card game. At the beginning of this game, each player gets a deck of cards, in which each card has some strength assigned to it. After that, each player picks a random card from his deck and compares the picked cards' strengths. The player who picked a card with the greatest strength wins. There is no winner if both players pick cards of equal strength. First friend got a deck with n cards. The i-th his cards have strength. Second friend got a deck with m cards. The i-th his cards have strength. First friend wants to win very much. So he decided to improve his cards. He can increase by 1 the strength of any card for 1 dollar. Any card can be improved as many times as he wants. The second friend can't improve his cards because he doesn't know about this possibility. What minimum amount of money does the first player need to guarantee a victory for himself?

1. Given an integer **N** denoting the Length of a line segment. You need to cut the line segment in such a way that the cut length of a line segment each time is either **x** , **y** or **z**. Here x, y, and z are integers.
After performing all the cut operations, your **total number of cut segments must be maximum**.

   Input : N = 4, x = 2, y = 1, z = 1
   Output : 4
   Explanation : Total length is 4, and the cut lengths are 2, 1 and 1.  We can make maximum 4 segments, each of length 1.

   Input : N = 5, x = 5, y = 3, z = 2
   Output : 2
   Explanation : Here total length is 5, and the cut lengths are 5, 3 and 2. We can make two segments of lengths 3 and 2.

2. Given an array **arr[]** of size **N**, check if it can be partitioned into two parts such that the sum of elements in both parts is the same.

   Input : N = 4, arr = {1,5,11,5}
   Output : YES
   Explanation : The two parts are {1, 5, 5} and {11}.

   Input : N = 3, arr = {1,3,5}
   Output : NO
   Explanation : This array can never be partitioned into two such parts.


Section 4:

1. Given a chain (A1, A2, ..., An) of n matrices, where matrix Ai (i = 1, 2, ..., n) has the dimension $p_{i-1}*p_i$ , find the optimal sequence of pairings for multiplication of matrices A1, A2...An. Once the sequence of pairings for matrix multiplication is done, the matrix chain product can be calculated with the best computation cost (number of scalar multiplications).

**Write the code to solve above scanerion using Dynamic Programming).**

2. Given the sequence of matrices (A1,A2,...,An), the s table calculated by MATRIX-CHAIN-ORDER, and the indices I and j, provide a recursive algorithm MATRIX-CHAIN-MULTIPLY (A,s,i,j) that actually executes the best matrix-chain multiplication. Write the code to solve it using Dynamic Programming.