Design and Analysis of Algorithms.

Lab 5 – Dynamic Programming and Greedy Algorithms

Problem 1:

Given an array T, find a sequence of the array elements in order to maximize the sum of absolute difference of the array elements. Calculate that sum.

Input: {1, 2, 4, 8}
Output: 18
Explanation:
For the given array, there are several possible sequences {2, 1, 4, 8} or {4, 8, 2, 1} and others.
For the sequence {1, 2, 4, 8}, the absolute difference sum is |1-2| + |2-4| + |4-8| + |8-1| = 1 + 2 + 4 + 7 = 14.
For the given array, we get the maximum value for the sequence {1, 8, 2, 4} where the absolute difference sum is |1-8| + |8-2| + |2-4| + |4-1| = 7 + 6 + 2 + 3 = 18.

Problem 2:

Zakaria loves to share things with his friends. He bought a candy ribbon whose length is n. He wants to cut the ribbon in a way that fulfils the following two conditions:

- After the cutting each ribbon piece should have length a, b or c.
- After the cutting the number of ribbon pieces should be maximum.

Help Zakaria and find the number of ribbon pieces after the required cutting so he can share candy with maximum number of friends.

Input: 5 5 3 2
Output: 2
Explanation: The first line contains four space-separated integers n, a, b and c; the length of the original ribbon and the acceptable lengths of the ribbon pieces after the cutting, correspondingly. The numbers a, b and c can coincide.

Problem 3:

Consider the row-coin problem which is a two-player coin game in which the two players alternate on taking turns (i.e. each player gets turn one by one).
There is a row of even number of coins. A player on their turn can pick a coin from any of the two corners of the row. A player that collects coins with more value wins the game.

Develop a strategy for the player making the first turn, such he/she never loses the game.

Input: 18 20 15 30 10 14

Output:

Player 1: “Please, choose a coin” → 18
- The row of coins becomes: 20 15 30 10 14
Player 2: “Please, choose a coin” → 20
- The row of coins becomes: 15 30 10 14
Player 1: “Please, choose a coin” → 15
- The row of coins becomes: 30 10 14
Player 2: “Please, choose a coin” → 30
- The row of coins becomes: 10 14
Player 1: “Please, choose a coin” → 14
- The row of coins becomes: 10
Player 2: “Please, choose a coin” → 10
- “GAME OVER!”, Player 2 wins.

Explanation:

The total value collected by the second player (20 + 30 + 10 = 60) is more than the first player (18+15+14 = 47), therefore the second player wins.

Problem 4:

Given a string containing just the characters '(' and ')', find the length of the longest valid (well-formed) parentheses substring.

Example:
Input: (()
Output: 2
Explanation: The longest valid parentheses substring is ()

Input:)()())

Output: 4
Explanation: The longest valid parentheses substring is ()().

Problem 5:

Given two strings str1 and str2, find the shortest string that has both str1 and str2 as subsequences.
Examples:
Input: str1 = “break”, str2 = “ake”.
Output: “breake”

Input: str1 = “AGGTAB”, str2 = “GXTXAYB”
Output: “AGXGTXAYB”