UCS415 – Design and Analysis of Algorithms

Lab Assignment 1
(Week 2 and 3)

Write a program to implement the following algorithms using divide and conquer approach:

1. Consider an array arr[] = {2, 5, 8, 12, 16, 23, 38, 56, 72, 91} and use Binary Search to find the target 23.

2. Implement Merge sort for the given array int arr[] = {12, 11, 13, 5, 6, 7}. After implementing Merge Sort, apply the same implementation to sort another array: int arr2[] = {38, 27, 43, 3, 9, 82, 10}.

3. Implement Quick Sort for arr[n] = { 4, 2, 6, 9, 2 }

4. You are given a 1D array that may contain both positive and negative integers, and find the sum of a contiguous subarray of numbers which has the largest sum. *For example, if the given array is {-2, -5, 6, -2, -3, 1, 5, -6}, then the maximum subarray sum is 7.*

Additional Questions:

1. You have an array *A* of length *N*. You have to divide the array into at-most *M* consecutive segments such that the maximum bitwise OR of these segments is minimum. Find the minimum possible maximum Bitwise OR of these segments if you divide optimally [Link].
2. You are given an array *A* consisting of *N* integers. *A* subsequence of the array is called good if every pair of elements in the subsequence have an absolute difference of at most 10. Determine the maximum possible length of a good subsequence [Link].
3. You are given an array *A* of *N* integers. You perform this operation *N-2* times: For each contiguous subarray of odd size greater than 2, you find the median of each subarray(Say medians obtained in a move are M_1, M_2, M_3, …, M_k). In each move, you remove the first occurrence of value $min(M_1, M_2, M_3, …, M_k)$ from the original array. After removing the element the array size reduces by 1 and no void spaces are left. For example, if we remove element 2 from the array {1, 2, 3, 4}, the new array will be {1, 3, 4}. Print a single integer denoting the sum of numbers that are left in the array after performing the operations [Link].
4. You are given a sequence *A* of length *n* and a number *k*. A number *A[l]* is special if there exists a contiguous subarray that contains exactly *k* numbers that are strictly greater than *A[l]*. The specialty of a sequence is the sum of special numbers that are available in the sequence. Your task is to determine the specialty of the provided sequence [Link].
5. The war between CCG and ghouls is rising in Tokyo, Kaneki being king of ghouls is working hard to win this war. Touka has given a very important chest to Kaneki which will increase his ghoul army's power significantly and might win them the war. But to open the chest Kaneki must solve a puzzle that is engraved on the lock of the chest.

Kaneki has *N* rectangles of width *W* and height *H*. Kaneki wants to fit all these rectangles in a square, (Rectangle cannot be rotated) also he doesn't want this square to be big so that his all resources will be wasted in the square instead of war. Kaneki doesn't have time to solve this puzzle as he is too busy fighting CCG operatives so he has asked for your help, you being a brilliant programmer Kaneki is sure you will be able to solve this puzzle and might treat you to world-famous anteiku's coffee.

The first line of input will contain one integer *T* containing the number of test cases in the input, For the next *T* lines, each line contains three integers *N*, *H*, and *W* respectively.

You need to find the minimum size of the square that will be able to fill all *n* rectangles in it [Link].

6. Given the following set of 16 points in a two-dimensional plane: [(9,3), (2,6), (15,3), (5,1), (1,2), (12,4), (7,2), (4,7), (16,5), (3,3), (10,5), (6,4), (14,6), (8,6), (11,1), (13,2)], find the closest pair of points and the minimum Euclidean distance between them using the Divide and Conquer approach [Link].