Lab 4

September 1, 2021

For each question in this lab, please use the concept of mergesort done in the class. Please also use the divide and conquer technique that we learned in the class. Try to find and implement them.

1. ## Merge

   You are given two sorted arrays. Merge them to find a single sorted array.

   Input: The first input line contain two integers integer m and $n(1 \leq m, n \leq 1000)$. In the second line, m sorted numbers are separated by a space (all numbers are ≤ 1000). In the second line, m sorted numbers are separated by a space (all numbers are ≤ 1000).

   Output: n numbers written in increasing order separated by a space.

Input	:	2 3
		1 5
		2 3 7
Output	:	1 2 3 5 7

2. ## MergeSort

   Implement the mergesort procedure that we learned in the class.

   Input: The first input line contains integer $n(1 \leq n \leq 1000)$. The second line n numbers seperated by a space (all numbers are ≤ 1000).

   Output: n numbers written in increasing order separated by a space.

Input	:	5
		1 2 5 3 4
Output	:	1 2 3 4 5

3. ## Subset Selection

   You are given an array A and B of size n .

   You must select a contiguous subset of indices from 1 to n such that for any pair of indices i, j in the subset, the following condition holds: $A[i] < B[j]$

   Your task is to determine the largest possible size of a subset that satisfies the provided conditions.

   Input: The first line contains an integer n. The second line contains n space-separated integers that denote the array A. The third line contains n space-separated integers that denote the array B.

   Output: Print the largest possible size of a subset that satisfies the provided conditions.

   Constraints: $n < 100$. All numbers are ≤ 1000.

   Sample Input

Input	:	5
		10 21 5 1 3
		3 1 4 23 56
Output	:	2

Choose the range [4,5] in the both the arrays.
$A[4] < B[4]$ and $A[4] < A[5]$ and $A[5] < B[4]$ and $A[5] < B[5]$
Thus, the largest possible size of a subset that satisfies the above conditions is 2.

4. Swap

You have a permutation of n numebers from 1 to $n - p_1, p_2, \ldots, p_n$. You can swap any two numbers of this permutation. The aim is to maximize the following quantity : $\sum_i |p_i - i|$. You must swap exactly one time.

Input: The first line of the input will be n ($n \leq 1000$). The second line contains the permutation $p_1, p_2 \ldots, p_n$ seperated by a space. All numbers are ≤ 1000.

Output: The maximum value of $\sum_i |p_i - i|$ after the swap.

Input   :   5
                 1 4 2 3 5
Output   :   12

Explanation: You can swap the first and fifth element, and the permutation becomes 5,4,3,2,1. For this permutaiton, the quantity $\sum_i |p_i - i| = |5 - 1| + |4 - 2| + |2 - 3| + |2 - 4| + |1 - 5| = 12$