INDIAN STATISTICAL INSTITUTE

MTech(CS) I year 2022-2023

Subject: Computing Laboratory

Lab Test 3 (November 25, 2022)

Total: 60 marks Duration: 3 hours

SUBMISSION INSTRUCTIONS

1. Please make sure that your file names are of the form `mtc22xx-progy.c`, where `xx` is your 2-digit roll number and `y` is the question number (`1`, `2` or `3`).
2. To submit, please upload your files to `https://www.dropbox.com/request/MDg9OcZVr46w2WA2ZFP0`.
3. Please make sure that your programs adhere strictly to the specified input and output format. Do not print extra strings asking the user for input, debugging messages, etc. These will cause the automatic checking system to fail.

Q1. You are given two arrays, A and B, each containing the same set S of n distinct integers. For a given $x \in S$, let $\text{index}_A(x)$ and $\text{index}_B(x)$ denote the position at which x occurs in A and B, respectively. Write a program to find the element y of S for which

$$\textit{displacement}(y) \triangleq |\text{index}_A(y) - \text{index}_B(y)|$$

is maximum. If there are multiple ys all of which have the same maximum displacement value, your program should select the **smallest** y.

Input format: Your program should read n from stdin, followed by the elements of A and the elements of B in order.

Output format: Your program should print 3 space-separated integers: y, $\text{index}_A(y)$ and $\text{index}_B(y)$, where y is as defined above. The 3 integers should be printed on a single line.

Sample input:

```
4
1 2 3 4        ⟵ elements of A
4 3 2 1        ⟵ elements of B
```

Sample output:

```
1 0 3
```

Explanation: The displacement for both `1` and `4` is 3, so your program should print the smaller value.

Q2. Write a program to merge k sorted lists of integers into one sorted list. Note that the k lists may not contain an equal number of elements.

Let n denote the total number of integers contained in the k lists together. Your program should work for any number of lists (k) and elements (n) (as long as k and n can be stored in an `int` type variable). Storage for each individual list should be allocated dynamically.

For full credit, your merging algorithm should run in $O(n \log k)$ time.

Input format: The input data will be provided in a text file. The first line of the file will contain the value of k. Each of the remaining k lines in the file will contain the size of a list and the elements of the list, as shown below.

```
4
3 24 99 103        ⟵ The first list contains 3 elements: 24, 99 and 103.
4 -1 1 1 1001
2 -10 -1
```

Your program should take a single command-line argument corresponding to the name of the input data file.

Output format: Your program should print the integers in the merged list on a single line, separated from each other by spaces. For the input given above, your program should produce the output below.

```
-10 -1 -1 1 1 24 99 103 1001
```

Q3. You are given 2 text files, `strings.txt` and `prefixes.txt`. Each contains a number of strings consisting only of lowercase letters (a–z). Write a program that prints, for each string contained in `prefixes.txt`, the **number** of strings contained in `strings.txt` that start with the string from `prefixes.txt`.

For example, if `prefixes.txt` contains the strings `xy` and `co`, and `strings.txt` contains the strings `common`, `proper`, `abstract`, `collective` and `grammar`, your program should print the following.

```
xy 0
co 2
```

Input format: The first line of `strings.txt` and `prefixes.txt` will contain an integer specifying the number of strings contained in the respective file, followed by the strings themselves, with one string per line.

Output format: Your program should print (to stdout) one line corresponding to each string contained in `prefixes.txt`. Each line should contain the string, followed by the number of strings in `strings.txt` that start with the string from `prefixes.txt`.