Assignment

SCS 2201 - Data Structures and Algorithms III

Greedy Algorithms

Question 01

For an upcoming programming contest, Poornima is forming some teams from the students of her university. A team can have any number of contestants. Poornima knows the skill level of each contestant. To make the teams work as a unit, she forms the teams based on some rules. Each of the team members must have a unique skill level for the team. Note that a contestant can write buggy code and thus can have a negative skill level.
The more contestants on the team, the more problems they can attempt at a time. So Poornima wants to form teams such that the smallest team is as large as possible.

For example, there are ***n=6*** contestants with skill levels ***skills = [-1,0,1,2,2,3]***. We could form ***team 1 = [-1,0,1,2,3]*** and ***team 2 = [2]***. We're looking for the largest smaller team size though. Two sets that meet the criteria are ***team 1 = [-1,0,1,2]*** and ***team 2 = [2,3]***. The largest smaller team size possible is ***2***.

Input Format

The first line contains an integer ***t***, the number of test cases.
Each of the next ***t*** lines contains a string of space-separated integers, followed by ***n*** and ***x[i]***, the number of elements in the x[i] and a list of the contestants' skill levels respectively.

Output Format

For each test case, print the size of the largest possible smallest team on a separate line.

Sample Input

```
4
7 4 5 2 3 -4 -3 -5
1 -4
4 3 2 3 1
7 1 -2 -3 -4 2 0 -1
```

Sample Output

```
3
1
1
7
```

Question 02

Piyasena is the owner of the “Lakmal” rice mill. He collects paddy from different areas of the country and converts them into polished rice. Every **sack** he brings for the collection process can hold a maximum of 7 KG of paddy. One day he went on collecting paddy and there were farmers with various types of paddy **containers** who were willing to sell their paddy to Piyasena. A paddy **container** is a large repository which has the capacity of multiple 7 KG sacks. Each container has various quantities. For example, there are some containers with 1 sack of 7 KG and some have multiple 7 KG sacks in them. Farmers are willing to sell either the whole container or the individual sack of 7KG from the container. But never agrees to sell a portion of the sack.

Each paddy container has a tag indicating the number of 7 KG sacks in each container and the price of the whole container.

You have to implement a program to help Piyasena to buy the maximum quantity of paddy by paying the least amount of money. Given the number of sacks he bought and the information on the paddy containers, you have to find the minimum value piyasena should be paying to purchase the maximum quantity of paddy.

Please note that he cannot fill any of the sacks with more than one type of paddy.

Input Format

First Line contains two integers **N** and **M**.

N is the number of sacks Piyasena bought and **M** is the number of paddy containers farmers had.

Second line contains M space-separated integers denoting the number of 7 KG sacks of paddy in each container.

Third line contains M space-separated integers containing the price of each paddy container.

Output Format

One integer containing the minimum amount of money Piyasena pays for the.

Sample Input

```
4  3
1  2  3
8 14 18
```

Sample Output

```
25
```

Question 03

WonderLand is a country with a number of evenly spaced districts along a line. The distance between adjacent districts is **1** unit. The newly appointed government of this country decides to initiate a drinking water treatment project. For that, the Ministry of Water Resource management wants to know the **least number of water treatment plants** which have the ability to supply water to the entire list of cities. Your task is to write a program to help the ministry to decide that number. If the task can not be done, you should return **-1**.

The Ministry is giving you a list of city data. The cities which are suitable for building a water treatment plant are labeled as **1**. The cities which are not suitable for building a water treatment plant are labeled as **0**. The Ministry also gives you a distribution range of **k**. This distribution range limits the supply to cities where distance is **less than k**.

Example
k = 3
MD = [0, 1, 1, 1, 0, 0, 0]

We will consider MD(Ministry Data) as an array with the 0 based indexing. Note that each city has a distance of **1** unit from its neighbors. From the given Ministry Data, we see that 3 cities are suitable to build the water treatment plant(cities MD[1], MD[2], MD[3]) and 4 cities are not suitable. If we build a water treatment plant in city MD[2], it can supply water to cities from MD[0] to MD[4] (Because, those are the endpoints at the distance 2, and 2<k). But if we want to supply water to city MD[6], there should be a water treatment plant in city MD[4] or MD[5] or MD[6]. Since all those cities are not suitable to build a water treatment plant, we cannot complete the task using the given distribution. Therefore, you should return -1 in your program.

Input Format
The first line contains two space-separated integers ***n*** and ***k***. ***n*** is the number of cities in WonderLand. ***k*** is the plant range constant.
The second line contains ***n*** space-separated binary integers whether each integer indicates whether it is suitable to build a water treatment plant in that city or not.

Constraints
$1 \leq k \leq n \leq 10^5$
each MD[i] $\in$ {0, 1}.

Output Format

The first line of the output should contain a single integer denoting the **minimum** number of water treatment plants that must be built so that all of WonderLand's cities will be able to get the treated drinking water. If that task is not possible for the given ***k*** value, print **-1**.
The second line of the output should contain the index of the cities where the water treatment plants should be built. (Use 0 based indexing). If there is more than 1 possible solution, print the index of the cities for each solution in a new line.

Sample Input

```
6 2
0 1 1 1 1 0
```

Sample Output

```
2
1 4
```