The International Collegiate Programming Contest
Sponsored by ICPC Foundation

The 2020 Ethiopian Collegiate Programming Contest

(Contest Problems)

Virtual
December 2020

Problem A. Digits

Input file:	`digits.in`
Output file:	`standard output`
Balloon Color:	`Pink`

Once again Jack and Greg are missing with each other, Jack wants to tell Greg a problem to solve but he doesn't want Greg to solve it as he couldn't solve Greg's problem that he gave him at the party he made in his house.

Jack is thinking about a problem that deals with numbers as Greg is so bad at math so, he can use this point of weakness, after a lot of thinking he came up with a nice problem.

The problem is as follows:

Given N numbers you need to find the minimum number from these numbers that have the maximum number of digits among the other numbers.

but he wants to make sure that it's hard so he asked you to solve it.

Input

You will be given in the first line an integer T ($1 \leq T \leq 20$) the number of test cases.

Each test case begins with one integer N the count of the numbers given ($1 \leq N \leq 10^4$).

The next line contains N integers $a_1, a_2, ..., a_n$ ($1 \leq a_i \leq 10^5$).

Output

For each test case print a single line, containing a single integer, the minimum number that has the maximum number of digits among the other numbers

Example

digits.in	standard output
2 4 4 7 18 11 3 412 874 100	11 100

Problem B. Etman and even summation

Input file:	`sum.in`
Output file:	`standard output`
Balloon Color:	`Brown`

Given an array a of length n, you are asked to print the lexicographically largest array you can obtain from the given array after applying the given operation any number of times you want (possibly zero).

The operation you can make is choosing 2 indices i and j where $a_i + a_j$ is an even number then swap a_i and a_j.

Input

The first line of the input contains an integer t ($1 \leq t \leq 10$) the number of test cases.

The first line of each test case contains an integer n ($1 \leq n \leq 10^4$) the number of elements in the array.

The second line of each test case contains n integers ($1 \leq a_i \leq 10^9$). The elements of the array a.

Output

For each test case, print a single line containing n elements, The lexicographically largest array by making the operation any number of times as you want.

Example

sum.in	standard output
1 4 6 8 2 4	8 6 4 2

Note

An array a is lexicographically larger than array b, if either $|a| > |b|$ and $a_i = b_i$ for each i ($1 \leq i \leq |b|$) , or there exists such i ($1 \leq i \leq min(|a|, |b|)$) where $a_i > b_i$, and for any j ($1 \leq j < i$) $a_j = b_j$. Here $|a|$ denotes the length of array a.

Problem C. Even and odds

Input file:	`evens.in`
Output file:	`standard output`
Balloon Color:	`Orange`

It's Christmas time, Jack and Greg woke up one day and found N presents under their Christmas tree, each present has a unique number from 1 to N, since Jack love even numbers and Greg love odd numbers they decided that Jack will take all the presents that have an even number written on it and Greg will take all the presents that have an odd number written on it, but they don't know how many presents they will get each and they are both lazy to count the presents right now so they asked for your help to tell them how many presents each of them will get.

Input

The first line contains an integer T ($1 \leq T \leq 20$), the number of test cases.

Each test case consists of one line containing an integer N ($1 \leq N \leq 10^5$).

Output

For each test case, print one line containing two integers the number of presents Jack and Greg will get respectively.

Example

evens.in	standard output
3 5 6 2	2 3 3 3 1 1

Problem D. Good arrays

Input file:	`good.in`
Output file:	`standard output`
Balloon Color:	`Yellow`

One day jack organized a party at his house and invited some of his friends including his best friend Greg, Greg is famous for being the game master he always invents games that are interesting to play so everybody loves him, so he is trying to invent this time an interesting game with strings as he loves it so much, but there are some talents in the invited friends such as George who's really good with it, so he doesn't want it to be so easy.

Greg will give to his friends string S and will ask them to count the number of good substrings in the string S, string a is called a good string if all of its characters are unique

A string a is a substring of a string b if a can be obtained from b by deletion of several (possibly, zero or all) characters from the beginning and several (possibly, zero or all) characters from the end. For example, strings "a "bc "abc"are substrings of a string "abc while strings "ac "ba "cba"are not.

Now he wants to make sure that the problem is not so hard that makes everyone mad at him, so he asked you to try it first.

Input

You will be given in the first line an integer T ($1 \leq T \leq 10$) the number of test cases.

Each test case begins with one integer N the length of the string S ($1 \leq N \leq 10^5$)

In the next line the string S itself where the string consists of only lower case English letter.

Output

For each test case print in a single line the number of good substrings.

Example

good.in	standard output
2 5 aabca 3 abz	10 6

Problem E. Is This Expected Value ?

Input file:	ev.in
Output file:	standard output
Balloon Color:	Gold

Isaac has just learned probability and expected value. So he decided to set an Expected value problem, Given two integers n and m. We say an array A of size n to be good if the following two conditions are met.

1- $A_i >= 0$.

2- $\sum_{i=1}^{n} A_i = m$.

let S be a set that contains all possible good arrays of size n.

you will choose at random exactly one array of S and you need to know the Expected power of this array.

We calcuate the power of an array A as follows :

$$\sum_{i=1}^{n} \sum_{j=i+1}^{n} A_i * A_j.$$

Let the answer be represented as p/q, then you are required to find the value of $p_* q^{-1} \bmod 10^9 + 7$.

Input

The first line contains one integer T — the number of test cases.

The following T lines each line contains two integers n and m. $(1 \leq n, m \leq 10^6)$.

Output

For each test case, output the required answer on a single line.

Example

ev.in	standard output
2 2 4 7 9	2 27

Problem F. Ole Ole Ole

Input file:	`ole.in`
Output file:	`standard output`
Balloon Color:	`Light Green`

It's finally here. The long awaited football tournament is here! It's $CP - World\ Football\ Champions\ League$.

8 teams will be competing in this tournament divided into two groups $G1$ and $G2$ with four teams each. The competing teams have been training very hard for this to gain enough power for the tournament. Each team will have *pow* power at the start of the tournament.

In each match: the team with the larger amount of power wins the match and its power increases by 1 and the team gains 3 points. The other team's power decreases by 1 and gains no points. If both teams has the same amount of power, they draw and gain 1 point each (**their powers remain the same**).

In the beginning of the tournament, each group will have 6 matches **in the following order**:

$G_{i,1}$ vs $G_{i,2}$

$G_{i,3}$ vs $G_{i,4}$

$G_{i,1}$ vs $G_{i,3}$

$G_{i,2}$ vs $G_{i,4}$

$G_{i,1}$ vs $G_{i,4}$

$G_{i,2}$ vs $G_{i,3}$

where i is the group number ($1 \leq i \leq 2$).

The two groups will play their matches simultaneously.

After the group stage matches are over, the **first** and the **second** team with the maximum number of points from $G1$ play against the **second** and the **first** team with the maximum number of points from $G2$ respectively. In case of a draw of points between the second and the third team with the maximum number of points in any of the groups, one of them will be chosen randomly (with no effect on its power).

The winners of both matches will play each other in the final. In case of a draw, a winner will be decided by penalty-shootout **with no change in its power**.

Note that the results of these matches still affects the teams' powers as mentioned earlier but the teams gain no points (the points system is only for the group stage matches).

As you are a big football fan, you couldn't wait for the tournament to end. You decided to make a program that predicts the power of the winner of the tournament.

So, can you spoil the result for us?

Input

The first line of input contains an integer T ($1 \leq T \leq 10^5$) - the number of test cases.

Each test case contains two lines with the powers *pow* of the teams of each group ($1 \leq pow \leq 10^6$).

Output

Print the power of the winner of the tournament.

Example

ole.in	standard output
1 1 2 3 4 1 2 3 4	8

Problem G. Etman and permutations

Input file:	`swap.in`
Output file:	`standard output`
Balloon Color:	`Blue`

A permutation of length n is an array $p = [p_1, p_2, \ldots, p_n]$, which contains every integer from 1 to n (inclusive) and each number appears exactly once. For example, $p = [3, 1, 4, 2, 5]$ is a permutation of length 5.

Given a permutation p of n numbers, you need to find the minimum number of swaps so that the condition $i \neq p_i$ is satisfied for each i $(1 \leq i \leq n)$.

Input

The first line of the input contains an integer t $(1 \leq t \leq 10)$ the number of test case.

The first line of each test case contains an integer n $(2 \leq n \leq 5 \cdot 10^4)$ the number of elements in the array.

The second line of eact test case contains n integer $(1 \leq a_i \leq n)$.

It is guaranteed the n numbers are a permutation of length n.

Output

for each test case, print a single line containing an integer, the minimum number of swaps required.

Example

swap.in	standard output
1 3 1 3 2	1

Problem H. Pro Clubs Back

Input file:	pcb.in
Output file:	standard output
Balloon Color:	Navy

Pro Clubs Back is a football game, has a mode named Beat Champion, in this mode there are M matches, every match you will play against a team with a rating of r_i.

Now *Khaled* wants to play all matches but he has N teams to play with and every team has a rating a_i and he has to play each match with a unique team or he can choose to skip this match.

Khaled needs your help to know for each i from 1 to M what is the maximum number of matches he can win after playing the first i matches.

Khaled can win if his team rating is greater than or equal to the rating of the opposite team.

Note that *Khaled* must play the M matches in their order but can choose his team in any order.

Input

The first line contains one integer t ($1 \leq t \leq 10$) — the number of test cases.

Each test case consists of three lines.

The first line contains two integers N and M ($1 \leq M \leq N \leq 10^5$).

The second line contains N integers $a_1, a_2, ..., a_n$ ($1 \leq a_i \leq 10^9$).

The third line contains M integers $r_1, r_2, ..., r_m$ ($1 \leq r_i \leq 10^9$).

Output

For each test case, print M integers separated with space, each integer representing the maximum matches wins after the current match.

Example

pcb.in	standard output
3 5 5 1 2 3 4 5 4 6 4 3 2 5 3 1 2 3 4 5 5 5 5 5 4 1 2 3 4 5 5 6 4 4	1 1 2 3 4 1 1 1 1 1 2 2

Note

In the first test $M = 5$ and teams have rating $4, 6, 4, 3, 2$ then *Khaled* has $N = 5$ teams and have rating $1, 2, 3, 4, 5$ so the answer will be $1, 1, 2, 3, 4$.

Khaled will choose this order for his teams to play $5, 1, 4, 3, 2$.

Problem I. Beautiful tree

Input file:	`shgra.in`
Output file:	`standard output`
Balloon Color:	`Violet`

Given an undirected tree that has n nodes numbered from 1 to n, rooted at node number 1, each node will have an integer number written on it.

Then you will be given q queries, each query will be represented by two integers u, val that asks for the lowest ancestor(nearest ancestor) of the node u such that the multiplication of the numbers written on the nodes on the path from this ancestor to node u is equal to val.

A tree is an undirected graph with no cycles such that there is only one path between any pair of nodes.

A vertex u is an ancestor of another vertex v if u lies on the path between 1 and v (in particular, v is an ancestor of itself).

Input

The first line will contain an integer T represents the number of test cases.

The first line of each test case will contain an integer n ($1 \leq n \leq 10^6$) represents the number of nodes in the tree.

The second line will contain n separated integers **a[i]** ($1 \leq a[i] \leq 10^9$) the i-th of these numbers represents the number written on the i-th node.

The next n-1 lines will contain two integers u,v ($1 \leq u < v \leq n$) which represent the edges of the tree, it is guaranteed that all the edges are distinct.

The next line will contain one integer q represents the number of queries.

The next q lines will contain two integers u,val ($1 \leq u \leq n$), ($1 \leq val \leq 10^9$) each of these lines represents one query.

Output

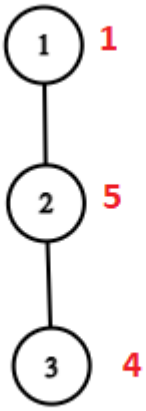
For each test case Print q lines, in each line print the number of the lowest ancestor of the node u such that the multiplication of the numbers written on the nodes on the path from this ancestor to node u is equal to val or print "-1"without the quote if such ancestor doesn't exist.

Example

shgra.in	standard output
2 3 1 5 4 1 2 2 3 4 3 4 3 20 1 1 1 5 10 5 3 1 3 1 2 6 11 1 10 1 2 2 3 3 4 3 5 5 6 6 7 1 8 8 9 8 10 8 9 1 9 55 9 60 7 6 7 12 7 36 3 1 2 1	3 2 1 -1 9 1 -1 7 6 2 3 -1

Note

Let's consider the first example:



The red numbers are the numbers written on the nodes.

In the first query in the first test case, the lowest ancestor of node 3 that has a multiplication equals to 4 is node 3 itself, the multiplication of numbers of nodes on the path from 3 to 3 is = 4 (this path have length zero).

In the second query, the answer will be node 2, because the multiplication of numbers written on the nodes on the path from 3 to 2 equals 4*5 which is equal 20, note that node number 1 also satisfies this condition because the multiplication of numbers written on the nodes on the path from 3 to 1 equals 20 also, but we ask for the **lowest ancestor** that satisfies this condition, so node 1 is **invalid** answer.

In the third query, the answer will be 1 (the node is an ancestor to itself).

In the fourth query, there is no such ancestor, so the answer is -1.

Problem J. Sticks

Input file:	`sticks.in`
Output file:	`standard output`
Balloon Color:	`White`

While Jack was playing with his friends in the garden he found N wooden sticks on the ground so he and his friends began to wonder about the maximum number of rectangles they can make from these sticks. But since Jack and his friends are busy playing they asked you to figure this number out.

Input

The first line contains an integer T, the number of test cases.

The first line of each test case contains an integer n ($1 \leq N \leq 10^4$), the number of wooden sticks.

The second line of each test case contains n integers a_i ($1 \leq a_i \leq 100$) the lengths of the wooden sticks.

Output

For each test case, output one integer denoting the maximum number of rectangles you can make from the wooden sticks.

Example

sticks.in	standard output
3 5 1 2 2 1 2 8 2 2 5 4 5 6 4 6 3 2 3 5	1 2 0

Note

You can use each stick in atmost one rectangle.

One rectangle consists of exactly 4 sticks.

Problem K. Subarray LIS

Input file:	`lis.in`
Output file:	`standard output`
Balloon Color:	`Silver`

You are given a digits string S of length N, every character in S is a digit from 0 to 9.

And you are also given Q queries, in each query you will be given two indices L and R, the answer to the query is the size of the longest strictly increasing subsequence in the substring S[L,R].

A substring S[L,R] is a string equals to $s_L s_{L+1} s_{L+2} ... s_{R-1} s_R$ and its length is equal to R - L + 1

A sequence a is a subsequence of an array b if a can be obtained from b by deletion of zero or more elements. The longest strictly increasing subsequence of an array is the longest subsequence such that its elements are ordered in strictly increasing order.

Input

The first line contains an integer T, the number of test cases.

The first line of each test case contains two integers N and Q ($1 \leq N \leq 10^5, 1 \leq Q \leq 2000$), the length of the string S and numbers of queries respectively.

The second line contains a string S consists of digits.

The following Q lines contain two integers each, L and R ($0 \leq L \leq R < N$).

Output

For each test case print Q lines with the required answer.

Example

lis.in	standard output
1 5 3 05248 0 4 1 2 1 3	4 1 2

Problem L. K Matrix

Input file:	`matrix.in`
Output file:	`standard output`
Balloon Color:	`Black`

One day, Zoma and Zula were playing chess. and since they are problem solvers they talk always about problems while playing. This time, they talked about a problem from the Math course. this problem made them curious about matrices and all the things that can be done with them.

The problem was: Given a matrix of size N * M, you need to check whether the matrix is in reduced echelon form or not (details in the notes). Zoma and Zula couldn't solve the problem since they didn't really understand that part of the lecture, so they asked for your help.

Input

You will be given in the first line an integer T ($1 \leq T \leq 100$) the number of test cases.

Each test case begins with two integers N and M the size of the ith matrix where ($1 \leq N, M \leq 100$), followed by N rows, each row consist of M integers the matrix elements ($-2 * 10^9 \leq aij \leq 2 * 10^9$).

Output

Print "YES"if the matrix is in the reduced echelon form or "NO"otherwise, the output is case insensitive.

Example

matrix.in	standard output
2 3 3 1 0 1 0 1 0 1 0 1 2 3 1 0 0 0 0 1	NO YES

Note

The reduced echelon form is a matrix with specific rules:

1) Rows of all zeros are below all nonzero rows.

2) The leading entry in each nonzero row is 1. The leading entry is the first non-zero number from the beginning of the row.

Ex: 0 0 1 5, The 1 is the leading entry of that row.

3) Each leading entry is the only nonzero element in its column.

4) Each leading entry of a row is in a column the right of the leading entry of the row above it.

Ex:This is a valid one:

(1) 0 0 2

0 (1) 0 4

0 0 (1) 6

While this is not:

0 (1) 0 2

(1) 0 0 4

0 0 (1) 6

Problem M. Simple Matrix

Input file:	sample.in
Output file:	standard output
Balloon Color:	Dark Green

One day, professor mike was with his son Matt in his office, Matt is a smart kid who loves anything related to mathematics.

Mike saw him bored drawing some matrices so, he decided to play with him a small game in one of his matrices that has N * M dimensions contains only these characters '+', '−', '*', '.', '_', '/', '|'. he gave him some tiny matrices and asked him to find how many times each of these sample matrices appeared in the big matrix that he draws.

Matt loved the challenge and start counting since that mike has no time to check if matt's answer is right or wrong he asked you to write a program that finds the actual answer.

Input

You will be given in the first line two integers N, M $(3 \leq N, M \leq 500)$ the dimensions of the matrix, followed by N lines contains M characters, each character is on from the characters listed in the problem statement.

After that, you will be given an integer K $(1 \leq K \leq 20)$ the number of the sample matrices.

For each sample matrix, you will be given two integers X, Y $(1 \leq X, Y \leq 3)$ the dimensions of the sample matrix, Followed by X lines contains Y characters, each character is on from the characters listed in the problem statement.

Output

For each sample matrix print the answer to the problem.

Example

sample.in	standard output
5 5 +.|.+ *-_-* *+*+* +.|.+ *-_-* 2 2 1 + * 2 2 +. *-	4 2