

Problem A. Harmonic Matrix Counter

Description

Freda is an expert of matrix theory. One day, she planned to do research on some specific matrixes consisting of N rows and M columns of "0"s and "1"s. Firstly, she defined a function for such a matrix A and a pair of integers x, y :

$$\text{VAL}(A, x, y) = \begin{cases} A_{x,y} & \text{if } 1 \leq x \leq N, 1 \leq y \leq M \\ 0 & \text{otherwise} \end{cases}$$

She called a matrix "harmonic", if and only if for any $1 \leq x \leq N, 1 \leq y \leq M$. (" \oplus " means bitwise XOR):

$$\text{VAL}(A, x, y) \oplus \text{VAL}(A, x-1, y) \oplus \text{VAL}(A, x, y-1) \oplus \text{VAL}(A, x+1, y) \oplus \text{VAL}(A, x, y+1) = 0$$

Then she came up with Q queries. At each time, three integers k, x, y were given by Freda. Meanwhile, you were asked to tell her the digit at the x -th row and y -th column of the k -th smallest harmonic matrix in lexicographic order.

Input

The input consists of multiple test cases. For each test case:

The first line contains three integers N, M, Q ($1 \leq N, M, Q \leq 800$).

Each of the following Q lines contains three integers k, x, y ($1 \leq k \leq 2^{800}, 1 \leq x \leq N, 1 \leq y \leq M$).

Two adjacent integers in a line are separated by a single space.

Totally, $1 \leq \sum N, \sum M, \sum Q \leq 10000$.

output

For each test case, output a string of length Q consisting of '0's and '1's. The i -th character should be the answer of the i -th query. Specially, for each query, if k is larger than the total number of harmonic matrixes under given conditions, output '?' instead.

Sample Input

```
1 2 3
1 1 1
2 1 1
3 1 2
3 5 9
1 2 5
2 1 2
3 2 3
4 1 5
5 1 2
6 2 5
7 3 5
```

8 3 1
9 2 3

Sample Output

01?
00010110?

Problem B. Binary Tree

Description

You may consider it weird, but I like trees.

Not the green ones, of course.

Among all kinds of trees, I favor binary trees.

Why?

Don't be so serious.

I always play with binary trees.

Recently, I defined a new value function on weighted binary trees.

I denoted the weight of node v as $w[v]$.

Then I defined the value of node v , $f[v]$, recursively as $w[v] + f[l] - f[r]$, where l is the left child and r is the right child of node v .

If the left child of node v does not exist, replace $f[l]$ by 0.

Similarly, if the right child of node v does not exist, replace $f[r]$ by 0.

And I do some operations to have fun:

1. Make node u be the left child of node v .
2. Make node u be the right child of node v .
3. Swap two children of node v .
4. Change the weight of node v into d .
5. Add d to the weight of all nodes which are in the subtree of node v .

I want to know the value of some nodes after doing some operations.

Can you do me a favor?

Input

There are no more than 10 trees.

For each tree, the first line contains one integer n ($1 \leq n \leq 40000$), indicating the number of nodes of the tree. All nodes are numbered from 1 to n .

The second line contains n integers. The i -th integer indicates $w[i]$ ($-1000 \leq w[i] \leq 1000$), indicating the initial weight of the node i (i starts from 1).

Then n lines follow. Among them, the i -th line contains two integer $l[i]$ and $r[i]$, indicating the left child and right child of node i .

If a child doesn't exist, replace it by 0.

It is guaranteed that node 1 is the root, and the tree is connected.

Then one line contains an integer m ($1 \leq m \leq 40000$), indicating the number of operations and requests.

Then m lines, and each line is an operation or a request.

There are 5 kinds of operations as shown below:

1. $1 \ u \ v$ Make node u be the left child of node v .

2. 2 u v Make node u be the right child of node v.
3. 3 v Swap two children of node v.
4. 4 v d Change the weight of node v into d.
5. 5 v d Add d to the weight of all nodes which are in the subtree of node v.

The request is in the following format:

6 v

It request the value of node v after all previous operations.

Please note that: $1 \leq u, v \leq n$, $-1000 \leq d \leq 1000$

Output

For each tree, output m lines.

For an operation, output 'S' or 'F', indicating the operation is successful or failed.

For operation 1: Output 'F' if node v is in the subtree whose root is node u, or if node v already has a left child. Output 'S' otherwise.

For operation 2: Output 'F' if node v is in the subtree whose root is node u, or if node v already has a right child. Output 'S' otherwise.

For operation 3: Output 'S' if node v has two children. Output 'F' otherwise.

For operation 4: Output 'S'.

For operation 5: Output 'S'.

Note that node v is in the subtree whose root is v.

If an operation failed, do nothing to the tree.

For each request, output the value of node v.

Sample Input

```

5
1 2 3 4 5
2 3
4 5
0 0
0 0
0 0
16
6 2
1 2 4
1 4 3
1 4 3
6 3
2 4 3
2 4 2
6 3
6 1
3 1

```

3 2
6 1
4 4 -1
6 3
5 2 1
6 1

Sample Output

1
F
S
F
7
S
F
-1
-1
S
F
3
S
4
S
8

Problem C. Asa's Chess Problem

Description

Asa comes up with a chess problem.

There are $N \times N$ chesses on a board with $N \times N$ grids, one chess in one grid.

Some chesses are black while others are white.

The $N \times N$ grids are divided into $(N \times N) / 2$ pairs (N is even), and each grid only belongs to one pair.

The two grids of a pair are in the same row or the same column.

We can swap the chesses in a pair of grids.

Suppose the number of black chesses in row i is $R[i]$, and the number of black chesses in column j is $C[j]$.

The problem is whether there is a solution satisfy that $Rl[i] \leq R[i] \leq Rh[i]$ and $Cl[j] \leq C[j] \leq Ch[j]$.

$Rl[i]$, $Rh[i]$, $Cl[j]$ and $Ch[j]$ are constant integers.

Please calculate the minimum number of swaps Asa needed to make the chess board satisfy the restriction.

Input

There are no more than 100 test cases.

For each test case, the first line is an integer N ($2 \leq N \leq 50$), indicating the size of the board.

Then an $N \times N$ matrix filled with 0 and 1 follows.

0 represents a white chess, and 1 represents a black chess.

In the next N lines, the i -th line contains two integers $Rl[i]$ and $Rh[i]$.

In the next N lines, the i -th line contains two integers $Cl[i]$ and $Ch[i]$.

($0 \leq Rl[i] \leq Rh[i] \leq N$; $0 \leq Cl[i] \leq Ch[i] \leq N$)

Then $N \times N / 2$ lines follow. Each line contains four integers $x1$, $y1$, $x2$ and $y2$, indicating that $(x1, y1)$ and $(x2, y2)$ make a pair.

(x, y) means the grid at row x , column y . ($1 \leq x1, y1, x2, y2 \leq N$)

Output

For each test case:

If there is a solution, output one line containing an integer indicating the minimum number of swaps needed.

Otherwise output -1.

Sample Input

```
2
0 0
1 1
```

2 2
0 1
0 2
0 2
1 1 2 1
1 2 2 2
4
0 0 1 1
0 0 1 1
1 1 0 0
1 1 0 0
2 2
1 3
1 3
2 2
0 1
3 4
0 1
3 4
1 1 1 3
1 2 1 4
2 1 2 3
2 2 2 4
3 1 3 4
3 2 3 3
4 1 4 4
4 2 4 3

Sample Output

2
4

Problem D. What a Beautiful Lake

Description

Weiming Lake, also named "Un-named Lake", is the most famous scenic spot in Peking University. It is located in the north of the campus and is surrounded by walking paths, small gardens, and old red buildings with typical Chinese curly roofs. The lake was once the royal garden in Qing Dynasty. Boya tower stands on a little hill beside the lake. The lake and the tower form a distinctive landscape and a symbol of Peking University.



Weiming Lake is a very good place for studying, reading, skating in the winter, and of course, jogging. More and more students and teachers run or walk around Weiming Lake every day and show how many paces they have covered in the mobile app WeChat Sports to get "Zans" (applauses).

ACMer X also enjoys jogging around Weiming Lake. His watch can measure and record an altitude value every meter. After a round of running, X collected the altitude data around the lake. Now he wants to find out the longest slope around the lake.

Input

There are no more than 20 test cases.

Each case has two lines.

The first line is an integer N ($2 \leq N \leq 100$) meaning that the length of the road around the lake is N meters.

The second line contains N integers a_1, a_2, \dots, a_N , ($0 \leq a_1, a_2, \dots, a_N \leq 100$) indicating N altitude sample values around the lake. The samples are given in clockwise order, and the distance between two adjacent samples is one meter. Of course the distance between a_1 and a_N is also one meter.

The input ends by a line of 0.

Output

For each test case, print the length of the longest slope in meters. A slope is a part of the road around the lake, and it must keep going up or going down. If there are no slope, print 0.

Sample Input

```
4
1 1 1 1
8
5 1 2 3 4 5 6 2
6
5 4 3 2 1 2
```


10
1 0 2 3 2 2 3 4 3 2
0

Sample Output

0
5
4
4

Problem E. What a Ridiculous Election

Description

In country Light Tower, a presidential election is going on. There are two candidates, Mr. X_1 and Mr. X_2 , and both of them are not like good persons. One is called a liar and the other is called a maniac. They tear (Chinese English word, means defame) each other on TV face to face, on newspaper, on internet.....on all kinds of media. The country is tore into two parts because the people who support X_1 are almost as many as the people who support X_2 .

After the election day, X_1 and X_2 get almost the same number of votes. No one gets enough votes to win. According to the law of the country, the Great Judge must decide who will be the president. But the judge doesn't want to offend half population of the country, so he randomly chooses a 6 years old kid Tom and authorize him to pick the president. Sounds weird? But the democracy in Light Tower is just like that.

The poor or lucky little kid Tom doesn't understand what is happening to his country. But he has his way to do his job. Tom's ao shu (Chinese English word, means some kind of weird math for kids) teacher just left him a puzzle a few days ago, Tom decide that he who solve that puzzle in a better way will be president. The ao shu teacher's puzzle is like this:

Given a string which consists of five digits ('0'-'9'), like "02943", you should change "12345" into it by as few as possible operations. There are 3 kinds of operations:

1. Swap two adjacent digits.
2. Increase a digit by one. If the result exceed 9, change it to it modulo 10.
3. Double a digit. If the result exceed 9, change it to it modulo 10.

You can use operation 2 at most three times, and use operation 3 at most twice.

As a melon eater (Chinese English again, means bystander), which candidate do you support? Please help him solve the puzzle.

Input

There are no more than 100,000 test cases.

Each test case is a string which consists of 5 digits.

Output

For each case, print the minimum number of operations must be used to change "12345" into the given string. If there is no solution, print -1.

Sample Input

```
12435
99999
12374
```

Sample Output

```
1
-1
3
```

Problem F. What a Simple Research

Description

Peking University Student Folk Music Band has a history of more than 90 years. They play Chinese traditional music by Chinese traditional instruments, such as Pipa, Erhu and Guzheng, etc. Doctor Li is a member of that band, and also a former ACMer. Now he is doing some research on Chinese ancient music. Many Chinese ancient music has only five kinds of tones, which can be denoted by 'C','D','E','G', and 'A'. Given a piece of music score, Li wants to do some simple statistics.

Input

There are no more than 20 test cases.

In each test case:

The first line contains two integers n and m ($2 \leq n, m \leq 20$), indicating that a piece of music score is represented by an $n \times m$ matrix of tones. Only 'C','D','E','G' and 'A' can appear in the matrix.

Then the $n \times m$ matrix follows.

The input ends with a line of "0 0".

Output

For each test case:

For each kind of tone shown in the matrix, calculate the appearing times of it, and print the result in descending order according to the appearing times. If more than one kind of tones has the same appearing times, print them in the lexicographical order.

Sample Input

```
4 5
AGCDE
AGDDE
DDDDD
EEEE
2 4
GADC
CDEE
0 0
```

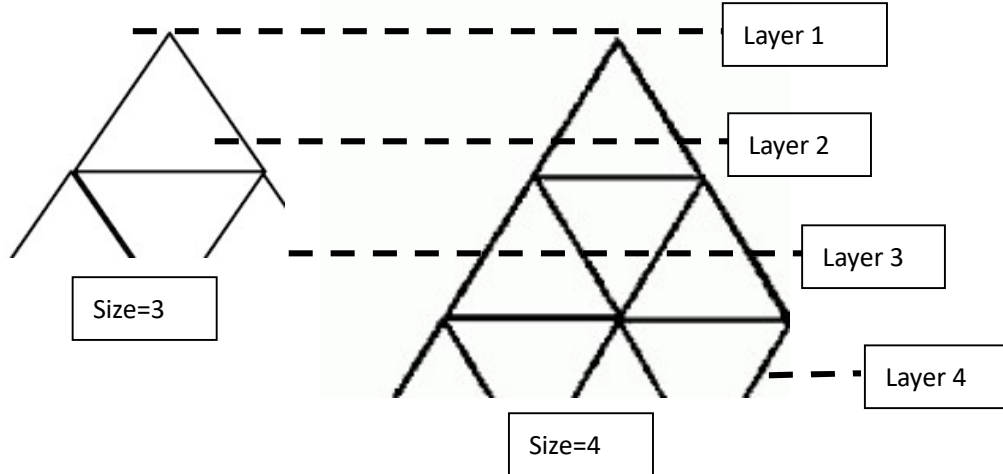
Sample Output

```
D 8 E 7 A 2 G 2 C 1
C 2 D 2 E 2 A 1 G 1
```


Problem G. A Triangle Puzzle

Description

We invented a new kind of puzzle.



It is played on triangle towers.

The structure of the triangle towers is as shown above. The i^{th} layer has i cross points.

There is one number on every cross point. Denote the j^{th} number on the i^{th} layer as $p(i, j)$. We can see each triad $p(i, j), p(i + 1, j), p(i + 1, j + 1)$ form a regular triangle. An operation rotates the numbers in a single triad $p(i, j), p(i + 1, j), p(i + 1, j + 1)$ in counterclockwise direction for 120 degrees.

The puzzle is, given two triangle towers of the same size with numbers on them, can the first tower become exactly the same with the second one by some operations?

Please note that this problem is special judged.

Input

There are no more than 20 test cases.

For each test case, the first line contains a integer N , indicating the number of layers of the two towers. Then N lines follow, the i^{th} line contains i numbers, the j^{th} number indicates $p(i, j)$ of the first triangle tower. The following N lines describe the second triangle tower in the same format. ($1 \leq N \leq 100, 0 \leq p(i, j) < 2^{31}$)

Output

For each test case, if the solution does not exist, output a single line "-1". Otherwise, output the number of used operations M in the first line. The following M lines describe the solution, each line with two numbers i, j , separated by a single space, indicating rotating $p(i, j), p(i + 1, j), p(i + 1, j + 1)$ in counterclockwise direction for 120 degrees. You should guarantee that $1 \leq j \leq i < N, M \leq N^3$.

Sample Input

```
3
1
```

2 3
4 5 6
6
5 3
4 2 1
1
2
2
1
2
3

Sample Output

12
2 2
1 1
2 1
2 2
2 2
2 2
2 1
2 2
2 2
2 1
2 2
2 2
0
-1

Problem H. A New Ground Heating Device

Description

A brand new photosensitive ground heating device is under developing.

This time, to test these devices and help local farmers, engineers placed several devices on the ground in a greenhouse. (You can assume the ground of the greenhouse as a plane and the height of all devices are zero)

There is only a light source in the greenhouse. Its coordinate at the plane must be (0,0), but you can put it at any height above the ground (or on the ground) as you want.

The effective warming radius of the i^{th} device is $\frac{W}{L_i \times Z_i}$, among which W is the power of the light source, L_i is the distance between light source and the i^{th} device, while owing to different degree of wear and tear, photoresistance factor of each device, z_i , may be different.

The winter is so harsh that a piece of land in this greenhouse is suitable for planting only when it is heated by at least K devices at the same time.

Considering the efficiency of production, farmers require that the area of arable land should be greater than S .

Engineers wonder, to satisfy the heating demand raised by farmers, what is the maximum height of the light source.

Input

There are multiple test cases.

The first line of the input contains an integer T which means the number of test cases.

The first line of each test case contains four integers, n, W, K and S , meaning that there are n devices, the power of the light source is W , an arable place must be heated by at least K devices, and the area of arable land should be greater than S .

In the next n lines, each line has two integers x, y , and a real number z ($0.1 \leq z \leq 1$), meaning that there is a device at position (x, y) and its photoresistance factor is z .

Output

For each test case, print a maximum height satisfying the demand, rounded to four decimals.

If the result exceeds 500, print "Oops!" instead.

If the demand can't be satisfied, print "No solution!".

Sample Input

```
1
3 100 2 10
0 0 0.1
0 1 0.2
1 0 0.3
```

Sample Output

307.0016

Note

$T \leq 50$

$n \leq 200$

There are only two groups of data having relatively large scale.

All the absolute values of numbers occurring in the input won't be greater than 10000.

Problem I. A Boring Problem

Description

As a student of the school of electronics engineering and computer science in Peking University, Kyle took the course named Advanced Algebra in his freshman year, which, unluckily, became his nightmare.

His teacher, Mr. X, has an approximately paranoid requirements in the ability of calculation, from which his students suffer a lot.

One day, Mr. X got a whim that he wanted to know for a given integer k and a long numeric string S whose length is N , what is the result of $\sum_{j=1}^i F(j, i)$ for each $i (1 \leq i \leq N)$, where $F(j, i) = (\sum_{l=j}^i S[l])^k$. $S[l]$ means the l^{th} digit in S , and l starts from 1.

Mr. X added the problem to the midterm test. Please give a hand to Kyle and tell him the answer mod 1000000007.

Input

There are multiple test cases.

The first line of the input contains an integer T which means the number of test cases.

The first line of each test case contains two integers, above mentioned N and k .

The next line is the above mentioned string S . S consists of only digits('0' - '9').

Output

For each test case, print a single line representing the result of $\sum_{j=1}^i F(j, i)$ for each $i (1 \leq i \leq N)$

Sample Input

```
2
5 1
12345
5 1
54321
```

Sample Output

```
1 5 14 30 55
5 13 22 30 35
```

Note

$T \leq 5$

$N \leq 50,000, k \leq 100$

Problem J. Parrot

Description

Parrots are intelligent. They can be trained to speak! Therefore, they can be used to carry messages over long distances.

The basic idea is to let a parrot remember the message and repeat it to the receiver (a microphone or something else that can record sound). Due to the limited memory of the parrot, this mechanism will fail when the message is long.

To handle a long message, a naive solution is that we divide the message into multiple words for transmission. However, there are two major problems for this mechanism:

- In the absence of context, words are difficult to identify.
- Parrots may arrive in arbitrary order, making it hard or even impossible to reconstruct the message.

The first problem can be solved by using specially designed words instead of English words in the transmission. In practice, we carefully choose k special words with the same length in pronunciation. Each parrot only transmit one of the k words instead of a part of the raw message.

The second problem can be solved by introducing special coding schemes. Fortunately, you do not need to worry about coding schemes because this problem is already solved by tourist in IOI2011 ☺.

Do we solve all the problems till now? No! As a result of applying such a special coding scheme, the encoded messages are no longer understandable by just listening to the sound. An automatic decoding system is essential. And guess what? The task of implement the decoding system is on you!

The receiver records a piece of waveform as a series of integers. Given the recorded waveform S which consists of n integers, the waveforms of the k special words $W_1 \dots W_k$ (each consists of m integers), and the number of words of the message(also the number of parrots) l , your decoding system should recover the l words transmitted by the parrots.

Parrots are well-behaved, so no two parrots speak at the same time. But there may be some periods of time without any parrot speaking, and during such periods, the receiver also record some useless data. So n may be larger than $l \times m$.

Since the sound we receive may be distorted for a variety of reasons, you only need to recover the words that are most likely to be the original ones. To be more specific, we define *Decoding Result* and *Similarity Value*. A *Decoding Result* is that you choose l none-overlapping sub-waveforms(a sub-waveform is a consecutive part of S) of length m from S and match each of them with one of the k special words. The *Similarity Value* of a sub-waveform A to its matched word B is defined as $\sum_{i=0}^{m-1} (a_i - b_i)^2$ (A is $a_0, a_1 \dots a_{m-1}$ and B is $b_0, b_1 \dots b_{m-1}$). The *Similarity Value* of a *Decoding Result* is defined as the sum of the *Similarity Values* of all the l chosen sub-waveforms to their matched words. Your task is to find a *Decoding Result* with the minimum *Similarity Value*.

Input

The first line contains a single integer T , indicating the number of test cases.

In each test case, the first line contains 4 integers, above mentioned n, m, k, l . The second line, consisting of n integers, is the waveform S recorded by the receiver. The k following lines, each of which consists of m integers, are the waveforms of the k special words $W_1 \dots W_k$.

Output

For each test case, print the minimum *Similarity Value* in a line. You are not required to print the corresponding *Decoding Result* because the problem writer is nice.

Sample Input

```
3
10 1 2 3
0 1 2 3 4 5 6 7 8 9
7
8
10 3 2 2
0 1 2 3 4 5 6 7 8 9
3 4 5
1 2 3
10 3 2 3
0 1 2 3 4 5 6 7 8 9
6 7 8
1 2 3
```

Sample Output

```
1
3
15
```

Constraints

$T \leq 15$,

$0 < n \leq 10^5$,

$0 < m \leq 3 \cdot 10^4$,

$0 < k \leq 5$,

$l \cdot m \leq n$,

All values of the waveforms are within range $[0,100]$.

Problem K. JiLi Number

Description

Driver Ji likes the digit "1". He has an accumulator which shows the sum of input number. He lists all of positive number no more than N and starts counting from one, two, three...Every time he counts a number he will add the number of digit "1" in this number to accumulator at the same time. The amazing thing happens! At some times, when he finishes counting a number X, the number which on the accumulator is X exactly, he will regard X as "JiLi Number" which means lucky number. Now he wants to know the number of "JiLi Numbers" and the biggest "JiLi Number" no more than N.

Input

There are several test cases and the each test case is a line contains an positive integer N. ($1 < N \leq 10^{100}$)

Output

For each test case, output two integers which donates the number of "JiLi Numbers" and the biggest "JiLi Number".

Sample Input

```
1
100000000000
```

Sample Output

```
1 1
83 1111111110
```