A. The Tower is Going Home,

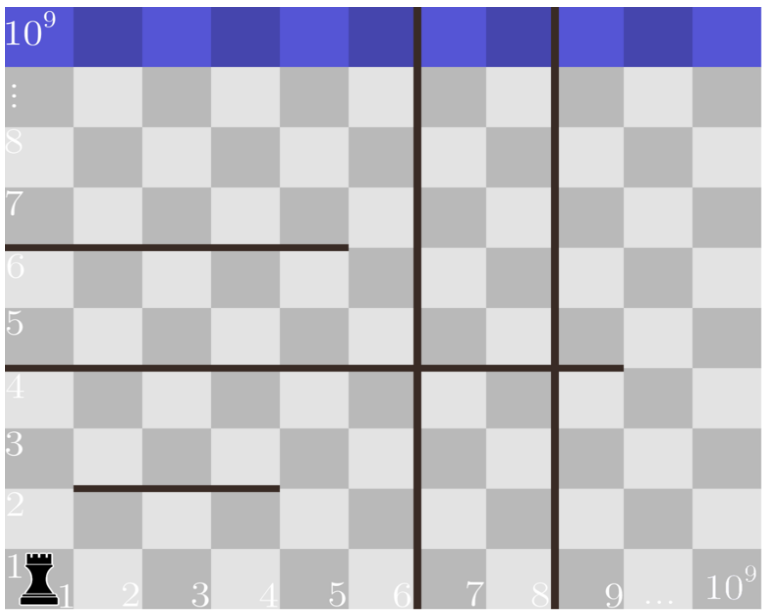
1 second, 256 megabytes, standard input, standard output

On a chessboard with a width of 10^9 and a height of 10^9, the rows are numbered from bottom to top from 1 to 10^9, and the columns are numbered from left to right from 1 to 10^9. Therefore, for each cell of the chessboard you can assign the coordinates (x, y), where x is the column number and y is the row number.

Every day there are fights between black and white pieces on this board. Today, the black ones won, but at what price? Only the rook survived, and it was driven into the lower left corner — a cell with coordinates $(1, 1)$. But it is still happy, because the victory has been won and it's time to celebrate it! In order to do this, the rook needs to go home, namely — on the **upper side** of the field (that is, in any cell that is in the row with number 10^9).

Everything would have been fine, but the treacherous white figures put spells on some places of the field before the end of the game. There are two types of spells:

- Vertical. Each of these is defined by one number x. Such spells create an infinite *blocking line* between the columns x and $x + 1$.
- Horizontal. Each of these is defined by three numbers x_1, x_2, y. Such spells create a *blocking segment* that passes through the top side of the cells, which are in the row y and in columns from x_1 to x_2 inclusive. The peculiarity of these spells is that it is **impossible** for a certain pair of such spells to have a common point. Note that horizontal spells can have common points with vertical spells.



An example of a chessboard.

Let's recall that the rook is a chess piece that in one move can move to any point that is in the same row or column with its initial position. In our task, the rook can move from the cell (r_0, c_0) into the cell (r_1, c_1) only under the condition that $r_1 = r_0$ or $c_1 = c_0$ and there is no *blocking lines* or *blocking segments* between these cells (For better understanding, look at the samples).

Fortunately, the rook can remove spells, but for this it has to put tremendous efforts, therefore, it wants to remove the minimum possible number of spells in such way, that after this it can return home. Find this number!

Input

The first line contains two integers n and m ($0 \le n, m \le 10^5$) — the number of vertical and horizontal spells.

Each of the following n lines contains one integer x ($1 \le x < 10^9$) — the description of the vertical spell. It will create a *blocking line* between the columns of x and $x + 1$.

Each of the following m lines contains three integers x_1, x_2 and y ($1 \le x_1 \le x_2 \le 10^9$, $1 \le y < 10^9$) — the numbers that describe the horizontal spell. It will create a *blocking segment* that passes through the top sides of the cells that are in the row with the number y, in columns from x_1 to x_2 inclusive.

It is guaranteed that all spells are different, as well as the fact that for each pair of horizontal spells it is true that the segments that describe them do not have common points.

Output

In a single line print one integer — the minimum number of spells the rook needs to remove so it can get from the cell $(1, 1)$ to at least one cell in the row with the number 10^9

input
```
2 3
6
8
1 5 6
1 9 4
2 4 2
```
output
```
1
```

input
```
1 3
4
1 5 3
1 9 4
4 6 6
```
output
```
1
```

input
```
0 2
1 1000000000 4
1 1000000000 2
```
output
```
2
```

input
```
0 0
```
output
```
0
```

input
```
2 3
4
6
1 4 3
1 5 2
1 6 5
```
output
```
2
```

In the first sample, in order for the rook return home, it is enough to remove the second horizontal spell.

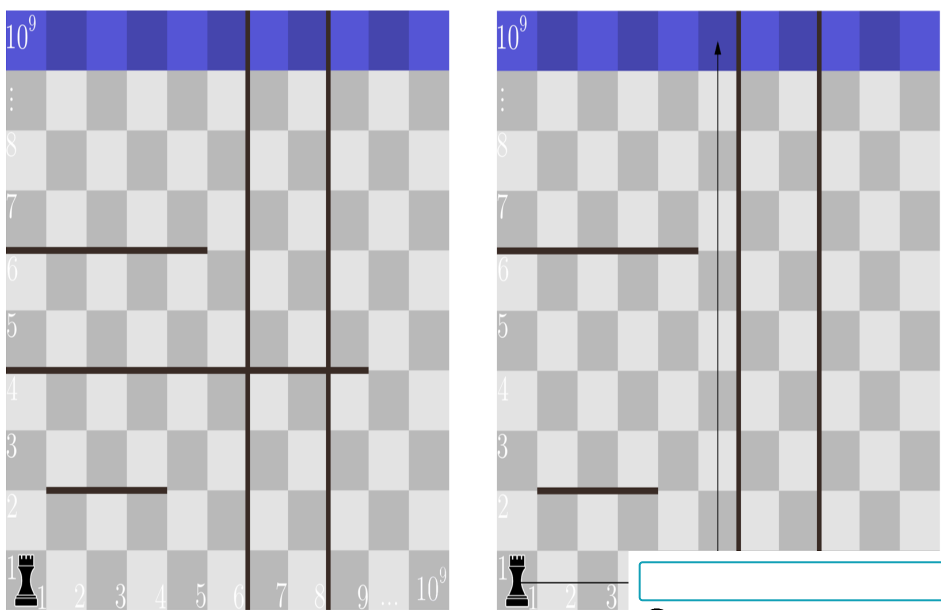


Illustration for the first sample. On the left it shows h
beginning. On the right it shows how the field looked afte

horizontal spell. It also shows the path, on which the rook would be going home.

In the second sample, in order for the rook to return home, it is enough to remove the only vertical spell. If we tried to remove just one of the horizontal spells, it would not allow the rook to get home, because it would be blocked from above by one of the remaining horizontal spells (either first one or second one), and to the right it would be blocked by a vertical spell.

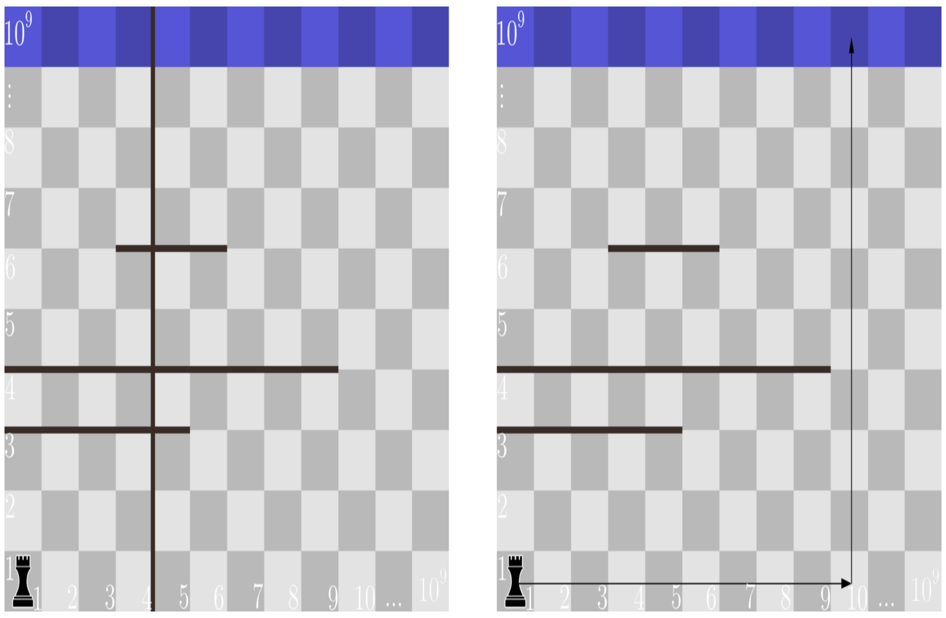


Illustration for the second sample. On the left it shows how the field looked at the beginning. On the right it shows how it looked after the deletion of the vertical spell. It also shows the path, on which the rook would be going home.

In the third sample, we have two horizontal spells that go through the whole field. These spells can not be bypassed, so we need to remove both of them.

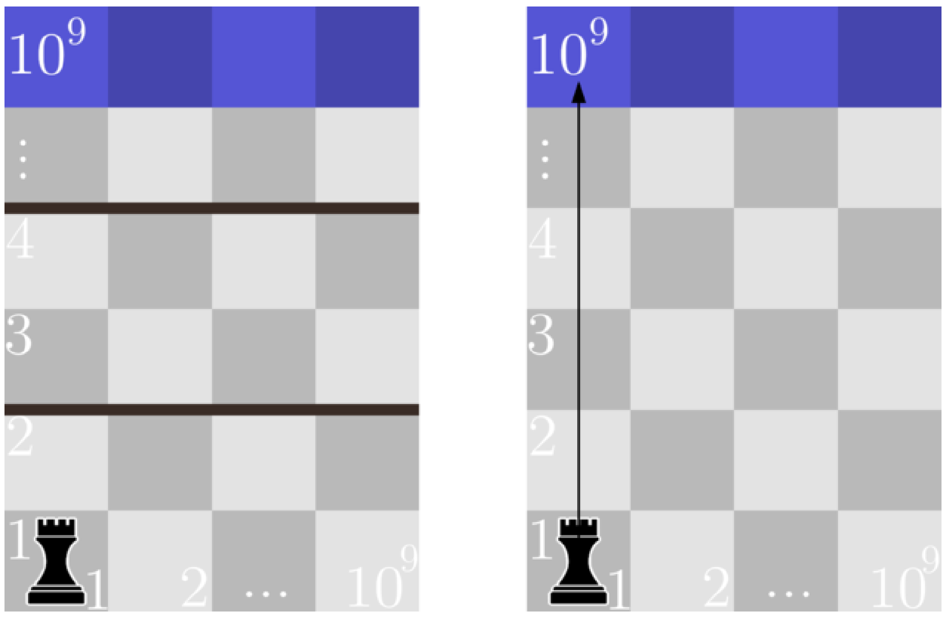


Illustration for the third sample. On the left it shows how the field looked at the beginning. On the right it shows how the field looked after the deletion of the horizontal spells. It also shows the path, on which the rook would be going home.

In the fourth sample, we have no spells, which means that we do not need to remove anything.

In the fifth example, we can remove the first vertical and third horizontal spells.

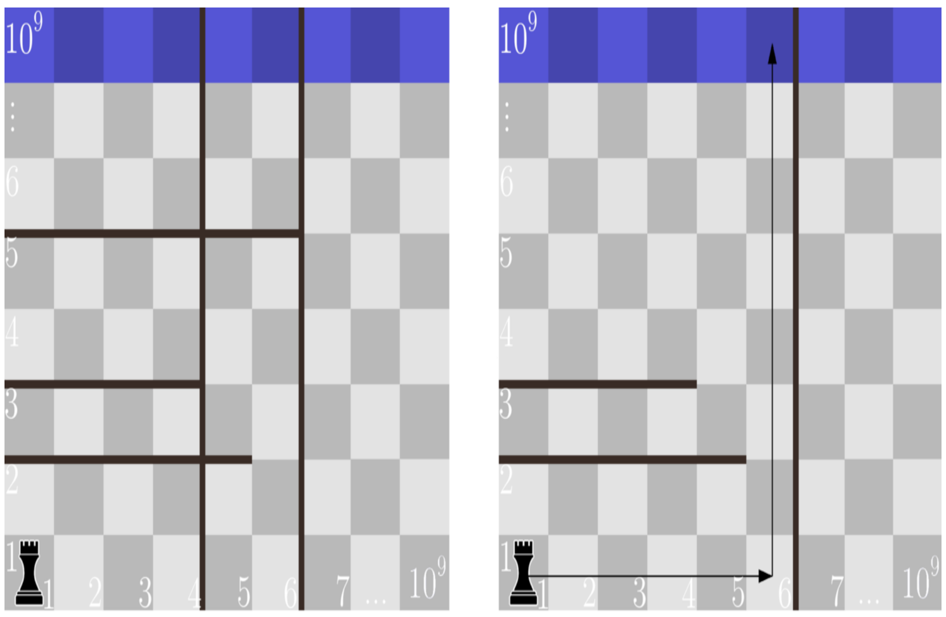
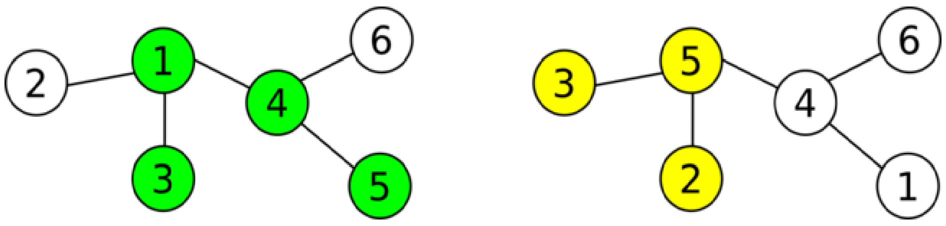


Illustration for the fifth sample. On the left it shows how the field looked at the beginning. On the right it shows how it looked after the deletions. It also shows the path, on which the rook would be going home.

B. Intersecting Subtrees, 2 seconds, 256 megabytes, standard input, standard output

You are playing a strange game with Li Chen. You have a tree with n nodes drawn on a piece of paper. All nodes are unlabeled and distinguishable. Each of you **independently** labeled the vertices from 1 to n. Neither of you know the other's labelling of the tree.

You and Li Chen each chose a subtree (i.e., a connected subgraph) in that tree. Your subtree consists of the vertices labeled $x_1, x_2, \ldots, x_{k_1}$ in **your labeling**, Li Chen's subtree consists of the vertices labeled $y_1, y_2, \ldots, y_{k_2}$ in **his labeling**. The values of $x_1, x_2, \ldots, x_{k_1}$ and $y_1, y_2, \ldots, y_{k_2}$ are known to both of you.



The picture shows two labelings of a possible tree: yours on the left and Li Chen's on the right. The selected trees are highlighted. There are two common nodes.

You want to determine whether your subtrees have at least one common vertex. Luckily, your friend Andrew knows both labelings of the tree. You can ask Andrew at most 5 questions, each of which is in one of the following two forms:

- A x: Andrew will look at vertex x in your labeling and tell you the number of this vertex in Li Chen's labeling.
- B y: Andrew will look at vertex y in Li Chen's labeling and tell you the number of this vertex in your labeling.

Determine whether the two subtrees have at least one common vertex after asking some questions. If there is at least one common vertex, determine one of your labels for any of the common vertices.

Interaction

Each test consists of several test cases.

The first line of input contains a single integer t ($1 \le t \le 100$) — the number of test cases.

For each testcase, your program should interact in the following format.

The first line contains a single integer n ($1 \le n \le 1\,000$) — the number of nodes in the tree.

Each of the next $n-1$ lines contains two integers a_i and b_i ($1 \le a_i, b_i \le n$) — the edges of the tree, indicating an edge between node a_i and b_i according to your labeling of the nodes.

The next line contains a single integer k_1 ($1 \le k_1 \le n$) — the number of nodes in your subtree.

The next line contains k_1 distinct integers $x_1, x_2, \ldots, x_{k_1}$ ($1 \le x_i \le n$) — the indices of the nodes in your subtree, according to your labeling. It is guaranteed that these vertices form a subtree.

The next line contains a single integer k_2 ($1 \le k_2 \le n$) — the number of nodes in Li Chen's subtree.

The next line contains k_2 distinct integers $y_1, y_2, \ldots, y_{k_2}$ ($1 \le y_i \le n$) — the indices (according to Li Chen's labeling) of the nodes in Li Chen's subtree. It is guaranteed that these vertices form a subtree according to Li Chen's labelling of the tree's nodes.

Test cases will be provided one by one, so you must complete interacting with the previous test (i.e. by printing out a common node or -1 if there is not such node) to start receiving the next one.

You can ask the Andrew two different types of questions.

- You can print "A x" ($1 \le x \le n$). Andrew will look at vertex x in your labeling and respond to you with the number of this vertex in Li Chen's labeling.
- You can print "B y" ($1 \le y \le n$). Andrew will look at vertex y in Li Chen's labeling and respond to you with the number of this vertex in your labeling.

You may only ask at most 5 questions per tree.

When you are ready to answer, print "C s", where s is your label of a vertex that is common to both subtrees, or -1, if no such vertex exists. Printing the answer does not count as a questio
your answer to start receiving the next test case

After printing a question do not forget to print end of line and flush the output. Otherwise, you will get Idleness limit exceeded. To do this, use:

- fflush(stdout) or cout.flush() in C++;
- System.out.flush() in Java;
- flush(output) in Pascal;
- stdout.flush() in Python;
- see documentation for other languages.

If the judge responds with -1, it means that you asked more queries than allowed, or asked an invalid query. Your program should immediately terminate (for example, by calling exit(0)). You will receive Wrong Answer; it means that you asked more queries than allowed, or asked an invalid query. If you ignore this, you can get other verdicts since your program will continue to read from a closed stream.

Hack Format

To hack, use the following format. Note that you can only hack with one test case.

The first line should contain a single integer t ($t = 1$).

The second line should contain a single integer n ($1 \le n \le 1\,000$).

The third line should contain n integers $p_1, p_2, \ldots, p_n$ ($1 \le p_i \le n$) — a permutation of 1 to n. This encodes the labels that Li Chen chose for his tree. In particular, Li Chen chose label p_i for the node you labeled i.

Each of the next $n-1$ lines should contain two integers a_i and b_i ($1 \le a_i, b_i \le n$). These edges should form a tree.

The next line should contain a single integer k_1 ($1 \le k_1 \le n$).

The next line should contain k_1 distinct integers $x_1, x_2, \ldots, x_{k_1}$ ($1 \le x_i \le n$). These vertices should form a subtree.

The next line should contain a single integer k_2 ($1 \le k_2 \le n$).

The next line should contain k_2 distinct integers $y_1, y_2, \ldots, y_{k_2}$ ($1 \le y_i \le n$). These vertices should form a subtree in Li Chen's tree according to the permutation above.

input

```
1
3
1 2
2 3
1
1
1
2
2
1
```

output

```
A 1
B 2
C 1
```

input

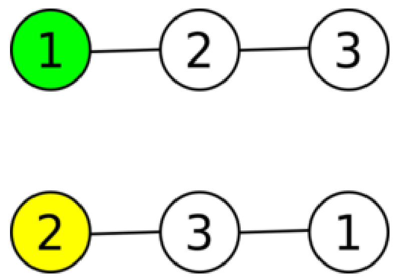
```
2
6
1 2
1 3
1 4
4 5
4 6
4
1 3 4 5
3
3 5 2
3
6
1 2
1 3
1 4
4 5
4 6
3
1 2 3
3
4 1 6
5
```

output

```
B 2
C 1
A 1
C -1
```

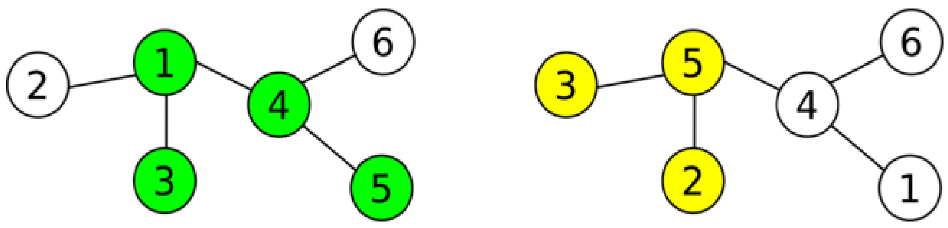
For the first sample, Li Chen's hidden permutation is $[2, 3, 1]$, and for the second, his hidden permutation is $[5, 3, 2, 4, 1, 6]$ for both cases.

In the first sample, there is a tree with three nodes in a line. On the top, is how you labeled the tree and the subtree you chose, and the bottom is how Li Chen labeled the tree and the subtree he chose:



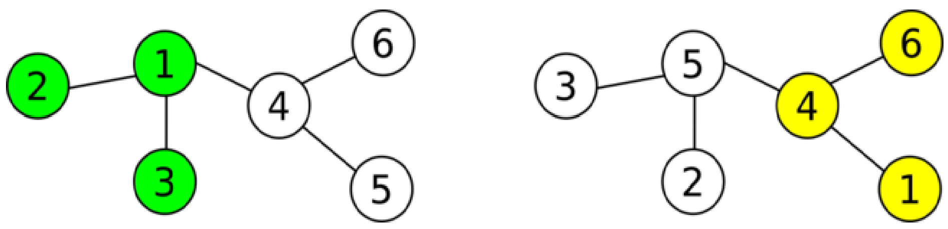
In the first question, you ask Andrew to look at node 1 in your labelling and tell you the label of it in Li Chen's labelling. Andrew responds with 2. At this point, you know that both of your subtrees contain the same node (i.e. node 1 according to your labeling), so you can output "C 1" and finish. However, you can also ask Andrew to look at node 2 in Li Chen's labelling and tell you the label of it in your labelling. Andrew responds with 1 (this step was given with the only reason — to show you how to ask questions).

For the second sample, there are two test cases. The first looks is the one from the statement:



We first ask "B 2", and Andrew will tell us 3. In this case, we know 3 is a common vertex, and moreover, any subtree with size 3 that contains node 3 must contain node 1 as well, so we can output either "C 1" or "C 3" as our answer.

In the second case in the second sample, the situation looks as follows:



In this case, you know that the only subtree of size 3 that doesn't contain node 1 is subtree $4, 5, 6$. You ask Andrew for the label of node 1 in Li Chen's labelling and Andrew says 5. In this case, you know that Li Chen's subtree doesn't contain node 1, so his subtree must be consist of the nodes $4, 5, 6$ (in your labelling), thus the two subtrees have no common nodes.

C. Optimal Polygon Perimeter,

2 seconds, 256 megabytes, standard input, standard output

You are given n points on the plane. The polygon formed from all the n points is **strictly convex**, that is, the polygon is convex, and there are no three collinear points (i.e. lying in the same straight line). The points are numbered from 1 to n, in clockwise order.

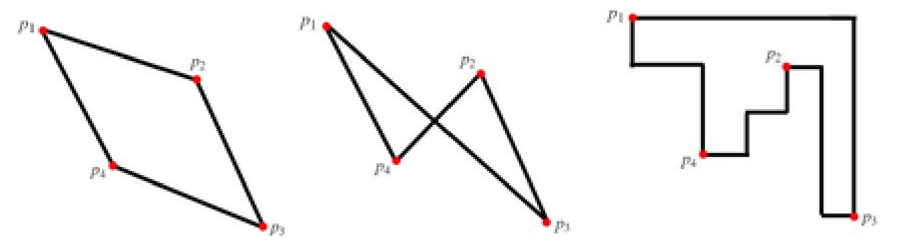
We define the distance between two points $p_1 = (x_1, y_1)$ and $p_2 = (x_2, y_2)$ as their Manhattan distance:

$$d(p_1, p_2) = |x_1 - x_2| + |y_1 - y_2|.$$

Furthermore, we define the perimeter of a polygon, as the sum of Manhattan distances between all adjacent pairs of points on it; if the points on the polygon are ordered as $p_1, p_2, \ldots, p_k$ ($k \ge 3$), then the perimeter of the polygon is $d(p_1, p_2) + d(p_2, p_3) + \ldots + d(p_k, p_1)$.

For some parameter k, let's consider all the polygons that can be formed from the given set of points, having **any** k vertices, such that the polygon is **not** self-intersecting. For each such polygon, let's consider its perimeter. Over all such perimeters, we define f
perimeter.

Please note, when checking whether a polygon is self-intersecting, that the edges of a polygon are still drawn as straight lines. For instance, in the following pictures:



In the middle polygon, the order of points (p_1, p_3, p_2, p_4) is not valid, since it is a self-intersecting polygon. The right polygon (whose edges resemble the Manhattan distance) has the same order and is not self-intersecting, but we consider edges as straight lines. The correct way to draw this polygon is (p_1, p_2, p_3, p_4), which is the left polygon.

Your task is to compute $f(3), f(4), \ldots, f(n)$. In other words, find the maximum possible perimeter for each possible number of points (i.e. 3 to n).

Input

The first line contains a single integer n ($3 \le n \le 3 \cdot 10^5$) — the number of points.

Each of the next n lines contains two integers x_i and y_i ($-10^8 \le x_i, y_i \le 10^8$) — the coordinates of point p_i.

The set of points is guaranteed to be convex, all points are distinct, the points are ordered in clockwise order, and there will be no three collinear points.

Output

For each i ($3 \le i \le n$), output $f(i)$.

input
```
4
2 4
4 3
3 0
1 3
```
output
```
12 14
```

input
```
3
0 0
0 2
2 0
```
output
```
8
```

In the first example, for $f(3)$, we consider four possible polygons:

- (p_1, p_2, p_3), with perimeter 12.
- (p_1, p_2, p_4), with perimeter 8.
- (p_1, p_3, p_4), with perimeter 12.
- (p_2, p_3, p_4), with perimeter 12.

For $f(4)$, there is only one option, taking all the given points. Its perimeter 14.

In the second example, there is only one possible polygon. Its perimeter is 8.

D. Deduction Queries,

2 seconds, 256 megabytes, standard input, standard output

There is an array a of 2^{30} integers, indexed from 0 to $2^{30}-1$. Initially, you know that $0 \le a_i < 2^{30}$ ($0 \le i < 2^{30}$), but you do not know any of the values. Your task is to process queries of two types:

- 1 l r x: You are informed that the **bitwise xor** of the subarray $[l, r]$ (ends inclusive) is equal to x. That is, $a_l \oplus a_{l+1} \oplus \ldots \oplus a_{r-1} \oplus a_r = x$, where $\oplus$ is the bitwise xor operator. In some cases, the received update contradicts past updates. In this case, you should **ignore** the contradicting update (the current update).
- 2 l r: You are asked to output the bitwise xor of the subarray $[l, r]$ (ends inclusive). If it is still impossible to know this value, considering all past updates, then output -1.

Note that the queries are **encoded**. That is, you need to write an **online** solution.

Input

The first line contains a single integer q ($1 \le q \le 2 \cdot 10^5$) — the number of queries.

Each of the next q lines describes a query. It contains one integer t ($1 \le t \le 2$) — the type of query.

The given queries will be **encoded** in the following way: let $last$ be the answer to the last query of the second type that you have answered (initially, $last = 0$). If the last answer was -1, set $last = 1$.

- If $t = 1$, three integers follow, l', r', and x' ($0 \le l', r', x' < 2^{30}$), meaning that you got an update. **First, do the following**:
  $$l = l' \oplus last, r = r' \oplus last, x = x' \oplus last$$
  and, if $l > r$, swap l and r.

  This means you got an update that the bitwise xor of the subarray $[l, r]$ is equal to x (notice that you need to ignore updates that contradict previous updates).
- If $t = 2$, two integers follow, l' and r' ($0 \le l', r' < 2^{30}$), meaning that you got a query. **First, do the following**:
  $$l = l' \oplus last, r = r' \oplus last$$
  and, if $l > r$, swap l and r.

  For the given query, you need to print the bitwise xor of the subarray $[l, r]$. If it is impossible to know, print -1. **Don't forget to change the value of $last$.**

It is guaranteed there will be at least one query of the second type.

Output

After every query of the second type, output the bitwise xor of the given subarray or -1 if it is still impossible to know.

input
```
12
2 1 2
2 1 1073741822
1 0 3 4
2 0 0
2 3 3
2 0 3
1 6 7 3
2 4 4
1 0 2 1
2 0 0
2 4 4
2 0 0
```
output
```
-1
-1
-1
-1
5
-1
6
3
5
```

input
```
4
1 5 5 9
1 6 6 5
1 6 5 10
2 6 5
```
output
```
12
```

In the first example, the real queries (without being encoded) are:

- 12
- 2 1 2
- 2 0 1073741823
- 1 1 2 5

- 2 1 1
- 2 2 2
- 2 1 2
- 1 2 3 6
- 2 1 1
- 1 1 3 0
- 2 1 1
- 2 2 2
- 2 3 3

- The answers for the first two queries are -1 because we don't have any such information on the array initially.
- The first update tells us $a_1 \oplus a_2 = 5$. Note that we still can't be certain about the values a_1 or a_2 independently (for example, it could be that $a_1 = 1, a_2 = 4$, and also $a_1 = 3, a_2 = 6$).
- After we receive all three updates, we have enough information to deduce a_1, a_2, a_3 independently.

In the second example, notice that after the first two updates we already know that $a_5 \oplus a_6 = 12$, so the third update is contradicting, and we ignore it.

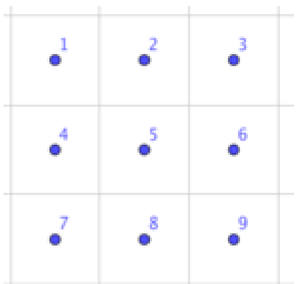
E. Grid Sort, 2 seconds, 256 megabytes, standard input, standard output

You are given an $n \times m$ grid. Each grid cell is filled with a unique integer from 1 to nm so that each integer appears exactly once.

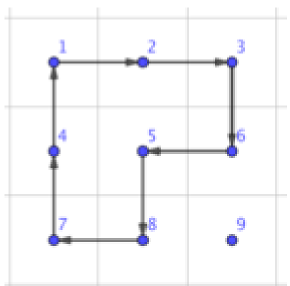
In one operation, you can choose an arbitrary cycle of the grid and move all integers along that cycle one space over. Here, a cycle is any sequence that satisfies the following conditions:

- There are at least four squares.
- Each square appears at most once.
- Every pair of adjacent squares, and also the first and last squares, share an edge.

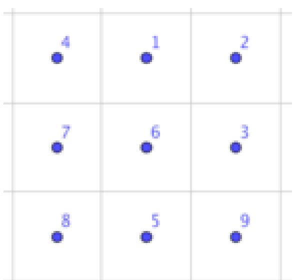
For example, if we had the following grid:



We can choose an arbitrary cycle like this one:



To get the following grid:



In this particular case, the chosen cycle can be represented as the sequence $[1, 2, 3, 6, 5, 8, 7, 4]$, the numbers are in the direction that we want to rotate them in.

Find any sequence of operations to sort the grid so that the array created by concatenating the rows from the highest to the lowest is sorted (look at the first picture above).

Note you do not need to minimize number of operations or sum of cycle lengths. The only constraint is that the sum of all cycles lengths must not be greater than 10^5. We can show that an answer always exists under the given constraints. Output any valid sequence of moves that will sort the grid.

Input

The first line contains two integers n and m ($3 \le n, m \le 20$) — the dimensions of the grid.

Each of the next n lines contains m integers $x_{i,1}, x_{i,2}, \dots, x_{i,m}$ ($1 \le x_{i,j} \le nm$), denoting the values of the block in row i and column j.

It is guaranteed that all $x_{i,j}$ are distinct.

Output

First, print a single integer k, the number of operations ($k \ge 0$).

On each of the next k lines, print a cycle as follows:

$$s \; y_1 \; y_2 \; \cdots \; y_s$$

Here, s is the number of blocks to move ($s \ge 4$). Here we have block y_1 moving to where block y_2 is, block y_2 moving to where block y_3 is, and so on with block y_s moving to where block y_1 is.

The sum of s over all operations must be at most 10^5.

input
```
3 3
4 1 2
7 6 3
8 5 9
```
output
```
1
8 1 4 7 8 5 6 3 2
```

input
```
3 5
1 2 3 5 10
11 6 4 14 9
12 7 8 13 15
```
output
```
3
4 4 14 13 8
4 5 10 9 4
4 12 7 6 11
```

The first sample is the case in the statement. Here, we can use the cycle in reverse order to sort the grid.

F. DFS, 6 seconds, 512 megabytes, standard input, standard output

Let T be a tree on n vertices. Consider a graph G_0, initially equal to T. You are given a sequence of q updates, where the i-th update is given as a pair of two distinct integers u_i and v_i.

For every i from 1 to q, we define the graph G_i as follows:

- If G_{i-1} contains an edge $\{u_i, v_i\}$, then remove this edge to form G_i.
- Otherwise, add this edge to G_{i-1} to form G_i.

Formally, $G_i := G_{i-1} \triangle \{\{u_i, v_i\}\}$ where $\triangle$ denotes the set symmetric difference.

Furthermore, it is guaranteed that T is always a subgraph of G_i. In other words, an update never removes an edge of T.

Consider a connected graph H and run a depth-first search on it. One can see that the tree edges (i.e. the edges leading to a not yet visited vertex at the time of traversal) form a spanning tree of the graph H. This spanning tree is not generally fixed for a particular graph — it depends on the starting vertex, and on the order in which the neighbors of each vertex are traversed.

We call vertex w *good* if one can order the neighbors of each vertex in such a way that the depth-first search started from w produces T as the spanning tree. For every i from 1 to q, find and report the number of good vertices.

Input

The first line contains two integers n and q ($3 \le$ $1 \le q \le 2 \cdot 10^5$) — the number of nodes and th respectively.

Each of the next $n-1$ lines contains two integers u and v ($1 \le u, v \le n, u \ne v$) — vertices connected by an edge in T. It is guaranteed that this graph is a tree.

Each of the next q lines contains two integers u and v ($1 \le u, v \le n$, $u \ne v$) — the endpoints of the edge that is added or removed. It is guaranteed that this edge does not belong to T.

Output

For each update, print one integer k — the number of good vertices w after the corresponding update.

input

```
3 2
1 2
1 3
2 3
3 2
```

output

```
2
3
```

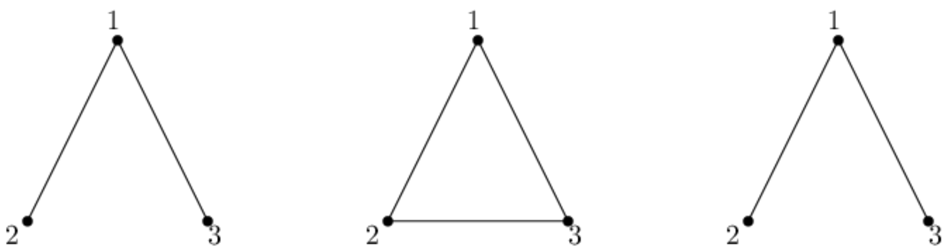
input

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

output

```
3
2
3
2
3
2
```

The first sample is depicted in the following figure.



$T = G_0$ G_1 G_2

After the first update, G contains all three possible edges. The result of a DFS is as follows:

- Let the starting vertex be 1. We have two choices of ordering the neighbors of 1, either $[2, 3]$ or $[3, 2]$.
  - If we choose the former, then we reach vertex 2. Regardless of the ordering of its neighbors, the next visited vertex will be 3. Thus, the spanning tree generated by this DFS will contain edges $\{1, 2\}$ and $\{2, 3\}$, which does not equal to T.
  - If we choose the latter, we obtain a spanning tree with edges $\{1, 3\}$ and $\{2, 3\}$.

  Hence, there is no way of ordering the neighbors of vertices such that the DFS produces T, and subsequently 1 is not a good vertex.
- Let the starting vertex be 2. We have two choices of traversing its neighbors. If we visit 3 first, then the spanning tree will consist of edges $\{2, 3\}$ and $\{1, 3\}$, which is not equal to T. If we, however, visit 1 first, then we can only continue to 3 from here, and the spanning tree will consist of edges $\{1, 2\}$ and $\{1, 3\}$, which equals to T. Hence, 2 is a good vertex.
- The case when we start in the vertex 3 is symmetrical to starting in 2, and hence 3 is a good vertex.

Therefore, the answer is 2.

After the second update, the edge between 2 and 3 is removed, and $G = T$. It follows that the spanning tree generated by DFS will be always equal to T independent of the choice of the starting vertex. Thus, the answer is 3.

In the second sample, the set of good vertices after the corresponding query is:

- $\{2, 3, 5\}$
- $\{3, 5\}$
- $\{3, 4, 5\}$
- $\{4, 5\}$
- $\{4, 5, 6\}$
- $\{5, 6\}$