Problem A. Adjustment Office

Input file: `adjustment.in`
Output file: `adjustment.out`

Garrison and Anderson are working in a company named "Adjustment Office". In competing companies workers change the reality, in this company they try to predict the future.

They are given a big square board $n \times n$. Initially in each cell (x, y) of this board the value of $x + y$ is written $(1 \le x, y \le n)$. They know that in the future there will be two types of queries on the board:

- "`R` r" — sum up all values in row r, print the result and set all values in row r to zero;
- "`C` c" — sum up all values in column c, print the result and set all values in column c to zero.

They have predicted what queries and results there will be. They need to ensure that they have correctly predicted the results. Help them by computing the results of the queries.

Input

The first line of the input contains two integers n and q $(1 \le n \le 10^6, 1 \le q \le 10^5)$ — the size of the square and the number of queries.

Each of the next q lines contains the description of the query. Each query is either "`R` r" $(1 \le r \le n)$ or "`C` c" $(1 \le c \le n)$.

Output

The output file shall contain q lines. The i-th line shall contain one integer — the result of the i-th query.

Sample input and output

adjustment.in	adjustment.out
3 7 R 2 C 3 R 2 R 1 C 2 C 1 R 3	12 10 0 5 5 4 0

Problem D. Distance on Triangulation

Input file: `distance.in`
Output file: `distance.out`

You have a convex polygon. The vertices of the polygon are successively numbered from 1 to n. You also have a triangulation of this polygon, given as a list of $n - 3$ diagonals.

You are also given q queries. Each query consists of two vertex indices. For each query, find the shortest distance between these two vertices, provided that you can move by the sides and by the given diagonals of the polygon, and the distance is measured as the total number of sides and diagonals you have traversed.

Input

The first line of the input file contains an integer n — the number of vertices of the polygon ($4 \le n \le 50\,000$).

Each of the following $n-3$ lines contains two integers a_i, b_i — the ends of the i-th diagonal ($1 \le a_i, b_i \le n$, $a_i \ne b_i$).

The next line contains an integer q — the number of queries ($1 \le q \le 100\,000$).

Each of the following q lines contains two integers x_i, y_i — the vertices in the i-th query ($1 \le x_i, y_i \le n$).

It is guaranteed that no diagonal coincides with a side of the polygon, and that no two diagonals coincide or intersect.

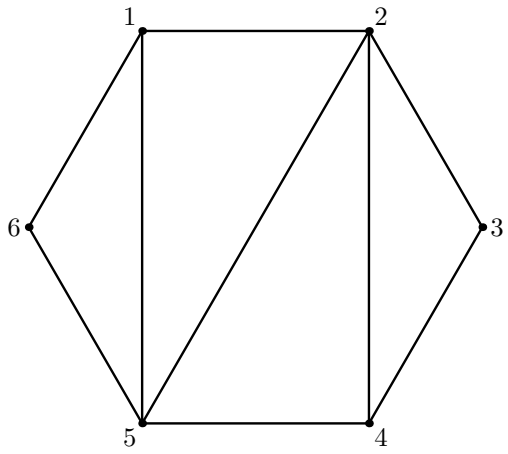
Output

For each query output a line containing the shortest distance.

Sample input and output

distance.in	distance.out
6 1 5 2 4 5 2 5 1 3 2 5 3 4 6 3 6 6	2 1 1 3 0

This is the polygon from the sample input.



Problem E. Easy Problemset

Input file: `easy.in`
Output file: `easy.out`

Perhaps one of the hardest problems of any ACM ICPC contest is to create a problemset with a reasonable number of easy problems. On Not Easy European Regional Contest this problem is solved as follows.

There are n jury members (judges). They are numbered from 1 to n. Judge number i had prepared p_i *easy problems* before the jury meeting. Each of these problems has a *hardness* between 0 and 49 (the higher the harder). Each judge also knows a very large (say infinite) number of *hard problems* (their hardness is 50). Judges need to select k problems to be used on the contest during this meeting.

They start to propose problems in the ascending order of judges numbers. The first judge takes the first problem from his list of remaining easy problems (or a hard problem, if he has already proposed all his easy problems) and proposes it. The proposed problem is selected for the contest **if its hardness is greater than or equal to the total hardness of the problems selected so far**, otherwise it is considered too easy. Then the second judge does the same etc.; after the n-th judge, the first one proposes his next problem, and so on. This procedure is stopped immediately when k problems are selected.

If all judges have proposed all their easy problems, but they still have selected less than k problems, then they take some hard problems to complete the problemset regardless of the total hardness.

Your task is to calculate the total hardness of the problemset created by the judges.

Input

The first line of the input file contains the number of judges n ($2 \le n \le 10$) and the number of problems k ($8 \le k \le 14$). The i-th of the following n lines contains the description of the problems prepared by the i-th judge. It starts with p_i ($1 \le p_i \le 10$) followed by p_i non negative integers between 0 and 49 — the hardnesses of the problems prepared by the i-th judge in the order they will be proposed.

Output

Output the only integer — the total hardness of the selected problems.

Sample input and output

easy.in	easy.out
3 8 5 0 3 12 1 10 4 1 1 23 20 4 1 5 17 49	94
3 10 2 1 3 1 1 2 2 5	354

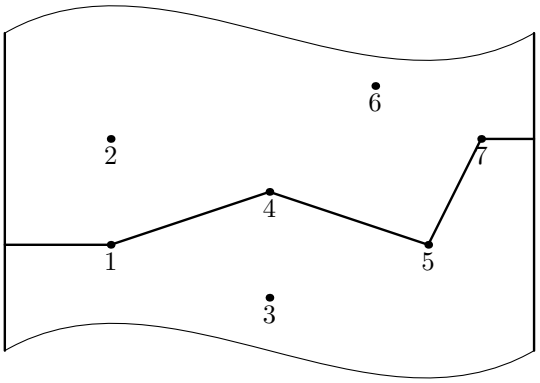
In the first example, three problems with hardnesses of 0, 1, and 1 are selected first. Then the first judge proposes the problem with hardness 3 and it is selected, too. The problem proposed by the second judge with hardness 1 is not selected, because it is too easy. Then the problems proposed by the third, the first, and the second judges are selected (their hardnesses are 5, 12 and 23). The following three proposed problems with hardness of 17, 1 and 20 are not selected, and the problemset is completed with a problem proposed by the third judge with hardness of 49. So the total hardness of the problemset is 94.

In the second example, three problems with hardnesses of 1, 1, and 2 are selected first. The second problem of the first judge (hardness 3) is too easy. The second judge is out of his easy problems, so he proposes a problem with hardness 50 and it is selected. The third judge's problem with hardness 5 is not selected. The judges decide to take 6 more hard problems to complete the problemset, which gives the total hardness of $54 + 6 \cdot 50 = 354$.

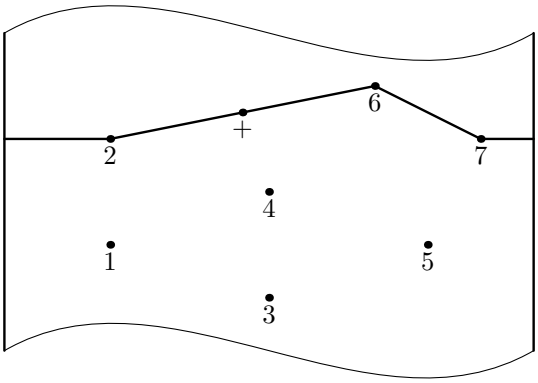
Problem F. Froggy Ford

Input file: `froggy.in`
Output file: `froggy.out`

Fiona designs a new computer game Froggy Ford. In this game, a player helps a frog to cross a river using stone fords. Frog leaps from the river's shore to the first stone ford, than to the second one and so on, until it reaches the other shore. Unfortunately, frog is pretty weak and its leap distance is quite limited. Thus, a player should choose the optimal route — the route that minimizes the largest leap required to traverse the route.



Optimal route



Optimal route with added stone

Fiona thinks that this game is not challenging enough, so she plans to add a possibility to place a new stone in the river. She asks you to write a program that determines such a location of the new stone that minimizes the largest leap required to traverse the optimal route.

Input

The first line of the input file contains two integers w — the width of the river and n — the number of stones in it ($1 \le w \le 10^9$, $0 \le n \le 1000$).

Each of the following n lines contains two integers x_i, y_i — the coordinates of the stones ($0 < x_i < w$, $-10^9 \le y_i \le 10^9$). Coordinates of all stones are distinct.

River shores have coordinates $x = 0$ and $x = w$.

Output

Write to the output file two real numbers x_+ and y_+ ($0 < x_+ < w$, $-10^9 \le y_+ \le 10^9$) — the coordinates of the stone to add. This stone shall minimize the largest leap required to traverse the optimal route. If a new stone cannot provide any improvement to the optimal route, then an arbitrary pair of x_+ and y_+ satisfying the constraints can be written, even coinciding with one of the existing stones.

Your answer shall be precise up to three digits after the decimal point.

Sample input and output

froggy.in	froggy.out
10 7 2 2 2 4 5 1 5 3 8 2 7 5 9 4	4.5 4.5

Problem G. Generators

Input file: `generators.in`
Output file: `generators.out`

Little Roman is studying *linear congruential generators* — one of the oldest and best known pseudo-random number generator algorithms. Linear congruential generator (LCG) starts with a non-negative integer number x_0 also known as *seed* and produces an infinite sequence of non-negative integer numbers x_i ($0 \le x_i < c$) which are given by the following recurrence relation:

$$x_{i+1} = (ax_i + b) \bmod c$$

here a, b, and c are non-negative integer numbers and $0 \le x_0 < c$.

Roman is curious about relations between sequences generated by different LCGs. In particular, he has n different LCGs with parameters $a^{(j)}$, $b^{(j)}$, and $c^{(j)}$ for $1 \le j \le n$, where the j-th LCG is generating a sequence $x_i^{(j)}$. He wants to pick one number from each of the sequences generated by each LCG so that the sum of the numbers is the maximum one, but is not divisible by the given integer number k.

Formally, Roman wants to find integer numbers $t_j \ge 0$ for $1 \le j \le n$ to maximize $s = \sum_{j=1}^{n} x_{t_j}^{(j)}$ subject to constraint that $s \bmod k \ne 0$.

Input

The first line of the input file contains two integer numbers n and k ($1 \le n \le 10\,000$, $1 \le k \le 10^9$). The following n lines describe LCGs. Each line contains four integer numbers $x_0^{(j)}$, $a^{(j)}$, $b^{(j)}$, and $c^{(j)}$ ($0 \le a^{(j)}, b^{(j)} \le 1000$, $0 \le x_0^{(j)} < c^{(j)} \le 1000$).

Output

If Roman's problem has a solution, then write on the first line of the output file a single integer s — the maximum sum not divisible by k, followed on the next line by n integer numbers t_j ($0 \le t_j \le 10^9$) specifying some solution with this sum.

Otherwise, write to the output file a single line with the number -1.

Sample input and output

generators.in	generators.out
2 3 1 1 1 6 2 4 0 5	8 4 1
2 2 0 7 2 8 2 5 0 6	-1

In the first example, one LCG is generating a sequence 1, 2, 3, 4, 5, 0, 1, 2, ..., while the other LCG a sequence 2, 3, 2, 3, 2, ...

In the second example, one LCG is generating a sequence 0, 2, 0, 2, 0, ..., while the other LCG a sequence 2, 4, 2, 4, 2, ...

Problem J. Jump

Input file: standard input
Output file: standard output

Consider a toy interactive problem OneMax which is defined as follows. You know an integer n and there is a hidden bit string S of length n. The only thing you may do is to present the system a bit string Q of length n, and the system will return the number OneMax(Q) — the number of bits which coincide in Q and S at the corresponding positions. The name of OneMax problem stems from the fact that this problem is simpler to explain when $S = 111\ldots11$, so that the problem turns into maximization (Max) of the number of ones (One).

When n is even, there is a similar (but harder) interactive problem called Jump. The simplest way to describe the Jump is by using OneMax:

$$\textsc{Jump}(Q) = \begin{cases} \textsc{OneMax}(Q) & \text{if } \textsc{OneMax}(Q) = n \text{ or } \textsc{OneMax}(Q) = n/2; \\ 0 & \text{otherwise.} \end{cases}$$

Basically, the only nonzero values of OneMax which you can see with Jump are n (which means you've found the hidden string S) and $n/2$.

Given an even integer n — the problem size, you have to solve the Jump problem for the hidden string S by making interactive Jump queries. Your task is to eventually make a query Q such that $Q = S$.

Interaction protocol

First, the testing system tells the length of the bit string n. Then, your solution asks the queries and the system answers them as given by the Jump definition. When a solution asks the query Q such that $Q = S$, the system answers n and terminates, so if your solution, after reading the answer n, tries reading or writing anything, it will fail.

The limit on the number of queries is $n + 500$. If your solution asks a $(n + 501)$-th query, then you will receive the "Wrong Answer" outcome. You will also receive this outcome if your solution terminates too early.

If your query contains wrong characters (neither `0`, nor `1`), or has a wrong length (not equal to n), the system will terminate the testing and you will receive the "Presentation Error" outcome.

You will receive the "Time Limit Exceeded" outcome and other errors for the usual violations.

Finally, if everything is OK (e.g. your solution finds the hidden string) on every test, you will receive the "Accepted" outcome, in this case you will have solved the problem.

Input

The first line of the input stream contains an even number n ($2 \le n \le 1000$). The next lines of the input stream consist of the answers to the corresponding queries. Each answer is an integer — either 0, $n/2$, or n. Each answer is on its own line.

Output

To make a query, print a line which contains a string of length n which consists of characters `0` and `1` only. Don't forget to put a newline character and to flush the output stream after you print your query.

Sample input and output

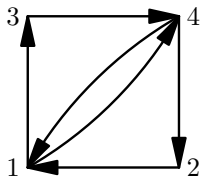
standard input	standard output
2 1 0 1 2	01 11 10 00

Problem K. King's Inspection

Input file: `king.in`
Output file: `king.out`

King Karl is a responsible and diligent ruler. Each year he travels across his country to make certain that all cities are doing well.

There are n cities in his country and m roads. In order to control the travelers, each road is unidirectional, that is a road from city a to city b can not be passed from b to a.



Karl wants to travel along the roads in such a way that he starts in the capital, visits every non-capital city exactly once, and finishes in the capital again.

As a transport minister, you are obliged to find such a route, or to determine that such a route doesn't exist.

Input

The first line contains two integers n and m ($2 \le n \le 100\,000$, $0 \le m \le n + 20$) — the number of cities and the number of roads in the country.

Each of the next m lines contains two integers a_i and b_i ($1 \le a_i, b_i \le n$), meaning that there is a one-way road from city a_i to city b_i. Cities are numbered from 1 to n. The capital is numbered as 1.

Output

If there is a route that passes through each non-capital city exactly once, starting and finishing in the capital, then output $n + 1$ space-separated integers — a list of cities along the route. Do output the capital city both in the beginning and in the end of the route.

If there is no desired route, output "`There is no route, Karl!`" (without quotation marks).

Sample input and output

king.in	king.out
4 6 1 4 4 1 4 2 2 1 3 4 1 3	1 3 4 2 1
4 3 1 4 1 4 2 2	There is no route, Karl!

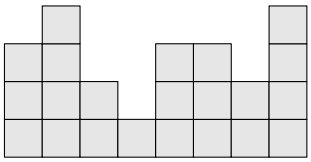
Problem L. Landscape Improved

Input file: `landscape.in`
Output file: `landscape.out`

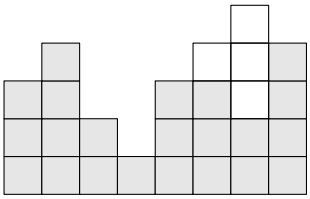
Louis L Le Roi-Univers has ordered to improve the landscape that is seen from the royal palace. His Majesty prefers to see a high mountain.

The Chief Landscape Manager is going to raise a mountain for Louis. He represents a landscape as a flat picture on a grid of unit squares. Some of the squares are already filled with rock, while others are empty. This greatly simplifies the design. Unit squares are small enough, and the landscape seems to be smooth from the royal palace.

The Chief Landscape Manager has a plan of the landscape — the heights of all rock-filled columns for each unit of width. He is going to add at most n square units of stones atop of the existing landscape to make a mountain with as high peak as possible. Unfortunately, piles of stones are quite unstable. A unit square of stones may be placed only exactly on top of the other filled square of stones or rock, moreover the squares immediately to the bottom-left and to bottom-right of it should be already filled.



Existing landscape



Improved landscape

Your task is to help The Chief Landscape Manager to determine the maximum height of the highest mountain he can build.

Input

The first line of the input file contains two integers w — the width of the existing landscape and n — the maximum number of squares of stones to add ($1 \le w \le 100\,000$, $0 \le n \le 10^{18}$).

Each of the following w lines contains a single integer h_i — the height of the existing landscape column ($1 \le h_i \le 10^9$).

Output

The output file shall contain the single integer — the maximum possible landscape height after at most n unit squares of stones are added in a stable way.

Sample input and output

landscape.in	landscape.out
8 4 3 4 2 1 3 3 2 4	5
3 100 3 3 3	4