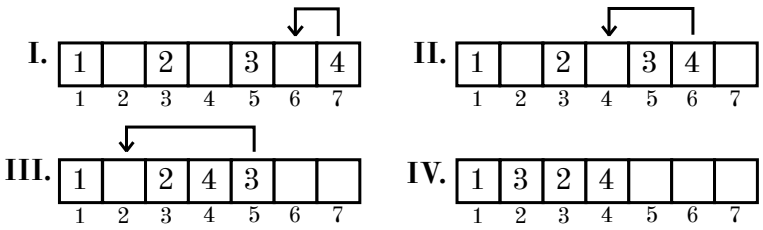
Problem Aivazovsky. A Leapfrog in the Array

Input file:	`input.txt` or standard input
Output file:	`output.txt` or standard output
Time limit:	2 seconds
Memory limit:	512 megabytes

Dima is a beginner programmer. During his working process, he regularly has to repeat the following operation again and again: to remove every second element from the array. One day he has been bored with easy solutions of this problem, and he has come up with the following extravagant algorithm.

Let's consider that initially array contains n numbers from 1 to n and the number i is located in the cell with the index $2i - 1$ (Indices are numbered starting from one) and other cells of the array are empty. Each step Dima selects a non-empty array cell with the maximum index and moves the number written in it to the nearest empty cell to the left of the selected one. The process continues until all n numbers will appear in the first n cells of the array. For example if $n = 4$, the array is changing as follows:



You have to write a program that allows you to determine what number will be in the cell with index x ($1 \le x \le n$) after Dima's algorithm finishes.

Input

The first line contains two integers n and q ($1 \le n \le 10^{18}$, $1 \le q \le 200\,000$), the number of elements in the array and the number of queries for which it is needed to find the answer.

Next q lines contain integers x_i ($1 \le x_i \le n$), the indices of cells for which it is necessary to output their content after Dima's algorithm finishes.

Output

For each of q queries output one integer number, the value that will appear in the corresponding array cell after Dima's algorithm finishes.

Example

input	output
4 3 2 3 4	3 2 4

Scoring

Tests for this problem are divided into three groups. For each of the groups you earn points only if your solution passes all tests in this group and all tests of the previous groups.

Group	Points	Additional constraints		Comment
		n	q	
0	0	–	–	Sample tests
1	31	$n \leq 1000$	$q \leq 1000$	–
2	29	$n \leq 200\,000$	–	–
3	40	–	–	–

Problem Van Gogh. Astronomy

Input file:	`input.txt` or standard input
Output file:	`output.txt` or standard output
Time limit:	5 seconds
Memory limit:	512 megabytes

Year 18 AD. Famous astronomer Philon the Berlander publishes a book "About Sky and Cosmos», in which he describes an incredible picture seen by him on a night sky while observing the skies. He once seen $2n$ stars on a clear sky and the Moon. Surprisingly, it was possible to divide all stars in pairs in such way that any line passing through the centers of two paired stars also passed through the center of the Moon, also all such lines were distinct. Philon carefully represented such a situation on a sky map, introducing a coordinate system. While doing that, he noticed that centers of all stars and the center of the Moon are points with integer coordinates. As Philon thought that the Earth and the Moon were flat, his coordinate system was two-dimensional. Coordinate system was chosen by an astronomer in such way that the coordinates of all objects (including the Moon) are no more than 10^6 by the absolute value. Moreover, no two objects (two stars or a star and a Moon) were not located at the same point.

Apart from the sky map Philon wrote a prediction that in 2000 years stars will take exactly the same places, but the Moon will be replaced by a huge comet which will destroy the Earth.

It is 2018 AD now. You got a book of Philon the Berlander and you were horrified to discover that the stars on the sky are in exactly the same position as they were 2000 years ago! Unfortunately, some parts of a sky map were lost, so there are only star locations that are visible on it and there are no details about how the stars were divided in pairs. Moreover,, there is no point corresponding to the center of the Moon on this map. In order to find out the possible location of a comet and save the humanity from the terrible end, you should immediately find out some suitable location for the center of the Moon!

Input

In the first line of input there is an integer n ($2 \le n \le 2600$), the number of star pairs seen by an astronomer in the sky.

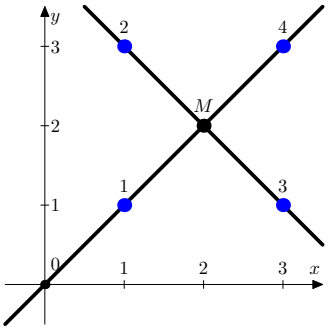
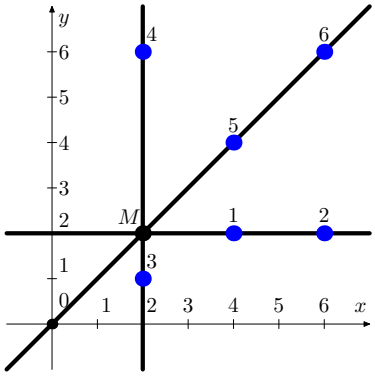
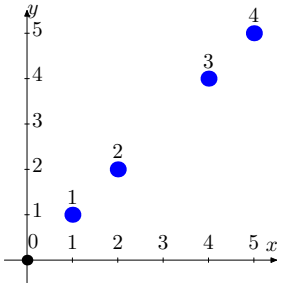
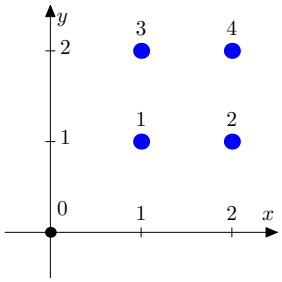
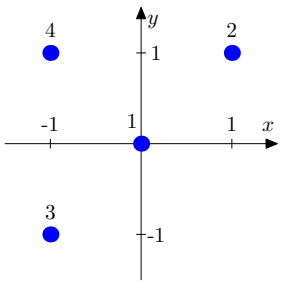
In the following $2n$ lines there are pairs of integers x_i, y_i ($-10^6 \le x_i, y_i \le 10^6$), the coordinates of star centers in the sky map. Note that the stars are listed in an arbitrary order that has nothing common with the distribution of stars into pairs as found out by Philon the Berlander. Centers of no two stars coincide.

Output

If astronomer was wrong and there is no way to distribute all points in pairs in such manner that all lines passing through these point pairs are distinct lines intersecting in a single point with integer coordinates, and this intersection point is different from centers of all stars, then print "`No`" (without the quotes) in the only line of input.

Otherwise print "`Yes`" (without the quotes). In the second line print pair of integers x, y ($|x|, |y| \le 10^6$), the coordinates of a point that contains a center of the Moon in your solution. If there are several possible answers, output any of them. Note that the printed point should be different from all the star centers.

Examples

input	output	illustration
2 1 1 1 3 3 1 3 3	Yes 2 2	
3 4 2 6 2 2 1 2 6 4 4 6 6	Yes 2 2	
2 1 1 2 2 4 4 5 5	No	
2 1 1 2 1 1 2 2 2	No	
2 0 0 1 1 -1 -1 -1 1	No	

Note

In the fourth sample test the Moon center could not have possibly been in a point $(1.5, 1.5)$ since the coordinates of this point are non-integer.

In the fifth sample test there are no suitable points that do not coincide with a center of some star.

Scoring

Tests for this problem are divided into eight groups. For each of the groups you earn points only if your solution passes all tests in this group and all tests in all previous groups.

Group	Points	Additional constraints	Comment
		n	
0	0	—	Sample tests
1	9	$n \leq 2$	–
2	10	$n \leq 5$	–
3	9	$n \leq 25$	–
4	9	$n \leq 200$	–
5	10	$n \leq 500$	–
6	11	$n \leq 1000$	–
7	10	$n \leq 1500$	**Offline evaluation**
8	11	$n \leq 2000$	**Offline evaluation**
9	11	$n \leq 2300$	**Offline evaluation**
10	10	–	**Offline evaluation**

Problem Raphael. OMOI

Input file:	`input.txt` or standard input
Output file:	`output.txt` or standard output
Time limit:	2 seconds
Memory limit:	512 megabytes

Organization of Meticulous Oil Inspectors (OMOI) is an association of n oil inspectors of the city N. All oil inspectors in the organization are numbered successively from 1 to n in the order of joining the OMOI. There is a tree-like hierarchy among the OMOI members so that the oil inspector 1 is the head of OMOI, and every other oil inspector i has an *immediate supervisor* p_i who joined OMOI prior to i, that is, has a smaller number. An oil inspector v is a *supervisor* of an oil inspector u if v is present in the chain of immediate supervisors starting at u, that is, in the sequence p_u, p_{p_u}, and so on. In this case, the oil inspector u is a *subordinate* of the oil inspector v.

All members of OMOI are very meticulous, and it is not uncommon for them to argue on business questions. We assume that two oil injectors may argue only if none of them is a supervisor of the other. To resolve their dispute, arguing oil inspectors ask their *closest common supervisor* for advice, that is, an oil inspector who is their common supervisor with the largest number. Every oil inspector i (expect for the head of OMOI) has a *perfectionism level* that is expressed with an integer c_i. *Intensity* of an argument between two oil inspectors is the sum of their perfectionism levels. Finally, *tension* of a working day is the total intensity of all arguments during the day.

At the end of a working day an oil inspector v thinks himself an *effective manager* if for each one of his subordinates he resolved at least one argument involving this subordinate during the day. Formally, that means that for each oil inspector u who is a subordinate of v there is an oil inspector w such that u and w had an argument during the day, and v was the closest common supervisor of u and w. In particular, every oil inspector who does not have any subordinates thinks himself an effective manager according to this definition.

You are employed at OMOI as a programmer, and know every oil inspector in the organization. At the end of today's workday every oil inspector in the organization told you in confidence that he thought himself an effective manager on this day. You are now interested what could be the smallest tension of today's workday if every oil inspector indeed was an effective manager today.

Input

The first line contains an integer n ($3 \le n \le 200\,000$), the number of oil inspectors in OMOI. The second line contains $n-1$ integers $p_2, p_3, \ldots, p_n$ ($1 \le p_i < i$), where p_i is the number of the immediate supervisor of the oil inspector i. The third line contains $n-1$ integers $c_2, c_3, \ldots, c_n$ ($1 \le c_i \le 10^6$), where c_i is the perfectionism level of the oil inspector i.

It is guaranteed that it is possible that every oil inspector would think himself an effective manager at the end of a working day assuming the given hierarchy.

Output

Print the smallest possible tension of the today's workday.

Examples

input	output
5 1 2 2 1 1 1 1 1	8
6 1 1 1 4 4 1 2 3 4 5	25

Note

Consider the first sample test. The desired value of tension can be achieved if during the day oil inspectors in pairs $(2, 5)$, $(3, 4)$, $(3, 5)$, and $(4, 5)$ have arguments.

- Oil inspectors 3, 4, and 5 automatically think themselves effective managers since they have no subordinates.
- The oil inspector 2 thinks himself an effective manager since he helped the oil inspector 3 in his argument with the oil inspector 4, and helped the oil inspector 4 in his argument with the oil inspector 3.
- The oil inspector 1 thinks himself an effective manager since he helped oil inspectors 2, 3, and 4 in their arguments with the oil inspector 5, and helped the oil inspector 5 with three different arguments.

Intensity of each argument is $2 = 1 + 1$, thus tension of this particular day is 8.

The second sample test only satisfies constraints of the second and fourth test groups. An optimal solution can be achieved with arguments in pairs $(2, 5)$, $(3, 6)$, $(4, 5)$, and $(5, 6)$. Tension of the day in this scenario is $(1 + 3) + (1 + 4) + (2 + 5) + (4 + 5) = 25$. Note that this collection of pairs is not the only possible way to achieve the smallest value of tension.

Scoring

Tests for this problem are divided into four groups. For each of the groups you earn points only if your solution passes all tests in this group and all tests in some of the previous groups. **Offline evaluation** means that your submission will be evaluated on the tests of the group only after the end of the contest.

Group	Points	Additional constraints		Required groups	Comment
		n	c_i		
0	0	–	–	–	Sample tests
1	25	$n \le 2000$	$c_i = 1$	–	–
2	26	$n \le 2000$	–	1	–
3	25	–	$c_i = 1$	1	**Offline evaluation**
4	24	–	–	0–3	**Offline evaluation**

Problem Leonardo. Culture Contact

Input file:	`input.txt` or standard input
Output file:	`output.txt` or standard output
Time limit:	1 second
Memory limit:	**128 megabytes**

At the beginning of 16-th century a group of European explorers arrived to the island inhabited by several tribes that never seen a person from Europe.

In order to establish friendship with island inhabitants, a group leader is going to give a present to the head of any local tribe explorers meet on their way. In order to do so, group leader brought a long chain of glass pieces that looks similar to jewels. Consider this chain to be a string s consisting of lowercase English letters, with each letter denoting the type of glass piece on the corresponding position. Explorers are going to cut down the chain into small fragments and give exactly one fragment to head of each tribe they meet. The group leader is going to divide the chain into fragments according to the following rules:

- To reduce time on cutting the chain apart, each fragment should be a contiguous group of glass pieces, i.e. a substring of string s.
- All glass pieces should be used, i.e. each glass piece should be included in exactly one fragment.
- As the explorers do not know how local inhabitants would like certain kinds of glass pieces, they want each tribe head to get exactly the same set of glass pieces ignoring the order of their appearance in a fragment. In the other words, for each glass piece type the number of glass pieces of this type should be the same in each of the fragments.
- Explorers do not know how many tribes there are on the island, so they would like the number of fragments to be maximum possible.

Help group leader to find out the maximum possible fragment count that may be obtained without violating the rules above.

Input

In the only line of input there is a non-empty string s consisting of lowercase English letters. The length of string s does not exceed $5 \cdot 10^6$ characters.

Output

Print the only number, the maximum possible number of fragments the explorers may cut the given chain without violating any of the rules of the group leader.

Examples

input	output
abbabbbab	3
aabb	1

Note

In the first sample test explorers may split a chain `abbabbbab` into fragments `abb`, `abb`, `bab`, in this case they will give each tribe head a fragment consisting of one glass piece of type `a` and two glass pieces of type `b`.

In the second sample case it is impossible to divide a chain into more than one fragment.

Scoring

Tests for this problem are divided into five groups. For each of the groups you earn points only if your solution passes all tests in this group and all tests in some of the previous groups. **Offline evaluation** means that your submission will be evaluated on the tests of the group only after the end of the contest.

Group	Points	Additional constrinats	Required groups	Comment
0	0	–	–	Sample tests
1	15	$\|s\| \le 100$	0	–
2	15	$\|s\| \le 1000$	0, 1	–
3	21	$\|s\| \le 500\,000$	0–2	–
4	20	String consists only of `a` and `b`	0	–
5	29	–	0–4	**Offline evaluation**