Problem A. assemble

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

The Avengers are trying to track down Thanos to get revenge after he erased half of all life! In order to do so, they need to intercept messages being sent between planets in the universe. For their decoding algorithm to work, they need your help to provide vital information. For the stolen message, they need to find the most and least frequent substrings. A substring is defined to be a group of contiguous letters in a string.

Input

The only line of input is the stolen message in the form of a string consisting of lowercase letters in the English alphabet. The length of the string is at most 10^5.

Output

On two separate lines, output the most frequent and least frequent substring respectively. If there is more than one correct answer, output any of them.

Examples

standard input	standard output
abcabc	abc abca
endgamenglish	en lish

Problem B. ironman

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	256 megabytes

In the aftermath of the Battle of New York, Tony Stark is helping rebuild the city. As you may know, New York City is organized as an n by n grid of skyscrapers having distinct heights.

Tony has drafted up a plan, but he has decided that he wants to make it **beautiful**. To Tony, a grid is beautiful if every skyscraper is taller than those directly west of it and taller than those directly north of it. In other words, every row has increasing skyscraper heights from west-to-east and every column has increasing heights from north-to-south.

He hasn't downloaded the newest update to the editing software, so to edit his plan, he can only make two kinds of edits. He can pick two rows of the grid and swap their values (i.e. if he picks the xth row and the yth row, then the ith value in the xth row and the ith value in the y row get swapped for all i), or he can pick two columns of the grid and swap their values. Can you help Tony determine whether he can use some nonnegative number of edits to make the plan beautiful?

Input

The first line contains one integer n ($1 \leq n \leq 10^3$), the size of the grid. The next n lines describe the grid. The ith line contains n space-separated integers, describing the n tower heights in the ith row. All tower heights are guaranteed to be between 1 and 10^9, and are distinct.

Output

Output one line containing either "Y" (without quotes) if the plan can be made beautiful or "N" (without quotes) if it cannot.

Examples

standard input	standard output
3 1 3 2 4 6 5 7 9 8	Y
3 1 3 2 4 9 5 6 8 7	N

Note

For the first sample, swap the second and third columns to make the grid beautiful.

For the second sample, it is impossible to make the grid beautiful.

Problem C. vision

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2.5 seconds
Memory limit:	256 megabytes

Vision is practicing his mental math skills. He has q equations, each of the form $n^3 = cm^2$ for a given constant c. He must solve the equation for n and m, and n and m must be **distinct** positive integers. If there are multiple solutions, he must find the one with the smallest n. Vision needs your help!

Input

The first line contains one integer q ($1 \leq q \leq 5000$), the number of equations. For the next q lines, the ith line contains one integer c_i ($1 \leq c_i \leq 10^{12}$) describing the ith equation $n^3 = c_i m^2$.

Output

Output q lines of input. On the ith line, output the solution for n and the solution for m separated by a single space. If there are multiple solutions, output the solution that has the smallest value of n.

Example

standard input	standard output
4 2 5 100 13	8 16 20 40 400 800 52 104

Problem D. captainamerica

Input file:	standard input
Output file:	standard output
Time limit:	2 seconds
Memory limit:	256 megabytes

Captain America is running through a maze and needs your help! His maze can be represented as an undirected graph that starts by containing exactly one node. The initial node is labeled 0. Next, you are given q operations to perform on this graph. There are only two types of operations. Both types of operations operate on two vertices $0 \leq u, v < q$, and create exactly one new vertex. The vertex created by the ith operation (counting from 1) will be labeled i. Here are the two operations:

- Type 0: Create a new vertex i. If $u = v$, then add the edge (u, i). If $u \neq v$, then add edges (u, i) and (i, v).
- Type 1: Create a new vertex i. You are guaranteed that (u, v) is an existing edge, and $u \neq v$. Delete edge (u, v) and add edges (u, i) and (i, v) to the graph.

In order to escape, Captain America wants to know how many triangles are there in the graph at the end of every operation. A triangle is defined as a triple (u, v, w) where $u < v < w$ such that the edges (u, v), (v, w) and (w, u) are all in the graph.

Input

The first line contains a single integer q ($1 \leq q \leq 10^5$).

Then q lines follow. The ith line among these q lines contains three space-separated integers t, u, v, where $t \in \{0, 1\}$. $0 \leq u, v < i$, representing the type and parameters of the ith operation.

Output

Output a single line for each operation containing one a single integer: the number of triangles in the graph after the operation.

Examples

standard input	standard output
3 0 0 0 0 0 1 1 1 2	0 1 0
6 0 0 0 0 1 1 0 1 2 0 1 2 0 3 2 1 1 2	0 0 1 2 3 1

Note

In the first sample, after the first operation, we have two nodes 0 and 1 with an edge joining them. After the second operation, nodes 0, 1, and 2 are all connected, forming one triangle. In the third operation, we remove the edge connecting node 1 and 2 and add edges between nodes 1 and 3 and nodes 2 and 3. There are now no triangles in the graph.

Problem E. titan

Input file:	standard input
Output file:	standard output
Time limit:	2 seconds
Memory limit:	256 megabytes

The planet Titan is a perfect sphere with radius 1 astronomical unit (au). On it, there are n towers at various locations on the surface. The towers will be built perpendicular to the surface of the sphere, or more formally, a tower will be constructed from a base point on the surface of the sphere and will be perpendicular to the plane tangent to sphere at the base point.

Two towers can directly communicate with one another if there is a straight line from one tower to the other without crossing the planet surface. Two towers t_x, t_y can indirectly communicate with each other if there exists a sequence of towers $t_1, t_2, t_3, \cdots, t_k$, $t_1 = t_x$, $t_k = t_y$, where for all $1 \leq i \leq k-1$, t_i can directly communicate with t_{i+1}. Thanos is going to snap the Infinity Gauntlet to save material, so he wants to make the tallest tower as short as possible, while still ensuring that all towers can communicate, at least indirectly, with each other.

Input

The first line contains one integer n ($2 \leq n \leq 1000$). The next n lines describe the longitude and latitude of the towers. Each line contains four tokens separated by spaces: a decimal as the line of latitude ($0 \leq a \leq 90$), one character "N"or "S"(without quotes), a decimal as the line of longitude ($0 \leq b \leq 180$), and one character "E"or "W"(without quotes). All decimals will be given to two decimal places.

Output

Output one line containing the shortest possible height of the tallest tower. Your answer will be considered correct if it is within absolute or relative error of 10^{-6}. It is guaranteed that an answer exists.

Examples

standard input	standard output
4 75.61 N 70.98 W 82.04 S 35.55 E 24.99 S 99.71 W 32.83 N 92.41 E	0.5928105242
2 0.00 N 0.00 E 90.00 N 0.00 W	0.4142135624

Problem F. blackwidow

Input file:	`standard input`
Output file:	`standard output`
Time limit:	5 seconds
Memory limit:	256 megabytes

Black Widow is trapped and needs to escape before Thanos can capture her!

She is stuck in a room with n boxes in a row, and the ith box contains a_i balls. She performs m operations on the balls in the boxes. For each operation, she chooses an interval $[l, r]$ and flip a fair coin. If the coin comes up heads, she moves all of the balls belonging to a box in that interval to box l. Otherwise, she moves all of the balls belonging to a box in that interval to box r. Black Widow can escape if all of the balls end up in one box after the operations, but she's not sure if that will happen. After performing all m operations, what is the expected number of balls in each of the n boxes?

Input

The first line contains two integers n and m ($1 \leq n, m \leq 10^5$), the number of boxes and operations, respectively. The second line contains n space-separated integers $a_1, a_2, ..., a_n$ ($0 \leq a_i \leq 10^9$) with a_i being the number of balls in the ith box. The next m lines contain two space-separated integers l and r ($1 \leq l \leq r \leq n$). The ith such line represents the ith operation.

Because of the large amount of input, Java users should use `BufferedReader` and `PrintWriter` and C++ users should use `scanf` and `printf`.

Output

Output one line containing n space-separated numbers. The ith number should be the expected number of balls in the ith box after performing all of the operations. Each answer should have an absolute or relative error of less than 10^{-6}.

Example

standard input	standard output
3 2 1 2 3 1 2 1 3	3.0000000000 0.0000000000 3.0000000000

Note

In the first sample, after Black Widow performs both operations, the expected number of balls in the first box is 3, the expected number of balls in the second box is 0, and the expected number of balls in the third box is 3.

Problem G. asgardians

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

Loki has a string s and Thor has a string t. Both strings are of length n and consist of lowercase letters in the English alphabet.

In one operation, Loki can pick a lowercase letter and change all occurrences of that letter in s to a different lowercase letter. For example, if his string is "hahaha" and Loki decides to change all occurrences of the letter 'a' to the letter 'e', his new string becomes "hehehe".

What is the minimum number of operations Loki can make on his string s so that he obtains Thor's string t? Print the minimum number of operations necessary or "-1" (without quotes) if it is impossible to change s to t.

Input

The first line contains an integer n ($1 \leq n \leq 100$), denoting the length of strings s and t. The second line of input contains Loki's string s. The third line of input contains Thor's string t. Each string has length exactly n and consists of only lowercase letters in the English alphabet.

Output

Print a single integer - the minimum number of operations to change s to t. If it is impossible to do so, print "-1" (without quotes).

Examples

standard input	standard output
5 hello jelly	2
4 abba abca	-1
4 book keep	3

Note

In the first sample, Loki can change all occurrences of 'h' to 'j' to get "jello". Then he can change all occurrences of 'o' to 'y' to get "jelly".

In the second sample, it is impossible to change the second 'b' in s to a 'c' without changing the first 'b' in s.

In the third sample, Loki can first change all occurrences of 'o' to 'e' to get "beek". Then he can change all occurrences of 'k' to 'p' to get "beep". Finally, he can change all occurrences of 'b' to 'k' to get "keep".

Problem H. hulk

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

Hulk is very bad at doing anything other than smashing. So when Iron Man assigned him a task he became very scared. He doesn't want to let down the team, so he needs your help!

Hulk wishes to generate a $n \times n$ grid of characters. All characters in the grid must be lowercase letters of the English alphabet. Hulk is also given a list of m_2 bigrams and m_3 trigrams. The bigrams and trigrams must not appear in certain configurations in the grid.

Let the top left character in the grid be $G(0,0)$ and the bottom right character $G(n-1,n-1)$. For every bigram ab and trigram xyz, the following conditions must hold for all $0 \leq i,j < n$:

- $G(i,j)G(i,j+1) \neq ab$ (horizontal bigram)
- $G(i,j)G(i+1,j) \neq ab$ (vertical bigram)
- $G(i,j-1)G(i,j)G(i,j+1) \neq xyz$ (horizontal trigram)
- $G(i-1,j)G(i,j)G(i+1,j) \neq xyz$ (vertical trigram)
- $G(i-1,j)G(i,j)G(i,j+1) \neq xyz$ (L-shaped trigram)
- $G(i,j-1)G(i,j)G(i+1,j) \neq xyz$ (L-shaped trigram)

Help Hulk determine whether it is possible to construct such a grid. If it is, print it.

Input

The first line contains a single integer n ($1 \leq n \leq 1000$). The second line contains two non-negative integers separated by a single space, m_2 and m_3. The next m_2 lines each contain two lowercase characters of the English alphabet, representing the bigrams. The next m_3 lines each contain three lowercase characters of the English alphabet, representing the trigrams. You are guaranteed that no bigram or trigram will be repeated.

Output

If it is possible to construct such a grid, print 1, otherwise print 0 on a single line. Then, if your answer was 1, print n lines containing exactly n lowercase characters each, representing the grid of characters. If multiple grids are possible, print any of them.

Examples

standard input	standard output
1 0 0	1 a
2 4 1 aa ab ac ad aez	1 ae fy

Problem I. spiderman

Input file:	`standard input`
Output file:	`standard output`
Time limit:	3 seconds
Memory limit:	256 megabytes

Spiderman is trying to help Mr. Stark fight Thanos in New York. However, being underage he can't drive (and forgot how to swing) so he has to take a taxi. Unfortunately, the way taxis are now charging fares is dependent on the rider's problem solving skills. You are charged as follows:

You are given an array of n integers, $a_1, \ldots, a_n$. Partition the array into at most k non-overlapping, contiguous subarrays. Then, for each subarray $a[i:j]$, pick some integer x and change all integers to x. The cost of this subarray is then the number of integers in $a[s:e]$ that are not equal to x. That is, the cost is equal to $|\{i : a_i \neq x, s \leq i \leq e\}|$. The total cost of the partition is the sum of the costs of each subarray.

You are allowed to pick the partitions and value of x. Find the minimum total cost to help Spiderman save his money!

Input

The first line contains two space-separated integers, n ($1 \leq n \leq 10^5$) and k ($1 \leq k \leq \min(n, 100)$). The next line contains n space-separated integers, $a_1, \ldots, a_n$. all the integers satisfy $|a_i| \leq 10^9$.

Output

Print a single integer on a single line, representing the minimum total cost.

Examples

standard input	standard output
11 2 1 1 2 1 3 3 4 3 4 4 4	4
11 3 1 1 2 1 3 3 4 3 4 4 4	2

Note

In the first sample, we can split the array into subarrays $a[1:6]$ and $a[7:11]$. In the first subarray, we change a_3, a_5, and a_6 to 1, incurring a cost of 3. In the second subarray, we change a_8 to 4, incurring a cost of 1. Thus, the total cost is 4.

In the second sample, we can split the array into subarrays $a[1:4]$, $a[5:8]$ and $a[9:11]$. In the first subarray, we change a_3 to 1, incurring a cost of 1. In the second subarray, we change a_7 to 3, incurring a cost of 1. Thus, the total cost is 2.