

## AIM Tech Round (Div. 1)

### A. Graph and String

time limit per test: 2 seconds

memory limit per test: 256 megabytes

input: standard input

output: standard output

One day student Vasya was sitting on a lecture and mentioned a string  $S_1S_2\dots S_n$ , consisting of letters "a", "b" and "c" that was written on his desk. As the lecture was boring, Vasya decided to complete the picture by composing a graph  $G$  with the following properties:

- $G$  has exactly  $n$  vertices, numbered from  $1$  to  $n$ .
- For all pairs of vertices  $i$  and  $j$ , where  $i \neq j$ , there is an edge connecting them **if and only if** characters  $S_i$  and  $S_j$  are either equal or neighbouring in the alphabet. That is, letters in pairs "a"- "b" and "b"- "c" are neighbouring, while letters "a"- "c" are not.

Vasya painted the resulting graph near the string and then erased the string. Next day Vasya's friend Petya came to a lecture and found some graph at his desk. He had heard of Vasya's adventure and now he wants to find out whether it could be the original graph  $G$ , painted by Vasya. In order to verify this, Petya needs to know whether there exists a string  $S$ , such that if Vasya used this  $S$  he would produce the given graph  $G$ .

#### Input

The first line of the input contains two integers  $n$  and  $m$  ( $1 \leq n \leq 500, 0 \leq m \leq \frac{n(n-1)}{2}$ ) — the number of vertices and edges in the graph found by Petya, respectively.

Each of the next  $m$  lines contains two integers  $u_i$  and  $v_i$  ( $1 \leq u_i, v_i \leq n, u_i \neq v_i$ ) — the edges of the graph  $G$ . It is guaranteed, that there are no multiple edges, that is any pair of vertexes appear in this list no more than once.

#### Output

In the first line print "Yes" (without the quotes), if the string  $S$  Petya is interested in really exists and "No" (without the quotes) otherwise.

If the string  $S$  exists, then print it on the second line of the output. The length of  $S$  must be exactly  $n$ , it must consist of only letters "a", "b" and "c" only, and the graph built using this string must coincide with  $G$ . If there are multiple possible answers, you may print any of them.

#### Examples

<b>input</b>
2 1 1 2
<b>output</b>
Yes aa

  

<b>input</b>
4 3 1 2 1 3 1 4
<b>output</b>
No

#### Note

In the first sample you are given a graph made of two vertices with an edge between them. So, these vertices can correspond to both the same and adjacent letters. Any of the following strings "aa", "ab", "ba", "bb", "bc", "cb", "cc" meets the graph's conditions.

In the second sample the first vertex is connected to all three other vertices, but these three vertices are not connected with each other. That means that they must correspond to distinct letters that are not adjacent, but that is impossible as there are only two such letters: a and c.

## B. Array GCD

time limit per test: 3 seconds  
memory limit per test: 256 megabytes  
input: standard input  
output: standard output

You are given array  $a_i$  of length  $n$ . You may consecutively apply two operations to this array:

- remove some subsegment (continuous subsequence) of length  $m < n$  and pay for it  $m \cdot a$  coins;
- change some elements of the array by at most  $1$ , and pay  $b$  coins for each change.

Please note that each of operations may be applied at most once (and may be not applied at all) so you can remove only one segment and each number may be changed (increased or decreased) by at most  $1$ . Also note, that you are not allowed to delete the whole array.

Your goal is to calculate the minimum number of coins that you need to spend in order to make the greatest common divisor of the elements of the resulting array be greater than  $1$ .

### Input

The first line of the input contains integers  $n, a$  and  $b$  ( $1 \leq n \leq 1\,000\,000, 0 \leq a, b \leq 10^9$ ) — the length of the array, the cost of removing a single element in the first operation and the cost of changing an element, respectively.

The second line contains  $n$  integers  $a_i$  ( $2 \leq a_i \leq 10^9$ ) — elements of the array.

### Output

Print a single number — the minimum cost of changes needed to obtain an array, such that the greatest common divisor of all its elements is greater than  $1$ .

### Examples

<b>input</b>
3 1 4 4 2 3
<b>output</b>
1

<b>input</b>
5 3 2 5 17 13 5 6
<b>output</b>
8

<b>input</b>
8 3 4 3 7 5 4 3 12 9 4
<b>output</b>
13

### Note

In the first sample the optimal way is to remove number  $3$  and pay  $1$  coin for it.

In the second sample you need to remove a segment  $[17, 13]$  and then decrease number  $6$ . The cost of these changes is equal to  $2 \cdot 3 + 2 = 8$  coins.

## C. Electric Charges

time limit per test: 2 seconds

memory limit per test: 256 megabytes

input: standard input

output: standard output

Programmer Sasha is a student at MIPT (Moscow Institute of Physics and Technology) and he needs to make a laboratory work to pass his finals.

A laboratory unit is a plane with standard coordinate axes marked on it. Physicists from Moscow Institute of Physics and Technology charged the axes by large electric charges: axis  $X$  is positive and axis  $Y$  is negative.

Experienced laboratory worker marked  $n$  points with integer coordinates  $(x_i, y_i)$  on the plane and stopped the time. Sasha should use "atomic tweezers" to place elementary particles in these points. He has an unlimited number of electrons (negatively charged elementary particles) and protons (positively charged elementary particles). He can put either an electron or a proton at each marked point. As soon as all marked points are filled with particles, laboratory worker will turn on the time again and the particles will come in motion and after some time they will stabilize in equilibrium. The objective of the laboratory work is to arrange the particles in such a way, that the diameter of the resulting state (the maximum distance between the pairs of points of the set) is as small as possible.

Since Sasha is a programmer, he naively thinks that all the particles will simply "fall" into their projections on the corresponding axes: electrons will fall on axis  $X$ , while protons will fall on axis  $Y$ . As we are programmers too, we will consider the same model as Sasha. That is, a **particle gets from point  $(x, y)$  to point  $(x, 0)$  if it is an electron and to point  $(0, y)$  if it is a proton.**

As the laboratory has high background radiation and Sasha takes care of his laptop, he did not take it with him, and now he can't write a program that computes the minimum possible diameter of the resulting set. Therefore, you will have to do it for him.

Print a **square** of the minimum possible diameter of the set.

### Input

The first line of the input contains a single integer  $n$  ( $1 \leq n \leq 100\,000$ ) — the number of points marked on the plane.

Each of the next  $n$  lines contains two integers  $x_i$  and  $y_i$  ( $-10^8 \leq x_i, y_i \leq 10^8$ ) — the coordinates of the  $i$ -th point. It is guaranteed that no two points coincide.

### Output

Print a single integer — the square of the minimum possible diameter of the set.

### Examples

input
3 1 10 1 20 1 30
output
0

  

input
2 1 10 10 1
output
2

### Note

In the first sample Sasha puts electrons at all points, all particles eventually fall at a single point  $(1, 0)$ .

In the second sample Sasha puts an electron at point  $(1, 10)$ , and a proton at point  $(10, 1)$ . The result is a set of two points  $(1, 0)$  and  $(0, 1)$ , which has a diameter of  $\sqrt{2}$ .

## D. Birthday

time limit per test: 2 seconds  
memory limit per test: 256 megabytes  
input: standard input  
output: standard output

A MIPT student named Misha has a birthday today, and he decided to celebrate it in his country house in suburban Moscow.  $n$  friends came by, and after a typical party they decided to play blind man's buff.

The birthday boy gets blindfolded and the other players scatter around the house. The game is played in several rounds. In each round, Misha catches exactly one of his friends and has to guess who it is. The probability of catching the  $i$ -th friend does not change between rounds and is equal to  $p_i$  percent (as we know, it is directly proportional to the amount of alcohol consumed by the  $i$ -th friend) and  $p_1 + p_2 + \dots + p_n = 100$  holds. Misha has no information about who he caught. After Misha makes an attempt to guess the caught person, the round ends. Even then, Misha isn't told whether he guessed correctly, and a new round begins.

The game ends when Misha guesses every friend at least once, that is, there exists such set of rounds  $k_1, k_2, \dots, k_n$ , that during round number  $k_i$  Misha caught the  $i$ -th friend and guessed him. Misha wants to minimize the expectation of the number of rounds of the game. Despite the fact that at any point in the game Misha has no information about who he has already guessed, his friends are honest, and if they see that the condition for the end of the game is fulfilled, the game ends immediately. Find the expectation of the number of rounds in the game if Misha plays optimally.

### Input

The first line of the input contains a single integer  $n$  ( $1 \leq n \leq 100$ ) — the number of Misha's friends.

The second line contains  $n$  integers  $p_i$  ( $p_i > 0, \sum_{i=1}^n p_i = 100$ ), giving the probability to catch the  $i$ -th friend in one particular round in percent.

### Output

Print a single real value — the expectation of the number of rounds provided that Misha plays optimally. Your answer will be considered correct if its absolute or relative error does not exceed  $10^{-6}$ .

Namely: let's assume that your answer is  $a$ , and the answer of the jury is  $b$ . The checker program will consider your answer correct, if  $\frac{|a-b|}{\max(1,b)} \leq 10^{-6}$ .

### Examples

input
2 50 50
output
5.0000000000

  

input
4 50 20 20 10
output
39.2846263444

### Note

The optimal strategy in the first sample is to guess friends alternately.

## E. Transforming Sequence

time limit per test: 7 seconds  
memory limit per test: 256 megabytes  
input: standard input  
output: standard output

Let's define the transformation  $P$  of a sequence of integers  $a_1, a_2, \dots, a_n$  as  $b_1, b_2, \dots, b_n$ , where  $b_i = a_1 \mid a_2 \mid \dots \mid a_i$  for all  $i = 1, 2, \dots, n$ , where  $\mid$  is the bitwise OR operation.

Vasya consequently applies the transformation  $P$  to all sequences of length  $n$  consisting of integers from  $1$  to  $2^k - 1$  inclusive. He wants to know how many of these sequences have such property that their transformation is a **strictly increasing** sequence. Help him to calculate this number modulo  $10^9 + 7$ .

### Input

The only line of the input contains two integers  $n$  and  $k$  ( $1 \leq n \leq 10^{18}$ ,  $1 \leq k \leq 30\,000$ ).

### Output

Print a single integer — the answer to the problem modulo  $10^9 + 7$ .

### Examples

<b>input</b>
1 2
<b>output</b>
3

  

<b>input</b>
2 3
<b>output</b>
30

  

<b>input</b>
3 3
<b>output</b>
48