Problem A. Inversion

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

You have a sequence $a_1, a_2, \ldots, a_n$. It is allowed to swap two **adjacent** numbers no more than k times.

Find the minimal number of inversions after the swaps (number of inversions is the number of pairs (i, j) where $1 \le i < j \le n$ and $a_i > a_j$).

Input

The first line of the input contains two integers n, k ($1 \le n \le 10^5, 0 \le k \le 10^9$). The second line contains n integers $a_1, a_2, \ldots, a_n$ ($0 \le a_i \le 10^9$).

Output

Print the minimum number of inversions.

Examples

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

Problem B. Paths on the Tree

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

You are given a tree with n vertices conveniently labeled with $1, 2, \ldots, n$.

You are also given m paths in the tree. You would like to select some of them so that no two selected paths share a common vertex.

Find the maximum number of paths you can pick.

Input

The first line of the input contains two integers n and m ($1 \le n, m \le 10^5$). Each of the following $(n-1)$ lines contains two integers a_i, b_i denoting an edge between vertices a_i and b_i ($1 \le a_i, b_i \le n$). Each of the following m lines contains two integers u_i and v_i denoting a path between vertices u_i and v_i ($1 \le u_i, v_i \le n$).

Output

Print a single integer — the maximum number of paths.

Examples

standard input	standard output
3 2 1 2 1 3 1 2 1 3	1
7 3 1 2 1 3 2 4 2 5 3 6 3 7 2 3 4 5 6 7	2

Problem C. Least Common Multiple

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

You are given an integer multiset $S = \{x_1, x_2, \ldots, x_n\}$, where $x_i = 2^{a_i} \cdot 3^{b_i}$.

Consider all $2^n - 1$ non-empty subsets of S. For each subset, find it's LCM (least common multiple) and output the sum of these values. As long as the answer can be very large, find the sum of LCM modulo $10^9 + 7$.

Input

The first line of the input contains an integer n ($1 \le n \le 10^5$). Each of the following n lines contains two integers a_i, b_i ($0 \le a_i, b_i \le 10^9$).

Output

Print one integer — answer to the problem.

Examples

standard input	standard output
2 0 1 1 0	11
3 1 2 2 1 1 2	174

Problem D. Linear Recursive Sequence

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

A well-known linear recursive sequence $f(n)$ is defined as follows:

- for $k \leq 0$, $f(k) = 1$;
- for $k \geq 1$, $f(k) = a \cdot f(k-p) + b \cdot f(k-q)$.

Given n, a, b, p, q, find the value of $f(n)$ modulo 119.

Input

First line of the input contains 5 integers n, a, b, p, q ($1 \leq n \leq 2 \cdot 10^9, 0 \leq a, b \leq 2 \cdot 10^9, 1 \leq p < q \leq 10^4$).

Output

Print the value of $f(n)$ modulo 119.

Examples

standard input	standard output
1 1 1 1 2	2
1000000000 1 2 3 4	100

Problem E. Parentheses Sequence

Input file:	*standard input*
Output file:	*standard output*
Time limit:	1 second
Memory limit:	512 mebibytes

Petya found an ancient string. The string contains only characters '(', ')' and '?'.

Petya would like to replace each '?' with '(' or ')' so that the string becomes valid (defined as follows).

- An empty string is valid.
- If S is valid, (S) is valid.
- If U, V are valid, UV is valid.

Check if the way of replacement can be uniquely determined.

Input

The input contains a string $s_1 s_2 \ldots s_n$ ($1 \le n \le 10^6$), consisting of '(', ')' and '?' only.

Output

If there is a unique way to obtain a valid string, print "Unique". If there is no way of replacement, print "None". Otherwise, print "Many".

Examples

standard input	standard output
??	Unique
????	Many
(??	None

Problem F. Count on the Path

Input file:	*standard input*
Output file:	*standard output*
Time limit:	5 seconds
Memory limit:	**128 mebibytes**

You are given a tree with n vertices conveniently labeled with $1, 2, \ldots, n$.

Let $f(a, b)$ be the minimum label of a vertex that is **not** on the path between vertices a and b.

You must answer q queries of the form (u_i, v_i) for the value of $f(u_i, v_i)$.

Input

The first line of the input contains two integers n and q ($4 \le n \le 10^6, 1 \le q \le 10^6$). Each of the following $(n-1)$ lines contains two integers a_i, b_i denoting an edge between vertices a_i and b_i ($1 \le a_i, b_i \le n$). Each of the following q lines contains 2 integers u'_i, v'_i ($1 \le u_i, v_i \le n$).

The queries are encrypted in the following manner.

- $u_1 = u'_1, v_1 = v'_1$.
- For $i \ge 2$, $u_i = u'_i \oplus f(u_{i-1}, v_{i-1}), v_i = v'_i \oplus f(u_{i-1}, v_{i-1})$.

Here $\oplus$ denotes bitwise exclusive-or.

It is guaranteed that $f(a, b)$ is defined for all a, b.

Output

For each query, print a single integer — an answer to this query.

Examples

standard input	standard output
4 1 1 2 1 3 1 4 2 3	4
5 2 1 2 1 3 2 4 2 5 1 2 7 6	3 1

Problem G. Permutation

Input file:	*standard input*
Output file:	*standard output*
Time limit:	1 second
Memory limit:	512 mebibytes

You are given a permutation $p_1, p_2, \ldots, p_n$ of $1, 2, \ldots, n$. You are also given m constraints of the form $p_{a_i} < p_{b_i}$. Find out the number of different permutations satisfying all the constraints.

It is guaranteed that there is at least one such permutation.

Input

The first line of the input contains n and m ($1 \le n \le 40, 0 \le m \le 20$). Each of the following m lines contains two integers a_i and b_i ($1 \le a_i, b_i \le n$).

Output

Print a single integer denoting the number of permutations modulo $10^9 + 7$.

Examples

standard input	standard output
3 1 1 2	3
3 2 1 2 2 3	1

Problem H. Queries on the Subtree

Input file:	*standard input*
Output file:	*standard output*
Time limit:	5 seconds
Memory limit:	512 mebibytes

You are given a tree with n vertices conveniently labeled with $1, 2, \ldots, n$. The vertex i is assigned with weight w_i.

You have to process q operations. Each operations has one of two types:

1. Change the weight of vertex v to x (denoted as "`!` v x").
2. Find out the total weight of vertices with distance less than or equal to d from vertex v (denoted as "`?` v d").

Note that the distance between vertices u and v is the number of edges in the shortest path between them.

You must answer the queries (operations of type 2) in order they are given in the input.

Input

The first line of the input contains n and q ($1 \le n, q \le 10^5$). The second line contains n integers $w_1, w_2, \ldots, w_n$ ($0 \le w_i \le 10^4$). Each of the following $(n-1)$ lines contains two integers a_i and b_i denoting an edge between vertices a_i and b_i ($1 \le a_i, b_i \le n$).

The following q lines contains the description of operations. Each operation is described in a separate line: the first character t is equal to '`!`' for the first type of operation and '`?`' for the second type of operation. Then follows v — the label of a vertex. Finally, the weight x is given for type 1 and the distance d is given for type 2 ($1 \le v \le n, 0 \le x \le 10^4, 0 \le d \le n$).

Output

For each query print a single integer — answer to this query.

Examples

standard input	standard output
4 3 1 1 1 1 1 2 2 3 3 4 ? 2 1 ! 1 0 ? 2 1	3 2
3 3 1 2 3 1 2 1 3 ? 1 0 ? 1 1 ? 1 2	1 6 6

Problem I. Exclusive Or

Input file:	*standard input*
Output file:	*standard output*
Time limit:	1 second
Memory limit:	512 mebibytes

Given n, find the value of

$$\sum_{i=1}^{n-1} i \oplus (n-i).$$

Here $\oplus$ denotes bitwise exclusive-or.

Input

The input consists of single integer n ($2 \le n < 10^{500}$).

Output

Print a single integer — the value of the sum.

Examples

standard input	standard output
3	6
4	4

Problem J. Expectation

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

Let's consider a random permutation $(p_1, p_2, \ldots, p_n)$ of numbers $1, 2, \ldots, n$. We are interested in the value $S = (X_2 + \cdots + X_{n-2})^k$ where

$$X_i = \begin{cases} 1 & \text{if } p_{i-1} < p_i > p_{i+1} \text{ or } p_{i-1} > p_i < p_{i+1} \\ 0 & \text{otherwise.} \end{cases}$$

You have to find the expected value of S as an irreducible fraction P/Q. Sure, P and Q can be quite large, so just find the value of $P \cdot Q^{-1}$ modulo 998244353.

Input

The first line of input contains two integers k and n ($1 \le k \le 30, 3 \le n \le 10^8$).

Output

Print a single integer — the value of $P \cdot Q^{-1}$ modulo 998244353.

Examples

standard input	standard output
1 6	665496238
2 11	232923720

Note

At the first sample expected value equals $8/3$ and $3^{-1} = 332748118$ modulo 998244353, so $8 \cdot 3^{-1} = 665496238$ modulo 998244353.

Problem K. Palindromic refrain

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

You are given a string of letters 'a' and 'b'. Let us define substring's "occurrence value" as the number of the substring occurrences in the string multiplied by the length of the substring. For a given string find the largest occurrence value of palindromic substrings.

Input

The only line of input contains a non-empty string of length n ($1 \le n \le 5\,000\,000$).

Output

Output one integer — the largest occurrence value of palindromic substrings.

Example

standard input	standard output
aaa	4