Problem A. Rikka with Game

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

Rikka and her classmates are playing an online game. There are n players in the game, and there are some pairs of friend relationships among players. The friend relationship is bidirectional.

At the beginning of the game, one player is selected as "dragon" randomly, and other players are marked as "hero".

The game proceeds in turns. Each turn contains the following three steps:

1. Each "hero" is asked to decide whether to attack the "dragon". Note that for each player, others' decisions are unknown when making this decision. If a "hero" is a friend of the "dragon", then this "hero" must choose not to attack;
2. If all the "hero"s choose not to attack the "dragon", the game ends immediately. Otherwise, the "dragon" is eliminated by "hero"s;
3. Suppose player i is the first "hero"(the player with the smallest index) who chooses to attack. Player i becomes a new "dragon" and then a new turn starts.

When the game ends, each alive "hero" will gain 10 points, the last "dragon" will get 100 points and each eliminated player will gain only 1 point.

All players want to maximize his/her points, and suppose all players are clever enough.

For each player, Rikka wants you to determine: If this player is selected as the "dragon" at the beginning, whether the game will end immediately in the first turn?

Input

The first line contains a single integer n ($1 \le n \le 500$), representing the number of players.

Then n lines follow. Each line contains an 01-string s_i of length n. $s_{i,j} = 1$ if and only if player i and player j are friends.

The input guarantees that $s_{i,j} = s_{j,i}$ and $s_{i,i} = 0$.

Output

Output a single line with a 01-string res of length n. $res_i = 1$ if and only if the game will end immediately in the first turn if player i is selected as the first "dragon".

Examples

standard input	standard output
2 00 00	00
3 000 000 000	111
4 0111 1000 1000 1000	1111
4 0101 1010 0101 1010	0000

Note

For the first sample, whatever which player is selected, the other player will choose to attack: He/she will get 100 points if he chooses to attack, otherwise, he/she can get only 10 points. Therefore, the game continues to the second turn.

For the second sample, without loss of the generality, suppose the third player is selected as the first "dragon". Then:

- For the first player, if he/she chooses to attack, he/she will become the "dragon" of the second turn. However, according to the first sample, he/she will then be eliminated and will get only 1 point. Therefore, he/she will choose not to attack and thus he/she can get 10 points;
- For the second player, for the same reason, he/she will choose not to attack, too.

Therefore, the game will end in the first turn.

Problem B. Rikka with Maximum Subsegment Sum

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

Maximum Subsegment Sum is a classical problem. When Rikka first saw this problem, she was still an outsider of competitive programming, and now, she has become a problem setter of this grand event.

Therefore, Rikka decides to set a problem about Maximum Subsegment Sum. Given an array x of length m, its maximum subsegment sum $\text{mss}(A)$ is defined as:

$$\text{mss}(A) = \max_{1 \le i \le j \le m} \left(\sum_{k=i}^{j} x_k \right).$$

Now, given an integer array A of length n, Rikka wants you to calculate the sum of the maximum subsegment sums of all subsegments of A, i.e.

$$\sum_{1 \le i \le j \le n} \text{mss}([A_i, \dots, A_j]).$$

Input

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

The second line contains n integers A_i ($-10^9 \le A_i \le 10^9$).

Output

Output a single line with a single integer, the answer. The answer can be very large, therefore, you are only required to output the answer modulo 2^{64}.

More formally, suppose the answer is x, you are required to find the smallest non-negative integer y satisfying $y = x + k \times 2^{64}$ for some integer k.

Examples

standard input	standard output
5 1 -1 1 -1 1	11
5 1 -2 3 -4 5	39
10 1 -3 -5 7 -9 10 8 -6 -4 2	555
4 -1 -2 -3 -4	18446744073709551596

Problem C. Rikka with Random Tree

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

Generating tests is always a boring and error-prone task for problem setters.

Recently, Rikka set a problem on trees, and now, she wants to generate some tests for this problem. At this time, Rikka tries an unusual way to generate trees. To generate a tree of size n:

1. Rikka sets vertex 1 as the root;
2. For the i-th ($i > 1$) vertex, let $a_1, \dots, a_k$ be all factors of i where $a_1 = 1, a_k = i$. Rikka uniformly randoms an integer j from $[1, k-1]$, and sets vertex a_j as the father of vertex i.

Clearly, the result of this process must be a valid tree.

Now, Rikka wants to verify whether the generated tests are strong enough. For a tree T of size n, she defines its complexity $c(T)$ as :

$$c(T) = \sum_{i=1}^{n} \sum_{j=1}^{n} \text{dis}(T, i, j)$$

where $\text{dis}(T, i, j)$ is the number of edges in the path from vertex i to vertex j on tree T.

Rikka wants you to calculate the expectation of $c(T)$.

Input

The first line contains two integers n, p ($1 \le n \le 3 \times 10^5, 10^8 \le p \le 10^9$).

The input guarantees that p is a prime number.

Output

Output a single line with a single integer, the answer module p. Formally, if the simplest fraction representation of the answer is $\frac{x}{y}$, you need to output $x \times y^{p-2} \bmod p$.

Examples

standard input	standard output
3 998244353	8
4 998244353	19
100 998244353	928958194

Note

For the first sample, there is only one possible result, of which the complexity is equal to 8.

For the second sample, there are two possible results, corresponding to the cases when the father of vertex 4 is vertex 1 or vertex 2. The complexities of these two cases are 18 and 20 respectively.

Problem D. Rikka with New Year's Party

Input file:	`standard input`
Output file:	`standard output`
Time limit:	3 seconds
Memory limit:	512 megabytes

Rikka is now organizing a new year's party for the algorithm association. She has invited n actors from 26 different groups, represented by lowercase letters. Rikka wants to select some actors among them for the opening show.

Now, the n actors are in a row. The i-th actor is from the s_i-th group. Rikka decides to choose a non-empty range $[l, r]$ $(1 \leq l \leq r \leq n)$ and lets all actors in this range join in the opening show.

Rikka has prepared 26 different actions. Suppose the range $[l, r]$ has been determined, the opening show will proceed in the following way:

- The actors will play in order. The l-th actor will play at first and the r-th will play at last;
- Suppose now the i-th player is going to play. He/she will decide his/her action in the following way: If there is a player j which plays before him/her and is also from group s_i, the i-th player will choose the same action as the player j. Otherwise, he/she will choose the first action (the action with the smallest index) which has not been chosen by anyone before.

For example, if 5 players from groups "abacb" are selected, they will chose actions $1, 2, 1, 3, 2$ respectively.

Rikka finds that different ranges may sometimes result in the same show. For example, if there are 6 players and they are from "abacbc" respectively, range $[1, 3]$ and $[4, 6]$ will result in the same show.

Given string s, Rikka wants you to calculate the number of different possible shows.

- Two shows are different if and only if they contain different numbers of actions or there exists an index i such that the i-th actions of these two shows are different;
- A show is possible if and only if it can be produced by some range $[l, r]$ of s.

Input

The first line contains a single integer n $(1 \leq n \leq 10^5)$, the number of actors.

The second line contains a lowercase string s of length n. s_i represents the group of the i-th actor.

Output

Output a single line with a single integer, the number of different possible shows.

Examples

standard input	standard output
5 ababc	7
6 abacbc	10
11 ababcdcefef	33

Note

For the first sample, there are 7 different possible shows:

1. Action 1, corresponding to range $[1, 1]$, $[2, 2]$, $[3, 3]$, $[4, 4]$, $[5, 5]$;
2. Actions $1, 2$, corresponding to range $[1, 2]$, $[2, 3]$, $[3, 4]$, $[4, 5]$;
3. Actions $1, 2, 1$, corresponding to range $[1, 3]$, $[2, 4]$;
4. Actions $1, 2, 3$, corresponding to range $[3, 5]$;
5. Actions $1, 2, 1, 2$, corresponding to range $[1, 4]$;
6. Actions $1, 2, 1, 3$, corresponding to range $[2, 5]$;
7. Actions $1, 2, 1, 2, 3$, corresponding to range $[1, 5]$.

Problem E. Rikka with Subsequence

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

As we all know, Rikka is not good at math. Yuta, her boyfriend, is worried about it. Therefore, he sets an interesting math problem For Rikka to practice.

Given a non-negative integer x, Rikka is required to find three non-negative integers a, b, c that satisfy the following three conditions:

1. $a + b = x$;
2. $\text{str}(c)$ is a subsequence of str(a);
3. $\text{str}(c)$ is a subsequence of str(b).

$\text{str}(d)$ represents the decimal string representation of integer d. For example, $\text{str}(0) =$"0", $\text{str}(103) =$"103".

String $s = s_1 \dots s_n$ is a subsequence of string $t = t_1 \dots t_m$ if and only if there exists an index sequence $1 \le i_1 < i_2 < \dots < i_n \le m$ satisfying $\forall j \in [1, n], s_j = t_{i_j}$.

To avoid the case of no solution, Yuta assumes there is a special choice "$-$" for c where $\text{str}(-)$ is equal to the empty string. Under this assumption, $a = 0, b = 9, c = -$ becomes a valid solution of $x = 9$.

Finding a valid solution is an easy task even for Rikka. Therefore, Rikka wants to increase the difficulty: Rikka wants you to find a valid solution (a, b, c) so that the length of $\text{str}(c)$ is as large as possible.

Input

The first line contains a single integer T $(1 \le T \le 10^4)$, representing the number of test cases.

For each test case, the first line contains a single integer x $(|\text{str}(x)| \le 5000)$.

The input guarantees that $\sum |\text{str}(x)| \le 10^5$.

Output

For each test case, output three lines, each with a single integer, representing a, b, c respectively.

If there are multiple optimal solutions, you need only to output any of them.

Example

standard input	standard output
3 2290283839620 1 9999999	1145141919810 1145141919810 1145141919810 0 1 - 4545454 5454545 454545

Problem F. Rikka with Lake

Input file:	`standard input`
Output file:	`standard output`
Time limit:	4 seconds
Memory limit:	512 megabytes

Thanks to Peanut and LGD, Rikka won a lot of money during S10. Rikka wants to use the money to buy a piece of land and builds a manor on it.

The map can be regarded as a two-dimensional Cartesian coordinate system. Rikka decides to build her bedroom on point $(0, 0)$. There is a lake on the map, of which the shape is a simple polygon. Of course, point $(0, 0)$ is outside the lake.

Rikka loves running. On each morning, starting from her bedroom, Rikka would firstly run away for k unit of distance and then run back. Therefore, Rikka wishes her manor could be large enough so that no matter how Rikka plans her path, she will always run inside her manor. Note that Rikka will only run on the land since she cannot swim.

Rikka is not a wasteful girl: Rikka wants her manor to be as small as possible. Therefore, she wants you to calculate the minimum possible area of her manor.

Input

The first line contains two integers n, k ($3 \leq n \leq 50, 1 \leq k \leq 3000$), representing the number of vertices of the lake and the distance Rikka can run.

Then n lines follow. Each line contains two integers x_i, y_i ($|x_i|, |y_i| \leq 200$), representing the coordinates of vertices on the polygon. These vertices are given in clockwise order.

The input guarantees that point $(0, 0)$ is not strictly inside the polygon, and no three continuous vertices of the polygon are on the same line.

Output

Output a single line with a single real number, the minimum possible area of Rikka's manor.

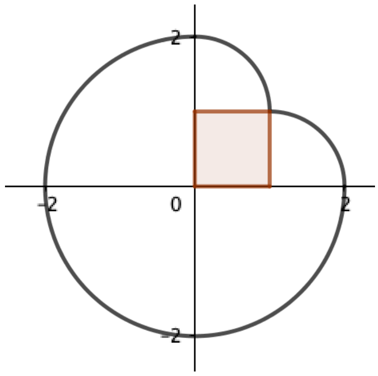
Your answer should have an absolute error or relative error of less than 10^{-6}.

Examples

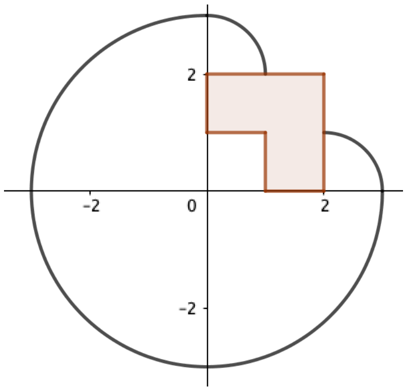
standard input	standard output
4 2 0 0 0 1 1 1 1 0	10.995574287564
6 3 1 0 1 1 0 1 0 2 2 2 2 0	23.776546738526

Note

For the first sample, the minimum possible area of Rikka's minor is $\frac{7}{2}\pi$. One possible plan is shown in the following figure.



For the second sample, the minimum possible area of Rikka's minor is $\frac{29}{4}\pi + 1$. One possible plan is shown in the following figure.



Problem G. Rikka with Game Theory

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

Game theory is an interesting subject in computer science.

SG function is an important concept in game theory. Given a directed acyclic graph G_1 with vertex set V_1 and directed edge set E_1, for each vertex $u \in V_1$, its SG function $sg(u)$ is defined as:

$$sg(u) = \mathrm{mex}(\{sg(v) | (u, v) \in E_1\})$$

where given a set S of non-negative integers, $\mathrm{mex}(S)$ is defined as the smallest non-negative integer which is not in S.

Today, Rikka wants to generalize SG function to undirected graphs. Given an undirected graph G with vertex set V and undirected edge set E, a function f over V is a valid SG function on G if and only if:

- For each vertex $u \in V$, $f(u)$ is a non-negative integer;
- For each vertex $u \in V$, $f(u) = \mathrm{mex}(\{f(v) | (u, v) \in E\})$.

Under this definition, there may be many valid SG functions for a graph. Therefore, Rikka wants to further figure out whether there is a connection between these valid SG functions. As the first step, your task is to calculate the number of valid SG functions for a given undirected graph G.

Input

The first line contains two integers n, m $(1 \le n \le 17, 0 \le m \le \frac{n(n-1)}{2})$, representing the number of vertices and edges in the graph.

Then m lines follow. Each line contains two integers u_i, v_i $(1 \le u_i, v_i \le n)$, representing an edge in the graph.

The input guarantees that there are no self-loops and duplicate edges in the graph.

Output

Output a single line with a single integer, representing the number of valid SG functions.

Example

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

Note

For simplicity, we use list $[f(1), \ldots, f(n)]$ to represent a function f.

For the sample input, there are 6 valid SG functions:

- $[0, 1, 0, 1, 0]$, $[0, 1, 2, 0, 1]$, $[0, 2, 1, 0, 1]$, $[1, 0, 1, 0, 1]$, $[1, 0, 1, 2, 0]$ and $[1, 0, 2, 1, 0]$.

Problem H. Rikka with Storehouse

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

On activities held by Algorithm Association, lemon teas are provided to the participants almost infinitely. To store such a large number of lemon teas, Rikka wants to build some storehouses.

Rikka plans to build $N = 2^n - 1$ storehouses, together with $N - 1$ bidirectional roads. The i-th road connects the $(i+1)$-th storehouse and the $\lceil \frac{i}{2} \rceil$-th storehouse.

These storehouses will be built on an uneven piece of land. For each $i \in [\lceil \frac{N}{2} \rceil, N]$, the altitude of the i-th storehouse is known to be a_i. Rikka can choose the altitudes for other storehouses arbitrarily. (The value of altitude can be any real number).

Carrying lemon teas on a steep hill is difficult. Rikka wants to make the road system as convenient as possible. Therefore, Rikka wants to minimize the square sum of the altitude difference of each road, i.e.

$$ans = \min_{a_1,\ldots,a_{\lfloor \frac{N}{2} \rfloor} \in \mathbb{R}} \sum_{i=1}^{N-1} \left(a_{i+1} - a_{\lceil \frac{i}{2} \rceil}\right)^2$$

Due to the geological movement, the altitude of the last $\lceil \frac{N}{2} \rceil$ storehouses often changes. Lucky, it is free for Rikka to change the altitude of the first $\lfloor \frac{N}{2} \rfloor$ storehouses at any time.

Your task is to help Rikka to find out the optimal plan after each change.

Input

The first line contains two integers n, m $(2 \le n \le 18, 0 \le m \le 2 \times 10^5)$.

The second line contains $\lceil \frac{N}{2} \rceil$ integers h_i $(1 \le h_i \le 10^8)$, representing $a_{\lceil \frac{N}{2} \rceil}, \ldots, a_N$ in order, where $N = 2^n - 1$.

Then m lines follow, each line with two integers x_i, w_i $(\lceil \frac{N}{2} \rceil \le x_i \le n, 1 \le w_i \le 10^8)$, representing the altitude of the x_i-th storehouse is changed to w_i during the i-th movement.

Output

Output $m + 1$ lines, each with a single number: the initial value of ans followed by the value of ans after each movement.

Writing a special judge is a tiring task. Therefore, you are required to output the answer module 998244353. Formally, if the simplest fraction representation of ans is $\frac{x}{y}$, you need to output $x \times y^{998244351} \bmod 998244353$.

Examples

standard input	standard output
2 0 1 3	2
3 3 1 2 3 4 6 4 5 4 4 4	332748120 83187032 748683270 0

Note

For the first sample, one optimal solution is $a_1 = 2$ and the value of ans is $(2-1)^2 + (2-3)^2 = 2$.

Problem I. Rikka with RCPC

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

Rikka is going to hold a worldwide competition, RCPC (Rikka's collegiate programming contest).

Preparing for a contest is time-consuming: It will take Rikka n days. Meanwhile, there are so many questions in the official QQ group of RCPC, raised by contestants, coaches, and even melon eating people. Therefore, Rikka decides to ignore the QQ group on some of the n days.

However, always ignoring questions may make contestants angry. Before the start of Day 1, the angry value A of contestants is 0. At the beginning of the i-th day, the angry value will be increased by a_i. Then:

- If A is strictly larger than a threshold T, contestants will be extremely angry, and Rikka will receive $2A$ points of attack. Then, at the end of this day, A will be cleared to 0;
- If A is no larger than T and Rikka chooses to ignore questions, nothing will happen on this day;
- If A is no larger than T and Rikka decides to answer questions, meanwhile, if Rikka ignores all questions on previous K days, i.e. from Day $i - K$ to Day $i - 1$, contestants will feel the hardness of Rikka. Rikka will not receive any attack, and at the end of this day, A will be cleared to 0;
- Otherwise, even though Rikka chooses to answer questions, contestants will still blame Rikka for answering questions so slowly, and Rikka will receive A points of attack. At the end of this day, A will be cleared to 0.

Your task is to help Rikka to decide which days to answer questions so that the total attacks she received is minimized.

Input

The first line contains three integers n, K $(1 \le K < n \le 2 \times 10^5)$ and T $(1 \le T \le 10^9)$.

The second line contains n integers a_i $(1 \le a_i \le T)$.

Output

Output a single integer, the answer.

Examples

standard input	standard output
4 1 5 3 1 4 2	3
10 2 7 2 7 4 4 1 5 6 7 3 1	36

Note

For the first sample, one optimal plan is to answer questions on Day 1 and Day 3:

- On Day 1, the angry value is 3, and thus Rikka will receive 3 points of attacks.
- On Day 2, the angry value is 1, and thus nothing will happen;
- On Day 3, the angry value is 5. Since Rikka does not answer the questions on Day 2, contestants will feel the hardness of Rikka, and thus nothing will happen;
- On Day 4, the angry value is 2, and thus nothing will happen.

Problem J. Rikka with Book

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

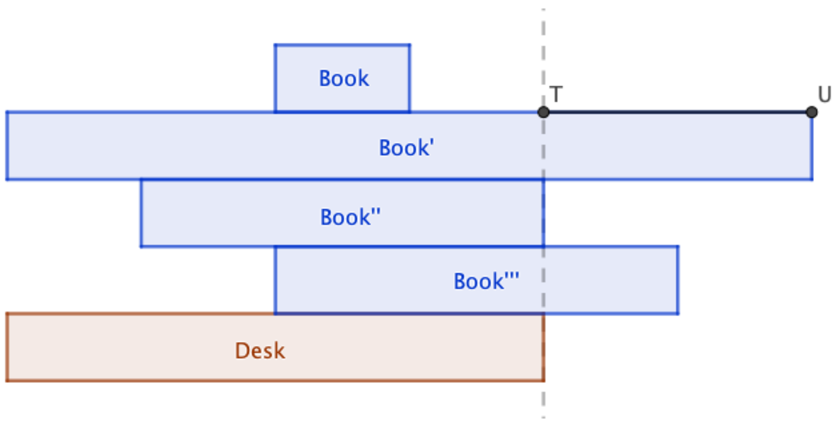
There are n books on Rikka's desk. The length, width, height and weight of the i-th book are l_i, 1, 1 and w_i respectively. We call the two sides of length l_i as long sides and two sides of length 1 as short sides. For each book, the mass is evenly distributed in its volume.

Today, Rikka wants to stack these books on her desk. Rikka plans to do it in n turns: In each turn, she will select out one book among all remaining books, and stack it directly above the previous book (The first book will be put directly on the desk).

For tidiness, Rikka makes the following four requirements:

- The left long sides of all books must be coplanar. So do the right long sides;
- The plane containing all left long sides must be vertical to the ground. So do the right long sides;
- All short sides of all books must be parallel to the border of the desk;
- The final book stack must be stable. Falling thick books are dangerous!

Informally, the books will be stacked as the following figure:



For fun, Rikka wants to make the book stack looking as strange as possible. For each book, Rikka defines its strangeness as the horizontal distance for its front short edge to be outside the desk. The strangeness of the whole book stack is defined as the maximum strangeness of books. For example, in the previous figure, the strangeness of the book stack is equal to the length of segment TU.

Rikka wants you to come up with a stacking plan so that the strangeness of the book stack is as large as possible.

More assumptions:

- Suppose the gravity coefficient is fixed. It will not change when the height change;
- Suppose the shape of the desk and books would never change.

Input

The first line contains a single integer n ($1 \le n \le 20$), the number of books.

The second line contains n integers l_i ($1 \le l_i \le 10^3$), representing the length of each book.

The third line contains n integers w_i ($1 \le w_i \le 10^3$), representing the weight of each book.

Output

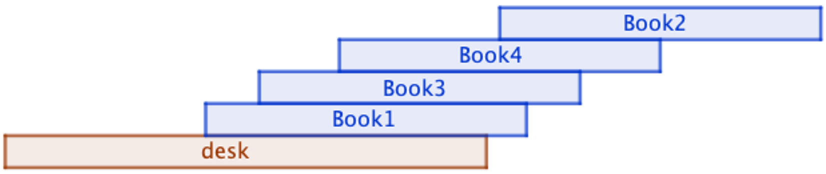
Output a single line with a single real number, representing the maximum possible strangeness value. Your answer should have an absolute error or relative error of less than 10^{-9}.

Examples

standard input	standard output
4 2 2 2 2 1 1 1 1	2.08333333333
3 1 2 3 3 2 1	2.95833333333

Note

For the first sample, one optimal plan is shown in the following figure.



Here the strangeness of book $1, 2, 3, 4$ is $\frac{1}{4}, \frac{25}{12}, \frac{7}{12}, \frac{13}{12}$ respectively. Therefore, the strangeness of the book stack is $\frac{25}{12}$.

Problem K. Rikka with Composite Number

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

Rikka is a professional problem setter. Today, she is going to generate test cases for a problem about Composite Number.

To randomly generate composite numbers, Rikka starts from a non-empty subset D of digits $\{1, 2, \dots, 9\}$ and integer $c = 0$, and then generates in turns. In each turn:

1. Rikka selects a digit d from D uniformly at random, and then changes c to $c \times 10 + d$;
2. If c has already been a composite integer, Rikka takes c as the result. Otherwise, Rikka returns to Step 1 and starts a new turn.

The time cost of a generator is crucial. Therefore, Rikka wants you to calculate the expected number of the turns used by the generator to generate a composite number.

A positive integer n is a composite integer if and only if there exists an integer $k \in [2, n-1]$ satisfying k is a factor of n.

Input

The first line contains a 01-string of length 9. The i-th character is 1 if and only if digit i is inside D.

The input guarantees that D is not empty.

Output

Output a single integer, representing the expected number of turns.

The answer is guaranteed to be a rational number. You are required to output the answer module 998244353. Formally, if the simplest fraction representation of the answer is $\frac{x}{y}$, you need to output $x \times y^{998244351} \bmod 998244353$.

Examples

standard input	standard output
`100000000`	`3`
`001100000`	`499122178`

Note

For the first sample, the generator must return 111 in the third turn.

For the second sample, there are 3 possibilities:

- Return 4 in the first turn, with probability $\frac{1}{2}$;
- Return 33 in the second turn, with probability $\frac{1}{4}$;
- Return 34 in the second turn, with probability $\frac{1}{4}$.

Therefore, the expected number of turns is $\frac{3}{2}$.

Problem L. Rikka with Generals

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

Today, Rikka is playing a strategic game. She has finished the first stage of the game: She has already established her own country.

Rikka owns n cities, connected by $n-1$ bidirectional roads. Any two cities are reachable through the roads. Rikka decides to award these cities to n loyal generals. These generals are labeled from 1 to n according to the increasing order of their contributions. Initially, Rikka decides to award the i-th city to the p_i-th general, where $p_1, p_2, \dots, p_n$ is a permutation of length n.

Then, Rikka summons all the generals and shows them the initial plan. Generals are allowed to exchange their cities under two restrictions. General u with city a can change his/her city with general v with city b if and only if:

- The contributions of general u and general v are close, i.e. $|u-v|$ should be equal to 1;
- The geometric positions of city a and city b are close, i.e. there should be a road between city a and city b.

During the exchange process, one general is allowed to change his/her city many times, and also, one city may be exchanged among many generals.

Not surprised, a quarrel broke out between the generals. It seems that it will take a long time to determine the ownership of the cities. All these things make Rikka bored. To make fun, Rikka wants you to calculate the number of possible award plans.

Input

The first line contains a single integer t ($1 \le t \le 2 \times 10^5$), representing the number of test cases.

For each test case, the first line contains a single integer n ($1 \le n \le 2 \times 10^5$), representing the number of cities.

Then $n-1$ lines follow, each line with two integers u, v ($1 \le u, v \le n$), representing a road between city u and city v.

The last line contains n integers p_i ($1 \le p_i \le n$), representing the initial award plan.

The input guarantees that $p_1, p_2, \dots, p_n$ is a permutation of length n, and $\sum n \le 2 \times 10^5$.

Output

For each test case, output a single line with a single integer, the number of possible award plans. The answer may be very large, you are only required to output the answer module 998244353.

Example

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

Note

For simplicity, we use $[a_1, \ldots, a_n]$ to represent an award plan, where a_i represents the city of the i-th general. There are 7 possible award plans:

- $[2, 1, 5, 4, 3]$, without any exchange;
- $[1, 2, 5, 4, 3]$, achieved by exchanging between General $(1, 2)$;
- $[2, 1, 5, 3, 4]$, achieved by exchanging between General $(4, 5)$;
- $[1, 2, 5, 3, 4]$, achieved by exchanging between General $(4, 5)$, $(1, 2)$ in order;
- $[2, 1, 3, 5, 4]$, achieved by exchanging between General $(4, 5)$, $(3, 4)$ in order;
- $[1, 2, 3, 5, 4]$, achieved by exchanging between General $(4, 5)$, $(3, 4)$, $(1, 2)$ in order;
- $[2, 3, 1, 5, 4]$, achieved by exchanging between General $(4, 5)$, $(3, 4)$, $(2, 3)$ in order.

Problem M. Rikka with Employees

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

Recently, Rikka became the boss of a big company. There are n employees in Rikka's company, indexed from 1 to n. Employee 1 is Rikka herself.

Each employee except Rikka has a direct supervisor. The direct supervisor of the i-th employee is the p_i-th employee. The supervision relationship constitutes a tree. Employee u is a subordinate of Employee v if and only if v is the direct supervisor or an indirect supervisor of u.

To encourage employees, Rikka decides to let each employee experience the feeling of being the boss. To achieve this, Rikka will give some employees a holiday. For an employee, he/she will feel like the boss only when the following three conditions are satisfied:

- He/she is at work;
- All his/her subordinates are at work;
- All employees except he/she and his/her subordinates are on holiday.

Now, Rikka is going to make a plan. In the beginning, all employees are at work. In each day, Rikka can make one of the following actions:

- Choose an index i and give the i-th employee a holiday. This action can be taken only when i is on work;
- Recall an employee which is on holiday. If there are multiple employees which are on holiday, the employee with the shortest holiday will be back. Since the longer the holiday is, the farther the employee will be from the company, and thus the harder recalling he/she will be. Note that this action can be taken only when there is at least one on-holiday employee;
- Choose an index i and interview him the feeling of being the boss. This action can be taken only when i is feeling like the boss at this time.

Rikka wants you to make a plan. Since it is expensive to give employees holidays, you are required to make every employee feel like the boss and interview them within 9×10^6 days.

Input

The first line contains a single integer n ($1 \leq n \leq 10^5$), the number of employees.

The second line contains $n-1$ integers $p_2, \ldots, p_n$ ($1 \leq p_i < i$), representing the direct supervisor of each employee.

Output

Output a single line with a single string. From left to right:

- Substring "$+x$" represents to give the x-th employee a holiday;
- Substring "$-$" represents to recall an employee;
- Substring "$=x$" represents to interview the x-th employee.

Besides, Substring "!" represents that all actions are finished. Any characters after "!" will be ignored.

Your answer will be regarded as correct if and only if the following three conditions are satisfied:

- The number of actions is no more than 9×10^6;
- All actions are valid;
- For each $x \in [1, n]$, "$=x$" is invoked exactly once.

Example

standard input	standard output
6 1 1 2 3 3	=1+1+3+5+6=2+2=4----+4+2=3+3+6=5-+5=6!