Problem A. Art calss

Input file:	`standard input`
Output file:	`standard output`
Time limit:	4 seconds
Memory limit:	256 megabytes

This class is on art. Mr. Picasso gives every baby a piece of white drawing paper and let them paint on it.

Baby Volcano is going to color the drawing paper black. For convenience, the drawing paper can be regarded as a Cartesian coordinate system, and initially, all points on it is white.

Baby Volcano plans to paint the drawing paper in n steps. In the ith step, he will color rectangular R_i black, where the lower left corner of R_i is $(l_i, 0)$, the upper right corner of R_i is (r_i, h_i).

Let P_i be the drawing paper after the first i steps, your task is to calculate the perimeter of black area on P_i.

Input

The first line contains a single integer $t (1 \leq t \leq 100)$, the number of testcases.

For each testcase, the first line contains a single integer $n (1 \leq n \leq 2 \times 10^5)$, the number of steps.

Then n lines follow. Each line contains 3 integers $l_i, r_i, h_i (1 \leq l_i, < r_i \leq 10^9, 1 \leq h_i \leq 10^9)$.

The input guarantees that there are no more than 3 testcases with $n > 1000$.

Output

For each testcase, output n lines. Each line contains a single integer, representing the perimeter of black area after the first i steps.

Example

`standard input`	`standard output`

`1`
`6`
`1 2 2`
`3 4 3`
`5 6 2`
`1 4 1`
`2 6 1`
`3 7 4`
	`6`
	`14`
	`20`
	`20`
	`20`
	`22`

Problem B. Graph Theory Class

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

This class is on graph theory. Mr. Kruskal teaches babies the concept of minimal spanning tree, and how to calculate the minimal spanning tree of a given graph.

Now, it's time for an in-class quizz. Mr. Kruskal shows a special graph G: G is a complete undirected graph with n vertices, and vertices in G are indexed from 1 to n. The weight of the edge between the ith vertex and the jth vertex is equal to $lcm(i+1, j+1)$. Babies are asked to find the minimal spanning tree of G.

As a super baby, Baby Volcano quickly finds an answer, but he is not sure on the correctness of his answer. Your task is to tell Baby Volcano the weight sum of all edges on the minimal spanning tree, so that he could verify his answer.

Given two positive integers, $lcm(i, j)$ is defined as the minimal positive integer k satisfying both i and j are factors of k.

Input

The first line contains a single integer $t (1 \leq t \leq 50)$, the number of testcases.

For each testcase, the first line contains two integers $n, K (1 \leq n \leq 10^{10}, 10^8 \leq K \leq 10^9)$.

The input guarantees that K is a prime number.

The input guarantees that there are no more than 5 testcases with $n > 10^9$.

Output

For each testcase, output a single line with a single integer, the answer module K.

Example

standard input	standard output

3
3 998244353
100 998244353
1000000000 998244353
	10
	6307
	192026508

Problem C. Express Mail Taking

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1.5 seconds
Memory limit:	256 megabytes

Besides on the traditional classes,Baby Volcano also needs to learn how to take the express mails.

Usually express mails are stored in cabinets. In Baby Volcano's school,there are n cabinets in a row,numbered by 1 to n. The distance between two adjacent cabinets is 1, and the entrance is at the cabinet 1. Among all n cabinets,the one numbered k is special and it is used to enter the code and open the cabinet door.

Baby Volcano has m express mails to take,the i-th is in the cabinet a_i. Two express mails will not be stored in the same cabinet. Also there is no express mail in the cabinet k.

To prevent expresses from being stolen, Baby Volcano have to take these express mails one by one, starting at the entrance. Generally, if he wants to take the express mail i, he have to walk to cabinet k first to enter the code, and then walks to cabinet a_i. After taking the last one,he walks to the entrance.

There are so many express mails to take, so Baby Volcano wants to find a taking order which minimize the distance he walks.

Input

The first line contains one integer $T(1 \leq T \leq 100)$,the number of testcases.

For each test cases,the first line contains three integer $n, m, k(1 \leq k \leq n \leq 10^9, 1 \leq m < \min(n, 10^6))$

The next line contains m integer,the i-th stand for $a_i(1 \leq a_i \leq n, a_i \neq k)$.

The input guarantees that $\sum m \leq 2 \times 10^6$

Output

For each test case,Output a single line contains one integer,representing for the minimal walking distance.

Example

standard input	standard output

2
10 2 5
6 7
10 2 5
3 4
	14
	10

Note

Because of the large input,it is prefered to use `scanf` instead of `cin`

Problem D. Chess Class

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

This class is on chess. Baby Volcano is playing a special chess game with his friend, Baby Evil.

In this chess game, there is a directed graph $G = (V, E)$. Vertices are indexed from 1 to n. It is guaranteed that every vertex has at least one out-going edge, i.e. $\forall v \in V, \exists w \in V, (v, w) \in E$, Baby Volcano takes control of a subset of vertices $X \subseteq V$, Baby Evil takes control of $V \setminus X$. Every vertex v is assigned a weight $W(v)$.

There is a chess, positioning at $s \in V$ initially. The game consists of three phases.

1. For every $p \in X$, Baby Volcano chooses an out-going edge $(p, q) \in E$ and delete other out-going edges of vertex p.
2. After Volcano's operation, Baby Evil would similarly choose an out-going edge $(p', q') \in E$ and delete other out-going edges of p' for every $p' \notin X$. Both two babies make decisions based on chess's initial position s.
3. After two processes above, every vertex would remain only one out-going edge. The chess starts moving along the unique path in the processed graph, resulting in an infinite path $L = v_0 v_1 v_2 \cdots$, where $v_0 = s$. Baby Volcano gains score CV at last, which is computed below:

$$CV := \max \{W(v_i) \mid v_i \text{ appears in } L\}$$

Baby Volcano wants to maximize CV, while Baby Evil wants to minimize it.

Your task is to determine, for every $s, 1 \le s \le n$, you need to compute CV under the circumstance that the chess is put at s initially.

Input

In the first line there is a number T, denotes the number of test cases.

Then there are T parts of input, each part describes a test case. Each parts begins with n, m, R, B, denotes the number of vertices, edges, the range of $W(v)$, and the size of X, the set which baby volcano takes control.

Then there is a line consists of B numbers, denotes elements in X.

Then there is a line with n numbers, the i-th number, denotes $W(i), 1 \le W(i) \le R$.

Then there are m lines, each line consists of 2 numbers, u, v, showing that there is an edge from u to v in G.

$1 \le T \le 100$

$1 \le m, R \le 5 \times 10^5$

$1 \le B \le n \le 5 \times 10^5$

$1 \le \sum n, \sum m, \sum R \le 10^6$

Output

For each test case, you should first output `Case #t:`, denotes the test number.

Then you need to output n numbers, the i-th number is CV under the circumstance that the chess is put at i initially.

Example

standard input	standard output

2
3 3 2 1
3
1 1 2
1 2
2 3
3 3
4 6 10 1
4
8 7 3 2
1 3
2 4
3 2
4 2
2 1
2 2
	Case #1:
	2 2 2
	Case #2:
	8 7 7 7

Problem E. Lunch

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

Now it's time for lunch. Today's menu is chocolate!

Though every baby likes chocolate, the appetites of babies are little. After lunch, there are still n pieces of chocolate remained: The length of the ith piece is l_i.

Using the remained chocolate, Baby Volcano is going to play a game with his teacher, Mr. Sprague. The rule of the game is quite simple.

Two player plays in turns, and Baby Volcano will play first:

- In each turn, the player needs to select one piece of chocolate. If the length of the selected piece is equal to 1, the player of this turn will loose immediately.
- Suppose the length of the selected piece is l. Then the player needs to select a positive integer k satisfying k is at least 2 and k is a factor of l.
- Then the player needs to cut the selected piece into k pieces with length $\frac{l}{k}$.

The game continues until one player selects a piece of chocolate with length 1.

Suppose both players plays optimally, your task is to determine whether Baby Volcano will win.

Input

The first line contains single integer $t(1 \leq t \leq 2 * 10^4)$, the number of testcases.

For each testcase, the first line contains a single integer $n(1 \leq n \leq 10)$.

The second line contains n positive integers $l_i(1 \leq l_i \leq 10^9)$, representing the length of each piece.

Output

For each testcase, output char 'W' if Baby Volcano will win, otherwise output char 'L'.

Example

standard input	standard output

3
2
4 9
2
2 3
3
3 9 27
	W
	L
	L

Problem F. Robotic Class

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

Baby volcano is now at a robotic class. In this class, students are required to program a special control system of a robot. This control system has a real-valued control variable x, which captures the behavior of this robot. In addition, this control system could be abstracted as an acyclic directed graph, with n node, the nodes are indexed from 1 to n. In this graph, the node n has no output edge, termed as the output node. Moreover, for each vertex $t, 1 \le t < n$, there is a number k_t, a set of **integer-valued** limits $a_{t,0} < a_{t,1} < a_{t,2} < \cdots < a_{t,k_t-1} < a_{t,k_t} := +\infty$, and a set of **integer-valued** coefficients, bias and destinations $c_{t,0}, b_{t,0}, d_{t,0}, c_{t,1}, b_{t,1}, d_{t,1}, c_{t,2}, b_{t,2}, d_{t,2} \cdots, c_{t,k_t}, b_{t,k_t}, d_{t,k_t}$. For every t and $i, 0 \le i \le k_t$, $-1 \le c_{t,i} \le 1$.

To use this system to control the robot, the user follows the steps below:

1. Choose x_0 and initialize $x := x_0$, then choose some node s_0 and set the currect node $t := s_0$
2. If t is the output node($t = n$), then output $x_{out} := x$, else go to step 3.
3. The user finds the smallest i such that $a_{t,i} \ge x$(Note that i always exists), then transform $x := c_{t,i} \times x + b_{t,i}$, and set $t := d_{t,i}$, and go back to step 2.

Note that for every fixed s_0, the output value x_{out} is a function with respect to the initial value $x_0 \in \mathbb{R}$, we call this function $C_{s_0}(x_0)$.

To precisely control the robot, it is required that for every initial node s_0, $C_{s_0}(x_0)$ is continuous with respect to x_0.

A function $f(x), x \in \mathbb{R}$ is continuous with respect to x iff

$$\forall x \in \mathbb{R}, \forall \epsilon > 0, \exists \delta > 0, \forall x' \in \mathbb{R}, |x - x'| \le \delta \implies |f(x) - f(x')| \le \epsilon$$

You need to verify this requirement is satisfied or not. In other words, if for every initial node s_0, $C_{s_0}(x_0)$ is continuous with respect to x_0, you should output `YES`. If there exists some node s^* such that $C_{s^*}(x_0)$ is not continuous, you should output `NO`.

Input

In the first line there is one integer T, denotes the number of test cases.

The rest of input has T part, each part corresponds to a test case.

For each part, in the first line there is a number n, denotes the number of nodes.

In the next $n - 1$ lines, the i-th line starts with k_i, follows with $4k_i + 3$ integers, they are $c_{i,0}, b_{i,0}, d_{i,0}, a_{i,0}, c_{i,1}, b_{i,1}, d_{i,1}, a_{i,1}, \cdots, a_{i,k_i-1}, c_{i,k_i}, b_{i,k_i}, d_{i,k_i}$.

It guarantees that $1 \le T \le 100$, and in a single test cases, $1 \le n \le 500$, $1 \le \sum k_i \le 2000$, $-1 \le c_{i,j} \le 1$, $-10^6 \le b_{i,j} \le 10^6$, $-10^9 \le a_{i,j} \le 10^9$, $i + 1 \le d_{i,j} \le n$. And it guarantees that $a_{i,j-1} < a_{i,j}$ for every $1 \le j < k_i$.

Output

For each test case, you should firstly output “`Case #t: `”(without quotes), where t is the index of this test case, then if for every initial node s_0, $C_{s_0}(x_0)$ is continuous with respect to x_0, you should output `YES`. If there exists some node s^* such that $C_{s^*}(x_0)$ is not continuous, you should output `NO`.

Example

standard input	standard output

3
4
1 1 1 2 -4 -1 -7 3
0 -1 -2 4
0 1 4 4
4
1 1 1 2 -4 -1 -7 3
0 -1 -3 4
0 1 4 4
1
	Case #1: YES
	Case #2: NO
	Case #3: YES

Problem G. CCPC training class

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

Baby volcano is helping his CCPC coach is preparing a new CCPC training contest. He wants to generate high quality data on border tree(There is no need to know what border tree is), but he encounters some troubles. Could you please help him?

In this paragraph we formally define the data quality problem. For some string $s = s_1s_2s_3\cdots s_n$, we use $s[l:r]$ to denote the substring starts from l and ends at r, if $l > r$, $s[l:r]$ is empty. We further define:

$$Lborder_i = \max\{0 \le j < i \mid s[1:j] = s[i-j+1:i]\}$$

to denote the longest border at some position i, then we define $D(i)$ to denote the length of border chain at position i:

$$D(i) = \begin{cases} 0 & i = 0 \\ D(LBorder_i) + 1 & i > 0 \end{cases}$$

The quality of string W is define as the maximum of D:

$$W = \max_{i=0}^{n} D(i)$$

To distinguish border tree with naive brute force algorithms, baby volcano need to generate strings such that its quality W is as large as possible.

Now given a string s, you could permute s arbitrarily. What is the maximum quality W you could reach after permuting s?

Input

In the first line there is a number $T (T \le 20)$, denotes the number of test cases. In the next T lines, for each line there is a string $s (1 \le |s| \le 10^5)$, denotes the input string, all inputs are formed in lowercases.

Output

Output T lines, for each line, you need to output `Case #t: m`, where `t` is the index of this test case, `m` is the maximum quality you could reach after permuting.

Example

standard input	standard output
5 abcde sankaranarayanan abbccaabc programming monotone	Case #1: 1 Case #2: 7 Case #3: 3 Case #4: 2 Case #5: 3

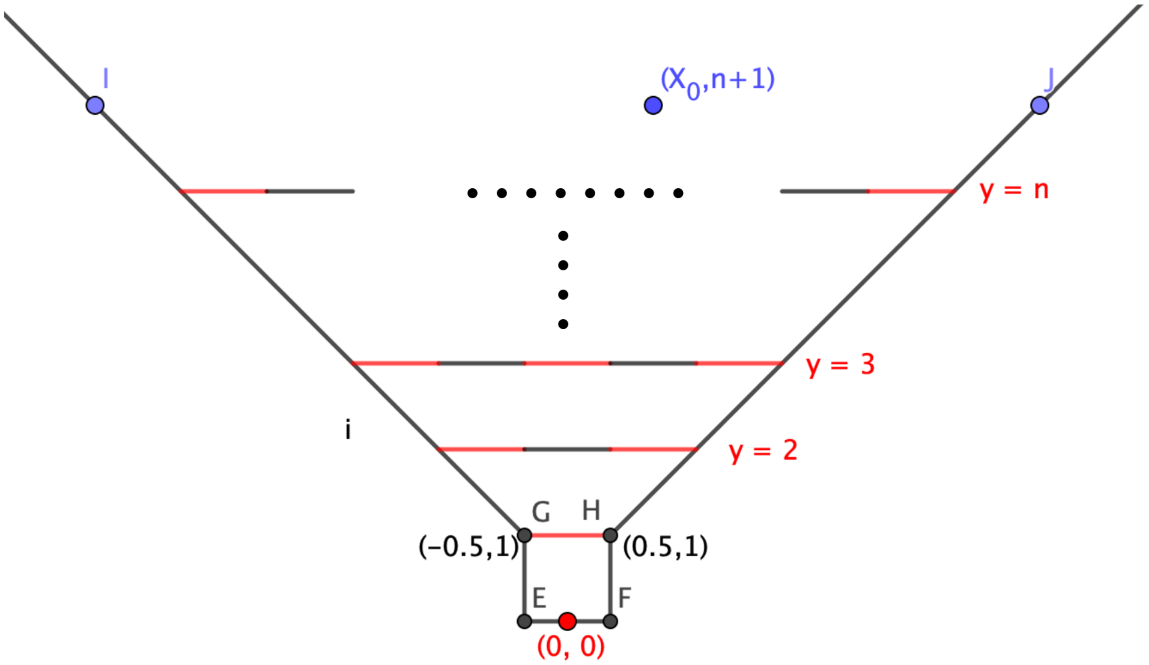
Problem H. PE Class

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

This class is on PE. Today, Baby Volcano is going to take part in a running competition in a maze. Could you help him win this competition?

For simplicity, we assume that this maze lies in a Euclidean plane. There is a graphical description for the maze shown in the following figure. We give some explanation here:

- There are two kinds of obstructions in this maze, walls and doors. Some doors are closed while others are open. Baby Volacno couldn't go through walls and closed doors, while he could pass open doors. He couldn't tell whether a door is open or not before reaching **its midpoint**.
- In the outmost layer there are 5 pieces of walls, corresponding to segment GE, EF, FH, and ray GI, HJ.
- In the inner part there are n layers of obstructions, the obstructions in the i-layer lies in $y = i$, consists of i doors and $i - 1$ walls, every obstruction is a segment with length 1. The j-th door$(1 \le j \le i)$ in i-th layer is the segement $\left(\left(\frac{1-2i}{2} + 2j - 2, i\right), \left(\frac{1-2i}{2} + 2j - 1, i\right)\right)$. The j-th wall$(1 \le j \le i - 1)$ in i-th layer is the segement $\left(\left(\frac{1-2i}{2} + 2j - 1, i\right), \left(\frac{1-2i}{2} + 2j, i\right)\right)$



Now for every $1 \le i \le n$, the teacher uniformly randomly choose $k_i (1 \le k_i \le i)$ doors to be open. Baby Volcano wonders, if he starts at $(x_0, n + 1)$, and try to approach $(0, 0)$, what is the minimum expected length of walk?

Input

In the first line there is a number T, denotes the number of test cases.

Next, there are $2 \times T$ lines demonstrating each test case.

For every case, in the first line there are two integers, n, x_0, denotes the number of layers in this maze and the start position of Baby Volcano.

In the second line there are n integers $k_1, k_2, k_3, \cdots, k_n$, showing the number of doors open in the i-th layer.

The input guarantees that $1 \le T \le 100, 1 \le n \le 50$, and $-n \le x_0 \le n$.

Output

Output T real numbers, for each test case, you need to output d, denotes the minimum expected length of walk. Assume the correct result is d^*, you need to ensure $\frac{|d-d^*|}{\max\{d^*,1\}} \le 10^{-6}$

Example

standard input	standard output

4
2 1
1 2
2 1
1 1
3 2
1 2 3
4 2
1 2 2 1
	3.414214
	4.414214
	4.828427
	10.323521

Problem I. Math class

Input file:	`standard input`
Output file:	`standard output`
Time limit:	6.5 seconds
Memory limit:	512 megabytes

Now it's time after math class!

The teacher taught Baby Volcano what can do with polynomials and how to use polynomials.The teacher said that a polynomial of degree n can be written as $f(x) = \sum_{i=0}^{n} a_i x^i$. Also,you can regard it as a function,and replace x with some number a in order to get a special value called $f(a)$

Today's math homework is to calculate $f(a)$ of a polynomial of degree n,$f(x)$.Because the answer is extremely large,Baby Volcano is only asked to write $f(x) \bmod p$ on the paper,where p is a prime number.

Baby Volcano writes number $f(0) \bmod p, f(1) \bmod p, \cdots, f(n) \bmod p$ on a textbook quickly. After a while,however,he lost $f(x)$ and can't continue with his homework.

Baby Volcano want to find $f(x)$,But he is too small to solve it.Baby Volcano needs your help!

Input

The first line contains one integer $T(1 \leq T \leq 50)$ stand for the test cases you should solve.

For each test cases,the first line contains two integer $n, p(1 \leq n < p - 1, 3 \leq p \leq 5 \times 10^5)$.

The next line contains $n + 1$ integer,the i-th stand for $f(i - 1)$.

The input garantees that $\sum p \leq 10^6, p$ is prime,$0 \leq f(i) < p$.

Output

For each test cases,Output a single line contains $n + 1$ integer.The i-th stands for $a_{i-1} \bmod p$.

It can be proved that there is only one solution if you modulo the coefficient by p,so there is and only one acceptable output.

Example

standard input	standard output
`3`	`Case #1:`
`2 10007`	`1 2 1`
`1 4 9`	`Case #2:`
`3 10007`	`1 3 3 1`
`1 8 27 64`	`Case #3:`
`12 10007`	`1 8594 9725 4829 7653 7268 9644 5003 6141 3793 9624 5125`
`1 1 4 5 1 4 1 9 1 9 8 1 0`	

Problem J. Reports

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

Because of Covid-19, Kanade needs to report every time when entering and leaving school. Now you want to check if Kanade's reports on a certain day are correct.

A sequence of reports is correct if and only if there does not exist two consecutive and same reports.

Input

There are T test cases in this problem.

The first line has one integer T.

For every test case:

The first line has one integer n which denotes the number of times Kanade reported on a certain day.

The second line has n integers $a_1, a_2, a_3, \cdots, a_n$, a_i denotes the type of the i-th report. $a_i = 0$ denotes a leaving school report and $a_i = 1$ denotes an entering school report.

$1 \le T \le 100$

$3 \le n \le 50$

$0 \le a_i \le 1$

Output

For every test case, output "YES" if Kanade's reports are correct, otherwise output "NO" (without quotes)

Example

standard input	standard output

4
3
1 1 1
3
1 0 1
5
0 1 0 1 0
4
1 0 1 1
	NO
	YES
	YES
	NO

Problem K. 3x3 Convolution

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

Given an $n \times n$ matrix A and a 3×3 matrix K. These two matrices are very special : they are both non-negative matrices and the sum of all elements in matrix K is 1 (In order to avoid floating-point error, we will give matrix K in a special way in input).

Now we define a function $C(A, K)$, the value of $C(A, K)$ is also a $n \times n$ matrix and it is calculated below(we use C to abbreviate $C(A, K)$):

$C_{x,y} = \sum_{i=1}^{min(n-x+1,3)} \sum_{j=1}^{min(n-y+1,3)} A_{x+i-1,y+j-1} K_{i,j}$

Now we define $C^m(A, K) = C(C^{m-1}(A, K), K)$ and $C^1(A, K) = C(A, K)$, Kanade wants to know $lim_{t \to \infty} C^t(A, K)$

It's guaranteed that the answer exists and is an integer matrix.

Input

There are T test cases in this problem.

The first line has one integer T.

Then for every test case:

The first line has one integer n.

Then there are n lines and each line has n non negative integers. The j-th integer of the i-th row denotes $A_{i,j}$

Then there are 3 lines and each line has 3 non negative integers. The j-th integer of the i-th row denotes $K'_{i,j}$

Then K could be derived from K' by the following formula:

$$K_{i,j} = K'_{i,j} / (\sum_{x=1}^{3} \sum_{y=1}^{3} K'_{x,y})$$

$1 \leq T \leq 100$

$3 \leq n \leq 50$

$0 \leq A_{i,j} \leq 1000$

$0 \leq K'_{i,j} \leq 1000$

$\sum_{x=1}^{3} \sum_{y=1}^{3} K'_{x,y} > 0$

Output

For each test case, output the answer matrix by using the same format as the matrix A in input.

Example

standard input	standard output

2
3
1 2 3
4 5 6
7 8 9
3 0 0
0 0 0
0 0 0
3
1 2 3
4 5 6
7 8 9
1 0 0
0 1 0
0 0 0
	1 2 3
	4 5 6
	7 8 9
	0 0 0
	0 0 0
	0 0 0

Problem L. Xor

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1.5 seconds
Memory limit:	256 megabytes

Given A, B, K, W, Kanade wants to know the number of (x, y) which satisfies the following conditions:

1. x, y are integers

2. $x \in [0, A], y \in [0, B]$

3. $|x - y| \leq K$

4. $x \; xor \; y \leq W$

Input

There are T test cases in this problem.

The first line has 1 integer T.

Then for every test case, the first line has 4 integers A, B, K, W

$1 \leq T \leq 2000$

$0 \leq A, B, K, W \leq 10^9$

Output

For every test case, output the answer in a line.

Example

standard input	standard output

3
3 3 1 2
10 10 3 7
998244353 998244353 114514 123456789
	8
	53
	228430202591616

Problem M. ResPoly

Input file:	`standard input`
Output file:	`standard output`
Time limit:	3 seconds
Memory limit:	1024 megabytes

Kanade has n polynomials $f_1(x)...f_n(x)$. These polynomials satisfy the following conditions:

1. $f_1(x) = \sum_{i=0}^{n} a_i x^i$

2. $\forall i \in [2, n], f_i(x) = b_i(f_{i-1}(x))' + c_i f_{i-1}(x)$

Given $a_0, a_1, \cdots, a_n, b_2, b_3, \cdots, b_n, c_2, c_3, \cdots, c_n$, Kanade wants to know $f_n(x)$

Because the coefficients of $f_n(x)$ may be very large, you only need to output them module 998244353

Input

There are T test cases.

The first line has 1 integer T.

Then for every test case:

The first line has 1 integer n.

The second line has $n + 1$ integers $a_{0...n}$

The third line has $n - 1$ integers $b_{2...n}$

The fourth line has $n - 1$ integers $c_{2...n}$

$1 \leq T \leq 100$

$3 \leq n \leq 10^5$

$0 \leq a_i, b_i, c_i < 998244353$

There are at most 3 test cases satisfy that $n > 1000$

Output

For every test case, if $f_n(x) = \sum_{i=0}^{n} w_i x^i$, then output $n + 1$ integers $w_{0...n}$ in a line and separate them by spaces.

Example

standard input	standard output
3	0 6 6 1
3	66 166 204 92 12
0 0 0 1	37940 117264 204708 207256 60900 3024
1 1	
1 1	
4	
1 1 1 1 1	
1 2 1	
2 3 2	
5	
3 4 5 6 5 4	
4 1 6 0	
6 9 2 7	