A. Gellyfish and Tricolor Pansy

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Input file:     standard input
Output file:    standard output
Time limit:     1 second
Memory limit:   256 megabytes
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Gellyfish and Flower are playing a game called "Duel".

Gellyfish has a HP, while Flower has b HP.

Each of them has a knight. Gellyfish's knight has c HP, while Flower's knight has d HP.

They will play a game in rounds until one of the players wins. For $k = 1, 2, \ldots$ in this order, they will perform the following actions:

- If k is odd and Gellyfish's knight is alive:
  - Gellyfish's knight can attack Flower and reduce b by 1. If $b \leq 0$, **Gellyfish wins**. Or,
  - Gellyfish's knight can attack Flower's knight and reduce d by 1. If $d \leq 0$, Flower's knight dies.
- If k is even and Flower's knight is alive:
  - Flower's knight can attack Gellyfish and reduce a by 1. If $a \leq 0$, **Flower wins**. Or,
  - Flower's knight can attack Gellyfish's knight and reduce c by 1. If $c \leq 0$, Gellyfish's knight dies.

As one of the smartest people in the world, you want to tell them who will win before the game. Assume both players play optimally.

It can be proven that the game will never end in a draw. That is, one player has a strategy to end the game in a finite number of moves.

Input

Each test contains multiple test cases. The first line contains the number of test cases t ($1 \leq t \leq 10^4$). The description of the test cases follows.

The first and only line of each test case contains four integers a, b, c, d ($1 \leq a, b, c, d \leq 10^9$) — the HP of Gellyfish, the HP of Flower, the HP of Gellyfish's knight, and the HP of Flower's knight, respectively.

Output

For each test case, if Flower will win, output "Flower", otherwise output "Gellyfish".

Standard Input	Standard Output
5 1 2 3 4 100 999 1 1 10 20 10 30 12 14 13 11 998 244 353 107	Flower Gellyfish Flower Gellyfish Gellyfish

Note

In the first test case, Gellyfish has only 1 HP. Therefore, no matter what Gellyfish does in the first round, Flower's knight will attack Gellyfish in the second round, allowing Flower to win.

In the second test case, Flower's knight has only 1 HP. Gellyfish will attack Flower's knight in the first round. Then Flower's knight will no longer be able to attack, allowing Gellyfish to win.

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B. Gellyfish and Baby's Breath

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Input file:     standard input
Output file:    standard output
Time limit:     1 second
Memory limit:   256 megabytes
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Flower gives Gellyfish two permutations* of $[0, 1, \ldots, n-1]$: $p_0, p_1, \ldots, p_{n-1}$ and $q_0, q_1, \ldots, q_{n-1}$.

Now Gellyfish wants to calculate an array $r_0, r_1, \ldots, r_{n-1}$ through the following method:

- For all i ($0 \le i \le n-1$), $r_i = \max\limits_{j=0}^{i} \left(2^{p_j} + 2^{q_{i-j}}\right)$

But since Gellyfish is very lazy, you have to help her figure out the elements of r.

Since the elements of r are very large, you are only required to output the elements of r modulo $998\,244\,353$.

*An array b is a permutation of an array a if b consists of the elements of a in arbitrary order. For example, $[4, 2, 3, 4]$ is a permutation of $[3, 2, 4, 4]$ while $[1, 2, 2]$ is not a permutation of $[1, 2, 3]$.

Input

Each test contains multiple test cases. The first line contains the number of test cases t ($1 \le t \le 10^4$). The description of the test cases follows.

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

The second line of each test case contains n integers $p_0, p_1, \ldots, p_{n-1}$ ($0 \le p_i < n$).

The third line of each test case contains n integers $q_0, q_1, \ldots, q_{n-1}$ ($0 \le q_i < n$).

It is guaranteed that both p and q are permutations of $[0, 1, \ldots, n-1]$.

It is guaranteed that the sum of n over all test cases does not exceed 10^5.

Output

For each test case, output n integers $r_0, r_1, \ldots, r_{n-1}$ in a single line, modulo $998\,244\,353$.

Standard Input	Standard Output
3 3 0 2 1 1 2 0 5 0 1 2 3 4 4 3 2 1 0 10 5 8 9 3 4 0 2 7 1 6 9 5 1 4 0 3 2 8 7 6	3 6 8 17 18 20 24 32 544 768 1024 544 528 528 516 640 516 768

Note

In the first test case:

- $r_0 = 2^{p_0} + 2^{q_0} = 1 + 2 = 3$
- $r_1 = \max(2^{p_0} + 2^{q_1}, 2^{p_1} + 2^{q_0}) = \max(1 + 4, 4 + 2) = 6$
- $r_2 = \max(2^{p_0} + 2^{q_2}, 2^{p_1} + 2^{q_1}, 2^{p_2} + 2^{q_0}) = (1 + 1, 4 + 4, 2 + 2) = 8$

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C. Gellyfish and Flaming Peony

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Input file:     standard input
Output file:    standard output
Time limit:     2 seconds
Memory limit:   512 megabytes
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Gellyfish hates math problems, but she has to finish her math homework:

Gellyfish is given an array of n positive integers $a_1, a_2, \ldots, a_n$.

She needs to do the following two-step operation until all elements of a are equal:

1. Select two indexes i, j satisfying $1 \leq i, j \leq n$ and $i \neq j$.
2. Replace a_i with $\gcd(a_i, a_j)$.

Now, Gellyfish asks you for the minimum number of operations to achieve her goal.

It can be proven that Gellyfish can always achieve her goal.

Input

Each test contains multiple test cases. The first line contains the number of test cases t ($1 \leq t \leq 5000$). The description of the test cases follows.

The first line of each test case contains a single integer n ($1 \leq n \leq 5000$) — the length of the array.

The second line of each test case contains n integers $a_1, a_2, \ldots, a_n$ ($1 \leq a_i \leq 5000$) — the elements of the array.

It is guaranteed that the sum of n over all test cases does not exceed 5000.

Output

For each test case, output a single integer — the minimum number of operations to achieve her goal.

Standard Input	Standard Output
3 3 12 20 30 6 1 9 1 9 8 1 3 6 14 15	4 3 3

Note

In the first test case, the following is a way that minimizes the number of operations:

1. Choose $i = 3$ and $j = 2$ and replace a_3 with $\gcd(a_3, a_2) = \gcd(30, 20) = 10$, then a becomes $[12, 20, 10]$.
2. Choose $i = 1$ and $j = 3$ and replace a_1 with $\gcd(a_1, a_3) = \gcd(12, 10) = 2$, then a becomes $[2, 20, 10]$.
3. Choose $i = 2$ and $j = 1$ and replace a_2 with $\gcd(a_2, a_1) = \gcd(20, 2) = 2$, then a becomes $[2, 2, 10]$.

4. Choose $i = 3$ and $j = 1$ and replace a_3 with $\gcd(a_3, a_1) = \gcd(10, 2) = 2$, then a becomes $[2, 2, 2]$.

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D. Gellyfish and Camellia Japonica

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

Gellyfish has an array of n integers $c_1, c_2, \ldots, c_n$. In the beginning, $c = [a_1, a_2, \ldots, a_n]$.

Gellyfish will make q modifications to c.

For $i = 1, 2, \ldots, q$, Gellyfish is given three integers x_i, y_i, and z_i between 1 and n. Then Gellyfish will set $c_{z_i} := \min(c_{x_i}, c_{y_i})$.

After the q modifications, $c = [b_1, b_2, \ldots, b_n]$.

Now Flower knows the value of b and the value of the integers x_i, y_i, and z_i for all $1 \leq i \leq q$, but she doesn't know the value of a.

Flower wants to find any possible value of the array a or report that no such a exists.

If there are multiple possible values of the array a, you may output any of them.

Input

Each test contains multiple test cases. The first line contains the number of test cases t ($1 \leq t \leq 10^4$). The description of the test cases follows.

The first line of each test case contains two integers n and q ($1 \leq n, q \leq 3 \cdot 10^5$) — the size of the array and the number of modifications.

The second line of each test case contains n integers $b_1, b_2, \ldots, b_n$ ($1 \leq b_i \leq 10^9$) — the value of the array c after the q modifications.

The following q lines each contain three integers x_i, y_i, and z_i ($1 \leq x_i, y_i, z_i \leq n$) — describing the i-th modification.

It is guaranteed that the sum of n and the sum of q over all test cases does not exceed $3 \cdot 10^5$.

Output

For each test case, if a exists, output n integers $a_1, a_2, \ldots, a_n$ ($0 \leq a_i \leq 10^9$) in a single line. Otherwise, output "-1" in a single line.

If there are multiple solutions, print any of them.

Standard Input	Standard Output
3 2 1 1 2 2 1 2 3 2 1 2 3 2 3 2 1 2 1	-1 1 2 3 1 2 3 4 5 5

6 4 1 2 2 3 4 5 5 6 6 4 5 5 3 4 4 2 3 3	

Note

In the first test case, based on the given sequence of modifications, we know that $b_1 = a_1$ and $b_2 = \min(a_1, a_2)$. Therefore, it is necessary that $b_2 \leq b_1$. However, for the given b, we have $b_1 < b_2$. Therefore, there is no solution.

In the second test case, we can see that the given c becomes b from a after the given modifications, and c is not changed at each modification.

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E. Gellyfish and Eternal Violet

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Input file:     standard input
Output file:    standard output
Time limit:     2 seconds
Memory limit:   1024 megabytes
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There are n monsters, numbered from 1 to n, in front of Gellyfish. The HP of the i-th monster is h_i.

Gellyfish doesn't want to kill them, but she wants to keep these monsters from being a threat to her. So she wants to reduce the HP of all the monsters to exactly 1.

Now, Gellyfish, with The Sword Sharpened with Tears, is going to attack the monsters for m rounds. For each round:

1. The Sword Sharpened with Tears shines with a probability of p.
2. Gellyfish can choose whether to attack:
    - If Gellyfish doesn't attack, nothing happens.
    - If Gellyfish chooses to attack and The Sword Sharpened with Tears shines, the HP of all the monsters will be reduced by 1.
    - If Gellyfish chooses to attack and The Sword Sharpened with Tears does not shine, Gellyfish can choose one of the monsters and reduce its HP by 1.

Please note that before Gellyfish decides whether or not to attack, she will know whether the sword shines or not. Also, when the sword shines, Gellyfish can only make attacks on all the monsters and cannot make an attack on only one monster.

Now, Gellyfish wants to know what the probability is that she will reach her goal if she makes choices optimally during the battle.

Input

Each test contains multiple test cases. The first line contains the number of test cases t ($1 \le t \le 100$). The description of the test cases follows.

The first line of each test case contains three integers n, m, and p' ($1 \le n \le 20$, $1 \le m \le 4000$, $0 \le p' \le 100$) — the number of monsters, the number of rounds of attacks, and an integer representing the probability $p = \frac{p'}{100}$ that the Sword Sharpened with Tears shines.

The second line of each test case contains n integers $h_1, h_2, \ldots, h_n$ ($1 \le h_i \le 400$) — the HP of the monsters.

It is guaranteed that the sum of n over all test cases does not exceed 100.

Output

For each test case, output a single real number representing the probability that Gellyfish will reach her goal.

Your answer is considered correct if its absolute or relative error does not exceed 10^{-6}.

Formally, let your answer be a, and the jury's answer be b. Your answer is accepted if and only if $\frac{|a-b|}{\max(1,|b|)} \le 10^{-6}$.

Standard Input	Standard Output

4 2 2 10 2 2 5 5 20 2 2 2 2 2 6 20 50 1 1 4 5 1 4 9 50 33 9 9 8 2 4 4 3 5 3	0.910000 0.672320 0.588099 0.931474

Note

In the first test case, Gellyfish will always attack whether the sword shines or not in the first round.

If the sword shines in the first round, then Gellyfish can reach her goal after the attack in the first round.

Otherwise, if the sword does not shine in the first round, she will attack monster 1 in the first round. For the second round:

- If the sword shines, since monster 1 was attacked in the first round, Gellyfish can't reach her goal.
- Otherwise, Gellyfish can attack monster 2, allowing her to reach her goal.

Therefore, the probability that Gellyfish can reach her goal is $10\% + (90\% \cdot 90\%) = 91\%$.

In the second test case, Gellyfish will only attack in the first round where the sword shines. It can be observed that the only way Gellyfish can't reach her goal is if the sword never shines in all 5 rounds. The probability that Gellyfish can reach her goal is $100\% - (80\%)^5 = 67.232\%$.

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F. Gellyfish and Forget-Me-Not

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Input file:     standard input
Output file:    standard output
Time limit:     2 seconds
Memory limit:   1024 megabytes
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Gellyfish and Flower are playing a game.

The game consists of two arrays of n integers $a_1, a_2, \ldots, a_n$ and $b_1, b_2, \ldots, b_n$, along with a binary string $c_1 c_2 \ldots c_n$ of length n.

There is also an integer x which is initialized to 0.

The game consists of n rounds. For $i = 1, 2, \ldots, n$, the round proceeds as follows:

1. If $c_i = \texttt{0}$, Gellyfish will be the active player. Otherwise, if $c_i = \texttt{1}$, Flower will be the active player.
2. The active player will perform **exactly one** of the following operations:
    - Set $x := x \oplus a_i$.
    - Set $x := x \oplus b_i$.

Here, $\oplus$ denotes the bitwise XOR operation.

Gellyfish wants to minimize the final value of x after n rounds, while Flower wants to maximize it.

Find the final value of x after all n rounds if both players play optimally.

Input

Each test contains multiple test cases. The first line contains the number of test cases t ($1 \le t \le 10^4$). The description of the test cases follows.

The first line of each test case contains a single integer n ($1 \le n \le 10^5$) — the number of rounds of the game.

The second line of each test case contains n integers $a_1, a_2, \ldots, a_n$ ($0 \le a_i < 2^{60}$).

The third line of each test case contains n integers $b_1, b_2, \ldots, b_n$ ($0 \le b_i < 2^{60}$).

The fourth line of each test case contains a binary string c of length n.

It is guaranteed that the sum of n over all test cases does not exceed 10^5.

Output

For each test case, output a single integer — the final value of x after all n rounds.

Standard Input	Standard Output
5 1 0 2 0 2 12 2 13 3	0 15 6 11 5

11 3 6 1 2 6 2 3 010 4 1 12 7 2 4 14 4 2 0111 9 0 5 10 6 6 2 6 2 11 7 3 15 3 6 7 6 7 8 110010010	

Note

In the first test case, there's only one round and Gellyfish is the active player of that round. Therefore, she will choose a_1, and the final value of x is 0.

In the second test case, Flower will be the active player in both rounds. She will choose a_1 and b_2, and the final value of x is $a_1 \oplus b_2 = 15$. Flower may also choose b_1 and a_2 instead for the same result of $x = a_2 \oplus b_1 = 15$.

In the third test case, $a_1 = b_1$ so it doesn't matter what decision Gellyfish makes in the first round. In the second round:

- If Flower chooses a_2, then x will become 7. Gellyfish will choose b_3 in the third round, so the final value of x will be 4.
- Otherwise, Flower chooses b_2, then x will become 4. Gellyfish will choose a_3 in the third round, so the final value of x will be 6.

Flower wants to maximize the final value of x, so Flower will choose b_2 in the second round. Therefore, the final value of x will be 6.