Problem A. Ages of Antiquity

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Light Blue`

Across the ages, Palestine has been a cradle of civilizations, witnessing the rise and fall of empires that left behind a rich tapestry of cultural heritage. Its ancient cities, such as Jericho, are among the oldest continuously inhabited places in the world, brimming with stories from millennia of human history. Wander through its streets, and you'll find echoes of the past in every corner.

You are given a tree consisting of n nodes numbered from 1 to n and rooted at node 1. The i_{th} node has value a_i.

You need to count the number of good unordered pairs of nodes in the tree. A pair of nodes (x, y) is good if the value of at least one of the nodes in the pair ($a[x]$ or $a[y]$) divides the value of their lca, $a[lca(x, y)]$.

More formally, an unordered pair of nodes x, y; where $1 \leq x, y \leq n$ is good if and only if

$$a[x] \mid a[lca(x, y)] \text{ OR } a[y] \mid a[lca(x, y)]$$

where $a|b$, a divides b — or equivalently b is a multiple of a.

Pair (x, y) is the same as the pair (y, x).

Here $lca(x, y)$ is the lowest common ancestor of nodes x and y in the tree.

Input

The first line of the input contains one integer n, the number of nodes in the tree. ($1 \leq n \leq 10^5$)

Each of the following n lines contains one integer a_i, the value on the i_{th} node. ($1 \leq a_i \leq 10^5$)

Each of the following $n-1$ lines contains two integers u, v representing the edges of the tree. ($1 \leq u, v \leq n$)

It is guaranteed that the given edges form a tree.

Output

Print one integer, the number of good pairs in the tree.

Examples

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

Note

In the first test case: The good pairs are (1, 1), (2, 2), (3, 3), (1, 2), (1, 3), (2, 3). Pairs (1, 1), (2, 2), (3, 3) are obviously good because the value of the node divides its value, this is also the case for pairs (1, 2) and (1, 3) since the *lca* is 1 and one of the nodes of the pair is 1. The *lca* of the pair (2, 3) is 1 and $a[2] = 5$ divides $a[1] = 10$.

In the second test case: The good pairs are (1, 1), (2, 2), (1, 2).

In the third testcase: The good pairs are (1, 1), (2, 2), (3, 3), (1, 2), (2, 3). Pair (2, 3) is not good. As lca(2, 3) = 1, and neither $a[2]$ divides $a[1]$ nor $a[3]$ divides $a[1]$.

Problem B. Beneath Beauty

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Bronze`

Beneath its rolling hills and fertile plains lies a land of stunning diversity, from the coastal plains of Gaza to the rugged mountains of the West Bank. The fertile valleys and terraced hillsides tell tales of generations of farmers who have cultivated the land with care and respect. Palestine's landscapes offer a unique blend of Mediterranean charm and ancient rural beauty.

Given a tree with n nodes where each node is assigned a numerical value a_i and q queries defining pairs of nodes u and v, the task is to determine the minimum number of operations required to ensure that the greatest common divisor (GCD) of all values along the path from node u to node v is greater than 1. The only permitted operation is to increase the value of any node by one, with the flexibility to perform this operation any number of times, including zero.

Each query is independent.

Input

The first line contains one integer t ($1 \leq t \leq 100$) — the number of test cases.

The first line of each test case contains two integers n and q ($2 \leq n \leq 2 * 10^5, 1 \leq q \leq 2 \cdot 10^5$) — the number of nodes and the number of queries.

Followed by one line n integers $a_1, a_2, ..., a_n$ ($1 \leq a_i \leq 1000$) the value of each node.

Followed by n-1 lines describes an edge of the tree. Edge i is denoted by two integers u_i and v_i, the labels of vertices it connects ($1 \leq u_i, v_i \leq n, u_i \neq v_i$).

Each of the next q lines have two nodes u_i and v_i ($1 \leq u_i, v_i \leq n$).

The sum of values of n over all test cases in the input does not exceed $2 * 10^5$ The sum of values of q over all test cases in the input does not exceed $2 * 10^5$.

Output

For each test case print q lines, each is the answer to i-th query.

Example

standard input	standard output
1 5 6 12 7 3 15 1 3 4 3 1 5 2 3 5 5 4 5 5 5 5 5 1 5 3 5 1	2 1 1 2 2 2

Problem C. Cultural Carvings

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`White`

Carved into the heart of Palestine are its legendary religious and historical sites, attracting pilgrims and tourists alike. The sacred city of Bethlehem, the birthplace of Jesus, stands as a beacon of spiritual significance, drawing visitors from around the globe. Every stone in this hallowed land whispers the sacred history that has shaped countless lives.

Moussa has watched a lot of movies in his life. He always got excited seeing how hackers use those green screens with zeros and ones all around to hack computers and do bad things, so he decided he is going to learn how all of these work.

Naseem, Moussa's friend, tried explaining that real-life programming and hacking are not as exciting as they seem in the movies. However, Moussa insisted he is going to learn them anyway, so Naseem offered help. For the next few days, Naseem would lecture Moussa on the binary representation and binary operators, then he made a small test for him, which was a single question that included everything he taught Moussa.

Naseem gave Moussa a binary string of n characters numbered from 0 to $n-1$. He asked Moussa to count the number of pairs of integer numbers (i, j) $(0 \leq i, j < n)$ where $s_{(i|j)} = s_{(i\&j)}$, where s_i is the $i-th$ character in the string, '|' is logical OR, and '&' is logical AND.

A binary string is a string containing characters 0 and 1 only.

Moussa found this so annoying and boring as Naseem had told him before all of the lectures and wanted to give up, but Naseem would insist that Moussa has to solve the question and pass the test as a payback for his effort even after he warned Moussa. Can you help Moussa solve the question so Naseem would leave him alone?

Input

The first line of the input contains a single integer number t, the number of test cases.

The first line of each test case contains a single integer number n $(1 \leq n \leq 10^5)$, the number of characters of s.

The second line of each test case contains a single binary string s.

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

Output

For each test case print a single line containing a single integer number, the number of pairs that satisfy the equation.

Example

standard input	standard output
5 1 1 5 11100 4 1010 2 01 7 0010110	1 9 8 2 21

Problem D. Deep-rooted Diversity

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Green`

Deep within its bustling markets and vibrant communities, the spirit of Palestinian culture thrives, full of warmth and hospitality. Traditional crafts like olive wood carvings, ceramics, and embroidery reflect centuries-old skills passed down through generations. These cultural treasures provide a window into the soul of a resilient and creative people.

Given two arrays of integers A and B having the same length, find the length of longest subsequence of array A, whose sum is greater than or equal to the corresponding subsequence of array B. Corresponding subsequence means indices chosen in both of the arrays must be the same.

Input

The first line has an integer N ($1 \leq N \leq 10^6$), the number of elements in the arrays A and B.

The second line contains N integers of the array A, ($0 \leq A_i \leq 10^9$).

The third line contains N integers of the array B, ($0 \leq B_i \leq 10^9$).

Output

For each test case, print the answer in a single line.

Example

standard input	standard output
3 50 50 5 2 2 1000	2

Problem E. Eternal Sunrises

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Light Green`

Every sunrise over the Jordan Valley casts a golden hue on the olive groves and vineyards that are integral to Palestinian life. The timeless practice of olive cultivation is not only a vital economic activity but also a symbol of peace and resilience. Yet, many of these ancient groves have been uprooted, leaving a scar on the landscape and the hearts of the people.

There is a tree of n nodes and an integer x, the root is at depth 1. Each node at any depth between depth 1 and $x-1$ has two children except for one node, which has three children. All nodes at depth x have no children.

You are only given an integer n. Find the depth of the node with three children. If there are multiple possible depths, print the minimum one. If there is no such node, print -1.

Input

The first line of the input contains a single integer t. The number of the test cases.

The first line of each test case contains a single integer number n ($1 \leq n \leq 10^{18}$). The number of nodes in the tree.

Output

For each test case print a single integer number in a single line. The answer to the problem.

Example

standard input	standard output
3 1 4 18	-1 1 2

Problem F. Fabled Trails

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Blue`

From the majestic heights of the Samarian hills to the serene waters of the Dead Sea, Palestine's natural beauty is simply breathtaking. Hiking trails crisscross the countryside, offering spectacular views and a chance to connect deeply with nature. However, some of these trails lead to areas where access is restricted, a poignant reminder of the ongoing conflict.

Given an array of N numbers and a set of M moves that you can make, each move belongs to one of two types:

- 1 x y c : Change a value x to y with cost of c
- 2 x c : Delete a value x from the array with cost of c

Can you make the array non-decreasing with minimum cost using zero or more moves? (you can use each move any number of times) or say that it's impossible.

Input

The first line of the input contains two integers N ($1 \leq N \leq 200$) and M ($1 \leq M \leq 10^5$).

The second line of the input contains N numbers $a_1, a_2, \ldots, a_N$ ($1 \leq a_i \leq 200$).

The following M lines of input contain the set of moves that you can make as described above ($1 \leq x, y \leq 200$, $1 \leq c \leq 10^9$).

Output

The minimum cost of turning the array into a non-decreasing array or print -1 if its impossible to do so.

Example

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

Problem G. Generational Genius

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Orange`

Generations of poets, artists, and writers have drawn inspiration from the beauty and complexities of Palestinian life. The rich cultural heritage is expressed through music, literature, and dance, celebrating the joys and sorrows of its people. Despite facing significant hardships and restrictions, Palestinian creativity and expression continue to thrive, undeterred.

Given a Binary String S without leading zero.

Determine the summation of all substrings of S in binary representation, We consider each substring as a binary number.

For example, if S is 101, then all substrings are 1, 0, 1, 10, 01, 101. Their summation in binary representation is 1010.

Input

First line contains an integer T ($1 \leq T \leq 10^4$) indicating the number of test cases.

Each test case contains a binary string S, ($1 \leq |S| \leq 10^6$).

Additional constraint on the input: the sum of $|S|$ over all test cases doesn't exceed 10^6.

Output

Output the sum of all substrings as binary number without leading zero.

Example

standard input	standard output
3 1010 101 11	11000 1010 101

Problem H. Heritage of Hebron

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Yellow`

Hidden within the ancient walls of Hebron lies a city that pulses with vibrant life and deep-rooted traditions. Its souks overflow with the aroma of spices and the sight of colorful textiles, reflecting a thriving commercial and cultural hub. Yet, the city's vibrancy is often overshadowed by tensions and barriers that divide its streets and communities.

Given a tree with N nodes and $N-1$ edges, with each node i colored with the color C_i.

We define $beauty(u, v)$ as the number of distinct colors of nodes on the path from u to v.

You are to answer a set of Q queries of the form:

$v\ l\ r$ — output the sum: $\sum_{i=l}^{i=r} beauty(i, v)$

Input

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

The first line of each test case contains two integers N, Q ($1 \leq N, Q \leq 10^5$).

The second line contains N space-separated integers $C_1, C_2..., C_N$ ($1 \leq C_i \leq 30$).

The following $N-1$ lines each contain two integers u, v representing an edge between node u and node v in the tree.

The following Q lines each contain three integers v, l, r ($1 \leq v \leq N$), ($1 \leq l \leq r \leq N$) described above.

It is guaranteed that the sum of N and the sum of Q over all test cases does not exceed 10^5

Output

For each query output $\sum_{i=l}^{i=r} beauty(i, v)$

Example

standard input	standard output
2 3 6 5 3 1 1 3 3 2 1 3 3 2 2 3 2 2 3 3 1 1 2 1 2 3 1 3 7 4 5 1 4 3 5 1 3 7 2 3 2 1 3 5 4 3 5 2 6 4 1 5 1 4 6 5 3 7 1 2 3	2 3 3 2 4 5 13 8 12 5

Problem I. Ingenious Agriculture

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Purple`

In the serene village of Battir, terraces carved into the hillsides stand as a testament to ingenious agricultural practices that have sustained the community for centuries. This UNESCO World Heritage site highlights the harmony between humans and nature, preserving traditional farming techniques that are as beautiful as they are sustainable.

You have 2 positive integers n and v, initially $v = 1$.

You are given q queries, each query has 2 types of operations:

1. 1 x: Multiply the value of v by x.
2. 2 x: Find the largest non-negative integer r such that x^r divides $(n! \times v)$.

For each query of type 2, output the largest r satisfying the condition.

Input

The first line of input contains integers n and q $(1 \leq n \leq 10^6)$, $(1 \leq q \leq 10^5)$ — the factorial sequence and the number of queries.

Following with q lines, each containing two positive integers t stands for the type, $(1 \leq t \leq 2)$ and x $(2 \leq x \leq 10^6)$, if t is 1, multiply v by x, if t is 2, find the largest non-negative integer r such that x^r divides $(n! \times v)$.

Output

For each query of type 2, output the largest r satisfying the condition.

Example

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

Problem J. Jewel of Jericho

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Silver`

Just as the ancient olive trees bear witness to centuries of history, so too do the ruins scattered across Palestine tell tales of bygone eras. Archaeological sites like the ancient city of Jericho reveal layers of human civilization, from the Neolithic age to the present. Despite their historical value, some sites have faced destruction or restricted access, complicating their preservation and study.

You are given n line segments each of the form $x1$, $y1$, $x2$, $y2$

Find the number of triples $(i < j < k)$ such that the ith, j_{th}, and k_{th} line segments form a triangle. Note that they don't need to intersect at the segments' endpoints.

Input

The first line of the input contains a single integer number t. The number of the test cases.

The first line of each test case contains a single integer number n $(1 \leq n \leq 2000)$. The number of line segments.

The next n lines each contains four space separated integer numbers x_{i1}, y_{i1}, x_{i2}, y_{i2} describing the i_{th} line. $(-400 \leq x_i, y_i \leq 400)$.

It is guaranteed that the sum of n over all of the test cases does not exceed 2000.

Output

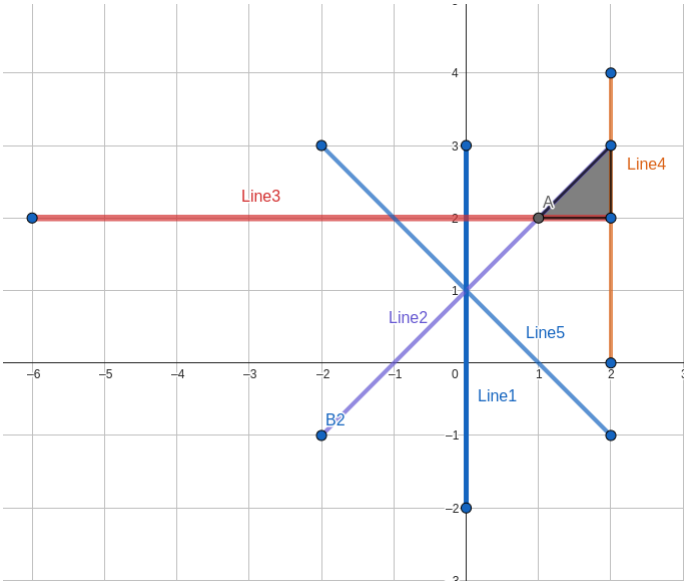
For each test case print a single line containing a single integer number. The number of triangles that can be formed by choosing three line segments.

Example

standard input	standard output
1 5 0 3 0 -2 2 3 -2 -1 2 2 -6 2 2 0 2 4 -2 3 2 -1	4

Note

The sketch of the problem...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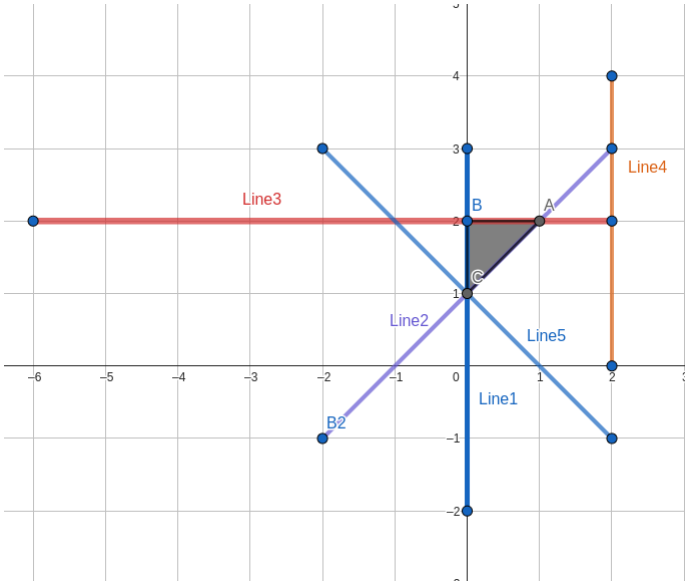
Line4
Line2
Line5
Line1
B2
A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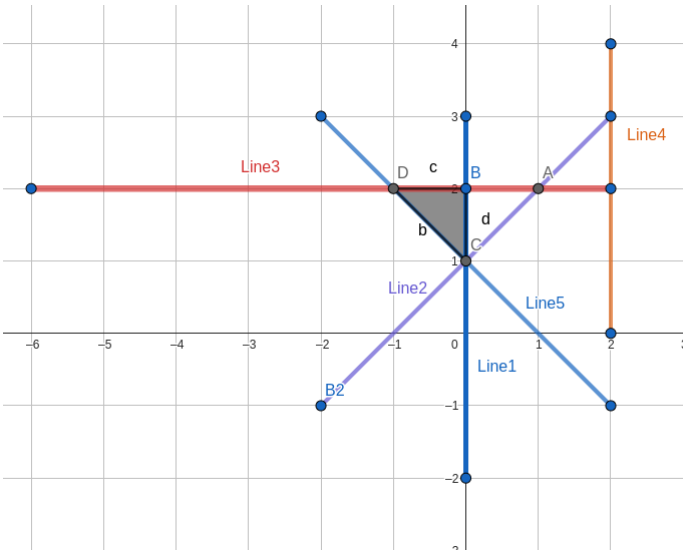
Line4
Line2
Line5
Line1
B2
A
B
C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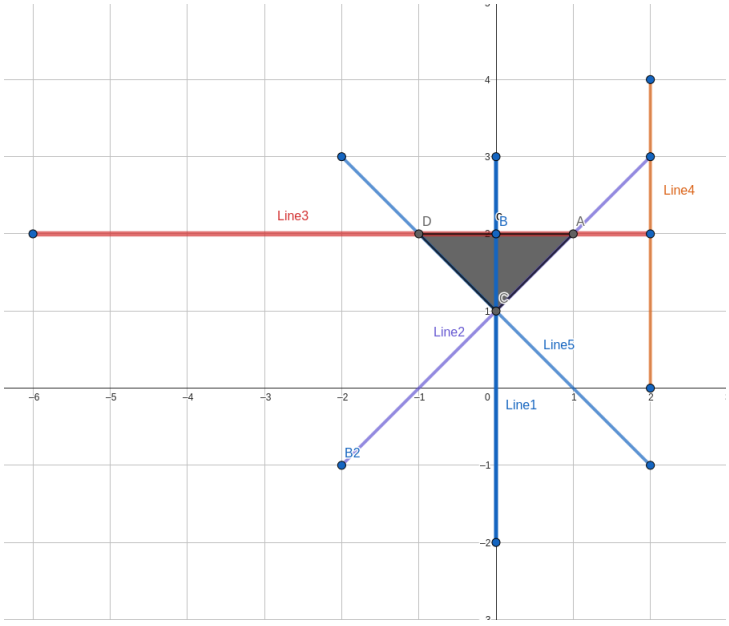
Line2
Line5
Line1
B2
D
c
B
A
b
d
C


Line3
Line4
Line2
Line5
Line1
B2
D
B
A
C

Problem K. Kitchen Kaleidoscope

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Pink`

Known for its diverse and flavorful cuisine, Palestinian food is a delightful blend of Middle Eastern and Mediterranean influences. Dishes like maqluba, musakhan, and knafeh showcase the rich culinary traditions that have been perfected over generations. Each meal is a celebration of community and shared heritage, bringing people together in a spirit of unity.

Gauss was a very bright student in his class, his teacher was very tired and asked the class solve a very hard problem; sum up all numbers from 1 to 100. As Gauss was very smart, he came up with the solution really fast and said loudly 5050. His teacher was very amazed. Now the teacher knows Gauss's power and wants to make him solve a harder problem. He gave Gauss a function $f(n,k) = \sum_{i=0}^{n} i^k$, where n, k are some integer numbers. He asked Gauss to compute $\sum_{i=0}^{k} f(n,i)$. As Gauss is not ready yet for such a problem you have to help him.

Input

The input contains two values n, k.

$0 \leq n < (2^{64} - 1)$, $0 \leq k \leq 100$

Output

output one integer, the value of $f(n,0) + f(n,1) + \cdots + f(n,k)$ As the answer could be very huge, output it mod 2^{64}

Examples

standard input	standard output
0 0	1
2 3	20
3 3	60
100 100	10192059831141196803

Note

in the first test case: 0^0 is considered 1 in this problem

in the second test case: the numbers are

$f(2,0) = 0^0 + 1^0 + 2^0$

$f(2,1) = 0^1 + 1^1 + 2^1$

$f(2,2) = 0^2 + 1^2 + 2^2$

$f(2,3) = 0^3 + 1^3 + 2^3$

Which sums up to 20

Problem L. Landmark Legacies

Input file:	standard input
Output file:	standard output
Balloon Color:	Gold

Landmarks such as the Church of the Nativity in Bethlehem and the Dome of the Rock in Jerusalem are not just religious sites; they are symbols of the profound cultural and historical legacy of Palestine. Despite their spiritual significance, access to these sites is often restricted, reflecting the broader struggle for cultural and religious freedoms. Their enduring presence inspires awe and reverence in all who visit.

One sad day, so that Eslam would not think about his sorrows that exhausted him psychologically, he decided to think about making a problem that he would give it to his friends so that they could solve it.

You are given a string s of length n consisting of lowercase English letters from a to z and an array a of length n, where a_i is the price of index i of string s.

You must perform the following operation exactly once: for each character in the string s remove all occurrences except one.

Your task is to print lexicographically the minimum string and maximum sum of prices of the remaining indexes after finishing this operation.

Input

The first line contains a single integer t ($1 \le t \le 100$) — the number of test cases.

The first line of each test case contains one integer n ($1 \le n \le 200000$) — the length of the string s.

The second line contains the string s. The string s consists of lowercase English letters from a to z.

The third line contains n integers $a_1, a_2, ..., a_n$ ($1 \le a_i \le 10^9$) — where a_i is the price of s_i in string s.

It is guaranteed that the sum of the values of n over all test cases does not exceed 200000.

Output

print lexicographically minimum string and maximum sum of prices of remaining indexes.

Example

standard input	standard output
5 2 gx 45 22 6 amkxks 32 34 17 6 32 2 13 ykinkezplvfja 43 49 41 10 5 18 31 30 7 18 34 28 26 5 mlvum 17 17 24 41 4 10 xcfycebeur 3 46 22 39 49 7 16 32 2 18	gx 67 amkxs 91 yinkezplvfja 291 lvum 86 xcfybeur 178

Problem M. Mesmerizing Jericho

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Red`

Magnificent sunsets over the Mediterranean coast paint the sky with hues of orange and pink, creating a serene backdrop for the vibrant city of Gaza. The coastal areas, with their pristine beaches and refreshing sea breeze, offer a tranquil escape and a glimpse into the simple beauty of Palestinian life by the water. Yet, the beauty of Gaza's coast contrasts sharply with the challenges faced by its residents, including economic hardship and restricted movement.

Yazan was playing with DNA in his laboratory. DNA can be represented as a string of lowercase Latin letters.

Yazan noticed that DNA sometimes does a mutation, a mutation is defined by power x, where x is an integer number. A mutation of power x happening on a DNA t of length m splits t into two strings t_1 and t_2, where t_1 is the substring of t between $[1, x]$ and t_2 is the substring of t between $[x + 1, m]$. The result of the mutation is the concatenation between t_2 and t_1 (notice that the order was swapped). For example, if initially $t =$ "$abcd$" and a mutation of power $x = 3$ happened of t, the resulting string would be $t =$ "$dabc$".

Yazan decided to play with a DNA that was put under high heat. He had a DNA string s of n lowercase Latin letters. Due to high heat, the string kept mutating every now and then, but he wanted to keep track of certain times. He wants you to do this for him as the number of mutations was unexpected. There will be two types of events:

- 1 x, which means a mutation of power x occurred on the DNA s.
- 2 i, which means that Yazan requested you to print the $i - th$ character of the DNA s.

Input

The first line of the input contains a single integer number t. The number of test cases.

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

The second line of each test case contains a string s of n lowercase Latin letters.

The third line of each test case contains a single integer number q ($1 \le q \le 10^5$). The number of events you need to handle.

Each of the following q lines follows one of the following formats:

- 1 x ($1 \le x \le n$), which means a mutation of power x occurred on the DNA s.
- 2 i ($1 \le i \le n$), which means that Yazan requested you to print the $i - th$ character of the DNA s.

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

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

Output

For each query of the second type for each test case, print a single line containing a single character, the $i - th$ character of the DNA s.

Example

standard input	standard output
1 10 ojlsspkjin 5 1 2 2 3 2 7 1 8 2 1	s i o

Problem N. Nablus Nostalgia

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Black`

Nestled in the hills, the city of Nablus is a treasure trove of historical and cultural riches. Famous for its bustling old market and the traditional soap-making industry, Nablus also boasts the stunning Ottoman-era architecture that gives the city its unique character. However, the city's charm is often marred by the lingering effects of conflict and economic struggles.

Jack is organizing his schedule and needs to determine if the day of the month he picks is for work or rest. He considers even-numbered days as workdays and odd-numbered days as rest days.

Help Jack by writing a program that determines if a given day number is a workday or a rest day.

Input

A single integer d representing the day of the month (1 to 31).

Output

Print "Work"if the day is a workday.

Print "Rest"if the day is a rest day.

Examples

standard input	standard output
3	Rest
1	Rest

Note

The answer is case sensetive.