Asociación Nacional
de Instituciones de Educación
en Tecnologías de la Información, A.C.

ANIEI

2024

Concurso de Programación ANIEI 2024

October 24th, 2024

Contest Session

This problem set contains 9 problems; pages are numbered from 1 to 12.

General information

Unless otherwise stated, the following conditions hold for all problems.

Program name

1. Your solution must be called *codename*`.c`, *codename*`.cpp`, *codename*`.java`, *codename*`.kt`, *codename*`.py3`, where *codename* is the capital letter which identifies the problem.

Input

1. The input must be read from standard input.
2. The input consists of a single test case, which is described using a number of lines that depends on the problem. No extra data appear in the input.
3. When a line of data contains several values, they are separated by *single* spaces. No other spaces appear in the input. There are no empty lines.
4. The English alphabet is used. There are no letters with tildes, accents, diaereses or other diacritical marks (ñ, Ã, é, Ì, ô, Ü, ç, etcetera).
5. Every line, including the last one, has the usual end-of-line mark.

Output

1. The output must be written to standard output.
2. The result of the test case must appear in the output using a number of lines that depends on the problem. No extra data should appear in the output.
3. When a line of results contains several values, they must be separated by *single* spaces. No other spaces should appear in the output. There should be no empty lines.
4. The English alphabet must be used. There should be no letters with tildes, accents, diaereses or other diacritical marks (ñ, Ã, é, Ì, ô, Ü, ç, etcetera).
5. Every line, including the last one, must have the usual end-of-line mark.
6. To output real numbers, round them to the closest rational with the required number of digits after the decimal point. Test case is such that there are no ties when rounding as specified.

Problem A – Problem A

In the faraway kingdom of Arboria, the Great Sage has discovered a magical rooted tree with an interesting property: it holds secrets about the paths connecting its inhabitants. The tree is home to N unique species, each living on a different node of the tree. The Sage has a fascination for measuring the distances between species in their own territories, especially within their own subtrees.

The rooted tree is structured such that each node (or territory) has a direct connection to another, forming a large, interconnected kingdom with $N-1$ roads with the root being node 1. The Great Sage has selected you, the brightest scholar in the land, to help him answer several queries about the distances between species in different parts of the tree.

For each query, you are given a node U (representing the root of a subtree) and a distance K. The Sage wants to know how many species in the subtree rooted at U can be found within a distance of at most K from U.

Can you help the Sage answer these queries efficiently?

Input

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

The next $N-1$ lines each contain two integers A and B ($1 \leq A, B \leq N$), representing an edge between node A and node B.

The next line contains an integer Q ($1 \leq Q \leq 10^5$), the number of queries.

Each of the following Q lines contains two integers U and K ($1 \leq U \leq N$, $0 \leq K \leq N-1$), representing a query asking how many nodes in the subtree rooted at U are at a distance of at most K from U.

Output

For each query, print a single integer separated with a space, the number of nodes in the subtree rooted at U that are at a distance of at most K from U.

Sample input 1	**Sample output 1**
10 1 2 1 3 2 4 2 5 2 6 4 7 7 8 7 9 7 10 5 1 1 1 4 2 1 2 2 2 3	3 10 4 5 8

Sample input 2	**Sample output 2**
5 1 2 1 3 1 4 1 5 4 1 0 1 1 2 0 2 4	1 5 1 1

Problem B – Problem B

In the mystical realm of Numeria, you have been given a collection of numbers. The Grand Mathematician wants to know which pair of numbers in this collection has the greatest number of divisors in common and what that number is. If the collection has fewer than two distinct numbers, the answer should be 0, as there is no valid pair.

Your task is to analyze the collection and report the maximum number of common divisors between any two numbers.

Input

- The first line contains an integer N ($2 \leq N \leq 10^5$) — the number of numbers in the collection. - The second line contains N integers $a_1, a_2, \ldots, a_N$ ($1 \leq a_i \leq 10^6$) — the numbers in the collection.

Output

Output a single integer representing the maximum number of divisors in common between any two numbers in the collection.

Sample input 1	**Sample output 1**
3 1 2 3	1

Sample input 2	**Sample output 2**
5 2 3 6 12 9	4

Sample input 3	**Sample output 3**
10 1 2 3 4 5 6 7 8 9 10	3

Problem C – Problem C

In the magical city of Chromia, there are N friends who love colorful balls. These friends often come together to play games, and the most recent challenge is a fun distribution of colorful balls. The challenge is to ensure that every pair of friends has at least one ball of the same color, symbolizing their friendship and connection.

There are K different colors of balls available, and you want to find out how many ways you can distribute the balls among the N friends such that **every pair of friends has at least one ball of the same color**. Each friend can receive any number of balls, but they can receive at most one ball of each color.

Can you calculate the number of valid ways to distribute the balls, ensuring that every pair of friends shares at least one ball of the same color?

Input

The first line contains two integers N and K ($2 \leq N \leq 10^3$, $1 \leq K \leq 10^2$) — the number of friends and the number of different ball colors available.

Output

Output a single integer representing the number of valid ways to distribute the balls, modulo $10^9 + 7$, where each pair of friends has at least one ball of the same color.

Sample input 1	**Sample output 1**
3 1	1

Sample input 2	**Sample output 2**
3 2	22

Sample input 3	**Sample output 3**
3 3	304

Problem D – Problem D

You accidentally knocked over a picture frame, and the frame fell apart into four wooden sticks. You want to reassemble it, but you're unsure if one of the sticks broke when it fell.

To figure out if all four sticks are still intact, you need to determine whether it's possible to use these four sticks to form a rectangular picture frame. If you can form a rectangle, then none of the sticks broke. However, if it's not possible, then it's likely that one or more sticks were damaged in the fall.

You are given the lengths of the four sticks, and your task is to determine whether they can form a rectangle by connecting their ends. Recall that a rectangle has opposite sides of equal length.

Input

The input consists of a single line with four space-separated integers a, b, c, and d ($1 \leq a, b, c, d \leq 10^3$), representing the lengths of the four sticks.

Output

Print "YES" if it is possible to form a rectangle using the four sticks, meaning none of them broke, or "NO" if it's not possible, meaning that one or more of them may have broken.

Sample input 1	**Sample output 1**
`4 6 6 4`	`YES`

Sample input 2	**Sample output 2**
`5 5 3 2`	`NO`

Problem E – Problem E

During the berry harvest season, you've collected a large number of berries from your farm. These berries are stored in baskets, and each basket contains a certain number of berries. You've partnered with a berry distribution company, which will only accept baskets that can be packed exactly into boxes that hold X berries each. This is important for efficient transportation and to ensure the berries don't spoil during handling.

Any baskets that do not contain a number of berries that can be boxed based on the distributor rule cannot be sent to the distributor and will instead be sold locally in your region.

Your task is to determine the maximum number of baskets from the harvest that can be sent to the distributor.

Input

The first line contains two integers N and X, $(1 \leq N \leq 1,000,000)$, $(1 \leq X \leq 10^9)$, representing the number of baskets harvested, and the number of berries each distrutors box can hold. The second line contains N space-separated integers $a_1, a_2, \ldots, a_N$ $(1 \leq a_i \leq 10^9)$, representing the number of berries in each basket.

Output

Print a single integer, the number of baskets that can be sent to the distributor.

Sample input 1	**Sample output 1**
5 3 3 6 8 10 9	3

Sample input 2	**Sample output 2**
4 7 7 14 22 5	2

Sample input 3	**Sample output 3**
5 1 10 20 30 40 50	5

Problem F – Problem F

A new road connecting Nlogonia and Quadradonia was built, the road is a straight line of D meters long. Nlogonia is at meter 0 in the road, and Quadradonia is at meter D in the road. One of the advantages of this road is it offers free internet access to anyone that travels it using public transportation system, this encourages people to travel between the cities without using their vehicles reducing in this way carbon emissions between the cities.

To provide internet access in all the road M internet antennas have been installed along the road. Two antennas in the road can pass internet signal between them if and only if the distance between them is less or equal than a configured frequency range. In the same way an antenna is connected to a city internet network if the distance from the antenna to the city is less or equal to the antenna range. The frequency range of the antennas can be configured to any positive integer, but, in order for the antennas to work properly, this value should be the same for all the antennas in the road.

People that travels using public transportation in the road have filled several complains stating they do not have internet access in all the road, so, the public transportation officers of the cities have asked you to investigate further and fix the problem.

You need to review the current installation of the internet antennas, your task is to find the minimum range that should be configured to the antennas to make sure that there is a connection between Nlogonia and Quadradonia. For such connection to exists, there should be a set of antennas in such way that at least one antenna is connected to Nlogonia internet network, at least one antenna is connected to Quadradonia internet network, and for every other antenna there is a way to pass internet signal to both cities, following a set of antennas with the configured frequency range. To help you in this mission the public transportation officers will assign a budget B, and they will allow you to move the antennas from their current position, but you can not install more antennas, moving an antenna m meters from it's initial position will cost you m from the given budget.

Given the current position of the M antennas, the budget B assigned, and the distance D of the road, write a program that finds the minimum range frequency that can be configured to the antennas to connect internet in all the road without exceeding the budget B.

Input

The first line of input contains three integers separated by a space, D, B, and M ($1 \leq D \leq 5000$, $0 \leq B \leq 10^6$, $1 \leq M \leq 100$), representing respectively, the distance of the road, the maximum budget you can spend, and the number of installed antennas in the road.The second and last line of input contains M integer numbers separated by a space, the values p_i ($0 \leq p_i \leq D$), representing the i-th antenna is positioned at meter p_i in the road.

Output

Output a line containing a single integer, the minimum range frequency that can be configured to the antennas to connect internet in all the road without exceeding the budget.

Sample input 1	**Sample output 1**
`10 0 2` `0 10`	`10`

Sample input 2	**Sample output 2**
`10 5 2` `0 10`	`5`

Sample input 3	**Sample output 3**
10 5 2 0 0	5

Problem G – Problem G

Jaime's delivery package organization is growing, the number of employees is getting bigger every month, and they bill and have earnings never seen before. Jaime decided it's time to have some hierarchy in the organization, therefore, he worked arranging the N employees of his company identified with the numbers from 1 to N, in such way that each employee has a manager who supervises the employee's work, the only employee who will not have a manager is Jaime. In this hierarchy, it is said that an employee A reports to another employee B if you can reach A following the hierarchy moving through the managers starting from B. The reporting unit of an employee A consists of all the employees B such that B reports to A, including also the employee A. The reporting unit of Jaime will always be the entire company (all the employees).

An organization growing is good news, and it does not mean only good news for Jaime, but for all the employees, during the last year Jaime hired a software company to develop an employee recognition program. This recognition program gives points to employees who have excelled in their work, and also it can give points to all the managerial chain of an employee if the employee has contributed significantly to the company, this is, in some cases the recognition points are earned only to an employee, in other cases the same amount of recognition points will be earned to the employee, the employee's manager, the employee's manager's manager, and so on until they reach Jaime.

Jaime has recorded all the M recognition prizes the company has granted to the employees during the year, and now, he wants to answer some queries that the software he has is incapable to answer: how many recognition points employee A has earned, and how many recognition points have been distributed to the entire reporting units of employee B. Since you have helped Jaime before, he came to you asking for help. Your task is to write a program, knowing who is the manager of each employee and the M recognition prizes, to answer all of Jaime's queries.

Input

he first line of input contains three integer numbers separated by a space, N, M, and Q ($1 \leq N, M, Q \leq 10^6$), representing the number of employees in Jaime's company, the number of recognition prizes, and the number of queries Jaime wants to answer. The next line contains N integer numbers separated by a space, where the i-th number in the line represents the id of the employee who is the manager of employee i, since Jaime does not have a manager, his manager in the input will have the id 0.

The next M lines contains three integer numbers separated by a space m_i ($1 \leq m_i \leq 2$), e_i ($1 \leq e_i \leq N$), v_i ($1 \leq v_i \leq 10$), describing the i-th recognition prize. If $m_i = 1$, then the recognition prize of v_i points was earned by the individual employee e_i, if $m_i = 2$ then the recognition prize of v_i points was earned to the managerial chain of employee e_i.

The next Q lines contains two integer numbers separated by a space t_i ($1 \leq t_i \leq 2$) and e_i ($1 \leq e_i \leq N$), each describing one of Jaimes queries. If $t_i = 1$, Jaime wants to know how many recognition points employee e_i earned. If $t_i = 2$, Jaime wants to know how many recognition points were distributed to the reporting unit of employee e_i.

Output

For each of Jaime's queries print a line with a single integer number, where the i-th line contains the answer to the i-th query Jaime made.

Sample input 1	**Sample output 1**
5 5 7 2 3 0 2 3 1 1 1 1 2 1 1 4 1 2 5 3 2 1 2 1 1 1 2 1 3 1 4 1 5 2 2 2 3	3 3 5 1 3 7 15

Problem H – Problem H

Alice and Bob are playing a new game with cards, the game is played with a deck which contains N cards, each card has a color blue or red, and half of the cards in the deck are blue, half are red. At the beginning of the game Alice will shuffle the deck, and will ask Bob to "cut the deck", which means to take a stack of cards off the top from the deck and place it on the bottom. For example, if a deck with 6 cards has the following configuration after shuffling: 'BRRRBB' and Bob cuts the deck at card 2, then the resulting deck will be 'RRBBBR'. Once the deck is cut by Bob, the game begins, Alice will start from the top of the deck, turning one card at a time, if in some point there are more red cards showing than blue cards, then, Alice wins the game, if Alice gets to turn all the cards from the deck, then Bob wins.

Bob insists this is unfair as he has not been able to win any of the games against Alice, he believes the secret for him to win is to properly select the card at which he has to cut the deck, so he will practice his technique shuffling a deck of cards and then selecting the card where to cut. Can you help Bob to given a deck configuration determine where he has to cut the deck in order to win the game?

Input

The first line of input contains a single integer T ($1 \leq T \leq 100$), the number of test cases. Each of the next T lines contains a string S representing the deck Bob has to cut, if the character at position i in the string is a 'B', it means the card at position i has blue color, if the character is 'R', the card has a red color. The length N ($1 \leq N \leq 10^6$) of the string will always be even, and it is guaranteed it has the same amount of 'R' and 'B'.

Output

For each test in the input print a line containing the number of cards Bob has to take from the top of the deck when cutting the deck so he can win the game, if more than one solution exists, print the one with the fewest number of cards. In case this is not possible print "-1" for that case.

Sample input 1	**Sample output 1**
3 BRBR RBRB BBRRRB	0 1 5

Problem I – Problem I

In the advanced kingdom of Techlandia, you have a set of computers that you want to fully connect into a network. To connect any two computers, both need available ports. However, enabling ports on each computer has a cost associated with it, and the more ports you enable, the higher the cost becomes.

The cost to enable k ports on computer i is $a_i \times k^2$, where a_i is a unique coefficient that determines how expensive it is to enable ports on that particular computer.

Your goal is to determine the minimum total cost required to enable enough ports across all computers such that all computers can connect to one another, directly or indirectly.

Given the number of computers and the costs associated with enabling ports on each computer, find the minimum total cost to enable enough ports such that any computer can connect to any other.

Input

The first line contains an integer N ($2 \leq N \leq 5x10^5$) — the number of computers.

The second line contains N integers $a_1, a_2, \ldots, a_N$ ($1 \leq a_i \leq 1000$) — the coefficient a_i for each computer i, which defines the cost to enable ports on that computer.

Output

Output a single integer representing the minimum total cost to enable enough ports to ensure that all computers can be fully connected.

Sample input 1	**Sample output 1**
5 1 1 1 1 1	14

Sample input 2	**Sample output 2**
5 1 2 3 4 5	29