8VC Venture Cup 2016 - Final Round (Div. 1 Edition)

A. Island Puzzle

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

A remote island chain contains n islands, labeled 1 through n. Bidirectional bridges connect the islands to form a simple cycle — a bridge connects islands 1 and 2, islands 2 and 3, and so on, and additionally a bridge connects islands n and 1. The center of each island contains an identical pedestal, and all but one of the islands has a fragile, uniquely colored statue currently held on the pedestal. The remaining island holds only an empty pedestal.

The islanders want to rearrange the statues in a new order. To do this, they repeat the following process: First, they choose an island directly adjacent to the island containing an empty pedestal. Then, they painstakingly carry the statue on this island across the adjoining bridge and place it on the empty pedestal.

Determine if it is possible for the islanders to arrange the statues in the desired order.

Input

The first line contains a single integer n ($2 \le n \le 200\,000$) — the total number of islands.

The second line contains n space-separated integers a_i ($0 \le a_i \le n - 1$) — the statue currently placed on the i-th island. If $a_i = 0$, then the island has no statue. It is guaranteed that the a_i are distinct.

The third line contains n space-separated integers b_i ($0 \le b_i \le n - 1$) — the desired statues of the ith island. Once again, $b_i = 0$ indicates the island desires no statue. It is guaranteed that the b_i are distinct.

Output

Print "YES" (without quotes) if the rearrangement can be done in the existing network, and "NO" otherwise.

Examples

input
3 1 0 2 2 0 1
output
YES

input
2 1 0 0 1
output
YES

input
4 1 2 3 0 0 3 2 1
output
NO

Note

In the first sample, the islanders can first move statue 1 from island 1 to island 2, then move statue 2 from island 3 to island 1, and finally move statue 1 from island 2 to island 3.

In the second sample, the islanders can simply move statue 1 from island 1 to island 2.

In the third sample, no sequence of movements results in the desired position.

B. XOR Equation

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Two **positive** integers a and b have a sum of s and a bitwise XOR of x. How many possible values are there for the ordered pair (a, b)?

Input

The first line of the input contains two integers s and x ($2 \leq s \leq 10^{12}$, $0 \leq x \leq 10^{12}$), the sum and bitwise xor of the pair of positive integers, respectively.

Output

Print a single integer, the number of solutions to the given conditions. If no solutions exist, print 0.

Examples

input
9 5
output
4

input
3 3
output
2

input
5 2
output
0

Note

In the first sample, we have the following solutions: $(2, 7)$, $(3, 6)$, $(6, 3)$, $(7, 2)$.

In the second sample, the only solutions are $(1, 2)$ and $(2, 1)$.

C. Factory Repairs

time limit per test: 4 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

A factory produces thimbles in bulk. Typically, it can produce up to a thimbles a day. However, some of the machinery is defective, so it can currently only produce b thimbles each day. The factory intends to choose a k-day period to do maintenance and construction; it cannot produce any thimbles during this time, but will be restored to its full production of a thimbles per day after the k days are complete.

Initially, no orders are pending. The factory receives updates of the form d_i, a_i, indicating that a_i new orders have been placed for the d_i-th day. Each order requires a single thimble to be produced on precisely the specified day. The factory may opt to fill as many or as few of the orders in a single batch as it likes.

As orders come in, the factory owner would like to know the maximum number of orders he will be able to fill if he starts repairs on a given day p_i. Help the owner answer his questions.

Input

The first line contains five integers n, k, a, b, and q ($1 \le k \le n \le 200\,000$, $1 \le b < a \le 10\,000$, $1 \le q \le 200\,000$) — the number of days, the length of the repair time, the production rates of the factory, and the number of updates, respectively.

The next q lines contain the descriptions of the queries. Each query is of one of the following two forms:

- $1\ d_i\ a_i$ ($1 \le d_i \le n$, $1 \le a_i \le 10\,000$), representing an update of a_i orders on day d_i, or
- $2\ p_i$ ($1 \le p_i \le n - k + 1$), representing a question: at the moment, how many orders could be filled if the factory decided to commence repairs on day p_i?

It's guaranteed that the input will contain at least one query of the second type.

Output

For each query of the second type, print a line containing a single integer — the maximum number of orders that the factory can fill over all n days.

Examples

input
5 2 2 1 8 1 1 2 1 5 3 1 2 1 2 2 1 4 2 1 3 2 2 1 2 3
output
3 6 4

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

Note

Consider the first sample.

We produce up to 1 thimble a day currently and will produce up to 2 thimbles a day after repairs. Repairs take 2 days.

For the first question, we are able to fill 1 order on day 1, no orders on days 2 and 3 since we are repairing, no orders on day 4 since no thimbles have been ordered for that day, and 2 orders for day 5 since we are limited to our production capacity, for a total of 3 orders filled.

For the third question, we are able to fill 1 order on day 1, 1 order on day 2, and 2 orders on day 5, for a total of 4 orders.

D. Package Delivery

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Johnny drives a truck and must deliver a package from his hometown to the district center. His hometown is located at point 0 on a number line, and the district center is located at the point d.

Johnny's truck has a gas tank that holds exactly n liters, and his tank is initially full. As he drives, the truck consumes exactly one liter per unit distance traveled. Moreover, there are m gas stations located at various points along the way to the district center. The i-th station is located at the point x_i on the number line and sells an unlimited amount of fuel at a price of p_i dollars per liter. Find the minimum cost Johnny must pay for fuel to successfully complete the delivery.

Input

The first line of input contains three space separated integers d, n, and m ($1 \le n \le d \le 10^9$, $1 \le m \le 200\ 000$) — the total distance to the district center, the volume of the gas tank, and the number of gas stations, respectively.

Each of the next m lines contains two integers x_i, p_i ($1 \le x_i \le d - 1$, $1 \le p_i \le 10^6$) — the position and cost of gas at the i-th gas station. It is guaranteed that the positions of the gas stations are distinct.

Output

Print a single integer — the minimum cost to complete the delivery. If there is no way to complete the delivery, print -1.

Examples

input
10 4 4 3 5 5 8 6 3 8 4
output
22

input
16 5 2 8 2 5 1
output
-1

Note

In the first sample, Johnny's truck holds 4 liters. He can drive 3 units to the first gas station, buy 2 liters of gas there (bringing the tank to 3 liters total), drive 3 more units to the third gas station, buy 4 liters there to fill up his tank, and then drive straight to the district center. His total cost is $2 \cdot 5 + 4 \cdot 3 = 22$ dollars.

In the second sample, there is no way for Johnny to make it to the district center, as his tank cannot hold enough gas to take him from the latest gas station to the district center.

E. Preorder Test

time limit per test: 7 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

For his computer science class, Jacob builds a model tree with sticks and balls containing n nodes in the shape of a tree. Jacob has spent a_i minutes building the i-th ball in the tree.

Jacob's teacher will evaluate his model and grade Jacob based on the effort he has put in. However, she does not have enough time to search his whole tree to determine this; Jacob knows that she will examine the first k nodes in a DFS-order traversal of the tree. She will then assign Jacob a grade equal to the minimum a_i she finds among those k nodes.

Though Jacob does not have enough time to rebuild his model, he can choose the root node that his teacher starts from. Furthermore, he can rearrange the list of neighbors of **each node** in any order he likes. Help Jacob find the best grade he can get on this assignment.

A DFS-order traversal is an ordering of the nodes of a rooted tree, built by a recursive DFS-procedure initially called on the root of the tree. When called on a given node v, the procedure does the following:

1. Print v.
2. Traverse the list of neighbors of the node v in order and iteratively call DFS-procedure on each one. Do not call DFS-procedure on node u if you came to node v directly from u.

Input

The first line of the input contains two positive integers, n and k ($2 \le n \le 200\,000$, $1 \le k \le n$) — the number of balls in Jacob's tree and the number of balls the teacher will inspect.

The second line contains n integers, a_i ($1 \le a_i \le 1\,000\,000$), the time Jacob used to build the i-th ball.

Each of the next $n - 1$ lines contains two integers u_i, v_i ($1 \le u_i, v_i \le n$, $u_i \neq v_i$) representing a connection in Jacob's tree between balls u_i and v_i.

Output

Print a single integer — the maximum grade Jacob can get by picking the right root of the tree and rearranging the list of neighbors.

Examples

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

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

Note

In the first sample, Jacob can root the tree at node 2 and order 2's neighbors in the order 4, 1, 5 (all other nodes have at most two neighbors). The resulting preorder traversal is 2, 4, 1, 3, 5, and the minimum a_i of the first 3 nodes is 3.

In the second sample, it is clear that any preorder traversal will contain node 1 as either its first or second node, so Jacob cannot do better than a grade of 1.

F. Orchestra

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Paul is at the orchestra. The string section is arranged in an $r \times c$ rectangular grid and is filled with violinists with the exception of n violists. Paul really likes violas, so he would like to take a picture including at least k of them. Paul can take a picture of any axis-parallel rectangle in the orchestra. Count the number of possible pictures that Paul can take.

Two pictures are considered to be different if the coordinates of corresponding rectangles are different.

Input

The first line of input contains four space-separated integers r, c, n, k ($1 \le r, c, n \le 3000$, $1 \le k \le min(n, 10)$) — the number of rows and columns of the string section, the total number of violas, and the minimum number of violas Paul would like in his photograph, respectively.

The next n lines each contain two integers x_i and y_i ($1 \le x_i \le r$, $1 \le y_i \le c$): the position of the i-th viola. It is guaranteed that no location appears more than once in the input.

Output

Print a single integer — the number of photographs Paul can take which include at least k violas.

Examples

input
2 2 1 1 1 2
output
4

input
3 2 3 3 1 1 3 1 2 2
output
1

input
3 2 3 2 1 1 3 1 2 2
output
4

Note

We will use '*' to denote violinists and '#' to denote violists.

In the first sample, the orchestra looks as follows:

*#
**

Paul can take a photograph of just the viola, the 1×2 column containing the viola, the 2×1 row containing the viola, or the entire string section, for 4 pictures total.

In the second sample, the orchestra looks as follows:

#*
*#
#*

Paul must take a photograph of the entire section.

In the third sample, the orchestra looks the same as in the second sample.