Problem A. Meet in the Middle

Time Limit 1000 ms
Mem Limit 524288 kB

You are given an array of n numbers. In how many ways can you choose a subset of the numbers with sum x?

Input

The first input line has two numbers n and x: the array size and the required sum.

The second line has n integers $t_1, t_2, \dots, t_n$: the numbers in the array.

Output

Print the number of ways you can create the sum x.

Constraints

- $1 \le n \le 40$
- $1 \le x \le 10^9$
- $1 \le t_i \le 10^9$

Example

Input	Output
4 5 1 2 3 2	3

Problem B. Hamming Distance

Time Limit 1000 ms

Mem Limit 524288 kB

The Hamming distance between two strings a and b of equal length is the number of positions where the strings differ.

You are given n bit strings, each of length k and your task is to calculate the minimum Hamming distance between two strings.

Input

The first input line has two integers n and k: the number of bit strings and their length.

Then there are n lines each consisting of one bit string of length k.

Output

Print the minimum Hamming distance between two strings.

Constraints

- $2 \leq n \leq 2 \cdot 10^4$
- $1 \leq k \leq 30$

Example

Input	Output
5 6 110111 001000 100001 101000 101110	1

Explanation: The strings `101000` and `001000` differ only at the first position.

Problem C. Corner Subgrid Check

Time Limit 1000 ms
Mem Limit 524288 kB

You are given a grid of letters. Your task is to find subgrids whose height and width is at least two and all the corners have the same letter.

For each letter, check if there is a valid subgrid whose corners have that letter.

Input

The first line has two integers n and k: the size of the grid and the number of letters. The letters are the first k uppercase letters.

After this, there are n lines that describe the grid. Each line has n letters.

Output

Print k lines: for each letter, `YES` if there is a valid subgrid and `NO` otherwise.

Constraints

- $1 \leq n \leq 3000$
- $1 \leq k \leq 26$

Example

Input	Output
4 5 AAAA CBBC CBBE AAAA	YES YES NO NO NO

Problem D. Corner Subgrid Count

Time Limit 1000 ms
Mem Limit 524288 kB

You are given an $n \times n$ grid whose each square is either black or white. A subgrid is called *beautiful* if its height and width is at least two and all of its corners are black. How many beautiful subgrids are there within the given grid?

Input

The first input line has an integer n: the size of the grid.

Then there are n lines describing the grid: `1` means that a square is black and `0` means it is white.

Output

Print the number of beautiful subgrids.

Constraints

- $1 \le n \le 3000$

Example

Input	Output
5 00010 11111 00110 11001 00010	4

Problem E. Reachable Nodes

Time Limit 1000 ms
Mem Limit 524288 kB

A directed acyclic graph consists of n nodes and m edges. The nodes are numbered $1, 2, \ldots, n$.

Calculate for each node the number of nodes you can reach from that node (including the node itself).

Input

The first input line has two integers n and m: the number of nodes and edges.

Then there are m lines describing the edges. Each line has two distinct integers a and b: there is an edge from node a to node b.

Output

Print n integers: for each node the number of reachable nodes.

Constraints

- $1 \leq n \leq 5 \cdot 10^4$
- $1 \leq m \leq 10^5$

Example

<table>
<tr><th>Input</th><th>Output</th></tr>
<tr><td><pre>5 6
1 2
1 3
1 4
2 3
3 5
4 5</pre></td><td><pre>5 3 2 2 1</pre></td></tr>
</table>

Problem F. Reachability Queries

Time Limit 1000 ms

Mem Limit 524288 kB

A directed graph consists of n nodes and m edges. The edges are numbered $1, 2, \dots, n$.

Your task is to answer q queries of the form "can you reach node b from node a?"

Input

The first input line has three integers n, m and q: the number of nodes, edges and queries.

Then there are m lines describing the edges. Each line has two distinct integers a and b: there is an edge from node a to node b.

Finally there are q lines describing the queries. Each line consists of two integers a and b: "can you reach node b from node a?"

Output

Print the answer for each query: either "YES" or "NO".

Constraints

- $1 \leq n \leq 5 \cdot 10^4$
- $1 \leq m, q \leq 10^5$

Example

Input	Output
4 4 3 1 2 2 3 3 1 4 3 1 3 1 4 4 1	YES NO YES

Problem G. Cut and Paste

Time Limit 1000 ms
Mem Limit 524288 kB

Given a string, your task is to process operations where you cut a substring and paste it to the end of the string. What is the final string after all the operations?

Input

The first input line has two integers n and m: the length of the string and the number of operations. The characters of the string are numbered $1, 2, \ldots, n$.

The next line has a string of length n that consists of characters A–Z.

Finally, there are m lines that describe the operations. Each line has two integers a and b: you cut a substring from position a to position b.

Output

Print the final string after all the operations.

Constraints

- $1 \leq n, m \leq 2 \cdot 10^5$
- $1 \leq a \leq b \leq n$

Example

Input	Output
7 2 AYBABTU 3 5 3 5	AYABTUB

Problem H. Substring Reversals

Time Limit 1000 ms
Mem Limit 524288 kB

Given a string, your task is to process operations where you reverse a substring of the string. What is the final string after all the operations?

Input

The first input line has two integers n and m: the length of the string and the number of operations. The characters of the string are numbered $1, 2, \ldots, n$.

The next line has a string of length n that consists of characters A–Z.

Finally, there are m lines that describe the operations. Each line has two integers a and b: you reverse a substring from position a to position b.

Output

Print the final string after all the operations.

Constraints

- $1 \leq n, m \leq 2 \cdot 10^5$
- $1 \leq a \leq b \leq n$

Example

Input	Output
7 2 AYBABTU 3 4 4 7	AYAUTBB

Problem I. Reversals and Sums

Time Limit 1000 ms
Mem Limit 524288 kB

Given an array of n integers, you have to process following operations:

1. reverse a subarray
2. calculate the sum of values in a subarray

Input

The first input line has two integers n and m: the size of the array and the number of operations. The array elements are numbered $1, 2, \ldots, n$.

The next line as n integers $x_1, x_2, \ldots, x_n$: the contents of the array.

Finally, there are m lines that describe the operations. Each line has three integers t, a and b. If $t = 1$, you should reverse a subarray from a to b. If $t = 2$, you should calculate the sum of values from a to b.

Output

Print the answer to each operation where $t = 2$.

Constraints

- $1 \leq n \leq 2 \cdot 10^5$
- $1 \leq m \leq 10^5$
- $0 \leq x_i \leq 10^9$
- $1 \leq a \leq b \leq n$

Example

Input	Output
8 3 2 1 3 4 5 3 4 4 2 2 4 1 3 6 2 2 4	8 9

Problem J. Necessary Roads

Time Limit 1000 ms
Mem Limit 524288 kB

There are n cities and m roads between them. There is a route between any two cities.

A road is called *necessary* if there is no route between some two cities after removing that road. Your task is to find all necessary roads.

Input

The first input line has two integers n and m: the number of cities and roads. The cities are numbered $1, 2, \ldots, n$.

After this, there are m lines that describe the roads. Each line has two integers a and b: there is a road between cities a and b. There is at most one road between two cities, and every road connects two distinct cities.

Output

First print an integer k: the number of necessary roads. After that, print k lines that describe the roads. You may print the roads in any order.

Constraints

- $2 \le n \le 10^5$
- $1 \le m \le 2 \cdot 10^5$
- $1 \le a, b \le n$

Example

Input	Output
5 5 1 2 1 4 2 4 3 5 4 5	2 3 5 4 5

Problem K. Necessary Cities

Time Limit 1000 ms
Mem Limit 524288 kB

There are n cities and m roads between them. There is a route between any two cities.

A city is called *necessary* if there is no route between some other two cities after removing that city (and adjacent roads). Your task is to find all necessary cities.

Input

The first input line has two integers n and m: the number of cities and roads. The cities are numbered $1, 2, \ldots, n$.

After this, there are m lines that describe the roads. Each line has two integers a and b: there is a road between cities a and b. There is at most one road between two cities, and every road connects two distinct cities.

Output

First print an integer k: the number of necessary cities. After that, print a list of k cities. You may print the cities in any order.

Constraints

- $2 \le n \le 10^5$
- $1 \le m \le 2 \cdot 10^5$
- $1 \le a, b \le n$

Example

Input	Output
5 5 1 2 1 4 2 4 3 5 4 5	2 4 5

Problem L. Eulerian Subgraphs

Time Limit 1000 ms
Mem Limit 524288 kB

You are given an undirected graph that has n nodes and m edges.

We consider subgraphs that have all nodes of the original graph and some of its edges. A subgraph is called *Eulerian* if each node has even degree.

Your task is to count the number of Eulerian subgraphs modulo $10^9 + 7$.

Input

The first input line has two integers n and m: the number of nodes and edges. The nodes are numbered $1, 2, \ldots, n$.

After this, there are m lines that describe the edges. Each line has two integers a and b: there is an edge between nodes a and b. There is at most one edge between two nodes, and each edge connects two distinct nodes.

Output

Print the number of Eulerian subgraphs modulo $10^9 + 7$.

Constraints

- $1 \leq n \leq 10^5$
- $0 \leq m \leq 2 \cdot 10^5$
- $1 \leq a, b \leq n$

Example

Input	Output
4 3 1 2 1 3 2 3	2

Explanation: You can either keep or remove all edges, so there are two possible Eulerian subgraphs.

Problem M. Monster Game I

Time Limit 1000 ms
Mem Limit 524288 kB

You are playing a game that consists of n levels. Each level has a monster. On levels $1, 2, \ldots, n-1$, you can either kill or escape the monster. However, on level n you must kill the final monster to win the game.

Killing a monster takes sf time where s is the monster's strength and f is your skill factor (lower skill factor is better). After killing a monster, you get a new skill factor. What is the minimum total time in which you can win the game?

Input

The first input line has two integers n and x: the number of levels and your initial skill factor.

The second line has n integers $s_1, s_2, \ldots, s_n$: each monster's strength.

The third line has n integers $f_1, f_2, \ldots, f_n$: your new skill factor after killing a monster.

Output

Print one integer: the minimum total time to win the game.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $1 \le x \le 10^6$
- $1 \le s_1 \le s_2 \le \cdots \le s_n \le 10^6$
- $x \ge f_1 \ge f_2 \ge \cdots \ge f_n \ge 1$

Example

Input	Output
5 100 20 30 30 50 90 90 60 20 20 10	4800

Explanation: The best way to play is to kill the third and fifth monster.

Problem N. Monster Game II

Time Limit 1000 ms
Mem Limit 524288 kB

You are playing a game that consists of n levels. Each level has a monster. On levels $1, 2, \ldots, n-1$, you can either kill or escape the monster. However, on level n you must kill the final monster to win the game.

Killing a monster takes sf time where s is the monster's strength and f is your skill factor. After killing a monster, you get a new skill factor (lower skill factor is better). What is the minimum total time in which you can win the game?

Input

The first input line has two integers n and x: the number of levels and your initial skill factor.

The second line has n integers $s_1, s_2, \ldots, s_n$: each monster's strength.

The third line has n integers $f_1, f_2, \ldots, f_n$: your new skill factor after killing a monster.

Output

Print one integer: the minimum total time to win the game.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $1 \le x \le 10^6$
- $1 \le s_i, f_i \le 10^6$

Example

Input	Output
5 100 50 20 30 90 30 60 20 20 10 90	2600

Explanation: The best way to play is to kill the second and fifth monster.

Problem O. Subarray Squares

Time Limit 1000 ms
Mem Limit 524288 kB

Given an array of n elements, your task is to divide into k subarrays. The cost of each subarray is the square of the sum of the values in the subarray. What is the minimum total cost if you act optimally?

Input

The first input line has two integers n and k: the array elements and the number of subarrays. The array elements are numbered $1, 2, \ldots, n$.

The second line has n integers $x_1, x_2, \ldots, x_n$: the contents of the array.

Output

Print one integer: the minimum total cost.

Constraints

- $1 \leq k \leq n \leq 3000$
- $1 \leq x_i \leq 10^5$

Example

Input	Output
8 3 2 3 1 2 2 3 4 1	110

Explanation: An optimal solution is $[2, 3, 1]$, $[2, 2, 3]$, $[4, 1]$, whose cost is $(2 + 3 + 1)^2 + (2 + 2 + 3)^2 + (4 + 1)^2 = 110$.

Problem P. Houses and Schools

Time Limit 1000 ms
Mem Limit 524288 kB

There are n houses on a street, numbered $1, 2, \ldots, n$. The distance of houses a and b is $|a - b|$. You know the number of children in each house.

Your task is to establish k schools in such a way that each school is in some house. Then, each child goes to the nearest school. What is the minimum total walking distance of the children if you act optimally?

Input

The first input line has two integers n and k: the number of houses and the number of schools. The houses are numbered $1, 2 \ldots, n$.

After this, there are n integers $c_1, c_2, \ldots, c_n$: the number of children in each house.

Output

Print the minimum total distance.

Constraints

- $1 \leq k \leq n \leq 3000$
- $1 \leq c_i \leq 10^9$

Example

Input	Output
6 2 2 7 1 4 6 4	11

Explanation: Houses 2 and 5 will have schools.

Problem Q. Knuth Division

Time Limit 1000 ms
Mem Limit 524288 kB

Given an array of n numbers, your task is to divide it into n subarrays, each of which has a single element.

On each move, you may choose any subarray and split it into two subarrays. The cost of such a move is the sum of values in the chosen subarray.

What is the minimum total cost if you act optimally?

Input

The first input line has an integer n: the array size. The array elements are numbered $1, 2, \ldots, n$.

The second line has n integers $x_1, x_2, \ldots, x_n$: the contents of the array.

Output

Print one integer: the minimum total cost.

Constraints

- $1 \le n \le 5000$
- $1 \le x_i \le 10^9$

Example

Input	Output
5 2 7 3 2 5	43

Problem R. Apples and Bananas

Time Limit 1000 ms
Mem Limit 524288 kB

There are n apples and m bananas, and each of them has an integer weight between $1 \dots k$. Your task is to calculate, for each weight w between $2 \dots 2k$, the number of ways we can choose an apple and a banana whose combined weight is w.

Input

The first input line contains three integers k, n and m: the number k, the number of apples and the number of bananas.

The next line contains n integers $a_1, a_2, \dots, a_n$: weight of each apple.

The last line contains m integers $b_1, b_2, \dots, b_m$: weight of each banana.

Output

For each integer w between $2 \dots 2k$ print the number of ways to choose an apple and a banana whose combined weight is w.

Constraints

- $1 \leq k, n, m \leq 2 \cdot 10^5$
- $1 \leq a_i \leq k$
- $1 \leq b_i \leq k$

Example

Input	Output
5 3 4 5 2 5 4 3 2 3	0 0 1 2 1 2 4 2 0

Explanation: For example for w = 8 there are 4 different ways: we can pick an apple of weight 5 in two different ways and a banana of weight 3 in two different ways.

Problem S. One Bit Positions

Time Limit 1000 ms
Mem Limit 524288 kB

You are given a binary string of length n. Your task is to calculate, for every k between $1 \dots n-1$, the number of ways we can choose two positions i and j such that $i - j = k$ and there is a one-bit at both positions.

Input

The only input line has a string that consists only of characters 0 and 1.

Output

For every distance k between $1 \dots n-1$ print the number of ways we can choose two such positions.

Constraints

- $2 \le n \le 2 \cdot 10^5$

Example

Input	Output
`1001011010`	`1 2 3 0 2 1 0 1 0`

Problem T. Signal Processing

Time Limit 1000 ms
Mem Limit 524288 kB

You are given two integer sequences: a signal and a mask. Your task is to process the signal by moving the mask through the signal from left to right. At each mask position calculate the sum of products of aligned signal and mask values in the part where the signal and the mask overlap.

Input

The first input line consists of two integers n and m: the length of the signal and the length of the mask.

The next line consists of n integers $a_1, a_2, \ldots, a_n$ defining the signal.

The last line consists of m integers $b_1, b_2, \ldots, b_m$ defining the mask.

Output

Print $n + m - 1$ integers: the sum of products of aligned values at each mask position from left to right.

Constraints

- $1 \le n, m \le 2 \cdot 10^5$
- $1 \le a_i, b_i \le 100$

Example

Input	Output
5 3 1 3 2 1 4 1 2 3	3 11 13 10 16 9 4

Explanation: For example, at the second mask position the sum of aligned products is $2 \cdot 1 + 3 \cdot 3 = 11$.

Problem U. New Roads Queries

Time Limit 1000 ms
Mem Limit 524288 kB

There are n cities in Byteland but no roads between them. However, each day, a new road will be built. There will be a total of m roads.

Your task is to process q queries of the form: "after how many days can we travel from city a to city b for the first time?"

Input

The first input line has three integers n, m and q: the number of cities, roads and queries. The cities are numbered $1, 2, \ldots, n$.

After this, there are m lines that describe the roads in the order they are built. Each line has two integers a and b: there will be a road between cities a and b.

Finally, there are q lines that describe the queries. Each line has two integers a and b: we want to travel from city a to city b.

Output

For each query, print the number of days, or -1 if it is never possible.

Constraints

- $1 \leq n, m, q \leq 2 \cdot 10^5$
- $1 \leq a, b \leq n$

Example

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

Problem V. Dynamic Connectivity

Time Limit 1000 ms
Mem Limit 524288 kB

Consider an undirected graph that consists of n nodes and m edges. There are two types of events that can happen:

1. A new edge is created between nodes a and b.
2. An existing edge between nodes a and b is removed.

Your task is to report the number of components after every event.

Input

The first input line has three integers n, m and k: the number of nodes, edges and events.

After this there are m lines describing the edges. Each line has two integers a and b: there is an edge between nodes a and b. There is at most one edge between any pair of nodes.

Then there are k lines describing the events. Each line has the form "t a b" where t is 1 (create a new edge) or 2 (remove an edge). A new edge is always created between two nodes that do not already have an edge between them, and only existing edges can get removed.

Output

Print $k+1$ integers: first the number of components before the first event, and after this the new number of components after each event.

Constraints

- $2 \leq n \leq 10^5$
- $1 \leq m, k \leq 10^5$
- $1 \leq a, b \leq n$

Example

<table>
<tr><th>Input</th><th>Output</th></tr>
<tr><td>5 3 3
1 4
2 3
3 5
1 2 5
2 3 5
1 1 2</td><td>2 2 2 1</td></tr>
</table>

Problem W. Parcel Delivery

Time Limit 1000 ms
Mem Limit 524288 kB

There are n cities and m routes through which parcels can be carried from one city to another city. For each route, you know the maximum number of parcels and the cost of a single parcel.

You want to send k parcels from Syrjälä to Lehmälä. What is the cheapest way to do that?

Input

The first input line has three integers n, m and k: the number of cities, routes and parcels. The cities are numbered $1, 2, \ldots, n$. City 1 is Syrjälä and city n is Lehmälä.

After this, there are m lines that describe the routes. Each line has four integers a, b, r and c: there is a route from city a to city b, at most r parcels can be carried through the route, and the cost of each parcel is c.

Output

Print one integer: the minimum total cost or -1 if there are no solutions.

Constraints

- $2 \leq n \leq 500$
- $1 \leq m \leq 1000$
- $1 \leq k \leq 100$
- $1 \leq a, b \leq n$
- $1 \leq r, c \leq 1000$

Example

Input	Output
4 5 3 1 2 5 100 1 3 10 50 1 4 7 500 2 4 8 350 3 4 2 100	750

Explanation: One parcel is delivered through route $1 \to 2 \to 4$ (cost $1 \cdot 450 = 450$) and two parcels are delivered through route $1 \to 3 \to 4$ (cost $2 \cdot 150 = 300$).

Problem X. Task Assignment

Time Limit 1000 ms
Mem Limit 524288 kB

A company has n employees and there are n tasks that need to be done. We know for each employee the cost of carrying out each task. Every employee should be assigned to exactly one task. What is the minimum total cost if we assign the tasks optimally and how could they be assigned?

Input

The first input line has one integer n: the number of employees and the number of tasks that need to be done.

After this, there are n lines each consisting of n integers. The ith line consists of integers $c_{i1}, c_{i2}, \ldots, c_{in}$: the cost of each task when it is assigned to the ith employee.

Output

First print the minimum total cost.

Then print n lines each consisting of two integers a and b: you assign the bth task to the a th employee.

If there are multiple solutions you can print any of them.

Constraints

- $1 \le n \le 200$
- $1 \le c_{ij} \le 1000$

Example

Input	Output
4 17 8 16 9 7 15 12 19 6 9 10 11 14 7 13 10	33 1 4 2 1 3 3 4 2

Explanation: The minimum total cost is 33. We can reach this by assigning employee 1 task 4, employee 2 task 1, employee 3 task 3 and employee 4 task 2. This will cost $9 + 7 + 10 + 7 = 33$.

Problem Y. Distinct Routes II

Time Limit 1000 ms
Mem Limit 524288 kB

A game consists of n rooms and m teleporters. At the beginning of each day, you start in room 1 and you have to reach room n.

You can use each teleporter at most once during the game. You want to play the game for exactly k days. Every time you use any teleporter you have to pay one coin. What is the minimum number of coins you have to pay during k days if you play optimally?

Input

The first input line has three integers n, m and k: the number of rooms, the number of teleporters and the number of days you play the game. The rooms are numbered $1, 2, \ldots, n$.

After this, there are m lines describing the teleporters. Each line has two integers a and b: there is a teleporter from room a to room b.

There are no two teleporters whose starting and ending room are the same.

Output

First print one integer: the minimum number of coins you have to pay if you play optimally. Then, print k route descriptions according to the example. You can print any valid solution.

If it is not possible to play the game for k days, print only `-1`.

Constraints

- $2 \le n \le 500$
- $1 \le m \le 1000$
- $1 \le k \le n - 1$
- $1 \le a, b \le n$

Example

Input	Output
8 10 2 1 2 1 3 2 5 2 4 3 5 3 6 4 8 5 8 6 7 7 8	6 4 1 2 4 8 4 1 3 5 8