1 Intercastellar

In 30XX, due to the constant efforts of scientists and engineers, interaction among different planets becomes very active. Bitaro is a beaver who is working as an ambassador of an exchange program. His task is to introduce foods from the Earth to the habitants in different planets. He will leave for the JOI Planet at 1:00 in the afternoon.

Now, Bitaro is planning to introduce castella to the habitants in the JOI Planet. The castella was already cut into several pieces. Castella is a baked sponge cake made of flour, egg, sugar, and starch syrup.

The shape of the castella is a horizontally long rectangular box. It was cut into N pieces. The length of the i-th piece ($1 \leq i \leq N$) from the left is an integer A_i.

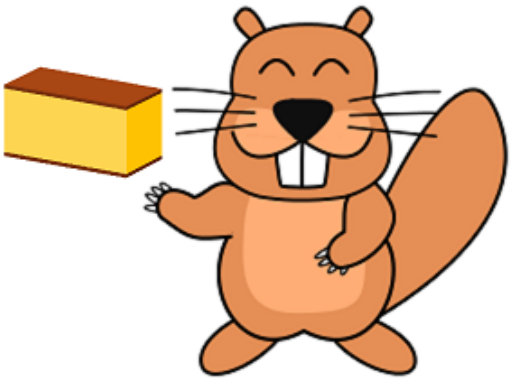
A couple of minutes ago, it turned out that the habitants in the JOI Planet do not like even integers. To cope with this problem, you will perform the following sequential operations until pieces of even length disappear.

1. Among the pieces of even length, you choose the rightmost one.
2. You cut the chosen piece into two pieces of equal length. Namely, if the length of the chosen piece is k, you cut it into two pieces of length $\frac{k}{2}$. You do not move the position of the pieces.

To confirm whether the operations are performed correctly, Bitaro will ask you Q questions. The j-th question ($1 \leq j \leq Q$) is as follows.

- After all the operations are performed, what is the length of the X_j-th piece from the left?

Given information of the castella and the questions, write a program which answer the questions.



Input

Read the following data from the standard input. Given values are all integers.

N
A_1
A_2
$\vdots$
A_N
Q
X_1
X_2
$\vdots$
X_Q

Output

Write Q lines to the standard output. The j-th line ($1 \leq j \leq Q$) should contain the answer to the j-th question.

Constraints

- $1 \leq N \leq 200\,000$.
- $1 \leq A_i \leq 1\,000\,000\,000$ ($1 \leq i \leq N$).
- $1 \leq Q \leq 200\,000$.
- $1 \leq X_j \leq 1\,000\,000\,000\,000\,000$ ($= 10^{15}$) ($1 \leq j \leq Q$).
- $X_j \leq X_{j+1}$ ($1 \leq j \leq Q - 1$).
- After all the operations are performed, the castella is cut into at least X_Q pieces.

Subtasks

1. (25 points) $A_i \leq 8$ ($1 \leq i \leq N$).
2. (35 points) $N \leq 1\,000$, $Q \leq 1\,000$.
3. (40 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
4 14 9 8 12 6 2 3 5 7 11 13	7 9 1 1 1 3

In the beginning, the lengths of the pieces of the castella are 14, 9, 8, 12 from the left.

After all the operations are performed, the castella is cut into 15 pieces. The lengths of the pieces are 7, 7, 9, 1, 1, 1, 1, 1, 1, 1, 1, 3, 3, 3, 3 from the left.

This sample input satisfies the constraints of Subtasks 2, 3.

Sample Input 2	Sample Output 2
13 1 4 1 4 2 1 3 5 6 2 3 7 3 8 2 10 11 13 15 17 18 20	1 1 1 1 5 3 1 3

This sample input satisfies the constraints of all the subtasks.

Sample Input 3	Sample Output 3
16 536870912 402653184 536870912 536870912 134217728 536870912 671088640 536870912 536870912 536870912 939524096 805306368 536870912 956301312 536870912 536870912 5 2500000000 3355443201 4294967296 5111111111 6190792704	5 1 7 57 1

This sample input satisfies the constraints of Subtasks 2, 3.

2 Self Study

In the third semester of the first grade of JOI High School, N courses are given for M weeks from the first week to the M-th week. The courses are numbered from 1 to N. In each week, N classes are given. The i-th class in each week is a class for Course i.

Bitaro is a student of the first grade. In each of the $N \times M$ classes, he takes one of the following actions.

- Action 1: Bitaro attends the class. If he attends a class for Course i ($1 \leq i \leq N$), the comprehension level of Course i will be increased by A_i.
- Action 2: Bitaro does not attend the class. Instead, he chooses any one of the courses, and studies for the chosen course by himself. If he studies for Course i ($1 \leq i \leq N$) by himself for the duration of a class, the comprehension level of Course i will be increased by B_i.

In the beginning, the comprehension level of every course is 0. Since Bitaro wants to practice competitive programming after school, he will not study outside the duration of the classes. When all the classes in the third semester finish, the final examination will be held.

Bitaro does not want to get a failing grade. Therefore, he wants to maximize the minimum comprehension level of the courses at the moment of the final examination.

Given the length of the semester, the number of the courses, and the incremental values of the comprehension levels, write a program which calculates the maximum possible value of the minimum comprehension level of the courses at the moment of the final examination.

Input

Read the following data from the standard input. Given values are all integers.

N M
A_1 A_2 $\cdots$ A_N
B_1 B_2 $\cdots$ B_N

Output

Write one line to the standard output. The output should contain the maximum possible value of the minimum comprehension level of the courses at the moment of the final examination.

Constraints

- $1 \leq N \leq 300\,000$.
- $1 \leq M \leq 1\,000\,000\,000$.
- $1 \leq A_i \leq 1\,000\,000\,000$ $(1 \leq i \leq N)$.
- $1 \leq B_i \leq 1\,000\,000\,000$ $(1 \leq i \leq N)$.

Subtasks

1. (10 points) $M = 1$.
2. (25 points) $N \times M \leq 300\,000$, $A_i = B_i$ $(1 \leq i \leq N)$.
3. (27 points) $N \times M \leq 300\,000$.
4. (29 points) $A_i = B_i$ $(1 \leq i \leq N)$.
5. (9 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
3 3 19 4 5 2 6 2	18

For example, if Bitaro studies in the following way, the compehension level of Course 1, 2, 3 will be 19, 18, 19, respectively.

- In the first week, at the time of Course 1, he studies for Course 2 by himself.
- In the first week, at the time of Course 2, he studies for Course 2 by himself.
- In the first week, at the time of Course 3, he attends the class for Course 3.
- In the second week, at the time of Course 1, he attends the class for Course 1.
- In the second week, at the time of Course 2, he studies for Course 3 by himself.
- In the second week, at the time of Course 3, he attends the class for Course 3.
- In the third week, at the time of Course 1, he studies for Course 3 by himself.
- In the third week, at the time of Course 2, he studies for Course 2 by himself.
- In the third week, at the time of Course 3, he attends the class for Course 3.

Since the minimum comprehension level of the courses cannot be larger than or equal to 19, output 18.

This sample input satisfies the constraints of Subtasks 3, 5.

Sample Input 2	Sample Output 2
2 1 9 7 2 6	7

This sample input satisfies the constraints of Subtasks 1, 3, 5.

Sample Input 3	Sample Output 3
5 60000 630510219 369411957 874325200 990002527 567203997 438920902 634940661 593780254 315929832 420627496	41397427274960

This sample input satisfies the constraints of Subtasks 3, 5.

Sample Input 4	Sample Output 4
4 25 1 2 3 4 1 2 3 4	48

This sample input satisfies the constraints of Subtasks 2, 3, 4, 5.

3 Let's Win the Election

Republic of JOI consists of N states, numbered from 1 to N. In 2022, the presidential election will be held in Republic of JOI. The election will be held in each state. The winner of the election in a state will get the vote of the state.

Rie will run for the president. She is planning to win the election. Her plan is to deliver a speech in order to increase the degree of reliability. After she delivers a speech, the following will happen.

- If the total time of speech in State i ($1 \leq i \leq N$) reaches A_i hours, she will get the vote of State i.
- If the total time of speech in State i ($1 \leq i \leq N$) reaches B_i hours, she will get a collaborator from State i. After that, the collaborator will be able to deliver a speech in order to increase the total time of speech.
- It may be the case that Rie cannot get any collaborator from State i. In this case, $B_i = -1$. Otherwise, it is guaranteed that $B_i \geq A_i$ holds.

A collaborator from State i ($1 \leq i \leq N$) may deliver a speech outside State i. More than one person may deliver a speech in the same state simultaneously. For example, if two people deliver a speech in a state for x hours, the total time of speech in the state will be increased by $2x$ hours. The time of speech needs not be an integer. We will ignore the travel time between states.

Since the election day is coming soon, Rie would like to get K votes as soon as possible.

Given the number of the states and information of each state, write a program which calculate the minimum number of hours required to get K votes.

Input

Read the following data from the standard input. Given values are all integers.

N
K
A_1 B_1
A_2 B_2
$\vdots$
A_N B_N

Output

Write one line to the standard output. The output should contain the minimum number of hours required to get K votes. Your solution will be judged correct if the absolute value of the difference from correct answer is less than or equal to 0.01. The output should be written in one of the following formats.

- An integer. (Example: `123`, `0`, `-2022`)
- A sequence consisting of an integer, a period, and a sequence of digits between 0 and 9. It should not contain separating characters. There is no restriction on the number of digits after the decimal point. (Example: `123.4`, `-123.00`, `0.00288`)

The output should not be written in exponential notation. For example, `1.23456e+05` and `1.23456e5` are not allowed.

Constraints

- $1 \leq N \leq 500$.
- $1 \leq K \leq N$.
- $1 \leq A_i \leq 1\,000$ $(1 \leq i \leq N)$.
- $A_i \leq B_i \leq 1\,000$ or $B_i = -1$ $(1 \leq i \leq N)$.

Subtasks

1. (5 points) $B_i = -1$ $(1 \leq i \leq N)$.
2. (5 points) $B_i = -1$ or $B_i = A_i$ $(1 \leq i \leq N)$.
3. (11 points) $N \leq 7$.
4. (12 points) $N \leq 20$.
5. (33 points) $N \leq 100$.
6. (11 points) $K = N$.
7. (23 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
3 3 1 5 2 3 4 5	5.500000000000000

If the election campaign is held in the following order, Rie will get the vote of every state in 5.5 hours.

1. Rie delivers a speech for 2 hours in State 2, and gets the vote of State 2.
2. Moreover, Rie delivers a speech for one hour in State 2, and gets a collaborator from State 2.
3. Rie and the collaborator deliver a speech for 2 hours in State 3, and Rie gets the vote of State 3.
4. Rie and the collaborator deliver a speech for 0.5 hour in State 1, and Rie gets the vote of State 1.

This sample input satisfies the constraints of Subtasks 3, 4, 5, 6, 7.

Sample Input 2	Sample Output 2
7 4 4 -1 11 -1 6 -1 12 -1 36 -1 11 -1 20 -1	32.000000000000000

If the election campaign is held in the following order, Rie will get 4 votes in 32 hours.

1. Rie delivers a speech for 4 hours in State 1, and gets the vote of State 1.
2. Rie delivers a speech for 11 hours in State 2, and gets the vote of State 2.
3. Rie delivers a speech for 6 hours in State 3, and gets the vote of State 3.
4. Rie delivers a speech for 11 hours in State 6, and gets the vote of State 6.

This sample input satisfies the constraints of Subtasks 1, 2, 3, 4, 5, 7.

Sample Input 3	Sample Output 3
5 3 4 -1 5 -1 6 -1 7 7 8 8	11.500000000000000

If the election campaign is held in the following order, Rie will get 3 votes in 11.5 hours.

1. Rie delivers a speech for 7 hours in State 4, and gets the vote of State 4 and a collaborator from State 4.
2. Rie delivers a speech for 4 hours in State 1, and gets the vote of State 1. At the same time, the collaborator delivers a speech for 4 hours in State 2.
3. Rie and the collaborator deliver a speech for 0.5 hour in State 2, and Rie gets the vote of State 2.

This sample input satisfies the constraints of Subtasks 2, 3, 4, 5, 7.

Sample Input 4	Sample Output 4
7 5 28 36 11 57 20 35 19 27 31 33 25 56 38 51	62.166666666666664

This sample input satisfies the constraints of Subtasks 3, 4, 5, 7.

Sample Input 5	Sample Output 5
20 14 106 277 175 217 170 227 164 245 118 254 139 261 142 270 185 200 162 241 153 239 128 264 103 299 147 248 158 236 160 232 183 205 194 197 135 260 153 234 128 260	644.203571428571422

This sample input satisfies the constraints of Subtasks 4, 5, 7.

4

Railway Trip 2

IOI Railway Company is operating lines on a railway track. There are N stations in a straight line, numbered from 1 to N. For each i ($1 \leq i \leq N-1$), Station i and Station $i+1$ are connected directly by a railway track.

IOI Railway Company is operating M lines, numbered from 1 to M. In Line j ($1 \leq j \leq M$), the starting station is Station A_j, and the terminal station is Station B_j. A train stops at every station. Namely, if $A_j < B_j$ a train of Line j stops at Station A_j, Station $A_j + 1$, ..., Station B_j, in this order. If $A_j > B_j$, a train of Line j stops at Station A_j, Station $A_j - 1$, ..., Station B_j, in this order.

JOI-kun is a traveler. He has Q travel plans. In the k-th plan ($1 \leq k \leq Q$), he travels from Station S_k to Station T_k by taking lines.

However, JOI-kun is tired from a long journey. He wants to take a vacant train and get a seat. Thus, JOI-kun decided that he takes a train of a line at a station only if it is the K-th or earlier stop from the starting station of the line. In other words, if $A_j < B_j$, he can take a train of Line j only at Station A_j, Station $A_j + 1$, ..., Station $\min\{A_j + K - 1, B_j - 1\}$. If $A_j > B_j$, he can take a train of Line j only at Station A_j, Station $A_j - 1$, ..., Station $\max\{A_j - K + 1, B_j + 1\}$. JOI-kun will get out of the train at a station between the station next to where he takes the train and the terminal station, inclusive.

Under these conditions, JOI-kun wants to minimize the number of times of taking trains.

Given the information of the lines of IOI Railway Company and JOI-kun's plans, write a program which calculates, for each of JOI-kun's plans, the minimum number of times of taking trains needed for JOI-kun to achieve it.

Input

Read the following data from the standard input. Given values are all integers.

$N\ K$
M
$A_1\ B_1$
$A_2\ B_2$
$\vdots$
$A_M\ B_M$
Q
$S_1\ T_1$
$S_2\ T_2$
$\vdots$
$S_Q\ T_Q$

Output

Write Q lines to the standard output. The k-th line ($1 \leq k \leq Q$) should contain the minimum number of times of taking trains needed for JOI-kun to achieve the k-th plan. If it is not possible to achieve the k-th plan, output `-1`.

Constraints

- $2 \leq N \leq 100\,000$.
- $1 \leq K \leq N - 1$.
- $1 \leq M \leq 200\,000$.
- $1 \leq A_j \leq N$ $(1 \leq j \leq M)$.
- $1 \leq B_j \leq N$ $(1 \leq j \leq M)$.
- $A_j \neq B_j$ $(1 \leq j \leq M)$.
- $(A_j, B_j) \neq (A_k, B_k)$ $(1 \leq j < k \leq M)$.
- $1 \leq Q \leq 50\,000$.
- $1 \leq S_k \leq N$ $(1 \leq k \leq Q)$.
- $1 \leq T_k \leq N$ $(1 \leq k \leq Q)$.

- $S_k \neq T_k$ $(1 \leq k \leq Q)$.
- $(S_k, T_k) \neq (S_l, T_l)$ $(1 \leq k < l \leq Q)$.

Subtasks

1. (8 points) $N \leq 300$, $M \leq 300$, $Q \leq 300$.
2. (8 points) $N \leq 2\,000$, $M \leq 2\,000$, $Q \leq 2\,000$.
3. (11 points) $Q = 1$.
4. (25 points) $K = N - 1$.
5. (35 points) $A_j < B_j$ $(1 \leq j \leq M)$, $S_k < T_k$ $(1 \leq k \leq Q)$.
6. (13 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
5 2 2 5 1 3 5 3 5 3 3 2 2 1	1 2 -1

In the first plan, JOI-kun travels from Station 5 to Station 3. For example, this plan is achieved if JOI-kun takes a train of Line 1 at Station 5, and get out of the train at Station 3. In total, JOI-kun will take one train. Since it is impossible to achieve the plan by taking less than one train, output 1 in the first line.

In the second plan, JOI-kun travels from Station 3 to Station 2. For example, this plan is achieved if JOI-kun takes a train of Line 2 at Station 3, get out of the train at Station 4, takes a train of Line 1 at Station 4, and get out of the train at Station 2. In total, JOI-kun will take two trains. Since it is impossible to achieve the plan by taking less than two trains, output 2 in the second line.

In the third plan, JOI-kun travels from Station 2 to Station 1. Since it is impossible for JOI-kun to achieve this plan, output -1 in the third line.

This sample input satisfies the constraints of Subtasks 1, 2, 6.

Sample Input 2	Sample Output 2
6 3 2 1 6 5 1 4 5 1 6 3 3 6 2 1	1 -1 1 2

This sample input satisfies the constraints of Subtasks 1, 2, 6.

Sample Input 3	Sample Output 3
6 5 4 3 1 2 4 5 3 4 6 5 1 5 3 2 2 6 6 3 5 4	-1 1 2 -1 1

This sample input satisfies the constraints of Subtasks 1, 2, 4, 6.

Sample Input 4	Sample Output 4
12 1 5 1 7 10 12 3 5 8 10 5 9 7 2 11 5 8 3 12 4 6 1 9 9 10 1 4	-1 1 4 -1 2 -1 1

This sample input satisfies the constraints of Subtasks 1, 2, 5, 6.

5 Sandcastle 2

JOI-kun is playing on a sand beach. He makes a sandcastle. The sandcastle made by JOI-kun is contained in a rectangular region in the sand beach. The rectangular region consists of cells of H horizontal rows and W vertical columns. The cell in the i-th row ($1 \leq i \leq H$) from the north and the j-th column ($1 \leq j \leq W$) from the west has height $A_{i,j}$. **Note that the values of $A_{i,j}$ are different from each other.**

To the sandcastle, JOI-kun performed the following actions.

1. First, JOI-kun chose a cell, and he started moving from the chosen cell.
2. Then, he moved from the current cell to an adjacent cell in one of the four direction. He had to move to a cell which is lower than the current cell. He repeated this zero or more times.

Finally, if we view the cells he visited from above, the cells form a rectangle.

Given the information of the height $A_{i,j}$ of each cell, write a program which calculates the number of possible rectangles formed by the the cells JOI-kun visited.

Input

Read the following data from the standard input. Given values are all integers.

H W
$A_{1,1}$ $A_{1,2}$ $\cdots$ $A_{1,W}$
$A_{2,1}$ $A_{2,2}$ $\cdots$ $A_{2,W}$
$\vdots$
$A_{H,1}$ $A_{H,2}$ $\cdots$ $A_{H,W}$

Output

Write one line to the standard output. The output should contain the number of possible rectangles formed by the cells JOI-kun visited.

Constraints

- $H \geq 1$.
- $W \geq 1$.
- $H \times W \leq 50\,000$.
- $1 \leq A_{i,j} \leq 10\,000\,000$ $(1 \leq i \leq H,\ 1 \leq j \leq W)$.
- $A_{i_1,j_1} \neq A_{i_2,j_2}$ $(1 \leq i_1 \leq H,\ 1 \leq j_1 \leq W,\ 1 \leq i_2 \leq H,\ 1 \leq j_2 \leq W,\ (i_1, j_1) \neq (i_2, j_2))$.

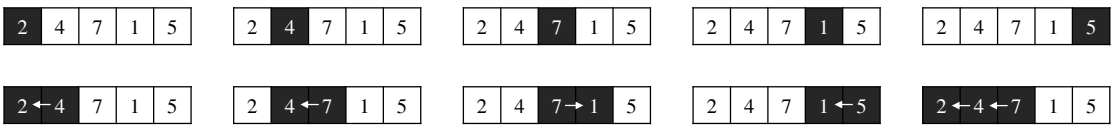
Subtasks

1. (9 points) $H = 1$.
2. (10 points) $H \times W \leq 100$.
3. (5 points) $H \times W \leq 1\,500$.
4. (56 points) $H \times W \leq 7\,000$.
5. (20 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
1 5 2 4 7 1 5	10

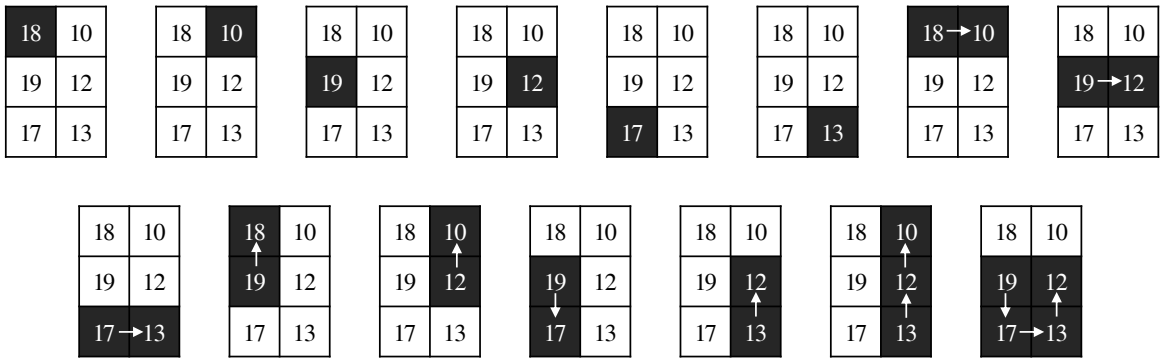
Since there are 10 possible rectangles formed by the cells JOI-kun visited, output 10.



This sample input satisfies the constraints of all Subtasks.

Sample Input 2	Sample Output 2
3 2 18 10 19 12 17 13	15

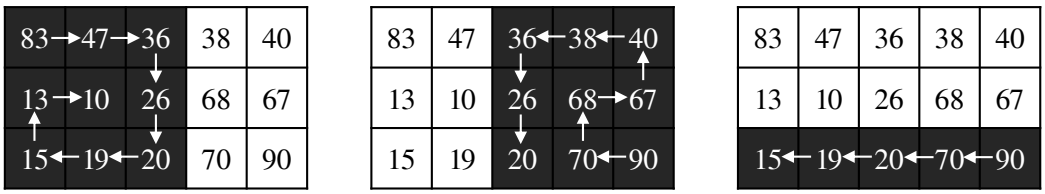
Since there are 15 possible rectangles formed by the cells JOI-kun visited, output 15.



This sample input satisfies the constraints of Subtasks 2, 3, 4, 5.

Sample Input 3	Sample Output 3
3 5 83 47 36 38 40 13 10 26 68 67 15 19 20 70 90	65

For example, the following rectangles can be formed by the cells JOI-kun visited. Since there are 65 possible rectangles in total, output 65.



This sample input satisfies the constraints of Subtasks 2, 3, 4, 5.