China Collegiate Programming Contest Guilin Site

CCPC 2021

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Problems

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Do not open before the contest has started.

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Problem A. A Hero Named Magnus

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

Dota 2 is a multiplayer online battle arena (MOBA) video game developed and published by Valve. Dota 2 is played in matches between two teams of five players, with each team occupying and defending their own separate base on the map. Each of the ten players independently controls a powerful character, known as a 'hero', who all have unique abilities and differing styles of play. During a match players collect experience points and items for their heroes to successfully defeat the opposing team's heroes in player versus player combat. A team wins by being the first to destroy the other team's 'Ancient', a large structure located within their base.

The International is an annual esports world championship tournament for the video game Dota 2, hosted and produced by the game's developer, Valve. The tournament consists of 18 teams; 12 based on final results from the Dota Pro Circuit and six more from winning regional playoffs from North America, South America, Southeast Asia, China, Eastern Europe, and Western Europe regions.

In Year 3021, The International is held in Guilin, China. Once again, just like 1000 years ago, Team LGD from China will compete against Team Spirit from Russia. But as the championship developing, the rule is that whoever wins the best of n (n is an odd positive integer) games will win the champion, so a team should win at least $\frac{n+1}{2}$ games. (In 2021, n equals to only 5 and Team Spirit won by $3:2$).

Before the game starts, teams can choose to ban specific heroes from being used by the opponent team. Among these 1000 years, everyone knows that Team Spirit is very good at using a hero called Magnus, which once helped them defeat Team LGD in 2021.

Although everyone thinks Team LGD will choose to ban Magnus from the beginning, team LGD thinks differently. Somehow they think that they are strong enough to beat the opponent's Magnus and they will only start to ban Magnus in the x-th game if there is one.

To simplify the problem, if team LGD choose to ban Magnus, they will certainly win the game. Otherwise, they may have a 50% possibility to win the game.

As one of Team LGD's fans, JB wants to know what's the minimum number of n that team LGD can win the champion in the worst case.

Input

The first line contains an integer T ($1 \le T \le 10^5$), indicating the number of test cases.

In the next following T lines, each line contains an integer x ($1 \le x \le 2 \times 10^9$), indicating that Team LGD will start to ban Magnus in the x-th game.

Output

For each test case, please output an integer in one line, indicating the minimum total number of games to let Team LGD win.

Example

standard input	standard output
2 1 3	1 5

Note

Ignoring everyone's strongest wish, there exists $x > 1$ in the test data, which means Team LGD won't always choose to ban Magnus from the beginning.

Problem B. A Plus B Problem

Input file:	`standard input`
Output file:	`standard output`
Time limit:	3 seconds
Memory limit:	512 megabytes

JB gets a machine that can solve "A Plus B Problem" and feels curious about the mechanism. He hears that you are proficient in competitive programming and have learned many advanced data structures and algorithms such as Link-Cut tree, Lagrange Inversion formula, Sweepline Mo, and so on. Hence, he asks you to help implement a program that can solve "A Plus B Problem" as same as the machine.

The machine consists of $3 \times n$ digits. The digits of the first two rows can be changed arbitrarily, and the third row always equals the decimal sum of the first two rows. The third row only consists of the lowest n digits even if the sum exceeds n digits.

For example, when $n = 5$, the three rows can be "`01234`", "`56789`", "`58023`" or "`56789`", "`58023`", "`14812`".

To test your function, you are given q queries. In the i-th query, the c_i-th digit of the r_i-th row is updated to d_i (the digit may not change). Because the digits are too many and JB has no time to check your answer, he only asks you to find the c_i-th digit of the third row after the query and how many digits of the machine change in the query.

Input

The first line contains two integers n and q $(1 \le n, q \le 10^6)$.

The second line contains a string consisting of n digits, representing the first row of the machine.

The third line contains a string consisting of n digits, representing the second row of the machine.

There are q lines in the following. The i-th of the following line consists of three integers r_i, c_i and d_i $(1 \le r_i \le 2,\ 1 \le c_i \le n,\ 0 \le d_i \le 9)$.

Output

Output q lines. In the i-th line, output two integers - the c_i-th digit of the third row after the query and how many digits of the machine change in the query.

Example

standard input	standard output

5 5
01234
56789
2 1 0
2 2 1
2 3 2
2 4 3
2 5 4
	0 2
	3 2
	5 3
	7 3
	8 3

Note

In the example, the initial rows are "`01234`", "`56789`", "`58023`".

After the 1-st query, the rows are "`01234`", "`06789`", "`08023`".

After the 2-nd query, the rows are "`01234`", "`01789`", "`03023`".

After the 3-th query, the rows are "`01234`", "`01289`", "`02523`".

After the 4-th query, the rows are "`01234`", "`01239`", "`02473`".

After the 5-th query, the rows are "`01234`", "`01234`", "`02468`".

Problem C. AC Automaton

Input file:	`standard input`
Output file:	`standard output`
Time limit:	9 seconds
Memory limit:	512 megabytes

JB is trying to get more "AC" on problems with his AC Automaton.

The AC Automaton is a rooted tree with n nodes and node 1 as root. Each node i except the root has its unique parent p_i and a character s_i on it, which is one of '`A`', '`C`', or '`?`'. A node x is called an ancestor of y if and only if $x = p_y$ or x is an ancestor of p_y. The number of "AC" JB can get equal to the number of ordered pairs (x, y) that x is an ancestor of y, $s_x =$ '`A`' and $s_y =$ '`C`'. JB can replace '`?`' arbitrarily with '`A`' or '`C`'. His goal is to get more "AC" after replacing all '`?`'.

However, the problem always changes. JB will change his AC Automaton q times. Each time he will modify the character on one of the nodes x to one of '`A`', '`C`', or '`?`' (the character will possibly not change). JB wants you to answer the maximum number of "AC" he can get if he replaces all '`?`' on his AC Automaton after each modification. Note that JB **will not** actually modify the AC Automaton while calculating the maximum number of "AC". You can refer to the sample to help you understand.

Input

The first line contains two integers n and q ($1 \le n, q \le 300\ 000$).

The second line contains a string consisting of n characters, representing the characters on each node. It's guaranteed that the characters in the string is one of '`A`', '`C`', and '`?`'.

The third line contains $n - 1$ integers, the i-th integer p_i ($1 \le p_i \le i$) represents the parent of node $i + 1$.

The next q lines describe the modifications. The i-th of the following line consists one integer x ($1 \le x \le n$) and a character y ($y \in \{$'`A`', '`C`', '`?`'$\}$), representing one modification.

Output

Output q lines.

In the i-th line, output one integer representing the maximum number of "AC" after the i-th modification.

Example

standard input	standard output

`5 3`
`AC??C`
`1 2 2 1`
`1 ?`
`4 A`
`2 ?`
	`4`
	`3`
	`3`

Note

After the first modification, one of the best way of replacing characters is "`ACCCC`", and there are 4 pairs $(1, 2), (1, 3), (1, 4)$, and $(1, 5)$.

After the second modification, one of the best way of replacing characters is "`ACCAC`", and there are 3 pairs $(1, 2), (1, 3)$, and $(1, 5)$.

After the third modification, one of the best way of replacing characters is "`AACAC`", and there are 3 pairs $(1, 3), (2, 3)$, and $(1, 5)$.

Problem D. Assumption is All You Need

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

JB holds the belief that assumption is all you need to solve a problem. In order to prove that, JB has given you two permutations of numbers from 1 to n: A and B, and JB wants you to output a sequence of element swapping operation (x_i, y_i) on A, so that:

1. every pair of swapped element forms an inversion pair (i.e. $x_i < y_i$ and $A_{x_i} > A_{y_i}$ when the i-th operation is being performed)
2. A will become B at the end of the swapping sequence.

or determine it is impossible. Help prove JB's belief by solving this problem!

Input

There are multiple test cases. The first line of the input contains one integer T indicating the number of test cases. For each test case:

The first line contains one integer n ($1 \le n \le 2\,021$), indicating the number elements in A and B.

The second line contains n distinct integers $A_1, A_2, \ldots, A_n$ ($1 \le A_i \le n$), indicating the array A.

The third line contains n distinct integers $B_1, B_2, \ldots, B_n$ ($1 \le B_i \le n$), indicating the array B.

It is guaranteed that the sum of n in all test cases will not exceed $2\,021$.

Output

For each test case, if there doesn't exist a sequence, output the one line containing one integer "`-1`".

Otherwise, in the first line output one integer k ($0 \le k \le \frac{n(n-1)}{2}$), indicating the length of the swapping sequence. Then, output k line each containing two integers x_i and y_i ($1 \le x_i < y_i \le n$), indicating the i-th operation swap(A_{x_i}, A_{y_i}).

Example

standard input	standard output

```
3
2
1 2
2 1
4
4 1 2 3
1 3 2 4
8
8 7 6 5 4 3 2 1
1 8 7 6 5 4 3 2
```
	```
	-1
	2
	1 2
	2 4
	7
	7 8
	6 7
	5 6
	4 5
	3 4
	2 3
	1 2
	```

Problem E. Buy and Delete

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	512 megabytes

Alice and Bob are playing a game on a directed graph G. There are n vertices in G, labeled by $1, 2, \ldots, n$. Initially, there are no edges in G. Alice will first buy some direct edges from the shop and then add them into G. After that, Bob needs to delete edges until there are no edges in G. In a deletion round, Bob can delete a subset of edges S from G, such that when only keeping edges in S, the graph is acyclic. Note that Alice can buy nothing, and in such a case the number of deletion rounds is 0.

There are m edges in the shop. Alice has c dollars, so the total price of edges she will buy should not exceed c. Alice wants to maximize the number of deletion rounds while Bob wants to minimize it. Both Alice and Bob will play optimally. Please write a program to predict the number of deletion rounds.

Input

The input contains only a single case.

The first line of the input contains three integers n, m and c ($2 \leq n \leq 2\,000$, $1 \leq m \leq 5\,000$, $1 \leq c \leq 10^9$), denoting the number of vertices in G, the number of edges in the shop, and how many dollars Alice has.

In the next m lines, the i-th line ($1 \leq i \leq m$) contains three integers u_i, v_i and p_i ($1 \leq u_i, v_i \leq n$, $u_i \neq v_i$, $1 \leq p_i \leq 100\,000$), denoting a directed edge in the shop. Alice can pay p_i dollars to buy it, and add an edge from vertex u_i to vertex v_i in G.

Output

Print a single line containing an integer, denoting the number of deletion rounds.

Examples

standard input	standard output

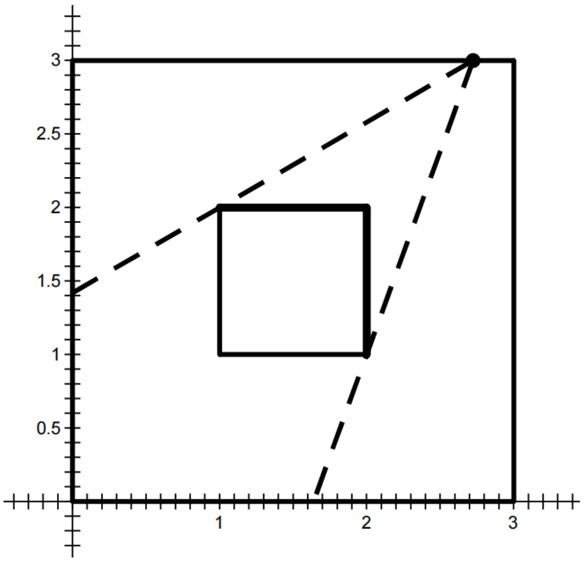
3 2 4
1 2 5
2 3 6
	0

3 3 3
1 2 1
2 3 1
1 3 1
	1

Problem F. Illuminations II

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

You are given two convex polygons, where the larger polygon has n vertices and the smaller polygon has m vertices. All the vertices of the smaller polygon locate strictly inside the larger polygon, thus the smaller polygon fully locates strictly inside the larger polygon.



Our dear friend JB is going to install an illuminant on the interior boundaries of the larger polygon to light up some exterior boundaries of the smaller polygon. Feeling indecisive, JB decides to choose where to install the illuminant uniformly at random on the interior boundaries of the larger polygon, and you need to calculate the expected length of the illuminated boundaries of the smaller polygon.

Input

The first line contains two integers n and m ($3 \le n, m \le 2 \times 10^5$).

The following n lines describe the vertices on the larger convex polygon, each of which contains two integers x and y ($|x|, |y| \le 10^9$), indicating the coordinates of a vertex on the polygon. All these n vertices are given in counter-clockwise order and any three of them are not collinear.

Then the following m lines describe the vertices on the smaller convex polygon, each of which contains two integers x and y ($|x|, |y| \le 10^9$), indicating the coordinates of a vertex on the polygon. All these m vertices are also given in counter-clockwise order and any three of them are not collinear.

It is guaranteed that all the vertices of the smaller polygon locate strictly inside the larger polygon.

Output

Output the expected length of the illuminated boundaries of the smaller polygon when JB chooses where to install the illuminant uniformly at random on the interior boundaries of the larger polygon.

Your answer is acceptable if its absolute or relative error does not exceed 10^{-9}. Formally speaking, suppose that your output is x and the jury's answer is y, your output is accepted if and only if $\frac{|x-y|}{\max(1,|y|)} \le 10^{-9}$.

Example

standard input	standard output

4 4
0 0
3 0
3 3
0 3
1 1
2 1
2 2
1 2
	1.666666666666667

Note

For the sample case, it can be shown that the length of the illuminated boundaries of the smaller polygon is 1 with probability $\frac{1}{3}$ and 2 with probability $\frac{2}{3}$, thus the expected length is $1 \times \frac{1}{3} + 2 \times \frac{2}{3} = \frac{5}{3}$.

Problem G. Occupy the Cities

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

JB is playing a game. There are n cities in the game, numbered as $1, 2, \cdots, n$. The i-th city and the j-th city are adjacent if and only if $i = j - 1$ or $i = j + 1$. Initially, some of the cities are occupied by JB.

The game runs in rounds. At the beginning of a round, each occupied city can mark at most one adjacent unoccupied city as the target of attack. At the end of the round, all the attack targets marked become occupied. The game ends when all the cities are occupied.

JB wants to occupy all the cities in minimum rounds. Can you help him?

Input

There are multiple test cases. The first line of the test case contains a positive integer T, indicating the number of test cases. For each test case:

The first line contains an integer n ($1 \le n \le 10^6$), indicating the number of cities.

The next line contains a string s of length n. It's guaranteed s only contains '`0`' and '`1`'. The i-th character describes the initial state of the i-th city: if s_i = '`1`', the i-th city is occupied by JB initially. Otherwise, the i-th city is not occupied initially.

It's guaranteed that the sum of n over all the test cases doesn't exceed 10^6. It's also guaranteed that there is at least one '`1`' in s.

Output

For each test case, output one line, containing the minimum number of rounds to occupy all the cities.

Example

standard input	standard output
5 3 010 4 0100 7 0001000 5 11111 6 010101	2 2 4 0 1

Note

For the second test case, the best way is $0100 \to 0110 \to 1111$.

Problem H. Popcount Words

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

The popcount word of interval $[l, r]$ is defined as

$$w(l, r) = s_l s_{l+1} \dots s_{r-1} s_r,$$

where $s_i = \text{popcount}(i) \bmod 2$. Here $\text{popcount}(i)$ means the number of ones in binary representation of integer i.

You will be given n intervals $[l_1, r_1], [l_2, r_2], \dots, [l_n, r_n]$. Let's build an extremely long string

$$S = w(l_1, r_1) + w(l_2, r_2) + \dots + w(l_n, r_n),$$

here "+" denotes concatenation of strings.

You will also be given q queries. In the i-th query, you will be given a bit pattern p_i, your task is to report how often does p_i occur as a substring in S. Note that occurrences may overlap.

Input

The input contains only a single case.

The first line of the input contains two integers n and q ($1 \le n, q \le 100\,000$), denoting the number of intervals and the number of queries.

In the next n lines, the i-th line ($1 \le i \le n$) contains two integers l_i and r_i ($1 \le l_i \le r_i \le 10^9$), describing the i-th interval.

In the next q lines, the i-th line ($1 \le i \le q$) contains a non-empty string p_i consists of characters in {'0', '1'}, describing the pattern of the i-th query.

It is guaranteed that the total length of all patterns is at most 500 000.

Output

For each query, print a single line containing an integer, denoting the number of occurrences of the bit pattern in S.

Example

standard input	standard output

3 5
2 6
1 3
4 8
0
1
11
101
0011010
	6
	7
	2
	2
	1

Note

- $w(l_1, r_1) = w(2, 6) =$ "10100", $w(l_2, r_2) = w(1, 3) =$ "110", $w(l_3, r_3) = w(4, 8) =$ "10011".
- $S = w(l_1, r_1) + w(l_2, r_2) + w(l_3, r_3) =$ "1010011010011".

Problem I. PTSD

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	512 megabytes

There are n soldiers in JB kingdom, numbered as $1, 2, \cdots, n$. The i-th soldier has a power value of i.

There is a tournament in the kingdom now. The soldiers need to be divided into several groups where each soldier belongs to exactly one group. Note that it's allowed for a group to contain only one single soldier. For some unknown reason, some soldiers have a disease called PTSD (post-traumatic stress disorder). The soldiers with PTSD don't like being the **second** strongest soldier in their groups. Formally speaking, a soldier with PTSD will be upset if there is exactly one other soldier with a larger power value than him in his group.

JB, the king of JB kingdom, wants to maximize the sum of the power values of the soldiers who feel upset because of PTSD. You are asked to help him divide the soldiers.

Input

There are multiple test cases. The first line of the input contains a positive integer T, indicating the number of test cases. For each test case:

The first line contains an integer n ($1 \le n \le 10^6$), indicating the number of soldiers.

The second line contains a string s of length n. It's guaranteed that s only contains '`0`' and '`1`'. The i-th character describes the i-th soldier: If s_i = '`1`', the i-th soldier has PTSD. Otherwise, the i-th soldier doesn't have PTSD.

It's guaranteed that the sum of n of all test cases doesn't exceed 10^6.

Output

For each test case, output one line containing an integer, indicating the maximum sum of power values of the upset soldiers.

Example

standard input	standard output
4 5 10101 8 11111111 4 1100 4 0110	4 16 3 3

Note

For the first test case, a valid division is [1, 2], [3, 4], [5], which makes the 1-st soldier and the 3-rd soldier upset. [1, 2], [3, 5], [4] is also valid.

For the second test case, a valid division is [1, 2], [3, 4], [5, 6], [7, 8].

For the third test case, a valid division is [1, 3], [2, 4].

For the fourth test case, a valid division is [1, 2, 3, 4].

Problem J. Suffix Automaton

Input file:	`standard input`
Output file:	`standard output`
Time limit:	6 seconds
Memory limit:	512 megabytes

JB is the National Olympiad Tutor of Suffix Automaton. Today he comes up with the following problem.

Suppose you have a string S, we write down all the distinct substrings in S. Then we sort the strings according to their length in increasing order. For two strings with the same length, the one that has the smaller lexicographical order comes first. Now we have a sorted string sequence A.

JB has Q questions, for each question, he will give you one integer k and suppose you to tell him the k-th string in A.

To simplify the problem, you just need to tell him the left and right positions in S of the first occurrence of the string.

Input

The first line contains one string S ($1 \le |S| \le 10^6$), containing only lowercase letters.

The second line contains one integer Q ($1 \le Q \le 10^6$).

The following Q lines describe the questions, each of which contains one integer k ($1 \le k \le 10^{12}$).

Output

For each question, print two integers l, r, denoting the left and right positions in S of the first occurrence of the answer string. If k is greater than the length of A, just print "`-1 -1`".

Examples

standard input	standard output

ccpcguilin
5
1
10
4
8
26
	1 1
	2 3
	8 8
	1 2
	4 7

banana
3
5
10
16
	1 2
	2 5
	-1 -1

Problem K. Tax

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	512 megabytes

JB received his driver's license recently. To celebrate this fact, JB decides to drive to other cities in Byteland. There are n cities and m bidirectional roads in Byteland, labeled by $1, 2, \ldots, n$. JB is at the 1-st city, and he can only drive on these m roads. It is always possible for JB to reach every city in Byteland.

The length of each road is the same, but they are controlled by different engineering companies. For the i-th edge, it is controlled by the c_i-th company. If it is the k-th time JB drives on an edge controlled by the t-th company, JB needs to pay $k \times w_t$ dollars for tax.

JB is selecting his destination city. Assume the destination is the k-th city, he will drive from city 1 to city k along the shortest path, and minimize the total tax when there are multiple shortest paths. Please write a program to help JB calculate the minimum number of dollars he needs to pay for each possible destination.

Input

The input contains only a single case.

The first line of the input contains two integers n and m ($2 \le n \le 50$, $n-1 \le m \le \frac{n(n-1)}{2}$), denoting the number of cities and the number of bidirectional roads.

The second line contains m integers $w_1, w_2, \ldots, w_m$ ($1 \le w_i \le 10\,000$), denoting the base tax of each company.

In the next m lines, the i-th line ($1 \le i \le m$) contains three integers u_i, v_i and c_i ($1 \le u_i, v_i \le n$, $u_i \ne v_i$, $1 \le c_i \le m$), denoting denoting an bidirectional road between the u_i-th city and the v_i-th city, controlled by the c_i-th company.

It is guaranteed that there are at most one road between a pair of city, and it is always possible for JB to drive to every other city.

Output

Print $n-1$ lines, the k-th ($1 \le k \le n-1$) of which containing an integer, denoting the minimum number of dollars JB needs to pay when the destination is the $(k+1)$-th city.

Example

standard input	standard output

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

Problem L. Wiring Engineering

Input file:	`standard input`
Output file:	`standard output`
Time limit:	8 seconds
Memory limit:	512 megabytes

On the north side of Bytestreet, there are n buildings standing sequentially one next to the other, labeled by $1, 2, \ldots, n$ from east to west. The coordinate of the i-th building is $(i, 1)$.

On the south side of Bytestreet, there are n communication towers standing sequentially one next to the other, labeled by $1, 2, \ldots, n$ from east to west. The coordinate of the i-th tower is $(i, -1)$.

You are an electrical engineer in Byteland, your job is to design a wiring scheme. A wire can be used to connect a building and a tower. Each connection runs along a straight line. For each pair of building and tower, you can connect at most one wire between them. When you use a wire to connect the i-th building with the j-th tower, you will get $w_{i,j}$ dollars from the owner of the building, and the wire can be regarded as a segment connecting $(i, 1)$ and $(j, -1)$.

Each building can be connected with multiple wires, but you need to pay u_i dollars if you want to connect at least one wire to the i-th building, because you should first install equipment in that place. For the same reason, each tower can be connected with multiple wires, but you also need to pay v_i dollars if you want to connect at least one wire to the i-th tower. What is more, two wires can only intersect at their endpoints, in order to prevent short-circuit.

Unfortunately, it is impossible to install equipment in some places, so they can not be connected with any wire. You will be given q queries, in the i-th query, you will be given four integers a_i, b_i, c_i and d_i, which means you can only install equipment in buildings whose label is in $[a_i, b_i]$, and you can only install equipment in towers whose label is in $[c_i, d_i]$. Your task is to find a wiring scheme to make money optimally. Note that the answer can't be negative because you can choose to do nothing.

Input

The input contains only a single case.

The first line of the input contains two integers n and q ($1 \le n \le 500$, $1 \le q \le 300\,000$), denoting the number of buildings (or towers) and the number of queries.

The second line contains n integers $u_1, u_2, \ldots, u_n$ ($1 \le u_i \le 10\,000$), denoting the cost to install equipment in each building.

The third line contains n integers $v_1, v_2, \ldots, v_n$ ($1 \le v_i \le 10\,000$), denoting the cost to install equipment in each tower.

In the next n lines, the i-th line ($1 \le i \le n$) contains n integers $w_{i,1}, w_{i,2}, \ldots, w_{i,n}$ ($1 \le w_{i,j} \le 10\,000$), describing how much money you can get if you connect the i-th building with the j-th tower.

In the next q lines, the i-th line ($1 \le i \le q$) contains four integers a_i, b_i, c_i and d_i ($1 \le a_i \le b_i \le n$, $1 \le c_i \le d_i \le n$), describing the i-th query.

Output

For each query, print a single line containing an integer, denoting the maximum amount of dollars you can earn.

Example

standard input	standard output

3 4
1 2 1
2 1 2
1 2 3
4 5 6
3 2 1
1 3 1 3
2 3 1 2
1 1 2 3
1 2 2 3
	8
	5
	1
	7