Problem A: Stones game

Time limit: 1s; Memory limit: 256 MB

Quyen and Thang are close friends and always invent new crazy games to play together since they were little kids. On the last super sale day on September 9th, Quyen accidentally decided to buy a large number of stones (with 2 colors: \`black\` and \`white\`). She said 'thanks for selling cheap' but honestly, she has no idea what to do with those useless stones.

Finally, as always, she came up with a new game with surprisingly unguessable rule. She will randomly arrange n stones in a row. Quyen and Thang can take 1 stone in his/her turn and only stones from left or right ends could be selected, and removed from the row. The person collected k \`black\` stone first will lose the game.

You are given 2 number n and k, and a string s (with n characters) illustrated the order of the stone row.

Suppose both players play optimally, whether or not, Quyen could win game she invented? If Quyen can win, return "YES", otherwise return "NO" (without quote)

Besides, Quyen always plays first because Thang is a gentleman.

Input

The first line contains 2 integers n and k. $(1 \leq k < n \leq 300)$

The second line is the string s representing the stone row. s only contains character 'B' and 'W' (which denotes black and white stone).

It is guaranteed that there is no tie, the winner can always be determined. Mathematically, the number of B (black stone) will be at least $2k + 1$.

Output

Return 1 line with "YES" or "NO" response depicted that Quyen could be the winner or not.

Sample

Input	Output
4 1 BBBW	YES
8 2 WBBWBBWB	NO

Explanation:

For sample 1:

- First player always selects `white` stone from the right end, thus the 2nd player just can take `black` from the remaining piles.

For sample 2:

The players will follow the below steps:

- Quyen takes first `white` stone from left side
- Thang selects the 2nd `black` stone from left side
- Quyen continues to take `black` stone (the same result from both sides)
- Thang takes the `white` stone
- At this time, Quyen has to take the `black` stone (from both ends) and lose the game.

Problem B: Baby String

Time limit: 1s; Memory limit: 256 MB

A string *t* is called **Baby String** of string *s* when:

- *t* is a prefix of s;
- *t* is a suffix of s;
- *t* is occurred in s more than 3 times.

Several definitions:

- The prefix of string *s* of length l ($1 \le l \le |s|$) is string $s[0 \ldots l\text{-}1]$.
- The suffix of string *s* of length l ($1 \le l \le |s|$) is string $s[|s| - l \ldots |s|\text{-}1]$.

You are given a string *s*, *length* $|s|$, and q queries $l_1,\ldots,l_q$ on it. For each query l_i you have to check if the prefix of s of length l_i is **Baby String** of s and count the number of occurrences of this prefix in s.

Input

The first line of the input contains string s ($1 \le |s| \le 10^5$). The string only consists of uppercase English letters.

The second line of the input contains integer q, ($1 \le q \le 10^5$), denoting the number of queries. Then follows q lines, each contain an integer l_i, ($1 \le l_i \le |s|$).

Output

For each query print the result in a separate line. In each line, If the prefix of *s* of length l_i is **Baby String** of *s* print **YES** and print the number of times it occurs in string *s* as a substring. Otherwise print **NO.**

Sample

Input	Output
AAACMMTACMAA 4 1 2 3 4	YES 6 YES 3 NO NO

ABABABABAB 5 1 2 3 4 5	NO YES 5 NO YES 4 NO

Problem C: Sort Problems

Time limit: 1s; Memory limit: 256 MB

You are given a result ranking in two rounds of n participants in an ACM/ICPC Contest. Suppose that Elo of one participant certainly higher than other participant's elo when he/she has higher ranking in all rounds than other one ($r_{1A} < r_{1B}$ AND $r_{2A} < r_{2B}$ where r_{1A} and r_{2A} are A's ranking of round 1 and round 2, and r_{1B} and r_{2B} are similar with B's); otherwise it's not certain. You have to find how many ways to select k participants in this contest and can be sorted by descending Elo of these participants.

Input

First line contains two integer values n – number of participants in this ACM/ICPC Contest and k ($1 \le n \le 10^5$, $1 \le k \le 10$).

Next n lines contain two integer r_{1i}, r_{2i} ($1 \le r_{1i}, r_{2i} \le n$). All values *ranking in each round* are different.

Output

Print one integer — the answer to the problem. It is guaranteed that the answer is not greater than 2^{63}.

Sample

Input	Output
5 3 2 2 1 1 3 3 5 4 4 5	7
3 2 1 1 2 3 3 2	2

Problem D: Median

Time limit: 1s; Memory limit: 256 MB

There is an array a with n integers a[1], a[2], …, a[n] where a[i] $\leq 10^5$. You are given q queries each of which contain two integers l and r where $l \leq r$ and you have to find the median value of the subarray in the range $[l, r]$. The median value of an array with n integers is the value at the position $\lfloor (n + 1)/2 \rfloor$ after the array is sorted ascendingly.

Input

The first line contains two integers n and q ($n \leq 10^5$ and $q \leq 10^5$) – the length of the array and the number of queries

The second line contains the array a, a[1], a[2],…, a[n] (a[i] $\leq 10^5$)

The next q lines contain the queries. Each of the lines has two integers l and r ($0 \leq l \leq r \leq n$) – represent the subarray

Output

For each query, print the median value of the given subarray.

Sample

Input	Output
8 5 2 8 4 16 5 2 10 6 1 3 2 5 6 8 5 8 1 8	4 5 6 5 5

Problem E: Birthday Cake

Time limit: 1s; Memory limit: 256 MB

Bob is celebrating his birthday with his friends. During the party, Bob wants to cut the birthday cake and share it with his friends.

The birthday cake is a rectangle of size R x C made from a variety of materials. Let a[*i*][*j*] is the calories of the cell in *i*-th row and *j*-th column, total calories of a piece of cake are the sum of its cells.

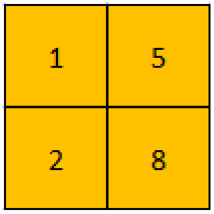
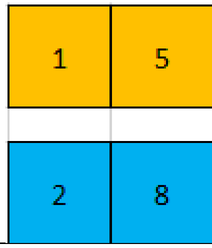
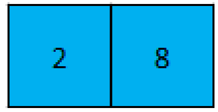
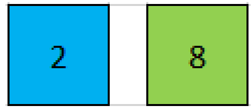
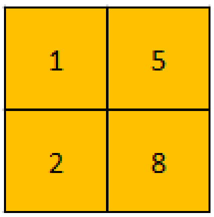
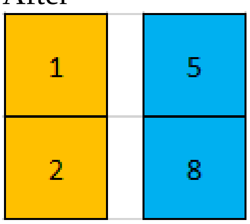
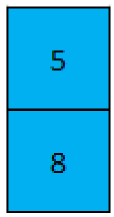
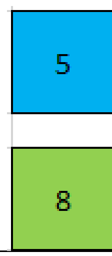
There are *n* friends in the party. Because of the fear of obesity, they do not want to eat too much. Let p[*k*] is the maximum calories of *k*-th friend.

Bob wants to cut this cake *n* – 1 times to obtain n smaller pieces which can be given to their friends. Bob must cut exactly *n* – 1 times, according to the following rule:

- During the *l*-th cut, Bob must cut the current (rectangular) piece of cake horizontally or vertically so that it results in two 2 smaller (rectangular) pieces, each piece must be of size at least 1×1.
    - If the *l*-th cut was done horizontally, the upper piece must be given to the *l*-th friend, and the lower piece of cake must be used for the next cutting phase.
    - If the *l*-th cut was done vertically, the left piece must be given to the *l*-th friend, and the right piece of cake must be used for the next cutting phase.
- After *n* - 1 cuts, there are exactly *n* pieces of cake to be given to *n* friends with no leftovers. The *l*-th piece of cake must satisfy the *l*-th friend's calorie condition, that is, total calories of the *i*-th piece of cake must not be greater than p[*l*].

For example: let *n* = 3, p = [5, 10, 15] and the below birthday cake:

1	5
2	8

<table>
<tr>
<td>Method 1:</td>
<td>Before the horizontal cut

After
</td>
<td>Before the vertical cut

After
</td>
<td>The total calories of the pieces of cake are [6, 2, 8]. The first piece is not satisfied due to 6 > 5.</td>
</tr>
<tr>
<td>Method 2:</td>
<td>Before the vertical cut

After
</td>
<td>Before the horizontal cut

After
</td>
<td>The total calories of the pieces are [3, 5, 8] satisfying for n friends.</td>
</tr>
</table>

Given the calories of the cake and the maximum calories of n friends, please help Bob compute the number of different ways to cut the cake that meet all rules and satisfy all friends.

Input

The first line contains 3 integers R, C, and n. ($1 \le R, C \le 100$, $1 \le n \le min(10, R + C - 1)$).

The next R lines, each line contains C numbers, that is the calorie of the cell $a[i][j]$. ($0 \le a[i][j] \le 100$).

The next line contains n integers, the i-th integer is the maximum calories $p[k]$ of the k-th friend. ($0 \le p[k] \le 10^6$).

Output

Output the number of different ways to cut the cake that meet all rules and satisfy all friends. Since the answer can be quite large, output the answer module 10^9+7.

Sample

Input	Output
2 2 3 1 5 2 8 5 10 15	1
3 3 2 10 8 6 8 4 10 1 1 0 78 25	3

Problem F: Paper Bracelet

Time limit: 1s; Memory limit: 256 MB

Alice wants to make paper bracelets by gluing the two ends of a long piece of paper together. On a piece of paper, there are 3×3 drawings in a row. The drawings are decorated by drawing on 1×1 cells with 'o'. In addition, a bracelet is surrounded by the characters '#' like the examples below:

#	#	#	#	#	#	#	#	#	#	#	#	#
#	.	o	.	#	.	.	.	#	.	.	.	#
#	.	o	.	#	.	.	.	#	.	.	.	#
#	.	o	.	#	.	.	.	#	.	.	.	#
#	#	#	#	#	#	#	#	#	#	#	#	#

#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
#	o	o	o	#	o	o	o	#	o	o	o	#	o	o	o	#
#	.	.	.	#	.	.	.	#	.	.	.	#	.	.	.	#
#	o	o	o	#	o	o	o	#	o	o	o	#	o	o	o	#
#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#

Bracelets are considered to be identical if their length and their drawings from left to right are the same. Note, when gluing a piece of paper into a bracelet, it always leaves the side with the drawing out. Also, it can flip over when comparing. The picture below shows 3 identical bracelets.

For example:

#	#	#	#	#	#	#	#	#	#	#	#	#
#	o	.	.	#	.	.	.	#	.	.	.	#
#	o	.	.	#	.	.	.	#	.	.	.	#
#	o	.	.	#	.	.	.	#	.	.	.	#
#	#	#	#	#	#	#	#	#	#	#	#	#

#	#	#	#	#	#	#	#	#	#	#	#	#
#	.	.	o	#	.	.	.	#	.	.	.	#
#	.	.	o	#	.	.	.	#	.	.	.	#
#	.	.	o	#	.	.	.	#	.	.	.	#
#	#	#	#	#	#	#	#	#	#	#	#	#

#	#	#	#	#	#	#	#	#	#	#	#	#
#	.	.	.	#	o	.	.	#	.	.	.	#
#	.	.	.	#	o	.	.	#	.	.	.	#
#	.	.	.	#	o	.	.	#	.	.	.	#
#	#	#	#	#	#	#	#	#	#	#	#	#

#	#	#	#	#	#	#	#	#	#	#	#	#
#	.	o	.	#	.	.	.	#	.	.	.	#
#	.	o	.	#	.	.	.	#	.	.	.	#
#	.	o	.	#	.	.	.	#	.	.	.	#
#	#	#	#	#	#	#	#	#	#	#	#	#

The first three pieces of paper can make three identical bracelets. The 2th bracelet can flip over 180 degree to be the same as the 1st and the 3rd. And the 4th piece of paper can make a different bracelet from the rest. Hence, there are two types of bracelets.

Initially, given a large paper, Alice will design and draw bracelets on this large paper, then she will cut out each bracelet and glue them. After designing, Alice wonders how many different and identical bracelets she has.

Given a large paper of size n x m with bracelet designs, please help Alice count the number of different bracelet types and for each type, count the number of identical bracelets.

Input

The first line contains two integers n and m ($1 \le n, m \le 10^3$).

In the next n lines, each line contains m characters including only '.', '#', 'o'. Characters '#' and 'o' are used to draw bracelets. Characters '.' represent empty cells. The large paper includes only complete bracelets, with no unused characters. Number of 3×3 drawings on a bracelet is not more than 6.

Output

In the first line, output k – number of different bracelets.

In the second line, output k integers – the numbers of identical bracelets of each type, in ascending order.

Sample

Input	Output

<pre>23 28
....
.#############.##########...
.#o..#...#...#.#o.o##o.o#...
.#o..#...#...#.#.o.##.o.#...
.#o..#...#...#.#o.o##o.o#...
.#############.##########...
....................#o.o#...
.#################..#.o.#...
.#ooo#ooo#ooo#ooo#..#o.o#...
.#...#...#...#...#..#####...
.#ooo#ooo#ooo#ooo#..#o.o#...
.#################..#.o.#...
.#############......#o.o#...
.#..o#...#...#......#####...
.#..o#...#...##############.
.#..o#...#...##.o.#...#...#.
.##############.o.#...#...#.
.##############.o.#...#...#.
.#...#o..#...##############.
.#...#o..#...#..............
.#...#o..#...#..............
.#############..............
............................</pre>
	<pre>5
	1 1 1 1 3</pre>

Explanation:

There are 5 types of bracelet.

There is one identical bracelet of type 1:

```
#####
#o.o#
#.o.#
#o.o#
#####
```

There is one identical bracelet of type 2:

```
#############
#○.○#○.○#○.○#
#.○.#.○.#.○.#
#○.○#○.○#○.○#
#############
```

There is one identical bracelet of type 3:

```
#################
#○○○#○○○#○○○#○○○#
#...#...#...#...#
#○○○#○○○#○○○#○○○#
#################
```

There is one identical bracelet of type 4:

```
#############
#.○.#...#...#
#.○.#...#...#
#.○.#...#...#
#############
```

There are 3 identical bracelets of type 5:

```
#############
#○..#...#...#
#○..#...#...#
#○..#...#...#
#############
```

```
#############
#..○#...#...#
#..○#...#...#
#..○#...#...#
#############
```

```
#############
#...#○..#...#
#...#○..#...#
#...#○..#...#
#############
```

Problem G: Ribbon

Time limit: 1s; Memory limit: 256 MB

Jeremy has a long ribbon with N equal pieces. Each piece has an integer number, we can describe it by an array A of integers with length N. Jeremy want to split the ribbon into multiple segments with length equals to K (we can abort some pieces). Each segment has its own beautiful level B which equals the sum of all numbers inside.

For example: A = [-3, 1, -2, 6, 2, 3] and K = 2. Jeremy can split the ribbon into [[-3, 1], [6, 2]] or [[-2, 6], [2, 3]] or [[-3, 1], [-2, 6], [2, 3]] ... not into [[-3,1,-2],[2,3]] and [[-3,-2],[6,2]]…

After that, he sticks the above segments together (keep the ordinary) and colors them with black or white to create a ribbon of alternating colors (they should be compiled with one of these forms black-white-black-white-… or white-back-white-black-...).

When Jeremy split the original ribbon to Q parts. Each part has a beautiful level B_j ($1 \leq j \leq Q$) and a color attribute M_j (the explanation below). The value L of the ribbon is described by following formula:

$$L = \sum_{j=1}^{N} M_j \times B_j$$

where, L is the value of the ribbon; B_i is the beautiful level of the i-th segment; and M_i equals to 1 (white segment) or -1 (black segment).

Determine the maximum value L of the ribbon.

Input

The first line of the input contains an integer T ($1 \leq T \leq 10$) - the number of test cases in the input. The descriptions of the test cases follow.

The first line of description of each test case contains two integers N and K ($1 \leq K \leq N \leq 2 \times 10^5$) - the length of ribbon and segment.

The second line of the description of each test case contains N integers A_i - numbers on the ribbon ($-10^9 \leq A_i \leq 10^9$).

Output

Output T numbers, each of which is the answer to the corresponding test case.

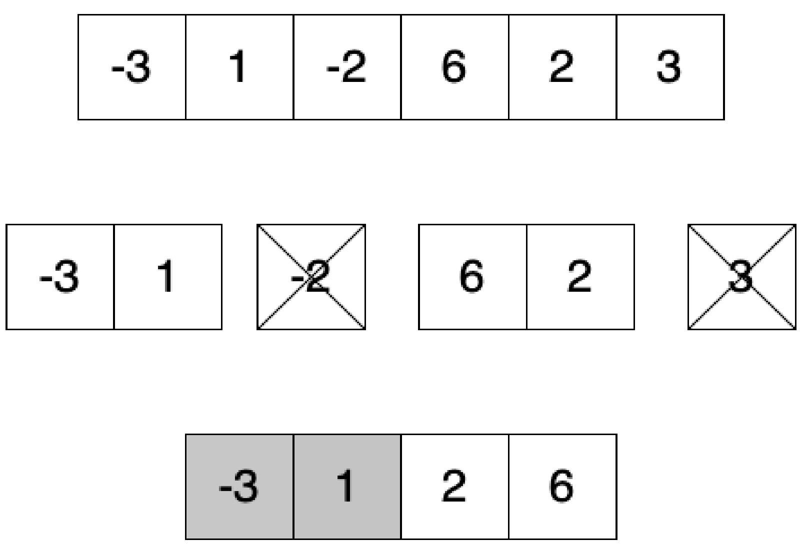
Sample

Input	Output
3 3 3 -2 -3 2 5 2 6 5 2 -5 -6 6 2 -3 1 -2 6 2 3	3 22 10

Explanation:

In the first test case, we can choose all elements of the array and color the second segment by black.

In the third test case, Jeremy can split it and get 2 segments [-3,1] and [6,2] (abort two pieces with value 2 and 3). Then he colors the first segment with black, second one with white. The answer is $-1 \times (-3 + 1) + 1 \times (2+6) = 10$.



Problem H: Escape the Maze

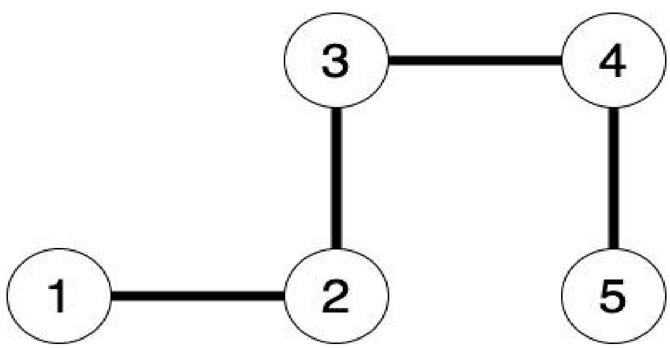
Time limit: 1s; Memory limit: 256 MB

Jeremy is attending an event from his company and he will play a game. Which has a maze and players need to escape. He's having a maze's map on his hand.

The maze has N rooms numbered from 1 to N. His initial position is room 1, the exit at room N.
There are M undirected ways, each way connects 2 rooms. Jeremy needs 1 unit of time to go through any of them (he doesn't need time to in and out the rooms).

A system will be in charge to add several ways in some points of time (in the start moment). Jeremy can go through these ways right after it is placed.

For example, the initial status of maze is described with the following map and a way from room 2 to room 5 will be put at the 3rd minute:



An optimal schedule will be describe bellow:
- In the first minute, Jeremy moves from room 1 to room 2.
- In the second minute, Jeremy stays in room 2.
- At the beginning of the 3rd minute, the system puts the way from room 2 to room 5. Jeremy will immediately go through this way and reach room 5 - the destination.

The answer is 3 minutes.

Determine the minimum number of minutes Jeremy needs to complete the game.

Input

The first line of the input contains three integers N, M ($2 \leq N \leq 10^5, 0 \leq M \leq 2 \times 10^5$) - the number of rooms, the number of ways and the number of signal rooms respectively.

The next M lines. The i-th line contains two integers u_i and v_i ($1 \leq u_i, v_i \leq N$) denoting that the i-th way connecting the u_i and v_i room.

The $(M + 2)$-th line contains a single number K ($0 \leq K \leq 2 \times 10^5$) - The number of edges will be added.

The next K lines. The i-th line contains three integers t_i , u_i and v_i ($1 \leq t_i \leq 10^9, 1 \leq u_i, v_i \leq N$) denoting that the i-th way added at time t_i which connects the u_i and v_i room.

Output

Only one integer - the shortest time. Output -1 if Jeremy can not complete the game.

Sample

Input	Output
5 4 1 2 3 4 2 3 5 4 1 3 2 5	3
4 3 3 1 1 2 2 3 1 10 1 4	10

Explanation:

The first test case is described in the above example.

In the second test case, Jeremy doesn’t need to take any moving and go to room 4 right after the way was placed..

Problem I: Three friends

Time limit: 1s; Memory limit: 256 MB

Three friends Larry, Curly and Moe are orphans, they have lived together since childhood. As adults, they are very successful even though they are not people with high IQ. It is explained that each person has a predestined index and if combined well, there will be good results. The life of three people with their achievements is always a multiple of 5. For example, the three of them have a total of 5 wives, 10 children, 15 houses, 5 companies, etc.

One day, on the occasion of meeting Everyone's face commented on that trait of the three. At that moment, Larry's eldest son Bobby gave a problem to all the children of the three friends as follows:

- How many triplets in n people whose total of predestined index numbers is same to total of predestined index numbers of Larry, Curly, and Moe. It means that, total of predestined index numbers of them must be divisible by 5.

Even though the children of the above friend have a smarter IQ than their father's generation, they still can't solve it. Please consider helping them.

Input

The first line of input contains a single integer n safety $1 \leq n \leq 10^5$ - the numbers of person need to check.

The next line contains n integers a_1, a_2,…, a_n safety $1 \leq a_i \leq 2 \times 10^6$ - the predestined index of n persons above.

Output

Print one integer: the numbers of triplets can be found.

Sample

Input	Output
5 3 4 2 3 4	3
4 3 6 9 12	0

Problem J: Reversi disks

Time limit: 1s; Memory limit: 256 MB

Reversi is a strategy board game for two players, played on an board. Today, Bob have n game pieces called disks, which are light on one side and dark on the other, numbered from 1 to n. Bob also has a board that is wide enough to hold exactly m disks and long enough to hold all the disks he has. Therefore, Bob decided to arrange them neatly, respectively disks from 1 to n in order from left to right and from top to bottom. All disks after arrangement are on the dark side.

Alice is a Bob's friend, and she loves numbers from a to b. Alice is going to visit Bob's house today. Bob wants to surprise her, so he decides to work on the disks he has arranged on the chessboard. Bob wants to flip all disks from a to b to have a light side and all of other disks to have a dark side. However, the implementation is quite time consuming because $b - a$ is quite a large number. Then, Bob decided to build a robot to do for him.

The robot that Bob built is capable of flipping all the disks in a rectangle of the desired size at same time. However, choosing the size of the rectangle as well as ordering the robot to do it is also very time consuming, so Bob wants your help to control the robot the least times and still satisfy the problem conditions.

Input

The input is only one line contains 4 integers n, m, a and b. ($0 \leq n, m \leq 10^9,\ 1 \leq a \leq b \leq n$).

Output

The first line prints a interger k representing the number of times Bob need to control the robot.

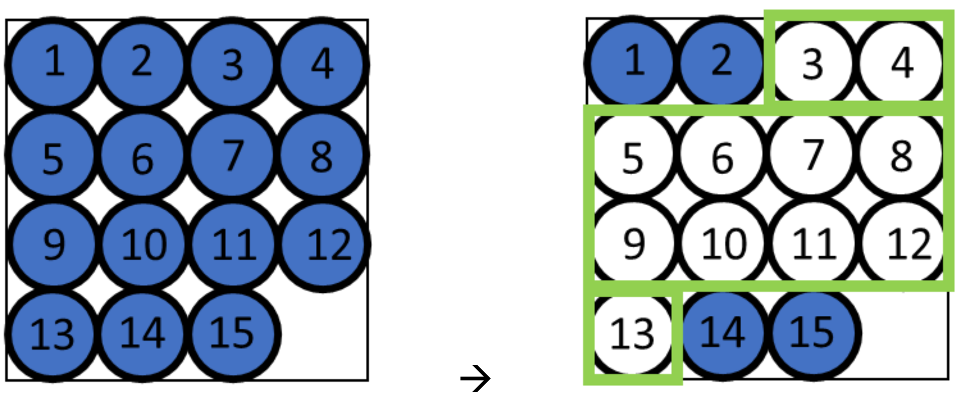
Next k lines, each line prints 4 non-negative integers x_1, x_2, x_1, y_2 respectively representing the coordinates of the upper left corner and bottom right corner of the rectangle where $0 \leq x_1 < x_2 \leq m$ and $0 \leq y_1 < y_2 \leq \lceil n/m \rceil$. Note that, square circumscribed the first disk whose upper right and lower left coordinates are (0,0) and (1,1). Square circumscribed the i-th disk whose upper right and lower left coordinates are $((i-1)\%m, (i-1)/m)$ and $((i-1)\%m + 1, (i-1)/m + 1)$.

Sample

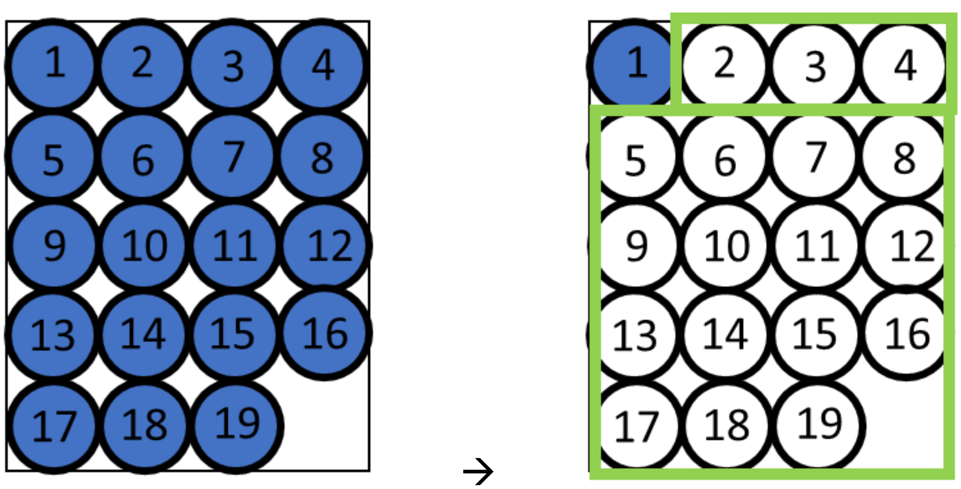
Input	Output
15 4 3 13	3 2 0 4 1 0 1 4 3 0 3 1 4
19 4 2 19	2 1 0 4 1 0 1 4 5

Explanation:

Explanation for sample 1,



Explanation for sample 2,



Problem K: Matrix Operations

Time limit: 1s; Memory limit: 256 MB

Given a matrix A of size $(n+1) \times (m+1)$ with zero-based indexing. Initially all the elements in the matrix A_{ij} are assigned the value 0 for all $i \in [0, \cdots, n]$ and $j \in [0, \cdots, m]$. Next you have k operations, each operation you are given 4 integers x_l, y_l, w_l, h_l and your task is to perform increment by 1 for all A_{ij} satisfying $i \in [x_l, \cdots, x_l + w_l]$ and $j \in [y_l, \cdots, y_l + h_l]$.

The question for you is after finishing all the operations, answer the following 3 questions:

- Count the number of odd elements in the matrix?
- Find the smallest value of $j \times (n+1) + i$ that satisfy the condition that A_{ij} is odd number?
- Find the largest value of $j \times (n+1) + i$ that satisfy the condition that A_{ij} is odd number?

Input

The first line contains 3 integers n, m and k. $(0 \le n, m \le 10^6,\ 1 \le k \le 20)$.

Next k lines: each line contains 4 integers x_l, y_l, w_l, h_l $(0 \le x_l \le n, 0 \le y_l \le m, 0 \le w_l \le n - x_l, 0 \le h_l \le m - y_l)$.

Output

Print out 3 intergers representing the answers. If the number of odd elements in the matrix is 0, please print out "0 -1 -1".

Sample

Input	Output
2 2 1 0 0 1 0	2 0 1
2 3 3 0 0 2 3 0 0 1 0 1 1 1 2	4 2 9
2 3 2 0 0 2 3 0 0 2 3	0 -1 -1

Problem L: Mold

Time limit: 2.5s; Memory limit: 256 MB

A mold or mould is one of the structures certain fungi can form. The dust-like, colored appearance of molds is due to the formation of spores containing fungal secondary metabolites. Only from a single individual, mold can be cloned and grow very quickly. The study of them interests many scientists.

Bob is a scientist, he is especially the range of their growth. Therefore, on the first day Bob planted a mold individual at a coordinate x_1, y_1. On the second day, he discovered that 2 new individuals had appeared at coordinates x_2, y_2 and x_3, y_3. On the j-th day the mold will add j individuals . And by the n-th day he had a total of $n \times (n+1)/2$ individuals with coordinates from x_1, y_1 to $x_{n\times(n+1)/2}, y_{n\times(n+1)/2}$. Bob defines the growth range of the mold individuals as defined by the circle with the smallest radius covering all the mold individuals at a given date.

Since Bob is very busy, he wants you to keep a record of the growth range of all the days that Bob did the research.

Input

The first line contains a natural number, n $(1 \leq n \leq 500)$.

Next $n \times (n+1)/2$ lines: each line contains 2 real numbers x_i, y_i $(0 \leq x_i, y_i \leq 10^4)$. Each of them has at most 14 decimal digits in the input.

Output

Print out n lines, each j-th line contains 3 real numbes x_j, y_j, r_j representing the center and radius of the growing range at day j. The answer is accepted if the absolute error or relative error does not exceed 10^{-6}.

Sample

Input	Output
3 1.0 1.0 2.0 2.0 2.0 1.0 3.0 1.0 2.0 0.0 2.0 0.5	1.0 1.0 0.0 1.5 1.5 0.7071067812 2.0 1.0 1.0

Problem M: Binary

Time limit: 1.5s; Memory limit: 256 MB

Binary is a base-2 number system that uses two states 0 (bit-0) and 1 (bit-1) to represent a number. Hieu is working on the topic of binary representation. Particularly, he wants to study the properties of numbers which the amount of bit-1 in its representation is odd. In order to understand that, he set up this problem.

Given n and m, calculate them sum $\sum_{x=0}^{2^n-1} x^m$ where the number of bit-1 in binary representation of x is odd.

This problem turns out to be harder than it looks, can you help him to solve it?.

Input

The input starts with T $(1 \leq T \leq 10^4)$ - the number of test cases.

Each test case consists of 2 integers n and m. $(1 \leq n \leq 10^6, m \leq n, 1 \leq m \leq 5000)$.

Output

For each test case, you should print the result modulo $10^9 + 7$.

Sample

Input	Output
1 3 3	416

Explaination

For $n = 3$, there are 4 numbers with odd number of bit 1 in its binary representation: 1, 2, 4, 7. Thus, the answer is $1^3 + 2^3 + 4^3 + 7^3 = 1 + 8 + 64 + 343 = 416$

Problem N: Pseudocode

Time limit: 1s; Memory limit: 256 MB

In computer science, pseudocode is a plain language description of the steps in an algorithm or another system. Pseudocode often uses structural conventions of a normal programming language, but is intended for human reading rather than machine reading. It typically omits details that are essential for machine understanding of the algorithm, such as variable declarations and language-specific code.* Wikipedia

Today, Bob gets a follow pseudocode from Alice:

```
begin
  int N, i = 1
  float sum = 0.0
  Input N from user
  do
    sum = sum + 1.0 / i * (i + 1)
    i = i + 1
  while i <= N
  Display the value of (1 - sum) * 10^9
end.
```

Bob wants to implement a program from that pseudocode, but he is not enough time to do it. So, please help him!!

Input

The input starts with T $(1 \leq T \leq 10^3)$ - the number of test cases.

Each test case is a natural number, N $(1 \leq N \leq 10^9)$.

Output

For each test case, you should print the output of your program implemented from given pseudocode. The answer is accepted if the absolute error or relative error does not exceed 10^{-9}.

Sample

Input	Output
3 1 2 4	500000000.0 333333333.333 200000000.0