ICPC SouthWestern Europe Practice Contest 2023–2024

Paris, 27 January 2024

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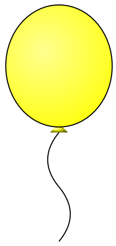
This problem set consists of 5 problems, on 11 pages.



A: Ascending hike

Participating in the Olympics requires training, e.g., climbing from deep valleys to high peaks. Hence, you decided to go out for a hike in which you would be continuously walking on an upward slope, with the largest possible elevation gain.

You have noted the altitude of several remarkable points through which your hike would go: these altitudes are pairwise distinct integers $A_1, A_2, \ldots, A_N$. The slope between the k^{th} and $(k+1)^{\text{th}}$ remarkable points is upward if $A_k < A_{k+1}$, and downward if $A_k > A_{k+1}$. Given this list of altitudes, what is the maximal elevation gain of a continuously upward slope on your hike?

Input

The input consists of two lines. The first line contains the number N. The second line contains N space-separated integers $A_1, A_2, \ldots, A_N$.

Output

The output should contain a single line, consisting of a single number: the maximal integer G for which there exist integers $k, k+1, k+2, \ldots, \ell$ such that $A_k < A_{k+1} < A_{k+2} < \ldots < A_\ell = A_k + G$.

Limits

- $2 \leqslant N \leqslant 1\,000\,000$;
- $0 \leqslant A_k \leqslant 1\,000\,000\,000$ for all $k \leqslant N$.

Sample Input 1

```
9
3 4 5 8 1 2 7 6 9
```

Sample Output 1

```
6
```

Sample Input 2

```
3
8 5 3
```

Sample Output 2

```
0
```

Page intentionally left blank

B: Close scores

The Olympic football tournament has started and, of course, France is going to win by a landslide, thus killing all the suspense. Or is it? Until now, only ties happened: not very exciting. . .

To hype the event, you would like every remaining match not to be a tie, and among all such configurations, you would like to find one which minimises the difference between the best score and the worst score. Remember that the score of a team is the number of its won matches minus its lost matches.

Given the list of remaining matches, find such an optimal configuration of matches.

Input

The first line contains two space-separated integers N and M; N is the number of teams, and M is the number of remaining matches. This line is followed by M lines: the k^{th} such line contains two space-separated integers x_k and y_k, indicating that the ${x_k}^{\text{th}}$ team has yet to play against the ${y_k}^{\text{th}}$ team during the k^{th} match.

Output

The output should contain M lines. The k^{th} such line should contain a single integer: the index of the team winning the k^{th} match (which should be equal to either x_k or y_k).

Limits

- $2 \leqslant N \leqslant 100\,000$;
- $1 \leqslant M \leqslant 100\,000$;
- $1 \leqslant x_k < y_k \leqslant N$ for all $k \leqslant M$.

Sample Input 1

```
4 4
1 4
1 3
2 3
2 4
```

Sample Output 1

```
4
1
3
2
```

Sample Input 2

```
3 4
1 3
1 3
1 3
1 3
```

Sample Output 2

```
3
1
3
1
```

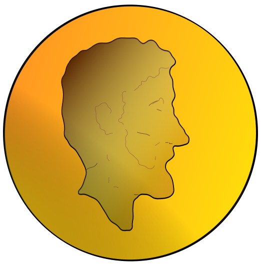
Sample Input 3

```
5 4
1 2
2 3
1 3
4 5
```

Sample Output 3

```
1
2
3
4
```

C: Everyone is a winner



Your friend is a kindergarten teacher. Since the Olympic Games in Paris are approaching, he wants to teach the kids about different aspects of sports competitions. As part of this idea, he plans to have one day when kids receive medals for their behaviour in kindergarten. For example, he would give out a medal for the kid who shares their toys the most, or for the kid who encourages their playmates most creatively. To ensure kids are not offended at the end of the day, the teacher wants no kid to get fewer medals than another. The teacher tells you the number of medals he prepared and the number of kids, and he asks you to say whether it is possible to give out all of these medals to the kids so that they each get the same number of medals.

Input

The input consists of one line. This line contains two space-separated integers M and K: M is the number of medals and K is the number of kids.

Output

The output should contain a single line, consisting of a word: the word `Yes` if it is possible to give out all M medals to the K kids so that each kid gets the same number of medals, or the word `No` otherwise.

Limits

- $1 \leqslant M \leqslant 1\,000\,000\,000$;
- $1 \leqslant K \leqslant 1\,000\,000\,000$.

Sample Input 1

```
6 3
```

Sample Output 1

```
Yes
```

Sample Input 2

```
5 3
```

Sample Output 2

```
No
```

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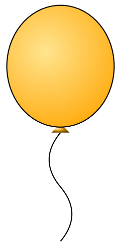
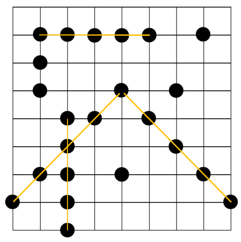
D: Five in a Row





Five in a Row, also called Gomoku, is a board game played with Go pieces (black and white stones). The winner is the first player to form an unbroken line of five stones of their color horizontally, vertically, or diagonally.

During leisure time at the Olympics, athletes and coaches also enjoy playing this game for recreation. Nevertheless, today they are playing a more advanced version in a K-dimensional board instead of a traditional 2-dimensional board. Stones A, B, C, D, E are considered as *five in a row* if, for every integer i such that $1 \leqslant i \leqslant K$, we have:

$$A[i] - B[i] = B[i] - C[i] = C[i] - D[i] = D[i] - E[i] = \text{one of } \{-1, 0, 1\}.$$

Here, $A[i]$ is the coordinate of the stone A on the i^{th} dimension.

Due to the complexity of the board, they sometimes get overwhelmed. Therefore you are asked to write a referee program that takes all the moves made by one player in chronological order and calculates after placing which stone we see five in a row for the first time.

Input

The first line contains two space-separated integers K and N: K is the number of dimensions of the board, and N is the number of stones. This line is followed by N lines, which describe the N stones placed by one player in chronological order. The i^{th} such line contains K space-separated integers $x_1, x_2, \ldots, x_K$, which are the K coordinates of the i^{th} stone.

Output

The output should contain a single line. This line must contain the smallest positive integer i for which we see five in a row after placing the i^{th} stone; or `NOT ALIGNED` if such an integer i does not exist.

Limits

- $1 \leqslant K \leqslant 15$;
- $5 \leqslant N \leqslant 2\,000$;
- the N stones have been placed in distinct positions on the board;
- each coordinate x_i is an integer such that $-10\,000 \leqslant x_i \leqslant 10\,000$.

Sample Input 1

```
4 9
5 5 5 5
5 5 4 6
5 5 3 7
5 5 2 8
6 6 6 6
9 9 9 9
7 7 7 7
5 5 1 9
8 8 8 8
```

Sample Output 1

```
8
```

Sample Explanation 1

After placing the 8^{th} stone, we see the following five in a row:

- 5 5 5 5
- 5 5 4 6
- 5 5 3 7
- 5 5 2 8
- 5 5 1 9

Actually, after placing the 9^{th} stone, we see another five in a row:

- 5 5 5 5
- 6 6 6 6
- 7 7 7 7
- 8 8 8 8
- 9 9 9 9

As the 8^{th} stone was put first, we output 8.

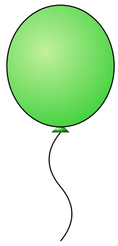
Sample Input 2

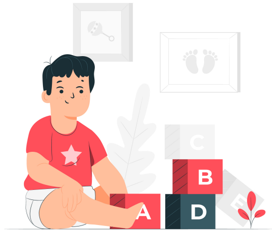
```
3 6
0 0 0
1 0 0
2 0 0
3 0 0
3 1 0
3 2 0
```

Sample Output 2

```
NOT ALIGNED
```

E: Wooden blocks





Giving in to the lobby of the International Toddlers Association, and with the full support of the International Exhausted Parents Association, the 2024 Olympic Committee decided to inaugurate the Toddlers Olympics, a special and massively attended event.

The Wooden Blocks Stacking contest is one of the main trials thereof, intended towards dramatically challenging contestants' strength, patience, and hand-to-eye coordination.

For this contest, participants are given N equal-depth wooden blocks $B_1, B_2, \ldots, B_N$, having integer height and width (measured in centimetres). The purpose of the contest is to obtain a *complete stack* containing all of these N blocks. The winner is the toddler achieving this truly impressive result in the least amount of time. To build the complete stack, contestants are allowed to build *partial stacks*, i.e., stacks containing consecutive blocks $B_i, B_{i+1}, \ldots, B_j$ from bottom to top, in that order; in particular, each block is a partial stack containing exactly one block, and a stack is complete when it contains all the blocks. Moreover, the contestants must comply with the following rules:

- Stacks are built against a wall. Thus, when placing the block B_{i+1} on top of the block B_i, both blocks are perfectly aligned depth-wise, with their front and back borders perfectly aligned. Moreover, the left border of B_{i+1} must be either perfectly aligned with the left border of B_i, or shifted left or right by an integer amount of centimetres.
- At each step, participants must place a partial stack containing blocks $B_j, B_{j+1}, \ldots, B_k$ on top of another partial stack containing blocks $B_i, B_{i+1}, \ldots B_{j-1}$.
- Each (partial or complete) stack ever formed must be *stable*: a stack containing the blocks $B_i, B_{i+1}, \ldots, B_j$ is stable if, for any block B_k such that $i \leqslant k \leqslant j-1$, the center of gravity of the sub-stack formed by the blocks $B_{k+1}, \ldots, B_j$ does not project strictly outside of the block B_k.

You have somehow managed to get the dream job of surveillance assistant in the Wooden Blocks Stacking trial. Although the contest is in itself intense and exciting, your tireless brain issues an additional challenge: you wonder, given the sequence of N blocks, how many possible configurations can be obtained for the complete stack? Since this may be a very large number, you further wish to count these configurations modulo the prime number 1 000 000 007.

Input

The first line contains the number N. This line is followed by N lines, which describe the N wooden blocks, starting from block 1 and up to block N. The i^{th} such line contains two space-separated integers w_i and h_i; w_i is the width of the block i, and h_i is its height.

Output

The output should contain a single line, consisting of an integer representing the number of distinct stable complete stacks that can be obtained by stacking the input blocks, modulo 1 000 000 007.

Limits

- $1 \leqslant N \leqslant 200$;
- $1 \leqslant w_i \leqslant 10$ and $1 \leqslant h_i \leqslant 10$ for all $i \leqslant N$.

Sample Input 1

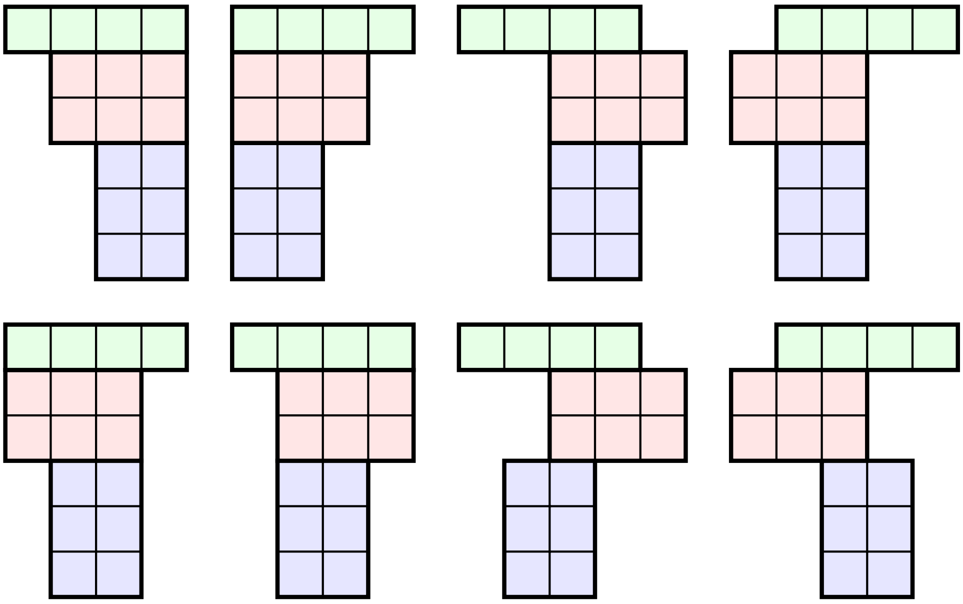
```
3
2 3
3 2
4 1
```

Sample Output 1

```
8
```

Sample Explanation 1

Given the three blocks provided as input, a contestant can build the 8 distinct configurations depicted below.



Among these configurations, the first six can be achieved by progressively stacking single blocks on top of an increasing partial stack.

The last two require, in order to maintain stability at all steps, the construction of a partial stack with blocks 2 and 3, then the placement of this partial stack on top of block 1.

Sample Input 2

```
2
1 1
5 1
```

Sample Output 2

```
1
```