

PROGRAM DESIGN(2) Final Exam (June 7, 2022)

Question 1: Hide and Seek

You are playing hide and seek (躲貓貓) with multiple seekers. You will be given two positive integers m and n , representing the size of a $m \times n$ room where you are playing hide and seek. You are given a positive array of integers $[row, column]$, which represents the place where you have decided to hide. The room has some furniture, where $furniture[i] = [row_i, column_i]$ represents the positions of the furniture, given in a 2D positive integer array. You are also given another 2D positive integer array, $seekers$, where $seekers[i] = [row_i, column_i]$ represents the positions of all the seekers looking for you. A seeker is able to find anyone within the four cardinal directions (north, east, south, west) from their position within the room, unless it is blocked by any furniture or another seeker. Print `true` if any of the seekers can find you, print `false` if they cannot find you.

Constraints:

- $1 \leq m, n \leq 10^5$
- $3 \leq m \times n \leq 10^5$
- $1 \leq furniture.length, seekers.length \leq 5 \times 10^4$
- $2 \leq furniture.length + seekers.length \leq m \times n$
- $furniture[i].length = seekers[i].length = 2$
- $0 \leq row_i, row_j < m$
- $0 \leq column_i, column_j < n$
- all the positions in furniture and seekers are unique

Input Order: $m, n, your_position, furniture, seekers$

Time Limit: 1000 ms

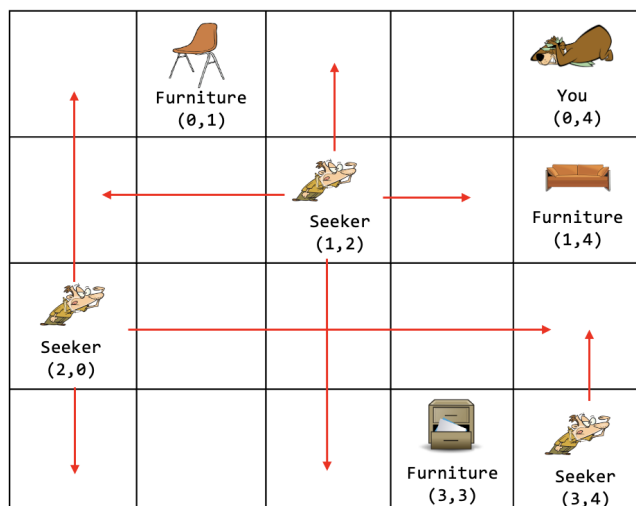
Example 1:

Input:

```
4
5
[0,4]
[[0,1],[1,4],[3,3]]
[[1,2],[2,0],[3,4]]
```

Output:

```
false
```



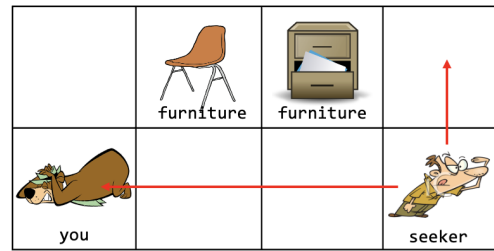
Example 2:

Input:

```
2
4
[1,0]
[[0,1],[0,2]]
[[1,3]]
```

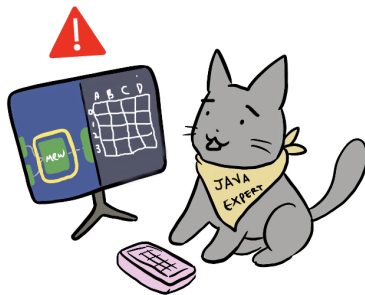
Output:

```
true
```



Question 2: DB Engineer Cat and Evil Bear

Cat is a DB engineer, her job is to tell the users what space can be used within their search range. But Evil Bear always likes to take part of the space to use without permission, so there are several spaces used by Evil Bear that the users cannot use. Therefore, you must help Cat to inform the users of all the space that can be used.



	A	B	C	D	E	F	G
1							Evil Bear
2		Evil Bear					
3							
4					Evil Bear		
5				Evil Bear			

You are given a string list `l1` and a string `s2`.

The first row of string list represents the spaces being used by Evil Bear.

Ex. `l1 = [A1,B7,C1,D3]` means that the spaces A1, B7, C1, D3 are being used by Evil Bear.

The second row of strings shows the range which the user wants to search.

Ex. `s2 = "A1:C3"` means that A1, A2, A3, B1, B2, B3, C1, C2, C3 are the spaces which the user wants to search.

Please list in order all the usable spaces in the search range.

Constraints:

- `0 <= l1.length <= 234`
- `s2.length == 5`
- `'A' <= s2[0] <= s2[3] <= 'Z'`
- `'1' <= s2[1] <= s2[4] <= '9'`
- `s2` consists of uppercase English letters, digits and `':'`.

Time Limit: 1000 ms

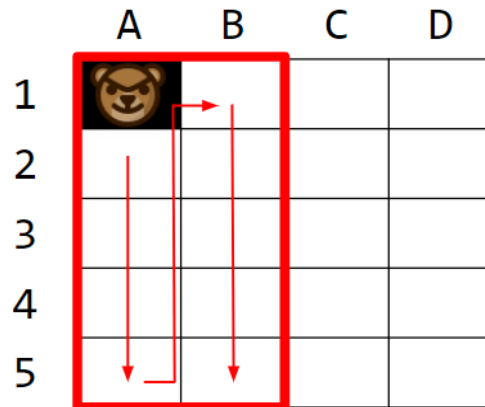
Example 1:

Input:

[A1]
A1:B5

Output:

[A2,A3,A4,A5,B1,B2,B3,B4,B5]



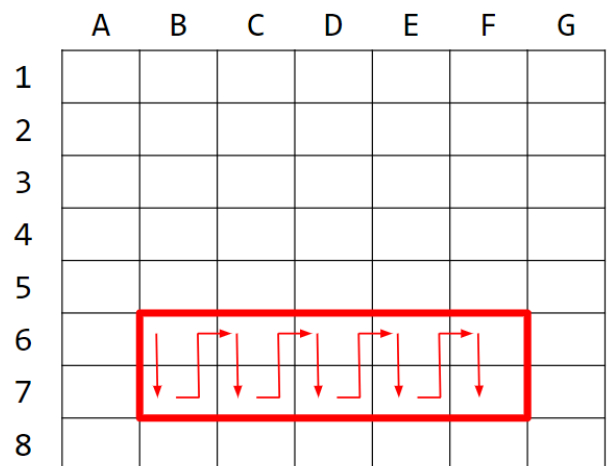
Example 2:

Input:

[]
B6:F7

Output:

[B6,B7,C6,C7,D6,D7,E6,E7,F6,F7]



Example 3:

Input:

[A2,C1,G5,I8,O9]
C1:I6

Output:

[C2,C3,C4,C5,C6,D1,D2,D3,D4,D5,D6,E1,E2,E3,E4,E5,E6,F1,F2,F3,F4,F5,F6,
G1,G2,G3,G4,G6,H1,H2,H3,H4,H5,H6,I1,I2,I3,I4,I5,I6]

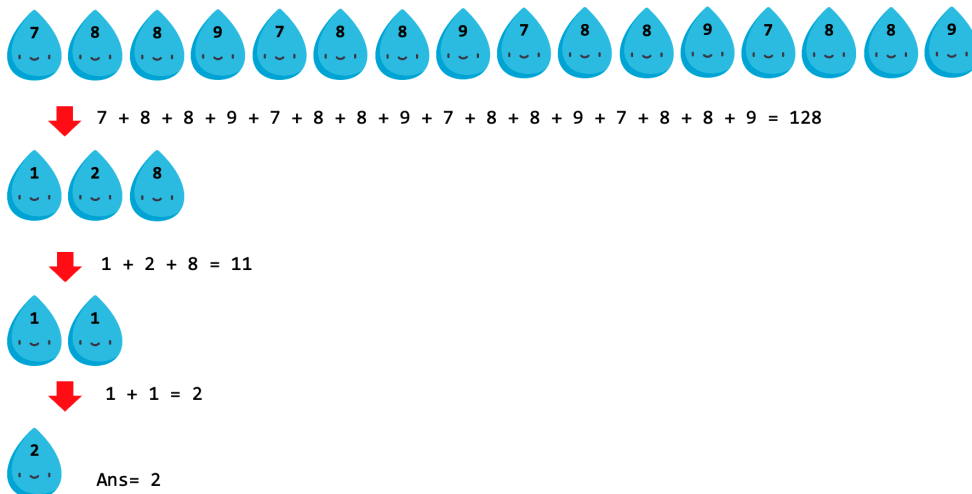
Question 3: Water Fairies

Professor Patrick is a world famous scientist. He recently observed a new creature, he calls them Water Fairies. His research maybe can solve the problem of water scarcity due to drought (乾旱). These water fairies have different water capacities in their bodies. Their water capacity only will be from 1 to 9. According to professor's research, he found that when the number of water fairies is larger than one, they will eat each other until there is only one water fairy left.

Professor Patrick usually tells the assistant to help him calculate the number of the last Water Fairies's water capacity in its body. But the assistant resigned recently, so it's your turn to help the Professor.

For example, there are four Water Fairies now, and their water capacity in their bodies are: 4, 8, 9, 6. Since there are more than one water fairies, they will eat each other, and the water capacity in their bodies will become the digits after summing up the original capacities, for instance 2, 7, because $4 + 8 + 9 + 6 = 27$. Since there are still more than one Water Fairies, they will eat each other again. So that 2, 7 will become 9. (Because of $2 + 7 = 9$). The last Water Fairy's water capacity will be 9.

Since water fairies are social animals. They usually come in n groups.



For example, if there are 4 groups of water fairies, and each group has a water capacity of: 7, 8, 8, 9.

In total, the capacities will be 7, 8, 8, 9, 7, 8, 8, 9, 7, 8, 8, 9, 7, 8, 8, 9.

Since there are more than one water fairies, they will eat each other, so it will become 1, 2, 8 \rightarrow 1, 1 \rightarrow 2. And the last Water Fairy's water capacity in its body will be 2.

Constraints:

- $1 \leq w \leq 10^{100000}$
- $1 \leq n \leq 10^5$

Input Format:

- The first line contains w , which means the water capacity of one group of water fairies
- The second line contains n , which means the number of groups of water fairies

Returns:

- The number of the last one Water Fairy's water capacity.

Time Limit: 1000 ms

Example 1:

Input:

```
4896
1
```

Output:

```
9
```

Example 2:

Input:

```
7889
4
```

Output:

```
2
```