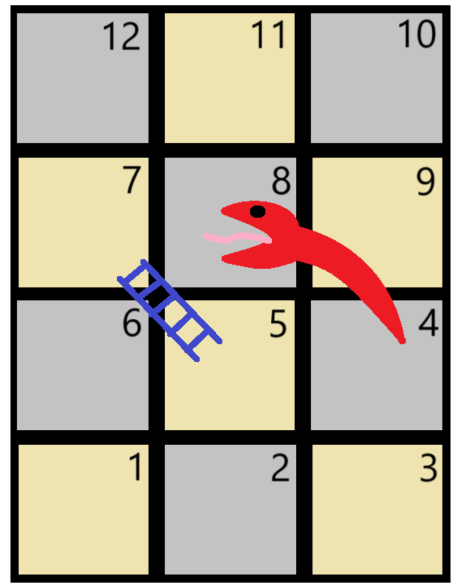
Problem A - Escadas e Serpentes

Paulo and Duarte have been playing board games since childhood, always moving on to more and more complex games. Recently, Duarte found an old copy of the game "Snakes and Ladders", along with its rule book:



- The board has squares numbered from 1 to $\boldsymbol{N}$;
- Each player has a piece that starts on square 1;
- The players alternate rolling the dice, moving their piece forward a number of squares given by the dice, unless that would go past $\boldsymbol{N}$, in which case the piece does not move (if the piece is on square x and the dice show y, the piece moves to square $x + y$ provided that $x + y \leq \boldsymbol{N}$; otherwise the turn immediately passes to the next player);
- There are two kinds of special squares: squares with the head of a snake and squares with the foot of a ladder. If a piece ends a move on the head of a snake, it slides down to the end of the snake's tail. If a piece ends a move on the foot of a ladder, it climbs to the top of that ladder. After this movement, **the turn ends immediately** (even if there is another snake or ladder on the destination square), and play passes to the next player. In total there are $\boldsymbol{M}$ such special squares.
- The game ends as soon as a player finishes their turn with their piece on square $\boldsymbol{N}$; that player wins.

Duarte, filled with nostalgia, suggested that they play the game again just like they did as children, but Paulo argued that it was hardly worth it because the game is purely a matter of luck—there are no decisions to make—and sometimes it seems to drag on forever. Duarte then proposed writing a program to play the game. You are given a description of a board together with a sequence of $\boldsymbol{S}$ positive integers $s_1, s_2, \ldots, s_S$, where s_i is the dice value on the i-th roll (if there are more than $\boldsymbol{S}$ rolls, the numbers repeat cyclically). Paulo and Duarte now want to determine whether the game ends and, if so, who wins.

Paulo and Duarte want to simulate a total of $\boldsymbol{T}$ independent games, each with its own board and its own dice-roll sequence, and you must determine the answer for every one of them.

Part I

Since they were only two, they decided to initially simulate only games with 2 players

Example

If $\boldsymbol{N} = 12$, $\boldsymbol{M} = 2$ and $\boldsymbol{S} = 6$, with a ladder from 5 to 7 and a snake from 8 to 4 (as shown on the first page), and dice rolls $\{5, 3, 2, 4, 6, 1\}$, then the game proceeds as follows with Paulo starting:

1. Paulo moves his piece from 1 to 6;
2. Duarte moves his piece from 1 to 4;
3. Paulo moves from 6 to 8, lands on the head of the snake, and ends his turn on 4;
4. Duarte moves from 4 to 8, lands on the head of the snake, and slides back to 4;
5. Paulo moves from 4 to 10;
6. Duarte moves from 4 to 5, lands on the foot of the ladder, and climbs to 7;
7. The sequence now repeats, and Paulo does not move because $10 + 5 > 12$;
8. Duarte moves from 7 to 10;
9. Paulo moves from 10 to 12 and wins the game.

Constraints

The following limits are guaranteed for every test case in this part:

$1 \leq \boldsymbol{T} \leq 10$	Number of games to simulate
$2 \leq \boldsymbol{N} \leq 100$	Board size
$0 \leq \boldsymbol{M} \leq \boldsymbol{N}$	Total number of snakes and ladders
$1 \leq \boldsymbol{S} \leq 100$	Length of the dice-roll sequence
$1 \leq s_i \leq \boldsymbol{N}$	Each dice value in the sequence

The test cases for this part are organised into two groups with additional restrictions:

Subtask	Points	Additional Constraints
1	30	The game always ends
2	20	No additional constraints

Part II

Now that they know who would win between them, they also want to simulate the game with J players instead of just 2, and with larger boards.

With J players, player 1 goes first, then player 2, and so on up to player J; afterwards the sequence repeats starting again with player 1.

Example

If $\boldsymbol{N} = 12, \boldsymbol{M} = 3, \boldsymbol{S} = 9$ and $\boldsymbol{J} = 3$, with a ladder from 5 to 7, a snake from 8 to 4, and another snake from 9 to 2, and dice rolls $\{5, 3, 2, 4, 6, 1, 4, 7, 1\}$, then the game proceeds as follows with Paulo starting:

1. Paulo moves his piece from 1 to 6;
2. Duarte moves his piece from 1 to 4;
3. You move your piece from 1 to 3;
4. Paulo moves from 6 to 10;
5. Duarte moves from 4 to 10;
6. You move from 3 to 4;
7. Paulo does not move because $10 + 4 > 12$;
8. Duarte does not move because $10 + 7 > 12$;
9. You move from 4 to 5, land on the foot of the ladder, and climb to 7;
10. Paulo does not move because $10 + 5 > 12$;
11. Duarte does not move because $10 + 3 > 12$;
12. You move from 7 to 9, land on the head of a snake, and slide down to 2.

From this point on, it can be shown that Paulo and Duarte will never again be able to move their pieces—because they will never roll a 1 or 2—and since you keep rolling only 1 or 2, you will never get past the two consecutive snakes on squares 8 and 9. Therefore the game never ends.

Constraints

The following limits are guaranteed for every test case in this part:

$1 \leq \boldsymbol{T} \leq 10$	Number of games to simulate
$2 \leq \boldsymbol{N} \leq 500$	Board size
$0 \leq \boldsymbol{M} \leq \boldsymbol{N}$	Total number of snakes and ladders
$1 \leq \boldsymbol{S} \leq 1000$	Length of the dice-roll sequence
$2 \leq \boldsymbol{J} \leq 500$	Number of players
$1 \leq s_i \leq \boldsymbol{N}$	Each dice value in the sequence

The test cases for this part are organised into two groups with additional restrictions:

Subtask	Points	Additional Constraints
3	25	$\boldsymbol{N}, \boldsymbol{S}, \boldsymbol{M} \leq 100,\ \boldsymbol{J} \leq 20$
4	25	No additional constraints

Summary of Subtasks

All test cases are organised into four groups with additional restrictions:

Subtask	Points	Part	Additional Constraints
1	30	Part I	The game always ends
2	20	Part I	No additional constraints
3	25	Part II	$\boldsymbol{N}, \boldsymbol{M}, \boldsymbol{S} \leq 100,\ \boldsymbol{J} \leq 20$
4	25	Part II	No additional constraints

Input Format

The first line contains an integer $\boldsymbol{P}$ indicating which part the test case belongs to (1 for Part I and 2 for Part II).

The second line contains an integer $\boldsymbol{T}$, the number of test cases to solve. Then follow $\boldsymbol{T}$ sets of parameters, one for each test case:

The first line of each test case contains three integers in Part I and four integers in Part II: $\boldsymbol{N}$ – the board size, $\boldsymbol{M}$ – the number of snakes and ladders, $\boldsymbol{S}$ – the length of the dice-roll sequence, and (only in Part II) $\boldsymbol{J}$ – the number of players.

Next come $\boldsymbol{M}$ lines, each with two integers $a_i \neq b_i$. If $a_i < b_i$, it is a ladder with foot on square a_i and top on square b_i. If $a_i > b_i$, it is a snake with head on square a_i and tail end on square b_i. It is guaranteed that for all $i \neq j$, $a_i \neq a_j$.

Finally, after the parameters of each test case, there is one line with $\boldsymbol{S}$ integers representing the dice rolls.

Output Format

Output $\boldsymbol{T}$ lines, one for each test case: if the game ends, print on that line a positive integer indicating the player who wins. If the game never ends, print -1.

Example 1 Input

```
1
1
12 2 6
5 7
8 4
5 3 2 4 6 1
```

Example 1 Output

```
1
```

Example 1 Description

This example corresponds to the example from Part I in the statement.

Example 2 Input

```
2
1
12 3 9 3
5 7
8 4
9 2
5 3 2 4 6 1 4 7 1
```

Example 2 Output

```
-1
```

Example 2 Description

This example corresponds to the example from Part II in the statement.

Example 3 Input

```
1
3
20 4 9
5 8
11 3
7 18
19 6
4 3 7 1 9 9 8 2 4
10 8 6
1 5
2 5
4 3
9 1
8 2
6 4
7 8
3 4
1 2 10 9 2 1
15 5 20
4 13
12 6
6 5
11 7
7 10
2 3 6 4 3 7 9 1 2 5 3 4 12 1 4 4 4 8 5 7
```

Example 3 Output

```
2
-1
1
```

Example 4 Input

```
2
2
10 6 12 4
3 7
4 10
7 2
8 9
2 4
6 1
1 6 4 3 9 2 3 5 9 8 3 5
16 3 17 20
4 9
15 6
14 3
2 5 4 3 5 9 11 12 9 4 3 7 2 3 4 1 12
```

Example 4 Output

```
4
7
```

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