You are given n bulbs and m switches. Each of the switches toggles a list of bulbs. Initially all the bulbs are turned off. Now for a set of desired states of the bulbs calculate the minimum number of switch presses required to reach that state.

Input

Input contains multiple test cases. First line contains an integer T the number of test cases. Each test case starts with a line containing 2 integers n ($1 \leq n \leq 15$) and m ($1 \leq m \leq 40$). Next m line contains the description of m switches. Each of these lines starts with an integer k denoting the number of bulbs that toggles their states after pressing this switch. The rest of the line contains k distinct integers denoting the indices of the bulbs. The bulbs are numbered from 0 to $n-1$. The next line contains an integer q ($1 \leq q \leq 5000$) that denotes the number of queries. Each of the following q line contains a binary string of length n denoting the desired states of the n bulbs: `1` means the bulb must be on and `0` means the bulb must be off. The rightmost character is the state of bulb 0 and the leftmost character is the state of bulb $n-1$.

Output

For each test case output contains $q+2$ lines. First line contains '`Case` x`:`' where x is the number of test cases. Each of the next q lines contains one integer denoting the minimum number of switch presses required to reach the bulb states in the ith query. If the state cannot be reachable by a series of switch presses output '`-1`'.

The last line will be a blank line.

Sample Input

```
2
3 3
3 0 1 2
2 1 2
1 2
3
101
010
111
4 5
1 0
1 1
2 2 3
3 0 1 3
2 2 3
3
1111
1010
0101
```

Sample Output

```
Case 1:
3
2
1

Case 2:
3
2
3
```