Alternating Current

Problem ID: alternating

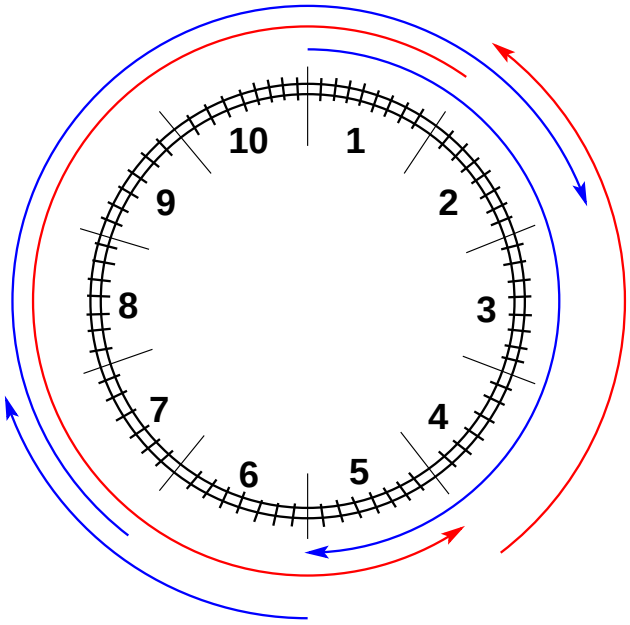
Time limit: 3 seconds

Fredrik is at home, playing with a custom-built model railway which he is very proud of. The railway consists of N segments connected in a circle, numbered $1, 2, \ldots, N$ in clockwise order. Electricity to the train is provided through M curved wires that pass along the circle. Each segment has at least one wire that goes along it.

However, Fredrik is becoming bored with his circling train and decides to add a *train switch* to every segment, which he could use to cause derailing accidents and other exciting scenarios. But the switches also need electricity. And not just any kind of electricity; they specifically need *alternating current*.[1]

The way you get alternating current, Fredrik figures, is by having current that goes in both directions. Each wire only gives current in one direction (either clockwise or counter-clockwise) but Fredrik is free to decide which. Thus, what he wants to do is to make a decision about the direction of the current in each wire, so that every track segment is covered by both a wire with clockwise-directed current and a wire with counter-clockwise-directed current.

Can you help Fredrik with this task?



A solution to the first sample. The curved arrows outside the railway represent the wires that provide electricity. The direction of each arrow represents Fredrik's choice of direction of the current (with the blue and red colors emphasizing the different directions). Note that all arrows could have been reversed to get the other valid solution: `11010`.

Input

The first line contains two integers N and M, the number of railway segments and the number of wires, respectively.

The next M lines each contains two numbers $1 \leq a, b \leq N$, indicating that there is a wire that covers segments $a, a+1, \ldots, b$. If b is smaller than a, it means that the sequence wraps around, i.e. segments $a, \ldots, N, 1, \ldots, b$ are covered. Note that if $a = b$, the wire covers only one segment.

Output

Output a single line with M characters, each being either `0` or `1`. The ith character of the line should be `0` if the current in the ith wire given in the input should be directed clockwise, or `1` if it should be directed counter-clockwise. If there are multiple solutions you may output any of them.

If there is no valid solution, output "`impossible`".

[1] This makes sense because the railway is a Swedish one – in Sweden, all train switches ("växlar") use alternating current ("växelström").

Constraints

Your solution will be tested on a set of test groups, each worth a number of points. Each test group contains a set of test cases. To get the points for a test group you need to solve all test cases in the test group. Your final score will be the maximum score of a single submission.

Group	Points	Limits	Additional Constraints
1	13	$2 \leq N, M \leq 15$	
2	20	$2 \leq N, M \leq 100$	
3	22	$2 \leq N, M \leq 1000$	
4	19	$2 \leq N, M \leq 100\,000$	No wire has $b < a$.
5	26	$2 \leq N, M \leq 100\,000$	

Sample Input 1

```
10 5
1 5
6 7
5 1
7 2
2 4
```

Sample Output 1

```
00101
```

Sample Input 2

```
10 5
1 4
2 5
4 7
6 10
8 1
```

Sample Output 2

```
impossible
```

Sample Input 3

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

Sample Output 3

```
impossible
```

Sample Input 4

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

Sample Output 4

```
101
```

Genetics

Problem ID: genetics

Time limit: 2 seconds

For villains that intend to take over the world, a common way to avoid getting caught is to clone themselves. You have managed to catch an evil villain and her $N - 1$ clones, and you are now trying to figure out which one of them is the real villain.

To your aid you have each person's DNA sequence, consisting of M characters, each being either `A`, `C`, `G` or `T`. You also know that the clones are not perfectly made; rather, their sequences differ in exactly K places compared to the real villain's.

Can you identify the real villain?

Input

The first line contains the three integers N, M, and K, where $1 \leq K \leq M$. The following N lines represent the DNA sequences. Each of these lines consists of M characters, each of which is either `A`, `C`, `G` or `T`.

In the input, there is exactly one sequence that differs from all the other sequences in exactly K places.

Warning: this problem has rather large amounts of input, and will require fast IO in Java.

Output

Output an integer – the index of the DNA sequence that belongs to the villain. The sequences are numbered starting from 1.

Constraints

Your solution will be tested on a set of test groups, each worth a number of points. Each test group contains a set of test cases. To get the points for a test group you need to solve all test cases in the test group. Your final score will be the maximum score of a single submission.

Group	Points	Limits	Additional Constraints
1	27	$3 \leq N, M \leq 100$	
2	19	$3 \leq N, M \leq 1800$	All characters are either `A` or `C`.
3	28	$3 \leq N, M \leq 4100$	All characters are either `A` or `C`.
4	26	$3 \leq N, M \leq 4100$	

Sample Input 1

```
4 3 1
ACC
CCA
ACA
AAA
```

Sample Output 1

```
3
```

Sample Input 2

```
4 4 3
CATT
CAAA
ATGA
TCTA
```

Sample Output 2

```
4
```

Paths

Problem ID: paths

Time limit: 3 seconds

A *graph* is a mathematical structure which consists of a set of *vertices*, and a set of *edges*, each connecting two vertices. An example of a graph with 4 vertices and 3 edges is shown in the sample explanation below.

A *path* in the graph is defined as an ordered list of 2 or more vertices, such that there are edges between consecutive vertices in the list. In this task we are only interested in *simple paths* in which no vertex occurs more than once. Note that the list is ordered; for example, "`5-6-7`", "`5-7-6`" and "`7-6-5`" are all treated as different paths.

In this task, each vertex in the graph has one of K colors. The task is to find the number of possible (simple) paths in which no two vertices have the same color.

Input

The first line of input contains three integers: N (the number of vertices), M (the number of edges), and K (the number of different colors).

The second line of input contains N integers between 1 and K – the colors of each vertex (starting with vertex 1 and ending with vertex N).

Each of the following M lines describes an edge and contains two integers a, b ($1 \leq a, b \leq N, a \neq b$) – the two vertices connected by the edge. There will be at most one edge between any two vertices.

Output

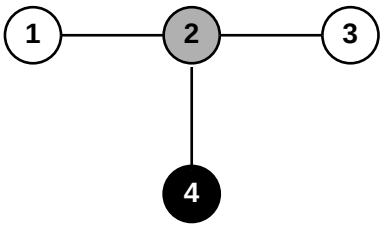
Output one integer – the number of paths whose vertices all have distinct colors. This number will always be smaller than 10^{18}.

Constraints

Your solution will be tested on a set of test groups, each worth a number of points. Each test group contains a set of test cases. To get the points for a test group you need to solve all test cases in the test group. Your final score will be the maximum score of a single submission.

Group	Points	Limits
1	23	$1 \leq N, M \leq 100, 1 \leq K \leq 4$
2	20	$1 \leq N, M \leq 300\,000, 1 \leq K \leq 3$
3	27	$1 \leq N, M \leq 300\,000, 1 \leq K \leq 4$
4	30	$1 \leq N, M \leq 100\,000, 1 \leq K \leq 5$

Explanation of Sample 1



The graph in the first example is illustrated in the figure, where each vertex has been filled with white (color 1), gray (color 2) or black (color 3). There are 10 paths whose vertices all have distinct colors: "`1-2`", "`2-1`", "`2-3`", "`3-2`", "`2-4`", "`4-2`", "`1-2-4`", "`4-2-1`", "`3-2-4`" and "`4-2-3`".

Note that "`1`" is not allowed as a path, because it is a single vertex, nor is "`1-2-3`", because it contains two nodes of color 1.

Sample Input 1

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

Sample Output 1

```
10
```

Sample Input 2

```
9 11 4
1 2 3 4 1 2 1 2 2
1 2
1 3
2 3
2 4
3 6
6 2
6 5
4 3
4 5
7 8
9 8
```

Sample Output 2

```
70
```