Problem Set 9: Counting
15-295 Spring 2018

A. Number of Ways

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

You've got array $a[1], a[2], ..., a[n]$, consisting of n integers. Count the number of ways to split all the elements of the array into three contiguous parts so that the sum of elements in each part is the same.

More formally, you need to find the number of such pairs of indices i, j $(2 \le i \le j \le n - 1)$, that $\sum_{k=1}^{i-1} a_k = \sum_{k=i}^{j} a_k = \sum_{k=j+1}^{n} a_k$.

Input

The first line contains integer n $(1 \le n \le 5 \cdot 10^5)$, showing how many numbers are in the array. The second line contains n integers $a[1], a[2], ..., a[n]$ $(|a[i]| \le 10^9)$ — the elements of array a.

Output

Print a single integer — the number of ways to split the array into three parts with the same sum.

Examples

input Copy

```
5
1 2 3 0 3
```

output

```
2
```

input Copy

```
4
0 1 -1 0
```

output

```
1
```

input Copy

```
2
4 1
```

output

```
0
```

B. Shaass and Lights

time limit per test: 1 second
memory limit per test: 256 megabytes
input: standard input
output: standard output

There are n lights aligned in a row. These lights are numbered 1 to n from left to right. Initially some of the lights are switched on. Shaass wants to switch all the lights on. At each step he can switch a light on (this light should be switched off at that moment) if there's at least one adjacent light which is already switched on.

He knows the initial state of lights and he's wondering how many different ways there exist to switch all the lights on. Please find the required number of ways modulo 1000000007 $(10^9 + 7)$.

Input

The first line of the input contains two integers n and m where n is the number of lights in the sequence and m is the number of lights which are initially switched on, $(1 \le n \le 1000, 1 \le m \le n)$. The second line contains m distinct integers, each between 1 to n inclusive, denoting the indices of lights which are initially switched on.

Output

In the only line of the output print the number of different possible ways to switch on all the lights modulo 1000000007 $(10^9 + 7)$.

Examples

input

```
3 1
1
```

output

```
1
```

input

```
4 2
1 4
```

output

```
2
```

input

```
11 2
4 8
```

output

```
6720
```

C. Polo the Penguin and Houses

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Little penguin Polo loves his home village. The village has n houses, indexed by integers from 1 to n. Each house has a plaque containing an integer, the i-th house has a plaque containing integer p_i $(1 \le p_i \le n)$.

Little penguin Polo loves walking around this village. The walk looks like that. First he stands by a house number x. Then he goes to the house whose number is written on the plaque of house x (that is, to house p_x), then he goes to the house whose number is written on the plaque of house p_x (that is, to house p_{p_x}), and so on.

We know that:

1. When the penguin starts walking from any house indexed from 1 to k, inclusive, he can walk to house number 1.
2. When the penguin starts walking from any house indexed from $k+1$ to n, inclusive, he definitely cannot walk to house number 1.
3. When the penguin starts walking from house number 1, he can get back to house number 1 after some non-zero number of walks from a house to a house.

You need to find the number of ways you may write the numbers on the houses' plaques so as to fulfill the three above described conditions. Print the remainder after dividing this number by 1000000007 $(10^9 + 7)$.

Input

The single line contains two space-separated integers n and k $(1 \le n \le 1000, 1 \le k \le min(8, n))$ — the number of the houses and the number k from the statement.

Output

In a single line print a single integer — the answer to the problem modulo 1000000007 $(10^9 + 7)$.

Examples

input

```
5 2
```

output

```
54
```

input

```
7 4
```

output

```
1728
```

D. Pluses everywhere

time limit per test: 3 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Vasya is sitting on an extremely boring math class. To have fun, he took a piece of paper and wrote out n numbers on a single line. After that, Vasya began to write out different ways to put pluses ("+") in the line between certain digits in the line so that the result was a correct arithmetic expression; formally, no two pluses in such a partition can stand together (between any two adjacent pluses there must be at least one digit), and no plus can stand at the beginning or the end of a line. For example, in the string `100500`, ways `100500` (add no pluses), `1+00+500` or `10050+0` are correct, and ways `100++500`, `+1+0+0+5+0+0` or `100500+` are incorrect.

The lesson was long, and Vasya has written all the correct ways to place exactly k pluses in a string of digits. At this point, he got caught having fun by a teacher and he was given the task to calculate the sum of all the resulting arithmetic expressions by the end of the lesson (when calculating the value of an expression the leading zeros should be ignored). As the answer can be large, Vasya is allowed to get only its remainder modulo $10^9 + 7$. Help him!

Input

The first line contains two integers, n and k ($0 \le k < n \le 10^5$).

The second line contains a string consisting of n digits.

Output

Print the answer to the problem modulo $10^9 + 7$.

Examples

input

```
3 1
108
```

output

```
27
```

input

```
3 2
108
```

output

```
9
```

Note

In the first sample the result equals $(1 + 08) + (10 + 8) = 27$.

In the second sample the result equals $1 + 0 + 8 = 9$.

E. Gerald and Giant Chess

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Giant chess is quite common in Geraldion. We will not delve into the rules of the game, we'll just say that the game takes place on an $h \times w$ field, and it is painted in two colors, but not like in chess. Almost all cells of the field are white and only some of them are black. Currently Gerald is finishing a game of giant chess against his friend Pollard. Gerald has almost won, and the only thing he needs to win is to bring the pawn from the upper left corner of the board, where it is now standing, to the lower right corner. Gerald is so confident of victory that he became interested, in how many ways can he win?

The pawn, which Gerald has got left can go in two ways: one cell down or one cell to the right. In addition, it can not go to the black cells, otherwise the Gerald still loses. There are no other pawns or pieces left on the field, so that, according to the rules of giant chess Gerald moves his pawn until the game is over, and Pollard is just watching this process.

Input

The first line of the input contains three integers: h, w, n — the sides of the board and the number of black cells $(1 \le h, w \le 10^5, 1 \le n \le 2000)$.

Next n lines contain the description of black cells. The i-th of these lines contains numbers r_i, c_i $(1 \le r_i \le h, 1 \le c_i \le w)$ — the number of the row and column of the i-th cell.

It is guaranteed that the upper left and lower right cell are white and all cells in the description are distinct.

Output

Print a single line — the remainder of the number of ways to move Gerald's pawn from the upper left to the lower right corner modulo $10^9 + 7$.

Examples

input

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

output

```
2
```

input

```
100 100 3
15 16
16 15
99 88
```

output

```
545732279
```

Problem F. Jigsaw Puzzle

Input file:	`stdin`
Output file:	`stdout`
Time limit:	1 second
Memory limit:	256 megabytes
Feedback:	

At an online course in discrete mathematics, one of the recent lectures was devoted to correct domino coverings of different rectangular fields of size $n \times m$ consisting of square cells. Some cells may be cut from these fields. The professor called such fields *jigsaw puzzles*. To solve a jigsaw puzzle means to find a covering of the given field with dominoes of size 1×2 such that the following conditions hold:

- the dominoes cover all the non-cut cells on the field;
- all the dominoes fully lie inside the field;
- the dominoes do not intersect each other;
- the dominoes do not lie on any of the cut cells.

Now the professor wants to know how understandable his lecture was. To find this out, he decides to give jigsaw puzzles to all students to solve. The professor doesn't want to make students' lives too difficult, so he decided that each jigsaw puzzle will have at least one solution. But he also wants everybody to do their homework themselves, and therefore, he wants all jigsaw puzzles to be different.

Before the professor will create his jigsaw puzzles, he wants to know how many different puzzles exist. Can you help him?

Your task is to compute the number of different fields of size $n \times m$ that have at least one correct domino covering. Remember that some cells of a field could be cut. This number can be quite large, so you must compute it modulo $10^9 + 7$.

Two fields are considered different if there exists a cell on an $n \times m$ grid that is cut from one field but not cut from the other. A field can not be reflected or rotated.

Input

The input contains only one line with two integers n and m ($1 \leqslant n \leqslant 6$, $1 \leqslant m \leqslant 500$) separated by a single space.

Output

The output must contain a single line with a single integer: the answer to the problem.

Examples

stdin	stdout
1 2	2
2 3	18