

## INOI 2017, Problem 1, Fence

You have a rectangular farm which consists of  $R \times C$  fields arranged in a grid consisting of  $R$  rows and  $C$  columns. Each field is a  $1 \times 1$  square. Some of these fields have been planted with potatoes while the others lie uncultivated. We say that two fields are adjacent if one lies immediately to the left or to the right or above or below the other. (Note that two fields which touch each other at just one corner are not considered adjacent). If two fields are adjacent then we say we may walk from one to the other. A **patch** is a collection of all the cultivated fields such that one may walk from any field in the patch to any other field in the same patch only via cultivated fields. There are no uncultivated fields in a patch. That is, all the cultivated fields in the farm can be partitioned into patches, and you can walk from one cultivated field to another cultivated field, if and only if, both of them belong to the same patch.

To prevent wild animals from destroying the cultivated fields you plan to enclose each patch within fences constructed all along the boundaries of the patch. Wild animals infest the uncultivated fields, and also beyond the  $R \times C$  farm. We need to ensure that the fences protect all the boundaries of each patch, so that the wild animals cannot get to any cultivated field without crossing a fence.

Clearly, the length of the fence needed for each patch may differ. If your patch consists of just a single field then the fence will be of length 4. If it consists of two adjacent fields then the fence will be length 6.

Your task is to output the maximum length of fence needed to enclose a patch, among all the patches in your farm. The input to your program will be a description of the positions of all the cultivated fields in your farm.

$(X,Y)$  refers to the field on the  $X^{\text{th}}$  row and  $Y^{\text{th}}$  column. So,  $(1,1)$  refers to the top-left corner field, and  $(R,C)$  refers to the bottom-right corner.

### Input

- The first line contains three space separated integers,  $R$ ,  $C$  and  $N$ , which are the number of rows, number of columns and the number of cultivated fields, respectively.
- The next  $N$  lines contain two space separated integers,  $X_i$  and  $Y_i$ , which signify that  $(X_i, Y_i)$  is a cultivated field.

### Output

- A single integer which is the maximum length of fence needed for any patch.

### Constraints

For all test cases you may assume that:

- $0 \leq \text{Number of cultivated fields} = N \leq 100000$
- $1 \leq X_i \leq R$
- $1 \leq Y_i \leq C$

**Subtask 1:** For 15% of the score,

- $1 \leq R, C \leq 20$

**Subtask 2:** For further 45% of the score,

- $1 \leq R, C \leq 2500$

**Subtask 3:** For 40% of the score,

- $1 \leq R, C \leq 1000000$

## Example

### Input :

```
4 4 9
1 4
2 1
2 2
2 3
4 3
4 1
4 2
3 1
3 3
```

### Output :

```
16
```

## Explanation

The input corresponds to the figure

```
. . . x
x x x .
x . x .
x x x .
```

'x' corresponds to a cultivated field, and '.' corresponds to an uncultivated field.

There are two patches. One patch, which includes only the (1,4) field needs a fence of length 4. The other patch, which has 8 fields in it, needs fence of length 16. A length of 12 to cover its outer boundary, and length 4 to cover its inner boundary.

Maximum(4,16) = 16. Hence, the answer is 16.

## INOI 2017, Problem 2, Training

Ash and his Pokemon Pikachu are going on a journey. Ash has planned his route for the journey so that it passes through  $N$  cities, numbered  $1, 2, \dots, N$ , and in this order.

When they set out, Pikachu has an initial **strength** of  $S_{in}$  as well as an **experience value (XV)** of  $0$ . As they travel they may increase his strength and experience value in a manner to be described below.

In each city, Ash can choose either to train Pikachu or let Pikachu battle the Gym-leader (but not both). The Gym-leader in  $i^{th}$  city has experience  $E[i]$ . If Pikachu enters a city  $i$  with strength  $S$  and decides to train, then this increases his strength by the cube of the sum of the digits in his current strength. For example, if he entered a city with a strength of  $12$ , then training will increase his strength to  $12 + (1+2)^3 = 39$ . On the other hand, if he enters city  $i$  with strength  $S$  and battles the Gym-leader, then this increases his experience value  $XV$  by  $S \cdot E[i]$ .

Ash wants your help to find out the maximum  $XV$  that Pikachu can attain at the end of his journey.

### Input

- The first line contains two space separated integers,  $N$  and  $S_{in}$ , which are the number of cities, and the initial strength, respectively.
- The second line contains  $N$  space separated integers, which correspond to  $E[1], E[2], \dots, E[N]$ .

### Output

- A single integer which is the maximum  $XV$  that Pikachu can attain.

### Constraints

For all test cases you may assume that:

- $1 \leq N \leq 5000$
- $0 \leq S_{in} \leq 10^9$
- $0 \leq E[i] \leq 10^4$

**Subtask 1:** For 10% of the score,

- $N \leq 20$  and  $S_{in} = 1$

**Subtask 2:** For further 40% of the score,

- $E[i] = k$  for all  $i$

i.e.  $E[i]$  is some constant  $k$ , for all  $i$

**Subtask 3:** For further 50% of the score,

- No further constraints.

### Example

**Input 1:**

```
2 12
5 10
```

**Output 1:**

390

## Explanation 1

Suppose Pikachu trains in the first city, his strength will increase to 39, because as explained above,  $12 + (1+2)^3 = 39$ . If he battles in the first city, his XV will increase by  $(12*5) = 60$ .

If Pikachu trains in the first city, and then battles in the second city, his XV will increase by  $39*10 = 390$ . So, the final XV will be  $0+390 = 390$ . You can check that you cannot do better than this. Hence the answer is 390.

**Input 2:**

4 1  
100 1 6 2

**Output 2:**

120

## Explanation 2

Pikachu battles in the first city, trains in the second and third, and then battles in the fourth city. So his strength going into each of the four cities is (1, 1, 2, 10). And so he gains  $1*100$  XV from the first city and  $10*2$  XV from the fourth city. This gets him a total of 120 XV, and you can verify that nothing better can be done.