A - Status Code

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 100 points

Problem Statement

You are given an integer S between 100 and 999 (inclusive).

If S is between 200 and 299 (inclusive), print `Success`; otherwise, print `Failure`.

Constraints

- $100 \leq S \leq 999$
- S is an integer.

Input

The input is given from Standard Input in the following format:

S

Output

Print the answer.

Sample Input 1

```
200
```

Sample Output 1

```
Success
```

200 is between 200 and 299, so print `Success`.

Sample Input 2

```
401
```

Sample Output 2

```
Failure
```

401 is not between 200 and 299, so print `Failure`.

Sample Input 3

```
999
```

Sample Output 3

```
Failure
```

B - Unauthorized

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 200 points

Problem Statement

One day, Takahashi performed N operations on a certain web site.

The i-th operation $(1 \leq i \leq N)$ is represented by a string S_i, which is one of the following:

- $S_i =$ `login`: He performs a login operation and becomes logged in to the site.
- $S_i =$ `logout`: He performs a logout operation and becomes not logged in to the site.
- $S_i =$ `public`: He accesses a public page of the site.
- $S_i =$ `private`: He accesses a private page of the site.

The site returns an **authentication error** if and only if he accesses a private page while he is not logged in.

Logging in again while already logged in, or logging out again while already logged out, does **not** cause an error. Even after an authentication error is returned, he continues performing the remaining operations.

Initially, he is not logged in.

Print the number of operations among the N operations at which he receives an authentication error.

Constraints

- $1 \leq N \leq 100$
- N is an integer.
- Each S_i is one of `login`, `logout`, `public`, `private`. $(1 \leq i \leq N)$

Input

The input is given from Standard Input in the following format:

$$
\begin{aligned}
&N \\
&S_1 \\
&S_2 \\
&\vdots \\
&S_N
\end{aligned}
$$

Output

Print the number of times Takahashi receives an authentication error.

Sample Input 1

```
6
login
private
public
logout
private
public
```

Sample Output 1

```
1
```

The result of each operation is as follows:

- Takahashi becomes logged in.
- He accesses a private page. He is logged in, so no error is returned.
- He accesses a public page.
- He becomes logged out.
- He accesses a private page. He is not logged in, so an authentication error is returned.
- He accesses a public page.

An authentication error occurs only at the 5th operation, so print 1.

Sample Input 2

```
4
private
private
private
logout
```

Sample Output 2

```
3
```

If he tries to access private pages consecutively while not logged in, he receives an authentication error for each such operation.

Note that logging out again while already logged out does not cause an authentication error.

Sample Input 3

```
20
private
login
private
logout
public
logout
logout
logout
logout
private
login
login
private
login
private
login
public
private
logout
private
```

Sample Output 3

```
3
```

C - K-bonacci

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 300 points

Problem Statement

You are given positive integers N and K. Define a sequence $A = (A_0, A_1, \ldots, A_N)$ of length $N+1$ as follows:

- $A_i = 1$ for $0 \leq i < K$;
- $A_i = A_{i-K} + A_{i-K+1} + \ldots + A_{i-1}$ for $K \leq i$.

Find A_N modulo 10^9.

Constraints

- $1 \leq N, K \leq 10^6$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

N K

Output

Print the answer.

Sample Input 1

```
4 2
```

Sample Output 1

```
5
```

We have $A_0 = A_1 = 1$, and $A_2 = A_0 + A_1 = 2$, $A_3 = A_1 + A_2 = 3$, $A_4 = A_2 + A_3 = 5$.

Sample Input 2

```
10 20
```

Sample Output 2

```
1
```

Sample Input 3

```
1000000 500000
```

Sample Output 3

```
420890625
```

Remember to print A_N modulo 10^9.

D - Logical Filling

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 400 points

Problem Statement

You are given a string S of length N consisting of the characters `.`, `o`, and `?`. Among the strings that can be obtained by replacing every `?` in S independently with either `.` or `o`, let X be the set of strings that satisfy all of the following conditions:

- The number of `o`s is exactly K.
- No two `o`s are adjacent.

It is guaranteed that X is non-empty.

Print a string T of length N that satisfies the following (let T_i denote the i-th character of T):

- If the i-th character of every string in X is `.`, then $T_i =$ `.`.
- If the i-th character of every string in X is `o`, then $T_i =$ `o`.
- If X contains both a string whose i-th character is `.` and a string whose i-th character is `o`, then $T_i =$ `?`.

Constraints

- $1 \leq N \leq 2 \times 10^5$
- $0 \leq K$
- S is a string of length N consisting of `.`, `o`, `?`.
- X is non-empty.
- All given numerical values are integers.

Input

The input is given from Standard Input in the following format:

```
N K
S
```

Output

Print the answer.

Sample Input 1

```
4 2
o???
```

Sample Output 1

```
o.??
```

The set X consists of the two strings `o.o.` and `o..o`.

- The 1st character of every string in X is `o`, so T_1 is `o`.
- The 2nd character of every string in X is `.`, so T_2 is `.`.
- The 3rd character of a string in X can be either `.` or `o`, so T_3 is `?`.

Sample Input 2

```
5 2
?????
```

Sample Output 2

```
?????
```

Sample Input 3

```
7 3
.o???o.
```

Sample Output 3

```
.o.o.o.
```

E - Reachable Set

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 450 points

Problem Statement

You are given an undirected graph with N vertices and M edges. The vertices are numbered $1, 2, \ldots, N$, and the i-th edge $(1 \leq i \leq M)$ connects vertices u_i and v_i.

For each $k = 1, 2, \ldots, N$, solve the following problem:

> Consider the following operation.
>
> - Choose one vertex, and delete that vertex together with all edges incident to it.
>
> Determine whether one can repeat this operation to satisfy the following condition:
>
> - The set of vertices reachable from vertex 1 by traversing edges consists exactly of the k vertices $1, 2, \ldots, k$.
>
> If it is possible, find the minimum number of operations required to do so.

Constraints

- $1 \leq N \leq 2 \times 10^5$
- $0 \leq M \leq 3 \times 10^5$
- $1 \leq u_i < v_i \leq N$ $(1 \leq i \leq M)$
- $(u_i, v_i) \neq (u_j, v_j)$ $(1 \leq i < j \leq M)$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$
\begin{array}{ll}
N & M \\
u_1 & v_1 \\
u_2 & v_2 \\
\vdots & \\
u_M & v_M
\end{array}
$$

Output

Print N lines. On the i-th line $(1 \leq i \leq N)$, if one cannot satisfy the condition for $k = i$, print `-1`; otherwise, print the minimum number of operations required to satisfy the condition.

Sample Input 1

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

Sample Output 1

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

For example, for $k = 2$, deleting the three vertices $3, 4, 5$ makes the set of vertices reachable from vertex 1 equal to the two vertices $1, 2$. It is impossible with two or fewer deletions, so print `3` on the 2nd line.

For $k = 6$, deleting zero vertices makes the set of vertices reachable from vertex 1 equal to the six vertices $1, 2, \ldots, 6$, so print `0` on the 6th line.

Sample Input 2

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

Sample Output 2

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

Sample Input 3

```
2 0
```

Sample Output 3

```
0
-1
```

There may be no edges.

Sample Input 4

```
11 25
6 9
5 9
2 3
1 9
10 11
4 5
9 10
8 9
7 8
3 5
1 7
6 10
4 7
7 9
1 10
4 11
3 8
2 7
3 4
1 8
2 8
3 7
2 10
1 6
6 11
```

Sample Output 4

```
5
-1
-1
-1
-1
-1
4
3
2
1
0
```

F - Add One Edge 3

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 500 points

Problem Statement

You are given two trees: tree 1 with N_1 vertices numbered 1 to N_1, and tree 2 with N_2 vertices numbered 1 to N_2. The i-th edge of tree 1 connects vertices $u_{1,i}$ and $v_{1,i}$ bidirectionally, and the i-th edge of tree 2 connects vertices $u_{2,i}$ and $v_{2,i}$ bidirectionally.

One can add a bidirectional edge between vertex i of tree 1 and vertex j of tree 2 to obtain a single tree. Let $f(i, j)$ be the diameter of this tree.

Find $\displaystyle\sum_{i=1}^{N_1}\sum_{j=1}^{N_2} f(i, j)$.

Here, the distance between two vertices of a tree is the minimum number of edges that must be used to move between them, and the diameter of a tree is the maximum distance between two vertices.

Constraints

- $1 \leq N_1, N_2 \leq 2 \times 10^5$
- $1 \leq u_{1,i}, v_{1,i} \leq N_1$
- $1 \leq u_{2,i}, v_{2,i} \leq N_2$
- Both given graphs are trees.
- All input values are integers.

Input

The input is given from Standard Input in the following format:

N_1
$u_{1,1}$ $v_{1,1}$
$\vdots$
u_{1,N_1-1} v_{1,N_1-1}
N_2
$u_{2,1}$ $v_{2,1}$
$\vdots$
u_{2,N_2-1} v_{2,N_2-1}

Output

Print the answer.

Sample Input 1

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

Sample Output 1

```
39
```

For example, one can connect vertex 2 of tree 1 and vertex 3 of tree 2 to obtain a tree of diameter 5. Thus, $f(2, 3)$ is 5.

The sum of $f(i, j)$ is 39.

Sample Input 2

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

Sample Output 2

```
267
```

G - Push Simultaneously

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 575 points

Problem Statement

There are N people and N buttons on a plane. The plane has an origin, and the coordinates (x, y) represents the position that is x meters east and y meters north of the origin. The i-th person $(1 \leq i \leq N)$ starts at (sx_i, sy_i). The i-th button $(1 \leq i \leq N)$ is located at (gx_i, gy_i).

The people want to move and press these N buttons **simultaneously**. A button can be pressed only by a person who is at the same coordinate as that button. The time required to press a button after reaching its coordinate is 0 seconds.

Each person can move in any direction with speed at most 1 meter per second. More formally, if the position of the i-th person t seconds after the start is $(x_i(t), y_i(t))$, all of the following must hold:

- $x_i(0) = sx_i$;
- $y_i(0) = sy_i$;
- For all non-negative real numbers t_0, t_1, the distance between $(x_i(t_0), y_i(t_0))$ and $(x_i(t_1), y_i(t_1))$ is at most $|t_0 - t_1|$.

Find the time required for the people to achieve the goal. Formally, find the minimum t that satisfies the following condition:

- It is possible to set x_i and y_i under the above conditions so that, for every integer j $(1 \leq j \leq N)$ and every real number t' $(t' > t)$, there exists an integer i $(1 \leq i \leq N)$ with $(x_i(t'), y_i(t')) = (gx_j, gy_j)$.

Constraints

- $1 \leq N \leq 300$
- $0 \leq sx_i \leq 10^{18}$ $(1 \leq i \leq N)$
- $0 \leq sy_i \leq 10^{18}$ $(1 \leq i \leq N)$
- $0 \leq gx_i \leq 10^{18}$ $(1 \leq i \leq N)$
- $0 \leq gy_i \leq 10^{18}$ $(1 \leq i \leq N)$
- $(sx_i, sy_i) \neq (sx_j, sy_j)$ $(1 \leq i < j \leq N)$
- $(gx_i, gy_i) \neq (gx_j, gy_j)$ $(1 \leq i < j \leq N)$
- $(sx_i, sy_i) \neq (gx_j, gy_j)$ $(1 \leq i \leq N, 1 \leq j \leq N)$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$
\begin{array}{l}
N \\
sx_1 \quad sy_1 \\
sx_2 \quad sy_2 \\
\vdots \\
sx_N \quad sy_N \\
gx_1 \quad gy_1 \\
gx_2 \quad gy_2 \\
\vdots \\
gx_N \quad gy_N
\end{array}
$$

Output

Print the time required for the N people to press the N buttons simultaneously. Your output is considered correct if the relative error from the true value is at most 10^{-6}.

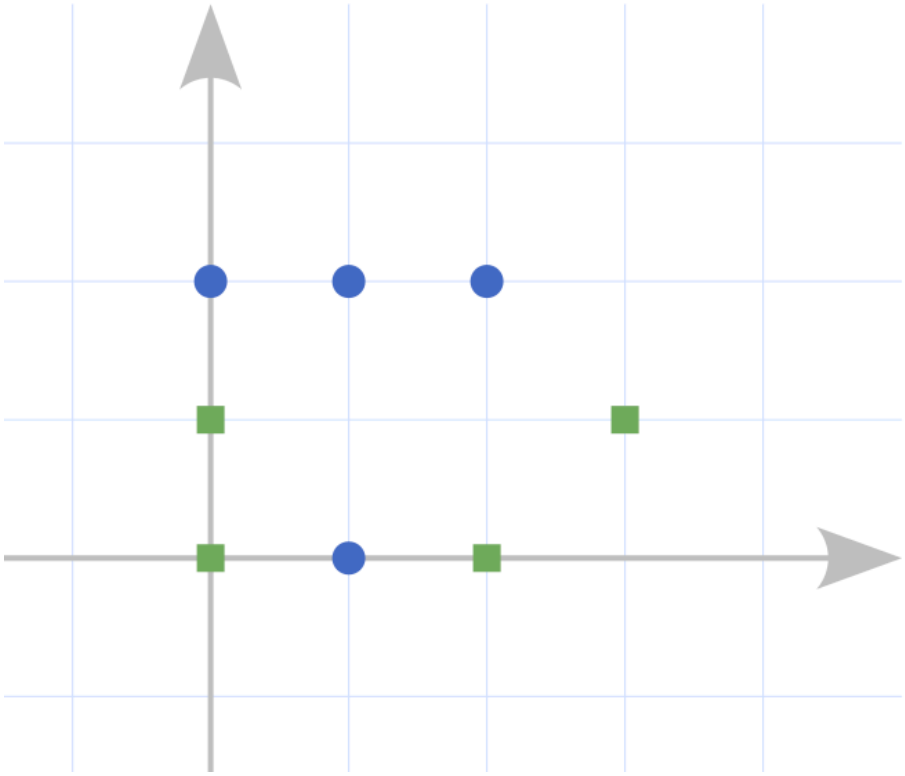
Sample Input 1

```
4
0 0
0 1
2 0
3 1
0 2
1 0
1 2
2 2
```

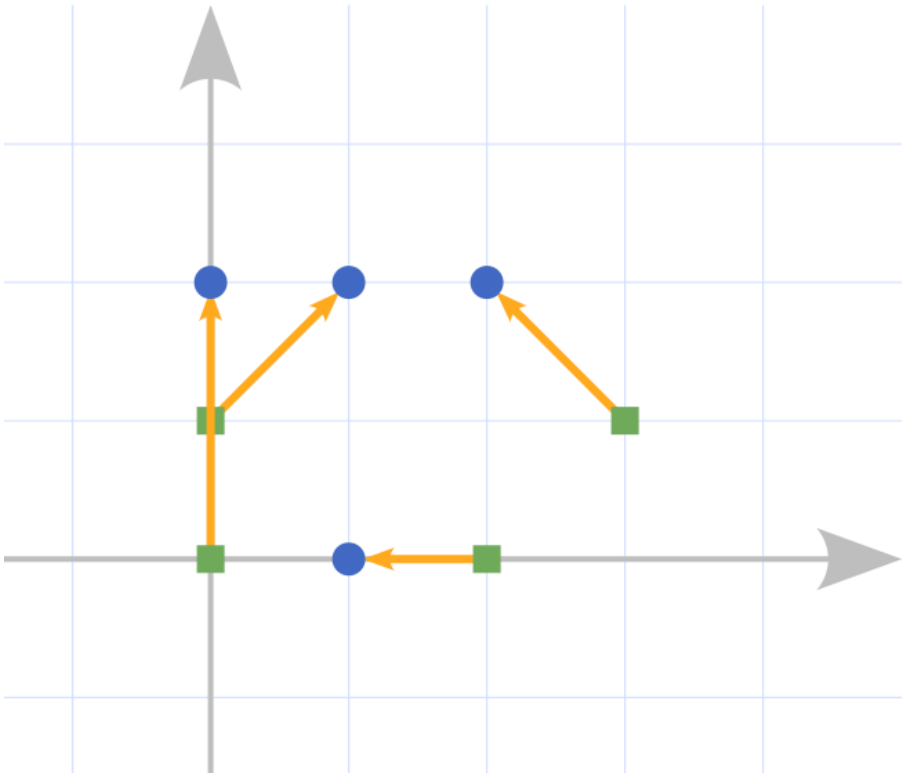
Sample Output 1

```
2
```

Initially, the positions of the people and buttons are as shown below.



Suppose persons $1, 2, 3, 4$ move straight toward buttons $1, 3, 2, 4$, respectively.



They reach their respective buttons after 2, $\sqrt{2}$, 1, and $\sqrt{2}$ seconds.

Thus, all buttons can be pressed simultaneously 2 seconds after the start.

Conversely, they cannot press all buttons simultaneously earlier than 2 seconds, so print 2.

Because an output is accepted if its relative error from the true value is at most 10^{-6}, outputs such as `1.999998` or `2.00000014` are also considered correct for this test case.

Sample Input 2

```
3
1 4
1 5
9 2
653589793238462643 383279502884197169
399375105820974944 592307816406286208
99862803482534211 706798214808651328
```

Sample Output 2

```
757682516069002110.045811693742626587107410055 25
```

Note that the input coordinates may not fit in 32-bit integers.

Sample Input 3

```
12
4459915897 5789359311
4393259463 4247016333
4827828467 4179021045
2654035685 3406423989
1790405301 4886103164
2978675817 4818583236
5912369644 5824121992
6016882384 4165667191
4305949638 3454894060
6545166942 5390976281
4043403253 4019611554
3462096432 4117859301
3528911877 4631601790
4627979431 4814676729
3810130146 5728760563
5586470124 3310360339
3664130072 4525834271
1710246881 3750440871
3143440609 5038869551
2294021341 3965849888
6189106395 4499485672
4799619607 5151972020
6905793542 3976136296
1764267574 4525373194
```

Sample Output 3

```
1299999319.116399442508650717909981965254
```