A - Pairing

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 100 points

Problem Statement

There are four balls, and the color of the i-th ball is A_i.

Find the maximum number of times you can perform this operation: choose two balls of the same color and discard both.

Constraints

- Each of A_1, A_2, A_3, A_4 is an integer between 1 and 4, inclusive.

Input

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

$$A_1 \quad A_2 \quad A_3 \quad A_4$$

Output

Print the maximum number of times the operation can be performed as an integer.

Sample Input 1

```
2 1 2 1
```

Sample Output 1

```
2
```

The first and third balls both have color 2, so you can perform the operation to discard the first and third balls together.

Next, the second and fourth balls both have color 1, so you can perform the operation to discard the second and fourth balls together.

Hence, you can perform a total of two operations.

Sample Input 2

```
4 4 4 1
```

Sample Output 2

```
1
```

Sample Input 3

```
1 2 3 4
```

Sample Output 3

```
0
```

There are cases where you cannot perform the operation even once.

B - Garbage Collection

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 200 points

Problem Statement

In AtCoder City, N types of garbage are collected regularly. The i-th type of garbage $(i = 1, 2, \ldots, N)$ is collected on days when the date modulo q_i equals r_i.

Answer Q queries. In the j-th query $(j = 1, 2, \ldots, Q)$, given that the t_j-th type of garbage is put out on day d_j, answer the next day on which it will be collected.

Here, if the i-th type of garbage is put out on a day when that type of garbage is collected, then the garbage will be collected on the same day.

Constraints

- $1 \leq N \leq 100$
- $0 \leq r_i < q_i \leq 10^9$
- $1 \leq Q \leq 100$
- $1 \leq t_j \leq N$
- $1 \leq d_j \leq 10^9$
- All input values are integers.

Input

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

$$
\begin{array}{l}
N \\
q_1 \quad r_1 \\
q_2 \quad r_2 \\
\vdots \\
q_N \quad r_N \\
Q \\
t_1 \quad d_1 \\
t_2 \quad d_2 \\
\vdots \\
t_Q \quad d_Q
\end{array}
$$

Output

Print Q lines. The j-th line $(1 \leq j \leq Q)$ should contain the answer to the j-th query.

Sample Input 1

```
2
7 3
4 2
5
1 1
1 3
1 4
1 15
2 7
```

Sample Output 1

```
3
3
10
17
10
```

- 1st query: The 1st type of garbage is collected on day 3 for the first time after day 1.
- 2nd query: The 1st type of garbage is collected on day 3 for the first time after day 3.
- 3rd query: The 1st type of garbage is collected on day 10 for the first time after day 4.

C - Repeating

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 300 points

Problem Statement

You are given a sequence of N positive numbers, $A = (A_1, A_2, \dots, A_N)$. Find the sequence $B = (B_1, B_2, \dots, B_N)$ of length N defined as follows.

- For $i = 1, 2, \dots, N$, define B_i as follows:
  - Let B_i be the most recent position before i where an element equal to A_i appeared. If such a position does not exist, let $B_i = -1$.
    More precisely, if there exists a positive integer j such that $A_i = A_j$ and $j < i$, let B_i be the largest such j. If no such j exists, let $B_i = -1$.

Constraints

- $1 \leq N \leq 2 \times 10^5$
- $1 \leq A_i \leq 10^9$
- All input values are integers.

Input

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

$$
\begin{array}{l}
N \\
A_1 \quad A_2 \quad \dots \quad A_N
\end{array}
$$

Output

Print the elements of B in one line, separated by spaces.

Sample Input 1

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

Sample Output 1

```
-1 -1 1 3 -1
```

- $i = 1$: There is no 1 before $A_1 = 1$, so $B_1 = -1$.
- $i = 2$: There is no 2 before $A_2 = 2$, so $B_2 = -1$.
- $i = 3$: The most recent occurrence of 1 before $A_3 = 1$ is A_1, so $B_3 = 1$.
- $i = 4$: The most recent occurrence of 1 before $A_4 = 1$ is A_3, so $B_4 = 3$.
- $i = 5$: There is no 3 before $A_5 = 3$, so $B_5 = -1$.

Sample Input 2

```
4
1 1000000000 1000000000 1
```

Sample Output 2

```
-1 -1 2 1
```

D - Count Simple Paths

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 425 points

Problem Statement

There is a grid of $H \times W$ cells. Let (i, j) denote the cell at the i-th row from the top and the j-th column from the left.

Cell (i, j) is empty if $S_{i,j}$ is `.`, and blocked if it is `#`.

Count the number of ways to start from an empty cell and make K moves to adjacent cells (up, down, left, or right), without passing through blocked squares and not visiting the same cell more than once.

Specifically, count the number of sequences of length $K + 1$, $((i_0, j_0), (i_1, j_1), \dots, (i_K, j_K))$, satisfying the following.

- $1 \leq i_k \leq H, 1 \leq j_k \leq W$, and S_{i_k, j_k} is `.`, for each $0 \leq k \leq K$.
- $|i_{k+1} - i_k| + |j_{k+1} - j_k| = 1$ for each $0 \leq k \leq K - 1$.
- $(i_k, j_k) \neq (i_l, j_l)$ for each $0 \leq k < l \leq K$.

Constraints

- $1 \leq H, W \leq 10$
- $1 \leq K \leq 11$
- H, W, and K are integers.
- Each $S_{i,j}$ is `.` or `#`.
- There is at least one empty cell.

Input

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

$$
\begin{array}{l}
H \quad W \quad K \\
S_{1,1}S_{1,2}\dots S_{1,W} \\
S_{2,1}S_{2,2}\dots S_{2,W} \\
\vdots \\
S_{H,1}S_{H,2}\dots S_{H,W}
\end{array}
$$

Output

Print the answer.

Sample Input 1

```
2 2 2
.#
..
```

Sample Output 1

```
2
```

Here are the two possible paths:

- $(1,1) \to (2,1) \to (2,2)$
- $(2,2) \to (2,1) \to (1,1)$

Sample Input 2

```
2 3 1
.#.
#.#
```

Sample Output 2

```
0
```

Sample Input 3

```
10 10 11
....#..#..
.#.....##.
..#...##..
...#......
......##..
..#......#
#........#
..##......
.###....#.
...#.....#
```

Sample Output 3

```
218070
```

E - Mod Sigma Problem

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 475 points

Problem Statement

You are given a sequence $A = (A_1, A_2, \dots, A_N)$ of N non-negative integers, and a positive integer M.

Find the following value:

$$\sum_{1 \le l \le r \le N} \left(\left(\sum_{l \le i \le r} A_i \right) \bmod M \right).$$

Here, $X \bmod M$ denotes the remainder when the non-negative integer X is divided by M.

Constraints

- $1 \le N \le 2 \times 10^5$
- $1 \le M \le 2 \times 10^5$
- $0 \le A_i \le 10^9$

Input

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

$N \quad M$
$A_1 \quad A_2 \quad \dots \quad A_N$

Output

Print the answer.

Sample Input 1

```
3 4
2 5 0
```

Sample Output 1

```
10
```

- $A_1 \bmod M = 2$
- $(A_1 + A_2) \bmod M = 3$
- $(A_1 + A_2 + A_3) \bmod M = 3$
- $A_2 \bmod M = 1$
- $(A_2 + A_3) \bmod M = 1$
- $A_3 \bmod M = 0$

The answer is the sum of these values, 10. Note that the outer sum is not taken modulo M.

Sample Input 2

```
10 100
320 578 244 604 145 839 156 857 556 400
```

Sample Output 2

```
2736
```

F - Add One Edge 2

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 500 points

Problem Statement

You are given a tree with N vertices. The i-th edge $(1 \leq i \leq N-1)$ connects vertices u_i and v_i bidirectionally.

Adding one undirected edge to the given tree always yields a graph with exactly one cycle.

Among such graphs, how many satisfy all of the following conditions?

- The graph is simple.
- All vertices in the cycle have degree 3.

Constraints

- $3 \leq N \leq 2 \times 10^5$
- $1 \leq u_i, v_i \leq N$
- The given graph is a tree.
- All input values are integers.

Input

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

$$
\begin{array}{l}
N \\
u_1 \quad v_1 \\
u_2 \quad v_2 \\
\vdots \\
u_{N-1} \quad v_{N-1}
\end{array}
$$

Output

Print the answer.

Sample Input 1

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

Sample Output 1

```
1
```

Adding an edge connecting vertices 2 and 4 yields a simple graph where all vertices in the cycle have degree 3 , so it satisfies the conditions.

Sample Input 2

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

Sample Output 2

```
0
```

There are cases where no graphs satisfy the conditions.

Sample Input 3

```
15
1 15
11 14
2 10
1 7
9 8
6 9
4 12
14 5
4 9
8 11
7 4
1 13
3 6
11 10
```

Sample Output 3

```
6
```

G - Everlasting LIDS

Time Limit: 4 sec / Memory Limit: 1024 MiB

Score : 650 points

Problem Statement

You are given integers A, B, and M.

How many permutations $P = (P_1, \dots, P_{AB-1})$ of $(1, 2, \ldots, AB - 1)$ satisfy all of the following conditions? Find the count modulo M.

- The length of a longest increasing subsequence of P is A.
- The length of a longest decreasing subsequence of P is B.
- There exists an integer n such that appending $n + 0.5$ to the end of P does not change either of the lengths of a longest increasing subsequence and a longest decreasing subsequence.

Constraints

- All input values are integers.
- $2 \leq A, B$
- $AB \leq 120$
- $10^8 \leq M \leq 10^9$
- M is a prime.

Input

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

$A \quad B \quad M$

Output

Print the number of permutations satisfying the conditions, modulo M.

Sample Input 1

```
3 2 998244353
```

Sample Output 1

```
10
```

For example, $P = (2, 4, 5, 1, 3)$ satisfies the conditions. This can be confirmed as follows:

- The length of a longest increasing subsequence of P is 3.
- The length of a longest decreasing subsequence of P is 2.
- For $n = 4$, the lengths of longest increasing and decreasing subsequences of $(2, 4, 5, 1, 3, 4.5)$ are 3 and 2, respectively.

There are 10 permutations of $(1, 2, 3, 4, 5)$ that satisfy the conditions.

Sample Input 2

```
10 12 924844033
```

Sample Output 2

```
623378361
```

Print the count modulo M.