A - 202<s>3</s>

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 100 points

Problem Statement

You are given a string S consisting of lowercase English letters and digits.

S is guaranteed to end with `2023`.

Change the last character of S to `4` and print the modified string.

Constraints

- S is a string of length between 4 and 100, inclusive, consisting of lowercase English letters and digits.
- S ends with `2023`.

Input

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

S

Output

Print the answer.

Sample Input 1

```
hello2023
```

Sample Output 1

```
hello2024
```

Changing the last character of `hello2023` to `4` yields `hello2024`.

Sample Input 2

```
worldtourfinals2023
```

Sample Output 2

```
worldtourfinals2024
```

Sample Input 3

```
2023
```

Sample Output 3

```
2024
```

S is guaranteed to end with `2023`, possibly being `2023` itself.

Sample Input 4

```
20232023
```

Sample Output 4

```
20232024
```

B - Tetrahedral Number

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 150 points

Problem Statement

You are given an integer N.

Print all triples of non-negative integers (x, y, z) such that $x + y + z \leq N$ in ascending lexicographical order.

▶ What is lexicographical order for non-negative integer triples?

Constraints

- $0 \leq N \leq 21$
- N is an integer.

Input

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

N

Output

Print all triples of non-negative integers (x, y, z) such that $x + y + z \leq N$ in ascending lexicographical order, with x, y, z separated by spaces, one triple per line.

Sample Input 1

```
3
```

Sample Output 1

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

Sample Input 2

```
4
```

Sample Output 2

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

C - Loong Tracking

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 300 points

Problem Statement

Takahashi has created a game where the player controls a dragon on a coordinate plane.

The dragon consists of N parts numbered 1 to N, with part 1 being called the **head**.

Initially, part i is located at the coordinates $(i, 0)$. Process Q queries as follows.

- `1 C`: Move the head by 1 in direction C. Here, C is one of `R`, `L`, `U`, and `D`, which represent the positive x-direction, negative x-direction, positive y-direction, and negative y-direction, respectively. Each part other than the head moves to follow the part in front of it. That is, part $i\ (2 \leq i \leq N)$ moves to the coordinates where part $i-1$ was before the move.
- `2 p`: Find the coordinates of part p.

Constraints

- $2 \leq N \leq 10^6$
- $1 \leq Q \leq 2 \times 10^5$
- For the first type of query, C is one of `R`, `L`, `U`, and `D`.
- For the second type of query, $1 \leq p \leq N$.
- All numerical input values are integers.

Input

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

$$
\begin{aligned}
&N \quad Q \\
&\mathrm{query}_1 \\
&\vdots \\
&\mathrm{query}_Q
\end{aligned}
$$

Each query is in one of the following two formats:

$$1 \quad C$$

$$2 \quad p$$

Output

Print q lines, where q is the number of queries of the second type.

The i-th line should contain x and y separated by a space, where (x, y) are the answer to the i-th such query.

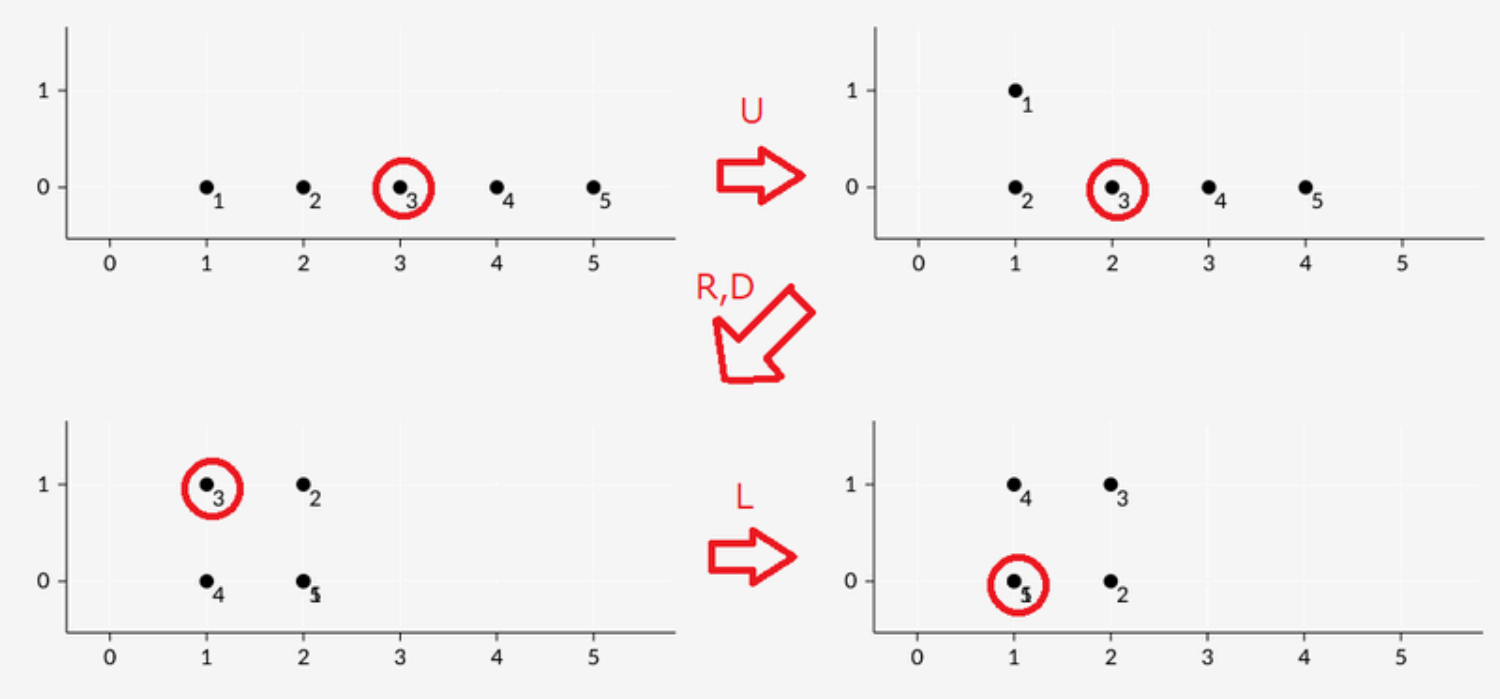
Sample Input 1

```
5 9
2 3
1 U
2 3
1 R
1 D
2 3
1 L
2 1
2 5
```

Sample Output 1

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

At each time when processing the second type of query, the parts are at the following positions:



Note that multiple parts may exist at the same coordinates.

D - Loong and Takahashi

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 350 points

Problem Statement

There is a grid with N rows and N columns, where N is an odd number at most 45.

Let (i, j) denote the cell at the i-th row from the top and j-th column from the left.

In this grid, you will place Takahashi and a dragon consisting of $N^2 - 1$ parts numbered 1 to $N^2 - 1$ in such a way that satisfies the following conditions:

- Takahashi must be placed at the center of the grid, that is, in cell $(\frac{N+1}{2}, \frac{N+1}{2})$.
- Except for the cell where Takahashi is, exactly one dragon part must be placed in each cell.
- For every integer x satisfying $2 \leq x \leq N^2 - 1$, the dragon part x must be placed in a cell adjacent by an edge to the cell containing part $x - 1$.
    - Cells (i, j) and (k, l) are said to be adjacent by an edge if and only if $|i - k| + |j - l| = 1$.

Print one way to arrange the parts to satisfy the conditions. It is guaranteed that there is at least one arrangement that satisfies the conditions.

Constraints

- $3 \leq N \leq 45$
- N is odd.

Input

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

```
N
```

Output

Print N lines.

The i-th line should contain $X_{i,1}, \ldots, X_{i,N}$ separated by spaces, where $X_{i,j}$ is T when placing Takahashi in cell (i, j) and x when placing part x there.

Sample Input 1

```
5
```

Sample Output 1

```
1 2 3 4 5
16 17 18 19 6
15 24 T 20 7
14 23 22 21 8
13 12 11 10 9
```

The following output also satisfies all the conditions and is correct.

```
9 10 11 14 15
8 7 12 13 16
5 6 T 18 17
4 3 24 19 20
1 2 23 22 21
```

On the other hand, the following outputs are incorrect for the reasons given.

Takahashi is not at the center.

```
1 2 3 4 5
10 9 8 7 6
11 12 13 14 15
20 19 18 17 16
21 22 23 24 T
```

The cells containing parts 23 and 24 are not adjacent by an edge.

```
1 2 3 4 5
10 9 8 7 6
11 12 24 22 23
14 13 T 21 20
15 16 17 18 19
```

E - Non-Decreasing Colorful Path

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 525 points

Problem Statement

There is a connected undirected graph with N vertices and M edges, where the i-th edge connects vertex U_i and vertex V_i bidirectionally.
Each vertex has an integer written on it, with integer A_v written on vertex v.

For a simple path from vertex 1 to vertex N (a path that does not pass through the same vertex multiple times), the score is determined as follows:

- Let S be the sequence of integers written on the vertices along the path, listed in the order they are visited.
- If S is not non-decreasing, the score of that path is 0.
- Otherwise, the score is the number of distinct integers in S.

Find the path from vertex 1 to vertex N with the highest score among all simple paths and print that score.

▶ What does it mean for S to be non-decreasing?

Constraints

- All input values are integers.
- $2 \leq N \leq 2 \times 10^5$
- $N - 1 \leq M \leq 2 \times 10^5$
- $1 \leq A_i \leq 2 \times 10^5$
- The graph is connected.
- $1 \leq U_i < V_i \leq N$
- $(U_i, V_i) \neq (U_j, V_j)$ if $i \neq j$.

Input

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

$$
\begin{array}{llll}
N & M & & \\
A_1 & A_2 & \dots & A_N \\
U_1 & V_1 & & \\
U_2 & V_2 & & \\
\vdots & & & \\
U_M & V_M & &
\end{array}
$$

Output

Print the answer as an integer.

Sample Input 1

```
5 6
10 20 30 40 50
1 2
1 3
2 5
3 4
3 5
4 5
```

Sample Output 1

```
4
```

The path $1 \to 3 \to 4 \to 5$ has $S = (10, 30, 40, 50)$ for a score of 4, which is the maximum.

Sample Input 2

```
4 5
1 10 11 4
1 2
1 3
2 3
2 4
3 4
```

Sample Output 2

```
0
```

There is no simple path from vertex 1 to vertex N such that S is non-decreasing. In this case, the maximum score is 0.

Sample Input 3

```
10 12
1 2 3 3 4 4 4 6 5 7
1 3
2 9
3 4
5 6
1 2
8 9
4 5
8 10
7 10
4 6
2 8
6 7
```

Sample Output 3

```
5
```

F - Hop Sugoroku

Time Limit: 2.5 sec / Memory Limit: 1024 MB

Score : 525 points

Problem Statement

There is a row of N squares labeled $1, 2, \ldots, N$ and a sequence $A = (A_1, A_2, \ldots, A_N)$ of length N. Initially, square 1 is painted black, the other $N - 1$ squares are painted white, and a piece is placed on square 1.

You may repeat the following operation any number of times, possibly zero:

- When the piece is on square i, choose a positive integer x and move the piece to square $i + A_i \times x$.
  - Here, you cannot make a move with $i + A_i \times x > N$.
- Then, paint the square $i + A_i \times x$ black.

Find the number of possible sets of squares that can be painted black at the end of the operations, modulo 998244353.

Constraints

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

Input

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

N
$A_1 \quad A_2 \quad \ldots \quad A_N$

Output

Print the answer as an integer.

Sample Input 1

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

Sample Output 1

```
8
```

There are eight possible sets of squares painted black:

- Square 1
- Squares $1, 2$
- Squares $1, 2, 4$
- Squares $1, 2, 4, 5$
- Squares $1, 3$
- Squares $1, 4$
- Squares $1, 4, 5$
- Squares $1, 5$

Sample Input 2

```
1
200000
```

Sample Output 2

```
1
```

Sample Input 3

```
40
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

Sample Output 3

```
721419738
```

Be sure to find the number modulo 998244353.

G - Discrete Logarithm Problems

Time Limit: 5 sec / Memory Limit: 1024 MB

Score : 600 points

Problem Statement

You are given N integers $A_1, \ldots, A_N$ and a prime number P. Find the number of pairs of integers (i, j) that satisfy both of the following conditions:

- $1 \leq i, j \leq N$;
- There is a positive integer k such that $A_i^k \equiv A_j \mod P$.

Constraints

- $2 \leq N \leq 2 \times 10^5$
- $1 \leq A_i < P$
- $2 \leq P \leq 10^{13}$
- P is prime.
- All input values are integers.

Input

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

N P
A_1 $\ldots$ A_N

Output

Print the answer.

Sample Input 1

```
3 13
2 3 5
```

Sample Output 1

```
5
```

Five pairs satisfy the conditions: $(1, 1), (1, 2), (1, 3), (2, 2), (3, 3)$.

For example, for the pair $(1, 3)$, if we take $k = 9$, then $A_1^9 = 512 \equiv 5 = A_3 \mod 13$.

Sample Input 2

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

Sample Output 2

```
25
```

Sample Input 3

```
10 9999999999971
141592653589 793238462643 383279502884 197169399375 105820974944 592307816406 286208998628 3482534211
7 67982148086 513282306647
```

Sample Output 3

```
63
```