A - 12435

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 150 points

Problem Statement

You are given an integer sequence $A = (A_1, A_2, A_3, A_4, A_5)$ obtained by permuting $(1, 2, 3, 4, 5)$.

Determine whether A can be sorted in ascending order by performing **exactly one** operation of swapping two adjacent elements in A.

Constraints

- A is an integer sequence of length 5 obtained by permuting $(1, 2, 3, 4, 5)$.

Input

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

$$A_1 \quad A_2 \quad A_3 \quad A_4 \quad A_5$$

Output

If A can be sorted in ascending order by exactly one operation, print `Yes`; otherwise, print `No`.

Sample Input 1

```
1 2 4 3 5
```

Sample Output 1

```
Yes
```

By swapping A_3 and A_4, A becomes $(1, 2, 3, 4, 5)$, so it can be sorted in ascending order. Therefore, print `Yes`.

Sample Input 2

```
5 3 2 4 1
```

Sample Output 2

```
No
```

No matter what operation is performed, it is impossible to sort A in ascending order.

Sample Input 3

```
1 2 3 4 5
```

Sample Output 3

```
No
```

You must perform exactly one operation.

Sample Input 4

```
2 1 3 4 5
```

Sample Output 4

```
Yes
```

B - Geometric Sequence

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 200 points

Problem Statement

You are given a length-N sequence $A = (A_1, A_2, \dots, A_N)$ of positive integers.

Determine whether A is a geometric progression.

Constraints

- $2 \leq N \leq 100$
- $1 \leq A_i \leq 10^9$
- All input values are integers.

Input

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

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

Output

If A is a geometric progression, print `Yes`; otherwise, print `No`.

Sample Input 1

```
5
3 6 12 24 48
```

Sample Output 1

```
Yes
```

$A = (3, 6, 12, 24, 48)$.
A is a geometric progression with first term 3, common ratio 2, and five terms.
Therefore, print `Yes`.

Sample Input 2

```
3
1 2 3
```

Sample Output 2

```
No
```

$A = (1, 2, 3)$.
Since $A_1 : A_2 = 1 : 2 \neq 2 : 3 = A_2 : A_3$, A is not a geometric progression.
Therefore, print `No`.

Sample Input 3

```
2
10 8
```

Sample Output 3

```
Yes
```

A is a geometric progression with first term 10, common ratio 0.8, and two terms.

Therefore, print `Yes`.

C - Paint to make a rectangle

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 300 points

Problem Statement

You are given a grid of H rows and W columns.
Let (i, j) denote the cell at row i $(1 \leq i \leq H)$ from the top and column j $(1 \leq j \leq W)$ from the left.
The state of the grid is represented by H strings $S_1, S_2, \ldots, S_H$, each of length W, as follows:

- If the j-th character of S_i is `#`, cell (i, j) is painted black.
- If the j-th character of S_i is `.`, cell (i, j) is painted white.
- If the j-th character of S_i is `?`, cell (i, j) is not yet painted.

Takahashi wants to paint each not-yet-painted cell white or black so that all the black cells form a rectangle.
More precisely, he wants there to exist a quadruple of integers (a, b, c, d) $(1 \leq a \leq b \leq H, 1 \leq c \leq d \leq W)$ such that:

> For each cell (i, j) $(1 \leq i \leq H, 1 \leq j \leq W)$, if $a \leq i \leq b$ and $c \leq j \leq d$, the cell is black;
> otherwise, the cell is white.

Determine whether this is possible.

Constraints

- $1 \leq H, W \leq 1000$
- H and W are integers.
- Each S_i is a string of length W consisting of `#`, `.`, `?`.
- There is at least one cell that is already painted black.

Input

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

$$
\begin{array}{l}
H \quad W \\
S_1 \\
S_2 \\
\vdots \\
S_H
\end{array}
$$

Output

If it is possible to paint all the not-yet-painted cells so that the black cells form a rectangle, print `Yes`; otherwise, print `No`.

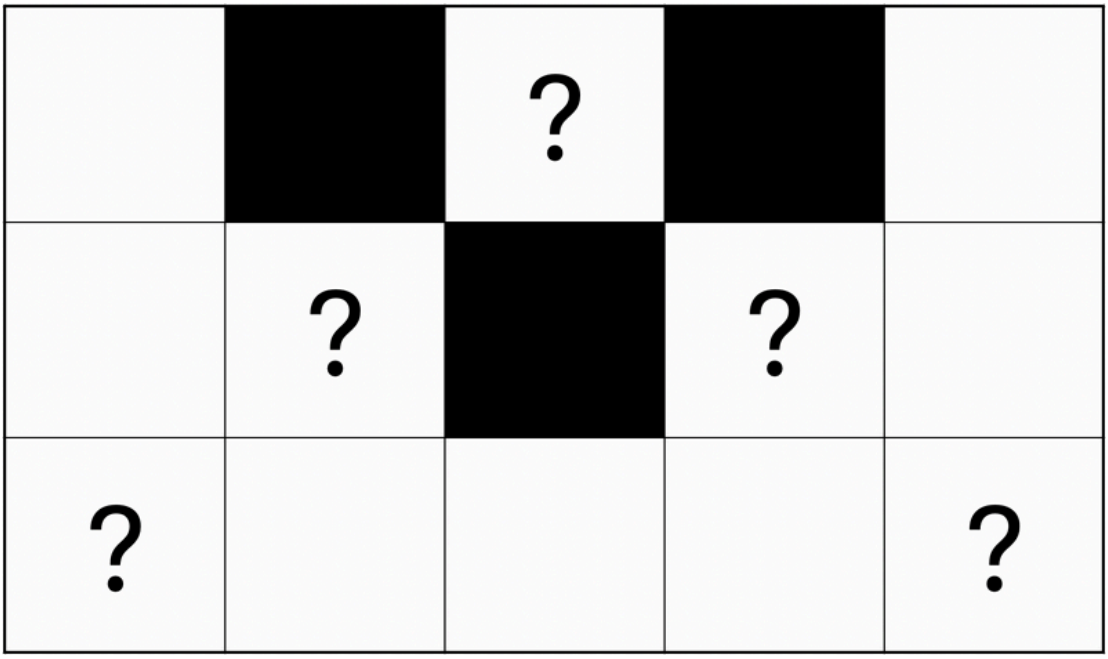
Sample Input 1

```
3 5
.#?#.
.?#?.
?...?
```

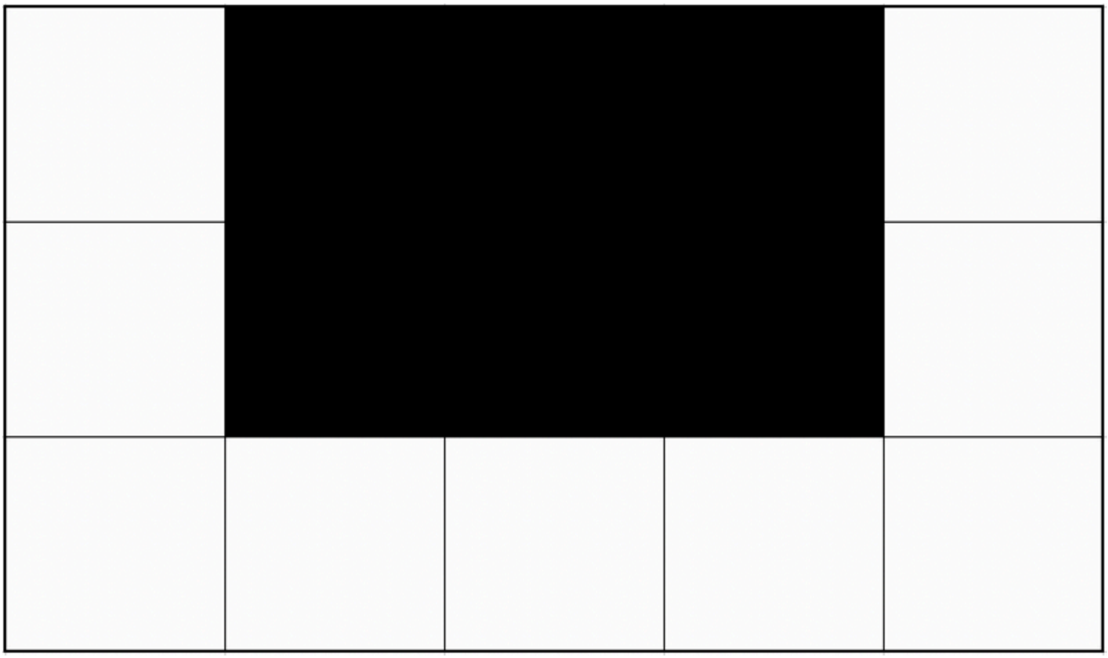
Sample Output 1

```
Yes
```

The grid is in the following state. `?` indicates a cell that are not yet painted.



By painting cells $(1, 3)$, $(2, 2)$, and $(2, 4)$ black and cells $(3, 1)$ and $(3, 5)$ white, the black cells can form a rectangle as follows:



Therefore, print `Yes`.

Sample Input 2

```
3 3
?##
#.#
##?
```

Sample Output 2

```
No
```

To form a rectangle with all black cells, you would need to paint cell $(2, 2)$ black, but it is already painted white.
Therefore, it is impossible to make all black cells form a rectangle, so print `No`.

Sample Input 3

```
1 1
#
```

Sample Output 3

```
Yes
```

D - Stone XOR

Time Limit: 3 sec / Memory Limit: 1024 MB

Score : 400 points

Problem Statement

There are N bags, labeled bag 1, bag $2, \ldots$, bag N.
Bag i ($1 \leq i \leq N$) contains A_i stones.

Takahashi can perform the following operation any number of times, possibly zero:

> Choose two bags A and B, and move **all** stones from bag A into bag B.

Find the number of different possible values for the following after repeating the operation.

- $B_1 \oplus B_2 \oplus \cdots \oplus B_N$, where B_i is the final number of stones in bag i.
  Here, $\oplus$ denotes bitwise XOR.

▶ About bitwise XOR

It can be proved that under the constraints of this problem, the number of possible values is finite.

Constraints

- $2 \leq N \leq 12$
- $1 \leq A_i \leq 10^{17}$
- All input values are integers.

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 number of different possible values for $B_1 \oplus B_2 \oplus \cdots \oplus B_N$ after repeating the operation.

Sample Input 1

```
3
2 5 7
```

Sample Output 1

```
3
```

For example, if Takahashi chooses bags 1 and 3 for the operation, then the numbers of stones in bags $1, 2, 3$ become $0, 5, 9$.
If he stops at this point, the XOR is $0 \oplus 5 \oplus 9 = 12$.

The other possible XOR values after repeating the operation are 0 and 14.
Therefore, the possible values are $0, 12, 14$; there are three values, so the output is 3.

Sample Input 2

```
2
100000000000000000 100000000000000000
```

Sample Output 2

```
2
```

Sample Input 3

```
6
71 74 45 34 31 60
```

Sample Output 3

```
84
```

E - Vitamin Balance

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 450 points

Problem Statement

There are N foods, each containing exactly one of vitamins $1, 2,$ and 3.
Specifically, eating the i-th food gives you A_i units of vitamin V_i, and C_i calories.

Takahashi can choose any subset of these N foods as long as the total calorie consumption does not exceed X.
Find the maximum possible value of this: the minimum intake among vitamins $1, 2,$ and 3.

Constraints

- $1 \leq N \leq 5000$
- $1 \leq X \leq 5000$
- $1 \leq V_i \leq 3$
- $1 \leq A_i \leq 2 \times 10^5$
- $1 \leq C_i \leq X$
- All input values are integers.

Input

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

$$
\begin{array}{l}
N \quad X \\
V_1 \quad A_1 \quad C_1 \\
V_2 \quad A_2 \quad C_2 \\
\vdots \\
V_N \quad A_N \quad C_N
\end{array}
$$

Output

Print the maximum possible value of "the minimum intake among vitamins $1, 2,$ and 3" when the total calories consumed is at most X.

Sample Input 1

```
5 25
1 8 5
2 3 5
2 7 10
3 2 5
3 3 10
```

Sample Output 1

```
3
```

Each food provides the following if eaten:

- 1st food: 8 units of vitamin 1, and 5 calories
- 2nd food: 3 units of vitamin 2, and 5 calories
- 3rd food: 7 units of vitamin 2, and 10 calories
- 4th food: 2 units of vitamin 3, and 5 calories
- 5th food: 3 units of vitamin 3, and 10 calories

Eating the 1st, 2nd, 4th, and 5th foods gives 8 units of vitamin 1, 3 units of vitamin 2, 5 units of vitamin 3, and 25 calories.
In this case, the minimum among the three vitamin intakes is 3 (vitamin 2).

It is impossible to get 4 or more units of each vitamin without exceeding 25 calories, so the answer is 3.

Sample Input 2

```
2 5000
1 200000 1
2 200000 1
```

Sample Output 2

```
0
```

F - Double Sum 3

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 525 points

Problem Statement

You are given an integer sequence $A = (A_1, A_2, \ldots, A_N)$ of length N.

For each integer pair (L, R) with $1 \leq L \leq R \leq N$, define $f(L, R)$ as follows:

- Start with an empty blackboard. Write the $R - L + 1$ integers $A_L, A_{L+1}, \ldots, A_R$ on the blackboard in order.
- Repeat the following operation until all integers on the blackboard are erased:
  - Choose integers l, r with $l \leq r$ such that every integer from l through r appears at least once on the blackboard. Then, erase all integers from l through r that are on the blackboard.
- Let $f(L, R)$ be the minimum number of such operations needed to erase all the integers from the blackboard.

Find $\displaystyle\sum_{L=1}^{N} \sum_{R=L}^{N} f(L, R)$.

Constraints

- $1 \leq N \leq 3 \times 10^5$
- $1 \leq A_i \leq N$
- All input values are integers.

Input

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

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

Output

Print the answer.

Sample Input 1

```
4
1 3 1 4
```

Sample Output 1

```
16
```

For example, in the case of $(L, R) = (1, 4)$:

- The blackboard has $1, 3, 1, 4$.
- Choose $(l, r) = (1, 1)$ and erase all occurrences of 1. The blackboard now has $3, 4$.
- Choose $(l, r) = (3, 4)$ and erase all occurrences of 3 and 4. The blackboard becomes empty.
- It cannot be done in fewer than two operations, so $f(1, 4) = 2$.

Similarly, you can find $f(2, 4) = 2$, $f(1, 1) = 1$, etc.

$\displaystyle\sum_{L=1}^{N} \sum_{R=L}^{N} f(L, R) = 16$, so print 16.

Sample Input 2

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

Sample Output 2

```
23
```

Sample Input 3

```
10
5 1 10 9 2 5 6 9 1 6
```

Sample Output 3

```
129
```

G - Permutation Concatenation

Time Limit: 2 sec / Memory Limit: 1024 MB

Score : 600 points

Problem Statement

You are given a positive integer N.

For an integer sequence $A = (A_1, A_2, \ldots, A_N)$ of length N. Let $f(A)$ be the integer obtained as follows:

- Let S be an empty string.
- For $i = 1, 2, \ldots, N$ in this order:
  - Let T be the decimal representation of A_i without leading zeros.
  - Append T to the end of S.
- Interpret S as a decimal integer, and let that be $f(A)$.

For example, if $A = (1, 20, 34)$, then $f(A) = 12034$.

There are $N!$ permutations P of $(1, 2, \ldots, N)$. Find the sum, modulo 998244353, of $f(P)$ over all such permutations P.

Constraints

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

Input

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

```
N
```

Output

Print the sum, modulo 998244353, of $f(P)$ over all permutations P of $(1, 2, \ldots, N)$.

Sample Input 1

```
3
```

Sample Output 1

```
1332
```

The six permutations of $(1, 2, 3)$ are $(1, 2, 3)$, $(1, 3, 2)$, $(2, 1, 3)$, $(2, 3, 1)$, $(3, 1, 2)$, $(3, 2, 1)$. Their $f(P)$ values are $123, 132, 213, 231, 312, 321$. Therefore, print $123 + 132 + 213 + 231 + 312 + 321 = 1332$.

Sample Input 2

```
390
```

Sample Output 2

```
727611652
```

Print the sum modulo 998244353.

Sample Input 3

```
79223
```

Sample Output 3

```
184895744
```