A - No Attacking

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 400 points

Problem Statement

There is a chessboard with N rows and N columns. Let (i, j) denote the square at the i-th row from the top and the j-th column from the left.

You will now place pieces on the board. There are two types of pieces, called **rooks** and **pawns**.

A placement of pieces is called a **good arrangement** when it satisfies the following conditions:

- Each square has zero or one piece placed on it.
- If there is a rook at (i, j), there is no piece at (i, k) for all k $(1 \leq k \leq N)$ where $k \neq j$.
- If there is a rook at (i, j), there is no piece at (k, j) for all k $(1 \leq k \leq N)$ where $k \neq i$.
- If there is a pawn at (i, j) and $i \geq 2$, there is no piece at $(i-1, j)$.

Is it possible to place all A rooks and B pawns on the board in a good arrangement?

You are given T test cases; solve each of them.

Constraints

- $1 \leq T \leq 10^5$
- $1 \leq N \leq 10^4$
- $0 \leq A, B$
- $1 \leq A + B \leq N^2$
- All input values are integers.

Input

The input is given from Standard Input in the following format. Here, case_i represents the i-th case.

$$
\begin{array}{l}
T \\
\mathrm{case}_1 \\
\mathrm{case}_2 \\
\vdots \\
\mathrm{case}_T
\end{array}
$$

Each test case is given in the following format.

$$N \quad A \quad B$$

Output

Print T lines. The i-th line should contain the answer for the i-th test case.

For each test case, print `Yes` if it is possible to place the pieces in a good arrangement and `No` otherwise.

Sample Input 1

```
8
5 2 3
6 5 8
3 2 2
11 67 40
26 22 16
95 91 31
80 46 56
998 2 44353
```

Sample Output 1

```
Yes
No
No
No
Yes
No
Yes
Yes
```

In the first test case, for example, you can place rooks at $(1, 1)$ and $(2, 4)$, and pawns at $(3, 3)$, $(4, 2)$, and $(5, 3)$ to have all the pieces in a good arrangement.
In the second test case, it is impossible to place all the pieces in a good arrangement.

B - Chmax

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 600 points

Problem Statement

For a permutation $P = (P_1, P_2, \ldots, P_N)$ of $(1, 2, \ldots, N)$, we define $F(P)$ by the following procedure:

- There is a sequence $B = (1, 2, \ldots, N)$.
  As long as there is an integer i such that $B_i < P_{B_i}$, perform the following operation:
  - Let j be the smallest integer i that satisfies $B_i < P_{B_i}$. Then, replace B_j with P_{B_j}.

  Define $F(P)$ as the B at the end of this process. (It can be proved that the process terminates after a finite number of steps.)

You are given a sequence $A = (A_1, A_2, \ldots, A_N)$ of length N. How many permutations P of $(1, 2, \ldots, N)$ satisfy $F(P) = A$? Find the count modulo 998244353.

Constraints

- $1 \leq N \leq 2 \times 10^5$
- $1 \leq A_i \leq N$
- 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 number, modulo 998244353, of permutations P that satisfy $F(P) = A$.

Sample Input 1

```
4
3 3 3 4
```

Sample Output 1

```
1
```

For example, if $P = (2, 3, 1, 4)$, then $F(P)$ is determined to be $(3, 3, 3, 4)$ by the following steps:

- Initially, $B = (1, 2, 3, 4)$.
- The smallest integer i such that $B_i < P_{B_i}$ is 1. Replace B_1 with $P_{B_1} = 2$, making $B = (2, 2, 3, 4)$.
- The smallest integer i such that $B_i < P_{B_i}$ is 1. Replace B_1 with $P_{B_1} = 3$, making $B = (3, 2, 3, 4)$.
- The smallest integer i such that $B_i < P_{B_i}$ is 2. Replace B_2 with $P_{B_2} = 3$, making $B = (3, 3, 3, 4)$.
- There are no more i that satisfy $B_i < P_{B_i}$, so the process ends. The current $B = (3, 3, 3, 4)$ is defined as $F(P)$.

There is only one permutation P such that $F(P) = A$, which is $(2, 3, 1, 4)$.

Sample Input 2

```
4
2 2 4 3
```

Sample Output 2

```
0
```

Sample Input 3

```
8
6 6 8 4 5 6 8 8
```

Sample Output 3

```
18
```

C - Swap on Tree

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 600 points

Problem Statement

There is a tree with N vertices numbered 1 to N. The i-th edge connects vertices u_i and v_i.
Additionally, there are N pieces numbered 1 to N. Initially, piece i is placed on vertex i.
You can perform the following operation any number of times, possibly zero:

- Choose one edge. Let vertices u and v be the endpoints of the edge, and swap the pieces on vertices u and v. Then, delete the chosen edge.

Let a_i be the piece on vertex i. How many different possible sequences $(a_1, a_2, \ldots, a_N)$ exist when you finish performing the operation? Find the count modulo 998244353.

Constraints

- $2 \leq N \leq 3000$
- $1 \leq u_i < v_i \leq N$
- The graph given in the input is a tree.

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 number, modulo 998244353, of possible sequences $(a_1, a_2, \ldots, a_N)$.

Sample Input 1

```
3
1 2
2 3
```

Sample Output 1

```
5
```

For example, the sequence $(a_1, a_2, a_3) = (2, 1, 3)$ can be obtained by the following steps:

- Choose the first edge, swap the pieces on vertices 1 and 2, and delete the edge. This results in $(a_1, a_2, a_3) = (2, 1, 3)$.
- Finish operating.

Also, the sequence $(a_1, a_2, a_3) = (3, 1, 2)$ can be obtained by the following steps:

- Choose the second edge, swap the pieces on vertices 2 and 3, and delete the edge. This results in $(a_1, a_2, a_3) = (1, 3, 2)$.
- Choose the first edge, swap the pieces on vertices 1 and 2, and delete the edge. This results in $(a_1, a_2, a_3) = (3, 1, 2)$.
- Finish operating.

The operation can yield the following five sequences:

- $(1, 2, 3)$
- $(1, 3, 2)$
- $(2, 1, 3)$
- $(2, 3, 1)$
- $(3, 1, 2)$

Sample Input 2

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

Sample Output 2

```
34
```

Sample Input 3

```
8
4 5
2 5
3 6
1 3
1 8
2 7
2 8
```

Sample Output 3

```
799
```

D - Rolling Hash

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 600 points

Problem Statement

You are given non-negative integers P and B. Here, P is prime, and $1 \leq B \leq P-1$.
For a sequence of non-negative integers $X=(x_1,x_2,\dots,x_n)$, the hash value $\mathrm{hash}(X)$ is defined as follows.

$$\mathrm{hash}(X) = \left(\sum_{i=1}^{n} x_i B^{n-i}\right) \bmod P$$

You are given M pairs of integers $(L_1,R_1),(L_2,R_2),\dots,(L_M,R_M)$.
Is there a sequence of non-negative integers $A=(A_1,A_2,\dots,A_N)$ of length N that satisfies the condition below?

- For all $i\ (1 \leq i \leq M)$, the following condition holds:
  - Let s be the sequence $(A_{L_i},A_{L_i+1},\dots,A_{R_i})$ obtained by taking the L_i-th to the R_i-th elements of A. Then, $\mathrm{hash}(s) \neq 0$.

Constraints

- $2 \leq P \leq 10^9$
- P is prime.
- $1 \leq B \leq P-1$
- $1 \leq N \leq 16$
- $1 \leq M \leq \frac{N(N+1)}{2}$
- $1 \leq L_i \leq R_i \leq N$
- $(L_i,R_i) \neq (L_j,R_j)$ if $i \neq j$.
- All input values are integers.

Input

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

$$
\begin{aligned}
&P \quad B \quad N \quad M \\
&L_1 \quad R_1 \\
&L_2 \quad R_2 \\
&\vdots \\
&L_M \quad R_M
\end{aligned}
$$

Output

If there is a sequence that satisfies the condition in the problem statement, print `Yes`; otherwise, print `No`.

Sample Input 1

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

Sample Output 1

```
Yes
```

The sequence $A = (2, 0, 4)$ satisfies the condition because $\mathrm{hash}((A_1)) = 2, \mathrm{hash}((A_1, A_2)) = 1, \mathrm{hash}((A_2, A_3)) = 1$.

Sample Input 2

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

Sample Output 2

```
No
```

No sequence satisfies the condition.

Sample Input 3

```
998244353 986061415 6 11
1 5
2 2
2 5
2 6
3 4
3 5
3 6
4 4
4 5
4 6
5 6
```

Sample Output 3

```
Yes
```

E - Rookhopper's Tour

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 800 points

Problem Statement

There is a grid with N rows and N columns. Let (i, j) denote the cell at the i-th row from the top and the j-th column from the left. Additionally, there is one black stone and M white stones.
You will play a single-player game using these items.

Here are the rules. Initially, you place the black stone at (A, B). Then, you place each of the M white stones on some cell of the grid. Here:

- You cannot place a white stone at (A, B).
- You can place at most one white stone per row.
- You can place at most one white stone per column.

Then, you will perform the following operation until you cannot do so:

- Assume the black stone is at (i, j). Perform one of the four operations below:
  - If there is a white stone at (i, k) where $(j < k)$, remove that white stone and move the black stone to $(i, k + 1)$.
  - If there is a white stone at (i, k) where $(j > k)$, remove that white stone and move the black stone to $(i, k - 1)$.
  - If there is a white stone at (k, j) where $(i < k)$, remove that white stone and move the black stone to $(k + 1, j)$.
  - If there is a white stone at (k, j) where $(i > k)$, remove that white stone and move the black stone to $(k - 1, j)$.
    - Here, if the cell to which the black stone is to be moved does not exist, such a move cannot be made.

The following figure illustrates an example. Here, `B` represents the black stone, `W` represents a white stone, `.` represents an empty cell, and `O` represents a cell to which the black stone can be moved.

```
..O...
..W...
......
......
..B.WO
......
```

You win the game if all of the following conditions are satisfied when you finish performing the operation. Otherwise, you lose.

- All white stones have been removed from the grid.
- The black stone is placed at (A, B).

In how many initial configurations of the M white stones can you win the game by optimally performing the operation? Find the count modulo 998244353.

Constraints

- $2 \leq M \leq N \leq 2 \times 10^5$
- $1 \leq A \leq N$
- $1 \leq B \leq N$
- N, M, A, and B are integers.

Input

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

$$N \quad M \quad A \quad B$$

Output

Print the number, modulo 998244353, of possible configurations of the white stones that can lead to your victory.

Sample Input 1

```
6 4 2 3
```

Sample Output 1

```
4
```

For example, consider the white stones placed as shown in the following figure:

```
......
..BW..
.....W
......
..W...
....W.
```

Here, you can win the game by moving the black stone in the following steps:

- Remove the white stone at $(5,3)$ and move the black stone to $(6,3)$.
- Remove the white stone at $(6,5)$ and move the black stone to $(6,6)$.
- Remove the white stone at $(3,6)$ and move the black stone to $(2,6)$.
- Remove the white stone at $(2,4)$ and move the black stone to $(2,3)$.
- Since all white stones have been removed from the grid and the black stone is placed at $(A,B) = (2,3)$, you win the game.

There are four configurations of white stones that can lead to your victory.

Sample Input 2

```
5 3 1 3
```

Sample Output 2

```
0
```

Sample Input 3

```
200000 47718 21994 98917
```

Sample Output 3

```
146958602
```

F - Both Reversible

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 1100 points

Problem Statement

A string T is called a **good string** when it satisfies the following condition:

- There is a pair of strings (A, B) that satisfies all of the following:
  - Both A and B are non-empty.
  - $A + B = T$.
  - Both $A + \mathrm{rev}(B)$ and $\mathrm{rev}(A) + B$ are palindromes.

Here, $A + B$ denotes the string formed by concatenating strings A and B in this order.
Also, $\mathrm{rev}(A)$ denotes the string formed by reversing the order of the characters in string A.

There is a string S of length N consisting of lowercase English letters and the character `?`.
Among the $26^{(\text{number of ?s})}$ ways to replace the `?`s in S with lowercase English letters, how many result in a good string? Find the count modulo 998244353.

Constraints

- $2 \leq N \leq 5 \times 10^4$
- S is a string of length N consisting of lowercase English letters and `?`.

Input

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

N
S

Output

Print the number, modulo 998244353, of ways to replace the characters that satisfy the condition in the problem statement.

Sample Input 1

```
4
?ba?
```

Sample Output 1

```
1
```

The string abab is good, because if we set $A =$ ab and $B =$ ab, then $A + B =$ abab, and both $A + \mathrm{rev}(B) =$ abba and $\mathrm{rev}(A) + B =$ baab are palindromes.
Among the strings that can be formed by replacing the ?s in S with lowercase English letters, there is only one good string, which is abab.

Sample Input 2

```
10
?y?x?x????
```

Sample Output 2

```
676
```

Sample Input 3

```
30
???a?????aab?a???c????c?aab???
```

Sample Output 3

```
193994800
```

Sample Input 4

```
36
????????????????????????????????????
```

Sample Output 4

```
363594614
```