A - Sort Left and Right

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 300 points

Problem Statement

You are given a permutation $P = (P_1, P_2, \dots, P_N)$ of $(1, 2, \dots, N)$.

You want to satisfy $P_i = i$ for all $i = 1, 2, \dots, N$ by performing the following operation zero or more times:

- Choose an integer k such that $1 \leq k \leq N$. If $k \geq 2$, sort the 1-st through $(k-1)$-th terms of P in ascending order. Then, if $k \leq N-1$, sort the $(k+1)$-th through N-th terms of P in ascending order.

It can be proved that under the constraints of this problem, it is possible to satisfy $P_i = i$ for all $i = 1, 2, \dots, N$ with a finite number of operations for any P. Find the minimum number of operations required.

You have T test cases to solve.

Constraints

- $1 \leq T \leq 10^5$
- $3 \leq N \leq 2 \times 10^5$
- P is a permutation of $(1, 2, \dots, N)$.
- All input values are integers.
- The sum of N across the test cases in a single input is at most 2×10^5.

Input

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

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

Each case is given in the following format:

$$
\begin{array}{l}
N \\
P_1 \quad P_2 \quad \ldots \quad P_N
\end{array}
$$

Output

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

Sample Input 1

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

Sample Output 1

```
1
0
2
```

For the first test case,

- Performing the operation with $k = 1$ results in P becoming $(2, 1, 3, 4, 5)$.
- Performing the operation with $k = 2$ results in P becoming $(2, 1, 3, 4, 5)$.
- Performing the operation with $k = 3$ results in P becoming $(1, 2, 3, 4, 5)$.
- Performing the operation with $k = 4$ results in P becoming $(1, 2, 3, 5, 4)$.
- Performing the operation with $k = 5$ results in P becoming $(1, 2, 3, 5, 4)$.

Specifically, performing the operation with $k = 3$ results in P satisfying $P_i = i$ for all $i = 1, 2, \dots, 5$. Therefore, the minimum number of operations required is 1.

For the third test case, performing the operation with $k = 4$ followed by $k = 3$ results in P changing as $(3, 2, 1, 7, 5, 6, 4) \rightarrow (1, 2, 3, 7, 4, 5, 6) \rightarrow (1, 2, 3, 4, 5, 6, 7)$.

B - Annoying String Problem

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 600 points

Problem Statement

For strings S and T consisting of lowercase English letters, and a string X consisting of `0` and `1`, define the string $f(S, T, X)$ consisting of lowercase English letters as follows:

- Starting with an empty string, for each $i = 1, 2, \dots, |X|$, append S to the end if the i-th character of X is `0`, and append T to the end if it is `1`.

You are given a string S consisting of lowercase English letters, and strings X and Y consisting of `0` and `1`.

Determine if there exists a string T (which can be empty) such that $f(S, T, X) = f(S, T, Y)$.

You have t test cases to solve.

Constraints

- $1 \leq t \leq 5 \times 10^5$
- $1 \leq |S| \leq 5 \times 10^5$
- $1 \leq |X|, |Y| \leq 5 \times 10^5$
- S is a string consisting of lowercase English letters.
- X and Y are strings consisting of `0` and `1`.
- The sum of $|S|$ across all test cases in a single input is at most 5×10^5.
- The sum of $|X|$ across all test cases in a single input is at most 5×10^5.
- The sum of $|Y|$ across all test cases in a single input is at most 5×10^5.

Input

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

$$
\begin{array}{l}
t \\
\mathrm{case}_1 \\
\vdots \\
\mathrm{case}_t
\end{array}
$$

Each case is given in the following format:

$$
\begin{array}{l}
S \\
X \\
Y
\end{array}
$$

Output

Print t lines. The i-th line should contain `Yes` if there exists a T that satisfies the condition for the i-th test case, and `No` otherwise.

Sample Input 1

```
3
araara
01
111
araaaa
100100
0010111
abacabac
0
1111
```

Sample Output 1

```
Yes
No
No
```

Below, string concatenation is represented using $+$.

For the 1st test case, if $T=$ `ara`, then $f(S,T,X)=S+T=$ `araaraara` and $f(S,T,Y)=T+T+T=$ `araaraara`, so $f(S,T,X)=f(S,T,Y)$.

For the 2nd and 3rd test cases, there is no T that satisfies the condition.

Sample Input 2

```
2
empty
10101
00
empty
11111
111
```

Sample Output 2

```
Yes
Yes
```

T can be empty.

C - Row and Column Order

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 600 points

Problem Statement

You are given two permutations $P = (P_1, P_2, \dots, P_N)$ and $Q = (Q_1, Q_2, \dots, Q_N)$ of $(1, 2, \dots, N)$.

Write one of the characters `0` and `1` in each cell of an N-by-N grid so that all of the following conditions are satisfied:

- Let S_i be the string obtained by concatenating the characters in the i-th row from the 1-st to the N-th column. Then, $S_{P_1} < S_{P_2} < \cdots < S_{P_N}$ in lexicographical order.
- Let T_i be the string obtained by concatenating the characters in the i-th column from the 1-st to the N-th row. Then, $T_{Q_1} < T_{Q_2} < \cdots < T_{Q_N}$ in lexicographical order.

It can be proved that for any P and Q, there is at least one way to write the characters that satisfies all the conditions.

▶ What does "$X < Y$ in lexicographical order" mean?

Constraints

- $2 \leq N \leq 500$
- P and Q are permutations of $(1, 2, \dots, N)$.
- All input values are integers.

Input

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

$$
\begin{array}{l}
N \\
P_1 \ P_2 \ \dots \ P_N \\
Q_1 \ Q_2 \ \dots \ Q_N
\end{array}
$$

Output

Print a way to fill the grid that satisfies the conditions in the following format, where A_{ij} is the character written at the i-th row and j-th column:

$$A_{11}A_{12}\ldots A_{1N}$$
$$\vdots$$
$$A_{N1}A_{N2}\ldots A_{NN}$$

If there are multiple ways to satisfy the conditions, any of them will be accepted.

Sample Input 1

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

Sample Output 1

```
001
101
110
```

In this sample, $S_1 =$`001`, $S_2 =$`101`, $S_3 =$`110`, and $T_1 =$`011`, $T_2 =$`001`, $T_3 =$`110`. Therefore, $S_1 < S_2 < S_3$ and $T_2 < T_1 < T_3$ hold, satisfying the conditions.

Sample Input 2

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

Sample Output 2

```
010001111110101
001000000101001
010001001100010
010000011110010
010011101101101
100101110100000
111100011001000
000001001100000
100011011000101
000111101011110
101010101010101
011010101011110
010011000010011
100110010110101
000101101100100
```

D - Prefix Bubble Sort

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 700 points

Problem Statement

You are given a permutation $P = (P_1, P_2, \dots, P_N)$ of $(1, 2, \dots, N)$.

Consider the following operations $k\ (k = 2, 3, \dots, N)$ on this permutation.

- Operation k: For $i = 1, 2, \dots, k-1$ in this order, if $P_i > P_{i+1}$, swap the values of the i-th and $(i+1)$-th elements of P.

You are also given a **non-decreasing** sequence $A = (A_1, A_2, \dots, A_M)\ (2 \leq A_i \leq N)$ of length M.

For each $i = 1, 2, \dots, M$, find the inversion number of P after applying the operations $A_1, A_2, \dots, A_i$ in this order.

▶ What is the inversion number of a sequence?

Constraints

- $2 \leq N \leq 2 \times 10^5$
- $1 \leq M \leq 2 \times 10^5$
- $2 \leq A_i \leq N$
- P is a permutation of $(1, 2, \dots, N)$.
- $A_i \leq A_{i+1}$ for $i = 1, 2, \dots, M-1$.
- All input values are integers.

Input

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

$$
\begin{array}{l}
N \\
P_1 \quad P_2 \quad \dots \quad P_N \\
M \\
A_1 \quad A_2 \quad \dots \quad A_M
\end{array}
$$

Output

Print M lines. The k-th line should contain the answer to the problem for $i = k$.

Sample Input 1

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

Sample Output 1

```
3
1
```

First, operation 4 is performed. During this, P changes as follows: $(3, 2, 4, 1, 6, 5) \rightarrow (2, 3, 4, 1, 6, 5) \rightarrow (2, 3, 4, 1, 6, 5) \rightarrow (2, 3, 1, 4, 6, 5)$. The inversion number of P afterward is 3.

Next, operation 6 is performed, where P eventually becomes $(2, 1, 3, 4, 5, 6)$, whose inversion number is 1.

Sample Input 2

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

Sample Output 2

```
117
116
113
110
108
105
103
99
94
87
79
72
65
58
51
```

E - Min and Max at the edge

Time Limit: 3 sec / Memory Limit: 1024 MiB

Score : 1000 points

Problem Statement

An undirected graph with numbered vertices is called a **good graph** if it has a spanning tree T that satisfies the following condition. Here, an edge connecting two vertices u and v $(u < v)$ is denoted as edge (u, v).

- For every edge (u, v) $(u < v)$ in the graph, the minimum and maximum vertex numbers on the unique simple path connecting vertices u and v in T are u and v, respectively.

You are given a simple connected undirected graph G with N vertices numbered from 1 to N. The graph G has M edges, and the i-th edge connects vertices A_i and B_i $(A_i < B_i)$.

For each $i = 1, 2, \ldots, M$, determine whether the graph obtained by removing the i-th edge from G is a **good graph**.

Constraints

- $2 \leq N \leq 2 \times 10^5$
- $N - 1 \leq M \leq 2 \times 10^5$
- $1 \leq A_i < B_i \leq N$
- All input values are integers.
- The given graph is a simple connected undirected graph.

Input

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

$$
\begin{array}{l}
N \quad M \\
A_1 \quad B_1 \\
\vdots \\
A_M \quad B_M
\end{array}
$$

Output

Print M lines. The i-th line should contain `Yes` if the graph obtained by removing the i-th edge from G is a **good graph**, and `No` otherwise.

Sample Input 1

```
6 9
1 3
1 5
2 5
2 6
3 4
3 5
3 6
4 6
5 6
```

Sample Output 1

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

Consider the case where edge $(4, 6)$ is removed. A spanning tree formed by edges $(1, 3), (2, 5), (3, 4), (3, 5), (5, 6)$ satisfies the condition. For example, for edge $(3, 6)$, the simple path connecting vertices 3 and 6 traverses vertices $3, 5, 6$ in this order, and the minimum and maximum vertex numbers on the path are 3 and 6, respectively, thus satisfying the condition. By verifying the other edges similarly, it can be seen that this spanning tree satisfies the condition, so the answer is `Yes`.

On the other hand, consider the case where edge $(1, 5)$ is removed. The same spanning tree does not satisfy the condition. For edge $(4, 6)$, the simple path connecting vertices 4 and 6 traverses vertices $4, 3, 5, 6$ in this order, and the minimum and maximum vertex numbers on the path are 3 and 6, respectively, thus not satisfying the condition. It can also be shown that no other spanning tree satisfies the condition, so the answer is `No`.

Sample Input 2

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

Sample Output 2

```
No
No
No
No
```

Removing an edge may disconnect the graph.

Sample Input 3

```
15 20
12 13
7 8
5 7
8 10
9 12
4 5
11 12
2 4
6 8
4 14
1 2
14 15
2 9
3 8
2 15
10 11
13 14
8 9
7 14
5 13
```

Sample Output 3

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

F - Colorful Reversi

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 1100 points

Problem Statement

You are given an integer sequence $A = (A_1, A_2, \ldots, A_N)$ of length N. On this sequence, the following operation can be performed:

- Choose l and r $(1 \leq l < r \leq N)$ such that $A_l = A_r$, $A_{l+1} = A_{l+2} = \cdots = A_{r-1}$, and $A_{l+1} \neq A_l$. Replace each of $A_{l+1}, A_{l+2}, \ldots, A_{r-1}$ with A_l. The cost of this operation is $r - l - 1$.

You will repeat this operation until there is no l and r $(1 \leq l < r \leq N)$ such that $A_l = A_r$, $A_{l+1} = A_{l+2} = \cdots = A_{r-1}$, and $A_{l+1} \neq A_l$. Find the minimum total cost of such a series of operations.

Constraints

- $3 \leq N \leq 5 \times 10^5$
- $1 \leq A_i \leq N$
- 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

```
7
1 2 3 2 3 2 1
```

Sample Output 1

```
7
```

For example, if you perform the operation with $(l, r) = (3, 5), (2, 6), (1, 7)$ in this order, A changes as follows: $(1, 2, 3, 2, 3, 2, 1) \to (1, 2, 3, 3, 3, 2, 1) \to (1, 2, 2, 2, 2, 2, 1) \to (1, 1, 1, 1, 1, 1, 1)$, after which there is no l and r with the said property. The total cost of this series of operations is $1 + 3 + 5 = 9$.

On the other hand, if you perform the operation with $(l, r) = (2, 4), (4, 6), (1, 7)$ in this order, A changes as follows: $(1, 2, 3, 2, 3, 2, 1) \to (1, 2, 2, 2, 3, 2, 1) \to (1, 2, 2, 2, 2, 2, 1) \to (1, 1, 1, 1, 1, 1, 1)$. The total cost of this series of operations is $1 + 1 + 5 = 7$.

Sample Input 2

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

Sample Output 2

```
0
```

Sample Input 3

```
40
1 2 3 4 5 6 7 8 7 6 5 6 7 8 7 6 5 4 3 2 2 1 2 3 4 5 4 5 6 7 8 7 7 6 5 6 6 7 8 8
```

Sample Output 3

```
44
```