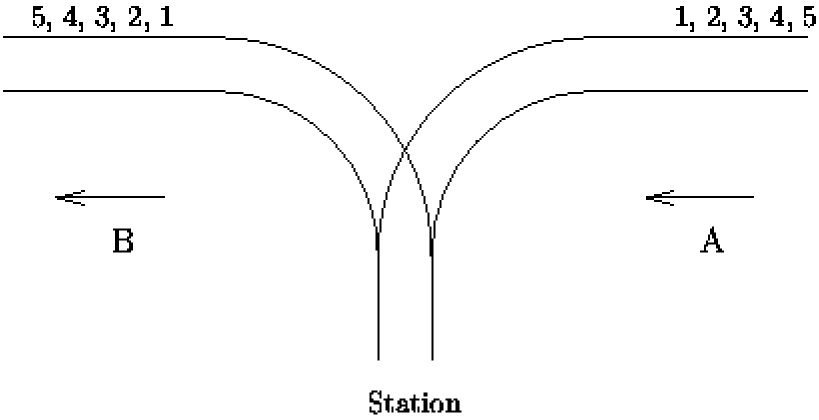
CMPSC 465 Project 1

Background

There is a famous railway station in PopPush City. Country there is incredibly hilly. The station was built in last century. Unfortunately, funds were extremely limited that time. It was possible to establish only a surface track. Moreover, it turned out that the station could be only a dead-end one (see picture) and due to lack of available space it could have only one track.



The local tradition is that every train arriving from the direction A continues in the direction B with coaches reorganized in some way.

- Assume that the train arriving from the direction A has N ≤ 1000 coaches numbered in increasing order 1, 2, ..., N.
- The chief for train reorganizations must know whether it is possible to marshal coaches continuing in the direction B so that their order will be a_1, a_2, ..., a_N. Help him and write a program that decides whether it is possible to get the required order of coaches.
- You can assume that single coaches can be disconnected from the train before they enter the station and that they can move themselves until they are on the track in the direction B.
- You can also suppose that at any time there can be located as many coaches as necessary in the station. But once a coach has entered the station it **cannot** return to the track in the direction A and also once it has left the station in the direction B it cannot return back to the station.

Program Input

- The input file consists of blocks of lines, each of which is a test case. Each block except the last describes one train and possibly more requirements for its reorganization. In the first line of the block there is the integer N, which is the number of coaches in the train. In each of the next lines of the block there is a permutation of 1, 2, ..., N . For example, if N is 5, and the permutation could be 5, 3, 2, 1, 4. Your program will take this permutation as input and determine whether you can marshal the coaches from track A an incoming order 1, 2, 3, 4, 5 to track B with an outgoing order 5, 3, 2, 1, 4 using the station, which can be treated as a stack.
- The last line of the block contains just 0.
- If a block starts with a zero, the program will terminate.

- You should use the input file named **lab1in.txt** (download from Canvas) to test your program; an output file named **lab1out.txt** (with correct output) is also provided for you to verify your program.

Input Sample

```
5           // start of first block
1 2 3 4 5
5 4 1 2 3
0           // end of first block
6           // start of second block
6 5 4 3 2 1
0           // end of second block
0           // end of input
```

Program Output

The output file contains the lines corresponding to the lines with permutations in the input file. A line of the output file contains "**Yes**" if it is possible to marshal the coaches in the order required on the corresponding line of the input file. Otherwise it contains "**No**". In addition, there is one empty line after the lines corresponding to one block of the input file. There is no line in the output file corresponding to the last "null'' block of the input file.

Output Sample

This is an output sample of the previous input sample

```
Yes
No

Yes
```

Hint

Key points to understand/solve the problem:

- The train station can be regarded as a stack.
- One can push a coach from track A into the stack; when the coach is popped out of the stack, it gets into track B, and a coach in the station can never go back to track A.
- Taking a train with 5 coaches as an example.
- Coaches in track A is always in strictly increasing order, i.e., 1, 2, 3, 4, 5
- The train chief tries to marshal the coaches into track B via a sequence of push and pop operations.
- Each test case in the input file is asking a question: is it possible to marshal the the coaches into track B such that the coach order matches the test case?
    - For instance, if the test case is "1, 2, 3, 4, 5", then we can perform the following sequence of operations

operation	**Track B**	**Stack (left side is the top)**	**Track A**
push(1)	empty	1	2, 3, 4, 5
pop	1	empty	2, 3, 4, 5
push(2)	1	2	3, 4, 5
pop	1, 2	empty	3, 4, 5
push(3)	1, 2	3	4, 5
pop	1, 2, 3	empty	4, 5
push(4)	1, 2, 3	4	5
pop	1, 2, 3, 4	empty	5
push(5)	1, 2, 3, 4	5	empty
pop	**1, 2, 3, 4, 5**	empty	empty

The final coach order in track B matches "1,2,3,4,5" in the test case, so program outputs "YES".

  - Now use a similar way to validate that why test case "5, 4, 1, 2, 3" will NOT work.
- Now you should be able to handle larger test cases as the ones in the input file provided by the instructor.