

C2. Guessing the Greatest (hard version)

time limit per test: 1 second

memory limit per test: 256 megabytes

input: standard input

output: standard output

The only difference between the easy and the hard version is the limit to the number of queries.

This is an interactive problem.

There is an array a of n **different** numbers. In one query you can ask the position of the second maximum element in a subsegment $a[l..r]$. Find the position of the maximum element in the array in no more than **20** queries.

A subsegment $a[l..r]$ is all the elements a_l, a_{l+1}, \dots, a_r . After asking this subsegment you will be given the position of the second maximum from this subsegment **in the whole** array.

Input

The first line contains a single integer n ($2 \leq n \leq 10^5$) — the number of elements in the array.

Interaction

You can ask queries by printing " $? \ l \ r$ " ($1 \leq l < r \leq n$). The answer is the index of the second maximum of all elements a_l, a_{l+1}, \dots, a_r . Array a is fixed beforehand and can't be changed in time of interaction.

You can output the answer by printing " $! \ p$ ", where p is the index of the maximum element in the array.

You can ask no more than **20** queries. **Printing the answer doesn't count as a query.**

After printing a query do not forget to output end of line and flush the output. Otherwise, you will get `Idleness limit exceeded`. To do this, use:

- `fflush(stdout)` or `cout.flush()` in C++;
- `System.out.flush()` in Java;
- `flush(output)` in Pascal;
- `stdout.flush()` in Python;
- see documentation for other languages

Hacks

To make a hack, use the following test format.

In the first line output a single integer n ($2 \leq n \leq 10^5$). In the second line output a permutation of n integers 1 to n . The position of n in the permutation is the position of the maximum

Example

input	Copy
5	
3	
4	

Codeforces Round #703 (Div. 2)

Contest is running

00:19:42

Contestant



→ Submit?

Language: GNU G++14 6.4.0

Choose file: 파일 선택 선택된 파일 없음

Be careful: there is 50 points penalty for submission which fails the pretests or resubmission (except failure on the first test, denial of judgement or similar verdicts). "Passed pretests" submission verdict doesn't guarantee that the solution is absolutely correct and it will pass system tests.

Submit

→ Score table

	Score
Problem A	270
Problem B	540
Problem C1	405
Problem C2	405
Problem D	945
Problem E	1215
Problem F	1620
Successful hack	100
Unsuccessful hack	-50
Unsuccessful submission	-50
Resubmission	-50

* If you solve problem on 01:55 from the first attempt

output

Copy

? 1 5

? 4 5

! 1

Note

In the sample suppose a is $[5, 1, 4, 2, 3]$. So after asking the $[1..5]$ subsegment 4 is second to max value, and it's position is 3. After asking the $[4..5]$ subsegment 2 is second to max value and it's position in the whole array is 4.

Note that there are other arrays a that would produce the same interaction, and the answer for them might be different. Example output is given in purpose of understanding the interaction.

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