Competitive Programming SS24

Submit until end of contest

Problem: skiing2 (5.0 second timelimit)

Note: This is a problem that is harder to solve than usual. Solve the other problems first before spending too much time on this one.

Zoe loves skiing. This winter, she visits the Donut mountain: a giant mountain on Mars that has the shape of a ring. Luckily the fine people at the Mars Donut Mountain Association (MDMA) have accurately measured the mountain over the years.

Zoe now wants to find some summit[1] on the Donut mountain that she can start from, but sadly the people do not want to give out a map, let alone the entirety of their n pairwise different height measurements they have collected over the years. Mars people are also very orderly, so they have enumerated their measurement points counterclockwise around the mountain.

Consequently, they only grant Zoe 200 questions, with each of which she can ask whether one point is higher than another.

Can you help her to find a downhill slope, starting from a summit?

Interaction First, you are given the number of measurement points $3 \leq n \leq 10^{17}$. Then you are left talking to the lady behind the counter. Query for a pair of points by printing `? a b`, where $0 \leq a, b < n$ represent two measurement points.

She will respond with `1` if height(a) $<$ height(b) and with `0` otherwise.[2] Be careful, after a while she needs a fresh cup of coffee and abruptly leaves you with a `WRONG-ANSWER`! In this case, you should not ask the unmanned counter any longer, since your questions will not be heard.

As soon as you have identified a summit of the Donut mountain, turn to Zoe and tell her the location by printing `! a`, where $0 \leq a < n$.

Example

```
> 5
< ? 1 2
> 1
< ? 2 3
> 1
< ? 3 4
> 1
< ? 4 0
> 0
< ! 4
```

[1] A location from which you cannot go any higher without descending first.

[2] Tune in your space suit to `stdin` to hear her answers, and do not forget to `flush` when speaking!