Counterfeit Coin

Problem Code: COIN

Design Challenge

Task Description

Most of the people have been asked this question before. But now let's do it again in an algorithmic sense.

You have n coins of the same type. Among them, one is counterfeit and has different weight. You do NOT know which coin is counterfeit and you do NOT know it is heavier or lighter than the others.

You have a scale. You can put any number of coins onto the two plates of the scale and measure them. The result of each measure will be either *balanced* or *unbalanced*. If it is unbalanced, you know which side is heavier (or equivalently, which side is lighter).

The goal is to design a strategy to find out the counterfeit coin by measuring $O(\log n)$ times.

Constraints

$n \geq 3$.

Example

Say we have $n = 5$ coins, we number the coins from 1 to 3. We can measure them as follows:

[1, 2] vs [3, 4]. If they are balanced, the counterfeit coin is 5. Otherwise, 5 is a good coin. Proceed.

[4] vs [5] If they are balanced, 4 is counterfeit. Otherwise, 4 is a good coin. Proceed.

[1, 2] vs [4, 5]. If they are balanced, 3 is counterfeit. Otherwise, either 1 or 2 is counterfeit. Proceed.

[1] vs [5]. If they are balanced, 2 is counterfeit. Otherwise, 1 is countefeit.

Note that this is only an example to give you some basic ideas with a fixed $n = 5$. You shall not assume any property of n in your solution. You shall address the cases when coins cannot be evenly divided into groups.

Requirements

Time: $O(\log n)$ **Space:** $O(n)$