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Coding note

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1.1 Basic questions

1.1.1 find missing number

Find missing number problem can have many different formulas.

First, let's look at find one missing number.

Problem 1.1 *Given an array containing n distinct numbers taken from 0, 1, 2, ..., n, find the one that is missing from the array.*

For example, Given nums = [0, 1, 3] return 2.

In this problem we need to use XOR($\oplus$) to prevent the overflow. XOR have some properties:

1. For bit:
   (a) $0 \oplus 0 = 0$
   (b) $0 \oplus 1 = 1$
   (c) $1 \oplus 0 = 1$
   (d) $1 \oplus 1 = 0$
2. For numbers
   (a) $x \oplus x = 0$
   (b) $x \oplus 0 = x$ actually this is the special case for $x \oplus y = z$, then $x \oplus z = y$
   (c) $x \oplus y \oplus z = x \oplus z \oplus y = y \oplus x \oplus z$

Thus we only need to do is xor all the numbers in the array with the array of the index. Thus we can find the missing number.