Competitive Programming

Lec 14
Bit Manipulation

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Data Type

Char = 1 byte
Int = 2/4 byte
Long = 8 byte
Float = 4 byte
Double = 8 byte

Code to check size.

Binary Number System

Convert 15 in Binary.

AND =   &
OR   = |
NOT = ~
XOR = ^
Left shift = <<
Right shift = >>

Try this signs in c++/python/java.

Read & Try this tricks with bits.

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Single Number

Given an array of integers, every element appears twice except for one. Find that single one.

Note: Your algorithm should have a linear runtime complexity. Could you implement it without using extra memory?

Example :

Input : [1 2 2 3 1]
Output : 3

Solution

Number of 1 Bits

Write a function that takes an unsigned integer and returns the number of 1 bits it has.

Example:

The 32-bit integer 11 has binary representation

00000000000000000000000000001011
so the function should return 3.

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Min XOR value

Given an array of N integers, find the pair of integers in the array which have minimum XOR value. Report the minimum XOR value.

Input
4 9 7 0

Output
3 (4 XOR 7)

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[Single Number II](), Google

Given an array of integers, every element appears thrice except for one which occurs once.

Find that element which does not appear thrice.

Note: Your algorithm should have a linear runtime complexity.

Could you implement it without using extra memory?

Example :

Input : [1, 2, 4, 3, 3, 2, 2, 3, 1, 1]
Output : 4

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[Different Bits Sum Pairwise](#), Google

We define f(X, Y) as number of different corresponding bits in binary representation of X and Y. For example, f(2, 7) = 2, since binary representation of 2 and 7 are 010 and 111, respectively. The first and the third bit differ, so f(2, 7) = 2.

You are given an array of N positive integers, A1, A2 ,…, AN. Find sum of f(Ai, Aj) for all pairs (i, j) such that 1 ≤ i, j ≤ N. Return the answer modulo 10^9+7.

For example,

A=[1, 3, 5]

We return

f(1, 1) + f(1, 3) + f(1, 5) +
f(3, 1) + f(3, 3) + f(3, 5) +
f(5, 1) + f(5, 3) + f(5, 5) =

0 + 1 + 1 +
1 + 0 + 2 +
1 + 2 + 0 = 8

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Homework

Solve all discussed questions.

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