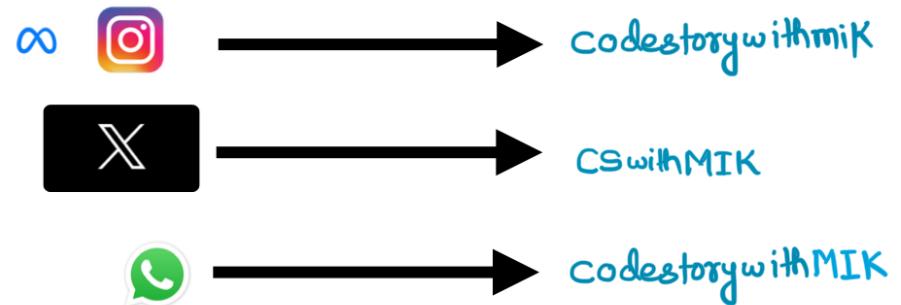


Bit-Manipulation



video - 28



Try this channel to

see "Life behind the Scenes"
+ "Tech news"

Motivation

Always choose the harder right
over the easier wrong.



The path to growth/success/reward
is often Harder. No shortcut.
If you have that will, you'll get it.

MIK

3314. Construct the Minimum Bitwise Array I & II

Easy
Medium

Topics

Companies

Hint

You are given an array `nums` consisting of n prime integers.

You need to construct an array `ans` of length n , such that, for each index i , the bitwise OR of $ans[i]$ and $ans[i] + 1$ is equal to $nums[i]$, i.e. $ans[i] \text{ OR } (ans[i] + 1) == nums[i]$.

Additionally, you must minimize each value of $ans[i]$ in the resulting array.

If it is not possible to find such a value for $ans[i]$ that satisfies the condition, then set $ans[i] = -1$.

Example:- $nums = [2, 3, 5, 7]$

1 1 4 2

Output = [-1, 1, 0, 0]

Part I ↗

Constraints:

- $1 \leq \text{nums.length} \leq 100$
- $2 \leq \text{nums}[i] \leq 1000$
- $\text{nums}[i]$ is a prime number.

Part-II

Constraints:

- $1 \leq \text{nums.length} \leq 100$
- $2 \leq \text{nums}[i] \leq 10^9$
- $\text{nums}[i]$ is a prime number.

$O(100 * 1000)$

$T.C = O(10^5)$

$O(100 * 10^9)$

$O(10^{14})$ T.L.E.

Thought Process

$\text{nums} = [2, 3, 5, 7]$

$\{x \text{ OR } (x+1)\}$

$x' \text{ OR } (x'+1)$

7

$$x \text{ OR } (x+1) = \boxed{7}$$

$$\begin{array}{l} x \quad x=0 \longrightarrow x \text{ OR } (x+1) = 0 \text{ OR } 1 = 1 \\ x \quad x=1 \longrightarrow 1 \text{ OR } 2 \end{array}$$

$$\begin{array}{r} 00 \\ 01 \\ \hline 01 \end{array}$$

$$\begin{array}{l} x \quad x=2 \longrightarrow 2 \text{ OR } 3 \\ \checkmark \quad \boxed{x=3} \longrightarrow \boxed{3 \text{ OR } 4} \end{array}$$

$$\begin{array}{r} 011 \\ 100 \\ \hline 111 \end{array}$$

$$\begin{array}{l} x \quad x=4 \longrightarrow 4 \text{ OR } 5 \\ \checkmark \quad \boxed{x=5} \longrightarrow \boxed{5 \text{ OR } 6} \end{array}$$

$$\begin{array}{r} 101 \\ 110 \\ \hline 111 \end{array}$$

$$\checkmark \quad \boxed{x=6} \longrightarrow \boxed{6 \text{ OR } 7}$$

$$\begin{array}{r} 110 \\ 111 \\ \hline 111 \end{array}$$

$$\begin{array}{l} \boxed{x=7} \longrightarrow 7 \text{ OR } 8 \\ x=8 \end{array}$$

$$\begin{array}{r} 0111 \\ 1000 \\ \hline 1111 \end{array}$$

$>>7$

$\nearrow 7$

`nums[i]`

$x = 0 \rightarrow x < \text{nums}[i]$

```

for (int i=0; i<n; i++) { ←
    bool found = False;
    for (int x=0; x<nums[i]; x++) {
        if ((x | (x+1)) == nums[i]) {
            result.push_back(x);
            found = True;
            break;
        }
    }
    if (found == False) {
        result.push_back(-1);
    }
}

```

$T.C = O(n * \max(\text{nums}[i]))$

$S.C = O(1)$

Optimal Approach (Part-II)

$$x \text{ OR } (x+1) = \text{nums}[i]$$

first 0 from right

$$x = \boxed{1 0 0 1 0} \quad \boxed{0 1 1 1} \quad 2 \rightarrow 1 \underline{0}$$
$$+ 1$$
$$x+1 = \boxed{1 0 0 1 0} \quad \boxed{1 0 0 0}$$

x

OR $x+1$

OR

$$\begin{array}{r} 1 0 0 1 0 \underline{0} \quad | \quad | \quad | \\ 1 0 0 1 0 1 \quad 0 0 0 \\ \hline 1 0 0 1 0 \quad 1 \quad 1 \quad 1 \quad 1 \end{array}$$

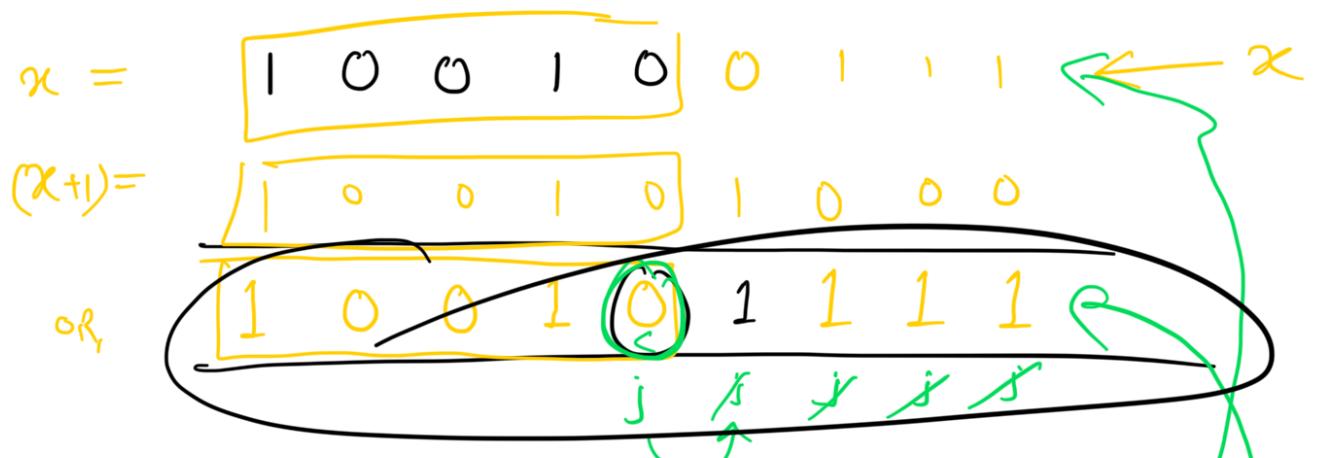
nums[i] \Rightarrow 1 0 0 1 0 1 1 1

$$(x \text{ or } (x+1)) = \boxed{\begin{array}{r} 1 0 0 1 0 1 1 1 \\ \hline \text{nums}[i] \end{array}}$$

nums[i] \rightarrow find first 0-bit (j^{th} bit)

\downarrow

$(j-1) \rightarrow 1\text{-bit} \rightarrow \text{make it } 0.$



$x = 1001001001111$

$x+1 = 1001001000000$

→ for (int i=0; i<n; i++) {

 if (num[i] == 2) {
 res[i] = -1; continue;

}

 2

 for (j=0; j < 32; j++) {

 if ((num[i] & (1 << j)) > 0) {
 continue;

}

 prev = (j-1);

$T \cdot C = O(n)$
 $S \cdot C = O(1)$
* →

//make prev-bit 0;
~~ok~~ → $x = (\text{nums}[i] \wedge (\text{l} \ll (j-1)))$;
 result.p_b(x);
 found = True;
 break;

j
 ↑
 | 0 0 | 0
 ↓
 xor 0 0 0 0 0
 ——————
 | 0 0 | 0 0 0 0
 ↓
 1 << (j-1)

↑
 prev
 ↑
 1
 | 0 0 0 0
 ↓
 0 1 1 1

$\text{nums}[i] \rightarrow \text{prime}$.

(2) 3, 5, 7, 11, 13 → odd.
 Even.

$\text{nums}[i]$
 2 → | 0 j ↗

prev = (j-1)

