BITWISE OPERATORS:

- AND

a	b	a & b
0	0	0
0	1	0
1	0	0
1	1	1

- OR

a	b	a || b
0	0	0
0	1	1
1	0	1
1	1	1

NOT:

a	b
0	1
1	0

* Where ever you and 1 by any number it gives that number

```
1010
1111
1010
```

(2) XOR ^

a	b	a ^ b
0	0	0
0	1	1
1	0	1
1	1	0

* only 1 should be true.

* Whenever we XOR any number with 1 we get opposite (NOT) of that number

```
a = 10101
    11111   NOT
    01010
```

a ^ 0 = a

a ^ a = 0

SHIFT OPERATORS

$a = 10_{10} = 1010_2 = 10$

$a << 1 = 0100_2 = 4$

In formula terms:

if i left shift a << b times

the ans = $a * 2^b$

Right SHIFT

$a = 10_{10} = 1010_{(2)} \Rightarrow 0101 = 5$

↓

This is always ignored in every number system

formula = $a >> b = \frac{a}{2^b}$

Problem for finding ith bit:

n => mask with n-1 zeros

if n = 4

the 1 << 3

and

Solution is n & (1 << (n-1)).

OR Set the ith bit

Position of right most set bit

Ans = N & (-N)

Negative Numbers in binary

n = -10 in binary

Suppose = 10 in in one byte

0000 1010 → LSB tells if the number is even or odd
MSB tells us if number is positive or negative
value of number.

1 = negative
0 = positive

to convert a number to negative

step ①: take complement
step 2: add 1 to it

.. 10 in binary

0000 1010
Not 10 = 1111 0101
+1 = 1
(1111 0110)$_2$ in negative.

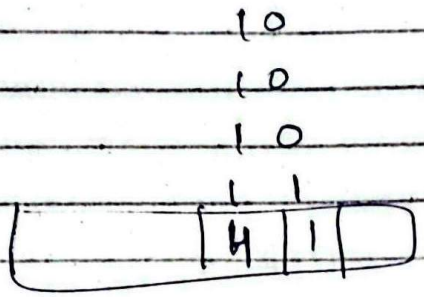
So
in programming ((~number) + 1)

Also in 1 byte it can store as high as 128
from -128 to 128
MSB gives the sign of numbers.
till 127 as 0 Also - of 0 is also 0 so -128 to 127

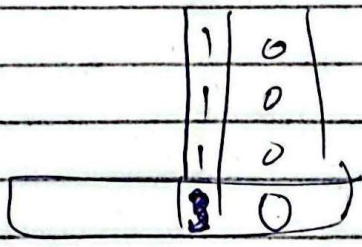
for n bits
-2^{n-1} to $2^{n-1} - 1$ n = no of bits
range of number.

Q: find the no that appeared once all others are appeared 3 times.

arr = [2, 2, 2, 3]

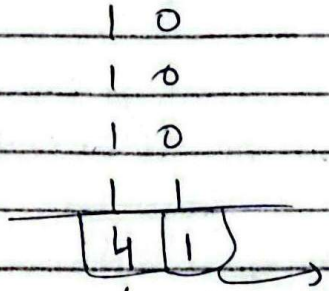


if there was no 3 then



% 3 = 0

but in case of 3



1 % 3 = 1

↳ 4 % 3 = 1

result = 00000001

↳ result = 00000011

we can also use this approach for K like if K times appeared.

Pascal triangle Problem:

```
1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
```

find the sum of n^{th} row:

Solution (1 << row)

Q:

range xor for (a,b) = xor(b) ^ xor(a-1)

Q: Prime numbers

2, 3, 5, 7, 13

a number which is divisible by itself and 1 only

if 13

only divisible

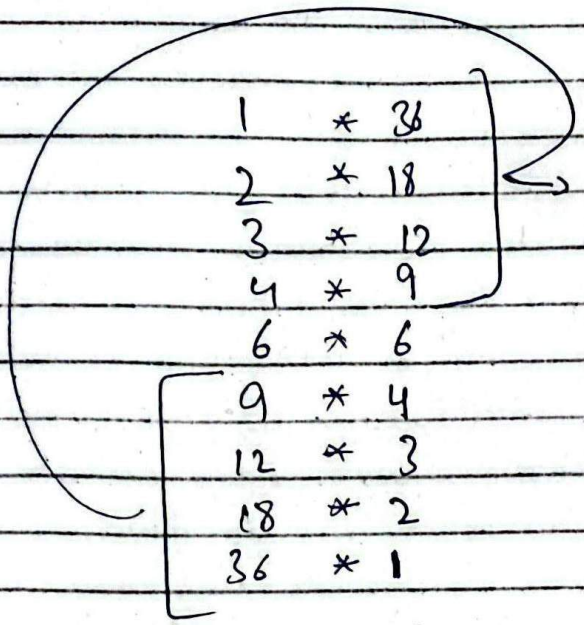
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

not devisible by them

so if any of them devide it then not prime.

we can also move till $\sqrt{n}$ cuz

if 36 is to check



It is same so we dont need to but till Sqrt+1 cuz in range function last one is excluded.