TRIES

- Prefix tree
- optimised in terms of space
- autocomplete

Q⇒ You're given an integer array, of length n. find the xor value of a pair such that the xor is maximum.

Ex → [3, 10, 5, 25, 2, 8]

ans → 5 xor 25 → 28 → ans

$n \leq 10^5$

pair → with maximum xor

A	B	A ^ B
0	0	0
1	0	1
0	1	1
1	1	0

Truth table of xor

Decimal	Binary
3	00011
10	01010
5	00101
25	11001
2	00010
8	01000

→ we need some hierarchical structure.

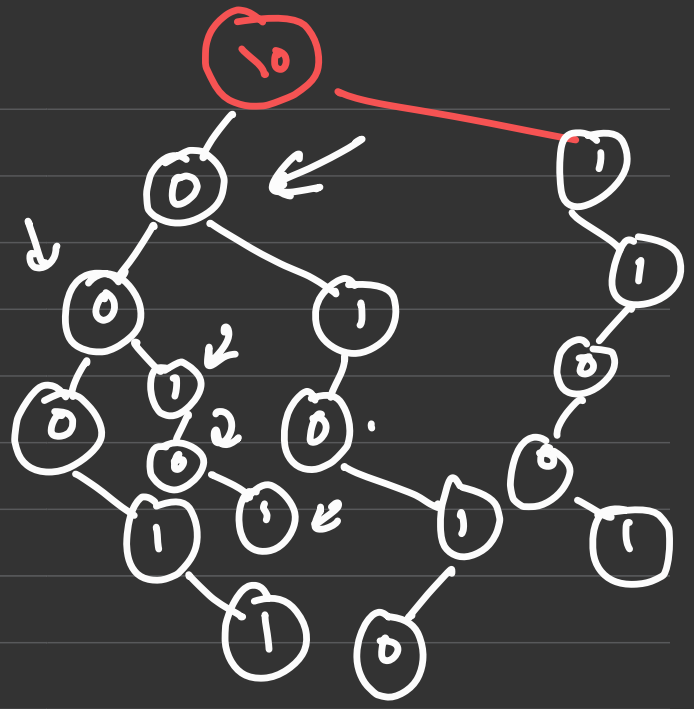
3	0	0	0	1	1
10	0	1	0	1	0
5	0	0	1	0	1
25	1	1	0	0	1
2	0	0	0	1	0
8	0	1	0	0	0

MSB affects the most

TRIE

Binary Trie

3	0	0	0	1	1
10	0	1	0	1	0
5	0	0	1	0	1
25	1	1	0	0	1
2	0	0	0	1	0
8	0	1	0	0	0



$O(N \times \log \text{MaxEl})$

Space → $O(N)$

ans → 11100 → 28

Q. Given an integer array of size n, find the xor of the subarray which has the max xor.

→ [8, 1, 2, 12, 7, 6]

[1, 2, 12] → and → 15

$n \leq 10^5$

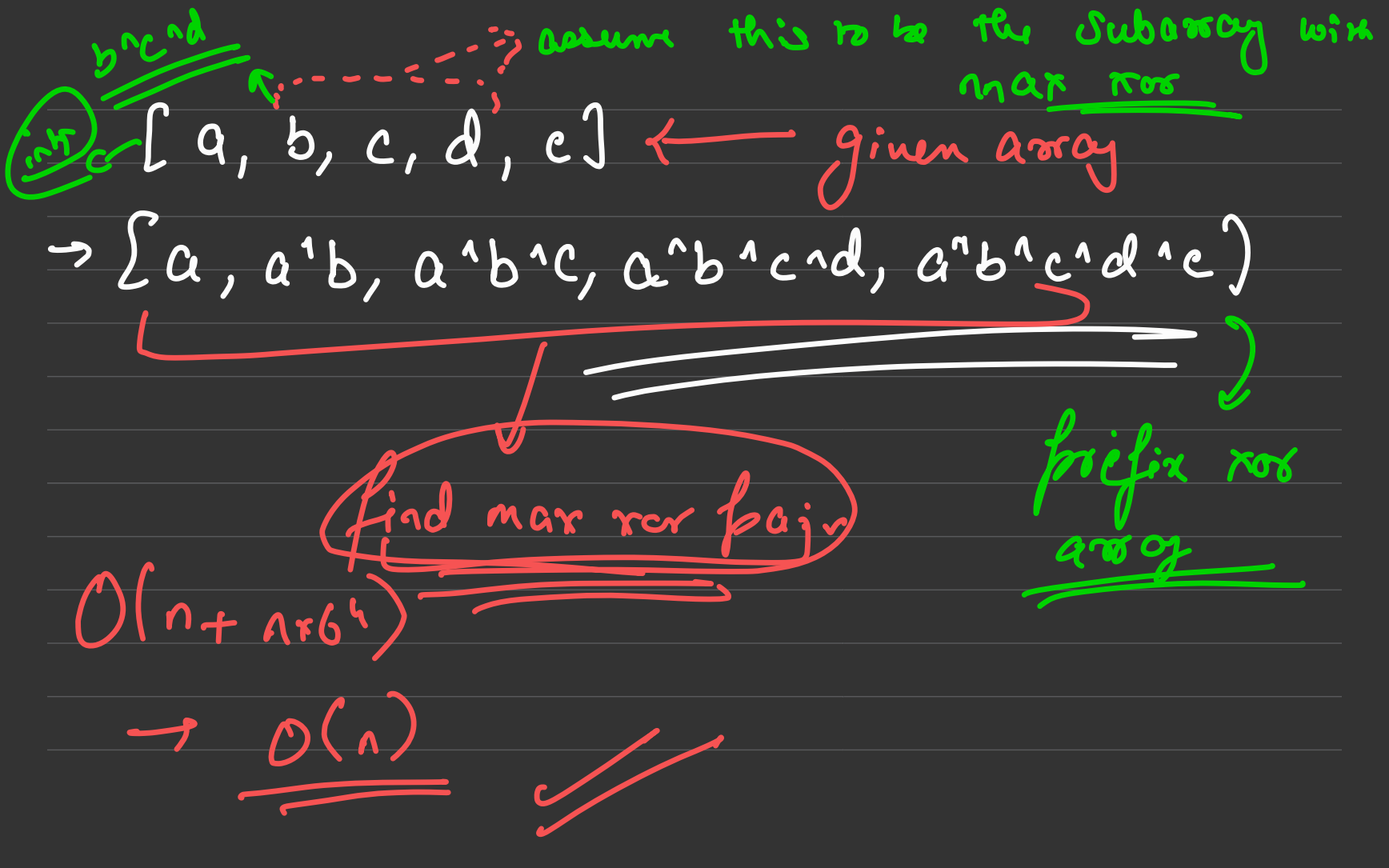
$f(i,j) = f(0,i-1) \text{ XOR } f(0,j)$

returns xor of elements of subarray [i..j]

2, 3, 5, 6, 7

$(2 \wedge 3) \wedge (2 \wedge 3 \wedge 5 \wedge 6 \wedge 7)$

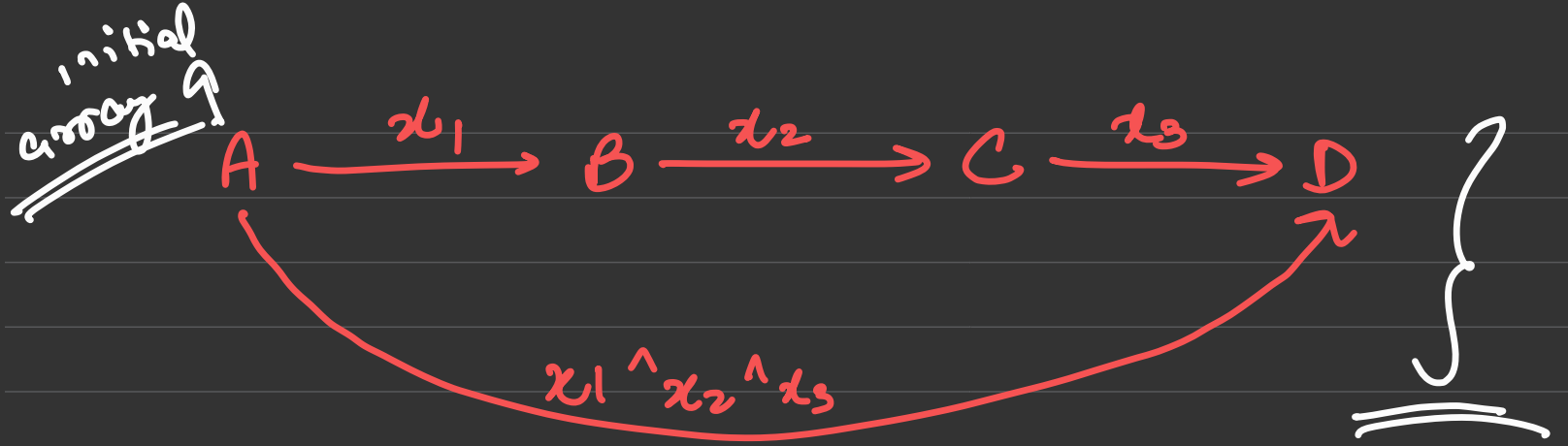
$5 \wedge 6 \wedge 7$


b^c^d
max
assume this to be the subarray with max xor
[a, b, c, d, e] ← given array
→ [a, a^b, a^b^c, a^b^c^d, a^b^c^d^e]
prefix xor array
find max xor pair
O(n + arr6^4)
→ O(n)

Qn Vitya & Strange Lesson.

$A \rightarrow a_1\ a_2\ \text{-----}\ a_n$

'm' query $\rightarrow$ x



We don't need to update the array again & again. We can update query x and apply logic on original array only.

$A \xrightarrow{x} A'$

$\hookrightarrow mex(A')$

$mex(A) = min(\{U - A\})$ $\rightarrow$ $B = U - A$

$B = [b_1, b_2 \cdots b_i]$

$U \rightarrow$ universal set

$A \rightarrow$ array A.

Claim $\rightarrow mex(A') = min(\{U - A'\})$

$U - A' = B' = [b_i \wedge x]$

$min([b_i \wedge x])$

$b_i \in B$

$A \rightarrow n$

$B = N - n$

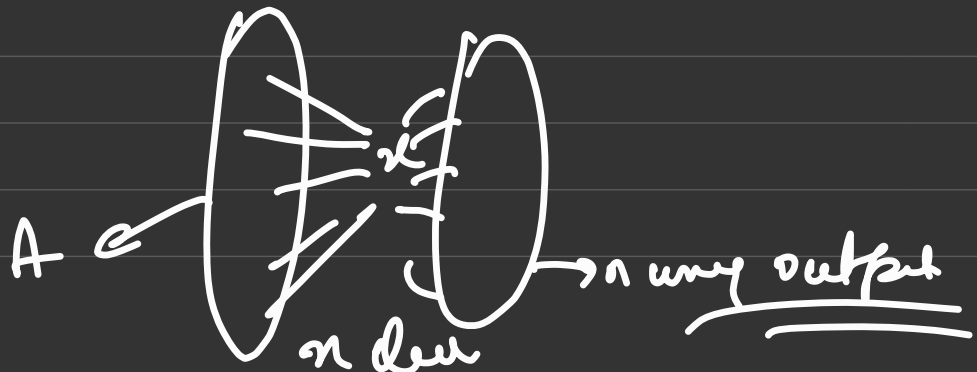
$N \rightarrow$ no. of elements in universal set

Non-coprime

$b_i \wedge n$

$A' = n$

$B' = N - n$

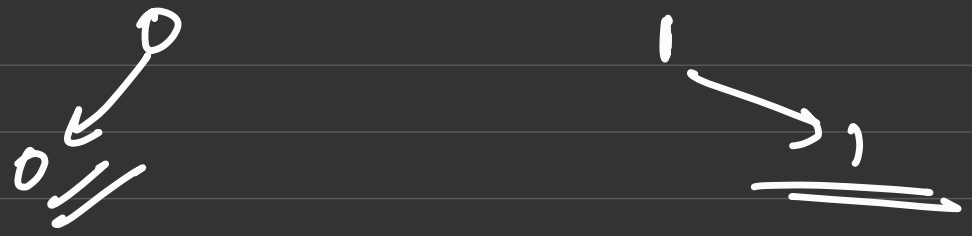


$a_i \overset{\wedge}{\alpha} = b_i' \wedge n$

$a_i = b_i'$

$[\quad]_n \rightarrow [\quad]_n$

x



Q) Given an integer array, and a no. K, find the count of subarrays with xor less than K.

[8, 9, 10, 11, 12] K=3

Ans. 3

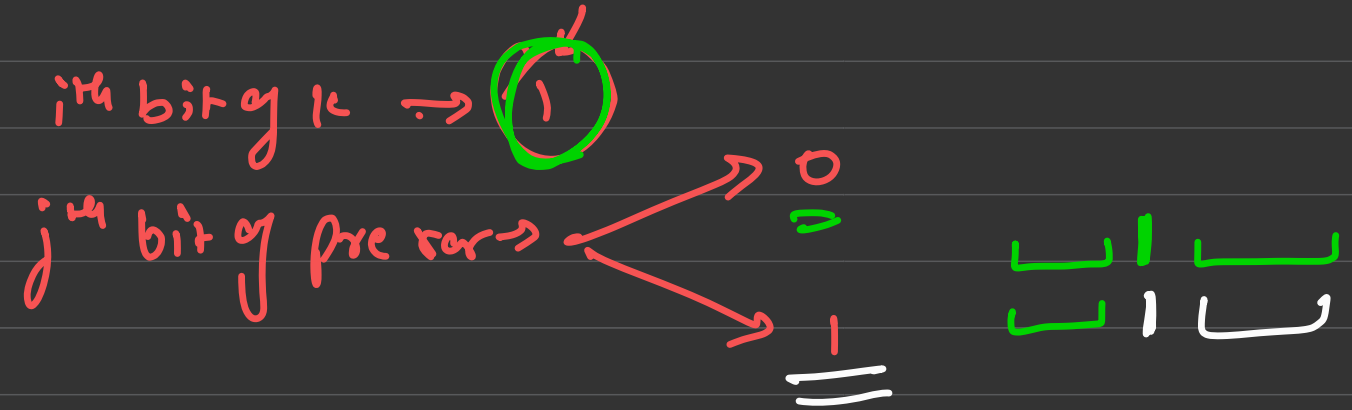
[8, 9] [10, 11]

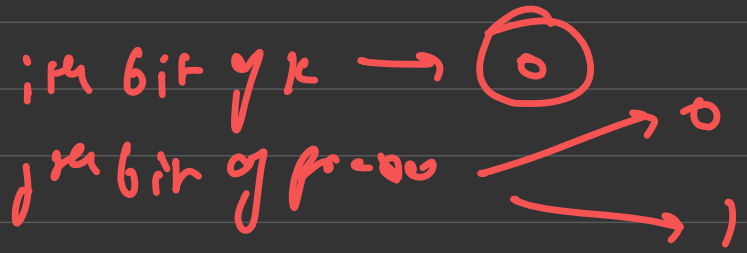
[8, 9, 10, 11]

Exactly K

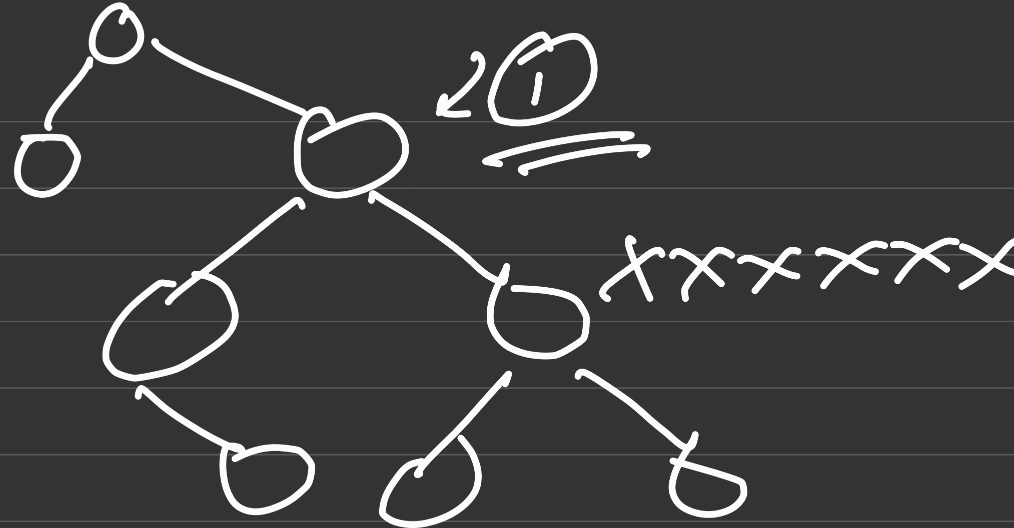
Xor < K

Prefix xor





K ith → 1
pre ith → 0



K → 0
p → 1

0 ____
11

0 ____
10

1 ____
01 ____

1 ____
00 ____
answer