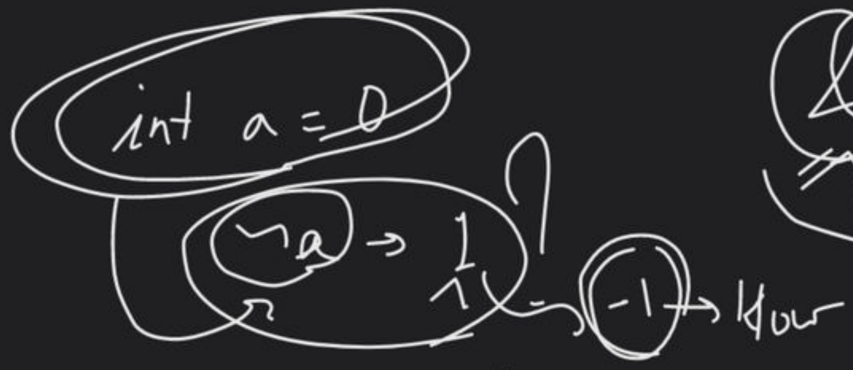
Bonus Class - Bit Manipulation

Special class

Love Babbar • July 7, 2023

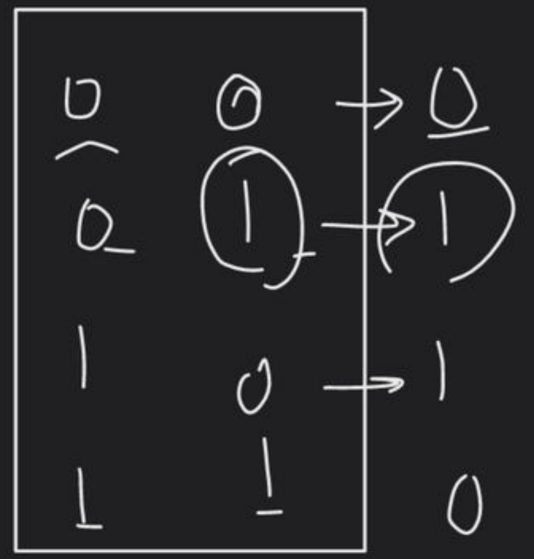
Bitwise Operators:-



1 << 1

a	b	o/p
0	0	0
0	1	0
1	0	0
1	1	1

a	b	OR o/p
0	0	0
0	1	1
1	0	1
1	1	1



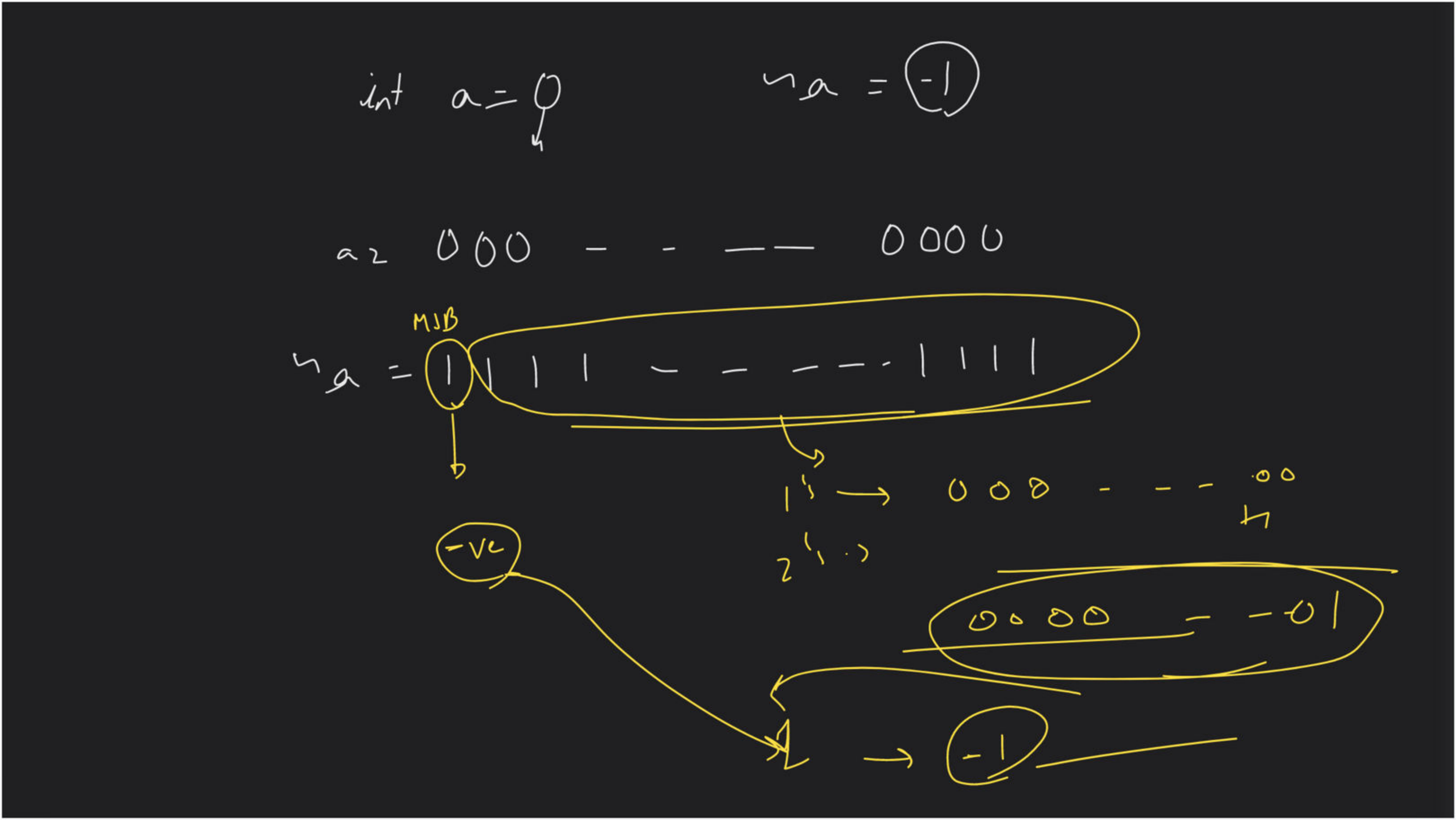
Decimal ⟶ Binary

Binary → Decimal = already

sign

1's comp

2's comp


int a = 0
~a = -1
a2 000 - - -- 0000
MSB
~a = 1 1 1 1 - - - - - 1 1 1 1
1's → 000 - - - 00
2's
-ve
0000 - - 01
-1

→ Bitwise op → &, |, ^, ~, <<, >>

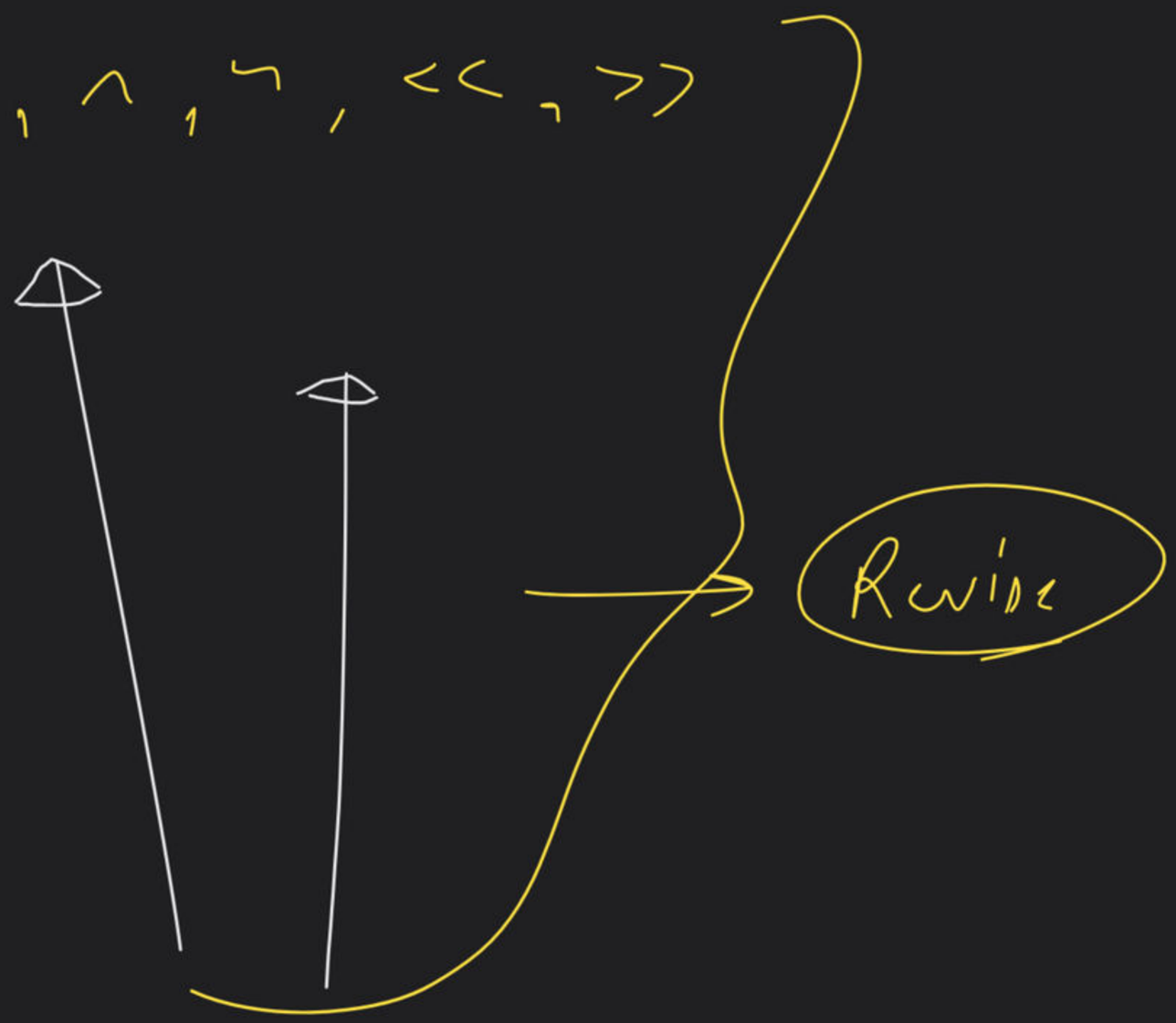
→ sign bit

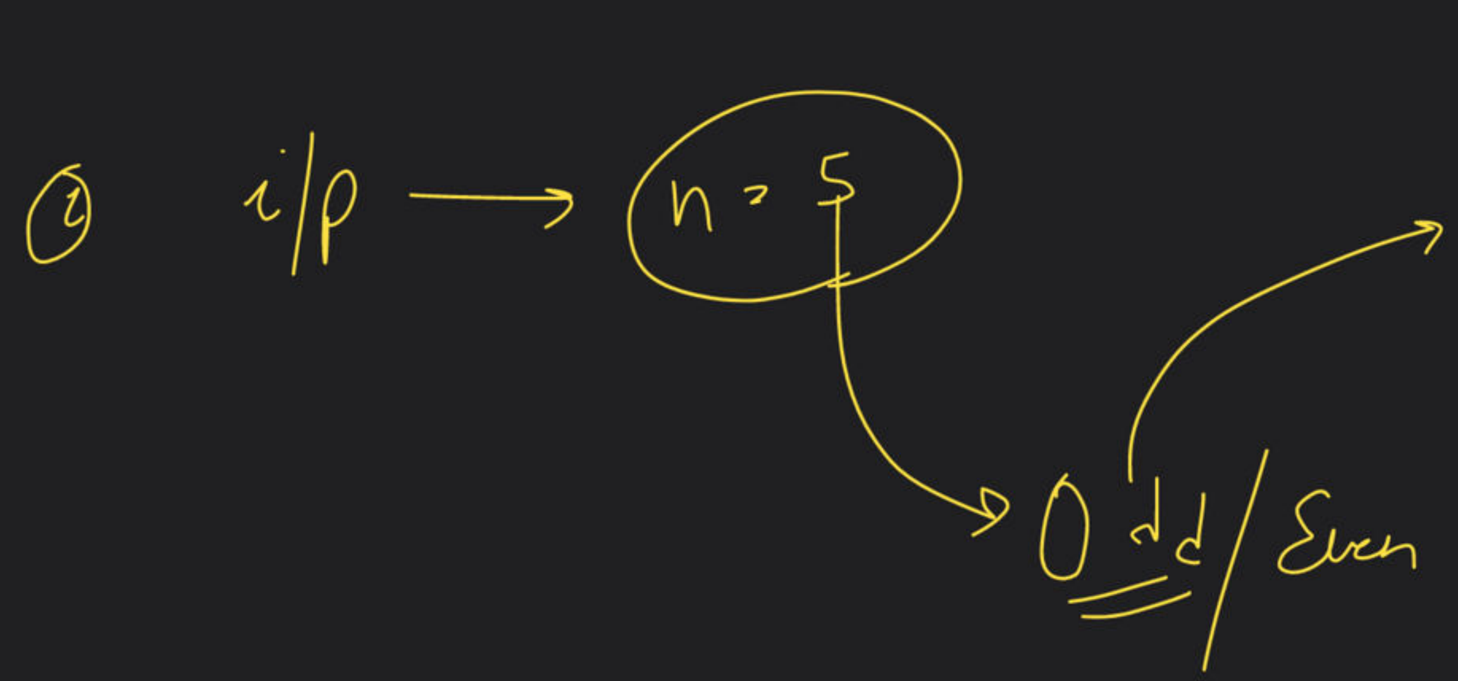
→ is comp

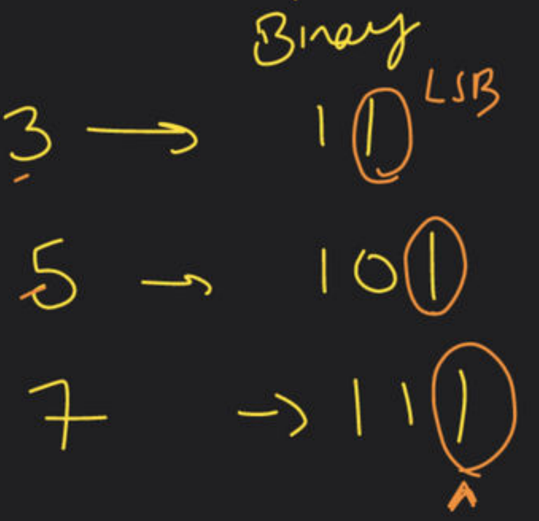
→ 2's comp

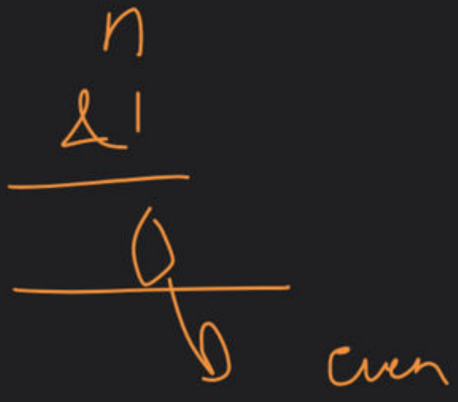
→ D → B

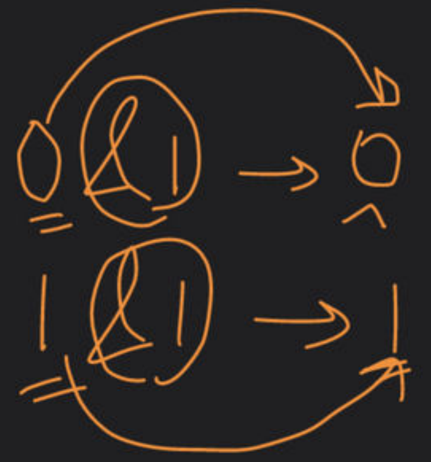
→ B → D



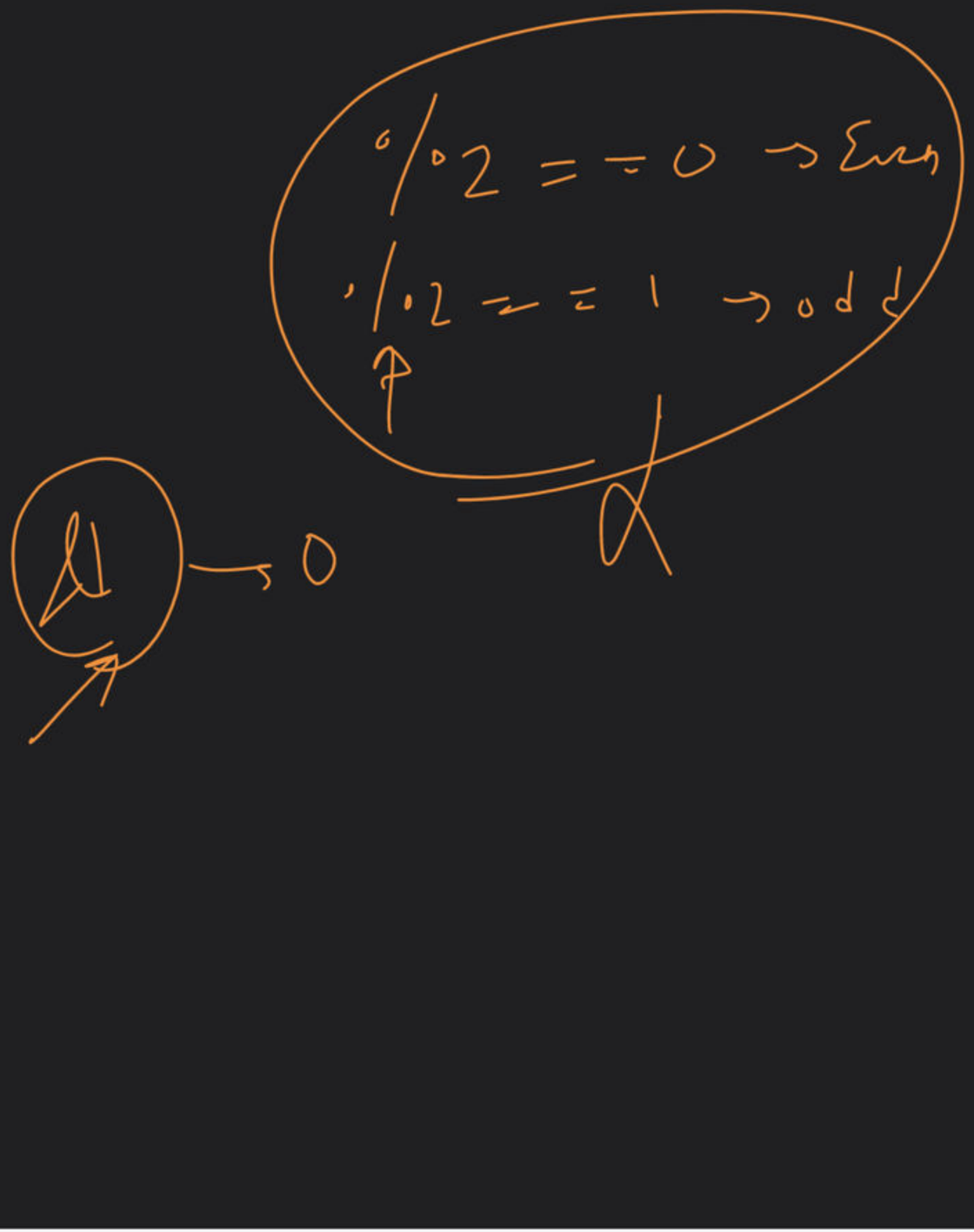


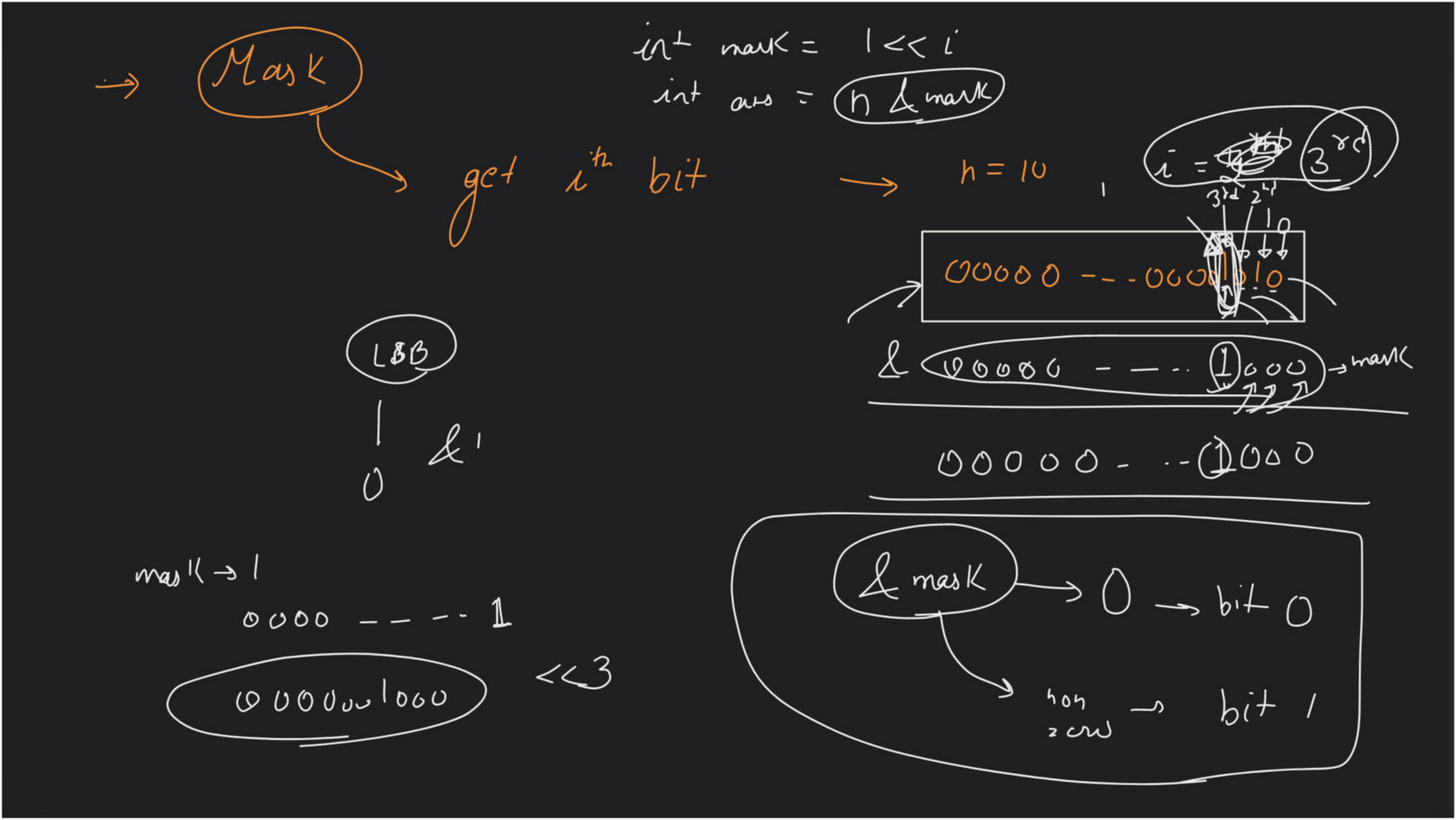


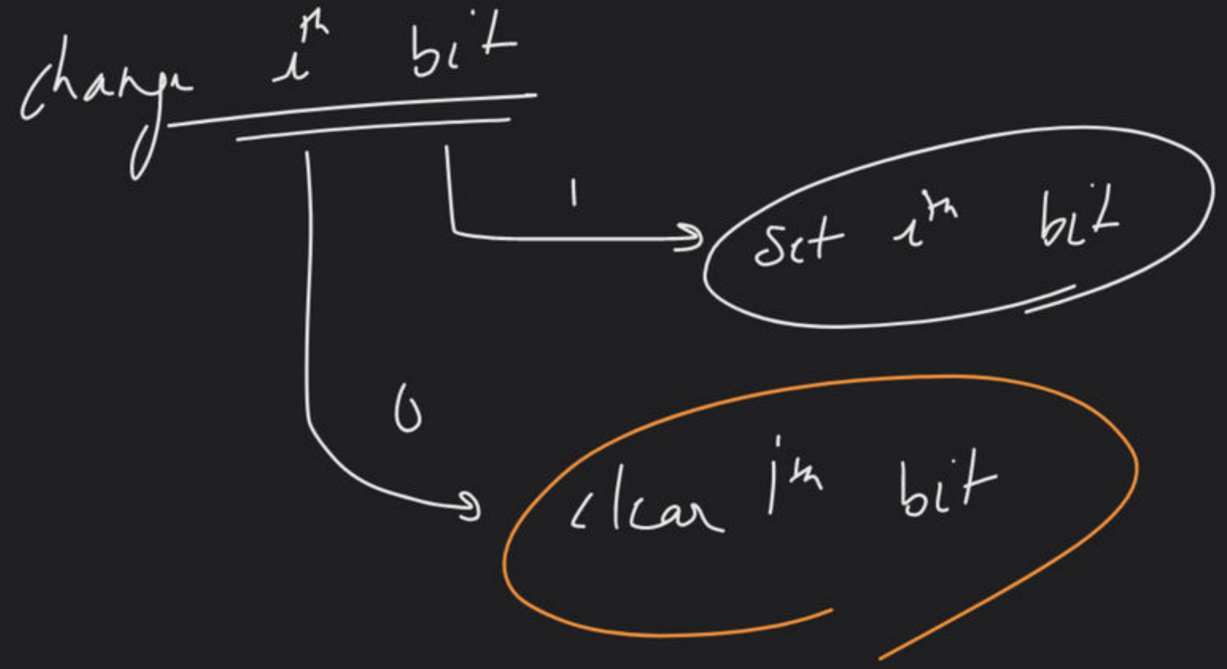




0/0


%2 == 0 → Even
%2 == 1 → odd
A
0


Mask
get ith bit
int mask = 1<<i
int ans = n & mask
n = 10
i = 3rd
3rd 2nd 1
00000 ---- 01010
& 00000 ---- 1000 → mask
01000
LBB
| & 1
0
mask → 1
0000 ---- 1
<<3
00001000
& mask → 0 → bit 0
non zero → bit 1


change i^{th} bit
1
Set i^{th} bit
0
clear i^{th} bit

Set i^{th} bit

$n = 1010$, $i = 2$

2nd bit ko set karo

3rd 2nd 1st 0th

0000 — —— 0000 1 0 1 0

mask 000000 .. 00000100 OR

000000 — — 0000 1110

0
1
1

↳ create mask

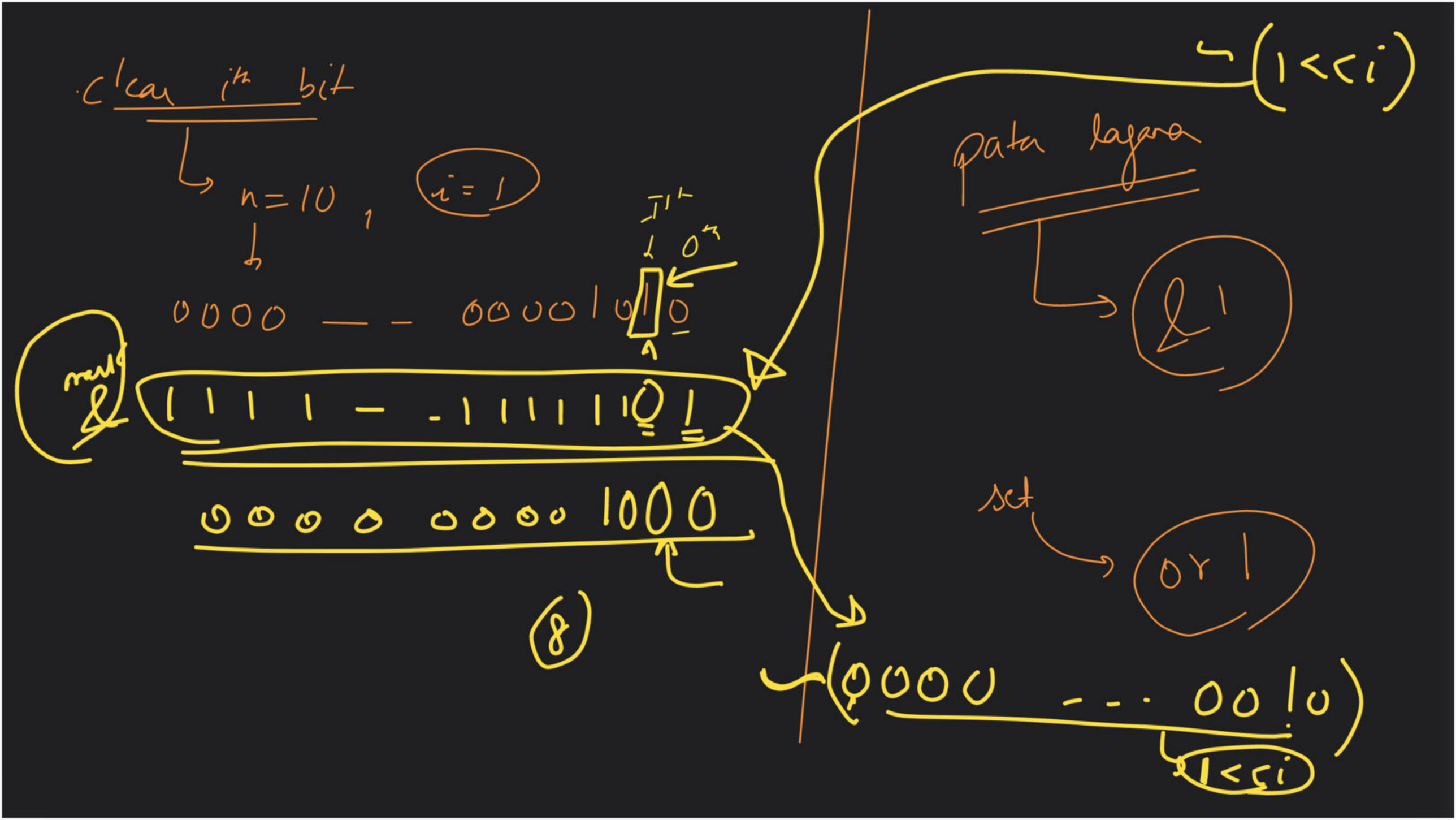
mask = 1<<2

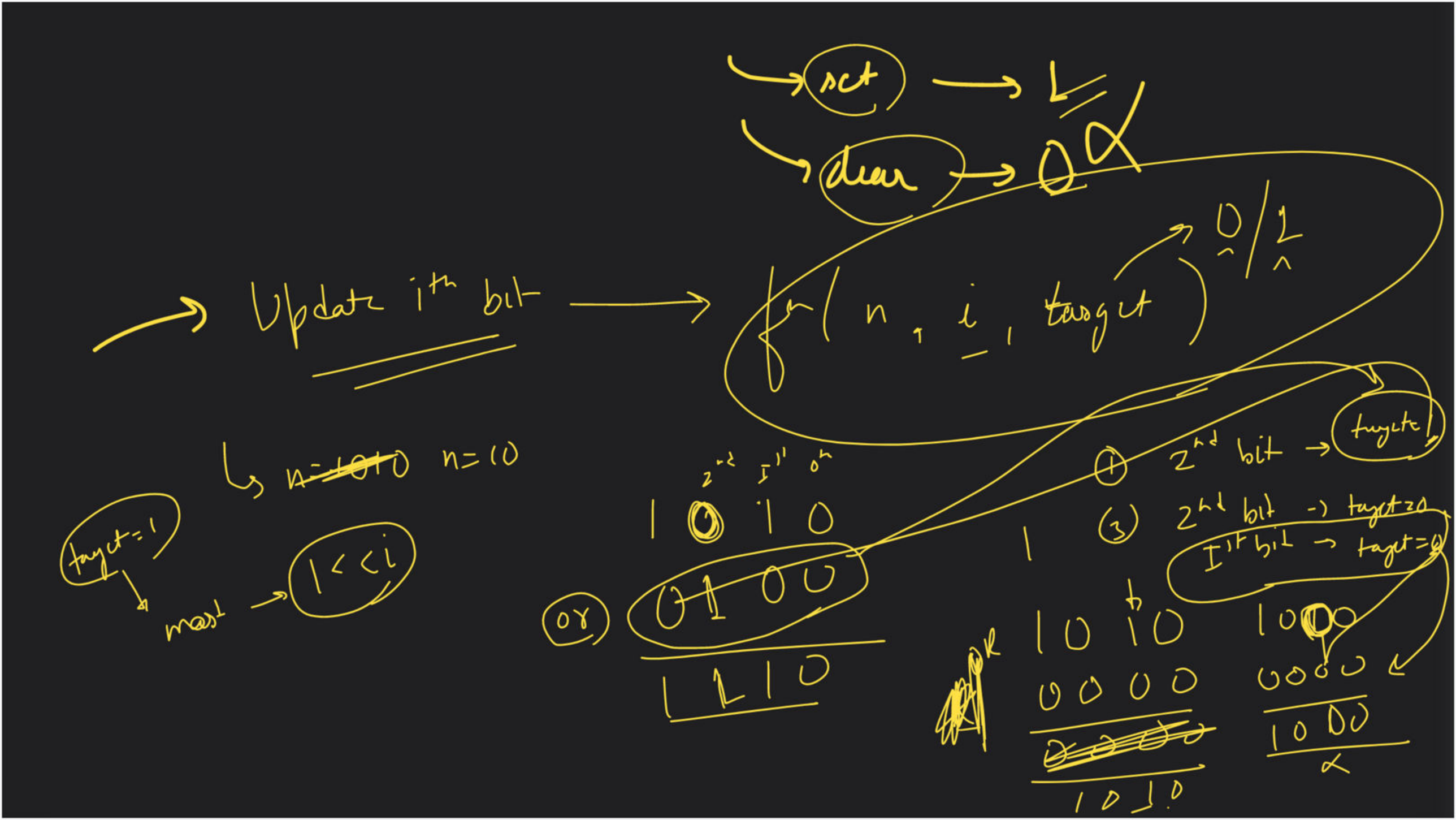
1<<i

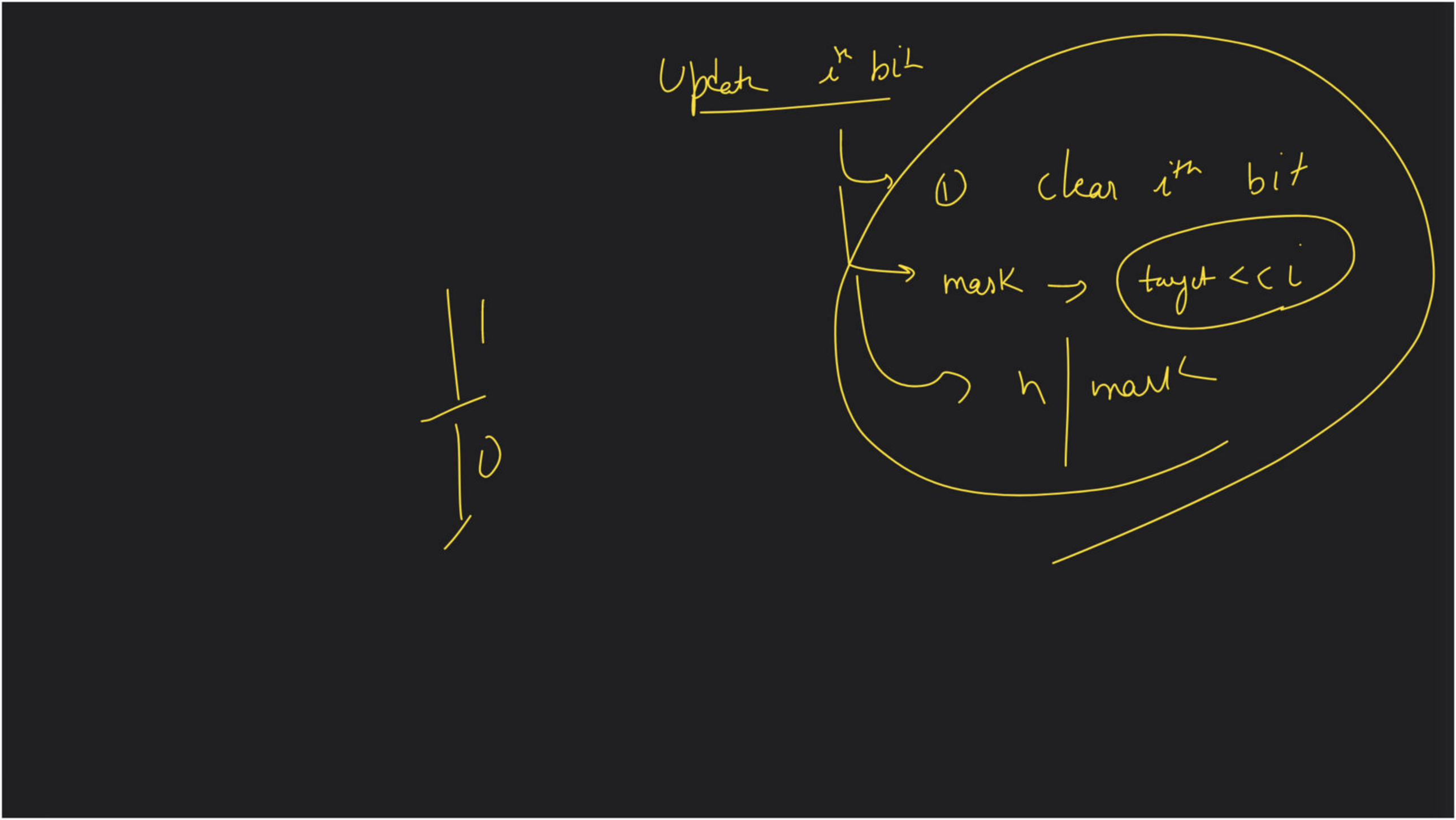
00001 <<2

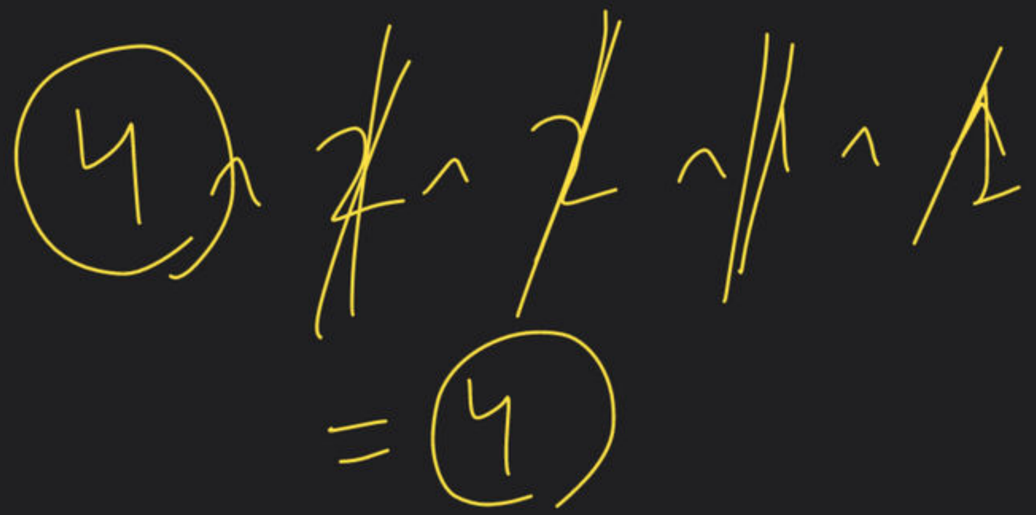
0000100

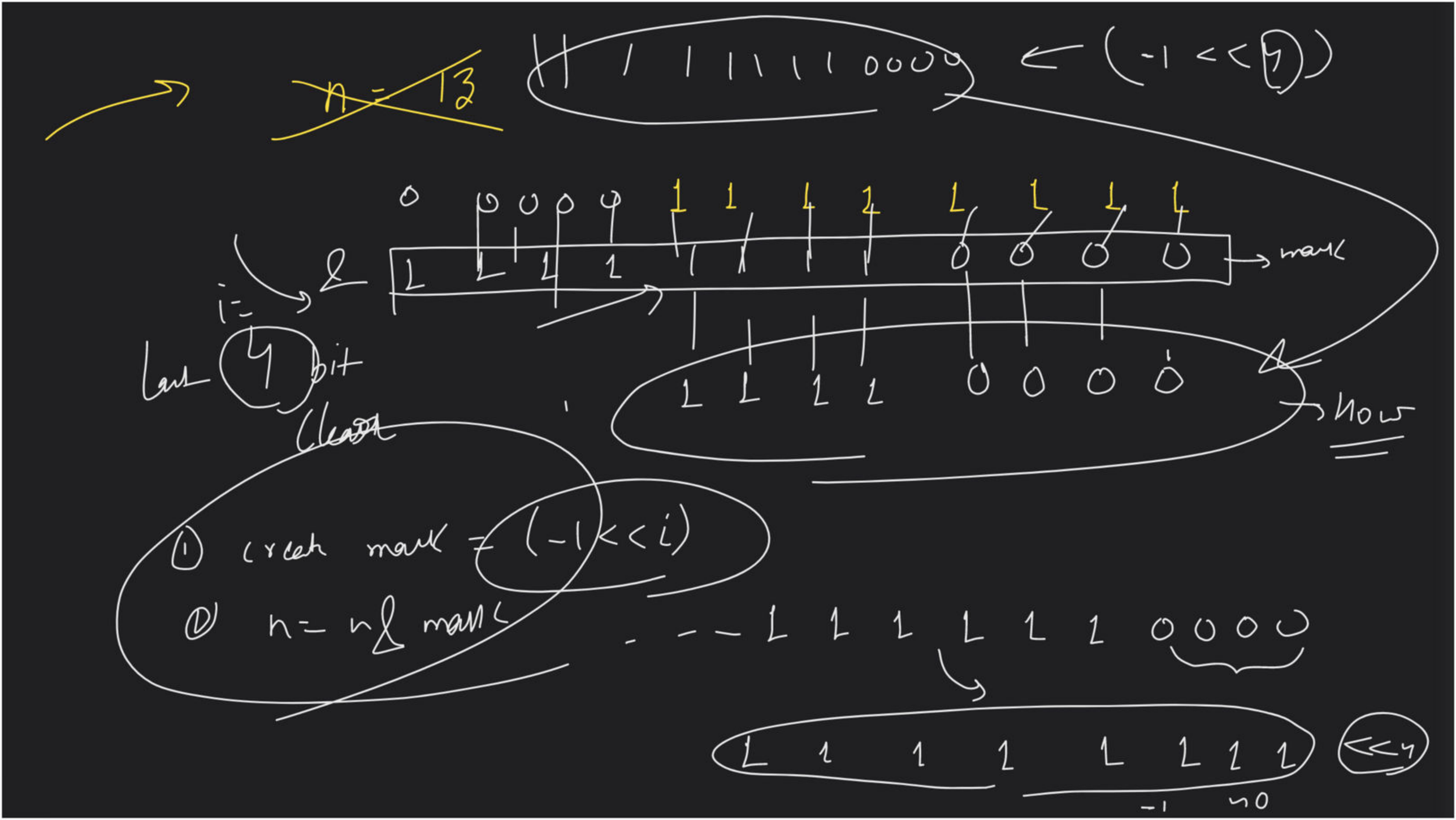
ans = n | mask

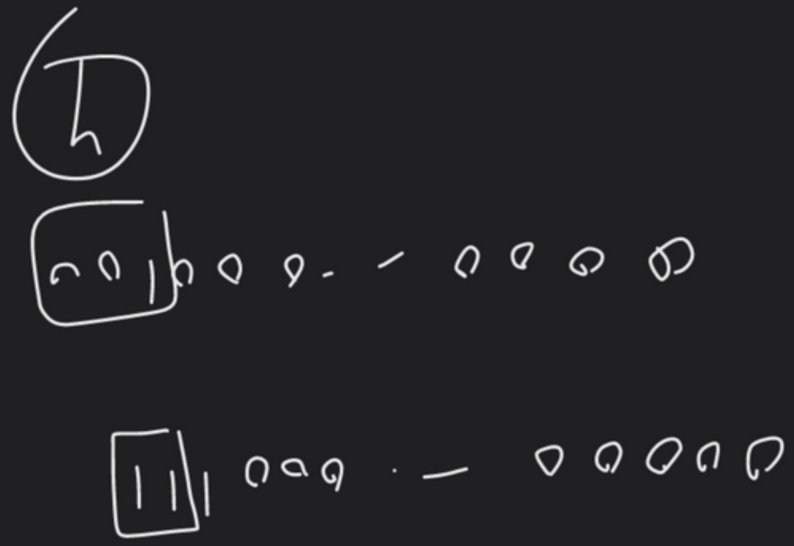

clear ith bit
n=10
i=1
0000 ... 00010
1111 ... 11101
0000 0000 1000
8
(1<<i)
Pata lagana
sct
or
(0000 ... 0010)
1<<i

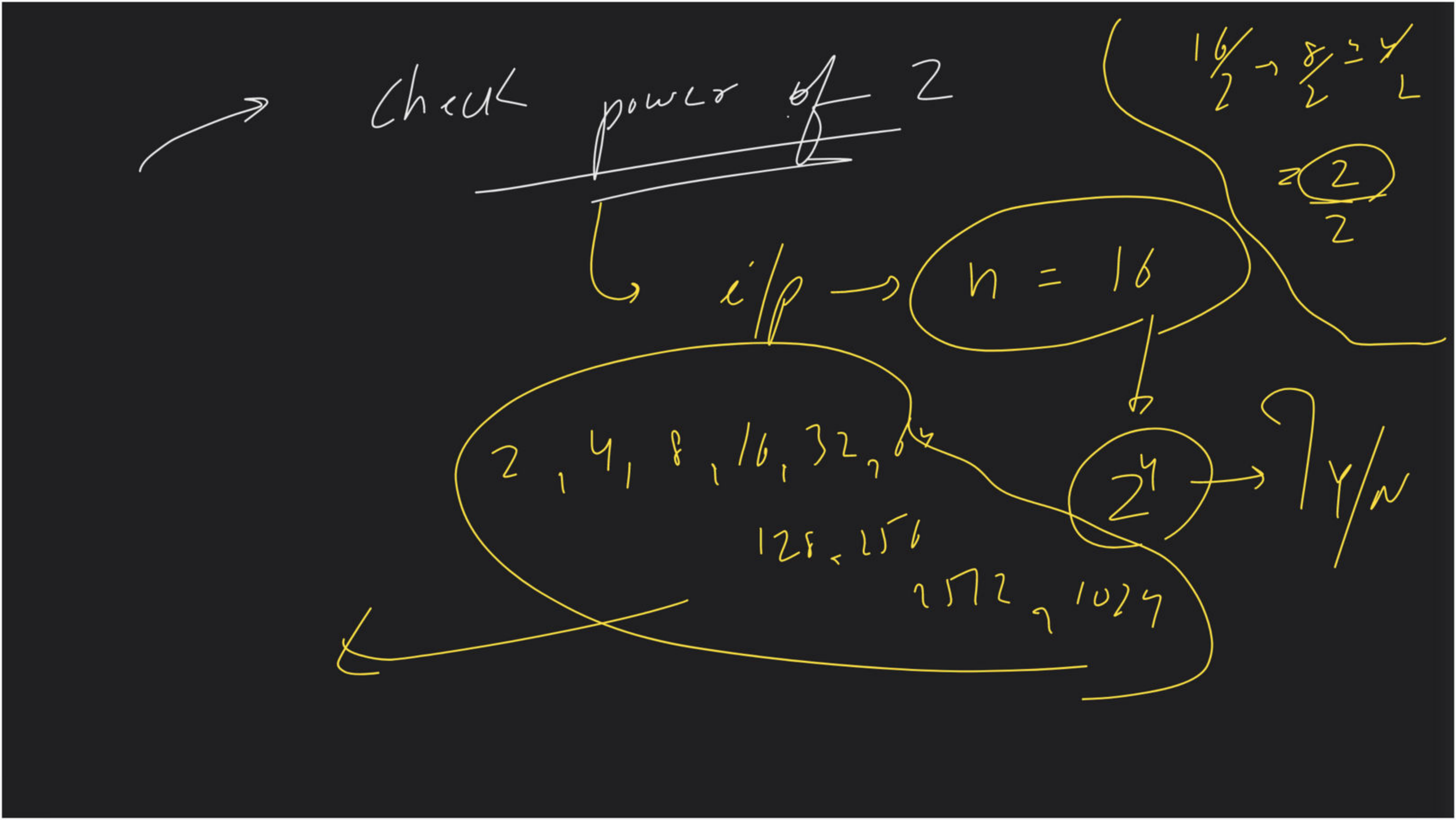

set
clear
Update ith bit
fn(n , i , target)
0/1
n=10
target=1
mask
1<<i
OR
1 1 1 0
target
2nd bit
3 2nd bit -> target=0
If bit -> target=0
1 0 1 0
0 0 0 0
1 0 1 0
1 0 0 0
0 0 0 0
1 0 0 0


Update i^{th} bit
① clear i^{th} bit
mask → target << i
n | mask
1
1
0




n = 13
(-1 << 7)
mask
i =
last 4 bit
clear
1 mask = (-1 << i)
2 n = n & mask
now
<< 4




Check power of 2
i/p
n = 16
2, 4, 8, 16, 32,
64
128, 256
512, 1024
2^4
Y/N
16/2 → 8/2 = 4/2
2/2

$8 \rightarrow 1000$

$7 \rightarrow 0111$ &

0000

$2^1 \rightarrow 2 \rightarrow 10$

$2^2 \rightarrow 4 \rightarrow 100$ B

$2^3 \rightarrow 8 \rightarrow 1000$

$2^4 \rightarrow 16 \rightarrow 10000$

$16 \rightarrow 10000$

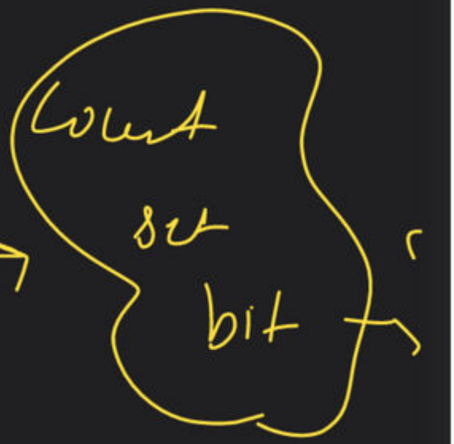
$15 \rightarrow 01111$ &

0000

$n \rightarrow 4 \rightarrow 100$

$n-1 \rightarrow 3 \rightarrow 011$ &

000



$n \;\&\; (n-1) == 0$

↳ if it is a power of 2

Count Set bits

8 → 0000 ... 1000

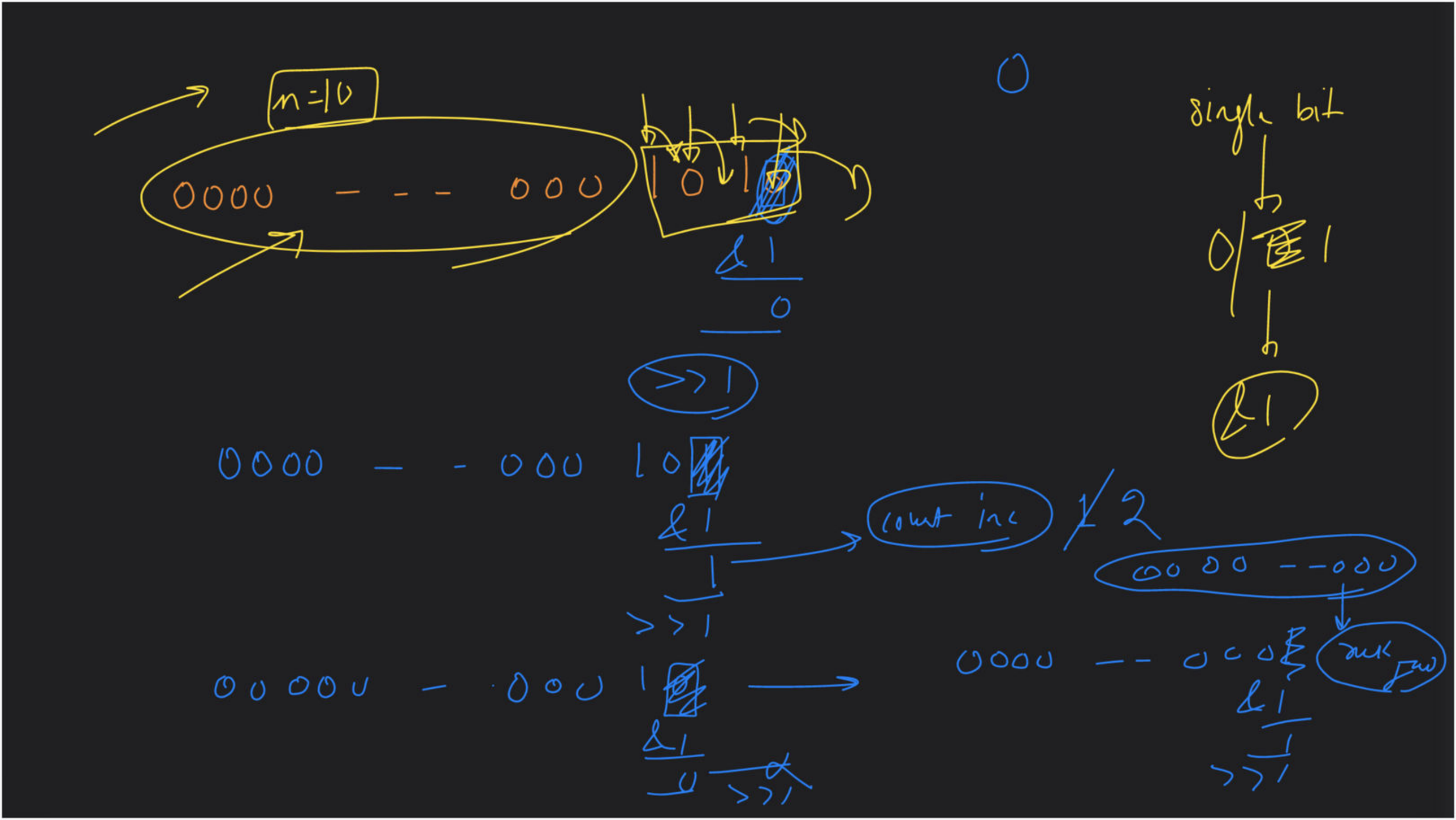
no of set bit = 1

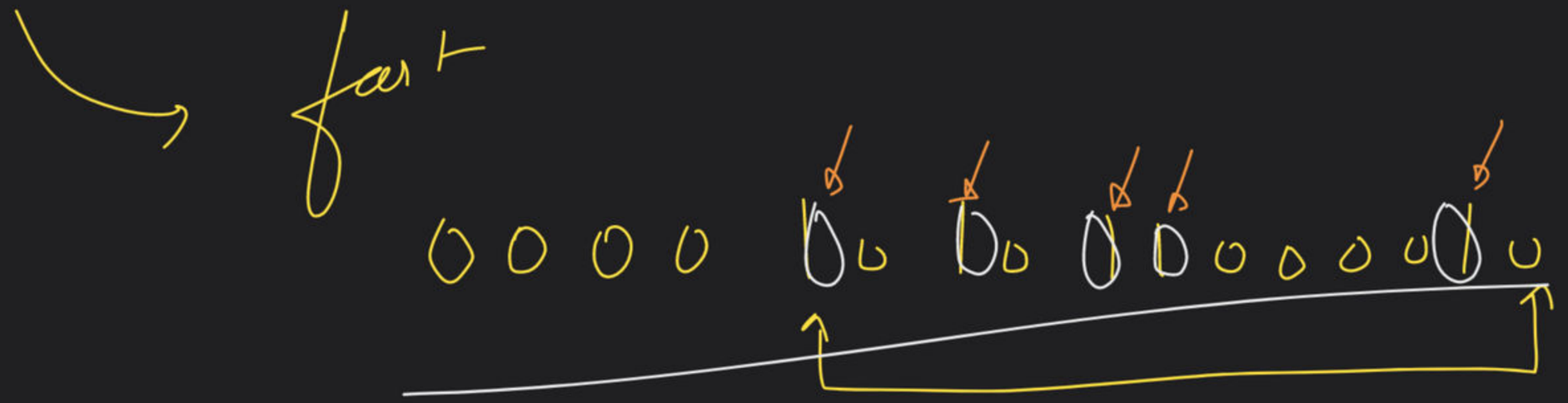
7 → 0000 ... 0111

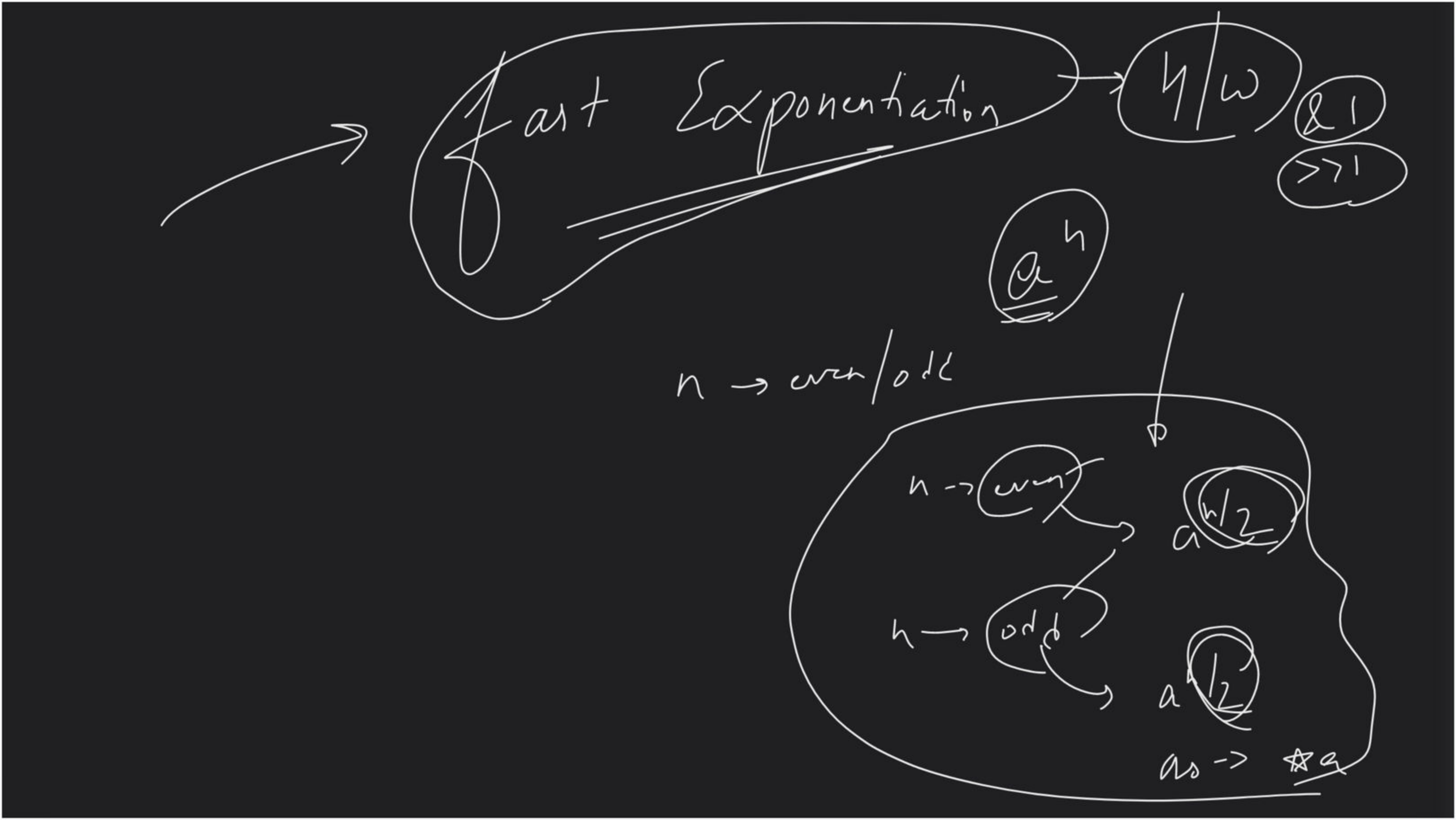
no of set bit = 3

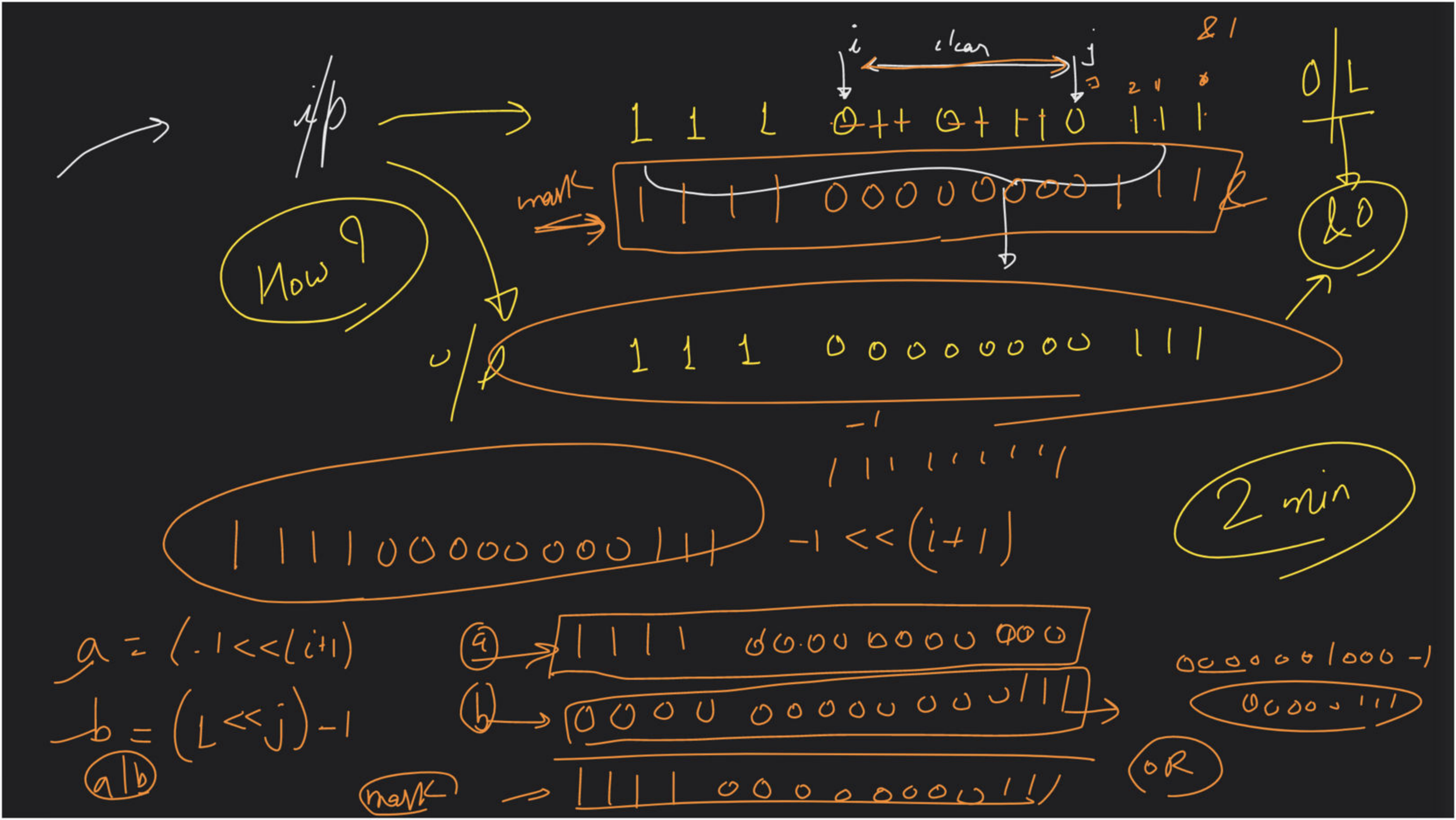
10 → 0000 ... 1010

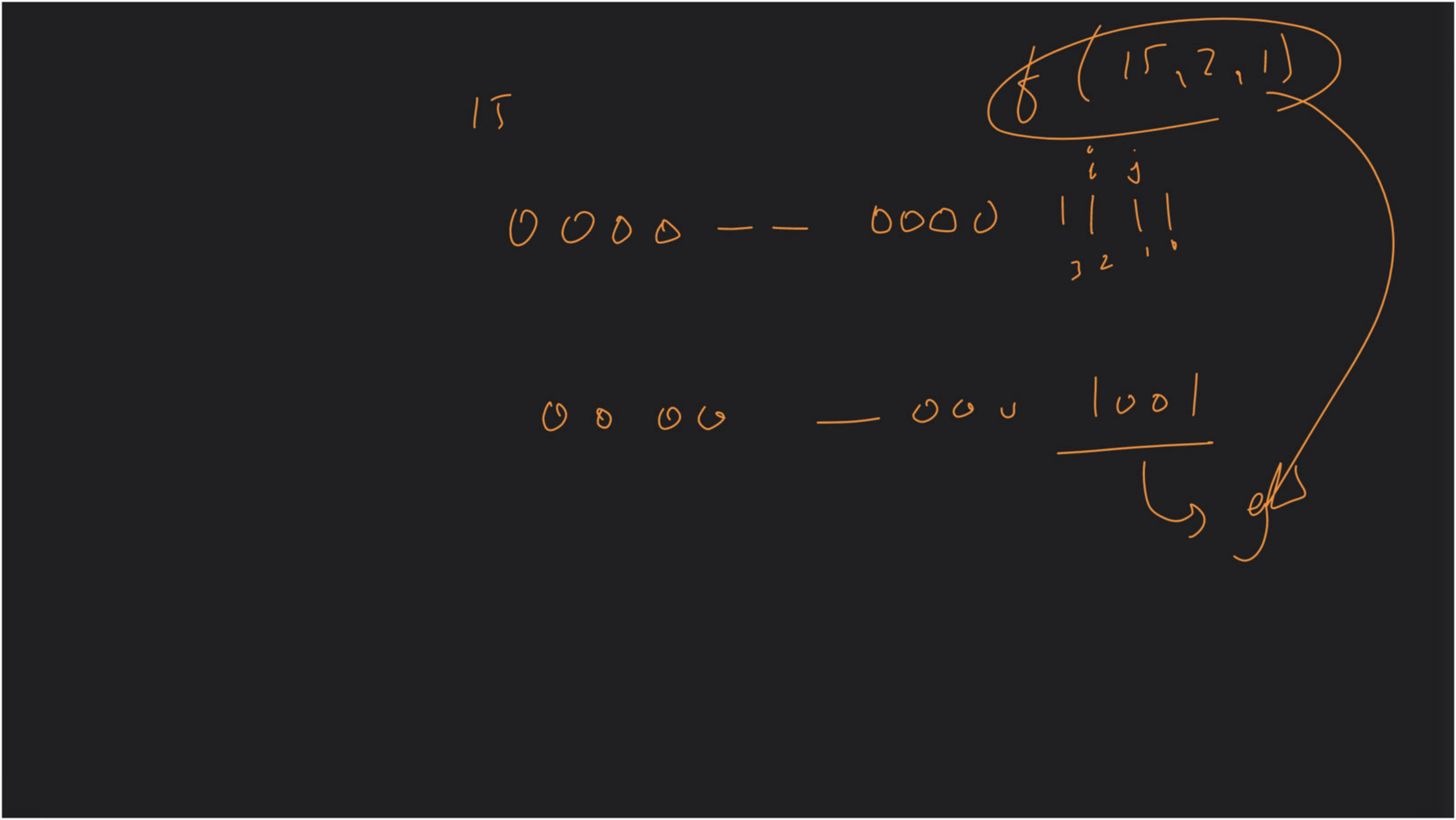
no of set bit = 2

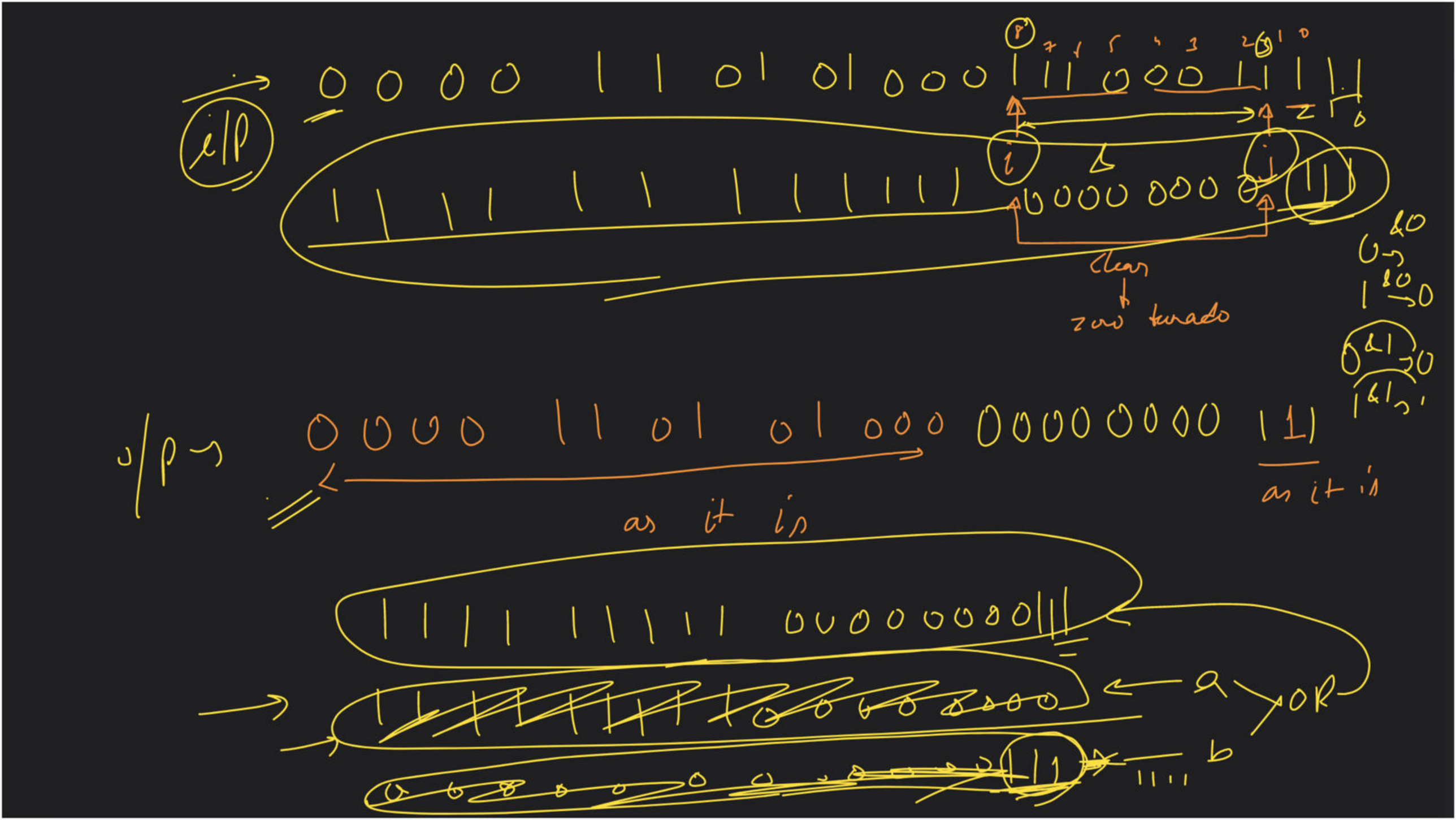

n=10
0000 - - - 000
101
&1
0
>>1
0000 - - 000 10
&1
1
>>1
00000 - 000 1
&1
0
>>1
0
single bit
0/1
&1
count inc
%2
00 00 - - 000
0000 - - 000
mark
&1
1
>>1

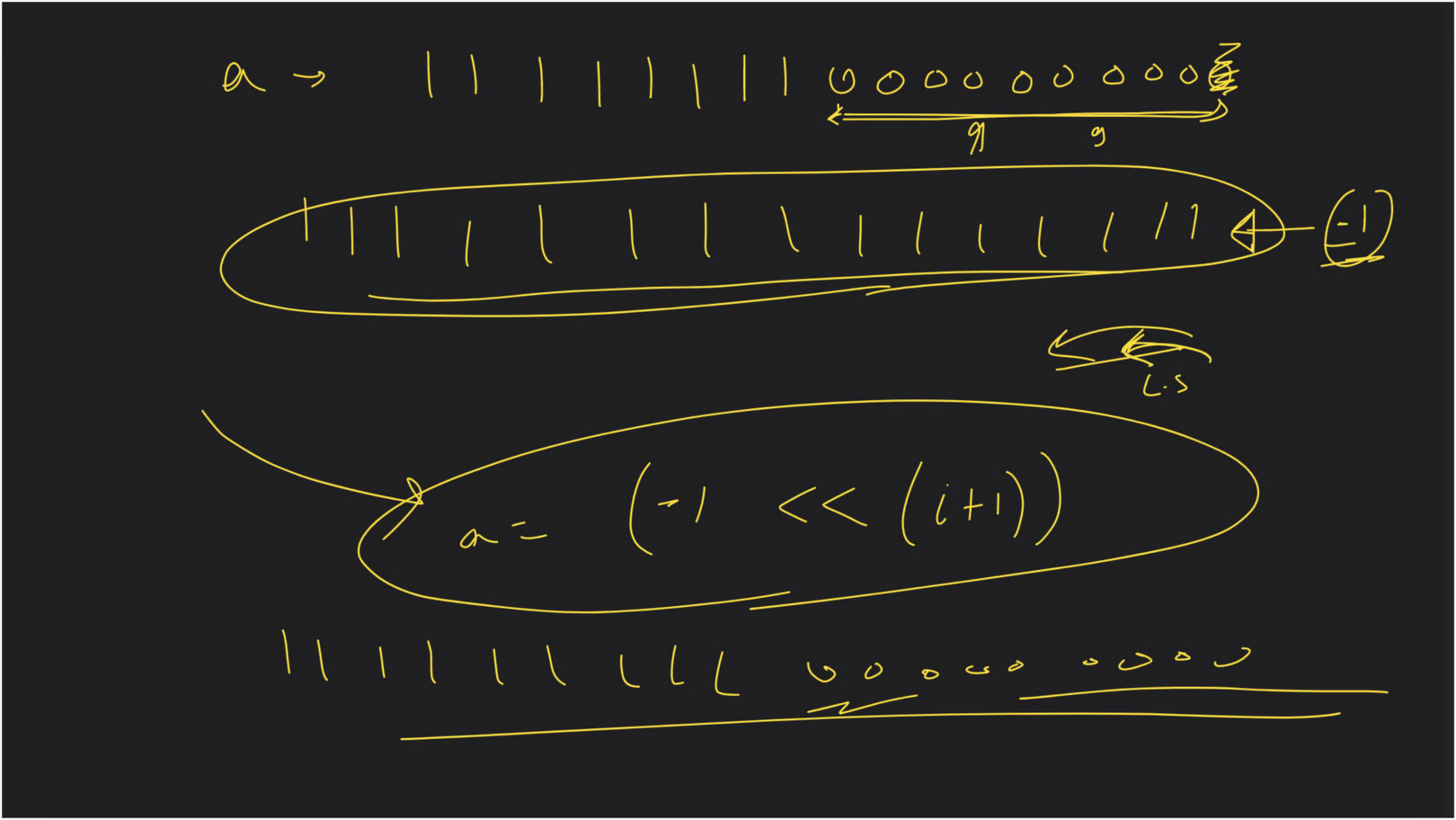

fast

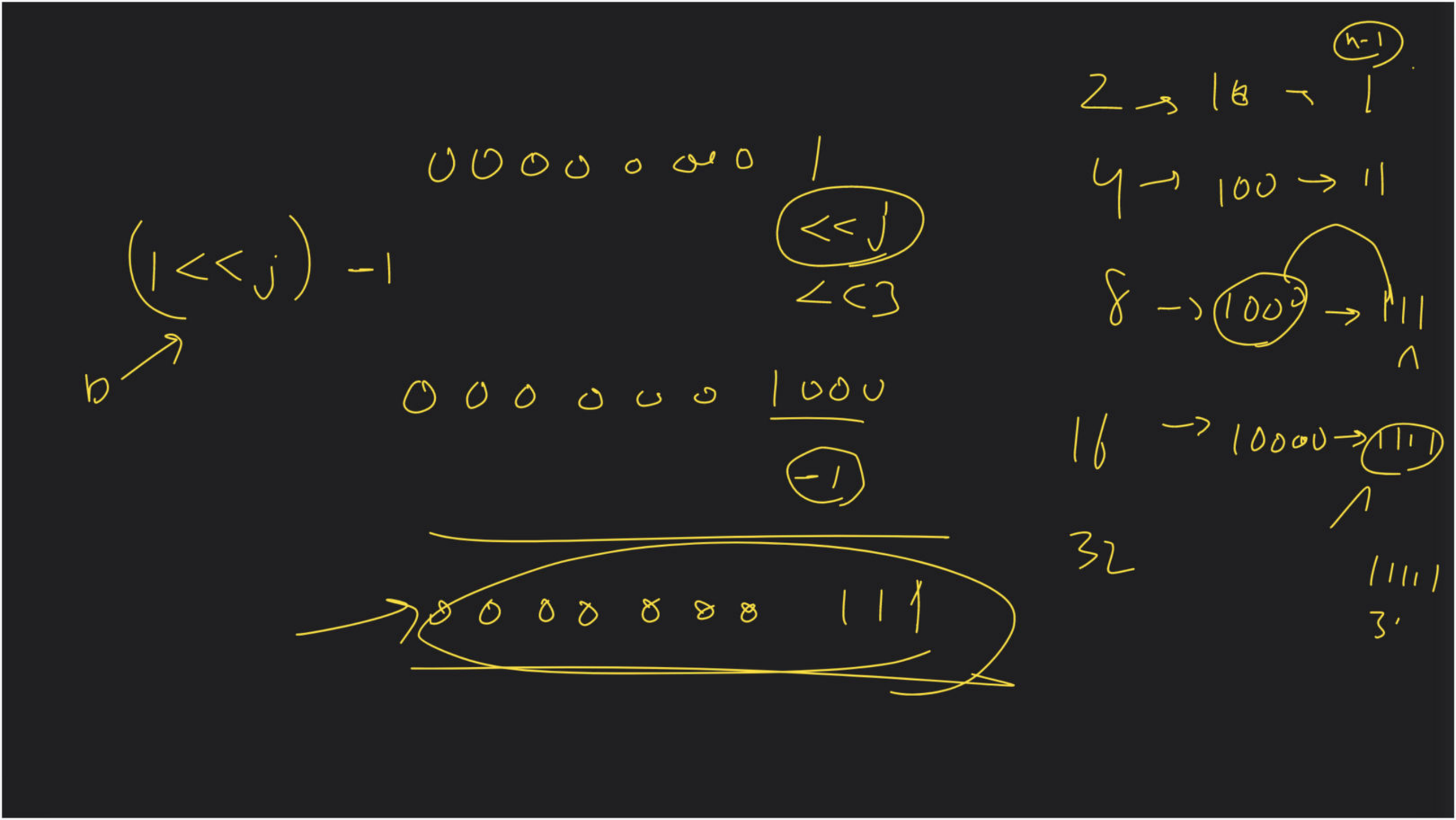

Fast Exponentiation
n/w
&1
>>1
a^n
n → even/odd
n -> even
a^n/2
n → odd
a^n/2
a^n -> a*a


i/p
i
i'can
j
&1
0/L
&0
mark
Now 9
o/p
1 1 1 0 0 0 0 0 0 0 0 1 1 1
-1
1 1 1 1 0 0 0 0 0 0 0 0 1 1 1
-1 << (i+1)
2 min
a = (1<<(i+1)
b = (1<<j)-1
a|b
a
b
mark
OR

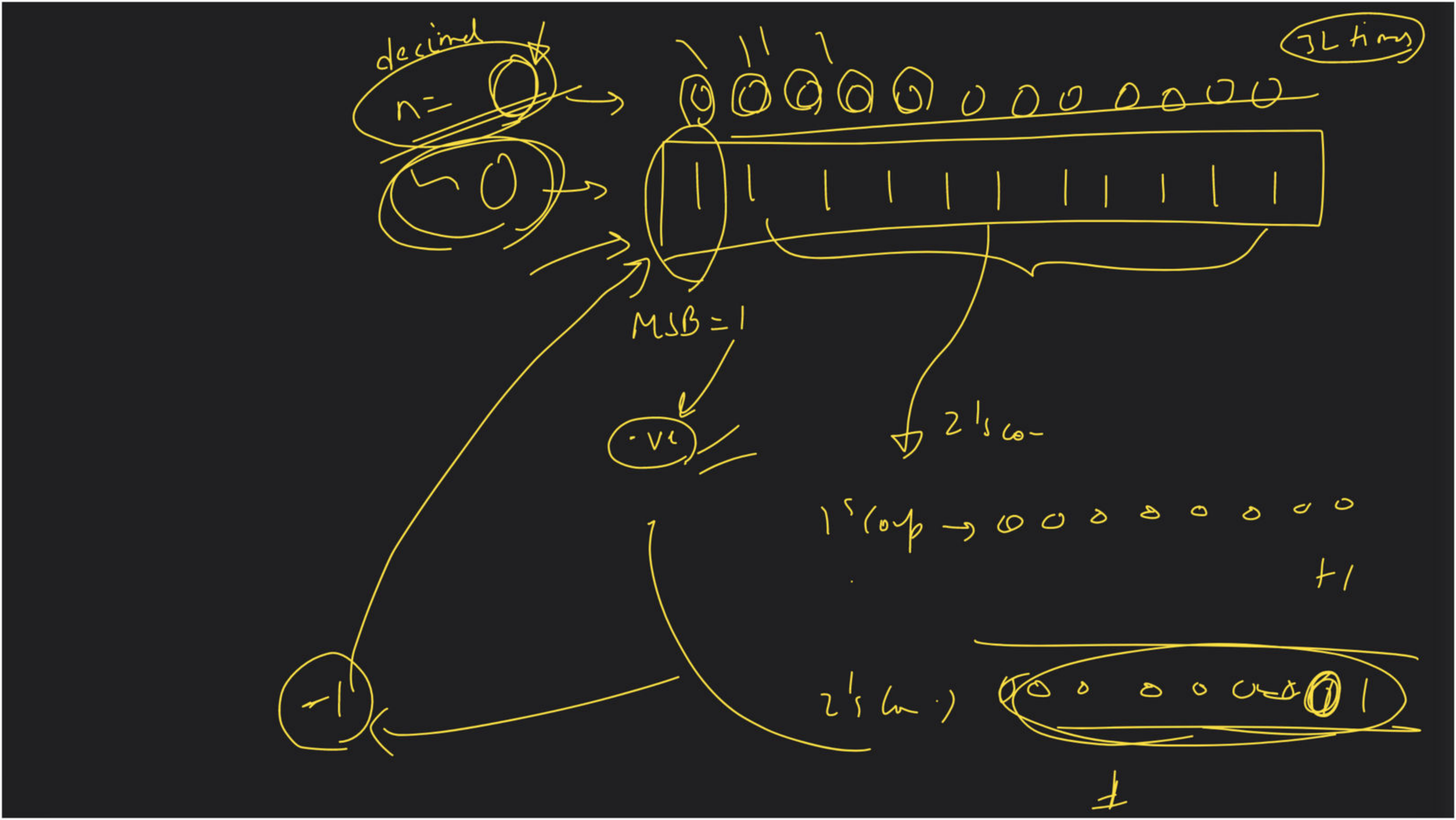


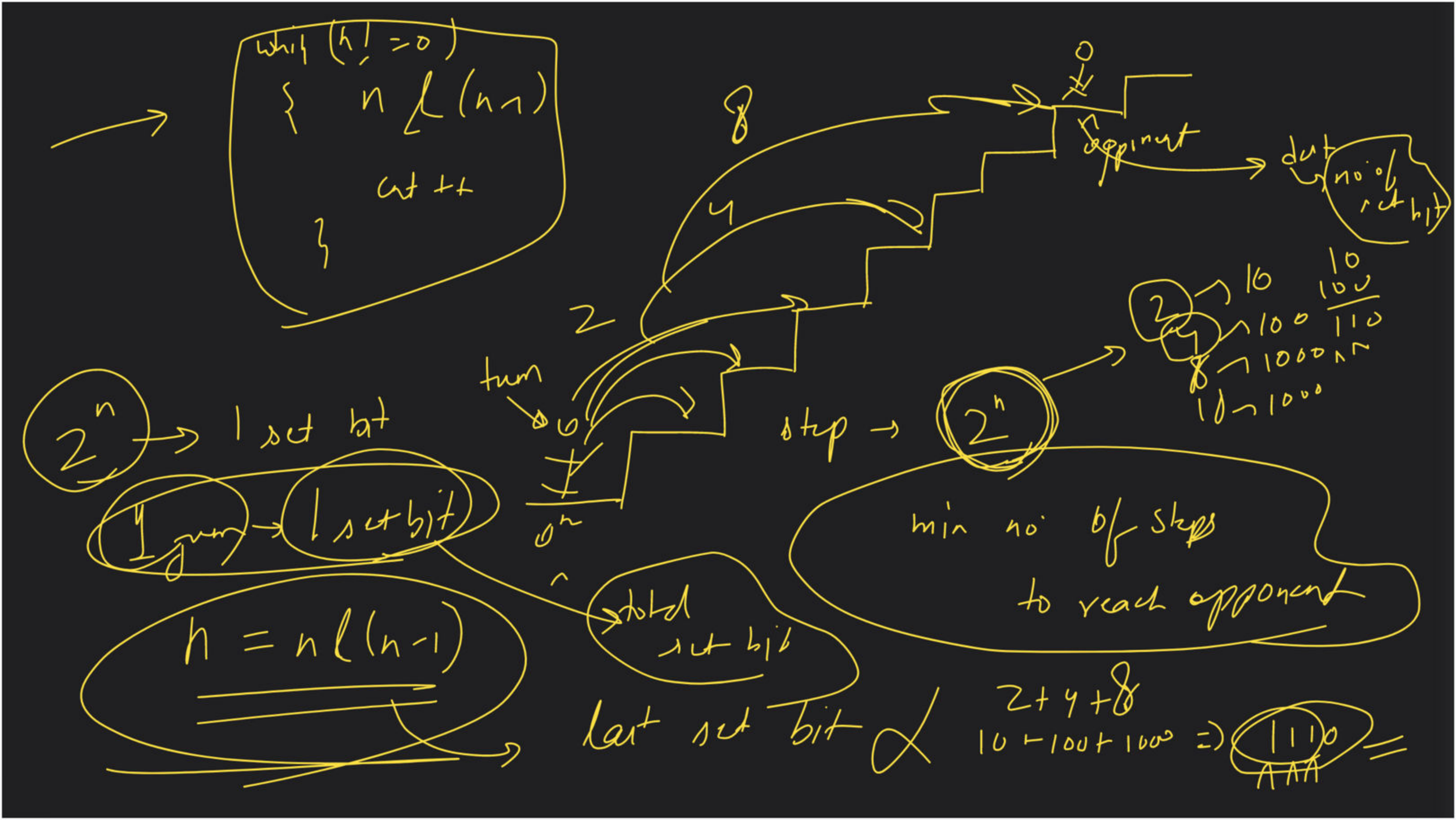

i/p
clear
zero terminated
o/p
as it is
as it is
OR
b


a →
-1
L.S
a = (-1 << (i+1))


(1<<j) -1
b
1<<j
<<3
1000
-1
111
n-1
2 → 16 → 1
4 → 100 → 11
8 → 1000 → 111
16 → 10000 → 1111
32
11111
3.


a/b
mark


decimal
n=
MSB=1
-ve
2's comp
1's comp
+1
-1

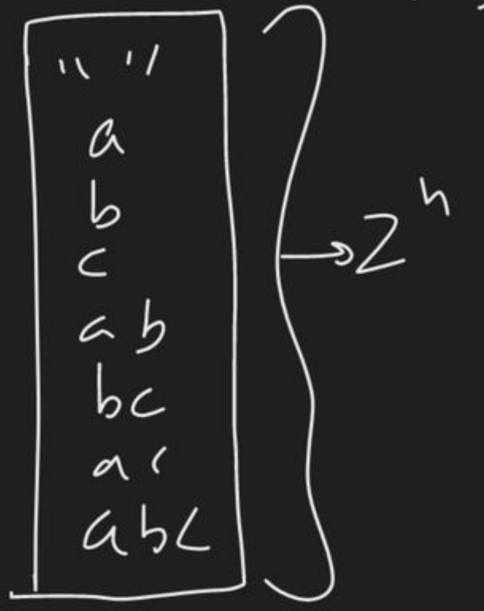

while (n != 0)
{ n = n & (n-1)
cnt ++
}
8
4
2
1
Sapient
dut
no. of set bit
10
100
1000
10 → 100
100 → 110
1000 → 1100
2^n → 1 set bit
1 num → 1 set bit
turn
0
0^n
step →
2^n
min no of steps
to reach opponent
n = n & (n-1)
total set bit
last set bit
2+4+8
10+100+1000 => 1110

→ Subsequence Using Bitmasking

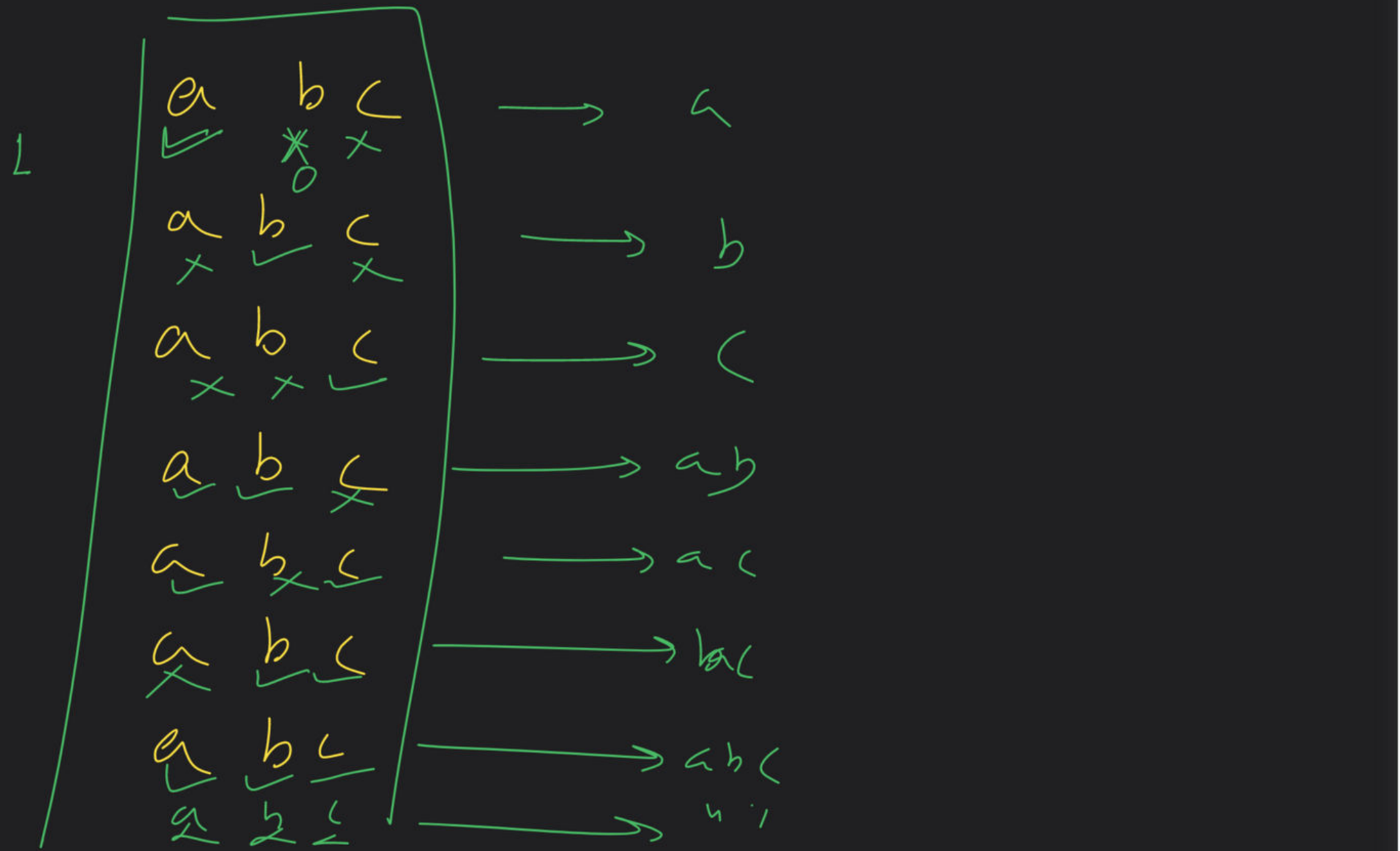
n → length of string

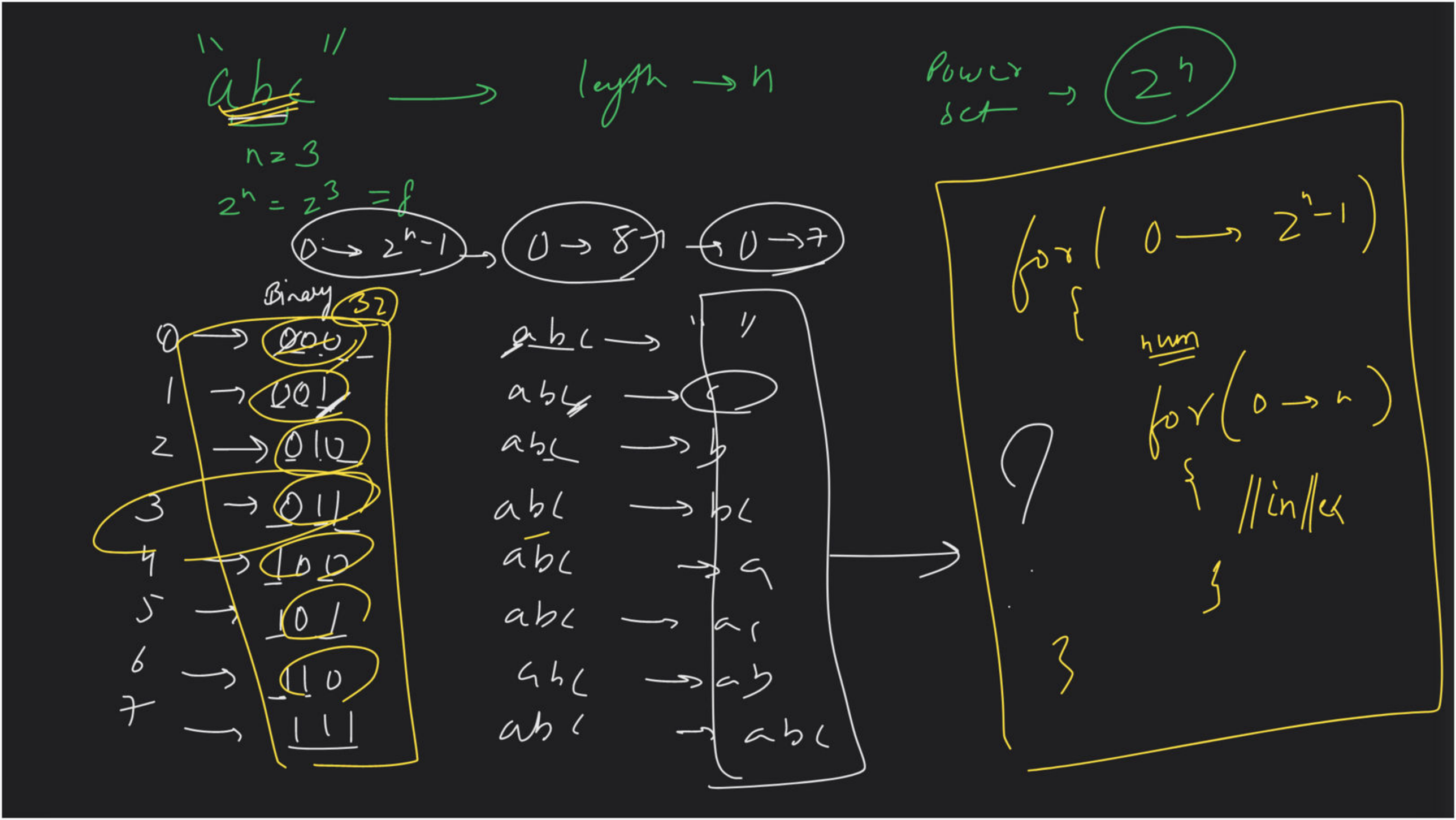
str = "abc"

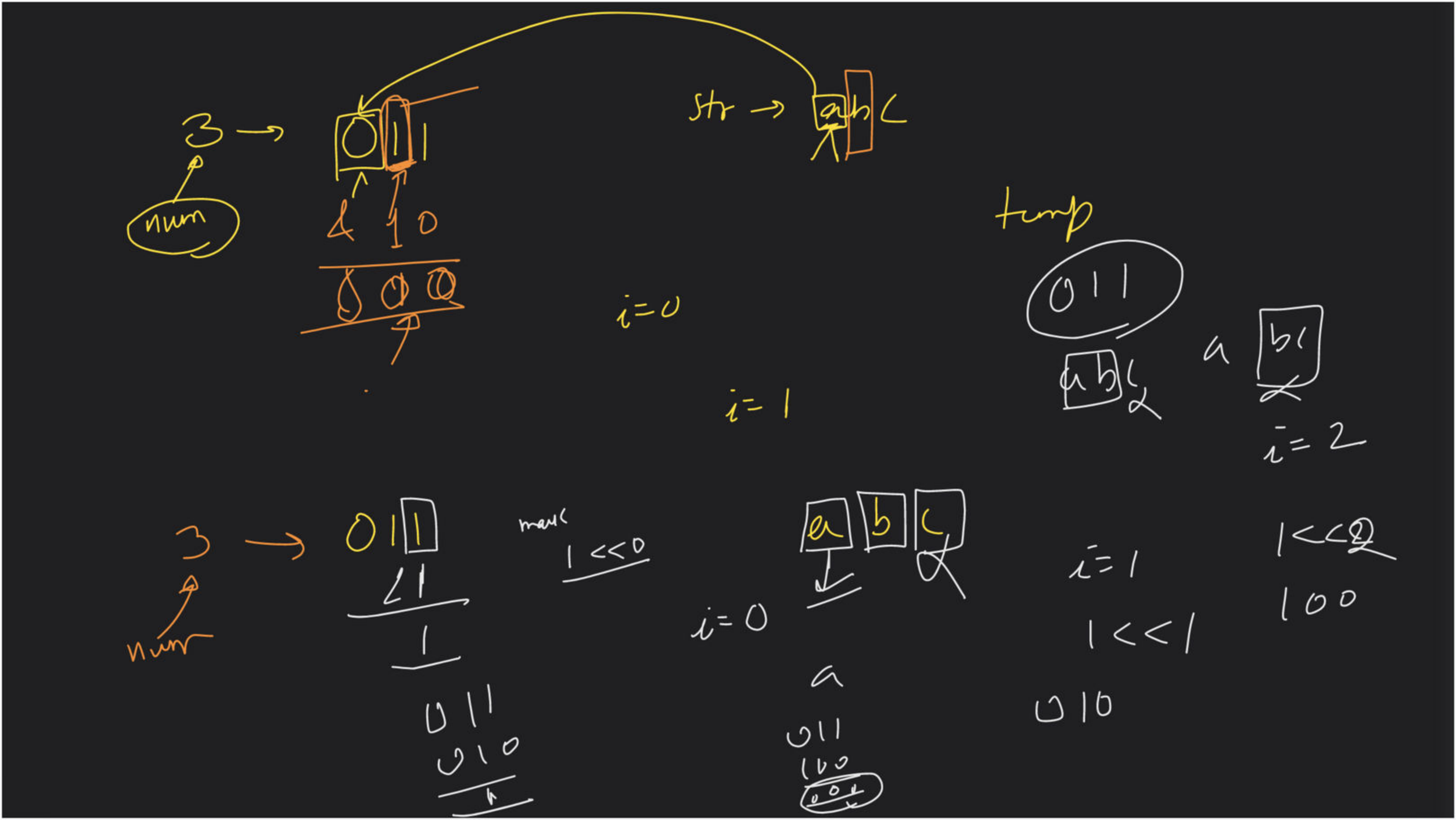
Power set or Subsequence →



already solved → Recursion → incl/excl pattern


a b c
a
a b c
b
a b c
c
a b c
ab
a b c
ac
a b c
bc
a b c
abc


"abc"
length → n
Power set → 2^n
n = 3
$2^n = 2^3 = 8$
0 → $2^n - 1$
0 → 8
0 → 7
Binary
32
0 → 000
1 → 001
2 → 010
3 → 011
4 → 100
5 → 101
6 → 110
7 → 111
abc → ""
abc → c
abc → b
abc → bc
abc → a
abc → ac
abc → ab
abc → abc
for (0 → $2^n - 1$)
{
num
for (0 → n)
{
//inner
}
?
}


3
num
str
a b c
i=0
i=1
i=2
temp
011
a b c
b
1<<0
1<<1
1<<2
100
010
011
010
001