(Binary Tries)

Tries 2

- Priyansh Agarwal

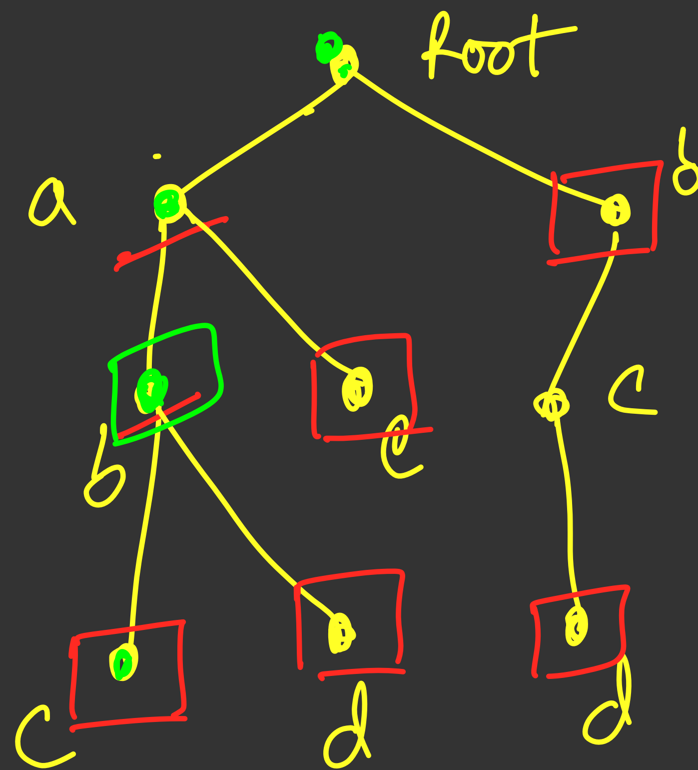
abc

abd

ae

bcd

b



ab

abc

x

w

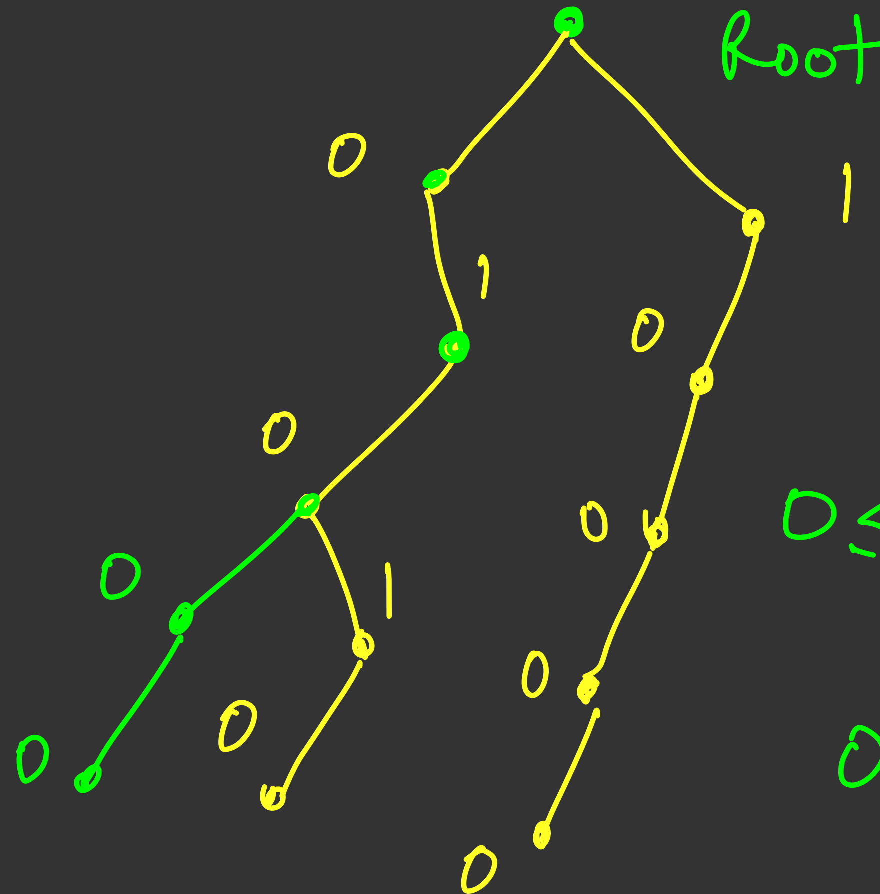
16 10000

10 01010

8 01000

7 00111

6 00110



$0 \le a_i \le 2^{63}$

$0 \le a_i \le 10^9$

$0 \le a_i \le 2^{31}$

Problem 1

$2 \le N \le 10^5$

- Given an array A of N integers ($0 <= a_i <= 1e9$), find the maximum XOR of 2 numbers.

$0 \le a_i \le 10^9$

10 2 $\boxed{3}$ 9 11

$9 \wedge 2$

$1001 \wedge 0010$

$1011 \to 11$

$10 \wedge 11$

$1010 \wedge 1011 = 1$

$10 \wedge 3$

$1010 \wedge 0011$

$\to 1001$ 9

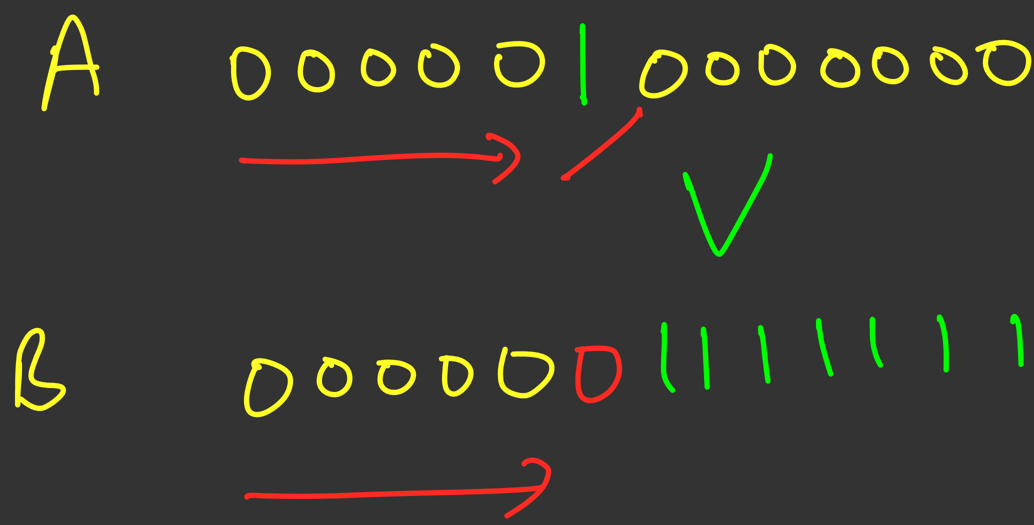
$$2^i > 2^{i-1} + 2^{i-2} + 2^{i-3} \cdots 2^0$$

4 3 2 1 0

A 1 0 0 0 0

B 0

A > B


A
B

10 — 1010 (3)

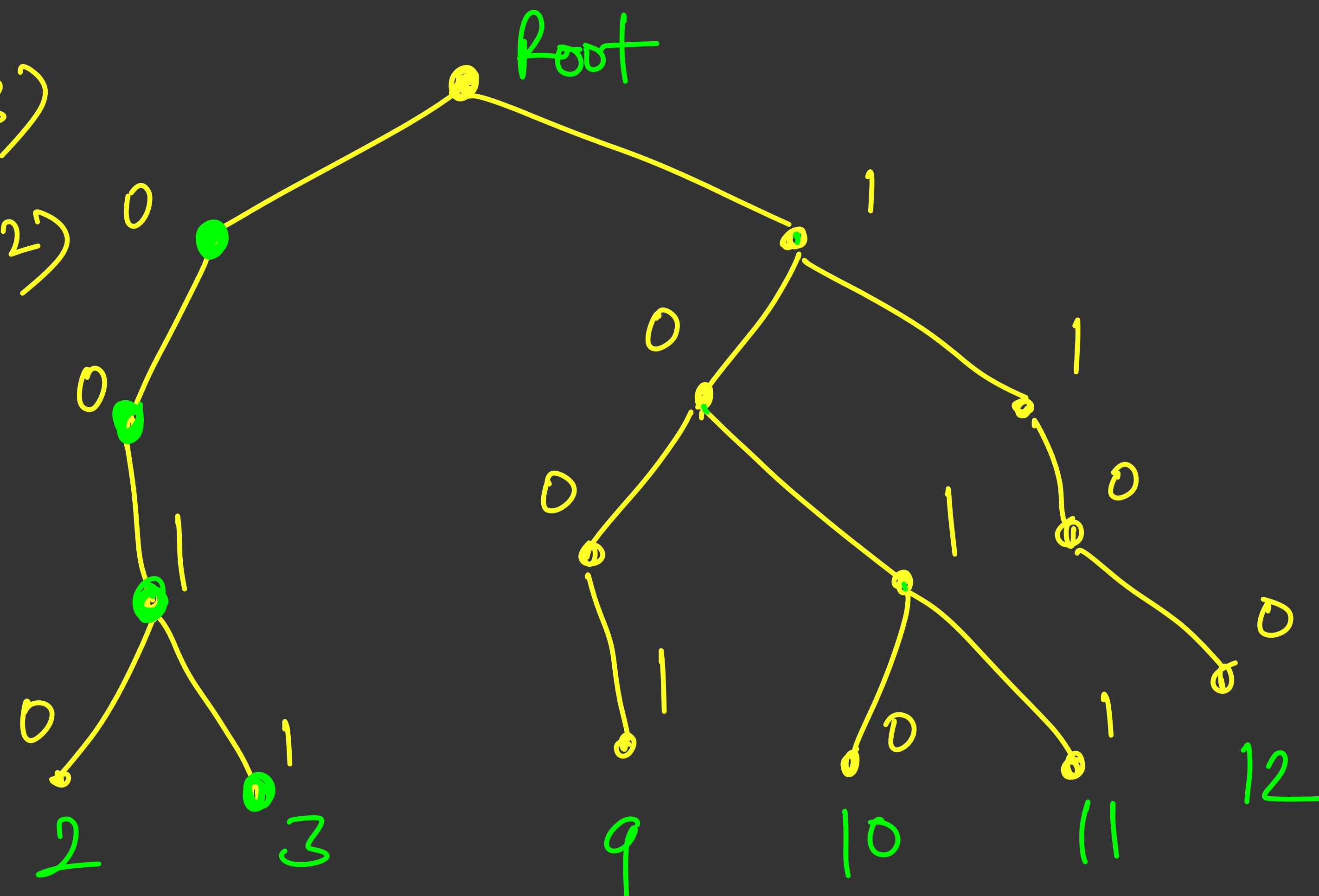
2 — 0010 (12)

3 — 0011

9 — 1001

11 — 1011

12 — 1100



N, $0 \le a_i \le 10^9$ $\qquad$ $0 \le a_i \le 2^{31}$

Problem 2

- Given an array A of N integers ($0 <= a_i <= 1e9$), find the maximum AND of 2 numbers.

10 — 1010

2 — 0010

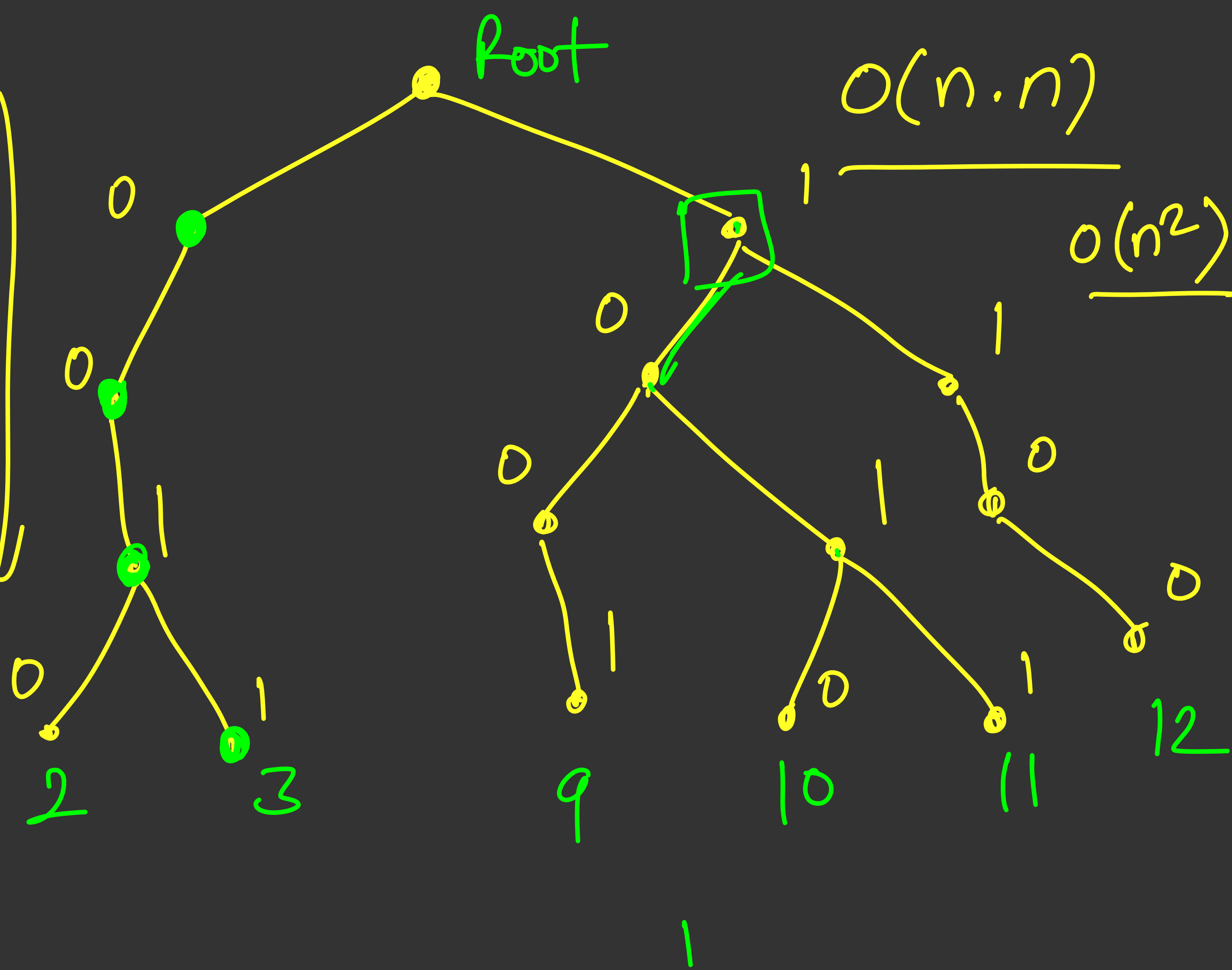
3 — 0011

9 — 1001

11 — 1011

12 — 1100

0 → 0000



10

0

11

1

1010

We want maximum AND b/w

i j two no's

a_1 — 1001

a_2

a_3

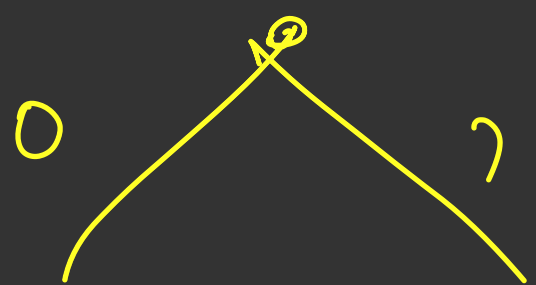
$\vdots$

a_n

$\boxed{a_i}$ & $\boxed{a_j}$

q_i q_j

$\boxed{0}$

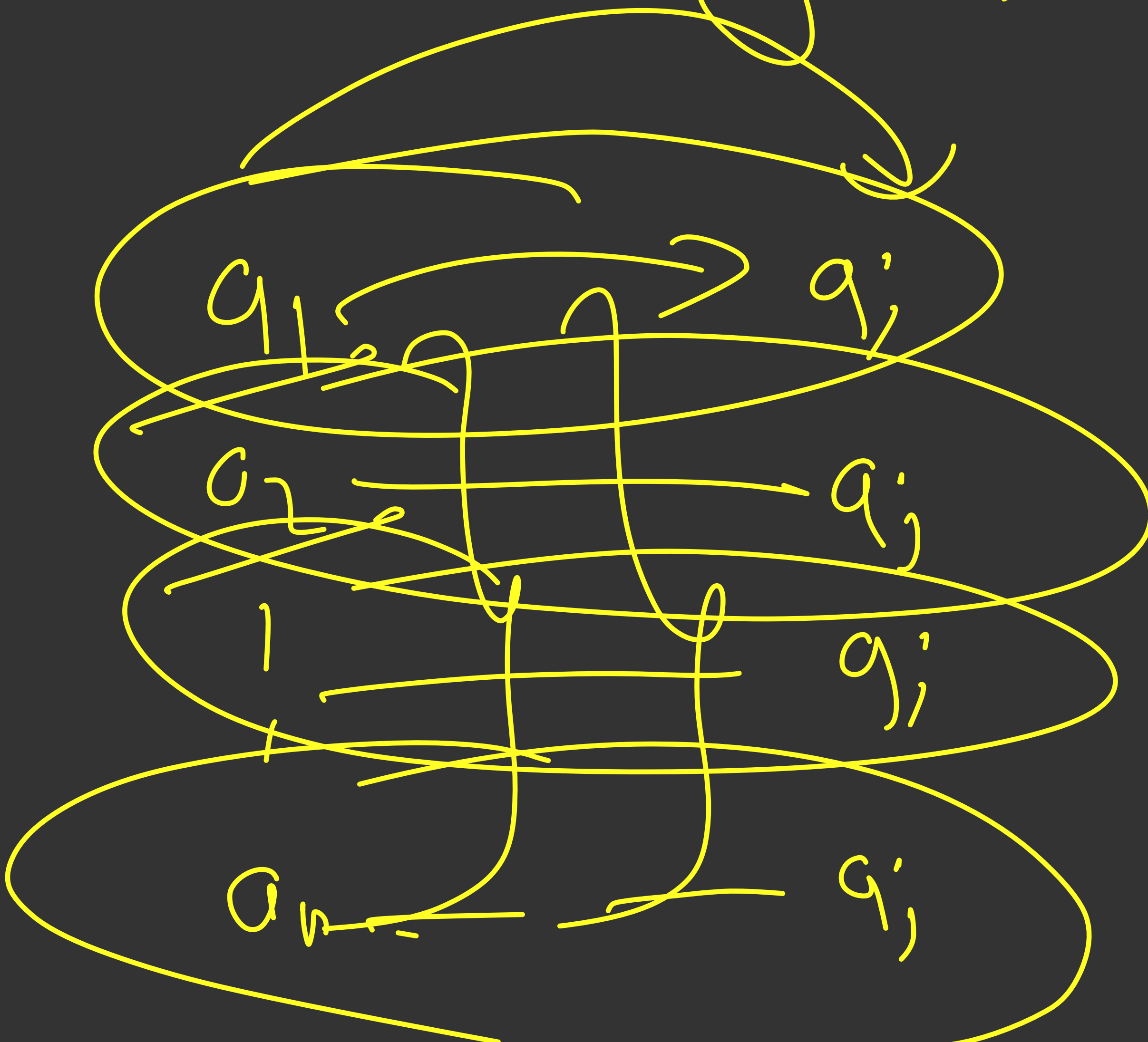


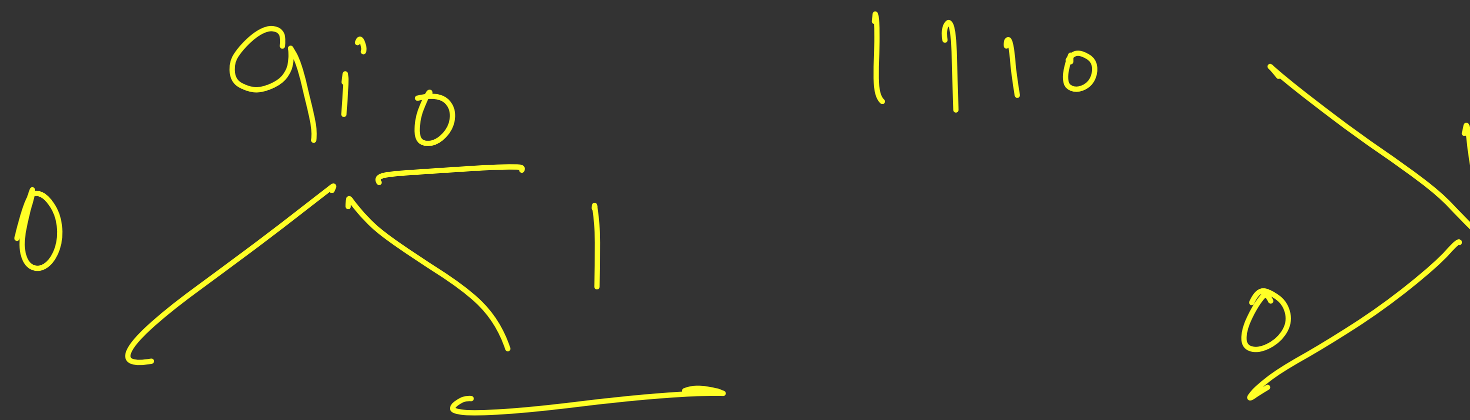
$q_j < q_i$

$q_i \longrightarrow$ any q'_j such that

$q_i \ 4 \ q'_j$ is

maximum





$a_i \longrightarrow$ that a_j such that $a_j < a_i$ and $a_i \& a_j$ is maximum

Problem 3

$1 \le N \le 10^5$

$(0 \le a_i \le 10^9)$

- Given an array arr of size N consisting of non-negative integers. You are also given Q queries represented by 2D integer array queries, where queries[i] = [xi, mi].

$1 \le Q \le 10^5$ $(0 \le x_i, m_i \le 10^9)$

- The answer to the ith query is the maximum bitwise XOR value of xi and any element of arr that does not exceed mi. In other words, the answer is max(arr [j] XOR xi) for all j such that arr [j] <= mi . If all elements in nums are larger than mi , then answer is -1.

10 — 1010

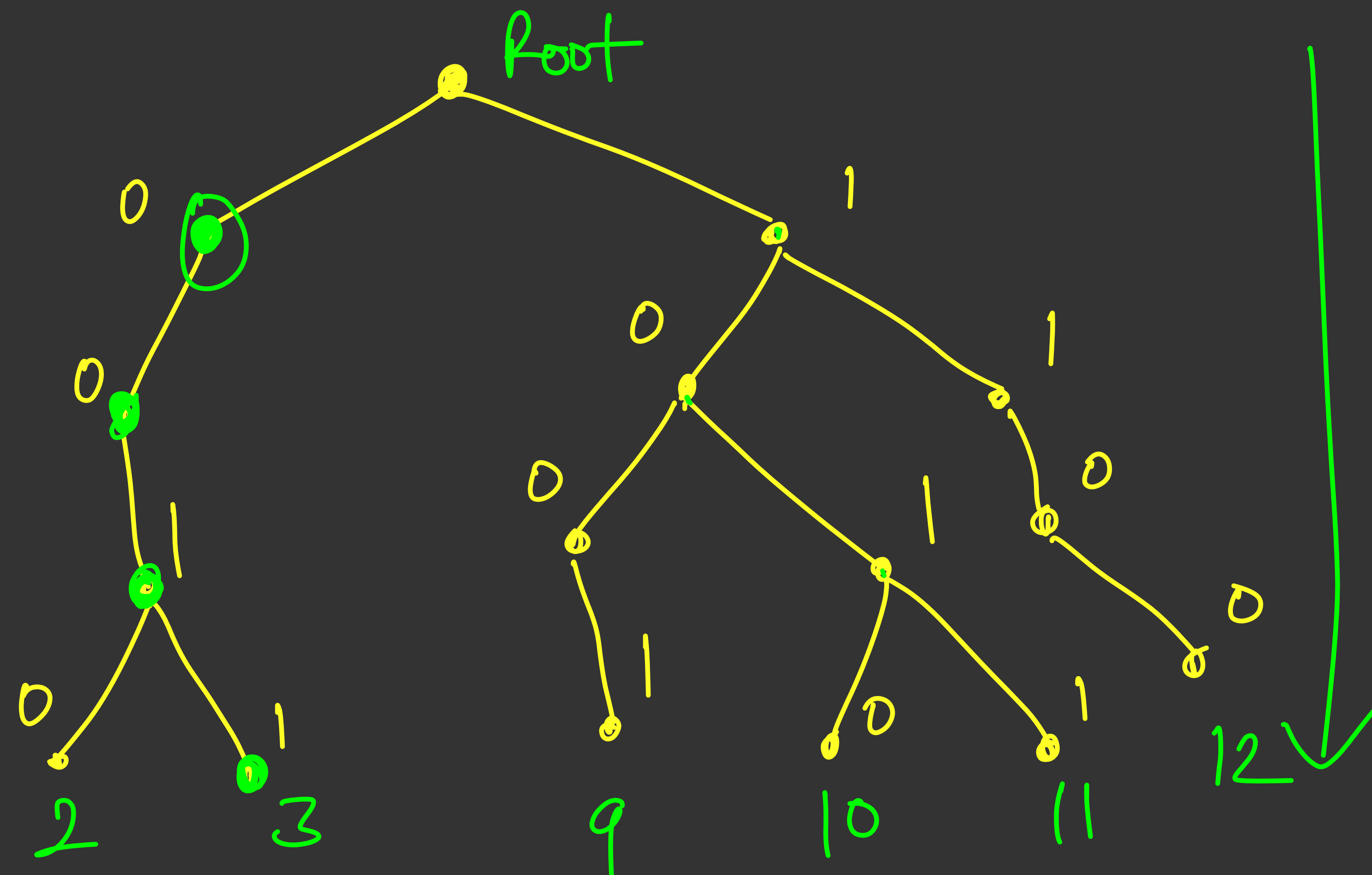
2 — 0010

3 — 0011

9 — 1001

11 — 1011

12 — 1100



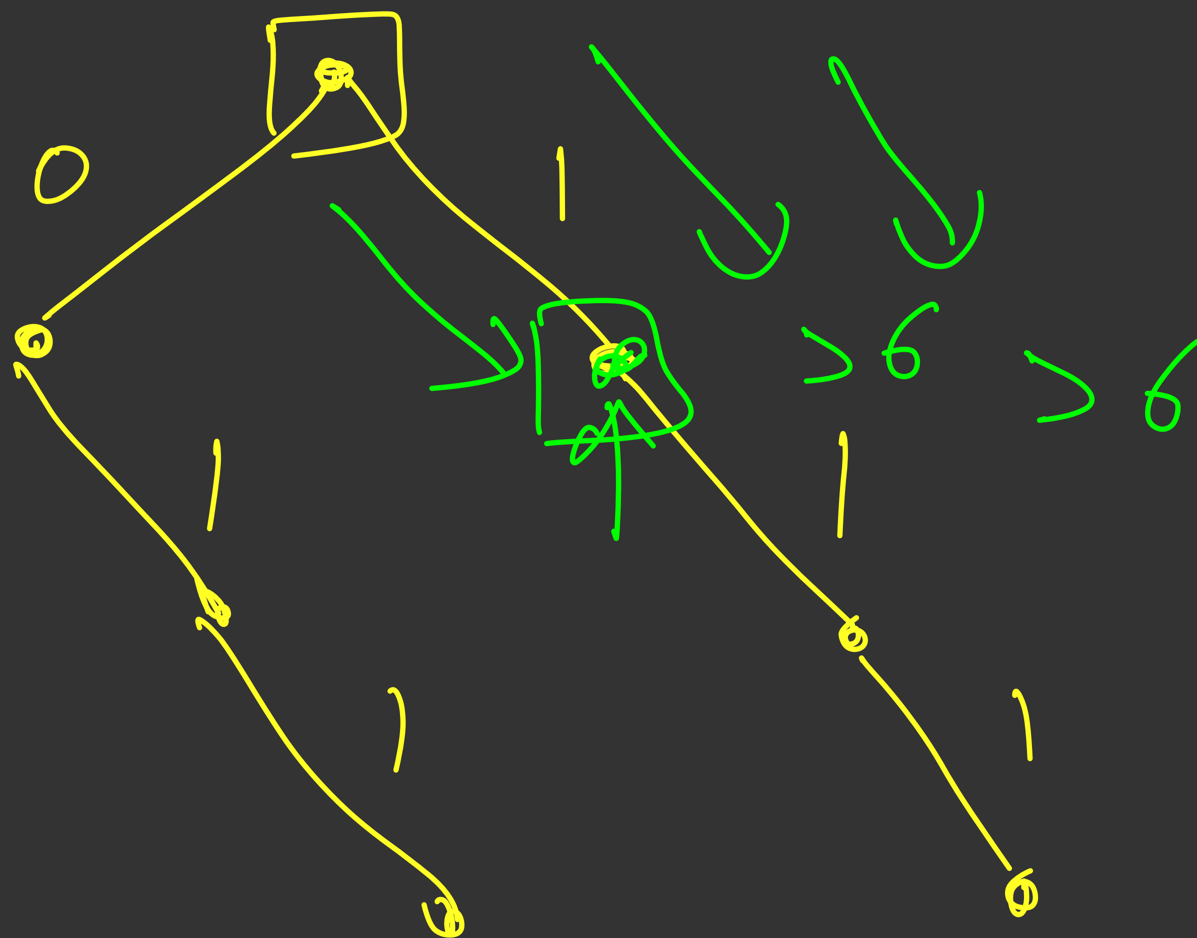
$X = 8$, $M = 6$

1000   0110

$Y \rightarrow 001$

$X = 0$

$M = 6$



We are standing on ith bit if the ith bit in x is

0 → we want to go towards 1

1 → we want to go towards 0

10 — 1010

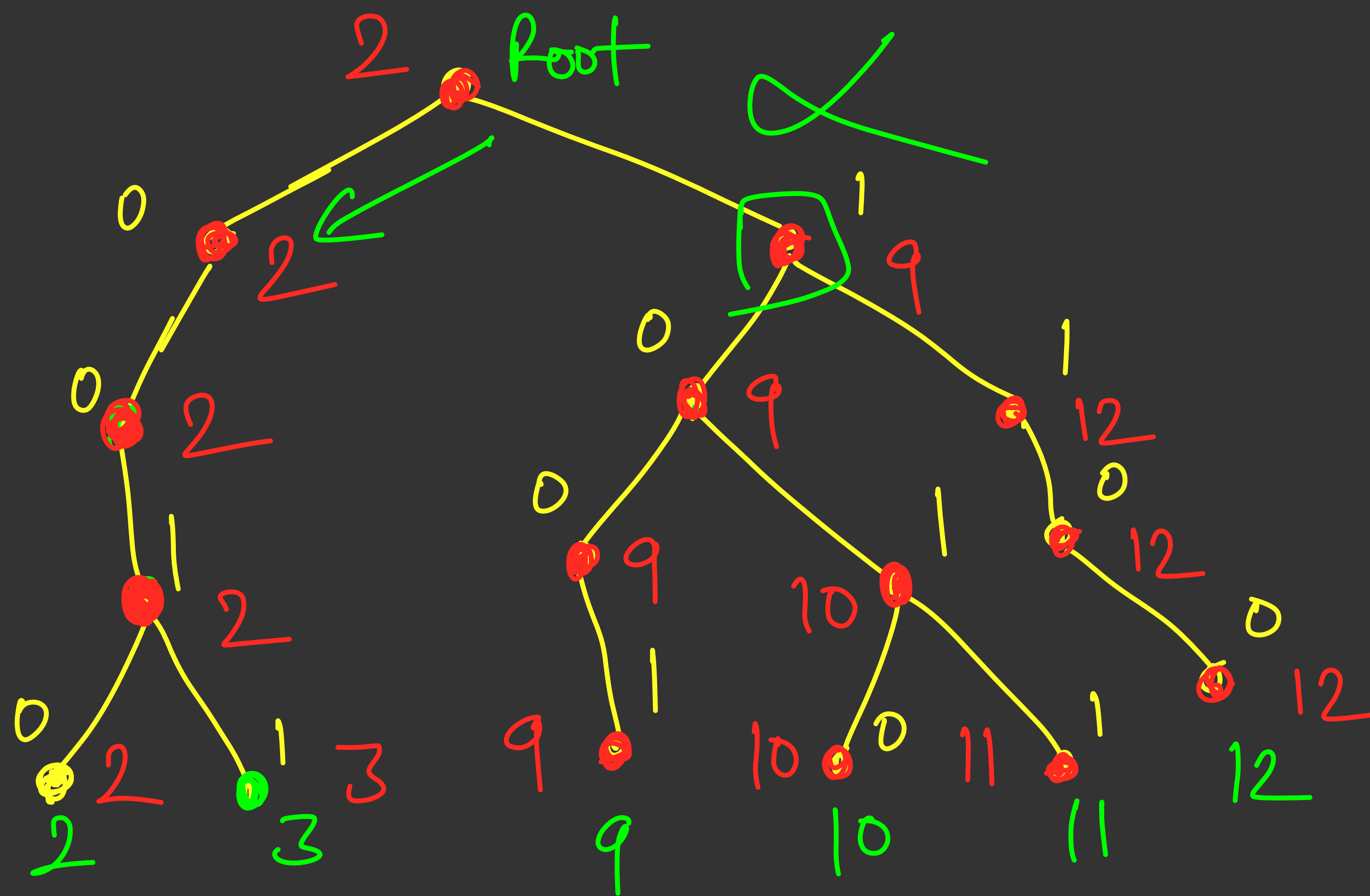
2 — 0010

3 — 0011

9 — 1001

11 — 1011

12 — 1100



$X = 7 \longrightarrow 0111$

$M = \underline{8}$