

$$\begin{array}{rcl}
 8734 & \Rightarrow & 8000 \\
 \hline
 + & 700 & \\
 + & 30 & \\
 + & 4 & \\
 \hline
 \end{array}$$

$$\Rightarrow 8 \times 10^3 + 7 \times 10^2 + 3 \times 10^1 + 4 \times 10^0$$

Decimal No system  $\Rightarrow [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]$

Base - 8

Octal No. system  $\Rightarrow [0-7]$

$$\begin{aligned}
 (0132)_8 & \Rightarrow 0 \times 8^3 + 1 \times 8^2 + 3 \times 8^1 + 2 \times 8^0 \\
 & \Rightarrow 64 + 24 + 2 \\
 & = (90)_{10}
 \end{aligned}$$

Base - 3

Ternary No system  $\Rightarrow [0-2]$

$$\begin{aligned}
 (1120)_3 & \Rightarrow 1 \times 3^3 + 1 \times 3^2 + 2 \times 3^1 + 0 \times 3^0 \\
 & \quad 27 + 9 + 6 + 0 \\
 & = (42)_{10}
 \end{aligned}$$

Quiz 1

$$\begin{array}{r} 7 \\ 5 \end{array} \quad \boxed{\begin{array}{r} 9 \\ 4 \end{array}} \quad \begin{array}{r} 8 \\ 3 \end{array} \quad \begin{array}{r} 4 \\ 2 \end{array} \quad \begin{array}{r} 2 \\ 1 \end{array} \quad \begin{array}{r} 3 \\ 0 \end{array}$$

$10^4$

Quiz 2

$$\begin{array}{r} \dots \\ \dots \end{array} \quad \begin{array}{r} \dots \\ x-1 \end{array} \quad \begin{array}{r} \dots \\ x \end{array} \quad \begin{array}{r} \dots \\ x-1 \end{array} \quad \dots \quad \begin{array}{r} 3 \\ 2 \end{array} \quad \begin{array}{r} 2 \\ 1 \end{array} \quad \begin{array}{r} 1 \\ 0 \end{array}$$

$\Downarrow$

$10^{(x-1)}$

Quiz 3

$$(125)_8 \Rightarrow 1 \times 8^2 + 2 \times 8^1 + 5 \times 8^0$$

$(85)_{10}$

Quiz 4

Incorrect octal representation

$$\underline{1} \quad \underline{0} \quad 0 \quad 0 \quad 0 \quad 0 \quad 1 \quad \checkmark$$

$$65\cancel{8}2 \quad \times$$

Quiz 5

$$(0 \underset{3}{2} \underset{2}{1} \underset{1}{0} \underset{0}{1})_3 \Rightarrow \underline{2 \times 3^3} + 1 \times 3^2 + 0 \times 3^1 + 1 \times 3^0$$

$54 + 9 + 0 + 1$

$(64)_{10}$

## Binary Number System (2 unique digits)

$[0, 1]$

$$(10110)_2 \Rightarrow 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$$

$$16 + 0 + 4 + 2 + 0$$

$$(22)_{10}$$

## Decimal to Binary

$$(28)_{10} \Rightarrow$$

2	28	0
2	14	0
2	7	1
2	3	1
2	1	1
	0	

$$\Rightarrow (11100)_2$$

Hexadecimal (16-Base)  $\Rightarrow [0-9] + [A-F]$

Quin 6

$$(37)_{10} \Rightarrow$$

2	37	1
2	18	0
2	9	1
2	4	0
2	2	0
2	1	1
	0	

$$(100101)_2$$

Quiz 7

$(25)_{10} \Rightarrow$

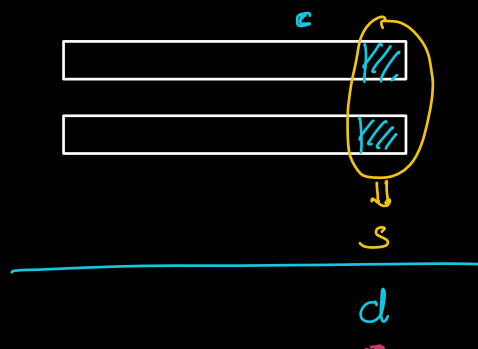
$$\begin{array}{r} 2 \overline{) 25} \\ \underline{12} \phantom{0} \\ 2 \overline{) 12} \\ \underline{6} \phantom{0} \\ 2 \overline{) 6} \\ \underline{3} \phantom{0} \\ 2 \overline{) 3} \\ \underline{1} \phantom{0} \\ 2 \overline{) 1} \\ \underline{0} \end{array}$$

$(11001)_2$

Addition

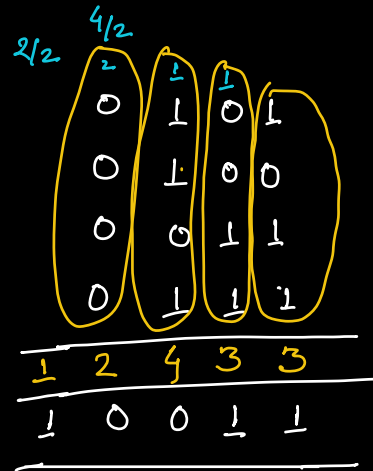
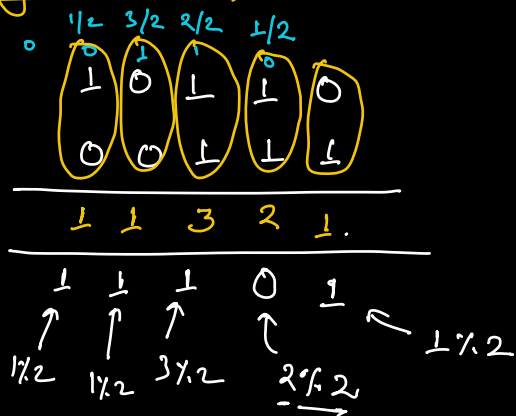
$$\begin{array}{r} \begin{array}{cccc} 6/10 & 13/10 & 10/10 & 16/10 \\ 0 & 3 & 4 & 5 \\ 2 & 8 & 4 & 9 \end{array} \\ \hline \begin{array}{cccc} 0 & 6 & 13 & 10 & 16 \end{array} \\ \begin{array}{cccc} 6 & 3 & 0 & 6 \end{array} \\ \begin{array}{cccc} \uparrow & \uparrow & \uparrow & \nwarrow \end{array} \\ \begin{array}{cccc} 6\%_{10} & 13\%_{10} & 10\%_{10} & (16\%_{10}) \end{array} \end{array}$$

$$\begin{array}{r} \begin{array}{cccc} 11/10 & 11/10 & 14/10 & 12/10 \\ 1 & 2 & 3 & 7 \\ 8 & 7 & 6 & 4 \end{array} \\ \hline \begin{array}{cccc} 1 & 11 & 11 & 14 & 12 \end{array} \\ \begin{array}{cccc} 1 & 1 & 1 & 4 & 2 \end{array} \\ \begin{array}{cccc} \uparrow & \uparrow & \nwarrow & \nwarrow \end{array} \\ \begin{array}{cccc} 11\%_{10} & 11\%_{10} & 14\%_{10} & 12\%_{10} \end{array} \end{array}$$



$$\begin{aligned} d &= s \% B \\ c &= s / B \end{aligned}$$

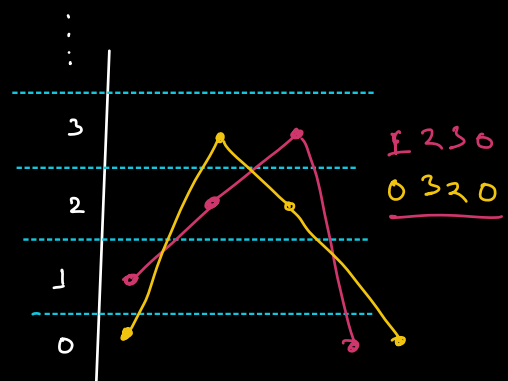
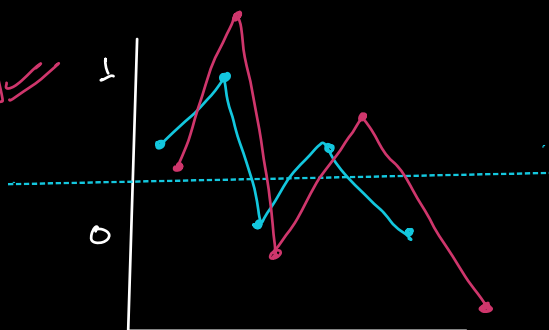
## Binary Addition



## Quiz 8

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

1 1 0 1 0  
1 1 0 1 0



$$(\oplus) \Rightarrow O(1)$$

$$(\ominus) \Rightarrow O(1)$$

$$(\otimes) \Rightarrow O(1)$$

$$(\div) \Rightarrow O(1)$$

$$(\%) \Rightarrow O(1)$$

1 1 1 1 0 0 1

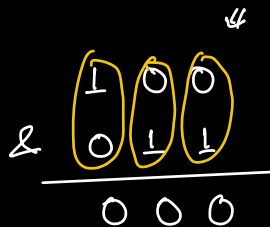
# Bit Manipulation

( $\&$ ,  $|$ ,  $\sim$ ,  $\wedge$ ,  $\ll$ ,  $\gg$ )

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

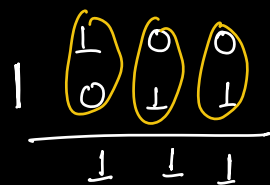
$a = 4, b = 3$

a & b



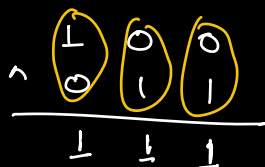
0

a | b



7

a ^ b



7

$$a = 13 : 1101$$

$$b = 10 : 1010$$

$$a \& b = 1000 \Rightarrow 8$$

$$a | b = 1111 \Rightarrow 15$$

$$a \wedge b = 0111 \Rightarrow 7$$

$\sim$  (Not)

a	$\sim a$
0	1
1	0

$$\sim(100) \Rightarrow 011$$

Quiz 9

$$11 | 1 = 11$$

$$\begin{array}{r} 1101 \text{ (1)} \\ 0001 \\ \hline 1011 \end{array}$$

$$\begin{array}{l} 0 | 0 = 0 \\ 1 | 0 = 1 \end{array}$$

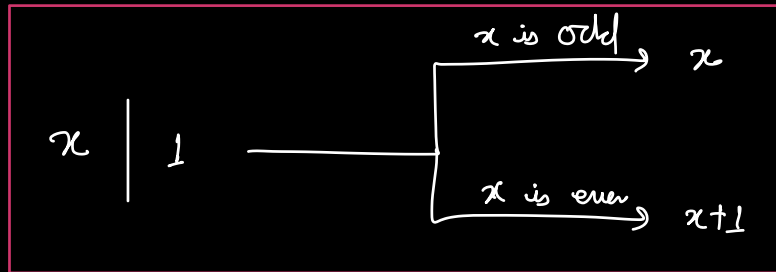
Quiz 10

$$10 | 1$$

$$\begin{array}{r} 1010 \\ 0001 \\ \hline 1011 \end{array}$$

$$\underline{12} \mid 1 \Rightarrow 13$$

$$13 \mid 1 \Rightarrow 13$$



### Quiz 13

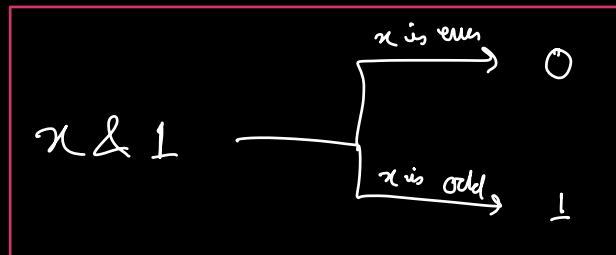
11 & 1

$x \& 1$

$$\begin{array}{r} \boxed{\begin{array}{ccc} 1 & 0 & 1 \end{array}} \begin{array}{c} 1 \\ 1 \end{array} \\ \& \begin{array}{ccc} 0 & 0 & 0 \end{array} \begin{array}{c} 1 \\ 1 \end{array} \\ \hline 0001 \end{array}$$

$\underline{10} \& 1$

$$\begin{array}{r} \boxed{\begin{array}{ccc} 1 & 0 & 1 \end{array}} \begin{array}{c} 0 \\ 1 \end{array} \\ \& \begin{array}{ccc} 0 & 0 & 0 \end{array} \begin{array}{c} 1 \\ 1 \end{array} \\ \hline 0000 \end{array}$$



### Quiz 14

$(11 \wedge 1)$

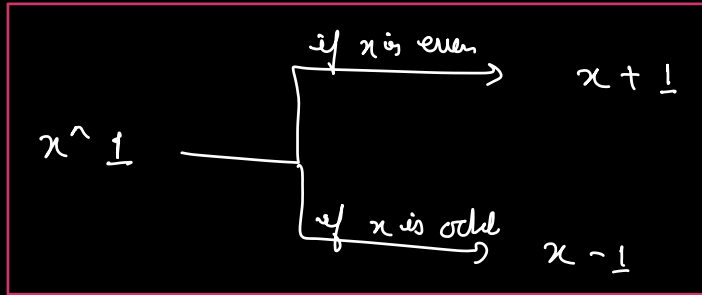
$x \wedge 1$

$$\begin{array}{r} \boxed{\begin{array}{ccc} 1 & 0 & 1 \end{array}} \begin{array}{c} 1 \\ 1 \end{array} \\ \wedge \begin{array}{ccc} 0 & 0 & 0 \end{array} \begin{array}{c} 1 \\ 1 \end{array} \\ \hline 1010 \Rightarrow 10 \end{array}$$

$(10 \wedge 1)$

$$\begin{array}{r} \boxed{\begin{array}{ccc} 1 & 0 & 1 \end{array}} \begin{array}{c} 0 \\ 1 \end{array} \\ \wedge \begin{array}{ccc} 0 & 0 & 0 \end{array} \begin{array}{c} 1 \\ 1 \end{array} \\ \hline 1011 \Rightarrow 11 \end{array}$$





$$\begin{aligned} a \mid a &\Rightarrow a \\ a \& a &\Rightarrow a \\ a \wedge a &\Rightarrow 0 \end{aligned}$$

$$\begin{array}{r} 101100 \\ - 101100 \\ \hline 101100 \end{array}$$

$$\begin{array}{r} 101101 \\ 101101 \\ \hline 000000 \end{array}$$

$$a \wedge 0 \Rightarrow a$$

$$\begin{array}{r} 101101 \\ \Rightarrow \wedge 000000 \\ \hline 101101 \end{array}$$

$1 \wedge 0 = 1$   
 $0 \wedge 0 = 0$

$$\begin{aligned} a \wedge b &= b \wedge a \\ a \mid b &= b \mid a \\ a \& b &= b \& a \end{aligned}$$

$$\begin{aligned} 4 \wedge 0 &= 4 \\ 120 \wedge 0 &= 120 \\ 110 \wedge 110 &= 0 \end{aligned}$$

$$\begin{aligned} a + b &= b + a \\ a - b &= b - a \times \\ a \times b &= b \times a \end{aligned}$$

$$\begin{aligned}
 a \wedge b \wedge c &= (a \wedge b) \wedge c \\
 &= (b \wedge c) \wedge a \\
 &= (c \wedge a) \wedge b
 \end{aligned}
 \left| \begin{array}{l} \text{Same} \\ \hline \end{array} \right.$$

$$\begin{aligned}
 &120 \wedge 3 \wedge 5 \wedge 3 \wedge 120 \wedge 5 \\
 \Rightarrow &(\cancel{120} \wedge \cancel{120}) \wedge (\cancel{3} \wedge \cancel{3}) \wedge (\cancel{5} \wedge \cancel{5}) \\
 \Rightarrow &0
 \end{aligned}$$

$$\text{if } a \wedge b = k$$

$$a \wedge k = b \checkmark$$

$$\text{and } b \wedge k = a \checkmark$$

$$a \wedge b = k$$

$\wedge b$  both side

$$a \wedge b \wedge b = k \wedge b$$

$$a \wedge 0 = k \wedge b$$

$$a = k \wedge b$$

$$\Rightarrow \boxed{b \wedge k = a}$$

$\wedge a$  both side

$$a \wedge b \wedge a = k \wedge a$$

$$a \wedge a \wedge b = k \wedge a$$

$$0 \wedge b = k \wedge a$$

$$b = k \wedge a$$

$$\boxed{a \wedge k = b}$$

Adobe  
Amazon  
MS  
Oyo

Q Given an array where all the numbers appear even no. of times except one no. which appears odd no. of times.  
Find the odd-time appearing no.

A: 2, 8, 3, 1, 2, 2, 3, 2, 8, 1, 1

$O(N) \rightarrow TC$

$O(1) \rightarrow SC$   
(Extra)

$$\left[ \begin{array}{l} 2 \wedge 2 \wedge 2 \wedge 2 = 0 \\ 8 \wedge 8 = 0 \\ 3 \wedge 3 = 0 \\ 1 \wedge 1 \wedge 1 = 1 \end{array} \right]$$

$$\cancel{2} \wedge \cancel{8} \wedge \cancel{3} \wedge \cancel{1} \wedge \cancel{2} \wedge \cancel{2} \wedge \cancel{3} \wedge \cancel{2} \wedge \cancel{8} \wedge \cancel{1} \wedge \textcolor{violet}{1}$$

ans = 0;

for ( $i=0; i < N; i++$ ) {

ans = ans ^ a[i];  $\Rightarrow O(1)$

}

return ans;

TC:  $O(N)$

SC:  $O(1)$   
(Extra)

+  $\Rightarrow O(1)$   
-

(Key  $\Rightarrow$  6)

int a, b;

$\leftarrow$  32  $\Rightarrow O(1)$

