8732

$8000 + 700 + 30 + 2$

thousands hundreds tens ones

$8\times10^3 + 7\times10^2 + 3\times10^1 + 2\times10^0$

thousand hund. tens ones

Base → 10

[0 9]

$(73)_{10} \rightarrow 7\times10^1 + 3\times10^0$

Binary No. System

[Base → 2]

[0 1]

$2^0 = 1$
$2^1 = 2$
$2^2 = 4$
$2^3 = 8$
$2^4 = 16$
$2^5 = 32$
$2^6 = 64$
$2^7 = 128$

$73 \rightarrow 2^6 + 2^3 + 2^0$

1 0 0 1 0 0 1

2^6 2^5 2^4 2^3 2^2 2^1 2^0

$1\times2^6 + 0\times2^5 + 0\times2^4 + 1\times2^3 + 0\times2^2 + 0\times2^1 + 1\times2^0$

$2^6 + 2^3 + 2^0$

Octal No. System

Base → 8

[0 7]

2	1	0	3	6
8^4	8^3	8^2	8^1	8^0

place values / base values.

$2\times8^4 + 1\times8^3 + 0\times8^2 + 3\times8^1 + 6\times8^0$

8734

Quiz 1

$(1\ 2\ 5)_8 \rightarrow (\ ?\ )_{10}$

1	2	5
8^2	8^1	8^0

$1\times8^2 + 2\times8^1 + 5\times8^0$

64 + 16 + 5

85

Quiz 2

a) 1000001

b) 6854

c) 2576

d) 7460

[0 7]

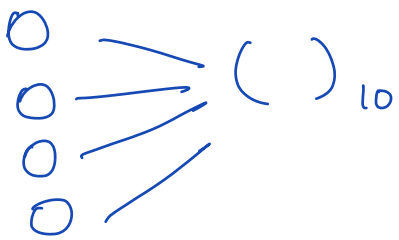
Quiz 3

$(0\ 2\ 1\ 0\ 1)_3$

$\frac{0}{3^4}\ \frac{2}{3^3}\ \frac{1}{3^2}\ \frac{0}{3^1}\ \frac{1}{3^0}$

$\frac{0\times3^4}{0} + \frac{2\times3^3}{54} + \frac{1\times3^2}{9} + \frac{0\times3^1}{0} + \frac{1\times3^0}{1}$

$\Rightarrow 64$



Binary No. System

Convert a dec no. to binary ?

$(22)_{10} \longrightarrow (\ ?\ )_2$

$22 \rightarrow 16 + 6$

$\downarrow$

$4 + 2$

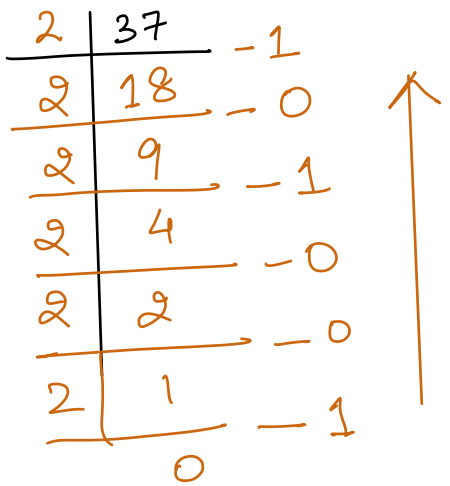
$2^4 + 2^2 + 2^1$

$\frac{0}{2^5}\ \frac{1}{2^4}\ \frac{0}{2^3}\ \frac{1}{2^2}\ \frac{1}{2^1}\ \frac{0}{2^0}$

2	22	– 0
2	11	– 1
2	5	– 1
2	2	– 0
2	1	– 1
	0	

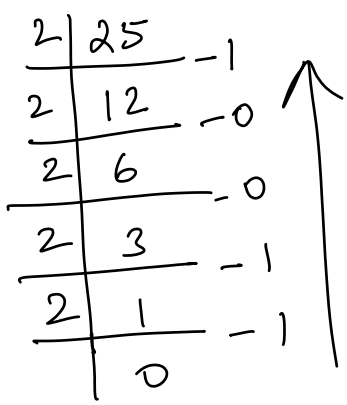
$1\ 0\ 1\ 1\ 0$

$(37)_{10} \longrightarrow (\ ?\ )_2$



$(1\ 0\ 0\ 1\ 0\ 1)_2$

$(25)_{10} \longrightarrow (\ ?\ )_2$



$(1\ 1\ 0\ 0\ 1)_2$

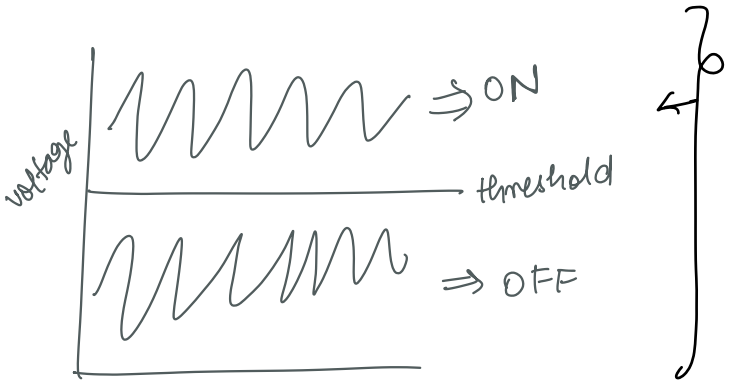
Microsoft → screening round.

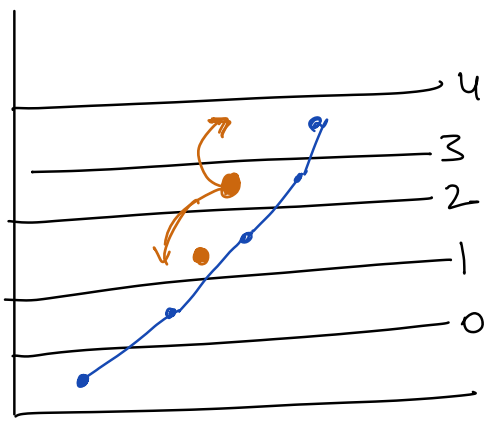
Computers

↳ Electronic device / Electrical circle

transistors / logic gates. ON →

OFF →

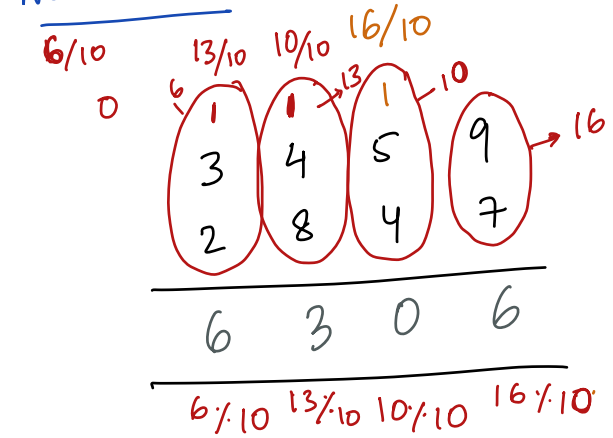




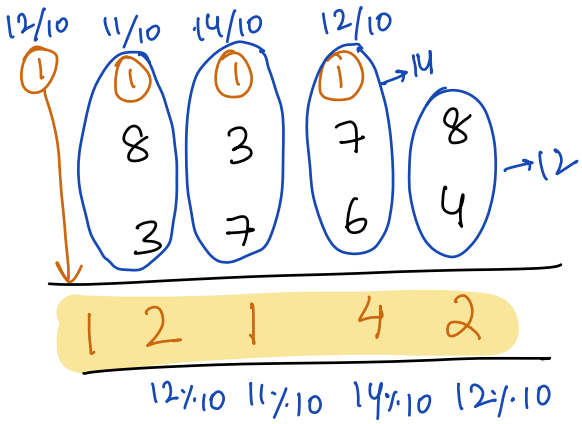
① High cost → value.

② Highly incorrect

Additions

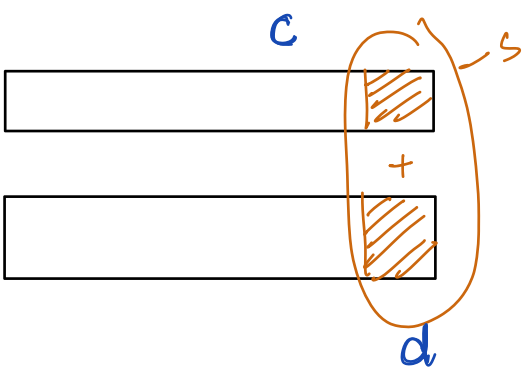


$x \% M \Rightarrow [0 \quad M-1]$



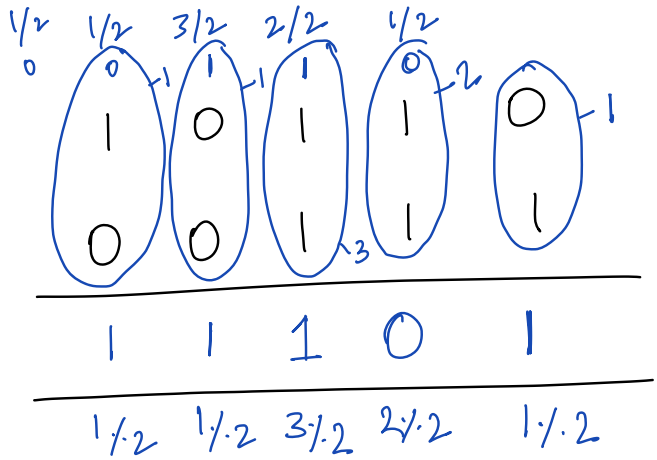
$[0 \quad 1]$

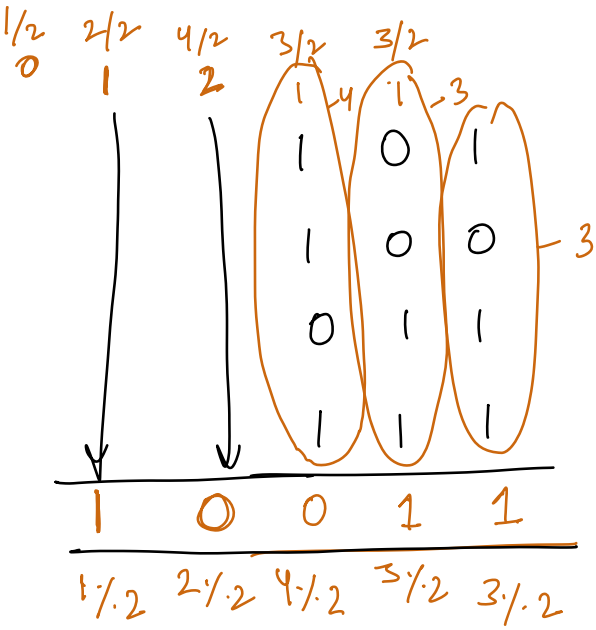
Generalise

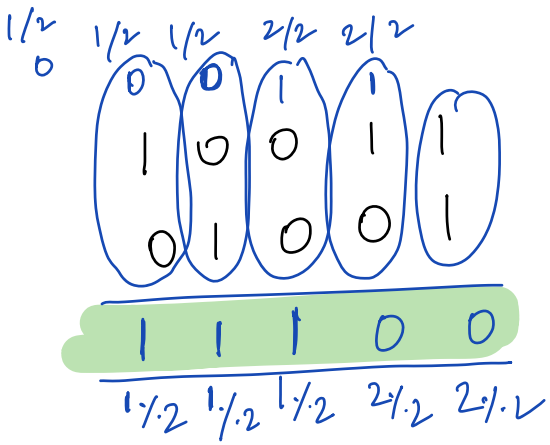


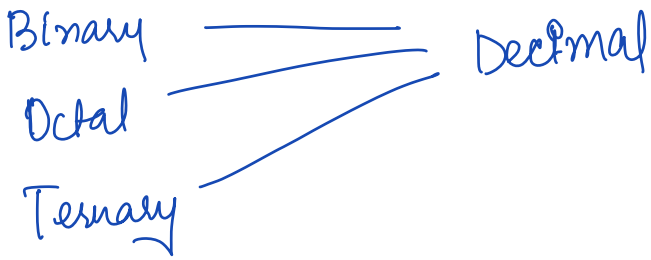
$d = S \% Base$

$c = S / Base$


1/2 1/2 3/2 2/2 1/2
1 1 1 0 1
1/2 1/2 3/2 2/2 1/2


1/2 2/2 4/2 3/2 3/2
1 0 0 1 1
1/2 2/2 4/2 3/2 3/2


1/2 1/2 1/2 2/2 2/2
1 1 1 0 0
1/2 1/2 1/2 2/2 2/2



Optional

#Todo / HW [Convert other bases]

#Todo ⇒ [Subtraction of Binary NOs.]

Break → 10:10

Bitwise Operators (&, |, ^, ~, >>, <<)

AND, OR, XOR, NOT

Bit Manip 2.

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

XOR $\Rightarrow$ $0 \wedge 0$, $1 \wedge 1$ $\rightarrow 0$

$0 \wedge 1$, $1 \wedge 0$ $\rightarrow 1$

a = 4 b = 3

4 & 3

2^2 2^1 2^0

4: 1 0 0

3: 0 1 1

0 0 0 $\rightarrow 0$

4 | 3

4: 1 0 0

3: 0 1 1

1 1 1 $\rightarrow 7$

4 ^ 3

4: 1 0 0

3: 0 1 1

1 1 1 $\Rightarrow 7$

a = 13 b = 10

	2^3	2^2	2^1	2^0
13:	1	1	0	1
10:	1	0	1	0
13 & 10:	1	0	0	0
13 | 10:	1	1	1	1
13 ^ 10:	0	1	1	1

= 8

= 15

= 7

~ NOT [single operand]

a	~a
0	1
1	0

$\sim (10110)_2 \Rightarrow (01001)_2$

Simple Observation

	2^4	2^3	2^2	2^1	2^0
4	0	0	1	0	0
8	0	1	0	0	0
2	0	0	0	1	0
6	0	0	1	1	0
10	0	1	0	1	0
22	1	0	1	1	0

	2^4	2^3	2^2	2^1	2^0
3	0	0	0	1	1
7	0	0	1	1	1
1	0	0	0	0	1
5	0	0	1	0	1
15	0	1	1	1	1
11	0	1	0	1	1

QUIZ

$a = 11$

$a \mid 1$ $\Rightarrow$

1	0	1	1	odd
0	0	0	1	
1	0	1	1	

$a = 10$

$a \mid 1$ $\Rightarrow$

1	0	1	0	even
0	0	0	1	
1	0	1	1	

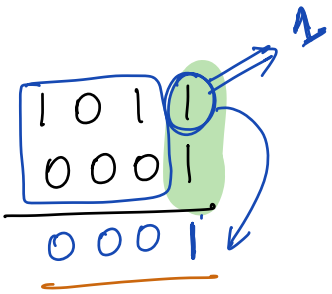
$1 \mid 0 \to 1$ $\quad$ $1 \mid 1 \to 1$

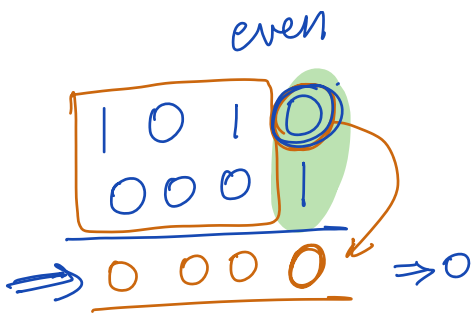
$0 \mid 0 \to 0$ $\quad$ $0 \mid 1 \to 1$

$a \mid 1$

- a is odd $\to a$
- a is even $\to a + 1$

Quiz $x \& 1$





$1 \& 0 \rightarrow 0$

$0 \& 0 \rightarrow 0$

$0 \& 1 \rightarrow 0$

$1 \& 1 \rightarrow 1$

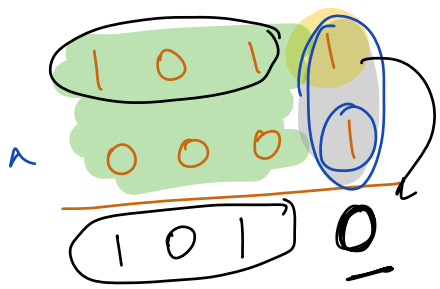
$x \& 1$

x is even $\rightarrow 0$

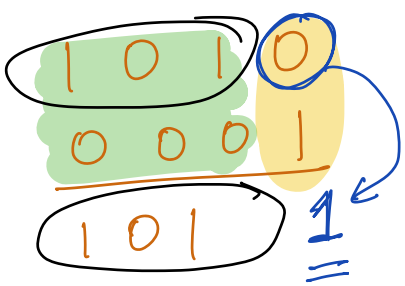
x is odd $\rightarrow 1$

Quiz $x \wedge 1$

odd



Even



gain 1

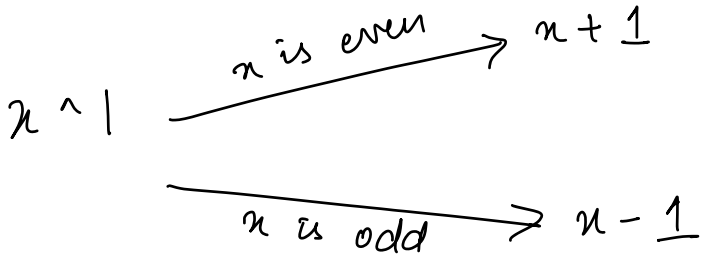
$1 \wedge 0 \rightarrow 1$

$0 \wedge 0 \rightarrow 0$

$1 \wedge 1 \rightarrow 0$

$0 \wedge 1 \rightarrow 1$

The bits gets toggled



Some more properties -

$a \mid a \rightarrow a$

```
  1 0 1 0 1 1
(OR) 1 0 1 0 1 1
-----------------
  1 0 1 0 1 1
-----------------
```

$a \,\&\, a \rightarrow a$

```
    1 0 1 0
&   1 0 1 0
-----------
    1 0 1 0
-----------
```

$a \wedge a \rightarrow 0$

$a \wedge 0 \rightarrow a$

$a \wedge b = b \wedge a$

$a \mid b = b \mid a$

$a \,\&\, b = b \,\&\, a$

} commutative

$a \wedge b \wedge c = (a \wedge b) \wedge c$

$(a \wedge c) \wedge b$

$(c \wedge a) \wedge b$

} Associative

If $a \wedge b = K$

To prove: $a \wedge K = b$

$a \wedge b = K$

XOR with a on both sides

$a \wedge a \wedge b = K \wedge a$

$0 \wedge b = K \wedge a$

$b = K \wedge a$

$b \wedge K = a$

$a \wedge b = K$

Take XOR b on both sides

$a \wedge b \wedge b = K \wedge b$

$a \wedge 0 = K \wedge b$

$a = K \wedge b$

Ques: Single Number I

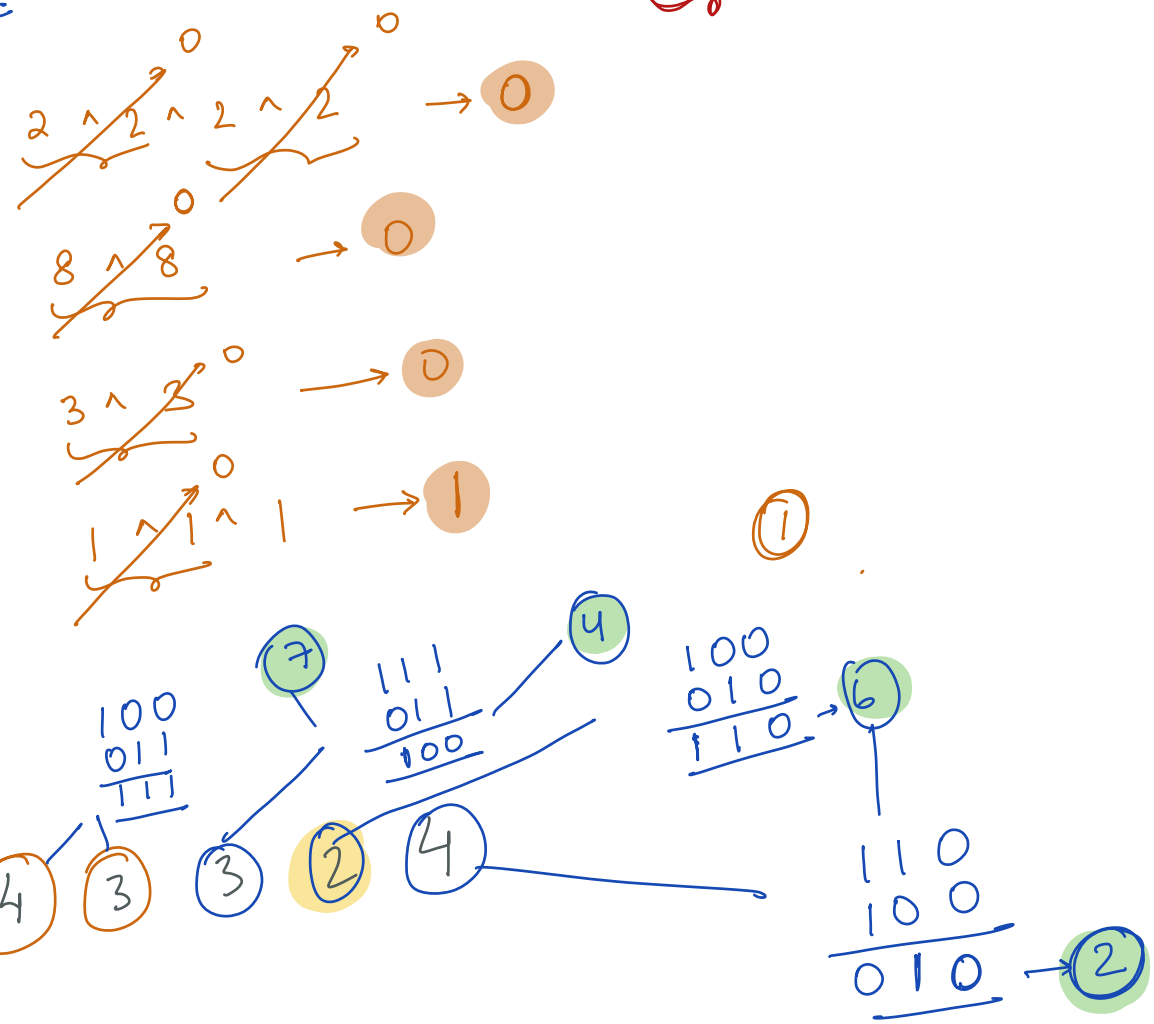
Goodera Nagaro Adobe MS Oyo Amazon Amdocs

Given an array where all elements appear even no. of times except 1 element which appears odd no. of times. Find the ele appearing odd no. of times

2, 8, 3, 1, 2, 2, 3, 2, 8, 1, 1

Ans → 1

$a \wedge a \Rightarrow 0$



Code

```
X = 0
for(i = 0 ; i < N ; i++){
|     X = X ^ A[i]
|
}
return X
```

TC ⇒ O(N)

SC ⇒ O(1)