

# Decimal to Binary

$(11)_{10}$  to  $(?)_2$

Sol:

$$\begin{array}{r} 2 \overline{) 11} - 1 \rightarrow \text{L.S.B} \\ 2 \overline{) 5} - 1 \\ 2 \overline{) 2} - 0 \\ 2 \overline{) 1} - 1 \rightarrow \text{m.s.B} \\ \hline 6 \end{array}$$

BASIC

m.s.B  $\rightarrow$  L.S.B

$(1011)_2$

Shortcut:

8	4	2	1
1	0	1	1

# Binary to Decimal

$(1011)_2$  to  $(?)_{10}$

3	2	1	0
1	0	1	1

$$(2^3 \times 1) + (2^2 \times 0) + (2^1 \times 1) + (2^0 \times 1)$$

$$= 8 + 0 + 2 + 1$$

$$= 11$$

Shortcut:

8	4	2	1
1	0	1	1

$$8 + 0 + 2 + 1$$

$$= 11$$

Q1.  $(22)_{10}$  to  $(?)_2$

Sol:  $\begin{array}{ccccc} 16 & 8 & 4 & 2 & 1 \end{array}$

$\begin{array}{ccccc} 1 & 0 & 1 & 1 & 0 \end{array}$

$\therefore (10110)_2$  (Ans).

Q2.  $(45)_{10}$  to  $(?)_2$

Sol:  $\begin{array}{cccccc} 32 & 16 & 8 & 4 & 2 & 1 \end{array}$

$\begin{array}{cccccc} 1 & 0 & 1 & 1 & 0 & 1 \end{array}$

# Boolean Algebra

Bitwise operator	Symbol
AND	&
OR	
XOR	^
NOT	~

Truth table;

Input		Output					
A	B	AND	OR	XOR	NAND	NOR	XNOR
0	0	0	0	0	3	3	3
0	1	0	1	1	3	2	2
0	2	0	2	2	3	1	1
0	3	0	3	3	3	0	0
1	0	0	1	1	3	2	2
1	1	1	1	0	2	2	3
1	2	0	3	3	3	0	0

# XOR

010110

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

Similarly — 010110

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

Key observation: occurrence of '0' doesn't matter.

Even number of '1', XOR = 0

Odd " " '1', XOR = 1

$$000000 = 0$$

$$000001 = 1$$

$$01110 = 0$$

# Bitwise Operations

Let,  $a = 9$ ,  $b = 19$

$$\therefore a \& b = \underline{1}$$

Explanation:

	128	64	32	16	8	4	2	1
$a =$	0	0	0	0	1	0	0	1
$b =$	0	0	0	1	0	0	1	1
<hr/>								
$a \& b =$	0	0	0	0	0	0	0	1

$$(1)_2 = (1)_{10}$$

Quiz.  $11 \& 19 = ?$

Sol:

	128	64	32	16	8	4	2	1
$11 \rightarrow$	0	0	0	0	1	0	1	1
$19 \rightarrow$	0	0	0	1	0	0	1	1
<hr/>								
$11 \& 19 \rightarrow$	0	0	0	0	0	0	1	1

$$\therefore (11)_2 = (3)_{10}$$

Q. Prove that  $11 \mid 19 = 27$

⇒

	128	64	32	16	8	4	2	1
11 →	0	0	0	0	1	0	1	1
19 →	0	0	0	1	0	0	1	1
<hr/>								
11 & 19 →	0	0	0	1	1	0	1	1

1 1 0 1 1

$$16 + 8 + 0 + 2 + 1 = 27$$

(Proved)

Q.  $11 \oplus 19 = ?$

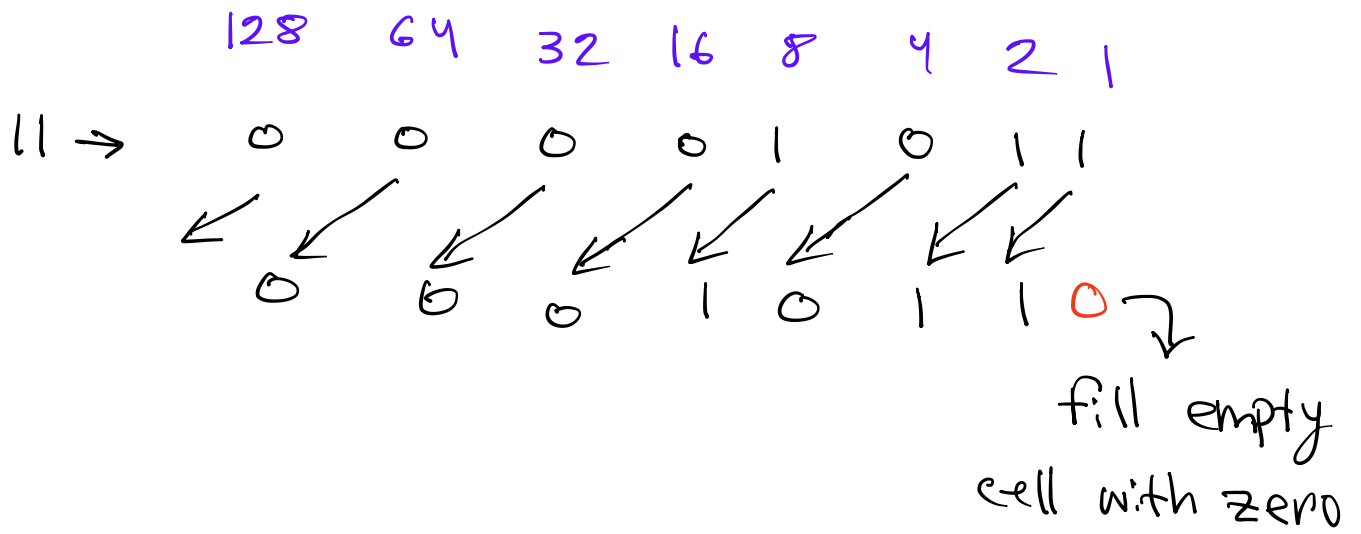
⇒

	128	64	32	16	8	4	2	1
11 →	0	0	0	0	1	0	1	1
19 →	0	0	0	1	0	0	1	1
<hr/>								
11 ⊕ 19 →	0	0	0	1	1	0	0	0

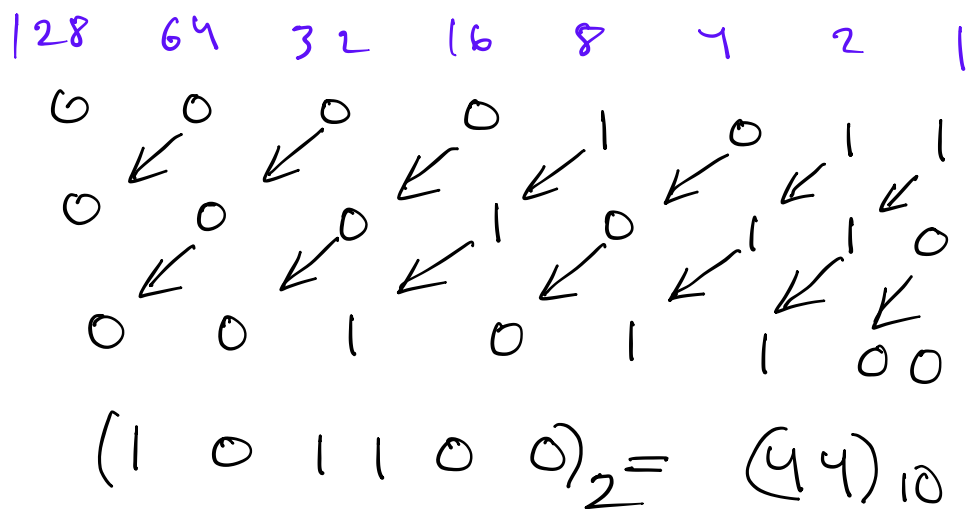
1 1 0 0 0

$$16 + 8 = 24 \text{ (Ans.)}$$

# Left-shift



11 Left-shift (one position) = 22



∴ 11 left-shift by 2 positions;

11 becomes 44

Observation:

11 → 22 → 44

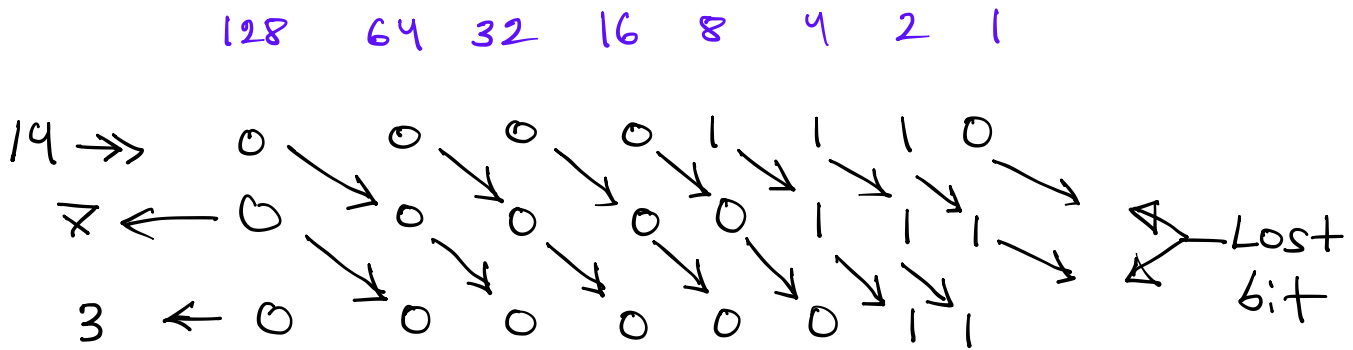
Guess 11 left-shift by 3 position :D

```
int a = 11;
cout << (a<<1) << nl; → 22
cout << (a<<2) << nl;
                        ↓
                        44
```

Guess the output...!

```
cout << (1<<5);
```

## Right-shift



Key observation:  $14 \rightarrow 7 \rightarrow 3$

~~#~~ floor division by 2 at each step

\* to handle overflow, add 1LL...