

Bit Manipulation

binary

int $n = 2;$

nibble

2^4

16

① $0 - 15$ X

② -ve zero

③ MSB - sign

1	0	0	0	-	-8
1	0	0	1	-	-7
1	0	1	0	-	-6
1	0	1	1	-	-5
1	1	0	0	-	-4
1	1	0	1	-	-3
1	1	1	0	-	-2
1	1	1	1	-	-1
0	0	0	0		0
0	0	0	1		1
0	0	1	0		2
0	0	1	1		3
0	1	0	0		4
0	1	0	1		5
0	1	1	0		6
0	1	1	1		7



-5

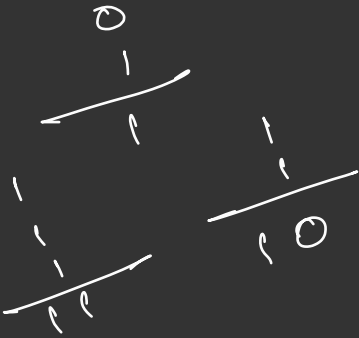
101

2's complement

① \rightarrow Complement bit

② add 1

$$\begin{array}{r}
 0101 \\
 \hline
 1010 \\
 1 \\
 \hline
 1011
 \end{array}$$



Decimal - binary base 10

$$487 \Rightarrow 4 \times 10^2 + 8 \times 10^1 + 7 \times 10^0$$

$$101 \Rightarrow 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

+ve

- ① Convert
- ② Fit to bits

$$x = -100$$

-ve

- ① Convert without sign
- ② Fit to bits
- ③ 2's complement

② Binary-Decimal

+ve

- ① MSB = 0
- ② Convert

-ve

- ① MSB = 1
- ② 2's complement
- ③ Convert
- ④ -ve sign

Bitwise Operators

① & (AND)

a	b	
0	0	0
0	1	0
1	0	0
1	1	1

$$a \& 1 \Rightarrow a$$

$$a \& 0 \Rightarrow 0$$

② | (OR)

a	b	
0	0	0
0	1	1
1	0	1
1	1	1

$$a | 0 \Rightarrow a$$

$$a | 1 \Rightarrow 1$$

③ ^ (XOR)

a	b	
0	0	0
0	1	1
1	0	1
1	1	0

$$a \wedge 1 \Rightarrow \sim a$$

$$a \wedge 0 \Rightarrow a$$

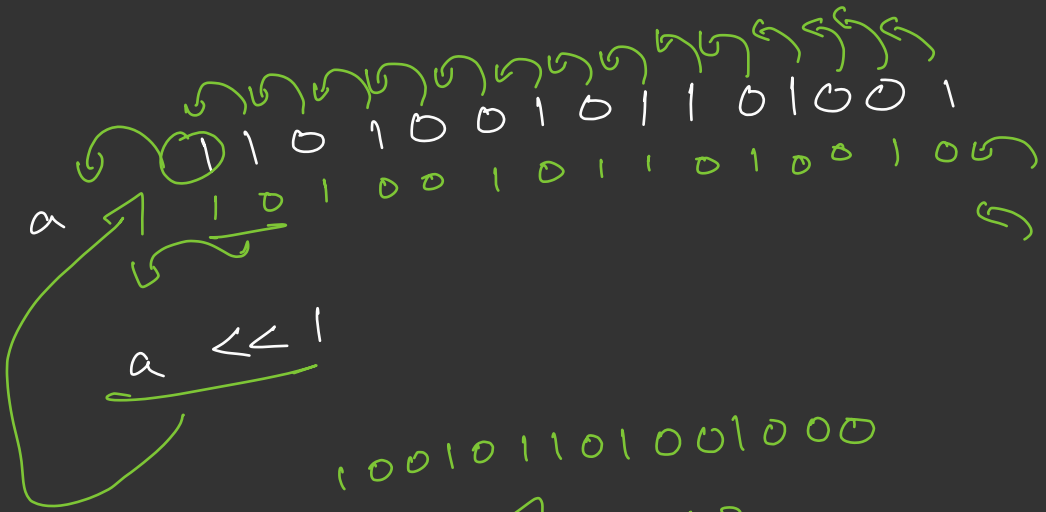
④ ~

$$\sim a$$

$$\sim 1 \Rightarrow 0$$

$$\sim 0 \Rightarrow 1$$

③ << (Left shift)



100101101001000



00001	$\Rightarrow 1$
00010	$\Rightarrow 2$
00100	$\Rightarrow 4$
01000	$\Rightarrow 8$

>> (Right Shift)

a = 01011
00010

a >> 2

b = 1101100

b >> 3

→ 111101

>>>

Only adds 0 on left

b = 1101100

b >> 3

0001101

Ques turn ^{ith} bit off (convert bit to 0)
a & mask

i = 4

	8	7	6	5	4	3	2	1
a	1	1	0	1	1	0	0	1
mask	1	1	1	1	0	1	1	1
<hr/>								
	1	1	0	1	0	0	0	1

Ques turn ith bit on (convert bit to 1)

i = 3

	8	7	6	5	4	3	2	1
a	1	1	0	1	1	0	0	1
mask	0	0	0	0	0	1	0	0
<hr/>								
	1	1	0	1	1	1	0	1

OR (1)

Ques toggle the bit

i = 6

	8	7	6	5	4	3	2	1
a	1	1	0	1	1	0	0	1
mask	0	0	1	0	0	0	0	0
<hr/>								
	1	1	1	1	1	0	0	1

0000001 << 2

i = 3

1 << (i-1)th

int n = 5



i = 2

1 << 1

0000100 mask

2	S
2	2 1
2	1 0
	0 1

0000101
0000010
0000001
0001111

1 1 1
2⁰
2¹
2²

4 + 2 + 1
= 7

00000001

0001000

1 << i-1

ith

