

Bitwise operation

AND

XOR

OR

NOT

$$N = 10110101$$

$$\sim N = \underbrace{01001010}$$

$$13 \rightarrow 001101$$

$$21 \rightarrow 010101$$

$$13 \text{ OR } 21 \rightarrow 011101 \rightarrow 29$$

$$13 \text{ XOR } 21 \rightarrow 011000 \rightarrow 24$$

NOT CYCLIC

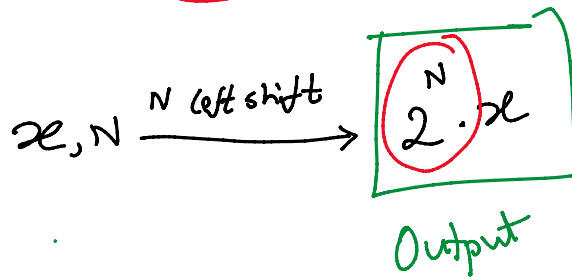
<< Left shift

$$\begin{array}{ccccccc} 0 & 0 & 1 & 0 & & 0 & 1 & 0 & 1 \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 0 & 1 & 0 & 0 & & 1 & 0 & 1 & 0 \end{array} \rightarrow 37 \rightarrow 74$$

$$\begin{aligned} & \textcircled{a_1} \textcircled{a_2} \textcircled{a_3} \dots \textcircled{a_p} = N \\ & 2^{a_1+K} + 2^{a_2+K} + 2^{a_3+K} + \dots + 2^{a_p+K} \\ & = 2^k \cdot 2^{a_1} + 2^k \cdot 2^{a_2} + \dots + 2^k \cdot 2^{a_p} \\ & = 2^k (2^{a_1} + 2^{a_2} + \dots + 2^{a_p}) \\ & = \textcircled{2^k \cdot N} \end{aligned}$$



$$= (2 \cdot N)$$



$$1, N \longrightarrow 2^N \cdot 1$$

$$1 \ll N \longrightarrow 2^N$$

75
2

$$1 \ll 75$$

$$1_{10} \longrightarrow$$

0000	0001 $\rightarrow 2^0$
0000	0010 $\rightarrow 2^1$
0000	0100 $\rightarrow 2^2$
0000	1000 $\rightarrow 2^3$

$$n = 24$$

$$\downarrow$$

$$12 \rightarrow 6 \rightarrow 3$$

$$60$$

$$\boxed{1 \leq n \leq 10^{18}}$$

$$\leftarrow 1000 \ 0000 \dots$$

$$16_{10} \longrightarrow 000010000$$

$$15_{10} \longrightarrow 000001111$$

$$\hline 0000 \ 0000$$

$$\log_2(N)$$

$$N \& (N-1) \longrightarrow 0$$

\rightarrow perfect power of two

④ signed ⑧ unsigned

$$\sim 10$$

$$\downarrow$$

$$0000 \ 1010$$

$$\boxed{1111 \ 0101}$$

$$-11$$

$$\sim 10$$

$$0000 \ 1010$$

$$\boxed{1111 \ 0101}$$

$$n$$

$$000 \ 1010$$

$$1011$$

$$\sim n = (2^{b_n} - 1) - n$$

$$= (2^{32} - 1) - 10 =$$

$$= (2^3 - 1) - 10 =$$

$$1 \rightarrow 2^0$$

$$2 \rightarrow 2^1$$

$$4 \rightarrow 2^2$$

$$8 \rightarrow 2^3$$

$$16 \rightarrow 2^4$$

$$32 \rightarrow 2^5$$

(k)

$$2^k = N$$

$$\therefore k = \log_2(N)$$

$$\Rightarrow \log(2^k) = \log(N)$$

$$\Rightarrow k \log(2) = \log(N)$$