

# Bitwise Operator

1 0

bits 0, 1

2 - ① - BR

2 → 010, -365

bin → 2

01✓  
25X

int → 4 bytes

8 bits ⇒ 1 bytes

32 bits ⇒ 4 bytes

2 | 2  
2 | 1 - 0  
0 - 1

010  
2 = 0010

2 | 7  
2 | 3 - 1  
2 | 1 - 1  
0 - 1

111 → 111

4 bits 0111

8 bits ⇒ 00000111

## Different Bitwise Operator

bits

1 & 2

0 0 ⇒ 0  
0 1 ⇒ 0  
1 0 ⇒ 0  
1 1 ⇒ 1

Logical AND  
2 & 2 = 1  
2 & 2 = 0

a = 5, b = 4

a & b

2 | 4  
2 | 2 - 0  
2 | 1 - 0  
0 - 1  
001 ⇒ 0100  
4 = 0101 ⇒ 5

32 bits ⇒ 4 bytes

00000000 — 0101

0101  
0100  
0100 ⇒ 4  
2<sup>3</sup> 2<sup>2</sup> 2<sup>1</sup> 2<sup>0</sup>

~~8~~ 4 ~~2~~ ~~1~~ ⇒ 12

$$a=3, b=2$$

$$a \& b$$

$$0011$$

$$0010$$

$$\underline{0010} \Rightarrow 2 //$$

$$\begin{array}{r} 2 \overline{) 2} \\ 2 \overline{) 1} - 0 \\ 0 - 1 \end{array} \quad \begin{array}{r} 2 \overline{) 3} \\ 2 \overline{) 1} - 1 \\ 0 - 1 \end{array}$$

$$01 \Rightarrow 10$$

$$0010$$

$$0011$$

$$\text{logical} = 11$$

27 1

$$00-0$$

$$01-1$$

$$10-1$$

$$11-1$$

$$a=8, b=9$$

$$a \mid b$$

$$1000$$

$$-1001$$

$$\underline{1001} \Rightarrow 9$$

$$2^3 \quad 2^4 \quad 2^5$$

$$\begin{array}{c} 2^7 \quad 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \\ \hline 64 \quad 16 \quad 4 \quad 1 \end{array}$$

$$64 + 16 + 4 + 1 \Rightarrow \text{Decimal}$$

37 ~

$$0-1$$

$$1-0$$

$$a=6$$

$$= 0110$$

$$\sim a = 1001 \Rightarrow 9 //$$

$$4 \text{ bits}$$

$$\begin{array}{r} 2 \overline{) 6} \\ 2 \overline{) 3} - 0 \\ 2 \overline{) 1} - 1 \\ 0 - 1 \end{array}$$

$$011 \Rightarrow 0110$$

$$(-7)$$

int  $\Rightarrow$  32 bits

0000

0110

$\sim a$  | 1 1 1 1

1001  $\Rightarrow$  Ans

How.

MSB  $\Rightarrow$  1 -ve

MSB  $\Rightarrow$  0 +ve

-ve

$\hookrightarrow$  2's complement

1's  $\Rightarrow$  0000

2's

0110  
+1  
-----  
1001  
2<sup>2</sup> 2<sup>1</sup> 2<sup>0</sup>  
4 + 2 + 1 = 7  
= -7 //

a = 4

000 000 000 000100

32 bits

2 | 4  
2 | 2 - 0  
2 | 1 - 0  
0 - 1

$\sim a \Rightarrow$  1111 1111 1111 111011  $\rightarrow$  Memory (-ve)

2's

MSB = 1 -ve

MSB = 0  $\rightarrow$  +ve

1's 0000 0000 0000 000100

+1

2's 000000

101  $\Rightarrow$  -5 //

doubt  
comment

\* 4) XOR (^)

0 . 0 = 0

0 . 1 = 1

1 . 0 = 1

1 . 1 = 0

$a \wedge a = 0$

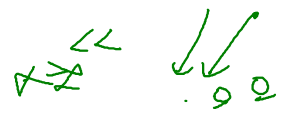
$a \wedge 0 = a$

a = 7, b = 3

0111  
0011  
-----  
0100  $\Rightarrow$  4

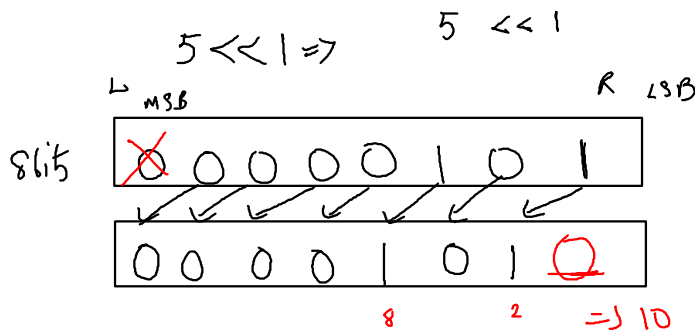
# 5/ Left shift operator ( $\ll$ )

LeS

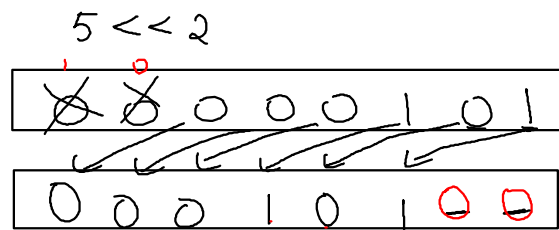


$\ll$

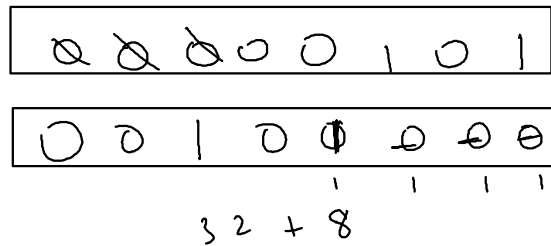
$\Rightarrow$  shift bits right to left  $3 \ll$



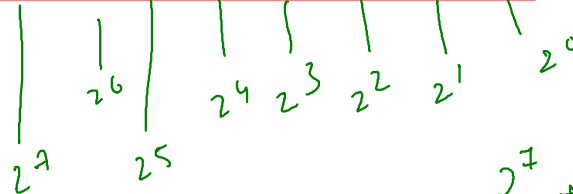
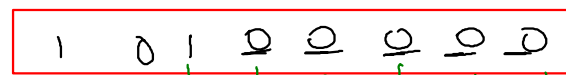
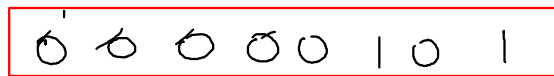
$$\left\{ \begin{array}{l} 5 \ll 1 = 10 \\ 5 \ll 2 = 20 \\ 5 \ll 3 = 40 \end{array} \right\}$$



5  $\ll$  3



5  $\ll$  5



$$2^7 + 2^5 \Rightarrow 128 + 32 \Rightarrow 160 //$$

$\left\{ \begin{array}{l} 100 \text{ --- } 11 \\ 000 \text{ --- } 110 \end{array} \right\} \times$  -ve

MSB = 1  $\Rightarrow$  -ve

Solve.

Proceed

$$5 * 2^1 = 10$$

$$5 * 2^2 = 20$$

$$5 + 2^3 + 2 = 40$$

$$5 \neq 5$$

$$5 * 2^5 \Rightarrow 5 + 32 \Rightarrow 160 //$$

4  $\ll$  2

$$4 * 2^2 \Rightarrow 16 //$$

Padding - 0

# Problem

$$A = 3$$

$$A = A \ll 2$$

$$A = A \ll 3$$

$$A = A \ll 4$$

$$\rightarrow 000000011$$

$$\rightarrow 00001100$$

$$\rightarrow 00100000$$

$$\rightarrow 000000000000 \Rightarrow 0 \times$$

$$4 \text{ bits}$$

$$32 \text{ bits}$$

=> final

$$11 \text{ bits}$$

$$8 \text{ bits}$$

$$32 \text{ bits}$$

$$\Rightarrow 1024$$

$$512$$

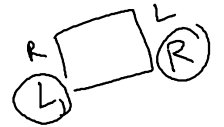
$$1536$$

47 Right Shift Operator

>>

6 bits will shift from left to right

$$2 \mid 10 \mid 10$$



$$4 > 3$$

$$\frac{4}{2 \times 2 \times 2} \frac{1}{2} = 0$$

$$6 >> 1$$

R

$$0000011$$

$$0000011$$

$$6 >> 1 = 3$$

$$6 >> 2 = 1$$

$$6 >> 3 = 0$$

00-padded

$$6 >> 2$$

$$00000110$$

$$00000110$$

$$8 \mid 60$$

$$6 >> 3$$

$$00000110 \Rightarrow 0$$

$$6 >> 1 = 3$$

$$6 >> 2 = 1$$

$$6 >> 3 = 0$$

$$\frac{6}{2} = 3$$

$$\frac{6}{2 \times 2} \Rightarrow \frac{6}{4} = 1$$

$$\frac{6}{2 \times 2 \times 2} \Rightarrow \frac{6}{8} = 0$$

$$<< 1 = \times 2$$

$$2 \Rightarrow \times 2 \times 2$$

$$>> \frac{2}{2}$$

$$\frac{2}{2 \times 2}$$

$$\begin{array}{l|l} \text{LS} & \text{RS} \\ \hline << & >> \\ \hline \leftarrow & \rightarrow \\ \hline \times 2 & \div 2 \end{array}$$

$$\begin{array}{r} 1.5 \\ 4 \overline{) 6} \\ \underline{4} \phantom{0} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

even or odd

number = 7

$$\begin{array}{r} 11 \textcircled{1} \\ 21 \\ \hline 001 \Rightarrow \textcircled{1} \end{array}$$

$\Rightarrow \textcircled{1}$

$$\begin{array}{r} 110 \\ 111 \\ \hline \end{array}$$

$\rightarrow \text{odd}$

$\rightarrow \text{even.}$

$$\begin{array}{r} 110 \\ 21 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 111 \\ 1 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 1000 \\ 21 \\ \hline 000 \textcircled{0} \rightarrow \text{even} \end{array}$$

$$\begin{array}{l} 2^3 = 8 + 9 = \text{odd} \\ 2^4 = 16 + 1 = 17 \text{ odd} \\ 1 \rightarrow \text{odd} \\ 0 \rightarrow \text{even} \\ 1000 \text{ } \\ 1000 \text{ } \\ 1000 \text{ } \rightarrow 17 \text{ odd} \end{array}$$

$$\begin{array}{r} \boxed{\phantom{000}} \\ 2^2 \ 2^1 \ 2^0 \\ 4 \ 2 \ \textcircled{1} \end{array}$$

27 2 Swap, without using any 3<sup>rd</sup> variable.

$$\left. \begin{array}{l} a = 5 \\ b = 4 \end{array} \right\}$$

$$\text{temp} = a$$

$$a = b$$

$$b = \text{temp}$$

xor ||

$$\boxed{\cancel{4} 5}$$

a

$$\boxed{\cancel{4} 5}$$

b

$$\boxed{5}$$

temp

↓

$$\left\{ \begin{array}{l} a = 4 \\ b = 5 \end{array} \right.$$

$$a = 4$$

$$b = 5$$

$$\Rightarrow \left. \begin{array}{l} a = 5 \\ b = 4 \end{array} \right\} \text{output.}$$

$$\left\{ \begin{array}{l} 0 \cdot 0 \Rightarrow 0 \\ 0 \cdot 1 \Rightarrow 1 \\ 1 \cdot 1 \Rightarrow 0 \end{array} \right\}$$

$$\begin{array}{l} a = a \wedge b; \\ b = a \wedge b \\ a = a \wedge b \end{array}$$

$$\left\{ \begin{array}{l} 100 \\ 101 \\ \hline 001 \Rightarrow 1 \end{array} \right\} a = 1$$

$$\begin{array}{l} a \wedge b \\ 001 \\ 101 \\ \hline 100 \end{array} \left\} b = 4 \right.$$

$$\begin{array}{r} a \Rightarrow a \wedge b \\ 001 \\ 100 \\ \hline 101 \end{array}$$

$$a = 5$$

$$a = 5, b = 4$$

1-What is the result of  $5 \& 3$ ?

Options:

- a) 7
- ☒ b) 1
- c) 5
- d) 0

$$\begin{array}{r} 101 \\ 011 \\ \hline 001 \rightarrow 2^0 = 1 \end{array}$$

2 - What is the value of  $6 | 3$ ?

Options:

- ☒ a) 7
- b) 4
- c) 5
- d) 9

$$\begin{array}{r} 110 \\ 011 \\ \hline 111 = 7 \end{array}$$

3 -What is  $7 \wedge 3$ ?

Options:

- ☒ a) 4
- b) 5
- c) 6
- d) 7

$$\begin{array}{r} 111 \\ 011 \\ \hline 100 \end{array}$$

4- What is the output of  $\sim 5$  (assuming 8-bit)?

Options:

- a) -5
- ☒ b) -6
- c) 6
- d) 5

$$\begin{array}{r} 00000101 \\ \sim 5 \text{ } \textcircled{1} 1111010 \\ \hline -6 \end{array}$$

$$\begin{array}{r} 1's \Rightarrow 00000101 \\ + 1 \\ \hline 00000110 \\ \hline 6 \end{array}$$

5 -What is the value of  $1 \ll 3$ ?

Options:

- a) 4
- ☒ b) 8
- c) 3
- d) 6

$$1 \ll 3$$

$$\neq 2$$

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

6- What is the result of  $16 \gg 2$ ?

Options:

- ☒ a) 4
- b) 8
- c) 2
- d) 16

$$\begin{array}{r} 16 \times 4 \\ \hline 2 \times 2 \end{array}$$

7- What is  $12 \wedge 10$ ?

Options:

- ☒ a) 6
- b) 2
- c) 4
- d) 0

$$\begin{array}{r} 2 | 12 \\ 2 | 6 - 0 \\ 2 | 3 - 0 \\ 2 | 1 - 1 \\ 2 | 0 - 1 \end{array}$$

$$\begin{array}{r} 0011 \\ 1100 \Rightarrow 12 \end{array}$$

$$\begin{array}{r} 1100 \\ 1010 \\ \hline 0110 \end{array}$$

8- Which expression checks if a number is even?

Options:

- a)  $\text{num} \& 1 = 1$
- b)  $\text{num} | 1 = 0$
- ☒ c)  $\text{num} \& 1 = 0$
- d)  $\text{num} \wedge 1 = 1$

9- What is the value of  $9 \& (\sim 0)$ ?

Options:

- ☒ a) 9
- b) 0
- c) -1
- d) 1

$$\begin{array}{r} 0000 \\ 11111111 \Rightarrow \sim 0 \\ \hline 00001001 \\ 00001001 \Rightarrow 9 \end{array}$$

10- What will be the result of  $4 \ll 1 \mid 3$ ?

Options:

- ☒ a) 8
- ☒ b) 11
- c) 10
- d) 7

$$4 + 2 = 8$$
$$8 \mid 3$$

$$\begin{array}{r} 1000 \\ 0011 \\ \hline 1011 \end{array}$$

### Homework

- 1) What will be the result of  $5 \ll 1$ ? ✓
- 2) What will be the value of  $8 \gg 2$ ? ✓
- 3) What is the output of this expression:  $3 \ll 3$ ? ✓
- 4) What is the result of  $32 \gg 4$ ? ✓
- 5) If  $x = 4$ , then what is the result of:  $(x \ll 2) + (x \gg 1)$ ? ✓

} LS, RS









