

2's Complement

$$11001 = -7$$

positive
negative

Signed

unsigned: 1101
841
13

$\begin{array}{r} 0101 \quad 5 \\ 1010 \quad -5 \\ + \quad 1 \\ \hline 1011 \quad -5 \end{array}$ 取反+1

①

①001
unsigned: $2^3 \cdot 1 + 2^2 \cdot 0 + 2^1 \cdot 0 + 2^0 \cdot 1$
 $= 8 + 1 = 9$

Signed (2's complement):
 $-2^3 \cdot 1 + 2^2 \cdot 0 + 2^1 \cdot 0 + 2^0 \cdot 1$
 $= -7$

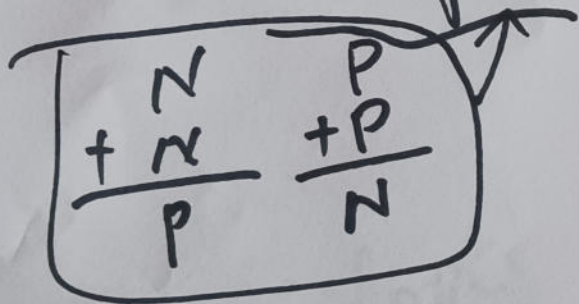
0111
1000
↑
1001
-

2 to the third power
 $2^3 = 8$

$$\begin{array}{r}
 11 -1 \\
 111 -1 \\
 1111 -1 \\
 \underline{ 1111} -1 \\
 1 \dots 1111 -1
 \end{array}$$

$$1 \dots \dots -10 \quad 1-1=-2$$

overflow \neq ~~carry~~ carry out



101	N	-3
+ 100	H	-4
1001	P	

overflow occurs

101	-3
+ 011	-3
000	

overflow doesn't occur

(2)

5-bit computer system

① 7+8 overflow?

② 12+11

③ -10 + ~~11~~ (-11)

~~0111~~

$$\begin{array}{r}
 01000 \text{ P} \\
 + 00111 \text{ P} \\
 \hline
 01111 \text{ P}
 \end{array}$$

adopt

$$\begin{array}{r}
 10110 \text{ N} \\
 + 10101 \text{ N} \text{ (2)} \\
 \hline
 10101 \text{ P} \\
 \hline
 -32 \\
 \hline
 8+3 \\
 \hline
 11 \\
 \hline
 \text{(3)}
 \end{array}$$

$$\begin{array}{r}
 01100 \text{ P } 12 \\
 01011 \text{ P } 11 \\
 \hline
 010111 \text{ N} \\
 \hline
 16 \quad 7
 \end{array}$$

$$\underline{12.625}_{(10)} \rightarrow \text{---}_{(2)}$$

$$\begin{array}{r} 2 \overline{) 12} \\ 2 \overline{) 6} \\ 2 \overline{) 3} \\ 2 \overline{) 1} \\ 0 \end{array} \begin{array}{l} 0 \\ 0 \\ 1 \\ 1 \\ \uparrow \end{array}$$

$$\begin{array}{r} \frac{1}{2} \overline{) 0.625} \\ \frac{1}{2} \overline{) 0.3125} \\ \frac{1}{2} \overline{) 0.15625} \\ \frac{1}{2} \overline{) 0.078125} \\ 0 \end{array} \begin{array}{l} 0.101 \\ 1 \\ 0 \\ 1 \\ \downarrow \end{array}$$

$$110 \frac{1}{(2)} \div 2 = 110.1_{(2)}$$

$$110 \frac{1}{(2)} \div 10$$

$$1101.1_{(2)}$$

$$\begin{array}{r} 2 \overline{) 1100.} \\ 2 \overline{) 110} \\ 2 \overline{) 11} \\ 2 \overline{) 1} \\ 0 \end{array} \begin{array}{l} \uparrow \\ 0 \\ 0 \\ 0 \\ 0 \\ \uparrow \end{array}$$

$$\begin{array}{r} \frac{1}{2} \overline{) 0.101}_{(2)} \\ \frac{1}{2} \overline{) 0.0505} \\ \frac{1}{2} \overline{) 0.02525} \\ \frac{1}{2} \overline{) 0.012625} \\ 0 \end{array} \begin{array}{l} 1 \\ 0 \\ 1 \\ 1 \\ \uparrow \end{array}$$

(4)

<< <

<= & 位与 bitwise AND

&& 事件逻辑与

| 位或 || 事件或

$A += 1;$ // $A = A + 1;$

$A \wedge = 1;$ // $A = A \oplus 1$, XOR

$\text{mask} \ll = 1;$ $A = \sim A$ bitwise XOR

⑤

棕棕黑黑—棕
1 1 0 $\times 10^0$ $\pm \frac{9}{10}$

⑥

1 1 1 1 0