

Binary Number Representation

$$(25)_{10} \Rightarrow \underline{11001}$$

↓

Unsigned Integer $(x)_{10} = (b_n b_{n-1} \dots b_0)_2$

8-bits

$n=8$

$2^n - 1$

0 → 0000 0000
255 → 1111 1111

$2^8 - 1$

$x + 1$

10 - - 0 00

$$= \sum_{i=0}^n b_i 2^i$$

Signed Version

$$+5 \rightarrow 0 \mid \underline{0000101}$$

$$-5 \rightarrow 1 \mid 0000101$$

$$-10 \rightarrow 1 \mid 0001010$$

Signed Magnitude

$$\text{Max: } 01111111$$

$$2^7 - 1 \mid 127$$

$$\text{Zero } (0)_{10} = 00000000$$

$$\text{Minimum: } 1111111$$

$$-(2^7 - 1) \mid 127$$

$$-127 = 126$$

$$1 \mid 0000000$$

$$255$$

Binary Unsigned

Signed Magnitude

(1)₁₀

0000 0001

0
0

(2)₁₀

0000 0010

(3)₁₀

0000 0100

(4)₁₀

0100 0000

(64)₁₀

X

-(4)

0100 0000

1100 0000

$n=32$

10 110

-10 110

$$\text{Min} \rightarrow - \begin{pmatrix} 3 \\ 2 \\ -1 \end{pmatrix}$$

Max $\rightarrow 2^{31} - 1$

h → bit (n-1)
Min → $(2^{h-1} - 1)$
Max → $(2^h - 1)$

0000 0000 0000 - 0000 0110
4 8 28 32

1 | 000 000 .
31

$$0 \mid \overset{1}{1} \overset{3}{1} \overset{1}{1} \quad \overset{1}{1} \overset{1}{1} \overset{1}{1} \overset{1}{1} \quad - \quad .$$

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Signed int

1's Complement

$$\underline{(x)}_{10} = (b_{n-1} b_{n-2} \dots b_1 b_0)_2$$

n-bit number

$$\begin{array}{r} 10 \rightarrow 0000 \ 0110 \\ - 10 \rightarrow 1111 \ 1111 \end{array}$$

$$-(x)_{10} = (\bar{b}_{n-1} \bar{b}_{n-2} \dots \bar{b}_1 \bar{b}_0)_2$$

0	+ve
1	-ve

5	0000 0101
-5	1111 1010

127	0111 1111
-127	1000 0000

2's complement.

$$(x)_{10} = (b_{n-1} b_{n-2} \dots b_1 b_0)_2$$

$$-(x)_{10} = \overline{b_{n-1}} \overline{b_{n-2}} \dots \overline{b_1} \overline{b_0} + 1$$

$$\begin{array}{r} (0)_{10} \quad 00000000 \\ -(0)_{10} \quad 11111111 \\ \hline \end{array}$$

$$\textcircled{1} \quad 00000001$$

$$\begin{array}{r} \quad \quad \quad 2^7 - 1 \\ w \rightarrow 00001010 \\ \quad 11110101 \\ \quad \quad \quad + 1 \\ \hline -(10)_2 \quad 11110110 \\ \quad \quad \quad \searrow \\ \quad \quad \quad -V_e \end{array}$$