

Binary Number Representation

$(25)_{10}$ \rightarrow

11001

\downarrow

Unsigned Integer

$$\underline{(x)_b} = (b_1 b_2 \dots b_n)_2$$

8-bits

$n=8$

$2^n - 1$

$$255 \xrightarrow{0 \rightarrow 0000} \begin{array}{cccc} 0 & 0 & 0 & 0 \end{array}$$

$2^8 - 1$

$$\xrightarrow{0000} \begin{array}{cccc} 1 & 1 & 1 & 1 \end{array}$$

$x + 1$

$$= \sum_{i=0}^{n-1} b_i 2^i$$

10 - - 6 80

Signed Version

$$\begin{array}{r} +5 \rightarrow 0|000\ 0101 \\ -5 \rightarrow 1|000\ 0101 \end{array}$$

$$-10 \rightarrow 1|000\ 1010$$

Signed Magnitude

$$\begin{array}{l} \text{Zero (0)}_{10} = \begin{cases} 0000 & \text{Mithium: } 1111111 \\ 1000 & 0000 \end{cases} \\ -127 \rightarrow 1|000\ 0000 \end{array}$$

$$\text{Max: } 0111\ 1111$$

$$2^7 - 1 | 127$$

$$\underline{255}$$

$$-(2^7 - 1) | 127$$

	Binary Unsigned	Signed Magnitude
$(1)_{10}$	0 0 0 0 0 0 0 1	0
$(2)_{10}$	0 0 0 0 0 0 1 0	0
$(3)_{10}$		
$(4)_{10}$	0 0 0 0 0 1 0 0	
$(64)_{10}$	1 0 0 0 0 0 0 0	0 1 0 0 0 0 0 0
<u>$-(64)$</u>	X	1 0 0 0 0 0 0 0 0

n=32

10	110	0 000 0000 0000 . - 0000 0110
-10	110	1 000 000 . 0000 0110

$$\text{Min} \rightarrow -(2^{\frac{31}{2}} - 1)$$

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

$$\overline{n \rightarrow \text{bit}_{(n-1)}(2^{\frac{n-1}{2}} - 1)}$$

Signed int

1's Complement

$$\underline{(x)}_{16} = (b_{n-1} b_{n-2} \dots b_1 b_0)_2$$

n-bit number

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

$$-10 \rightarrow \begin{array}{r} 1111 \\ 1011 \\ \hline \end{array}$$

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

$\frac{0}{1}$ <u>+ve</u> <u>-ve</u>	$\frac{5}{-5}$	$\frac{0000\ 0101}{1111\ 1010}$	$\frac{127}{-127}$	$\frac{01111111}{10000000}$
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2^r 's complement .

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

$$-(x)_{10} = \overline{b_{n-1} b_{n-2}} \quad \overline{\begin{matrix} b_1 & b_0 \\ + & 1 \end{matrix}}$$

$$(0)_{10} \quad 0000 \quad 0000$$

$$-(0)_{10} \quad 1111 \quad 1111$$

$$\underline{\underline{0000 \quad 0000}}$$

$$\begin{array}{r}
 2^r - 1 \\
 \hline
 10 \rightarrow 0 \overline{0000} \quad | 010 \\
 1111 \quad 010 \\
 + 1 \\
 \hline
 -(10)_2 \quad \overline{1111010} \\
 \downarrow \\
 -ve
 \end{array}$$