Numeri negativi

4 cifre $\square\ \square\ \square\ \square$

$\underbrace{\square}_{\text{segno}}\ \underbrace{\square\ \square\ \square}_{\text{contenuto numeri}}$

$\left.\begin{array}{l} 1\ 000 \\ 0\ 000 \end{array}\right\} \equiv \emptyset$

Rappresentazione a complemento

$x = 13$ $\qquad 13 - 13 = 0$

$y = -13$ $\qquad 13 + (-13) = 0$

4 cifre con base 10:

$\square\ \square\ \square\ \square$ $\qquad 0, \ldots, 9999$

$\# \text{ numeri} = \text{base}^{\# \text{cifre}} = 10^4$

$x = 3547$

$x + K = \text{base}^{\# \text{cifre}}$

$K =: \text{base}^n - x$

$K = 10^4 - 3547 = 6453$

$\boxed{3547} + \boxed{6453} = 1\boxed{0000}$

$3547 - 3547 = \boxed{0000}$

numero -3547 $\longleftrightarrow$ rappresentato da 6453

$0000, \ldots, 4999, 5000, 5001, \ldots, 9999$

$5001 \leftrightarrow -4999$

$9999 \leftrightarrow -1$

base = 10 cifre = 10

$-4'999'999'999$

$0, \dots, \frac{10^{10}}{2}, -\frac{10^{10}}{2} - 1, \dots, -1$

$\frac{10\,000\,000\,000}{2} = 5'000'000'000$

base 2

□ □ □ □

1 bit

cifre = 0, 1

1 bit

8 bit = 1 byte

1 KB = 1024 Byte

1 MB = 1024 KiloByte

Rapp. a Complemento in base 2

$b = 2, \quad n = 3$ □ □ □

$000, \dots, 111$

$\#$ numeri $= \text{base}^{\text{cifre}} = 2^3 = 8$

Senza negativi: $0, \dots, 7 \equiv 111_2$

num negativi con $b = 2, n = 3$

$x = 11_2 = 3_{10}$

$x + K = b^n = 1000$

$11_2 - K = 0$

$K = b^n - 11_2 = 1000 - 11$

$$\begin{array}{r} 1000 \; - \\ 11 \\ \hline 0101 \end{array}$$

$x = 11_2$

$K = 101_2$

$$\begin{array}{r} 1000 \; - \\ 11 \\ \hline 1 \end{array}$$

$0, 1, 2, 3, 4, -3, -2, -1$

$11 \longleftrightarrow 3$

$101 \longleftrightarrow -3$

$b = 2, \quad n = 3$ 8 numeri

Calcolo Complemento in base 2

1) $x = 1010100111 0101$

$K = ?$

Da destra lasciare bit invariati fino al primo 1

poi scambiare $0 \to 1$, $1 \to 0$

$K = 0101011000 1011$

$K + x = ?$

2) algoritmo: Complemento a 1 + somma di 1.

$x = 1010$

$x' = 0101$ complemento a 1

$x'' = x' + 1$

$$\begin{array}{r} \overset{1}{} \\ 0101 + \\ 0001 \\ \hline 0110 \end{array} \quad K$$

base 2

$1 + 1 = 10$

macchina a 32 bit intero occupa 32 bit.

$$-\frac{2^{32}}{2} + 1 \quad \cdots \quad \frac{2^{32}}{2}$$

Numeri reali

$x = 23.20197$

$= 2 \times 10 + 3 \times 10^{0} + 2 \times 10^{-1} + 0 \times 10^{-2}, \ldots + 7 \times 10^{-5}$

Sistema posizionale

$x = 101.101_2 = 1 \times 2^{2} + 0 \times 2^{1} + 1 \times 2^{0} + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$

$= 5.625_{10}$

$x = 127.931$ $\qquad$ $x = -975.75$

Rappresentazione normale:

$$x = 2.320197 \times 10^{1}$$

$$\cancel{= 232.0197 \times 10^{-1}}$$

$$x = (\text{segno})\ m \times b^{e}$$

$0 < m < \text{base}$

m: mantissa.
b: base.
e: esponente

$b = 10$ $\qquad$ $m = 2.320197$

$e = 1$

$$x = -127.23 = -\underbrace{1.2723}_{m} \times 10^{2}$$

e

Numero razionale standard IEEE

S	8 bit	23 bit
1 bit segno	esponente rapp. a complemento	mantissa

[illegible] $\times 2^{-1} +$ [illegible] $\times 2^{-2} + \cdots$ [illegible] $\times 2^{-23}$

$$x = (\text{segno})\ m \times 2^{e}$$

$2^{8} - 1$

$0, \dots, 255$

$-127, \dots, 128$

000000000
00000010
01000000

$2^{5} = 32$

$2^{6} = 64$

$2^{7} = 128$

$2^{8} = 256$

$01000001 \equiv -127$

□	□	□	10
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	−3
1	1	0	−2
1	1	1	−1

00000000	0
00011011	27
01111111	
1000 0000 →	128
10000001	−127

$$x = \underbrace{1.234}_{m} \times 2^{27} \quad e$$

27/2	13	1
13/2	6	1
6/2	3	0
3/2	1	1
1/2	0	1

$11011_2 =$

$1 + 2 + 8 + 16$