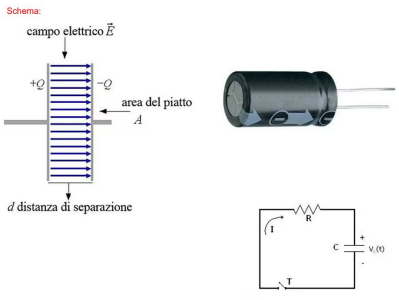
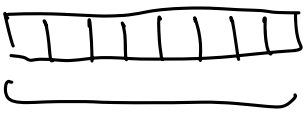
Condensatore



Carica $Q \propto \Delta V$ differenza di potenziale

Realizzazione di bit 0/1 nei sistemi elettronici.

1 bit 0/1 8bit ≡ 1 Byte



1 KB = 1024 Byte

1 MB = 1024 KByte

1 GB = 1024 MB

Hard Disk ⟶ Solid State Disk

Numeri Negativi:

4 bit/cifre □ □ □ □

Base 10 10^4 numeri: 0000, - - -, 9999

1) Bit del segno

000, - - -, 999

1000	0 *
1012	12
⋮	
1999	999
0000	-0 *
0123	-123
0999	-999

Ridondanza dello 0.

-999, - - -, 0, - - - 999

10^4 numeri ⟶ 1999 numeri

Base 2, 4 cifre ☐ ☐ ☐ ☐

1 000 · 0

⋮

1 111₂ +7

0 001 −1

⋮

0 111 −7

4 cifre $2^4 = 16$ numeri

−7, ---, −1, 7

acuto delle cifre ⇒ maggiore sacrificio dei numeri

Somma non op. meccanica

2) Rappresentazione a Complemento

Base 10, 4 cifre ☐ ☐ ☐ ☐

0000, ---, 9999

a = 3547

3547 + 6453 = 10000

6453: K. Complemento

K = b^cifra − a

```
  1 1 1
  3 5 4 7
  6 4 5 3
-------------
1 0 0 0 0
```

K ≡ −a

6453 Rappr in bit base 10. ⟶ −3547 numero che rappresenta

num. positivi

0000, ---, 5000, −4999, ---, −1

5001 + 4999 = 10000

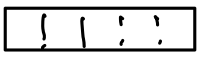
9999 $\longleftrightarrow$ -1

$9999 + 1 = 10000$

-27: $10000 - 27 = 9973$

$321 - 27 \equiv 321 + (-27)$

Rappr a Complemento in base 2

$b = 2 \quad n = 5$ 

$\#num = 2^5 = 32$ num. 00000, - - , 11111

0 31 in base 10.

$x = 111$ K t.c. $x + K = 100000$

$$\begin{array}{r} 100000 - \\ \quad 111 \\ \hline \end{array}$$

Somma in binario:

$1 + 1 = 10$ $\qquad 10 - 1 = 1$

$b = 2 \quad n = 3$ $\qquad 2^3 = 8 = 1000$

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

$11 + x = 1000$ base 2

$$\begin{array}{r} {\scriptstyle 1\ \ 1\ \ 10} \\ 1000 - \\ \quad 11 \\ \hline 0101 \end{array}$$

Verifica se 101 è complemento di 011

$$\begin{array}{r} {\scriptstyle 1\ \ 1} \\ 101 \\ 011 \\ \hline 1000 \end{array}$$

$x = 011_2 = 3_{10}$.

$K = 101_2 = 5_{10}$

$b = 2, \ n = 3$ $\qquad 11 \longleftrightarrow 3$

$101 \longleftrightarrow -3$

000, ..., ... 111

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

overflow

In C, C++, Integer int 32 bit.

Calcolo Complemento in base 2

1) $x = 1010$

$K = 0110$

$$\begin{array}{r} {\scriptstyle 1}\,{\scriptstyle 1}\,{\scriptstyle 1}\,{\scriptstyle 1} \\ 1010 \\ 0110 \\ \hline 10000 \end{array}$$

2) $x = 100101$

$K = 011011$

$$\begin{array}{r} {\scriptstyle 1}\,{\scriptstyle 1}\,{\scriptstyle 1}\,{\scriptstyle 1}\,{\scriptstyle 1}\,{\scriptstyle 1} \\ 100101 \\ 011011 \\ \hline 1000000 \end{array}$$

3) $x = 101$

$K = 011$

Da destra lasciare 0 fino al primo 1 che viene lasciato, poi scambiare $0 \rightarrow 1$, $1 \rightarrow 0$

$x = 1010100111101$

$K = 0101011000101 1$

Algoritmo: Complemento a 1 + 1

$x = 1010$

Compl. a 1 $x' = 0101$

Sommare 1 $x'' = x' + 1$

$$\begin{array}{r} {\scriptstyle 1} \\ 0101 \\ \quad 1 \\ \hline 0110 \end{array} \quad K$$

Vantaggi

1) Rapp di num + e − con gli stessi bit

2) operazione $\underset{\text{sott.}}{-}$ diventa una Somma.

$4 - 2 = 4 + (-2)$

$4_{10} = 0100$

$2_{10} = 0010$

$(-2)_{10} = 1110$

$$\begin{array}{r} {\scriptstyle 1\,1} \\ 0010 \\ 1110 \\ \hline 10000 \end{array} \quad 2\text{-}2$$

base 2 con 4 bit

$4 - 2 = 4 + (-2) = 2_{10}$

$$\begin{array}{r} 0100 + \\ 1110 \\ \hline 10010 \end{array} \quad = 10_2 \quad 2_{10}$$

Numeri Reali:

$x = 23.20197$

$2\times10^{1} + 3\times10^{0} + 2\times10^{-1} + 0\times10^{-2} + 1\times10^{-3} + 9\times10^{-4} + 7\times10^{-5}$

$x = 101.101_2$

$1\times2^{2} + 0\times2^{1} + 1\times2^{0} + 1\times2^{-1} + 0\times2^{-2} + 1\times2^{-3}$

$= 4 + 1 + 0.5 + 0.125 = 5.625_{10}$

$x = 23.20197 = 232.0197 \times 10^{-1}$

$= 2.320197 \times 10^{1}$ Rapp. normale.

$\sim$ intera $\in (0, b)$

$x = 101.101_2 = 1.01101_2 \times 2^{2}$

$x = 0.110 = 1.10 \times 2^{-1}$

$x = 0.235 = 2.35 \times 10^{-1}$

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

m: mantissa

e: esponente.

b: base.

(I) 3.23×10^{-3} $\quad m = 3.23$ $\quad e = -3.$ $\quad b = 10$

(I) 1.01101×2^{2} $\quad m = 1.01101$ $\quad e = 2$ $\quad b = 2$

Standard IEEE 32 bit — Virgola mobile

Float

S	esponente	mantissa

1 bit — 8 bit. — 23 bit

Segno. — Rappa compl. $-127 \to 128$

$(\ )\times 2^{-1} + (\ )\times 2^{-2} + \dots + (\ )\times 2^{-23}$

Rapp in virgola mobile

Num razionale: $x = \frac{n}{m}$

numero più grande: tutti bit 1.

Zero: tutti bit 0

1 000 — — 0. $\quad -0.0$

31 bit

0 00 — — — 0 $\quad +0.0$

31 bit