Sistemas de representação numérica

base 10

$$\underset{3}{2}\,\underset{2}{0}\,\underset{1}{5}\,\underset{0}{6} \rightarrow \text{notação posicional}$$

$$2 \times \boxed{10}^{3} + 0 \times \boxed{10}^{2} + 5 \times \boxed{10}^{1} + 6 \times \boxed{10}^{0} \rightarrow \text{polinomial}$$

base 2

$$1011_{(2)}$$

$$1 \times \boxed{2}^{3} + 0 \times \boxed{2}^{2} + 1 \times \boxed{2}^{1} + 1 \times \boxed{2}^{0} =$$

$$1 \times 8 + 0 + 1 \times 2 + 1 \times 1 = 11_{(10)}$$

$$\rightarrow \quad \overbrace{\boxed{d_{n-1}}\boxed{d_{n-2}}\boxed{\cdot}\ \cdots\ \boxed{d_0}}^{\text{inteira}} \; . \; \overbrace{\boxed{d_{-1}}\boxed{d_{-2}}\ \cdots\ \boxed{d_{-m}}}^{\text{parte fracionária}}$$

$$\rightarrow \quad \underbrace{d_{n-1} * b^{n-1} + d_{n-2} * b^{n-2} + \cdots + d_0 \underbrace{b^0}_{1}}_{\text{inteira}} + \underbrace{d_{-1} b^{-1} + \cdots + d_{-m} b^{-m}}_{\text{fracionária}}$$

n dígitos (d_{n-1} a d_0)

m dígitos (d_{-1} a d_{-m})

$$\overset{4}{1}\overset{3}{1}\overset{2}{0}\overset{1}{0}\overset{0}{1}_{(2)} = 2^4 + 2^3 + 2^0$$

$$= 16 + 8 + 1$$

$$= 25_{(10)}$$

153

$$153 = 128 + 16 + 8 + 1$$
$$= 2^7 + 2^4 + 2^3 + 2^0$$

$$\begin{array}{r} 153 \\ 128 \\ \hline 025 \\ 16 \\ \hline 09 \\ 8 \\ \hline 1 \end{array}$$

2^7			2^4	2^3			2^0
1	0	0	1	1	0	0	1

$2^0 \rightarrow 1$

$2^1 \rightarrow 2$

$2^2 \rightarrow 4$

$2^3 \rightarrow 8$

$2^4 \rightarrow 16$

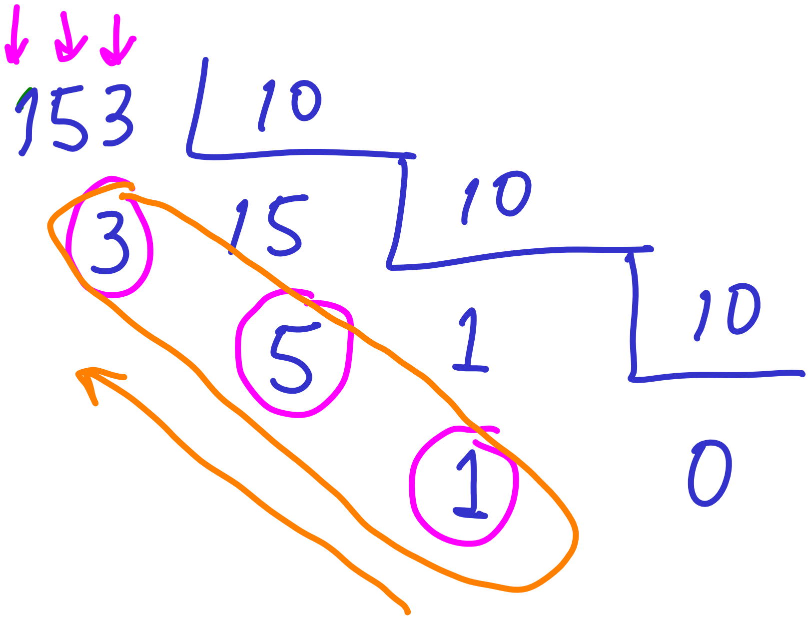
$2^5 \rightarrow 32$

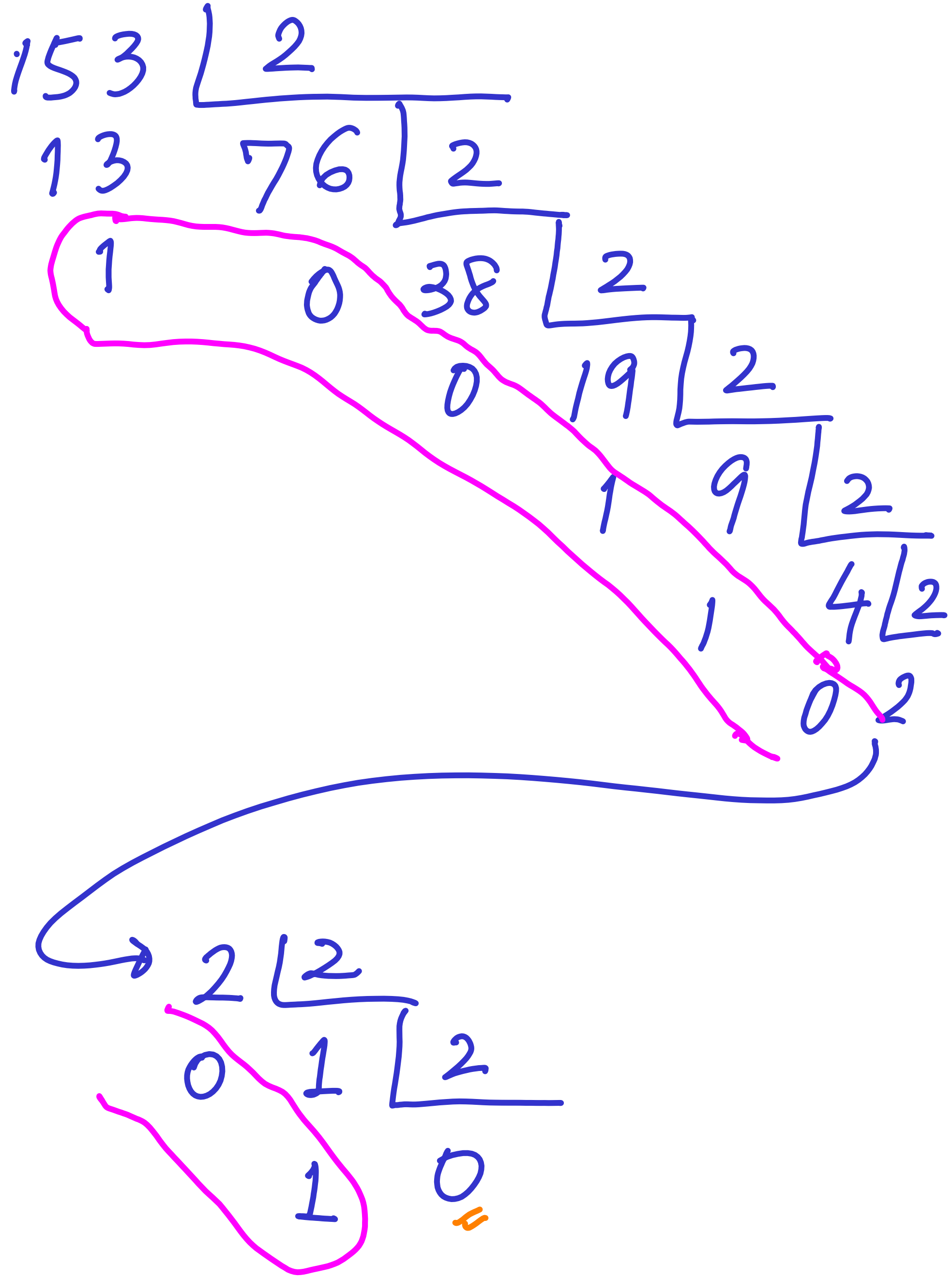
$2^6 \rightarrow 64$

$2^7 \rightarrow 128$

$2^8 \rightarrow 256$

$2^9 \rightarrow 512$





153

$\downarrow$

$\boxed{1\,0\,0\,1\,1\,0\,0\,1}_{(2)}$

$11_{(10)}$

$$1011_{(2)} = 1\times 2^3 + 1\times 2^1 + 1\times 2^0$$

$$= 2^3 + 2^1 + 2^0$$

$$\frac{2^3+2^1+2^0}{2} = \frac{2^2+2}{2} + 1$$

$$= 2^1 + 1$$

$$= \frac{2^1 + 0\times 2^0}{2} = 1 + 0$$

$153 \,\lfloor 10$

$3 \quad 15$

$150 + 3$

$\frac{15\times 10}{10} + 3$

153

0 1 0 0 1 1 0 0 1 ← base 2

2 3 1 ← base 8

000	0
001	1
010	2
011	3
100	4
101	5
110	6
111	7

1001 1001

9 9

$$9 \times 16 + 9 = 144 + 9 = 153$$

0 1 2 3 4 5 6 7 8 9 A B C D E F

1	1	1	1	1	1	1	1

F	F

BIT → Binary digit

Byte → 8 bits (8 dígitos binários)

nos inteiros → 64 bits

32 bits

25!

întreagă . fracționară

0!

1!

2!

⋮

25!

$$1094 = .1094 \times 10^{4}$$

$$1.094 = .1094 \times 10^{1}$$

$$0.1094 = .1094 \times 10^{0}$$

$$0.001094 = .1094 \times 10^{-2}$$

~~baza~~ + exponent

mantisa

base | exp.

64 bits $\rightarrow$ 0 a $2^{64}-1$

	3	2	1	0
2^4	2^3	2^2	2^1	2^0

$\leftarrow$ 4 bits

$2^4 - 1 =$

$$\boxed{1\,|\,0\,|\,0\,|\,0\,|\,0} = 2^4$$

$$\underbrace{\boxed{0\,|\,1\,|\,1\,|\,1\,|\,1}}_{2^3+2^2+2^1+2^0} + \underbrace{\boxed{0\,|\,0\,|\,0\,|\,0\,|\,1}}_{1} = \underbrace{\boxed{1\,|\,0\,|\,0\,|\,0\,|\,0}}_{2^4}$$

3	2	1	0

bit sinal

0 a 7

16 padrões binários possíveis

$\boxed{-7 \text{ a } 7}$

15 números

0 → positivo

1 → negativo

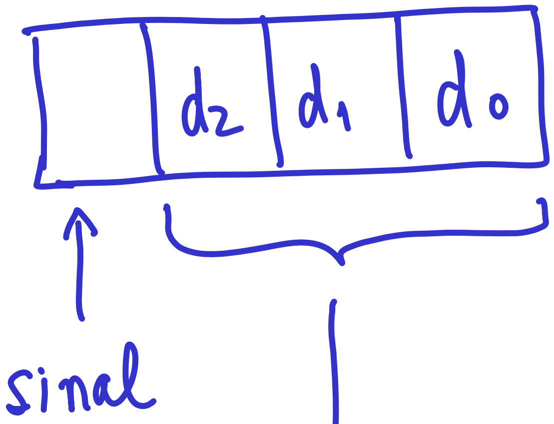
1000 −0

0000 +0

Complemento de um

$0101 \to +5$

$\underline{1}\underbrace{101}_{010} \to -2$



$0000 \to +0$

$1\underbrace{111} \to -0$

se sinal = 0 → magnitude é o próprio ($d_2 d_1 d_0$)

se sinal = 1 → magnitude é o complemento

$\overline{d_2}\,\overline{d_1}\,\overline{d_0}$

Complemento de dois

	d_2	d_1	d_0

Sinal

se $= 0 \longrightarrow$ valor $+\, d_2 d_1 d_0$

se $= 1 \longrightarrow$ valor $-\, (\bar{d}_2 \bar{d}_1 \bar{d}_0 + 1)$

Exemplo

$0101 \longrightarrow +5$

$1\underbrace{101}_{} \longrightarrow -3$

$$
\begin{array}{r}
010 \\
1 \\
\hline
011
\end{array}
$$

Binário	1º bit sinal	compl. um	compl. dois
000	0	0	0
001	1	1	1
010	2	2	2
011	3	3	3
100	-0	-3	-4
101	-1	-2	-3
110	-2	-1	-2
111	-3	-0	-1

$$-2^{63} \text{ até } 2^{63}-1$$

$$0 \text{ até } 2^{64}-1$$

$$00 \xrightarrow{\text{compl}} 11 \xrightarrow{+1}$$

$$\begin{array}{r} 11 \\ 1 \\ \hline \boxed{1}00 \end{array}$$

$$\begin{array}{r} 10 \\ 1 \\ \hline 11 \end{array} \qquad \begin{array}{r} 01 \\ 1 \\ \hline 10 \end{array} \qquad \begin{array}{r} 00 \\ 1 \\ \hline 01 \end{array}$$