Ficha: Sistemas de Numeração

1. binário → decimal

$$101.01_{(2)} = 1\times 2^2 + 0\times 2^1 + 1\times 2^0 + 0\times 2^{-1} + 1\times 2^{-2}$$
$$= 4 + 0 + 1 + 1/2 + 1/4 = 5 + 3/4 = 20/4 + 3/4 = 23/4 = 5.75_{(10)}$$

2. octal → decimal

$$234.5_{(8)} = 2\times 8^2 + 3\times 8^1 + 4\times 8^0 + 5\times 8^{-1}$$
$$= 2\times 64 + 24 + 4 + 5/8 = 128 + 28 + 5/8 = 152.625_{(10)}$$

3. hexadecimal → decimal

$$A3.3_{(10)} = 10\times 16^1 + 3\times 16^0 + 3\times 16^{-1}$$
$$= 160 + 3 + 3/16 = 163 + 3/16 = 163.1875_{(10)}$$

4. decimal → binário

123 | 2
03 61 | 2
1 01 30 | 2
1 10 15 | 2
0 1 7 | 2
1 3 | 2
1 1 | 2
1 0

$0,662\times 2 = 1,324$
$0,324\times 2 = 0,648$
$0,648\times 2 = 1,296$
$0,296\times 2 = 0,592$
$0,592\times 2 = 1,182$
$0,182\times 2 = 0,368$
$0,368\times 2 = 0,736$

$123_{(10)} = 111011_{(2)}$

$0,662_{(10)} = 1010100_{(2)}$

assim, $123,662_{(10)} = 1111011,1010100$

4. decimal → octal

123 | 8
43 15 | 8
3 7 1 | 8
1 0

$0,662\times 8 = 5,296$
$0,296\times 8 = 2,368$
$0,368\times 8 = 2,944$

$123_{(10)} = 371_{(8)}$

$0,662_{(10)} = 0,522_{(8)}$

assim, $123,662_{(10)} = 371,522_{(8)}$

4. decimal → hexadecimal

$$123 \,|\, \underline{16}$$
$$\underset{B}{\overset{\shortparallel}{11}} \quad 7 \,|\, \underline{16} \quad 7 \quad 0$$

$0,662 \times 16 = \overset{A}{\overset{\shortparallel}{10}},592$

$0,592 \times 16 = 9,472$

$0,472 \times 16 = 2,832$

$123_{(10)} = 7B_{(16)}$

$0,662_{(10)} = A92_{(16)}$

assim, $123,662_{(10)} = 7B,A92_{(10)}$

5. binário → hexadecimal

$\underbrace{1}_{1}\underbrace{0010}_{2}\underbrace{1001}_{9}\underbrace{1010}_{A},\underbrace{1110}_{E}\underbrace{1011}_{B}\,_{(2)} = 129A,EB_{(16)}$

5. binário → octal

$\underbrace{1}_{1}\underbrace{001}_{1}\underbrace{010}_{2}\underbrace{011}_{3}\underbrace{010}_{2},\underbrace{111}_{7}\underbrace{010}_{2}\underbrace{11}_{6}\,_{(2)} = 11232,726_{(8)}$

6. hexadecimal → octal → necessita de conversão intermédia

hexadecimal → binário

$ABC1,FE8_{(16)} = 1010\ 1011\ 1100\ 0001,1111\ 1110\ 1000_{(2)}$

binário → octal

$\underbrace{1}_{1}\underbrace{010}_{2}\underbrace{101}_{5}\underbrace{111}_{7}\underbrace{000}_{0}\underbrace{001}_{1},\underbrace{111}_{7}\underbrace{111}_{7}\underbrace{010}_{2}\underbrace{00}_{0}\,_{(2)}$ — $1010\ 1011\ 1100\ 0001,1111\ 1110\ 1000_{(2)} = 125701,7250_{(8)}$

$1 \quad 2 \quad 5 \quad 7 \quad 0 \quad 1 \quad 7 \quad 2 \quad 5 \quad 0$

7. octal → binário

$72_{(8)} = 111\ 010_{(2)}$

7. binário → hexadecimal

$111\ 010_{(2)} = 3A_{(16)}$

8. a) base 5 → decimal

$23,4_{(5)} = 2 \times 5^1 + 3 \times 5^0 + 3 \times 4^{-1}$

$= 10 + 3 + 3/4 = 13 + 3/4 = 13,75_{(10)}$

8. b) base 11 → decimal

$1A3_{(11)} = 11101010_{(2)} = 234_{(10)}$

8. c) base 9 → decimal

$375_{(9)} = 3\times9^2 + 7\times9^1 + 5\times9^0 = 243 + 63 + 1 = 311_{(10)}$

11. binário puro: $10001000_{(2)}$

positivo em cod. comp 1: $010001000_{(2)}$

negativo em cod. comp 1: $101110111_{(2)}$

12 binário puro: $10000001_{(2)}$

positivo em cod. comp. 2: $01000\,0001_{(2)}$

negativo em cod. comp. 2: $10111\,1111_{(2)}$

13. a) decimal → binário

32 | 2
12 16 | 2
0 0 8 | 2
0 4 | 2
0 2 | 2
0 1 | 2
1

$32_{(10)} = 100000_{(2)}$

$+32_{(10)} = 00100000_{(2)}$

↓

em Representação de sinal e valor absoluto c/ 8 bits

13. b) decimal → binário

12 | 2
0 6 | 2
0 3 | 2
1 1 | 2
1 0

$12_{(10)} = 1100_{(2)}$

$-12_{(10)} = 0000\,1100_{(2)}$

↓

em Representação de sinal e valor absoluto c/ 8 bits

14. a) decimal → binário em cod. comp. 2

135 | 2
15 67 | 2
1 7 33 | 2
1 13 16 | 2
1 0 8 | 2
0 4 | 2
0 2 | 2
0 1 | 2
1 0

$135_{(10)} = 10000111_{(2)}$

↓

binário puro

14. b) decimal $\rightarrow$ binário em cod. comp. 2

$$
\begin{array}{llllll}
63 & \underline{\lfloor 2} & & & & \\
3 & 31 & \underline{\lfloor 2} & & & \\
1 & 11 & 15 & \underline{\lfloor 2} & & \\
 & 1 & 1 & 7 & \underline{\lfloor 2} & \\
 & & & 1 & 3 & \underline{\lfloor 2} \\
 & & & & 1 & 1 \ \underline{\lfloor 2} \\
 & & & & & 1 \quad 0
\end{array}
$$

$63_{(10)} = 111111_{(2)}$

$-63_{(10)} = 10000001_{(2)}$ em c.c.2

15. a) hexadecimal $\rightarrow$ binário

$8000\,H = 1000\ 0000\ 0000\ 0000_{(2)}$

$\hookrightarrow$ número negativo em cod. comp. 2 c/ 16 bits

binário em cod. comp. 2 $\rightarrow$ decimal

$-1000\ 0000\ 0000\ 0000_{(2)} = -1 \times 2^{15} + 0 = -3278_{(10)}$

15. b) hexadecimal $\rightarrow$ binário

$100\,H = 0000\ 0001\ 0000\ 0000_{(2)}$

$\hookrightarrow$ positivo em cod. comp. 2 c/ 16 bits

binário em cod. comp. 2 $\rightarrow$ decimal

$0000\ 0001\ 0000\ 0000_{(2)} = 256_{(10)}$

15. c) $7FFF\,H = 0111\ 1111\ 1111\ 1111_{(2)}$

$\hookrightarrow$ positivo em cod. comp. 2 c/ 16 bits

$0111\ 1111\ 1111\ 1111_{(2)} = 32767_{(10)}$

15. d) $0FFF\,H = 0000\ 1111\ 1111\ 1111_{(2)}$

$\hookrightarrow$ positivo em cod. comp. 2 c/ 16 bits

$0000\ 1111\ 1111\ 1111_{(2)} = 4095_{(10)}$

15. e) $FFFF\,H = 1111\ 1111\ 1111\ 1111_{(2)}$

$\hookrightarrow$ negativo em cod. comp. 2 c/ 16bits

$-0000\ 0000\ 0000\ 0001_{(2)} = -2^{0} = -1$

16. a) se possível, estender para 16 bits

$80H = 1000\ 0000_{(2)}$

↳ negativo em cod. comp. 2

$1000\ 0000_{(2)} = -\ 0000\ 0000\ 1000\ 0000_{(2)} = 1111\ 1111\ 1000\ 000_{(2)}$ c.c. 2 c/ 16 bits

$= FF80$ ✗

16. b) $28H = 0010\ 1000_{(2)}$

↳ positivo em c.c. 2

$0010\ 1000_{(2)} = 0000\ 0000\ 0010\ 1000_{(2)}$ c.c. 2 c/ 16 bits

$= 0028H$ ✓

16. c) $9AH = 1001\ 1010_{(2)}$

↳ negativo em c.c. 2

$1001\ 1010_{(2)} = -\ 0000\ 0000\ 1001\ 1010_{(2)} = 1111\ 1111\ 0110\ 0110_{(2)}$ c.c. 2 c/ 16 bits

$= FF66H$ ✗

16. d) $7FH = 0111\ 1111_{(2)}$

↳ positivo em c.c. 2

$0111\ 1111_{(2)} = 0000\ 0000\ 0111\ 1111_{(2)}$ c.c. 2 c/ 16 bits

$= 007FH$ ✓

16. e) $1020H = 0001\ 0000\ 0010\ 0000_{(2)}$

↳ positivo em c.c. 2 c/ 16 bits ✓

16. f) $8088H = 1000\ 0000\ 0010\ 0000_{(2)}$

↳ negativo em c.c. 2 c/ 16 bits

17. a) $0040H = 0000\ 0000\ 0100\ 0000_{(2)}$

↳ positivo em c.c. 2 c/ 16 bits

$0000\ 0000\ 0100\ 0000_{(2)} = 0100\ 0000$ em c.c. 2 c/ 8 bits ✓

17. b) $1078H = 0000\ 0001\ 0111\ 1000_{(2)}$

↳ positivo em c.c. 2 ✗ não é possível

17. c) $FFFF67H = 1111\ 1111\ 1111\ 1111\ 0110\ 0111_{(2)}$

↳ negativo em c.c. 2

$1111\ 1111\ 1111\ 1111\ 0110\ 0111_{(2)} = -\ 0000\ 0000\ 0000\ 0000\ 1001\ 0111_{(2)} =$

$= -10010111_{(2)}$

$= 01100111_{(2)}$ c.c. 2 c/ 8 bits ✓

17\. d) FFFF85H = 1111 1111 1111 1111 1000 0101

↳ negativo em c.c. 2

$1111\ 1111\ 1111\ 1111\ 1000\ 0101_{(2)} = -\ 0000\ 0000\ 0000\ 0000\ 1000\ 0101_{(2)}$

$= -\ 0111\ 1011$

$= 1000\ 0101$ c.c. 2 c/ 8 bits

$= 85$ H

17\. e) 0000 67H = $0000\ 0000\ 0000\ 0000\ 0110\ 0111_{(2)}$

↳ positivo em c.c. 2

$0000\ 0000\ 0000\ 0000\ 0110\ 0111_{(2)} = 0110\ 0111$ em c.c. 2 c/ 8 bits

$= 67$ H

18\) a)
$$\begin{array}{r} 1001,11 \\ +\ 100,11 \\ \hline 1110,10 \end{array}$$

b)
$$\begin{array}{r} 1000,1 \\ -\ 0,11 \\ \hline 1000,11 \end{array}$$

c)
$$\begin{array}{r} 1011,01 \\ -\ 11,11 \\ \hline 1001,10 \end{array}$$

19\. $32_{(10)} = 100000_{(2)}$ $27_{(10)} = 11011_{(2)}$

$+32_{(10)} = 00100000_{(2)}$ $+27_{(10)} = 00011011_{(2)}$

$-32_{(10)} = 11100000_{(2)}$ $-27_{(10)} = 11100101_{(2)}$

a) 32 - 27

Não há transbordo =

$$\begin{array}{r} 00100000 \\ +\ 11100101 \\ \hline 1,00000101 \end{array}$$

$1,00000101$ c.c.2 $= +5_{(10)}$

↳ Resultado positivo

b) 27 - 32

Não há transbordo =

$$\begin{array}{r} 00011011 \\ +\ 11100000 \\ \hline 0\ 11111101 \end{array}$$

$0\ 11111101$ c.c.2 $= -5$

↳ Resultado negativo

20. a)

$$\begin{array}{r} 0010\,1101 \\ +\ 0011\,1110 \\ \hline (0)\ 0100\,1011 \end{array}$$

$= +(2^6+2^3+2^1+2^0)$

$= +(64+8+2+1)$

$= +75_{(10)}$

b)

$$\begin{array}{r} 1110\,0101 \\ +\ 1111\,0110 \\ \hline (1)\ 1101\,1011 \end{array}$$

$= -(0010\,0101)$

$= +(2^5+2^2+2^0)$

$= -37_{(10)}$

21. a) $1AH + 31H = 4BH$ b) $6AFH + A13H$ c) $1E,FH + 2,FFH$ d) $10H - 3H = 0DH$ e) $FBD3H - EAG1H = 0E72H$

22. a) decimal → IEEE754 de precisão simples

$9_{(10)} = 1001_{(2)} = 1,001 \times 2^{3} \longrightarrow$ expoente real

bit sinal = 0

expoente real = 3

expoente codificado = expoente real + 127 = 3 + 127 = $130_{(10)}$ = $1000\,0010_{(2)}$

significando = $1,\underbrace{0010\,(\underset{\times 20}{\ldots})\,0}_{\text{mantissa}}$

Norma IEEE754 = $\underbrace{0}_{\text{bit sinal}}\ \underbrace{10000010}_{\text{expoente codificado}}\ \underbrace{001\,(\underset{\times 20}{\ldots})\,0}_{\text{mantissa}}$ = 41100000 H

22. b) decimal → IEEE754 de precisão simples

$-5/_{20} = -5 \times 1/_{32} = -5 \times 2^{-5} = -101 \times 2^{-1}$

101×2^{-1} → não se pode aplicar a norma porque não tem vírgula,

então: $101 \times 2^{-1} = 1,01 \times 2^{-3}$

bit sinal = 0

expoente real = -3

expoente codificado = $-3 + 127 = 124 = 0111\,1100_{(2)}$

significando = $1,\underbrace{010\,(\underset{\times 20}{\ldots})\,0}_{\text{mantissa}}$

Norma IEEE 754 = $1011\,1110\,0010\,(\underset{\times 20}{\ldots})\,0$ = BE200000 H

23. a) IEEE 754 de precisão simples $\rightarrow$ decimal

$C2E4\,0000\,H = 1100\ 0010\ 1100\ 1000\ \underbrace{0(\ldots)0}_{\times 12}$

bit sinal = 1

expoente real = 6

expoente codificado = 1000 0101 = $133_{(10)}$

significando = $1,110\ 0100\ 1000\ \underbrace{0(\ldots)0}_{\times 12}$

número decimal = $1,1100\ 1001 \times 2^6 = 1110010,01 = -114,25_{(10)}$

b) IEEE754 de precisão simples $\rightarrow$ decimal

$3F88\,0000\,H = 0011\ 1111\ 1000\ \underbrace{0(\ldots)0}_{\times 16}$

bit sinal = 0

expoente real = 127 - 127 = 0

expoente codificado = $0111\ 1111_{(2)} = 127_{(10)}$

significando = $1,00010000\ \underbrace{(\ldots)0}_{\times 16}$

número decimal = $1,0001 \times 2^0 = 1,0625_{(10)}$