

1. *Sistemes de numeració.*

Com a regla general, si no ens diuen el contrari, en aquelles conversions de part decimal d'un nombre en base 10 a binari ens quedarem amb tres *bits* per cada xifra del nombre original. De tota manera als exercicis resolts aquí es calcularan totes les xifres.

1. (a)  $100110_2 = 2^5 + 2^2 + 2 = 38_{10}$   
 (b)  $110011_2 = 2^5 + 2^4 + 2 + 1 = 51_{10}$   
 (c)  $110111_2 = 2^5 + 2^4 + 2^2 + 2 + 1 = 55_{10}$   
 (d)  $1001,10_2 = 2^3 + 1 + 2^{-1} = 9,5_{10}$   
 (e)  $101010110,001_2 = 2^8 + 2^6 + 2^4 + 2^2 + 2 + 2^{-3} = 342,125_{10}$

2. (a)  $93_{10} \longrightarrow$

$$\begin{array}{r|l} 9 & 2 \\ 3 & 4 \end{array} \quad \begin{array}{r|l} 6 & 2 \\ 0 & 2 \end{array} \quad \begin{array}{r|l} 3 & 2 \\ 0 & 1 \end{array} \quad \begin{array}{r|l} 1 & 2 \\ 1 & 5 \end{array} \quad \begin{array}{r|l} 5 & 2 \\ 1 & 2 \end{array} \quad \begin{array}{r|l} 2 & 2 \\ 0 & 1 \end{array}$$

$$93_{10} = 1011101_2$$

- (b)  $647_{10} \longrightarrow$

$$\begin{array}{r|l} 6 & 2 \\ 0 & 3 \end{array} \quad \begin{array}{r|l} 4 & 2 \\ 0 & 1 \end{array} \quad \begin{array}{r|l} 7 & 2 \\ 0 & 1 \end{array} \quad \begin{array}{r|l} 1 & 2 \\ 6 & 8 \end{array} \quad \begin{array}{r|l} 1 & 2 \\ 8 & 4 \end{array} \quad \begin{array}{r|l} 0 & 2 \\ 0 & 4 \end{array} \quad \begin{array}{r|l} 4 & 2 \\ 0 & 2 \end{array}$$

$$\begin{array}{r|l} 2 & 2 \\ 0 & 1 \end{array} \quad \begin{array}{r|l} 1 & 2 \\ 0 & 5 \end{array} \quad \begin{array}{r|l} 5 & 2 \\ 1 & 2 \end{array} \quad \begin{array}{r|l} 2 & 2 \\ 0 & 1 \end{array}$$

$$647_{10} = 1010000111_2$$

- (c)  $310_{10} \longrightarrow$

$$\begin{array}{r|l} 3 & 2 \\ 1 & 1 \end{array} \quad \begin{array}{r|l} 1 & 2 \\ 5 & 7 \end{array} \quad \begin{array}{r|l} 5 & 2 \\ 5 & 7 \end{array} \quad \begin{array}{r|l} 7 & 2 \\ 7 & 3 \end{array} \quad \begin{array}{r|l} 3 & 2 \\ 8 & 1 \end{array} \quad \begin{array}{r|l} 1 & 2 \\ 9 & 1 \end{array}$$

$$\begin{array}{r|l} 9 & 2 \\ 1 & 4 \end{array} \quad \begin{array}{r|l} 4 & 2 \\ 0 & 2 \end{array} \quad \begin{array}{r|l} 2 & 2 \\ 0 & 1 \end{array}$$

$$310_{10} = 100110110_2$$

$$(d) \ 131_{10} \longrightarrow$$

$$\begin{array}{r|l} 1 \ 3 \ 1 & 2 \\ 1 \ 1 & 6 \ 5 \\ 1 & \end{array} \quad \begin{array}{r|l} 6 \ 5 & 2 \\ 0 \ 5 & 3 \ 2 \\ 1 & \end{array} \quad \begin{array}{r|l} 3 \ 2 & 2 \\ 1 \ 2 & 1 \ 6 \\ 0 & \end{array} \quad \begin{array}{r|l} 1 \ 6 & 2 \\ 0 & 8 \end{array} \quad \begin{array}{r|l} 8 & 2 \\ 0 & 4 \end{array}$$

$$\begin{array}{r|l} 4 & 2 \\ 0 & 2 \end{array} \quad \begin{array}{r|l} 2 & 2 \\ 0 & 1 \end{array}$$

$$131_{10} = 10000011_2$$

$$(e) \ 258, 75_{10} \longrightarrow$$

$$\begin{array}{r|l} 2 \ 5 \ 8 & 2 \\ 0 \ 5 & 1 \ 2 \ 9 \\ 1 \ 8 & \\ 0 & \end{array} \quad \begin{array}{r|l} 1 \ 2 \ 9 & 2 \\ 0 \ 9 & 6 \ 4 \\ 1 & \end{array} \quad \begin{array}{r|l} 6 \ 4 & 2 \\ 0 \ 4 & 3 \ 2 \\ 0 & \end{array} \quad \begin{array}{r|l} 3 \ 2 & 2 \\ 1 \ 2 & 1 \ 6 \\ 0 & \end{array} \quad \begin{array}{r|l} 1 \ 6 & 2 \\ 0 & 8 \end{array}$$

$$\begin{array}{r|l} 8 & 2 \\ 0 & 4 \end{array} \quad \begin{array}{r|l} 4 & 2 \\ 0 & 2 \end{array} \quad \begin{array}{r|l} 2 & 2 \\ 0 & 1 \end{array}$$

$$258_{10} = 100000010_2$$

$$0,75 \times 2 = 1,5 \geq 1 \Rightarrow 1$$

$$0,5 \times 2 = 1 \geq 1 \Rightarrow 1$$

$$0,75_{10} = 0,11_2 \rightarrow 258,75_{10} = 10000010,11_2$$

$$(f) \ 1,625_{10} \longrightarrow$$

$$0,625 \times 2 = 1,25 \geq 1 \Rightarrow 1$$

$$0,25 \times 2 = 0,5 < 1 \Rightarrow 0$$

$$0,5 \times 2 = 1 \geq 1 \Rightarrow 1$$

$$1,625_{10} = 1,101_2$$

$$(g) \ 19,3125_{10} \longrightarrow$$

$$\begin{array}{c|c|c|c|c} 1 & 9 & 2 & 9 & 2 & 4 & 2 & 2 & 2 \\ \hline & 1 & 9 & 1 & 4 & 0 & 2 & 0 & 1 \end{array}$$

$$19_{10} = 10011_2$$

$$0,3125 \times 2 = 0,625 < 1 \Rightarrow 0$$

$$0,625 \times 2 = 1,25 \geq 1 \Rightarrow 1$$

$$0,25 \times 2 = 0,5 < 1 \Rightarrow 0$$

$$0,5 \times 2 = 1 \geq 1 \rightarrow 1$$

$$19,3125_{10} = 10011,0101_2$$

$$3. \quad (a) \ 13_{16} = 1 \cdot 16^1 + 3 \cdot 16^0 = 19_{10}$$

$$(b) \ 65_{16} = 6 \cdot 16^1 + 5 \cdot 16^0 = 101_{10}$$

$$(c) \ 3F0_{16} = 3 \cdot 16^2 + F \cdot 16^1 + 0 \cdot 16^0 = 3 \cdot 16^2 + 15 \cdot 16^1 + 0 \cdot 16^0 = 1008_{10}$$

$$(d) \ D0CE_{16} = D \cdot 16^3 + 0 \cdot 16^2 + C \cdot 16^1 + E \cdot 16^0 = 13 \cdot 16^3 + 0 \cdot 16^2 + 12 \cdot 16^1 + 14 \cdot 16^0 = 53454_{10}$$

$$(e) \ 0,2_{16} = 0 \cdot 16^0 + 2 \cdot 16^{-1} = 0,125_{10}$$

$$(f) \ 12,9_{16} = 1 \cdot 16^1 + 2 \cdot 16^0 + 9 \cdot 16^{-1} = 18,5625_{10}$$

$$(g) \ F1, A_{16} = F \cdot 16^1 + 1 \cdot 16^0 + A \cdot 16^{-1} = 15 \cdot 16^1 + 1 \cdot 16^0 + 10 \cdot 16^{-1} = 241,625_{10}$$

$$(h) \ C8, D_{16} = C \cdot 16^1 + 8 \cdot 16^0 + D \cdot 16^{-1} = 12 \cdot 16^1 + 8 \cdot 16^0 + 13 \cdot 16^{-1} = 200,8125_{10}$$

$$4. \quad (a)$$

$$3, A2_{16} \rightarrow 0011, 1010 \ 0010_2 \rightarrow 011, 101 \ 000 \ 10\textcolor{red}{0}_2 \rightarrow 3, 504_8 \rightarrow \\ \rightarrow 3, 6328125_{10}$$

(b)

$$1B1,9 \rightarrow 0001\ 1011\ 0001, 1001_2 \rightarrow 110\ 110\ 001, 100\ 100_2 \rightarrow \\ \rightarrow 661, 44_8 \rightarrow 433, 5625_{10}$$

(c)

$$6416213A, 17B_{16} \rightarrow \\ \rightarrow 0110\ 0100\ 0001\ 0110\ 0010\ 0001\ 0011\ 1010, 0001\ 0111\ 1011_2 \rightarrow \\ \rightarrow 001\ 100\ 100\ 000\ 101\ 100\ 010\ 000\ 100\ 111\ 010, 000\ 101\ 111\ 011_2 \rightarrow \\ \rightarrow 14405420472, 0573_8 \rightarrow 1679171898, 0092529296_{10}$$

5. (a) Podem passar el nombre a base 10, després a binari i d'allà és trivial obtenir el nombre en hexadecimal

$$204231, 134_5 = \\ 2 \cdot 5^5 + 0 \cdot 5^4 + 4 \cdot 5^3 + 2 \cdot 5^2 + 3 \cdot 5^1 + 1 \cdot 5^0 + 1 \cdot 5^{-1} + 3 \cdot 5^{-2} + 4 \cdot 5^{-3} = 6816,352_{10}$$

Part entera

$$\begin{array}{r|l} 6\ 8\ 1\ 6 & 2 \\ \hline 0\ 8 & 3\ 4\ 0\ 8 \\ 0\ 1\ 6 & 1\ 4 \\ 0 & 0\ 0\ 8 \\ & 0 \end{array} \quad \begin{array}{r|l} 3\ 4\ 0\ 8 & 2 \\ \hline 1\ 4 & 1\ 7\ 0\ 4 \\ 0\ 0\ 8 & 1\ 0 \\ 0 & 0\ 4 \\ & 0 \end{array} \quad \begin{array}{r|l} 1\ 7\ 0\ 4 & 2 \\ \hline 1\ 0 & 8\ 5\ 2 \\ 0\ 4 & \\ 0 & \end{array}$$

$$\begin{array}{r|l} 8\ 5\ 2 & 2 \\ \hline 0\ 5 & 4\ 2\ 6 \\ 1\ 2 & 0\ 2 \\ 0 & 0\ 6 \\ & 0 \end{array} \quad \begin{array}{r|l} 4\ 2\ 6 & 2 \\ \hline 0\ 2 & 2\ 1\ 3 \\ 0\ 6 & 2\ 1\ 3 \\ 0 & 0\ 1\ 3 \\ & 1 \end{array} \quad \begin{array}{r|l} 2\ 1\ 3 & 2 \\ \hline 0\ 1\ 3 & 1\ 0\ 6 \\ 1 & 0\ 6 \\ & 0 \end{array} \quad \begin{array}{r|l} 1\ 0\ 6 & 2 \\ \hline 0\ 6 & 5\ 3 \\ 0 & \end{array}$$

$$\begin{array}{r|l} 5\ 3 & 2 \\ \hline 1\ 3 & 2\ 6 \\ 1 & 0\ 6 \\ & 0 \end{array} \quad \begin{array}{r|l} 2\ 6 & 2 \\ \hline 0\ 6 & 1\ 3 \\ 0 & 1\ 3 \\ & 1 \end{array} \quad \begin{array}{r|l} 1\ 3 & 2 \\ \hline 1 & 6 \\ & 0 \end{array} \quad \begin{array}{r|l} 6 & 2 \\ \hline 0 & 3 \\ & 1 \end{array} \quad \begin{array}{r|l} 3 & 2 \\ \hline 1 & 1 \end{array}$$

$$= 0001\ 1010\ 1010\ 0000_2 = 1AA0_{16}$$

Part decimal

$$0,352_{10} = 0,0101\ 1010\ 0001\ 1100\ 1010\ 1100\ 0000 \\ 1000\ 0011\ 0001\ 0010\ 0110\ 1110\ 1000$$

$$= 0,5A1CAC083126E8_{16}$$

$$204231, 1345_5 = 1A9F, 5C28F_{16}$$

Alternativament, passem a base 10 i després amb mètodes vistos en exercicis anteriors, a hexadecimal

Part entera

$$\begin{array}{r|l}
 204231 & 16 \\
 44 & 12764 \\
 122 & \\
 103 & \\
 71 & \\
 7 &
 \end{array}
 \quad
 \begin{array}{r|l}
 12764 & 16 \\
 156 & 797 \\
 124 & \\
 12 &
 \end{array}
 \quad
 \begin{array}{r|l}
 797 & 16 \\
 157 & 49 \\
 13 &
 \end{array}
 \quad
 \begin{array}{r|l}
 49 & 16 \\
 1 & 3
 \end{array}$$

$$204231_{10} = 31DC7_{16}$$

Part decimal

$$\begin{aligned}
 0,36 \times 16 &= 5,76 \geq 1 \Rightarrow 5 \\
 0,76 \times 16 &= 12,16 \geq 1 \Rightarrow 12 \equiv C \\
 0,16 \times 16 &= 2,56 \geq 1 \Rightarrow 2 \\
 0,56 \times 16 &= 8,96 \geq 1 \Rightarrow 8 \\
 0,96 \times 16 &= 15,36 \geq 1 \Rightarrow 15 \equiv F \\
 &\text{---} \\
 0,36 \times 16 &= 5,76 \geq 1 \Rightarrow 5
 \end{aligned}$$

$$0,36_{10} = \overline{5C28F}...16$$

$$(b) \ 165433_7 = 1 \cdot 7^5 + 6 \cdot 7^4 + 5 \cdot 7^3 + 4 \cdot 7^2 + 3 \cdot 7^1 + 3 \cdot 7^0 = 33148_{10}$$

$$\begin{array}{r|l}
 33148 & 16 \\
 114 & 2071 \\
 28 & \\
 12 &
 \end{array}
 \quad
 \begin{array}{r|l}
 2071 & 16 \\
 47 & 129 \\
 151 & \\
 7 &
 \end{array}
 \quad
 \begin{array}{r|l}
 129 & 16 \\
 1 & 8
 \end{array}$$

$$33148_{10} = 817C_{16}$$

6. (a)  $62 \rightarrow 0110\ 0010$   
 (b)  $25 \rightarrow 0010\ 0101$   
 (c)  $274 \rightarrow 0010\ 0111\ 0100$   
 (d)  $284 \rightarrow 0010\ 1000\ 0100$   
 (e)  $42, 91 \rightarrow 0100\ 0010, 1001\ 0001$   
 (f)  $5, 014 \rightarrow 0101, 0000\ 0001\ 0100$
7. (a)  $1001 \rightarrow 9$   
 (b)  $0101 \rightarrow 5$   
 (c)  $0110\ 0001 \rightarrow 61$   
 (d)  $0100\ 0111 \rightarrow 47$   
 (e)  $0011\ 0110, 1000 \rightarrow 36, 8$   
 (f)  $0011\ 1000, 1000\ 1000 \rightarrow 38, 88$

2. *Introducció als circuits lògics.*

1. (a)  $f(a, b) = ab + a$

$a$	$b$	$ab + a$
0	0	0
0	1	0
1	0	1
1	1	1

- (b)  $f(a, b) = (a \oplus b)\bar{b}$

$a$	$b$	$(a \oplus b)\bar{b}$
0	0	0
0	1	1
1	0	0
1	1	0

- (c)  $f(a, b) = \overline{(\bar{a} + b)} \oplus (a \cdot \bar{b})$

$a$	$b$	$\overline{(\bar{a} + b)} \oplus (a \cdot \bar{b})$
0	0	0
0	1	0
1	0	0
1	1	0

(d)  $f(a, b, c) = (a \cdot b) + c$

$a$	$b$	$c$	$ab + c$
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

(e)  $f(a, b, c) = \overline{(a \cdot b) \oplus c}$

$a$	$b$	$c$	$\overline{(a \cdot b) \oplus c}$
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1



(f)  $f(a, b, c, d) = \overline{\overline{a + b} \oplus (c \cdot \overline{d})}$

$a$	$b$	$c$	$d$	$\overline{\overline{a + b} \oplus (c \cdot \overline{d})}$
0	0	0	0	1
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1