

Sistemas de numeración

Nievas Martin

5 de abril de 2018

Rev 2.0

Numeración

Teorema Fundamental de la Numeración

Cualquier número natural N puede expresarse, de manera única, en la forma:

$$N = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_2 x^2 + a_1 x^1 + a_0 x^0$$

Donde:

x: número natural denominado base tal que $x > 1$.

Sistema Decimal

$$simbolos = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$$

$$x = 10$$

Sistema Decimal

Ejemplos:

$$146 = 1 \cdot 10^2 + 4 \cdot 10^1 + 6 \cdot 10^0$$

Sistema Decimal

Ejemplos:

$$146 = 1 \cdot 10^2 + 4 \cdot 10^1 + 6 \cdot 10^0$$

$$5346 = 5 \cdot 10^3 + 3 \cdot 10^2 + 4 \cdot 10^1 + 6 \cdot 10^0$$

Sistema Binario

$$simbolos = \{0, 1\}$$

$$x = 2$$

Sistema Binario

Ejemplos:

$$111_{(2)} = 1 \cdot 2^2 + 1 \cdot 2^1 + 1 \cdot 2^0 = 7_{(10)}$$

Sistema Binario

Ejemplos:

$$111_{(2)} = 1 \cdot 2^2 + 1 \cdot 2^1 + 1 \cdot 2^0 = 7_{(10)}$$

$$1001_{(2)} = 1 \cdot 2^3 + 0 \cdot 2^2 + 0 \cdot 2^1 + 1 \cdot 2^0 = 9_{(10)}$$

Sistema Hexadecimal

simbolos = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F}

$$x = 16$$

Sistema Hexadecimal

Ejemplos:

$$A3_{(16)} = 10 \cdot 16^1 + 3 \cdot 16^0 = 163_{(10)}$$

Sistema Hexadecimal

Ejemplos:

$$A3_{(16)} = 10 \cdot 16^1 + 3 \cdot 16^0 = 163_{(10)}$$

$$1CE_{(16)} = 1 \cdot 16^2 + 12 \cdot 16^1 + 14 \cdot 16^0 = 462_{(10)}$$

Sistema Octal

$$simbolos = \{0, 1, 2, 3, 4, 5, 6, 7\}$$

$$x = 8$$

Sistema Octal

Ejemplos:

$$23_{(8)} = 2 \cdot 8^1 + 3 \cdot 8^0 = 19_{(10)}$$

Sistema Octal

Ejemplos:

$$23_{(8)} = 2 \cdot 8^1 + 3 \cdot 8^0 = 19_{(10)}$$

$$30_{(16)} = 3 \cdot 8^1 + 0 \cdot 8^0 = 24_{(10)}$$

Conversión decimal-binario

Ejemplo:

10

Conversión decimal-binario

Ejemplo:

$$\begin{array}{r} 10 \quad | \quad 2 \\ 10 \quad | \quad 5 \\ \hline 0 \end{array}$$

Conversión decimal-binario

Ejemplo:

$$\begin{array}{r} 10 \\ \underline{-\quad 0} \\ 10 \\ \underline{-\quad 4} \\ 6 \\ \underline{-\quad 4} \\ 2 \end{array}$$

The diagram shows the division of 10 by 2. The quotient is 5 and the remainder is 0. The next step shows 5 divided by 2, resulting in a quotient of 2 and a remainder of 1. The remainder 1 is highlighted in red.

Conversión decimal-binario

Ejemplo:

$$\begin{array}{r} 10 \\ \underline{-} 10 \\ 0 \end{array} \quad \begin{array}{r} 2 \\ \underline{-} 5 \\ 1 \end{array} \quad \begin{array}{r} 2 \\ \underline{-} 2 \\ 0 \end{array} \quad \begin{array}{r} 2 \\ \underline{-} 1 \\ 1 \end{array}$$

A diagram illustrating the conversion of the decimal number 10 to binary using successive division by 2. The quotient 10 is written above the first bracket. The remainder 0 is written below the first bracket. The quotient 5 is written above the second bracket. The remainder 1 is written below the second bracket. The quotient 2 is written above the third bracket. The remainder 0 is written below the third bracket. The quotient 1 is written above the fourth bracket. The remainder 1 is written below the fourth bracket.

Conversión decimal-binario

Ejemplo:

$$\begin{array}{r} 10 \\ \underline{-\quad 10} \\ 0 \end{array} \qquad \begin{array}{r} 2 \\ | \\ 5 \\ | \\ 2 \\ | \\ 1 \end{array}$$

←

$$10 = 1010_2$$

Conversión decimal-binario

$$\begin{array}{r} 42 \\ \hline 42 & \xrightarrow{2} \\ \hline 0 & \quad 21 \\ 20 & \xrightarrow{2} \\ \hline 1 & \quad 10 \\ 10 & \xrightarrow{2} \\ \hline 0 & \quad 5 \\ 4 & \xrightarrow{2} \\ \hline 1 & \quad 2 \\ 2 & \xrightarrow{2} \\ \hline 0 & \quad 1 \end{array}$$

$$\begin{array}{r} 16 \\ \hline 16 & \xrightarrow{2} \\ \hline 0 & \quad 8 \\ 8 & \xrightarrow{2} \\ \hline 0 & \quad 4 \\ 4 & \xrightarrow{2} \\ \hline 0 & \quad 2 \\ 2 & \xrightarrow{2} \\ \hline 0 & \quad 1 \end{array}$$

$$42 = 101010_2$$



$$16 = 10000_2$$

Conversión decimal-Octal

Ejemplo:

10

Conversión decimal-Octal

Ejemplo:

$$\begin{array}{r} 10 \quad | \quad 8 \\ 8 \\ \hline 2 \end{array}$$

Conversión decimal-Octal

Ejemplo:

$$\begin{array}{r} 10 \quad | \quad 8 \\ 8 \quad \quad | \quad \color{red}{1} \\ \hline \color{red}{2} \end{array}$$

←

$$10 = 12_8$$

Conversión decimal-Octal

$$\begin{array}{r} 42 \\ \text{---} \\ 40 \\ \text{---} \\ 2 \end{array}$$

←

$$42 = 52_8$$

$$\begin{array}{r} 16 \\ \text{---} \\ 16 \\ \text{---} \\ 0 \end{array}$$

←

$$16 = 20_8$$

Conversión decimal-Hexadecimal

Ejemplo:

3412

Conversión decimal-Hexadecimal

Ejemplo:

$$\begin{array}{r} 3412 \longdiv{16} \\ 3408 \quad 213 \\ \hline 4 \end{array}$$

Conversión decimal-Hexadecimal

Ejemplo:

$$\begin{array}{r} 3412 \quad | \quad 16 \\ 3408 \quad | \quad 213 \quad | \quad 16 \\ \hline 4 \quad 208 \quad | \quad 13 \\ \hline \quad \quad \quad 5 \end{array}$$

Conversión decimal-Hexadecimal

Ejemplo:

$$\begin{array}{r} 3412 \quad | \quad 16 \\ 3408 \quad | \quad 213 \quad | \quad 16 \\ \hline 4 \quad 208 \quad | \quad 13 \\ \hline \quad \quad \quad 5 \end{array}$$



Conversión decimal-Hexadecimal

Ejemplo:

$$\begin{array}{r} 3412 \Big| 16 \\ 3408 \quad 213 \Big| 16 \\ \hline 4 \quad 208 \quad 13 \\ \hline \quad \quad 5 \end{array}$$



$$3412 = D54_{16}$$

Conversión decimal-binario

$$\begin{array}{r} 42 \\ \text{---} \\ 40 \\ \text{---} \\ 2 \end{array}$$

←

$$42 = 52_8$$

$$\begin{array}{r} 16 \\ \text{---} \\ 16 \\ \text{---} \\ 0 \end{array}$$

←

$$16 = 20_8$$

Conversión decimal-binario/binario-hexadecimal

Conversión decimal-binario/binario-hexadecimal

$$\begin{array}{r} 43 \\ \underline{- 42} \\ 1 \\ \hline 20 \\ \underline{- 10} \\ 10 \\ \hline 0 \\ \hline 4 \\ \underline{- 2} \\ 2 \\ \hline 0 \\ \hline \end{array}$$

←

$$43_{10} = 110101_2$$

Conversión decimal-binario/binario-hexadecimal

$$\begin{array}{r} 43 \\ \underline{- 42} \\ 1 \\ \hline 20 \\ \underline{- 10} \\ 10 \\ \hline 0 \\ \hline 4 \\ \underline{- 2} \\ 2 \\ \hline 0 \\ \hline \end{array}$$

←

$$43_{10} = 00110101_2$$

Conversión decimal-binario/binario-hexadecimal

$$\begin{array}{r} 43 \\ \underline{- 42} \\ 1 \\ \hline 20 \\ \underline{- 10} \\ 10 \\ \hline 0 \\ \hline 4 \\ \underline{- 2} \\ 2 \\ \hline 0 \end{array}$$

←

The diagram shows the division of 43 by 2 to find the binary representation. The quotient is 0011 0101₂. The remainders are 1, 0, 1, 0, 1, 0, 1, 0, 0. The remainders 1, 0, 1, 0, 1, 0, 1, 0 are grouped into pairs of 2's, which are then grouped into a pair of 10's, and finally into a pair of 5's. The remainders 0, 1, 0, 1, 0, 1, 0, 0 are grouped into pairs of 2's.

$$43_{10} = \underline{\textcolor{red}{0}}\underline{\textcolor{red}{0}}\underline{\textcolor{red}{1}}\underline{\textcolor{red}{1}}\underline{\textcolor{red}{0}}\underline{\textcolor{red}{1}}\underline{\textcolor{red}{0}}\underline{\textcolor{red}{1}}_2$$

Conversión decimal-binario/binario-hexadecimal

$$\begin{array}{r} 43 \\ \underline{- 42} \\ 1 \\ \hline 20 \\ \underline{- 10} \\ 10 \\ \hline 0 \\ \hline 4 \\ \underline{- 2} \\ 2 \\ \hline 0 \end{array}$$

←

$$0011 = 3$$

$$43_{10} = \underline{\textcolor{red}{0011}} \underline{\textcolor{red}{0101}}_2$$

Conversión decimal-binario/binario-hexadecimal

$$\begin{array}{r} 43 \\ \underline{- 42} \\ 1 \\ \hline 20 \\ \underline{- 10} \\ 10 \\ \hline 0 \\ \hline \end{array} \quad \begin{array}{r} 2 \\ | \\ 21 \\ | \\ 2 \\ | \\ 10 \\ | \\ 2 \\ | \\ 5 \\ | \\ 2 \\ | \\ 2 \\ | \\ 1 \\ \hline \end{array}$$

←

$$0011 = 3$$

$$0101 = 5$$

$$43_{10} = \underline{0011} \underline{0101}_2$$

Conversión decimal-binario/binario-hexadecimal

$$\begin{array}{r} 43 \\ \underline{- 42} \\ 1 \\ \hline 20 \\ \underline{- 10} \\ 10 \\ \hline 0 \\ \hline \end{array} \quad \begin{array}{r} 2 \\ | \\ 21 \\ | \\ 2 \\ | \\ 10 \\ | \\ 2 \\ | \\ 5 \\ | \\ 2 \\ | \\ 2 \\ | \\ 1 \\ \hline \end{array}$$

$$0011 = 3$$

$$0101 = 5$$

$$43_{10} = 35_{16}$$

$$43_{10} = \underline{0011} \underline{0101}_2$$



Consultas:

mnievas@frc.utn.edu.ar