calc_binary_example

Student Group

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Calculation example for binary value

Idea: The numeral 2658.47 is only the representation with the digits $[0..9]$, but what is the value behind it?

so lets start

1. Put space between the digits
$\quad$

$$\begin{align*} \begin{smallmatrix} \color{black}{\text{numeral}:} & \color{black}{} & \color{black}{1} & \color{black}{0} & \color{black}{0} & \color{black}{1 } & \color{black}{1} & \color{black}{1} & \color{black}{0} & \color{black}{1} \\ \color{white}{\text{index}:} & \color{white}{i} & \color{white}{7} & \color{white}{6} & \color{white}{5} & \color{white}{4 } & \color{white}{3} & \color{white}{2} & \color{white}{1} & \color{white}{0} \\ \color{white}{\text{place factor}:} & \color{white}{B^i} & \color{white}{2^7} & \color{white}{2^6} & \color{white}{2^5} & \color{white}{2^4} & \color{white}{2^3} & \color{white}{2^2} & \color{white}{2^1} & \color{white}{2^0} \\ \color{white}{} & \color{white}{} & \color{white}{128} & \color{white}{64} & \color{white}{32} & \color{white}{16} & \color{white}{8} & \color{white}{4} & \color{white}{2} & \color{white}{1} \\ \color{white}{\text{digits }:} & \color{white}{z_i} & \color{white}{1} & \color{white}{0} & \color{white}{0} & \color{white}{1 } & \color{white}{1} & \color{white}{1} & \color{white}{0} & \color{white}{1} \\ \color{white}{\text{place value}:} & \color{white}{z_i \cdot B^i} & \color{white}{128} & \color{white}{0} & \color{white}{0} & \color{white}{16} & \color{white}{8} & \color{white}{4} & \color{white}{0} & \color{white}{1} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{157} \\ \end{smallmatrix} \end{align*}$$

2. Write down the index for each position.
$\quad$

$$\begin{align*} \begin{smallmatrix} \color{black}{\text{numeral}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{blue }{\text{index}:} & \color{blue }{i} & \color{blue }{3} & \color{blue }{2} & \color{blue }{1} & \color{blue }{0 } & \color{blue }{-1} & \color{blue }{-2} \\ \color{white}{\text{place factor}:} & \color{white}{B^i} & \color{white}{10^3} & \color{white}{10^2} & \color{white}{10^1} & \color{white}{10^0} & \color{white}{10^{-1}} & \color{white}{10^{-2}} \\ \color{white}{} & \color{white}{} & \color{white}{1000} & \color{white}{100 } & \color{white}{10 } & \color{white}{1 } & \color{white}{0.1 } & \color{white}{0.01 } \\ \color{white}{\text{digits }:} & \color{white}{z_i} & \color{white}{2} & \color{white}{6} & \color{white}{5} & \color{white}{8 } & \color{white}{4} & \color{white}{7} \\ \color{white}{\text{place value}:} & \color{white}{z_i \cdot B^i} & \color{white}{2000} & \color{white}{600} & \color{white}{50} & \color{white}{8 } & \color{white}{0.4} & \color{white}{0.07} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{2658.47} \\ \end{smallmatrix} \end{align*}$$

3. calculate the place factor
$\quad$

$$\begin{align*} \begin{smallmatrix} \color{black}{\text{numeral}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{black}{\text{index}:} & \color{black}{i} & \color{black}{3} & \color{black}{2} & \color{black}{1} & \color{black}{0 } & \color{black}{-1} & \color{black}{-2} \\ \color{blue }{\text{place factor}:} & \color{blue }{B^i} & \color{blue }{10^3} & \color{blue }{10^2} & \color{blue }{10^1} & \color{blue }{10^0} & \color{blue }{10^{-1}} & \color{blue }{10^{-2}} \\ \color{white}{} & \color{white}{} & \color{white}{1000} & \color{white}{100 } & \color{white}{10 } & \color{white}{1 } & \color{white}{0.1 } & \color{white}{0.01 } \\ \color{white}{\text{digits }:} & \color{white}{z_i} & \color{white}{2} & \color{white}{6} & \color{white}{5} & \color{white}{8 } & \color{white}{4} & \color{white}{7} \\ \color{white}{\text{place value}:} & \color{white}{z_i \cdot B^i} & \color{white}{2000} & \color{white}{600} & \color{white}{50} & \color{white}{8 } & \color{white}{0.4} & \color{white}{0.07} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{2658.47} \\ \end{smallmatrix} \end{align*}$$

3. calculate the place factor
(= …, thousands, hundreds, tens, ones, tenths, …)

$$\begin{align*} \begin{smallmatrix} \color{black}{\text{numeral}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{black}{\text{index}:} & \color{black}{i} & \color{black}{3} & \color{black}{2} & \color{black}{1} & \color{black}{0 } & \color{black}{-1} & \color{black}{-2} \\ \color{blue }{\text{place factor}:} & \color{blue }{B^i} & \color{blue }{10^3} & \color{blue }{10^2} & \color{blue }{10^1} & \color{blue }{10^0} & \color{blue }{10^{-1}} & \color{blue }{10^{-2}} \\ \color{blue }{} & \color{blue }{} & \color{blue }{1000} & \color{blue }{100 } & \color{blue }{10 } & \color{blue }{1 } & \color{blue }{0.1 } & \color{blue }{0.01 } \\ \color{white}{\text{digits }:} & \color{white}{z_i} & \color{white}{2} & \color{white}{6} & \color{white}{5} & \color{white}{8 } & \color{white}{4} & \color{white}{7} \\ \color{white}{\text{place value}:} & \color{white}{z_i \cdot B^i} & \color{white}{2000} & \color{white}{600} & \color{white}{50} & \color{white}{8 } & \color{white}{0.4} & \color{white}{0.07} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{2658.47} \\ \end{smallmatrix} \end{align*}$$

4. write down each digit of the numeral
$\quad$

$$\begin{align*} \begin{smallmatrix} \color{black}{\text{numeral}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{black}{\text{index}:} & \color{black}{i} & \color{black}{3} & \color{black}{2} & \color{black}{1} & \color{black}{0 } & \color{black}{-1} & \color{black}{-2} \\ \color{black}{\text{place factor}:} & \color{black}{B^i} & \color{black}{10^3} & \color{black}{10^2} & \color{black}{10^1} & \color{black}{10^0} & \color{black}{10^{-1}} & \color{black}{10^{-2}} \\ \color{black}{} & \color{black}{} & \color{black}{1000} & \color{black}{100 } & \color{black}{10 } & \color{black}{1 } & \color{black}{0.1 } & \color{black}{0.01 } \\ \color{blue }{\text{digits }:} & \color{blue }{z_i} & \color{blue }{2} & \color{blue }{6} & \color{blue }{5} & \color{blue }{8 } & \color{blue }{4} & \color{blue }{7} \\ \color{white}{\text{place value}:} & \color{white}{z_i \cdot B^i} & \color{white}{2000} & \color{white}{600} & \color{white}{50} & \color{white}{8 } & \color{white}{0.4} & \color{white}{0.07} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{2658.47} \\ \end{smallmatrix} \end{align*}$$

5. calculate the place value
$\quad$

$$\begin{align*} \begin{smallmatrix} \color{black}{\text{numeral}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{black}{\text{index}:} & \color{black}{i} & \color{black}{3} & \color{black}{2} & \color{black}{1} & \color{black}{0 } & \color{black}{-1} & \color{black}{-2} \\ \color{black}{\text{place factor}:} & \color{black}{B^i} & \color{black}{10^3} & \color{black}{10^2} & \color{black}{10^1} & \color{black}{10^0} & \color{black}{10^{-1}} & \color{black}{10^{-2}} \\ \color{black}{} & \color{black}{} & \color{black}{1000} & \color{black}{100 } & \color{black}{10 } & \color{black}{1 } & \color{black}{0.1 } & \color{black}{0.01 } \\ \color{black}{\text{digits }:} & \color{black}{z_i} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8 } & \color{black}{4} & \color{black}{7} \\ \color{blue }{\text{place value}:} & \color{blue }{z_i \cdot B^i} & \color{blue }{2000} & \color{blue }{600} & \color{blue }{50} & \color{blue }{8 } & \color{blue }{0.4} & \color{blue }{0.07} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{2658.47} \\ \end{smallmatrix} \end{align*}$$

6.Add all place values
$\quad$

$$\begin{align*} \begin{smallmatrix} \color{black}{\text{numeral}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{black}{\text{index}:} & \color{black}{i} & \color{black}{3} & \color{black}{2} & \color{black}{1} & \color{black}{0 } & \color{black}{-1} & \color{black}{-2} \\ \color{black}{\text{place factor}:} & \color{black}{B^i} & \color{black}{10^3} & \color{black}{10^2} & \color{black}{10^1} & \color{black}{10^0} & \color{black}{10^{-1}} & \color{black}{10^{-2}} \\ \color{black}{} & \color{black}{} & \color{black}{1000} & \color{black}{100 } & \color{black}{10 } & \color{black}{1 } & \color{black}{0.1 } & \color{black}{0.01 } \\ \color{black}{\text{digits }:} & \color{black}{z_i} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8 } & \color{black}{4} & \color{black}{7} \\ \color{black}{\text{place value}:} & \color{black}{z_i \cdot B^i} & \color{black}{2000} & \color{black}{600} & \color{black}{50} & \color{black}{8} & \color{black}{0.4} & \color{black}{0.07} \\ \color{blue }{\text{result}:} & \color{blue }{\sum_i{ z_i \cdot B^i }} & & & \color{blue }{2658.47} \\ \end{smallmatrix} \end{align*}$$

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