

calc_logic_example

Student Group

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example for a simplification with the rule for boolean algebra $\overline{a \vee (b \wedge \overline{a}) \vee c} \wedge 1 \vee a$

At first we will switch the representation to the following:

$$\frac{1}{(a + (b \cdot (1/a + c) \cdot 1) + a)}$$

so lets start

1. Put space between the digits

$$\quad$$
$$\begin{matrix} \text{\color{black}\text{\text{numeral}:}} & \text{\color{black}} & \text{\color{black}\text{\text{2}}} & \text{\color{black}\text{\text{6}}} & \text{\color{black}\text{\text{5}}} & \text{\color{black}\text{\text{8.}}} & \text{\color{black}\text{\text{4}}} & \text{\color{black}\text{\text{7}}} \\ \text{\color{white}\text{\text{index}:}} & \text{\color{white}\text{\text{i}}} & \text{\color{white}\text{\text{3}}} & \text{\color{white}\text{\text{2}}} & \text{\color{white}\text{\text{1}}} & \text{\color{white}\text{\text{0}}} & \text{\color{white}\text{\text{-1}}} & \text{\color{white}\text{\text{-2}}} \\ \text{\color{white}\text{\text{place factor}:}} & \text{\color{white}\text{\text{B}^i}} & \text{\color{white}\text{\text{10}^3}} & \text{\color{white}\text{\text{10}^2}} & \text{\color{white}\text{\text{10}^1}} & \text{\color{white}\text{\text{10}^0}} & \text{\color{white}\text{\text{10}^{-1}}} & \text{\color{white}\text{\text{10}^{-2}}} \\ \text{\color{white}\text{\text{digits}:}} & \text{\color{white}\text{\text{z}_i}} & \text{\color{white}\text{\text{2}}} & \text{\color{white}\text{\text{6}}} & \text{\color{white}\text{\text{5}}} & \text{\color{white}\text{\text{8}}} & \text{\color{white}\text{\text{4}}} & \text{\color{white}\text{\text{7}}} \\ \text{\color{white}\text{\text{place value}:}} & \text{\color{white}\text{\text{z}_i \cdot \text{B}^i}} & \text{\color{white}\text{\text{2000}}} & \text{\color{white}\text{\text{600}}} & \text{\color{white}\text{\text{50}}} & \text{\color{white}\text{\text{8}}} & \text{\color{white}\text{\text{0.4}}} & \text{\color{white}\text{\text{0.07}}} \\ \text{\color{white}\text{\text{result}:}} & \text{\color{white}\text{\text{\sum_i z_i \cdot \text{B}^i}}} & \text{\color{white}\text{\text{2658.47}}} \end{matrix}$$

2. Write down the index for each position.

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

3. calculate the place factor

$$\quad$$

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\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}{\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} & & & & & & \end{smallmatrix} \end{align*}
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3. calculate the place factor

(= ..., thousands, hundreds, tens, ones, tenths, ...)

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\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}{\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}{\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} & & & & & & \end{smallmatrix} \end{align*}
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4. write down each digit of the numeral

$\$ \quad \$$

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\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}{\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}{\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{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} & & & & & & \end{smallmatrix} \end{align*}
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5. calculate the place value

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\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*}
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6. Add all place values

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\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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