

calc_decimal_example

Student Group

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Calculation example for decimal 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

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

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

$$\quad$$
$$\begin{pmatrix} \text{numeral} & & & & \\ & 2 & & & \\ & & 6 & & \\ & & & 5 & \\ & & & & 8 \\ & & & & & 4 \end{pmatrix}$$

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\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} \\ \text{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*}

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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 }{} & \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*}

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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}{} & \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*}

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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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