

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

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

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

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

$$\begin{matrix} \text{\color{black}\{\text{numeral}\}:} & \text{\color{black}\{}} & \text{\color{black}\{2}} & \text{\color{black}\{6}} & \text{\color{black}\{5}} & \text{\color{black}\{8}} & \text{\color{black}\{4}} \end{matrix}$$

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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 factor}:} & \color{blue}{B^i} & \color{blue}{10^3} & \color{blue}
\color{blue}{10^2} & \color{blue}{10^1} & \color{blue}{10^0} & \color{blue}{10^{-1}} & \color{blue}
\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

\$\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}
\color{blue}{10^2} & \color{blue}{10^1} & \color{blue}{10^0} & \color{blue}{10^{-1}} & \color{blue}
\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

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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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\begin{align*} \begin{smallmatrix} \color{blue}{\text{numeral:}} & \color{blue}{} & \color{blue}{} & \color{blue}{} & \color{blue}{} & \\ \color{blue}{2} & \color{blue}{6} & \color{blue}{5} & \color{blue}{8.} & \color{blue}{4} & \color{blue}{} \\ \color{blue}{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{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}{} & \color{blue}{1000} & \color{blue}{100} & \color{blue}{10} \\ & \color{blue}{1} & \color{blue}{0.1} & \color{blue}{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{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{blue}{\text{result:}} & \color{blue}{\sum_i z_i \cdot B^i} & & & & & \\ & & \color{blue}{2658.47} & & & & & & \end{smallmatrix} \end{align*}
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First: But space between the digits to see the thousands, hundreds, tens, ones, tenths, hundredths

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

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