

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

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

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

 $\quad\quad\quad$
$$\begin{matrix} \text{\color{black}\text{\text{numeral}}:} & \text{\color{black}} & \text{\color{black}} & \text{\color{black}} & \text{\color{black}} & \text{\color{black}} & \text{\color{black}} & \text{\color{black}} & \text{\color{black}} & \text{\color{black}} \\ \text{\color{black}}^2 & \text{\color{black}}^6 & \text{\color{black}}^5 & \text{\color{black}}^8 & \text{\color{black}}^4 & \text{\color{black}}^3 & \text{\color{black}}^7 & \text{\color{black}}^1 & \text{\color{black}}^9 & \text{\color{black}}^0 \end{matrix}$$

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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

(= ..., 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}
\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

\$\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

\$\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{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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Last update: **2021/09/15 03:44**

