

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

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

2. Write down the index for each position.

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

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 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

\$\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} \\ \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

\$\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{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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