

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

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

2. Write down the index for each position.

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

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} \\ \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*}

```

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

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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 03:43**

