

calc_decimal_example

Student Group

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Table of Contents

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

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

2. Write down the index for each position.

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

3. calculate the place factor

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

3. calculate the place factor

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

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

4. write down each digit of the numeral

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

$$\begin{matrix} \text{0.07} \\ \text{2658.47} \end{matrix}$$
 &
$$\sum_i z_i \cdot B^i$$
 & &

5. calculate the place value

$$\quad$$

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

6. Add all place values

$$\quad$$

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

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