

calc_binary_example

Student Group

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Calculation example for binary 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\$

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\begin{align*} \begin{smallmatrix} \color{black}{\text{numeral}:} & \color{black}{} & \color{black}{1} & \color{black}{0} & \color{black}{0} & \color{black}{1} & \color{black}{1} & \color{black}{1} & \color{black}{0} & \color{black}{1} \\ \color{white}{\text{index}:} & \color{white}{i} & \color{white}{7} & \color{white}{6} & \color{white}{5} & \color{white}{4} & \color{white}{3} & \color{white}{2} & \color{black}{1} & \color{black}{0} \\ \color{white}{\text{place factor}:} & \color{white}{B^i} & \color{white}{2^7} & \color{white}{2^6} & \color{white}{2^5} & \color{white}{2^4} & \color{white}{2^3} & \color{white}{2^2} & \color{white}{2^1} & \color{white}{2^0} \\ \color{white}{\text{digits }} & \color{white}{z_i} & \color{white}{1} & \color{white}{0} & \color{white}{0} & \color{white}{1} & \color{white}{1} & \color{white}{1} & \color{black}{1} & \color{black}{0} \\ \color{white}{\text{place value}:} & \color{white}{z_i \cdot B^i} & \color{white}{128} & \color{white}{64} & \color{white}{32} & \color{white}{16} & \color{white}{8} & \color{white}{4} & \color{white}{2} & \color{white}{1} \\ \color{white}{\text{result}:} & \color{white}{\sum_i z_i \cdot B^i} & \color{white}{157} \end{smallmatrix} \end{align*}
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2. Write down the index for each position.

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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{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{white}{\text{place factor}:} & \color{white}{B^i} & \color{white}{10^3} & \color{white}{10^2} & \color{white}{10^1} & \color{white}{10^0} & \color{white}{10^{-1}} & \color{white}{10^{-2}} \\ \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}{500} & \color{white}{800} & \color{white}{400} & \color{white}{700} \\ \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

\$\quad\$

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

3. calculate the place factor

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

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

4. write down each digit of the numeral

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

5. calculate the place value

\$\quad\$

```
\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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