Number Base Conversion

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The methods of converting a number to and from base 10 are shown below. To convert from a base other than 10 to another base other than 10, it is usually best to first convert to base 10 before performing a second conversion to the desired base.

From Base 10

Integer

Divide the integer repeatedly by the base to which you are converting. The remainders represent the digits of the result with the least significant digit obtained first.

Example:

Convert 13_{10} to binary.

$$
\begin{array}{rl}
2 \,/\, 13 & \\
2 \,/\, 6 & \text{rem.} = 1 \\
2 \,/\, 3 & \text{rem.} = 0 \\
2 \,/\, 1 & \text{rem.} = 1 \\
0 & \text{rem.} = 1
\end{array}
$$

Answer = 1101_2

Fraction

Multiply the decimal fraction repeatedly by the base to which you are converting. The whole number part of each result becomes a digit in the final result with the most significant digit found first.

Example:

Convert $.375_{10}$ to binary.

$$
\begin{array}{rrr}
.375 & .75 & .5 \\
\times \quad 2 & \times \quad 2 & \times \quad 2 \\
\hline
\underline{0}.750 & \underline{1}.5 & \underline{1}.0
\end{array}
$$

Answer = $.011_2$

Mixed Fraction

The whole and fractional parts of the value are converted separately using the techniques above. For example converting 13.375_{10} to binary is a combination of the two examples above with the result of 1101.011_2.

To Base 10

Multiplication by Powers

Each digit of the value to be converted is multiplied by the appropriate power of the number base. The sum of these results yields the final result.

Example:

Convert 1011.11_2 to base 10.

$$
\begin{aligned}
1011.11_2 &= 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0 + 1\times2^{-1} + 1\times2^{-2} \\
&= 8 + 0 + 2 + 1 + 1/2 + 1/4 \\
&= 11.75_{10}
\end{aligned}
$$

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