

UNIT 1 *Base Arithmetic*

Overhead Slides

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Binary to Base 10

Convert the binary numbers 1011, 110011 and 100101 to base 10 numbers.

$$\begin{array}{rcccc}
 8 & 4 & 2 & 1 \\
 \hline
 1 & 0 & 1 & 1
 \end{array}
 \rightarrow + + + =$$

$$\begin{array}{rcccccc}
 32 & 16 & 8 & 4 & 2 & 1 \\
 \hline
 1 & 1 & 0 & 0 & 1 & 1
 \end{array}
 \rightarrow$$

$$\begin{array}{rcccccc}
 32 & 16 & 8 & 4 & 2 & 1 \\
 \hline
 1 & 0 & 0 & 1 & 0 & 1
 \end{array}
 \rightarrow$$

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Base 10 to Binary

Convert these base 10 numbers into binary numbers:

$$5 = 4 + 1 \quad \rightarrow \quad \begin{array}{r} 4 \quad 2 \quad 1 \\ \hline \end{array}$$

$$12 = 8 + 4 \quad \rightarrow \quad \begin{array}{r} 8 \quad 4 \quad 2 \quad 1 \\ \hline \end{array}$$

$$23 = \quad \rightarrow \quad \begin{array}{r} 16 \quad 8 \quad 4 \quad 2 \quad 1 \\ \hline \end{array}$$

$$77 = \quad \rightarrow \quad \begin{array}{r} 64 \quad 32 \quad 16 \quad 8 \quad 4 \quad 2 \quad 1 \\ \hline \end{array}$$

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Adding Binary Numbers

Key results with binary numbers

$$1 + 0 =$$

$$1 + 1 =$$

$$1 + 1 + 1 =$$

Calculate, using these binary numbers

$$\begin{array}{r} 1\ 0\ 1 \\ +\ 1\ 1 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 1\ 1 \\ +\ 1\ 0\ 1 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 0\ 1\ 1 \\ +\ 1\ 0\ 1 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 1\ 1\ 1 \\ +\ 1\ 1\ 0\ 1 \\ \hline \\ \hline \end{array}$$

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Subtracting Binary Numbers

Key results with binary numbers

$$1 - 0 =$$

$$10 - 1 =$$

$$11 - 1 =$$

Calculate, using these binary numbers

$$\begin{array}{r} 1\ 1\ 1 \\ - 1\ 0\ 1 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 1\ 0\ 1\ 1 \\ - 1\ 0\ 1\ 0 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 0\ 0\ 1 \\ - 1\ 0\ 1 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 1\ 1\ 0 \\ - 1\ 1\ 1 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 0\ 0\ 1 \\ - 1\ 1 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1\ 0\ 0\ 1\ 1 \\ - 1\ 0\ 1\ 0 \\ \hline \\ \hline \end{array}$$

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Binary Multiplication

Calculate, using these binary numbers:

$$\begin{array}{r} 110 \\ \times 11 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 111 \\ \times 11 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1101 \\ \times 110 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 10110 \\ \times 111 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1111 \\ \times 110 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1101 \\ \times 101 \\ \hline \\ \hline \\ \hline \end{array}$$

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Examples in Base 5

Convert the base 5 numbers 124 and 1223 into base 10.

$$\frac{25}{1} - \frac{5}{2} - \frac{1}{4} \rightarrow + + =$$

$$\frac{125}{1} - \frac{25}{2} - \frac{5}{2} - \frac{1}{3} \rightarrow + + + =$$

Convert 152 from base 10 to base 5.

$$152 = 125 + 25 + 2 \rightarrow \frac{125}{1} - \frac{25}{2} - \frac{5}{2} - \frac{1}{3}$$

Carry out the following base 5 calculations:

$$\begin{array}{r} 4 \ 1 \\ + \ 2 \ 2 \\ \hline \end{array}$$

$$\begin{array}{r} 1 \ 0 \ 4 \ 3 \\ + \ \ \ 1 \ 2 \ 3 \\ \hline \end{array}$$

$$\begin{array}{r} 1 \ 2 \\ \times \ 2 \ 4 \\ \hline \end{array}$$

$$\begin{array}{r} 1 \ 4 \ 4 \\ \times \ \ \ 2 \ 3 \\ \hline \end{array}$$

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Examples in Base 7

Convert 164 from base 7 to base 10.

$$\frac{49}{1} \frac{7}{6} \frac{1}{4} \rightarrow + + =$$

Convert 142 from base 10 to base 7.

$$142 = (2 \times 49) + (6 \times 7) + (2 \times 1) \rightarrow \frac{49}{-} \frac{7}{-} \frac{1}{-}$$

Carry out the following calculations in base 7:

$$\begin{array}{r} 14 \\ + 23 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 143 \\ + 225 \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 34 \\ \times 12 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 46 \\ \times 34 \\ \hline \\ \hline \\ \hline \end{array}$$