

# Section 1.4: Converting Between

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3:04 PM

# Binary, Octal, and Hexadecimal

converting between binary and octal:

octal	binary
0	0 = 000 <sub>2</sub>
1	1 = 001 <sub>2</sub>
2	10 <sub>2</sub> = 010 <sub>2</sub>
3	11 <sub>2</sub> = 011 <sub>2</sub>
4	100 <sub>2</sub>
5	101 <sub>2</sub>
6	110 <sub>2</sub>
7	111 <sub>2</sub>

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6 <sub>8</sub>	110 <sub>2</sub>
3 <sub>8</sub>	011 <sub>2</sub>
4 <sub>8</sub>	100 <sub>2</sub>

so  $634_8 = 110\ 011\ 100_2$

nifty, no?

example: convert the following octal numbers to binary:

a)  $15_8 = 001\ 101_2 = 1101_2$

$$b) \quad 703_8 = 111\ 000\ 011_2$$

binary  $\rightarrow$  octal: works in the way you'd expect:  
 group the digits into sets of three starting from the right-hand side

$$10101110_2 \rightarrow \text{octal}$$

$$2\ 5\ 6_8$$

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examples: convert from binary to octal:

①	$101_2 = 5_8$	octal	binary
		0	$000_2$
		1	$001_2$
②	$1011_2 = 13_8$	2	$010_2$
		3	$011_2$
		4	$100_2$
③	$1111001101110_2 = 17156_8$	5	$101_2$
		6	$110_2$
		7	$111_2$

hexadecimal works the same way, except that you use groups of 4

hexadecimal	binary	hexadecimal	binary
0	0000 <sub>2</sub>	8	1000 <sub>2</sub>
1	0001 <sub>2</sub>	9	1001 <sub>2</sub>
2	0010 <sub>2</sub>	A <sub>16</sub>	1010 <sub>2</sub>
3	0011 <sub>2</sub>	B <sub>16</sub>	1011 <sub>2</sub>
4	0100 <sub>2</sub>	C <sub>16</sub>	1100 <sub>2</sub>
5	0101 <sub>2</sub>	D <sub>16</sub>	1101 <sub>2</sub>
6	0110 <sub>2</sub>	E <sub>16</sub>	1110 <sub>2</sub>
7	0111 <sub>2</sub>	F <sub>16</sub>	1111 <sub>2</sub>

so  $E8_{16} = 11101000_2$

examples: convert to binary:

①  $94_{16} = 1001\ 0100_2$

②  $FAB_{16} = 1111\ 1010\ 1011_2$

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converting octal  $\leftrightarrow$  hexadecimal

best way? convert to binary first, then regroup the digits

example: convert  $705_8$  to hexadecimal

$$\begin{aligned} 705_8 &= \begin{array}{|c|c|c|} \hline 111 & 000 & 101 \\ \hline \end{array} 101_2 \\ &= 1\ 1100\ 0101_2 \quad \leftarrow \text{can skip} \\ &= 1C5_{16} \end{aligned}$$

examples: perform the following conversions:

①  $5670_8 \rightarrow$  hexadecimal

②  $30D1_{16} \rightarrow$  octal

answer: ①  $5670_8 = 101\ 110\ 111\ 000_2$   
 $= 1011\ 1011\ 1000_2$   
 $= BB8_{16}$

②  $30D1_{16} = \begin{array}{|c|c|c|c|} \hline 0011 & 0000 & 1101 & 0001 \\ \hline \end{array}$   
 $= 11\ 000\ 011\ 010\ 001$   
 $= 30321_8$