

Section 1.5: Converting Between

Wednesday, September 13, 2023 10:30 AM

Binary, Octal, Hexadecimal
all powers of 2

converting between binary and octal:

<u>octal</u>	<u>binary</u>
0	$0 = 000$
1	$1 = 001$
2	$10_2 = 010$
3	$11_2 = 011$
4	100_2
5	101_2
6	110_2
7	111_2

6_8	110_2
3_8	011_2
4_8	100_2

$$\text{so } 634_8 = 110\ 011\ 100_2$$

examples: convert to binary:

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

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

c) $42.62_8 = 100\ 010.110\ 010_2 = 100\ 010.110\ 01_2$

good practice to drop leading zeros to left of radix point

$$c) 42.62_8 = 100\ 010.110\ 010_2 = 100\ 010.110\ 01_2$$

\nearrow
 drop trailing zeros
 to right of
 radix point

$$d) 2.4_8 = 010.100_2 = 10.1_2$$

$$\text{note: } 2 + \frac{4}{8} = 1 \times 2^1 + 1 \times 2^{-1} = 2 + \frac{1}{2} \quad \checkmark$$

binary to octal: works the way you'd expect

- group the digits into sets of three starting from the radix point

convert to octal:

$$a) 10|10|110_2 = 256_8$$

$$b) 1010.11_2 = 1|010|110_2 = 12.6_8$$

\swarrow need to add trailing zero to make groups of 3 to the right of the radix point

$$c) 0.10101_2 = 0.101|010_2 = 0.52_8$$

$$d) 1|11|00|110|110_2 = 17156_8$$

$$d) \quad 1111001101110_2 = 17156_8$$

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

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

convert to binary:

$$a) \quad 94_{16} = 10010100_2$$

$$b) \quad FAB_{16} = 111110101011_2$$

$$c) \quad 2.E_{16} = 0010.1110_2 = 10.111_2$$

convert to hexadecimal:

$$11.01_2 = 0011.0100_2$$

↙ need

$$= 3.4_{16}$$

converting octal \leftrightarrow hexadecimal

best way?

convert to binary first,
then regroup digits

examples: convert the following:

a) 705_8 to hexadecimal

$$\begin{aligned} 705_8 &= \overline{111} \overline{000} \overline{101}_2 \\ &= 11100101_2 \\ &= 1C5_{16} \end{aligned}$$

$$b) 1.3_8 = 001.011_2 = 0001.0110_{16} = 1.6_{16}$$

Section 1.5: cont'd 2023/09/14

c) $A1.B2_{16}$ to octal

$$\begin{aligned} A1.B2_{16} &= \overset{0}{1}010 \overline{0001}.\overline{1011} \overline{0010}_2 \\ &= 010100001.101100100_2 \quad \leftarrow \text{can skip} \\ &= 241.544_8 \end{aligned}$$