

Section 1.5: Converting Between

Tuesday, January 16, 2024 11:07 AM

Binary, Octal, and Hexadecimal
 all powers of 2

converting between binary and octal:

octal	binary
0	$0 = 000_2$
1	$1 = 001_2$
2	$10_2 = 010_2$
3	$11_2 = 011_2$
4	100_2
5	101_2
6	110_2
7	111_2
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6_8	110_2
3_8	011_2
4_8	100_2

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

examples: convert to binary:

a) $15_8 = 001\ 101_2 = 1101_2$ ↙ drop leading zeros to left of radix point

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

c) $42.62_8 = 100\ 010.110\ 010_2 = 100\ 010.110\ 01_2$ ↘ drop trailing zeros to right of radix point

Section 1.5: cont'd : 2024/01/17

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

$\underbrace{\hspace{2em}}$
 $\underbrace{\hspace{2em}}$

$2 + \frac{4}{8}$
 $2 + \frac{1}{2}$

binary \rightarrow octal

works in the way you'd expect
 - group the digits into sets of three starting from the radix point

examples: Convert to octal

$$a) \quad 1010110_2$$

$2 \ 5 \ 6_8$

$$b) \quad 1010.11_2 = 1010.110_2 = 12.6_8$$

need to add trailing zero to make groups of three to the right of the radix point

$$c) \quad 0.10101_2 = 0.101010_2 = 0.52_8$$

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
...

3	0011 ₂	3 ₁₆	0011 ₂
4	0100 ₂	4 ₁₆	0100 ₂
5	0101 ₂	5 ₁₆	0101 ₂
6	0110 ₂	6 ₁₆	0110 ₂
7	0111 ₂	7 ₁₆	0111 ₂

convert to binary:

a) $94_{16} = 1001\ 0100_2$

b) $FAB_{16} = 1111\ 1010\ 1011_2$

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

what about binary to hexadecimal?

convert 11.01_2 to hexadecimal

$$11.01_2 = 0011.0100_2$$

$$= 3.4_{16}$$

← super important!
don't skip the zeros on the right

note: $0.01_2 = 1 \times 2^{-2} = 1/4$
 $0.4_{16} = 4 \times 16^{-1} = 4/16$

converting octal \leftrightarrow hexadecimal

best way? convert to binary first, then regroup digits

example: convert to hexadecimal

c) $705_8 = 111\ 000\ 101_2$

$= 1\ 1100\ 0101_2$ ← can skip this step

$$= 1C5_{16}$$

$$b) 1.3_8 = {}^0 001.011_2$$

$$= 0001.0110_2$$

↑
necessary

$$= 1.6_{16}$$

example: convert to octal

$$a) 30D1_{16} = \begin{array}{|c|c|c|c|} \hline 0011 & 0000 & 1101 & 0001 \\ \hline \end{array}_2$$

↑
dec

$$= 3 \ 0 \ 3 \ 2 \ 1_8$$

$$b) A1.B2_{16} = \begin{array}{|c|c|c|c|} \hline 1010 & 0001 & 1011 & 0010 \\ \hline \end{array}_2$$
$$= 10 \ 100 \ 001. \ 101 \ 100 \ 100_2 \quad \leftarrow \text{can skip}$$
$$= 241.544_8$$