

1.5 Converting Between Binary, Octal and Hexadecimal

In this section all bases are powers of 2.

Octal	Binary	Octal	Binary
0_8	000_2	4_8	100_2
1_8	001_2	5_8	101_2
2_8	010_2	6_8	110_2
3_8	011_2	7_8	111_2

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

Ex: Convert to binary

a) 15_8

$$= 001\ 101_2$$

$$= 1101_2$$

Can drop leading zeros in an integer

b) 703_8

$$= 111\ 000\ 011_2$$

$$c) 42.62_8$$

$$= 100\ 010. 110\ 010_2$$

$$= 100\ 010. 110\ 01_2$$

Can drop trailing zeros in a non-integer

$$d) 2.4_8$$

$$= 010. 100_2$$

$$= 10. 1_2$$

Ex: Convert to octal

$$a) 10101110_2$$

$$= 10|101|110_2$$

$$= 256_8$$

$$b) 1010. 11_2$$

$$= 001|010. 110_2$$

$$= 12.6_8$$

$$\begin{aligned}
 \text{c) } & 0.10101_2 \\
 & = 0.101 \mid 010_2 \\
 & = 0.52_8
 \end{aligned}$$

Hexadecimal	Binary
0_{16}	0000_2
1_{16}	0001_2
2_{16}	0010
3	0011
4	0100
5	0101
6	0110
7_{16}	0111_2

Hexadecimal	Binary
8_{16}	1000_2
9_{16}	1001_2
10	1010
11	1011
12	1100
13	1101
14	1110
15_{16}	1111_2

Ex: Convert to binary

$$\begin{aligned}
 \text{a) } & 94_{16} \\
 & = 1001 \ 0100_2
 \end{aligned}$$

$$b) \text{ FAB}_{16}$$

$$= 1111 \ 1010 \ 1011_2$$

$$c) \ 2.E_{16}$$

$$= 0010.1110_2$$

$$= 10.111_2$$

Ex: Convert to hexadecimal:

$$11.01_2$$

$$= 0011.0100_2$$

$$= 3.4_{16}$$

To convert between octal and hexadecimal,
convert to binary first.

Ex: a) $705_8 \rightarrow$ hexadecimal

$$705_8 = 111000101_2$$

$$= 1|1100|0101_2$$

$$= 1C5_{16}$$

$$\begin{pmatrix} A=10 \\ B=11 \\ C=12 \end{pmatrix}$$

b) $1.3_8 \rightarrow$ hexadecimal

$$\begin{aligned} 1.3_8 &= 001.011_2 \\ &= 0001.0110_2 \\ &= 1.6_{16} \end{aligned}$$

c) $30D1_{16} \rightarrow$ octal

$$\begin{aligned} 30D1_{16} &= 0011000011010001_2 \\ &= 0011|0000|1101|0001_2 \\ &= 30321_8 \end{aligned}$$

$$\begin{pmatrix} A=10 \\ B=11 \\ C=12 \\ D=13 \end{pmatrix}$$

d) $5670_8 \rightarrow$ hexadecimal

$$\begin{aligned} 5670_8 &= 101110111000_2 \\ &= 1011|1011|1000_2 \\ &= BB8_{16} \end{aligned}$$

$$\begin{pmatrix} A=10 \\ B=11 \end{pmatrix}$$

e) $A1.B2_{16} \rightarrow$ octal

$$\begin{aligned} A1.B2_{16} &= 10100001.10110010_2 \\ &= 0101|0001.1011|0010_2 \\ &= 241.544_8 \end{aligned}$$