

Conversion Between Decimal and Binary Representations

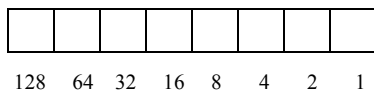
R. Mukundan

Department of Computer Science and Software Engineering
University of Canterbury, Christchurch, New Zealand.

1. Conversion from Binary to Decimal

The conversion of a binary number to decimal can be done in two ways:

Method 1: Multiply each binary number by its position-value, and add the results together. The rightmost bit has a position value 1, the next 2, the value at the third position is 4, fourth 8 and so on (See figure below)

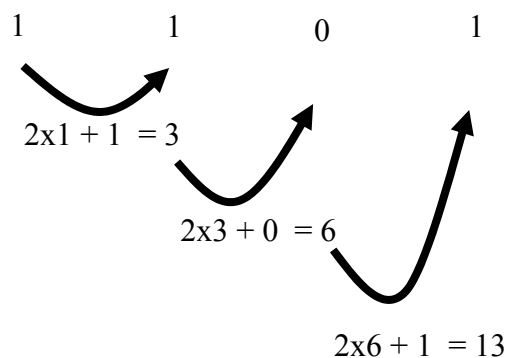


Example: $1101 = 8 \times 1 + 4 \times 1 + 1 \times 1$ (or simply, $8+4+1$) = 13

The position-value of the nth bit from right is 2^{n-1} .

Method 2: The advantage of this method is that you need not remember or compute position-values. Starting from leftmost bit, multiply the first bit by 2 and add to the next. Multiply the result by 2 and add to the third bit. Multiply the result by 2 and add to the fourth bit. Continue this process till you have reached the rightmost bit.

Example: 1101



Exercise: Convert the following binary numbers to decimal:

111

11001

10010110

2. Conversion from Decimal to Binary

Here also we give two equivalent methods for converting a decimal number to binary.

Method 1: Subtract the largest power of two, and change the bit at that position to 1. Keep subtracting the next largest possible power from the remainder, each time assigning a bit value 1 at the corresponding bit position. Repeat the process till you get a 1 or 0 for the last bit.

Example: 43

$$43 - 32 = 11$$

		1						
128	64	32	16	8	4	2	1	

$$11 - 8 = 3$$

		1		1				
128	64	32	16	8	4	2	1	

$$3 - 2 = 1$$

		1		1		1		
--	--	---	--	---	--	---	--	--

The process stops when you get a remainder 1 or 0, and this number occupies the last bit position.

		1	0	1	0	1	1
--	--	---	---	---	---	---	---

Method 2: In this method, we repeatedly divide the given decimal number by 2, and the remainders are placed from right to left:

Example: 43

43 ÷ 2:	Quotient 21, remainder 1:	Result > 1
21 ÷ 2:	Quotient 10, remainder 1:	Result > 1 1
10 ÷ 2:	Quotient 5, remainder 0:	Result > 0 1 1
5 ÷ 2:	Quotient 2, remainder 1:	Result > 1 0 1 1
2 ÷ 2:	Quotient 1, remainder 0:	Result > 0 1 0 1 1
1 ÷ 2:	Quotient 0, remainder 1:	Result > 1 0 1 0 1 1

The process stops when the quotient becomes 0

Exercise: Convert the following decimal numbers to binary

22

63

174

3000