Binary to Decimal Conversion

To convert binary into decimal is very simple and can be done as shown below:

Say we want to convert the 8 bit value **10011101** into a decimal value; we can use a formula like that below:

128	64	32	16	8	4	2	1
1	0	0	1	1	1	0	1

As you can see, we have placed the numbers 1, 2, 4, 8, 16, 32, 64, 128 (powers of two) in reverse numerical order, and then written the binary value below.

To convert, you simply take a value from the top row wherever there is a 1 below, and then add the values together.

For instance, in our example we would have **128 + 16 + 8 + 4 + 1 = 157**.

Now convert the following binary numbers to decimal.

10101001 = $(1 \times 2^7) + (0 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$	= 169
00110010 = $(0 \times 2^7) + (0 \times 2^6) + (1 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$	= 50
00111000 =$(0 \times 2^7) + (0 \times 2^6) + (1 \times 2^5) + (1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (0 \times 2^0)$	= 56
11101110 =$(1 \times 2^7) + (1 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$	= 238
11100001 =$(1 \times 2^7) + (1 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (0 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$	= 225
00101101 =$(0 \times 2^7) + (0 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$	= 45
00011000 =$(0 \times 2^7) + (0 \times 2^6) + (0 \times 2^5) + (1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (0 \times 2^0)$	= 24
11010110 =$(1 \times 2^7) + (1 \times 2^6) + (0 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$	= 214
01110010 =$(0 \times 2^7) + (1 \times 2^6) + (1 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$	= 114
10000011 =$(1 \times 2^7) + (0 \times 2^6) + (0 \times 2^5) + (0 \times 2^4) + (0 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (1 \times 2^0)$	= 131
00010111 =$(0 \times 2^7) + (0 \times 2^6) + (0 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0)$	= 23
11110100 =$(1 \times 2^7) + (1 \times 2^6) + (1 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (0 \times 2^0)$	= 244
01000010 =$(0 \times 2^7) + (1 \times 2^6) + (0 \times 2^5) + (0 \times 2^4) + (0 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$	= 66
11100110 =$(1 \times 2^7) + (1 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$	= 230

01011001 =$(0 \times 2^7) + (1 \times 2^6) + (0 \times 2^5) + (1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$	= 89
01111101 =$(0 \times 2^7) + (1 \times 2^6) + (1 \times 2^5) + (1 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$	= 125

Decimal to Binary Conversion

To convert decimal to binary is also very simple, you simply divide the decimal value by 2 and then write down the remainder, repeat this process until you cannot divide by 2 anymore, for example let's take the decimal value 157:

157 ÷ 2 = 78 with a remainder of **1**
78 ÷ 2 = 39 with a remainder of **0**
39 ÷ 2 = 19 with a remainder of **1**
19 ÷ 2 = 9 with a remainder of **1**
9 ÷ 2 = 4 with a remainder of **1**
4 ÷ 2 = 2 with a remainder of **0**
2 ÷ 2 = 1 with a remainder of **0**
1 ÷ 2 = 0 with a remainder of **1** <--- to convert write this remainder first.

Next write down the value of the remainders from bottom to top (in other words write down the bottom remainder first and work your way up the list) which gives:

10011101 = 157

Now convert the following decimal numbers to binary:

250	250 / 2 = 125 125 / 2 =	
125 01111101	125 / 2 = 62 62 / 2 = 31 31 / 2 = 15 15 / 2 = 7 7 / 2 = 3 3 / 2 = 1 1 / 2 = 0	1 0 1 1 1 1 1

64 01000000	64 / 2 = 32 32 / 2 = 16 16 / 2 = 8 8 / 2 = 4 4 / 2 = 2 2 / 2 = 1 1 / 2 = 0	0 0 0 0 0 0 1
17 00010001	17 / 2 = 8 8 / 2 = 4 4 / 2 = 2 2 / 2 = 1 1 / 2 = 0	1 0 0 0 1
9 00001001	9 / 2 = 4 4 / 2 = 2 2 / 2 = 1 1 / 2 = 0	1 0 0 1
134 10000110	134 / 2 = 67 67 / 2 = 33 33 / 2 = 16 16 / 2 = 8 8 / 2 = 4 4 / 2 = 2 2 / 2 = 1 1 / 2 = 0	0 1 1 0 0 0 0 1
88 01011000	88 / 2 = 44 44 / 2 = 22 22 / 2 = 11 11 / 2 = 5 5 / 2 = 2 2 / 2 = 1 1 / 2 = 0	0 0 0 1 1 0 1
32 00100000	32 / 2 = 16 16 / 2 = 8 8 / 2 = 4 4 / 2 = 2 2 / 2 = 1 1 / 2 = 0	0 0 0 0 0 1
12 00001100	12 / 2 = 6 6 / 2 = 3 3 / 2 = 1 1 / 2 = 0	0 0 1 1
180 10110100	180 / 2 = 90 90 / 2 = 45 45 / 2 = 22 22 / 2 = 11	0 0 1 0

	11 / 2 = 5 5 / 2 = 2 2 / 2 = 1 1 / 2 = 0	1 1 0 1
3 00000011	3 / 2 = 1 1 / 2 = 0	1 1
77 01001101	77 / 2 = 38 38 / 2 = 19 19 / 2 = 9 9 / 2 = 4 4 / 2 = 2 2 / 2 = 1 1 / 2 = 0	1 0 1 1 0 0 1
19 00010011	19 / 2 = 9 9 / 2 = 4 4 / 2 = 2 2 / 2 = 1 1 / 2 = 0	1 1 0 0 1
222 11011110	222 / 2 = 111 111 / 2 = 55 55 / 2 = 27 27 / 2 = 13 13 / 2 = 6 6 / 2 = 3 3 / 2 = 1 1 / 2 = 0	0 1 1 1 1 0 1 1