

# Binary / Decimal



BytesOfProgress

Converting Decimal to Binary:  $239_{10} \longrightarrow X_2$

First, we need to write down our "Bits" in some sort of table:

$2^{10}$	$2^9$	$2^8$	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
1024	512	256	128	64	32	16	8	4	2	1

Then, we will take a look at what the smallest number in the our table is, where our decimal number can fit in. Our Example is "239". The smallest number on the table where our "239" does fit in is 256. Now we know that 256 is a zero, but 128 is a one.

$2^{10}$	$2^9$	$2^8$	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
1024	512	256	128	64	32	16	8	4	2	1
0	0	0	1							

Now we got 128 out of 239. We got to "build" it out of the numbers on the table which are smaller than 128.  $239 - 128 = 111 \implies$  We need to "build" the difference (111) out of 64, 32, 16, 8, 4, 2, 1.

Hint: 239 is an odd number. If you take a look at the number in the beginning and see if it is an odd or even number, you already know, if it contains a one, or not. For example:

239 = xxxxxx1

238 = xxxxxx0

You should get something like this:

$2^{10}$	$2^9$	$2^8$	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
1024	512	256	128	64	32	16	8	4	2	1
0	0	0	1	1	1	0	1	1	1	1

239 in decimal equals 11101111 in binary, because  $128 + 64 + 32 + 8 + 4 + 2 + 1 = 239$ .

Some additional notes:

1. We always start counting at zero. That means:

$$\underline{2^7 = 8 \text{ bit}}$$

3. The highest representable number

with 8 bit is one number less than 9 bit: 255.

Highest representable number with:

8 bit = 255

9 bit = 511

4 bit = 16



Converting Binary to decimal:  $11101111_2 \rightarrow x_{10}$

First, we will make our "Bit-Table" again:

$2^{10}$	$2^9$	$2^8$	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
1024	512	256	128	64	32	16	8	4	2	1

Now we will write our binary-number in the table. Important: We start on the right side and write to the left!

$2^{10}$	$2^9$	$2^8$	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
1024	512	256	128	64	32	16	8	4	2	1
			1	1	1	0	1	1	1	1

We can now add up all the ones:

$$128 + 64 + 32 + 8 + 4 + 2 + 1 = 239$$

11101111 in binary equals 239 in decimal.

Of course there are quite a few different ways to convert binary to decimal or decimal to binary, but this is the one I can recommend. It is not very hard to learn, and it is much quicker to do than some other methods.

Congratulations! You are now able to convert binary to decimal and the other way around!