Collin's Lab: Binary & Hex

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Video

Decimal isn't the only way to represent a value - get acquainted with Binary & Hexadecimal, two very important numeral systems often found lurking within the depths of technology.

Transcript

In code, you'll often see number values written out something like this:

or maybe even this ...

In both cases, they're describing the number we commonly refer to as two hundred and fifty.

So why don't programmers just write "250"?

Well, the answer lies deep within the nature of digital electronics.

But first, it helps to get an objective idea of how the system we already know works.

Decimal is a base-10 numeral system.

That means it uses 10 different character symbols to represent numeric values -

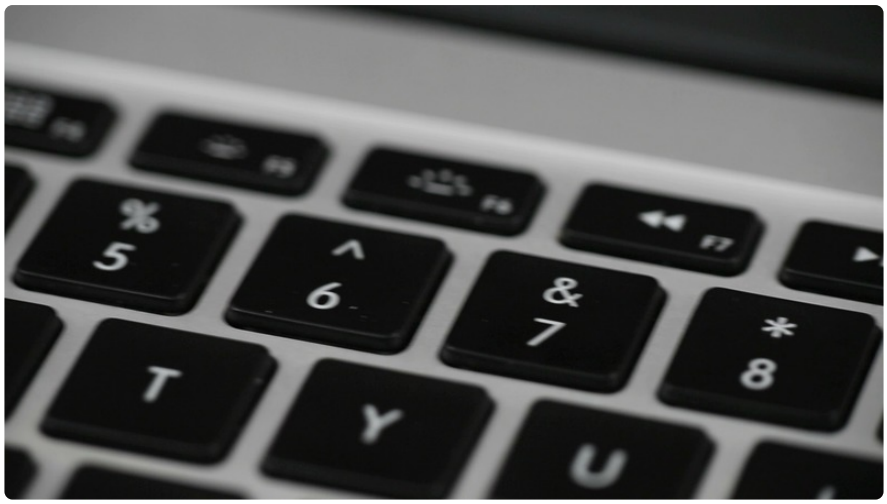
0, 1, 2, 3, 4, 5, 6, 7, 8, & 9

A single Decimal digit can represent a maximum value of nine, one more than that

and we have to add another digit to the left of the original

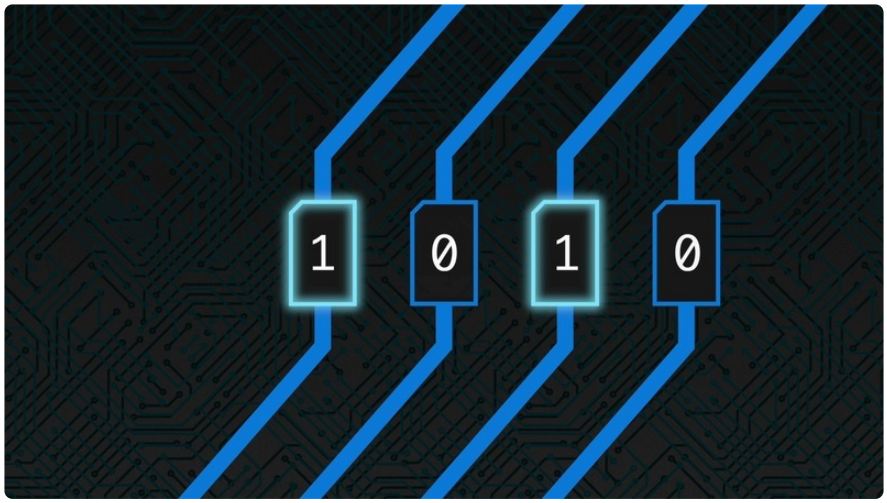
Decimal is a fine system, quite popular in fact.

Why - there it is on the top of my computer keyboard.



But - the computer itself doesn't "think" in Decimal.

It stores values as electrical charges that can be measured as either Low or High, Off or On ... zero or one.

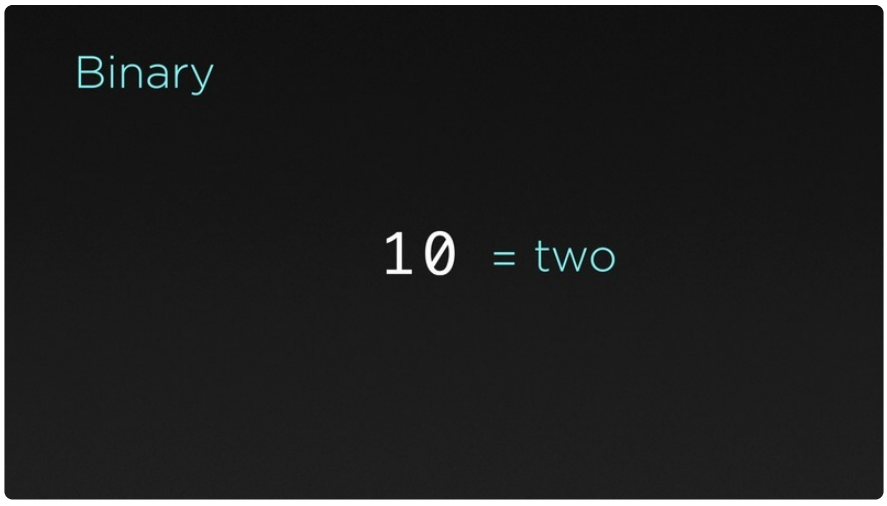


This system is known as "Binary",

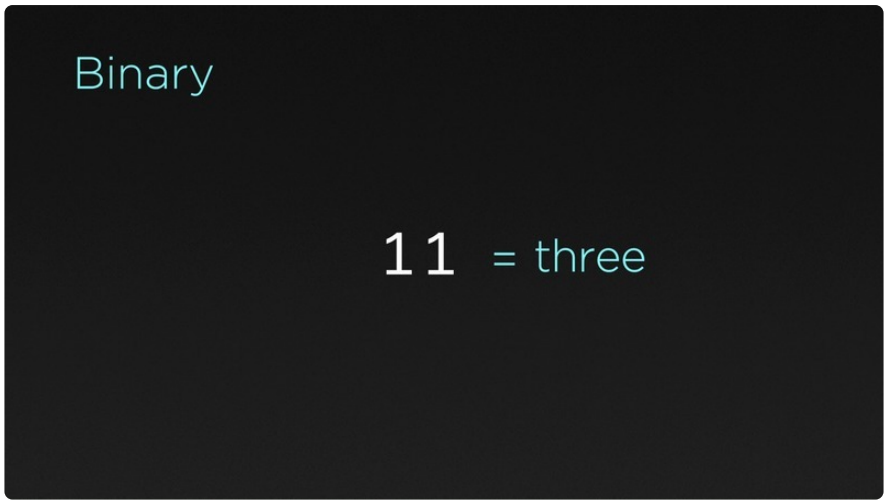
and in binary, each digit is known as a bit.

A bit can hold a maximum value of 1, in order to represent more than 1 we need to add another bit.

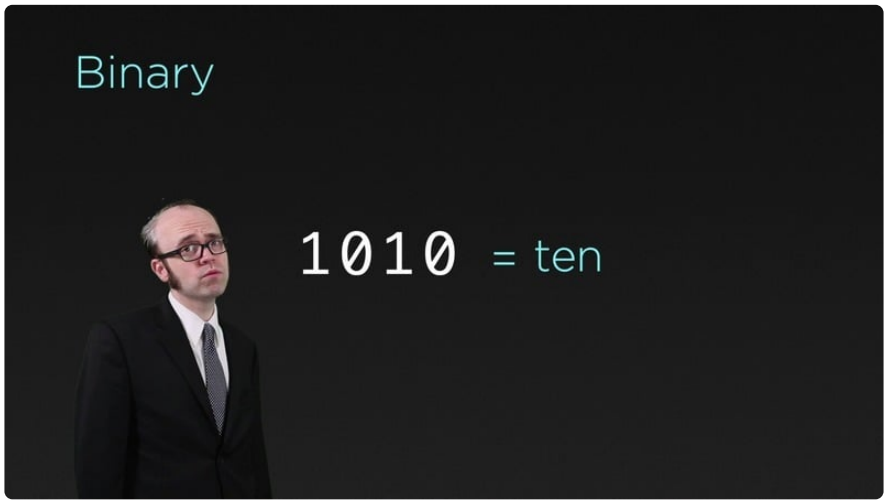
So a 2 in binary looks like this ...



and a three in binary looks like this ...



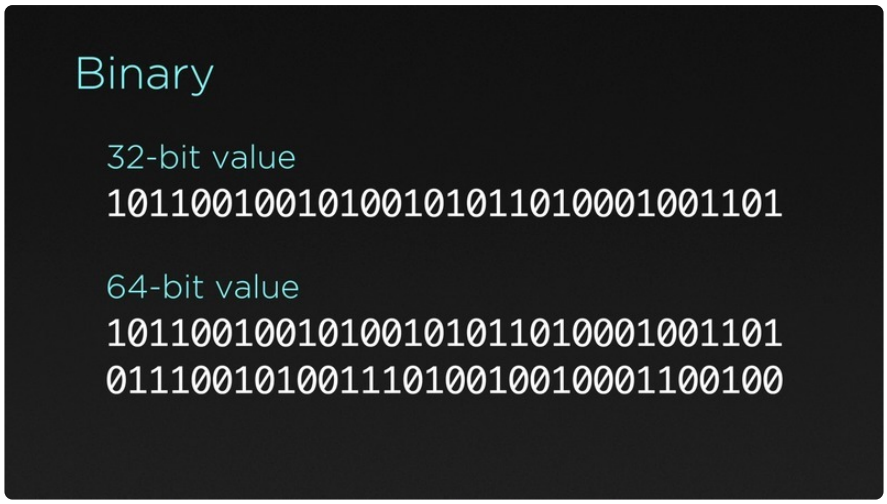
As we keep counting up to ten, you'll notice that binary uses up a lot more space compared to good old decimal notation.



And that's just a 4-bit value, most computers nowadays work with binary values of 32-bit length ...

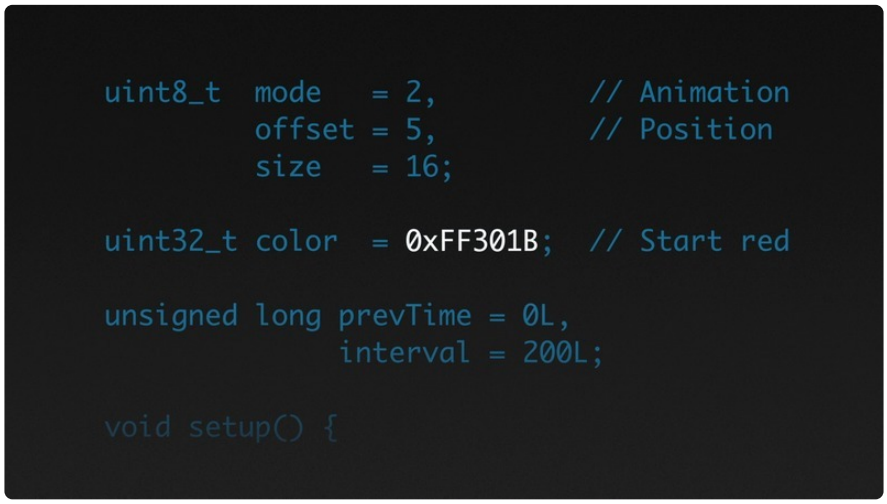
Some even use 64-bit values ...

At this point, even if we displayed these values in decimal notation, they're just ridiculously long and unwieldy.



So when writing code, it's helpful to have a more convenient way to represent them.

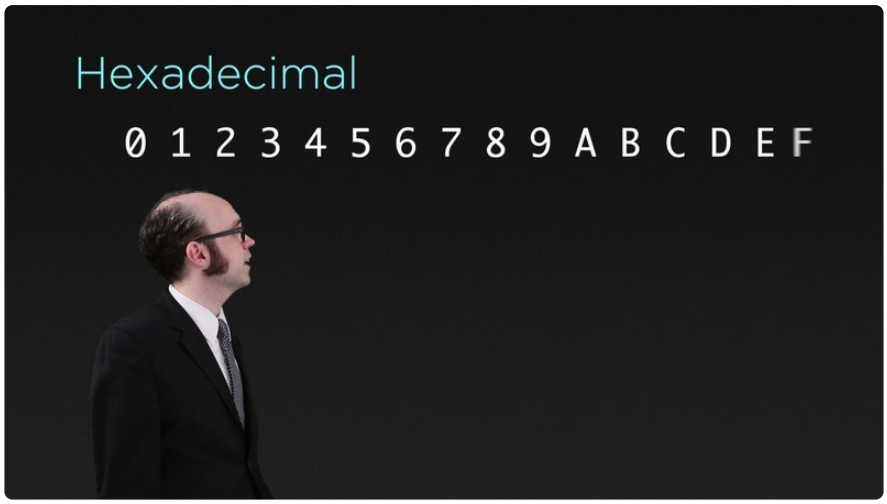
And that's where "Hexadecimal" notation comes in handy.

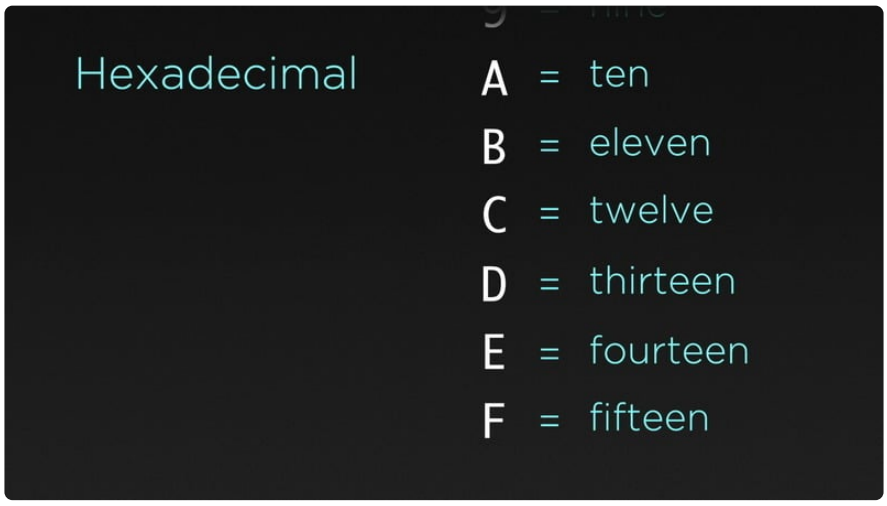


Hexadecimal, or simply "hex" as it's known to friends, uses 16 characters to represent a number value.

Like decimal, it uses the classics - 0,1,2,3,4,5,6,7,8, & 9

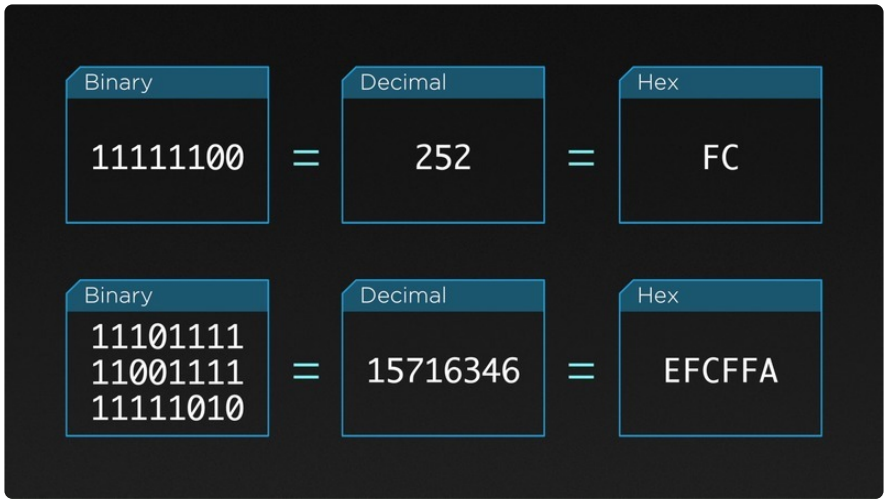
But It also uses letters, to represent values 10 through 15 - like so ...





Because of those extra characters, hexadecimal notation takes up less space in text

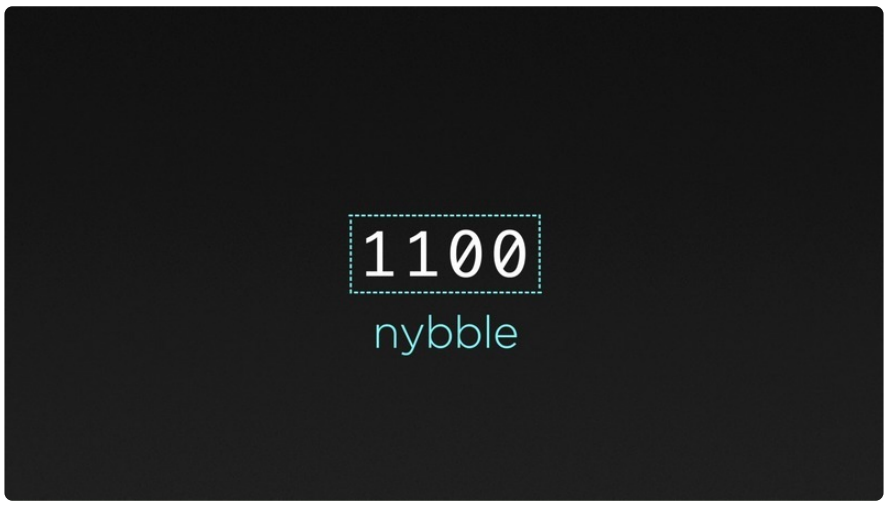
Making it easier for us humans to type out or even simply remember a specific value.

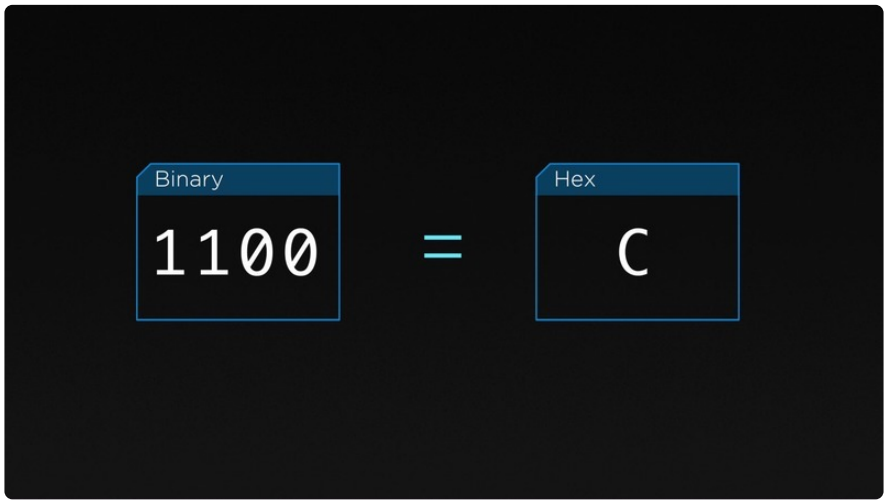


Oh but wait - that's not all. Hex also syncs up nicely with the way we group Binary bits.

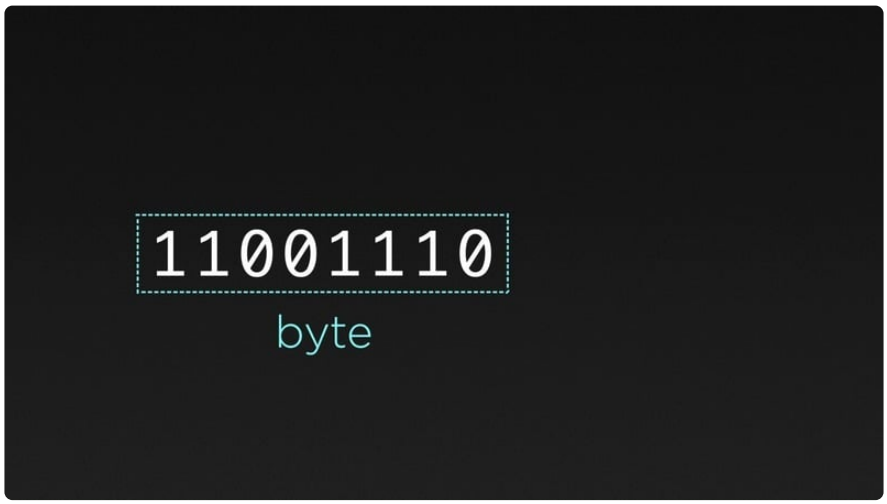
In Binary - a group of four bits is called a “nybble”

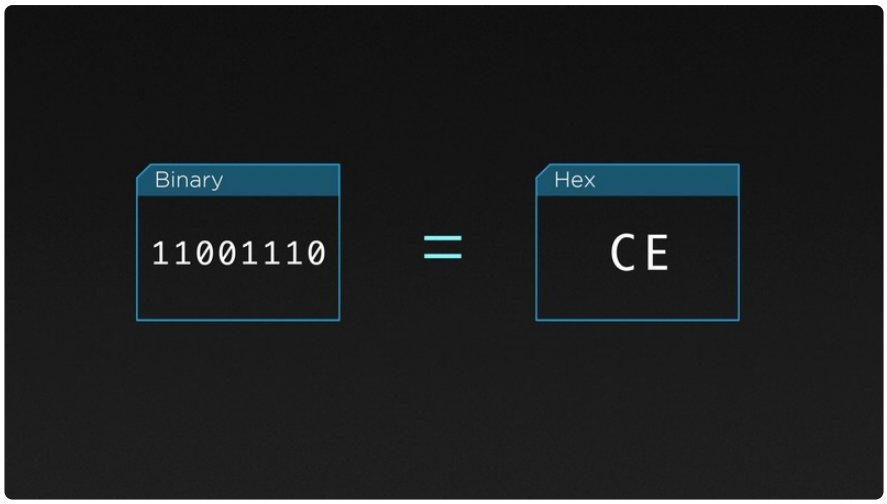
and a nybble can conveniently be represented by a single character in hexadecimal.



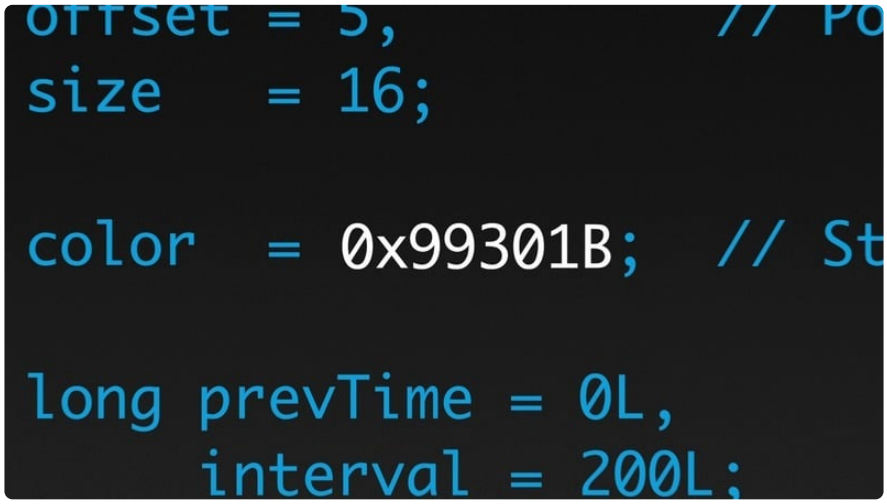


And 8 bits in Binary, which is called a byte, can be represented using only 2 hex characters.





In order to clearly specify when we're using hexadecimal in code, we add a "0x" at the beginning of the value.



But in the end - no matter what system we use to represent a value in code, it'll always be converted to binary & use the same amount of space within digital memory.

So regardless of what we see on the screen, underneath it all - its bits all the way down.

Learn More

Comparison

To get a clear idea of how binary, decimal, and hexadecimal compare - check out the table below:

Value	Binary	Decimal	Hexadecimal
zero	0	0	0
one	1	1	1
two	10	2	2
three	11	3	3
four	100	4	4
five	101	5	5

six	110	6	6
seven	111	7	7
eight	1000	8	8
nine	1001	9	9
ten	1010	10	A
eleven	1011	11	B
twelve	1100	12	C
thirteen	1101	13	D
fourteen	1110	14	E
fifteen	1111	15	F

Converters

There are a number of great tools on the web which allow you to convert between binary, decimal, and hexadecimal. Here's just a few:

Mobile

Circuit Playground for iOS (https://adafru.it/d5R)

Dec Hex Bin ASCII Converter for Android (https://adafru.it/dRE)

Web

Math is Fun Converter (https://adafru.it/dRF)

Desktop

HexDecBin for OSX & Win32 (https://adafru.it/dRG)