Decimal and Hexadecimal

A gentle 🙂 introduction to ***hexadecimal*** (base 16).

Decimal numbers

In our standard ***decimal*** system each ***digit*** (which can be 0,1,2,3,4,5,6,7,8,9) in a number represents a ***power of ten*** in that place:

decimal (base 10) digits in decimal terms:		100s	10s	1s	
decimal (base 10) number:	349	3	4	9	= (3 x 100) + (4 x 10) + (9 x 1)

Hexadecimal numbers

The ***hexidecimal*** (base 16) system is similar, except that each ***digit*** represents a ***power of 16*** in that place.

Because a digit can have values greater than 9, there are additional digit symbols allowed in hex:

- **A** (10), **B** (11), **C** (12), **D** (13), **E** (14) and **F** (15)

To convert a decimal number to hex, you remove multiples of those powers of 16 as shown below.

hexadecimal digits in hex terms:		0x100s	0x10s	0x1s	
hexadecimal digits in decimal terms:		256s	16s	1s	
decimal (base 10) number:	349	1	5	D	= (1 * 256) + (5 * 16) + (13 * 1)
	349 - 256 = 93				= (1 * 0x100) + (5 * 0x10) + (13 * 0x1)
	93 - (5*16) = 13				
	13 = 0xD				
hexadecimal (base 16) number:	0x15D				

Binary numbers

In the ***binary*** (base 2) system, each ***digit*** is a ***power of two***, and the digits are just 0 and 1.

It's easy to translate a hexadecimal number into binary because you can decompose each hex digit into its 4 bits.

binary bit (in hex terms):	0x800s	0x400s	0x200s	0x100s	0x80s	0x40s	0x20s	0x10s	0x8s	0x4s	0x2s	0x1s
hex number 0x15D in binary:	0	0	0	1	0	1	0	1	1	1	0	1
= 0b000101011101												

The benefit of using hexadecimal instead of ***binary***, is that hex is much shorter to write, but still lets us easily determine the value of specific bits.

Octal numbers

Another popular base in the computer world is ***octal*** – (base 8) where each digit is a ***power of 8***, and digits are 0, 1, 2, 3, 4, 5, 6, 7.

Octal is more compact than binary, but less compact than either decimal or hexadecimal.