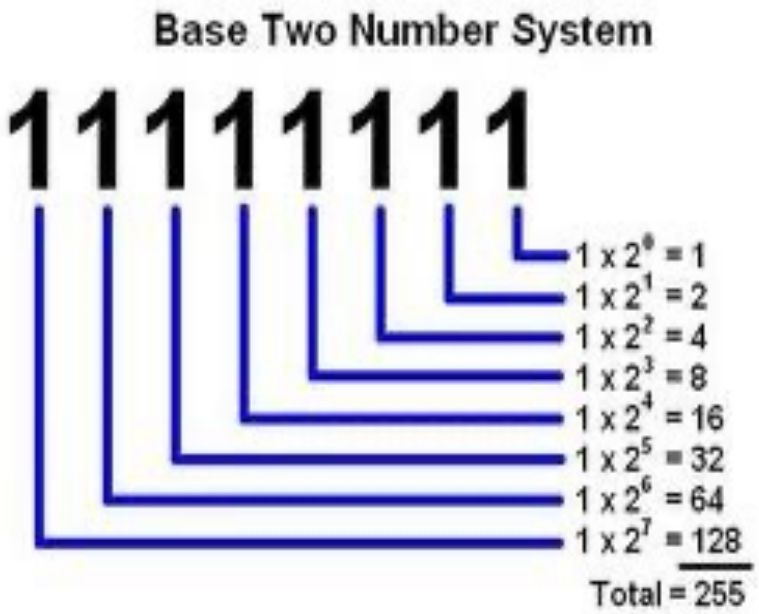
Let's backup. What we study will require BINARY

0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Binary terminology

- Binary uses only 1's and 0's as symbols
- A binary digit is called a bit
- Eight binary digits together is a byte (or an octet)



Why all the ones and zeros?

- Only two states: on & off, high & low, etc.

If Binary is base 2, why only ones and zeros?

- Think about normal numbers…

To talk about Binary, let's talk about normal numbers (Decimal)

- $904_{10} = 9 \times 10^2 + 0 \times 10^1 + 4 \times 10^0$
- $904_{10} = 9 \times 10^2 + 4 \times 10^0$

n	5	4	3	2	1	0
10^n	100000	10000	1000	100	10	1

So let's count in Binary

- Only 1s and 0s…

Binary, like Decimal, is a positional number system

n	5	4	3	2	1	0
10^n	100000	10000	1000	100	10	1

n	5	4	3	2	1	0
10^n	100000	10000	1000	100	10	1
2^n	32	16	8	4	2	1

Aside, nice, pretty round numbers in number system aren't necessarily so in another:

n	3	2	1	0
10^n (Decimal)	1000_{10}	100_{10}	10_{10}	1
10^n (Binary)	1111010002	11001002	1010_2	1

So let's look at some Binary numbers

$$101101_2 = 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

$$101101_2 = 1 \times 2^5 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^0$$

n	5	4	3	2	1	0
2^n (Binary)	100000_2	10000_2	1000_2	100_2	10_2	0
2^n (Decimal)	32_{10}	16_{10}	8_{10}	4_{10}	2_{10}	0

And how do you get the binary for a "normal" number?

- Subtracting Method: Subtract the largest power of two you can until you get to 0

- Dividing Method: Divide by 2 (writing down the remainder) until the number is gone.

Subtracting method

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

Dividing method

Hexadecimal will help us

Decimal	Hexadecimal
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A
11	B
12	C
13	D
14	E
15	F

Which Number is This?

- 1234 decimal (base 10)
- 0x1234 hexadecimal (base 16)
- 01234 octal (base 8)
- 0b1010 binary (base 2)
- 1010_2 binary (base 2)

What We Talked About Today

- The Doubles … 128 64 32 16 8 4 2 1
- The decimal value of a binary number
- The binary form of a decimal value
- The binary/hexadecimal table
- The binary form of a hex number
- The hex form of a binary number
- Octal numbers
- Studying with a blank piece of paper