

# LIS-3353

Everything is a number  
aka “Binary”

aka “I get to bring back this thing that a lot of people hate because cryptocurrency is a thing these days”

# Binary System



# Binary System

0 and 1

# How many light switches..

..would it take to store “what season is it?”

# A minimum of 2:

Winter	OFF-OFF	00
Fall	OFF-ON	01
Spring	ON-OFF	10
Summer	ON-ON	11

# Binary System

0 and 1



Humans counting things !!!!

# Humans counting!

In the beginning, there was...probably just a buncha lines, right?

THEN....Tally Marks

THEN ...Roman Numerals

THEN..Arabic Numerals



# Humans counting!

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THEN ...Roman Numerals



THEN..Arabic Numerals?

# Humans counting!

In the beginning, there was...probably just a buncha lines, right?



THEN...Tally Marks



THEN ...Roman Numerals



THEN..Arabic Numerals

uh... 5.

# Humans counting!

THEN...

Arabic Numerals

and (this is huge)

“Place Value”

# Humans counting!

THEN...

Arabic Numerals

and (this is huge)

“Place Value”

05.00

Let's get weird:

# Let's get weird:

5

V

5.0

2 + 3



# Let's get weird:

5

V

5.0

2 + 3

cinco

"five"

"dedos en su mano"

"number of fingers on one hand for the majority of people."

.

.

101 (wtf)

# Place Value

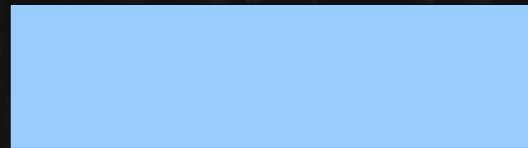
Arabic numerals include ZERO.

This is important for two related reasons:

ONE: Sometimes you want to talk about nothing.

TWO: This enables place value. That is, 10 unique symbols, but both SYMBOL and its LOCATION are important: (would you take the following salary?)

5



# Place Value

And now, you can do magic amazing ridiculous things in your head.

5436

v

5438

101 (Dalmatians)

(100s) (10s) (1s)

$$100 \times 1 + 10 \times 0 + 1 \times 1$$

$$(10^2) \times 1 + (10^1) \times 0 + (10^0) \times 1$$

“101”

(fingers)

(4s) (2s) (1s)

$$4x1 + 2x0 + 1x1$$

$$(2^2)x1 + (2^1)x0 + (2^0)x1$$



decimal (base 10) v. binary (base 2)

0 1 2 3 4 5 6 7 8 9 10 11

0 1 10 11 100 101 110 111 1000 1001 1010 1011



# Let's get even weirder...

So, decimal is good because “people,

Binary is good because computers.

What about both?

(e.g, something “**binary-like**”  
but also “**compact and easy to read?**”

# Let's get even weirder...

We need a power of 2 that's close to 10.

Could do 8, but why not go with 16?'

We just need 6 more familiar symbols...

hexadecimal.

(6 + 10)

decimal (base 10) v. binary (base 2) v. hexadecimal (base 16)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0	1	10	11	100	101	110	111	1000	1001	1010	1011	1100	1101	1110	1111	10000	10001	10010
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12

# Quick Binary Review and some bad jokes

How many fingers and toes do you have?

In Base Ten(10) or Decimal?

20

(Twenty)

$$10 \times 2 + 1 \times 0$$

# Quick Binary Review and some bad jokes

How many fingers and toes do you have?

In Base Two (2) or Binary?

10100

- 16x1 8x0 4x1 2x0 1x0



# Quick Binary Review and some bad jokes

How many fingers and toes do you have?

In Base Sixteen (16) or Hexadecimal?

14

$$16 \times 1 + 1 \times 4$$



# Place Value

Decimal	4-bit Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F
16	0001 0000	10 (1+0)
17	0001 0001	11 (1+1)

# The jokes...

“There are 10 kinds of people, those who understand binary, and those who don't.”

If you want to get technical, ALL bases are Base 10.

Exponential growth =  
Wide range of possibilities

Exponential REDUCTION =  
“Easy to specify things”

# The “shape” of computer numbers

e.g. – 128, 256, 1024, etc.

(why hard drive sizes are “wrong”)

# Where this comes up today...

IP addresses – e.g.

MAC addresses e.g.

(are more similar than you thought)

# Where this comes up today...

IP addresses:

127.0.0.1

192.168.0.1

146.201.195.214



# Where this comes up today...

0-255!

BUT, MAC addresses are like:

ac:d5:b8:c0:e1:03

0-FF?

**SAME THING!** See, also RGB Colors!

# Where this comes up today...

HTML Web Safe Colors											
#000000 0,0,0	#000033 0,0,51	#000066 0,0,102	#000099 0,0,153	#0000CC 0,0,204	#0000FF 0,0,255	#990000 153,0,0	#990033 153,0,51	#990066 153,0,102	#990099 153,0,153	#9900CC 153,0,204	#9900FF 153,0,255
#003300 0,51,0	#003333 0,51,51	#003366 0,51,102	#003399 0,51,153	#0033CC 0,51,204	#0033FF 0,51,255	#993300 153,51,0	#993333 153,51,51	#993366 153,51,102	#993399 153,51,153	#9933CC 153,51,204	#9933FF 153,51,255
#006600 0,102,0	#006633 0,102,51	#006666 0,102,102	#006699 0,102,153	#0066CC 0,102,204	#0066FF 0,102,255	#996600 153,102,0	#996633 153,102,51	#996666 153,102,102	#996699 153,102,153	#9966CC 153,102,204	#9966FF 153,102,255
#009900 0,153,0	#009933 0,153,51	#009966 0,153,102	#009999 0,153,153	#0099CC 0,153,204	#0099FF 0,153,255	#999900 153,153,0	#999933 153,153,51	#999966 153,153,102	#999999 153,153,153	#9999CC 153,153,204	#9999FF 153,153,255
#00CC00 0,204,0	#00CC33 0,204,51	#00CC66 0,204,102	#00CC99 0,204,153	#00CCCC 0,204,204	#00CCFF 0,204,255	#99CC00 153,204,0	#99CC33 153,204,51	#99CC66 153,204,102	#99CC99 153,204,153	#99CCCC 153,204,204	#99CCFF 153,204,255
#00FF00 0,255,0	#00FF33 0,255,51	#00FF66 0,255,102	#00FF99 0,255,153	#00FFCC 0,255,204	#00FFFF 0,255,255	#99FF00 153,255,0	#99FF33 153,255,51	#99FF66 153,255,102	#99FF99 153,255,153	#99FFCC 153,255,204	#99FFFF 153,255,255
#330000 51,0,0	#330033 51,0,51	#330066 51,0,102	#330099 51,0,153	#3300CC 51,0,204	#3300FF 51,0,255	#CC0000 204,0,0	#CC0033 204,0,51	#CC0066 204,0,102	#CC0099 204,0,153	#CC00CC 204,0,204	#CC00FF 204,0,255
#333300 51,51,0	#333333 51,51,51	#333366 51,51,102	#333399 51,51,153	#3333CC 51,51,204	#3333FF 51,51,255	#CC3300 204,51,0	#CC3333 204,51,51	#CC3366 204,51,102	#CC3399 204,51,153	#CC33CC 204,51,204	#CC33FF 204,51,255
#336600 51,102,0	#336633 51,102,51	#336666 51,102,102	#336699 51,102,153	#3366CC 51,102,204	#3366FF 51,102,255	#CC6600 204,102,0	#CC6633 204,102,51	#CC6666 204,102,102	#CC6699 204,102,153	#CC66CC 204,102,204	#CC66FF 204,102,255
#339900 51,153,0	#339933 51,153,51	#339966 51,153,102	#339999 51,153,153	#3399CC 51,153,204	#3399FF 51,153,255	#CC9900 204,153,0	#CC9933 204,153,51	#CC9966 204,153,102	#CC9999 204,153,153	#CC99CC 204,153,204	#CC99FF 204,153,255
#33CC00 51,204,0	#33CC33 51,204,51	#33CC66 51,204,102	#33CC99 51,204,153	#33CCCC 51,204,204	#33CCFF 51,204,255	#CCCC00 204,204,0	#CCCC33 204,204,51	#CCCC66 204,204,102	#CCCC99 204,204,153	#CCCCCC 204,204,204	#CCCCFF 204,204,255
#33FF00 51,255,0	#33FF33 51,255,51	#33FF66 51,255,102	#33FF99 51,255,153	#33FFCC 51,255,204	#33FFFF 51,255,255	#CCFF00 204,255,0	#CCFF33 204,255,51	#CCFF66 204,255,102	#CCFF99 204,255,153	#CCFFCC 204,255,204	#CCFFFF 204,255,255
#660000 102,0,0	#660033 102,0,51	#660066 102,0,102	#660099 102,0,153	#6600CC 102,0,204	#6600FF 102,0,255	#FF0000 255,0,0	#FF0033 255,0,51	#FF0066 255,0,102	#FF0099 255,0,153	#FF00CC 255,0,204	#FF00FF 255,0,255
#663300 102,51,0	#663333 102,51,51	#663366 102,51,102	#663399 102,51,153	#6633CC 102,51,204	#6633FF 102,51,255	#FF3300 255,51,0	#FF3333 255,51,51	#FF3366 255,51,102	#FF3399 255,51,153	#FF33CC 255,51,204	#FF33FF 255,51,255
#666600 102,102,0	#666633 102,102,51	#666666 102,102,102	#666699 102,102,153	#6666CC 102,102,204	#6666FF 102,102,255	#FF6600 255,102,0	#FF6633 255,102,51	#FF6666 255,102,102	#FF6699 255,102,153	#FF66CC 255,102,204	#FF66FF 255,102,255
#669900 102,153,0	#669933 102,153,51	#669966 102,153,102	#669999 102,153,153	#6699CC 102,153,204	#6699FF 102,153,255	#FF9900 255,153,0	#FF9933 255,153,51	#FF9966 255,153,102	#FF9999 255,153,153	#FF99CC 255,153,204	#FF99FF 255,153,255
#66CC00 102,204,0	#66CC33 102,204,51	#66CC66 102,204,102	#66CC99 102,204,153	#66CCCC 102,204,204	#66CCFF 102,204,255	#FFCC00 255,204,0	#FFCC33 255,204,51	#FFCC66 255,204,102	#FFCC99 255,204,153	#FFCCCC 255,204,204	#FFCCFF 255,204,255
#66FF00 102,255,0	#66FF33 102,255,51	#66FF66 102,255,102	#66FF99 102,255,153	#66FFCC 102,255,204	#66FFFF 102,255,255	#FFFF00 255,255,0	#FFFF33 255,255,51	#FFFF66 255,255,102	#FFFF99 255,255,153	#FFFFCC 255,255,204	#FFFFFF 255,255,255
#000000 0,0,0	#333333 51,51,51	#666666 102,102,102	#999999 153,153,153	#CCCCCC 204,204,204	#FFFFFF 255,255,255	#FF0000 255,0,0	#00FF00 0,255,0	#0000FF 0,0,255	#FFFF00 255,255,0	#FF00FF 255,0,255	#00FFFF 0,255,255

Also, computer “gibberish?”

Like...

**Ox19C653CB3D30EeEe2F99f9f4B987E3b2288OFFCF**

# Also, computer “gibberish?”

## Like...

**0x19C653CB3D30EeEe2F99f9f4B987E3b22880FFCF**

Public address for cryptocurrency; here, ethereum.

**Also, simply a big ol' base 16 number**

Is this real? Maybe send it some money and find out :)

(later in the class, how are you **not** able to steal my money now that you have this?)