# LIS-5362

Numbers and such

# Simplest computer I can think of...

If the British went out by Water, we would shew two Lanthorns in the North Church Steeple; and if by Land, one, as a Signal.

(Paul Revere)

izquotes.com

BINARY system. TWO possible choices

# 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!

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

THEN....Tally Marks

THEN ...Roman Numerals

V

THEN..Arabic Numerals?

# Humans counting!

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

THEN....Tally Marks

THEN ...Roman Numerals

V

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."

.

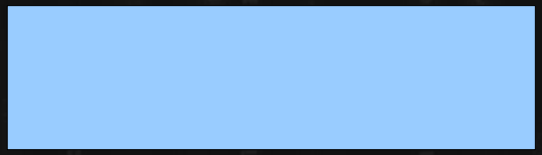
.

```
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?)



# Place Value

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

5436 v 5438

# 101 (Dalmatians)

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

100x1 + 10x0 + 1x1

(10^2)x1 + (10^1)x0 + (10^0)x1

“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)

10x2 + 1x0

# 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”)

Also, computer gibberish?

Like bitcoin addresses?
(3kKno34bvEl...?) –
base 64 numbers

Or Blue screens of death?
(923E0BC902...)
base 16 numbers.

# Where this comes up today...

IP addresses -

MAC addresses

(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...