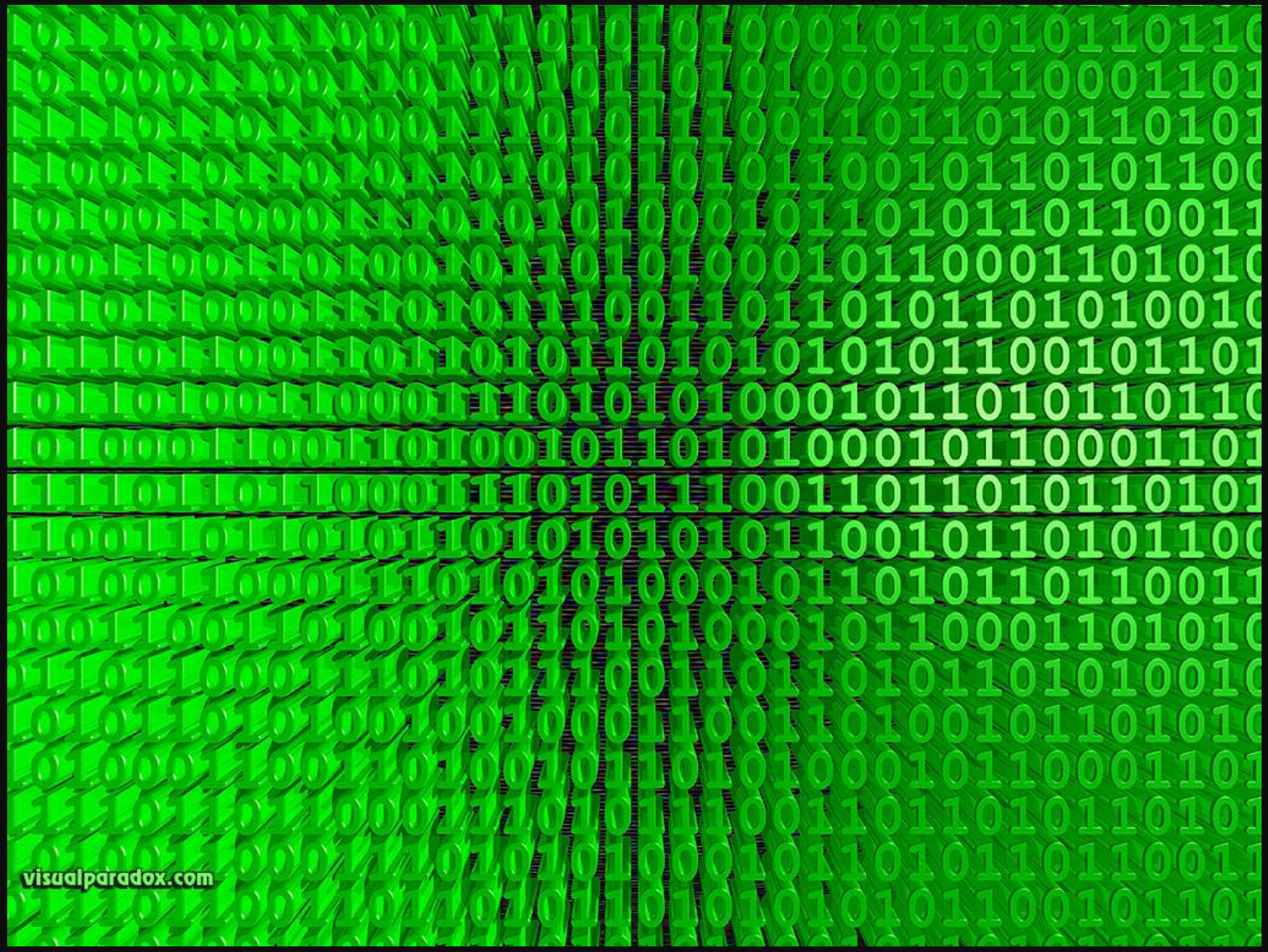
ΔIΦ

Lesson 01: The Bit

What is This?

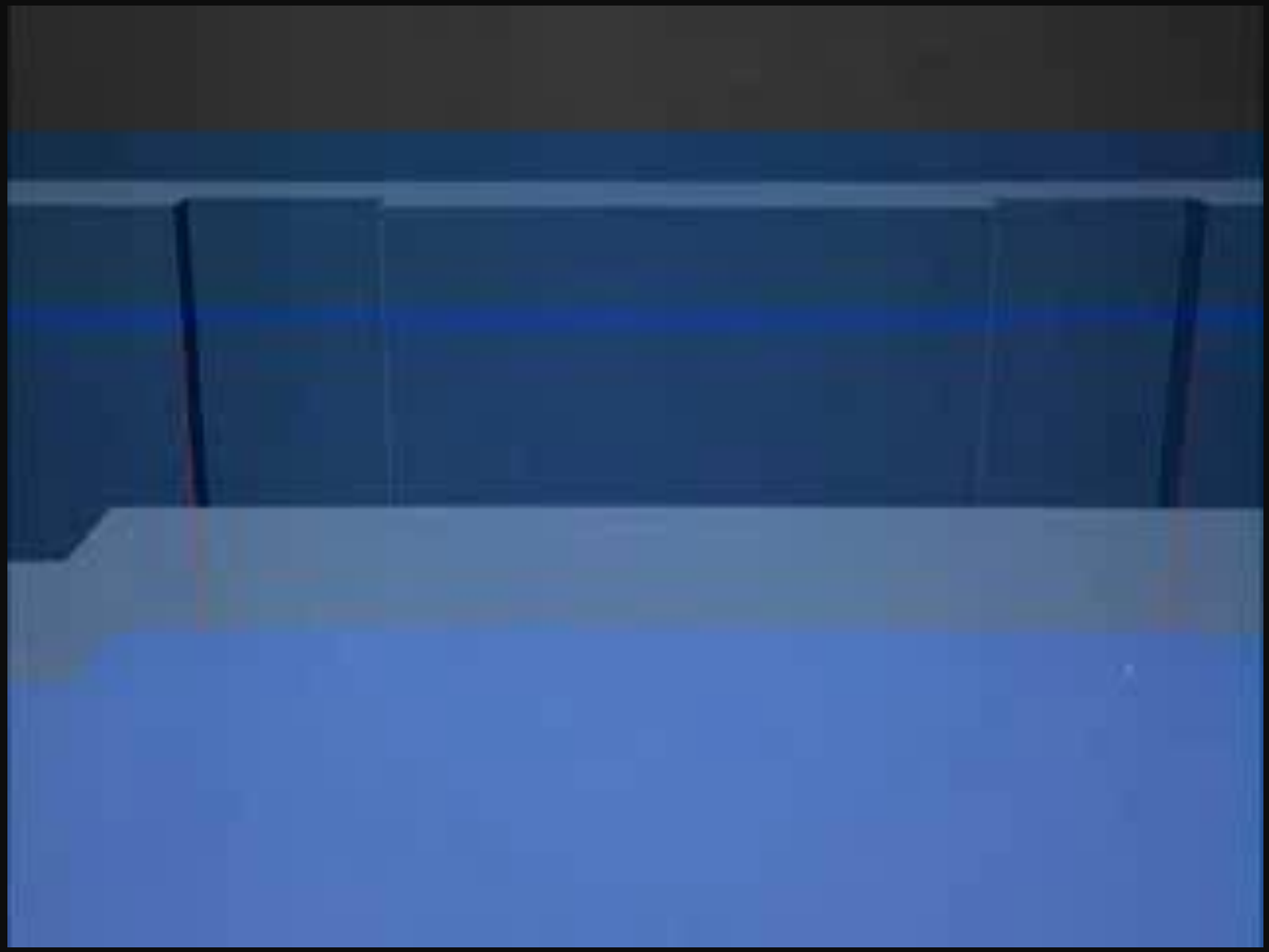


Binary Code is Made of Binary Digits

The Bit

- Short for “Binary Digit”
- The basic unit of information storage and communication.
- Only has two states…

A Bit Only has Two States



http://www.youtube.com/watch?v=BbBqPkdheFg&feature=related

From the Disney Movie *Tron*

Examples of Bits

0 / 1

True / False

Yes / No

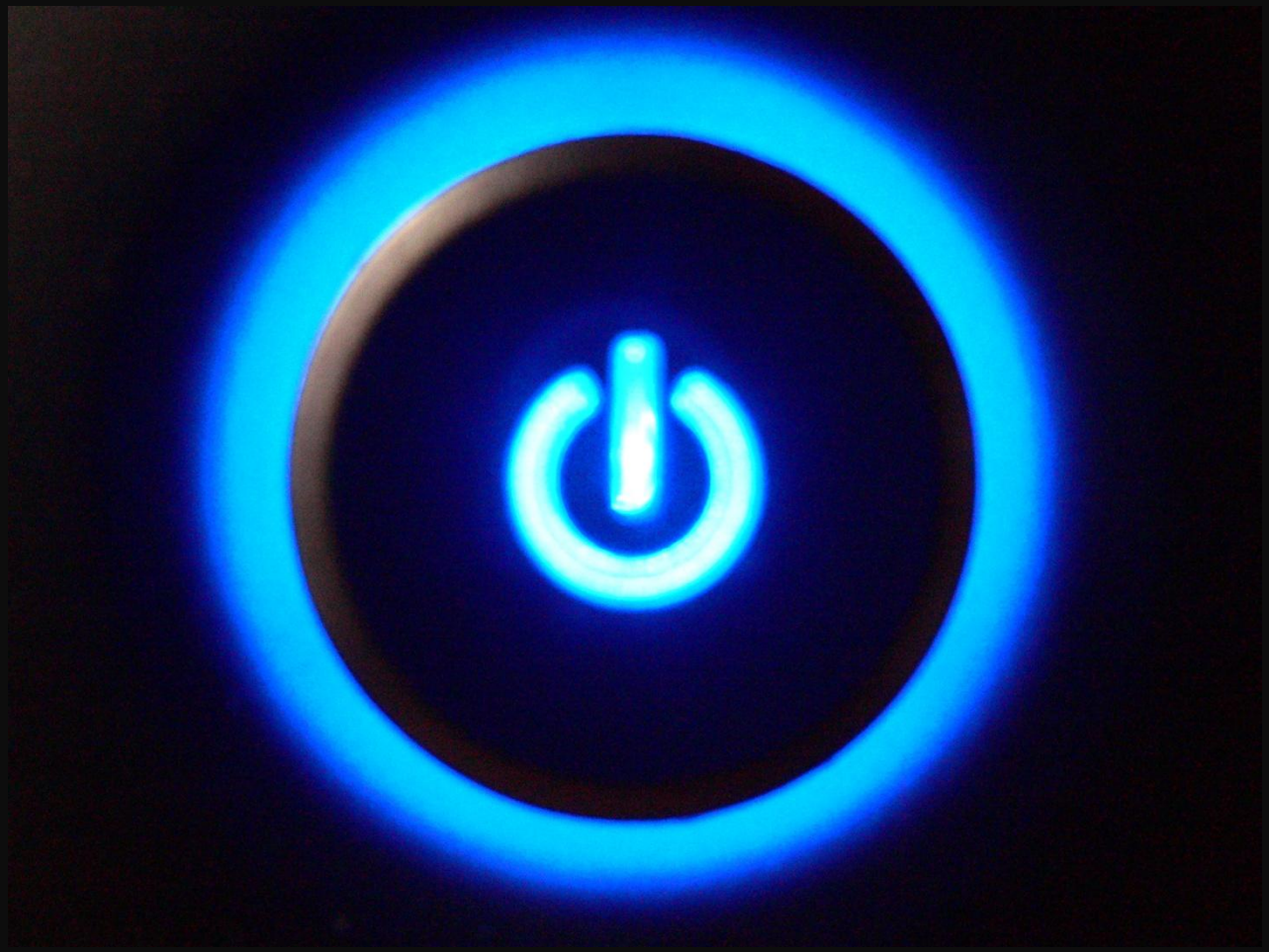
Heads / Tails

+ / -

Pass / Fail

Can you find the bit on your laptop?

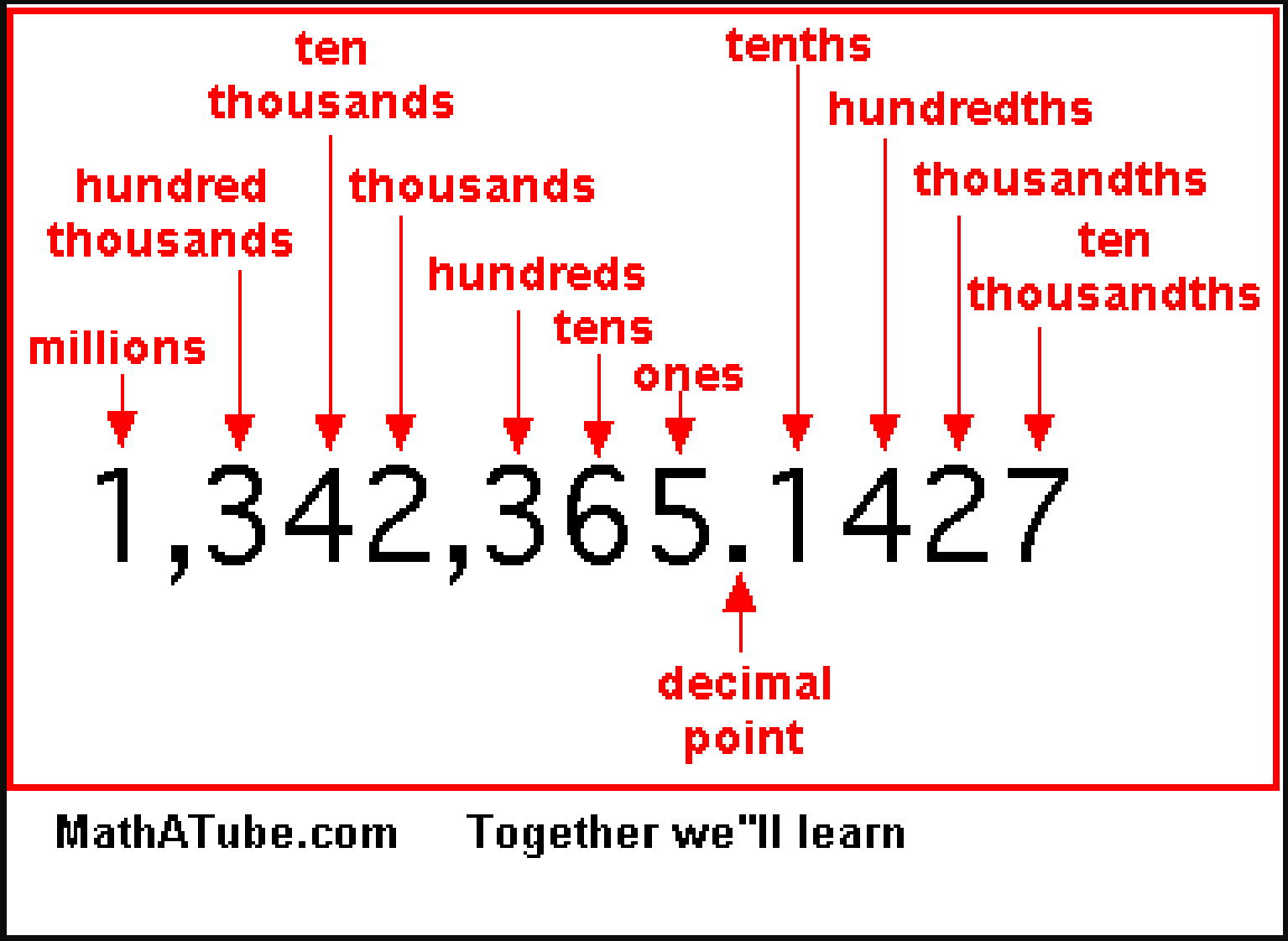
I/O Switch
(on / off Switch)



How Bits String Together

- Bits can represent numbers in Base-2.
- We work in a Base-10 Number System:
  1. We count from 0 to 9 in the “ones” place.
  2. Go back to zero in the ones place and put a “1” in front of it in the tens place to make “10”
  3. Repeat 0 to 9 in ones place, and add one to tens place.
  4. What happens when we add 1 to a number with a 9 in the ones place and 9 in the tens place?

Base-10


millions
hundred thousands
ten thousands
thousands
hundreds
tens
ones
tenths
hundredths
thousandths
ten thousandths
1,342,365.1427
decimal point
MathATube.com
Together we"ll learn

Binary is Base-2

Count from 0 to 1 in the ones place, reset to zero and put a 1 in front of it in the twos place to make 10.

Binary Place Values

Decimal	Binary	Place Value
0	0	Ones
1	1	Ones
2	10	Twos
4	100	Fours
8	1000	Eights
16	10000	Sixteenths
32	100000	Thirty-Twos
64	1000000	Sixty-Fours
128	10000000	One-Hundred Twenty-Eights
256	100000000	Two-Hundred Fifty-Sixes
512	1000000000	Five-Hundred Twelfths
1024	10000000000	One-Thousand Twenty-Fours

There are 10 types of people in the world: those who understand binary and those who don’t.

Counting in Binary

We've seen 1, 2, 4, and 8 in binary, but how do we show 3, 5, 6, and 7?

Decimal	Binary
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000

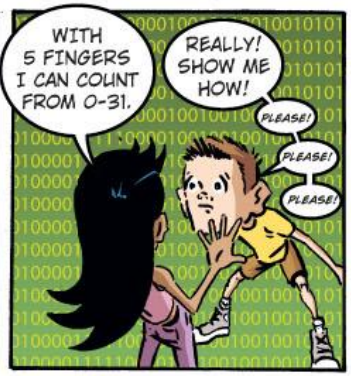
Deciphering Binary Numbers

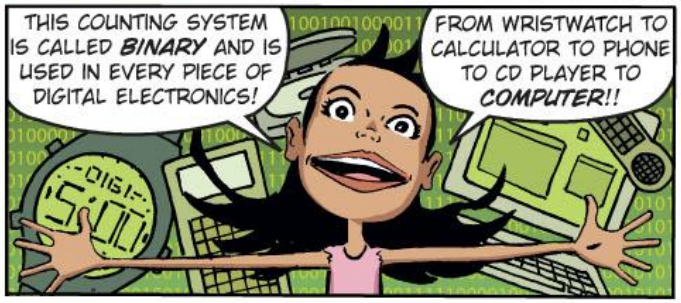
Binary	Place Values	Decimal
1011	8 + 4 + 2 + 1	15
1011	8 + _ + 2 + 1	11
1100	8 + 4 + _ + _	12
11111	16 + 8 + 4 + 2 + 1	31
10110	16 + _ + 4 + 2 + _	22
11001	16 + 8 + _ + _ + 1	25
110011	32+ 16 + _ + _ + 2 + 1	51
101110	32 + _ + 8 + 4 + 2 + _	46
1010010010	512 + _ + 128 + _ + _ + 16 + _ + _ + 2 + _	658
1010010111		
10010011011		

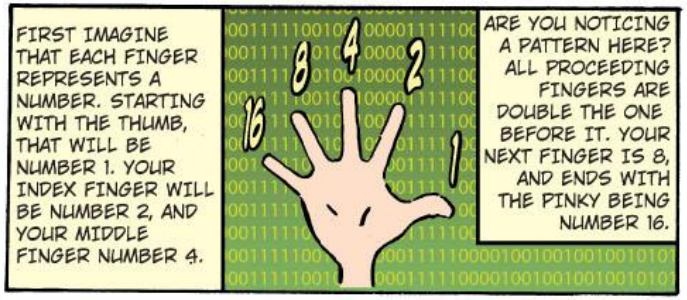
Count in Binary on Your Hands

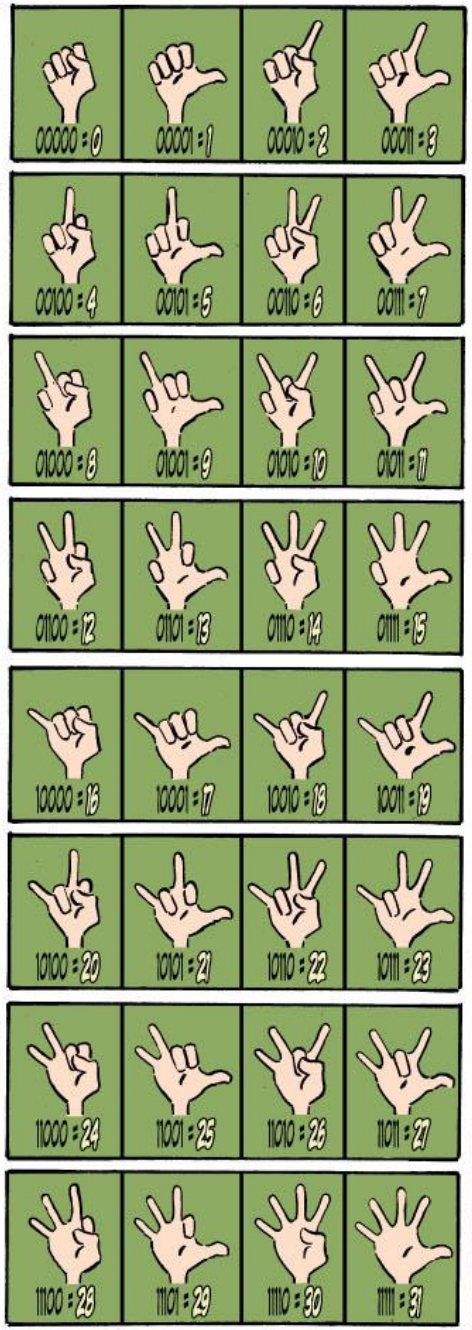
COUNT LIKE A COMPUTER

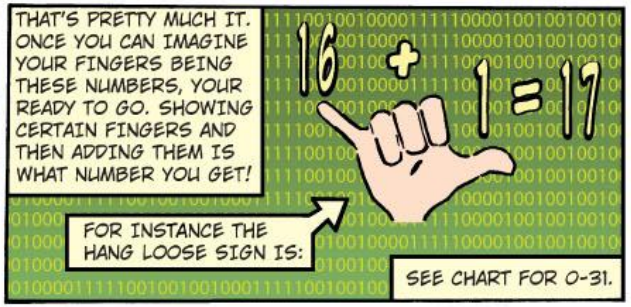
HOWTOONS STYLE!

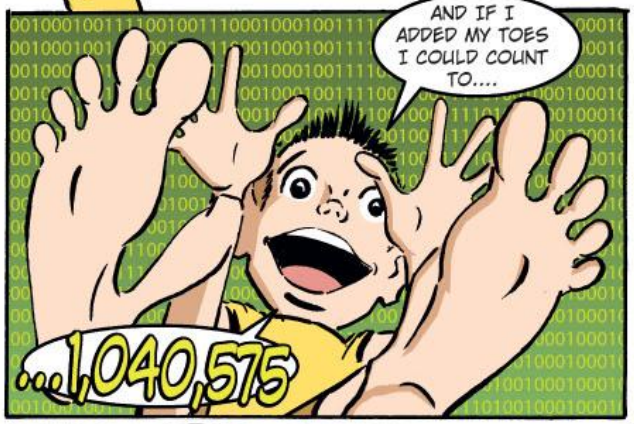


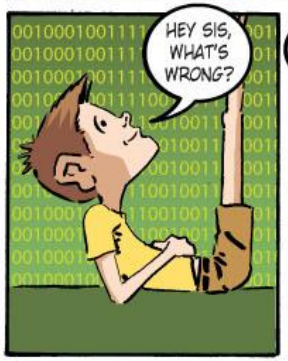


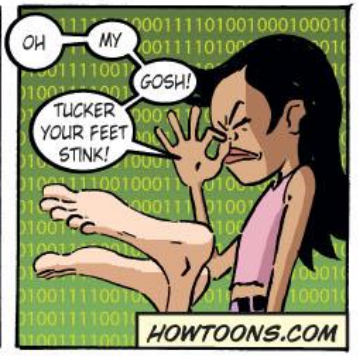












How many numbers can we represent using both hands?

Other Base Number Systems

Quaternary: Base 4

{1, 2, 3, 10, 11, 12, 13, 20…}

Octal: Base 8

{1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13…}

Duodecimal: Base 12

{1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, 10, 11, 12…}

Hexadecimal: Base 16

{1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, 10, 11, 12…}

Sexagesimal: Base 60

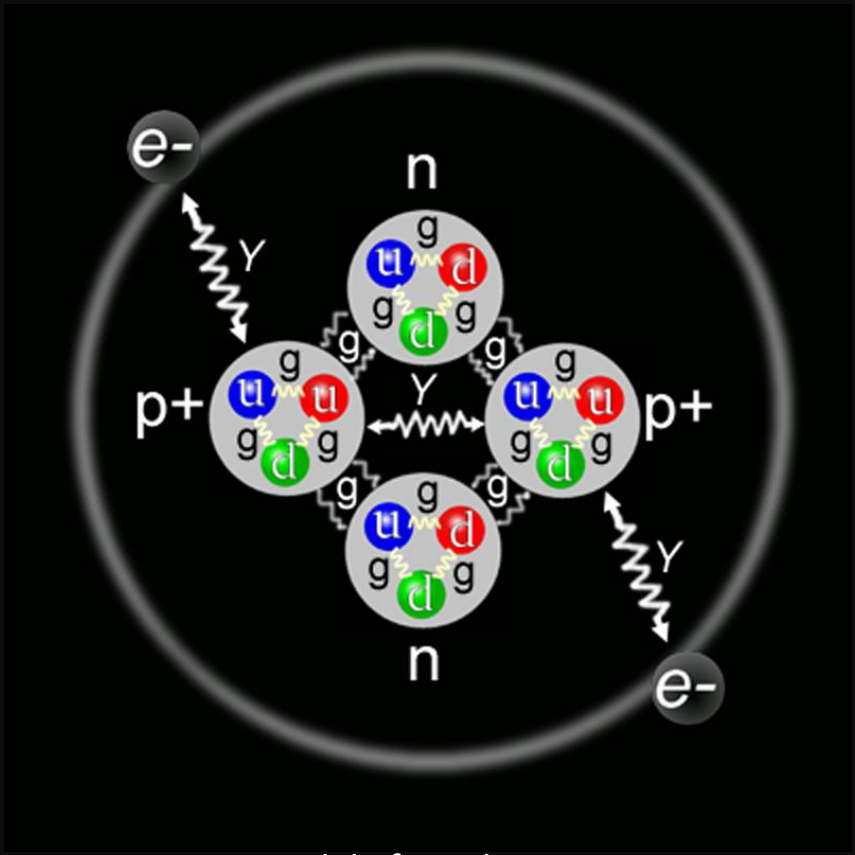
So why do we use Base-10?

Q: Why do Geeks get Halloween and Christmas confused?

A: Because

25 DEC = 31 OCT

The Bit is the Basic Unit of Information Storage and Communication



Model of a Helium Atom

Bits aren't the atoms of the Information Technology Universe, and they aren't the Protons and Neutrons of the IT Universe. Bits are the quarks and electrons of the IT Universe.

The Byte

1 Byte = 8 Bits

1. On your desktop: Right Click and select “New > Text Document”
2. Name it “byte.txt”, Open it and type a single character in it.
3. Save it (CTRL + S). Close it (ALT + F, X).
4. Right click on the file, select “Properties”.
5. What is the size of the file?
6. Try adding another character to the file and saving it.

Making Letters Out of Bytes

American Standard Code for Information Interchange

ASCII

Binary	Glyph	Binary	Glyph
0100 0001	A	0110 0001	a
0100 0010	B	0110 0010	b
0100 0011	C	0110 0011	c
0100 0100	D	0110 0100	d
0100 0101	E	0110 0101	e
0100 0110	F	0110 0110	f
0100 0111	G	0110 0111	g
0100 1000	H	0110 1000	h
0100 1001	I	0110 1001	i

There is also Unicode Standard (UTF-8)

The Kilobyte (KB)

1 Kilobyte = 1000 Bytes

Examples of Files Measured in Kilobytes:

- Images (JPG, GIF, BMP).
- Text files larger than 1000 characters
- Word Processor documents (DOC, PPT, PDF).

The Megabyte (MB)

1 Megabyte = 1000 Kilobytes

Examples of Files Measured in Megabytes:

- Song files (MP3)
- Commercials or Music Videos (MPG, MOV)
- Books / Novels (PDF, DOC, TXT)

When Windows shows a file in KB with a comma, everything to the left of the comma is the MB

(ie. 123,456 KB = 123.456 MB)

The Gigabyte (GB)

1 Gigabyte = 1,000 Megabytes

1. Open “My Computer”.
2. Right click on the “C:” drive, select “Properties”.
3. What is the capacity of your disk? How much space is used? How much is free?
4. Note the value is expressed in bytes too.

Examples of Files in GB: DVD Movies, Video Games

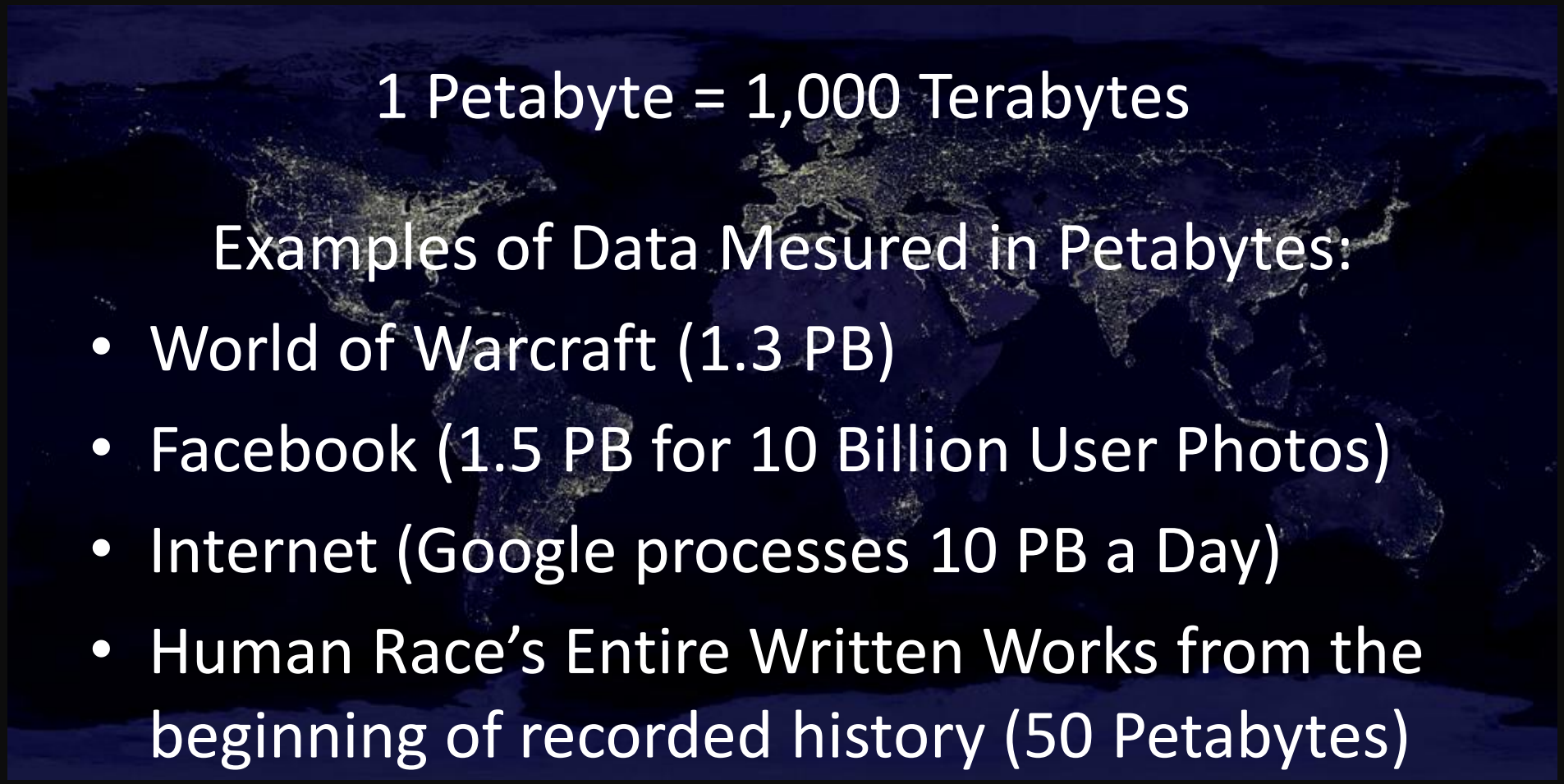
The Terabyte (TB)

1 Terabyte = 1,000 Gigabytes

One Library of Congress = 20 Terabytes

New Hard Drives are Being measured in TB too.

The Petabyte (PB)



1 Petabyte = 1,000 Terabytes

Examples of Data Mesured in Petabytes:

- World of Warcraft (1.3 PB)
- Facebook (1.5 PB for 10 Billion User Photos)
- Internet (Google processes 10 PB a Day)
- Human Race's Entire Written Works from the beginning of recorded history (50 Petabytes)

The Exabyte (EB)

1 Exabyte = 1,000 Petabytes

The Sum of All Human-Produced Information, Including Text, Audio, and Video is about 12 Exabytes of Data

Powers of 10
B, KB, MB, GB, TB, PB, EB

http://www.youtube.com/watch?v=wm0bIuAVmOA

"Power of 10" by Charles and Ray Eames 1977