

# Induction

- How did your parents represent you to the world when you were born?
- Why do you think we use base 10 as our “normal” counting system?

# How Computers Represent Data

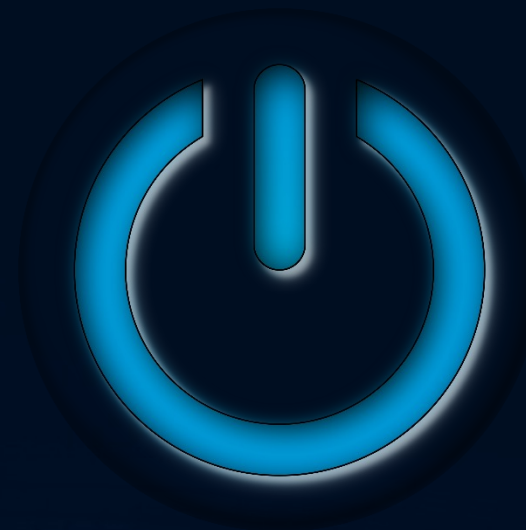
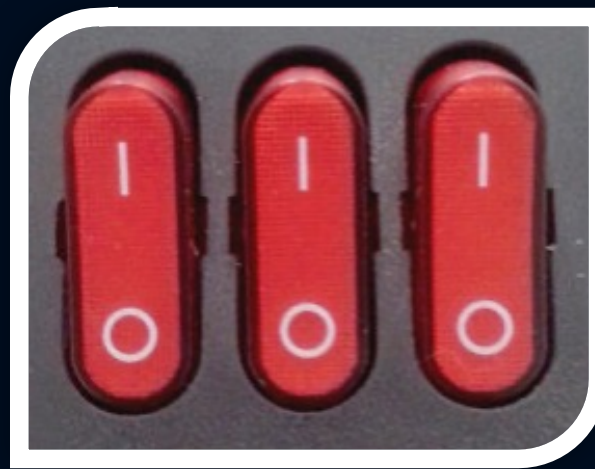
THE FIRST ABSTRACTION



# Induction

- How did your parents represent you to the world when you were born?
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# Binary State



# Binary Thinking

There are 10 types of people in the world...

Those who understand binary, and those who don't.

# Numbers

$$\begin{array}{cccccccc} 2^7 & 2^6 & 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \\ 128 & 64 & 32 & 16 & 8 & 4 & 2 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 = 5 \end{array}$$

Why this matters...



Feb 25, 1991  
Dhahran, Saudi Arabia

We missed.

28 soldiers died,  
100 others were injured.

The software fix arrived  
at Dhahran the next day.

# Teletype





# Pick Something (It's Arbitrary)

IBM

EBCDIC Code Table

B8	B7	B6	B5	B4	B3	B2	B1	HEX-0	HEX-1	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	0	0	0	0	0	0	0	0	NUL	DLE	DS	SP	&	-										0
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1										1
0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1										2
0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1										3
0	1	0	0							PF	RES	BYP	PN											4	
0	1	0	1							PT	NL	LF	RS											5	
0	1	1	0							LC		ETB	UC											6	
0	1	1	1							DEL	IL	ESC	EOT											7	
1	0	0	0								CAN													8	
1	0	0	1								EM													9	
1	0	1	0								SMM	CC	SM											A	
1	0	1	1								VT													B	
1	1	0	0								FF	DUP	RA	<	*	%	#							C	
1	1	0	1								CR	SF	ENQ	NAK	(	)	-							D	
1	1	1	0								SO	FM	ACK	+	;	>	=							E	
1	1	1	1								SI	ITB	BEL	SUB	I	?	"							F	

Everyone Else

American National Standards Institute (ANSI)

American Standard Code for Information Interchange (ASCII)

(IBM Lost)

# ASCII

7-bit encoding standard

$2^7 = 128$  characters available

- 26 Capital Letters
- 26 Small Letters
- 10 0 – 9 Digits
- 32 Punctuation Marks
- 01 Space bar
- 33 Codes left over
- 31 Control Codes
- 2 Special Reserved
  - 0 = NULL
  - 127 = DEL

# Teletype

0 = No Holes  
(End of data block)

127 = All Holes  
(Erase All Data)



ASCII

Digits

- 011 0001 1
- 011 0010 2
- 011 0011 3
- 011 0100 4

ASCII

## Upper Case Letters

- 100 0001 A
- 100 0010 B
- 100 0011 C
- 100 0100 D

ASCII

## Lower Case Letters

- 110 0001 a
- 110 0010 b
- 110 0011 c
- 110 0100 d

# ASCII

## Changing Case = Flipping a Bit

- 1**0**0 0001      A
- 1**1**0 0010      a
  
- 1**0**0 1010      J
- 1**1**0 1010      j

# ASCII

Computers use a byte for an ASCII char.

The 8-bit position is always 0



Light Show

John's Creek Binary Trainer Demo

# Closure

- How do we switch case from capital to lower case?
- What is the ASCII code for NULL (`\0`)? Delete?
- What is the character for **011** 0010?