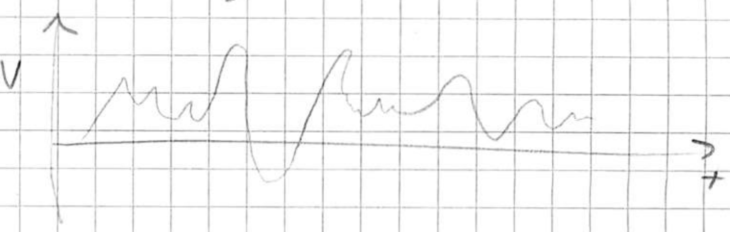
Class #1

Digital Electronics I

→ Circuits in which there are only 2 states possible at any point

Until now we've dealt w/ signals that are continuous, analog signals.



- sometimes information is discrete (yes/no)

  e.g. particle detector, switch, keyboard

- converting continuous (analog) data to digital form can make calculation and storage simpler.

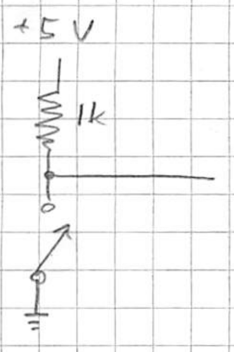
- Transmission of digital data is noiseless.

  → Analog data picks up noise while being transmitted. Data represented by numbers represented by HIGH & LOW voltage levels is insensitive to noise below the threshold of changing HIGH to LOW.

But... world is analog, analog uses less power & is faster

E.g. • cassettes vs. mp3s
• long distance phone call

Example of a Digital Signal



Switch Closed	Output	
true (1)	low (0V)	(0)
False (0)	high (+5 V)	(1)

"not" gate → $(\overline{\text{Switch Closed}})$

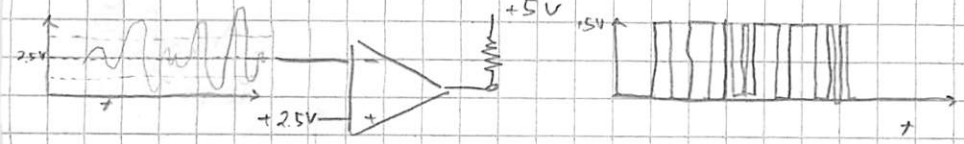
Noise Immunity

e.g. CMOS →

0 - 1.5 V → low

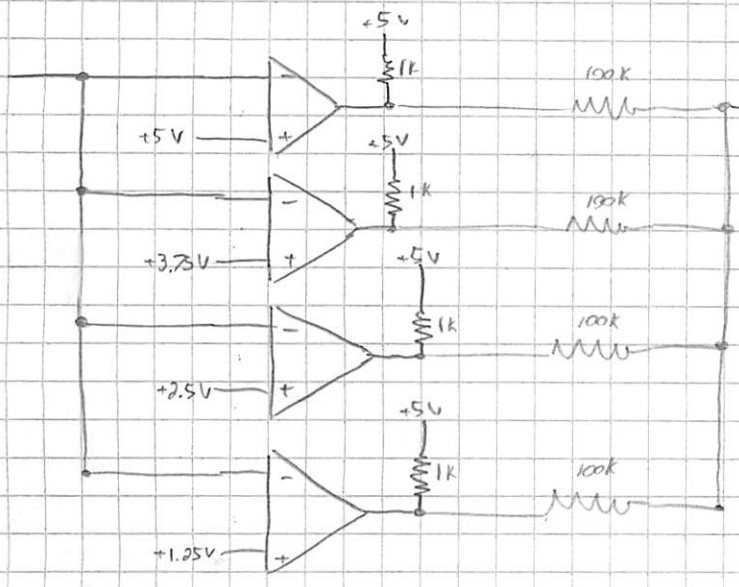
3.5 - 5 V → high

Analog to Digital



← bad fidelity

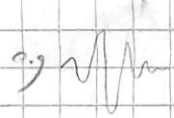
2 states



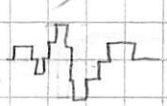
better fidelity

5 states

Analog → Digital → Analog

e.g. 

e.g. 0000 0 V
0001 1.25 V
0011 2.5 V
0111 3.75 V
1111 5 V

e.g. 

Decimal vs. Binary

Base 10: $137.06 = 1\times10^2 + 3\times10^1 + 7\times10^0 + 0\times10^{-1} + 6\times10^{-2}$

Base 2:

$1101_2 = 1\times2^3 + 1\times2^2 + 0\times2^1 + 1\times2^0 = 13$

Base 16 or Hex: → (0-9, A-F$_{16}$ = 0-15)

$2C3_{16} = 2\times16^2 + 12\times16^1 + 3\times16^0 = 707$

2 C 3 $_{16}$

0010 1100 0011 $_2$

1-bit → 2^1 states

4-bits → $2^4 = 16$ states

8-bit (byte) → $2^8 = 256$ states

1-bit

4-bit

8-bit = 1 byte

Example

2 byte # → 0000_{16} - $FFFF_{16}$ → $2^8 \cdot 2^8 = 2^{16} = 65,536$ states

(byte byte)

Number Representations

Sign magnitude

Offset binary → good for counting

2's Complement → good for add, ← most used

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