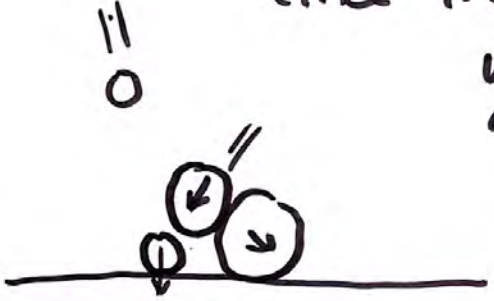
COGS 300 **Movement 03** Sep 16/25

Warm up: Draw as many circles as you can acting with "physics" (like last time)



what direction are they moving?

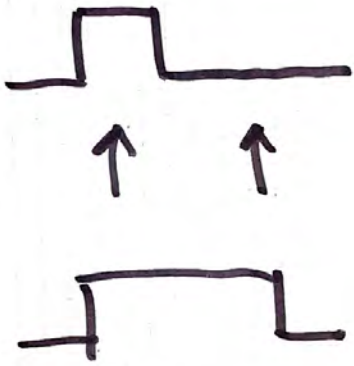
IO1 MO1 MO2 MO3 MO4

Control 01 02 03 04

Modulation

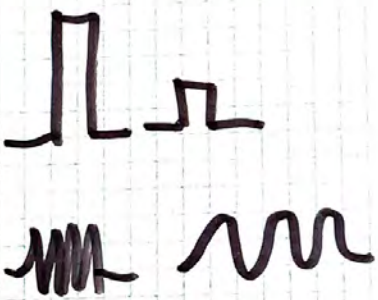
Pulse width modulation

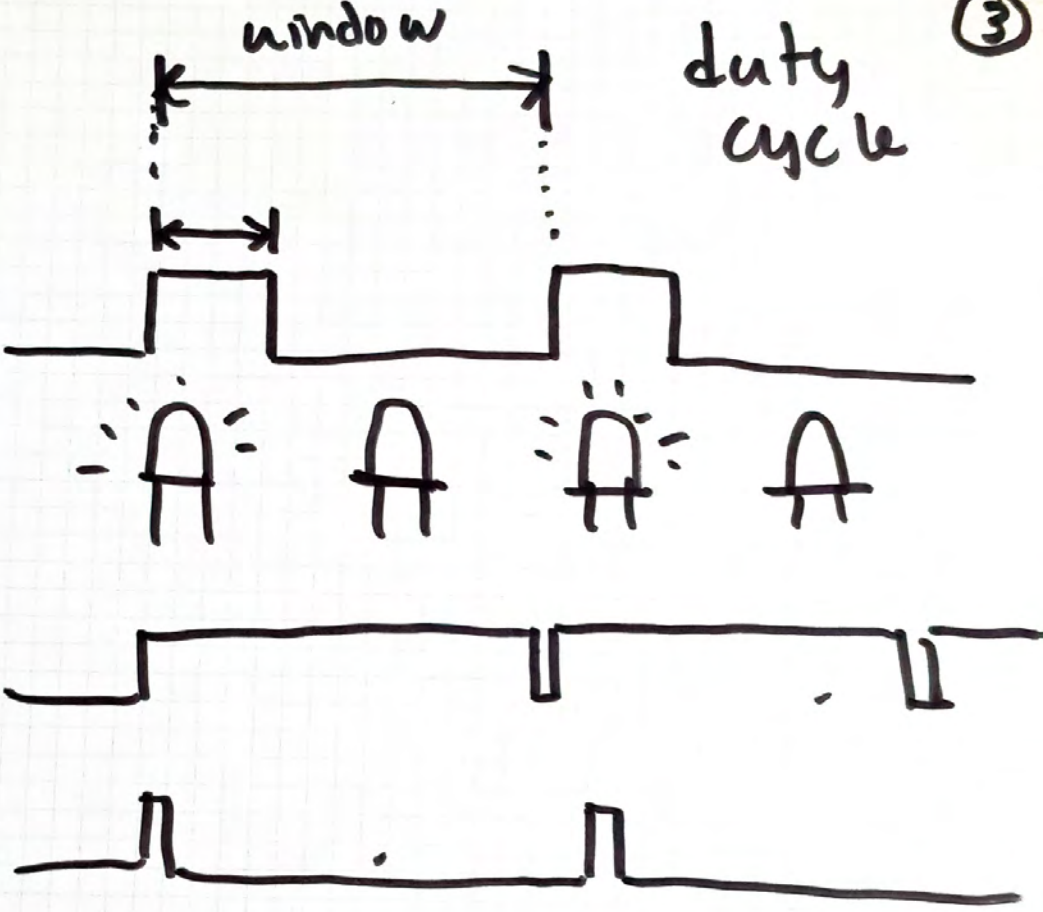
Dimmer
PWM ~

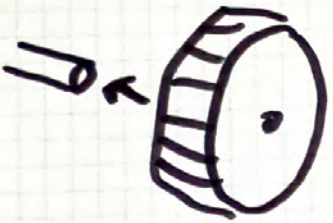


AM Amplitude

FM Frequency

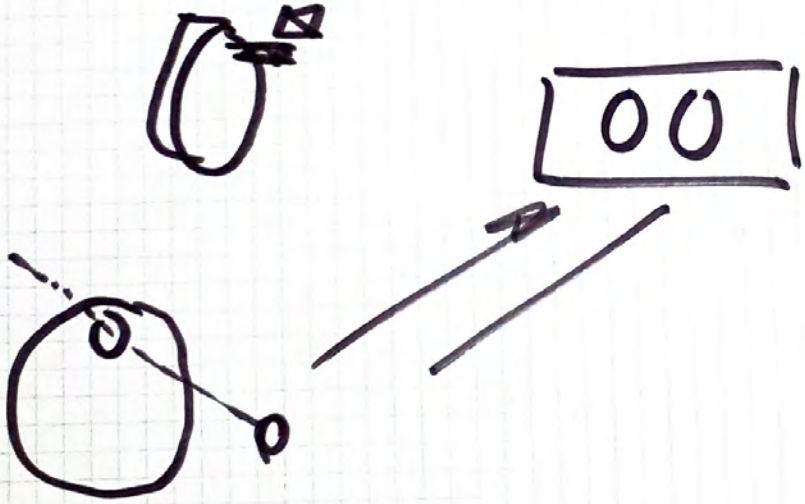


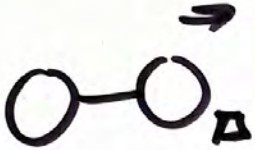

window
duty cycle



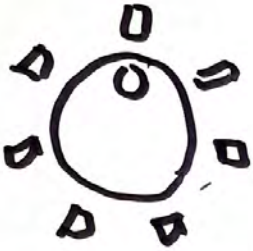
Design challenge:

How do you measure the wheel?





ML

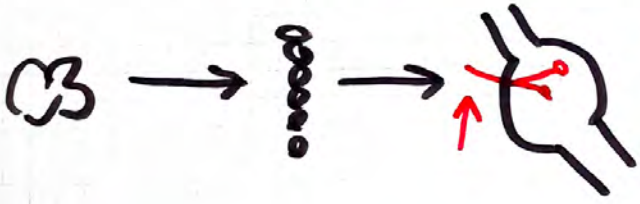


hi res.

optical encoder

motor

PWM is like neuron communication



1 pulse = 1 twitch

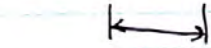
COGS 300 movement 03 Sept 16/25

Today we are starting to move towards control. You've already seen our topic for today:

pulse width modulation.

send out a pulse

time →



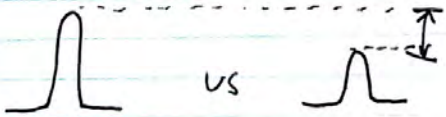
the pulse has a width

the Arduino (or other microcontroller, etc.) measures the width.

to modulate some value of interest

This is a common paradigm.

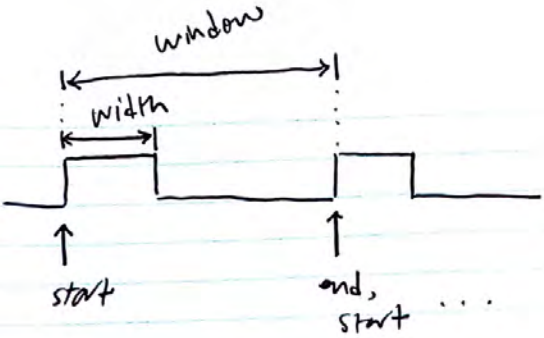
AM : Amplitude modulation



diff height = diff meaning

FM : frequency modulation

diff wavelengths = diff meaning



duty cycles

more width = more duty

more on = brighter (LED)

more on = faster (Motor)

☆ Motor driver. activity + demo.

You can see that the motor driver doesn't include a sensor.

☆ How can you measure how far the wheel has turned?

Time: potentially! what about load?

Voltage: We'd need to hook it in, why not more direct?

etc.

⋮

Potentiometer as encoder

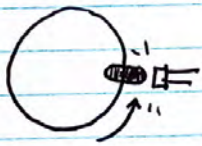
This works! but...

↑ what happens here?

at some point, we need a counter.

* Counter demo.

If we attach a notch or pin to a wheel, we can count.



1, 2, 3 ---

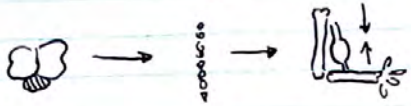
It's bad but it works!

Design a better counter-style encoder.

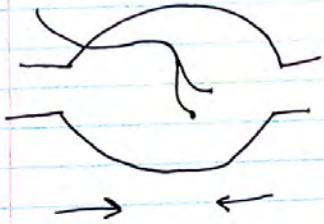
Connection to muscles:

our body needs to know where it is in space, too.

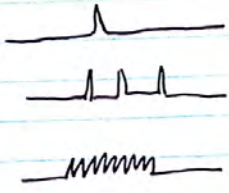
PWM is "like" motor neuron communication (to muscles).



zoom in:



one pulse = 1 twitch



small contraction

bigger

perceptible.

PWM is a model (=) of motor neurons. + muscle movement.

You can stimulate motor neurons with electricity. Some people make products + research for this.

Re: piano-playing robot.

is this similar or diff to a robot?

Are our muscles "just" motors?