

Neural Networks

UCSB Robotics, Winter 2021 | Alex Mei

ANNOUNCEMENTS

- CodePath iOS Development Course - Spring, 2021: <https://discord.gg/BzqjEPv38x>
- Robotics T-Shirt Design Competition

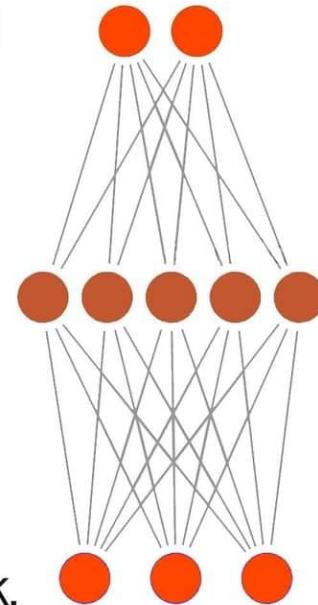
DAILY RUNDOWN

- What is a Neural Network?
- Neural Network Use Cases
- Project Sprint 1 Work Time

This is a neural network.

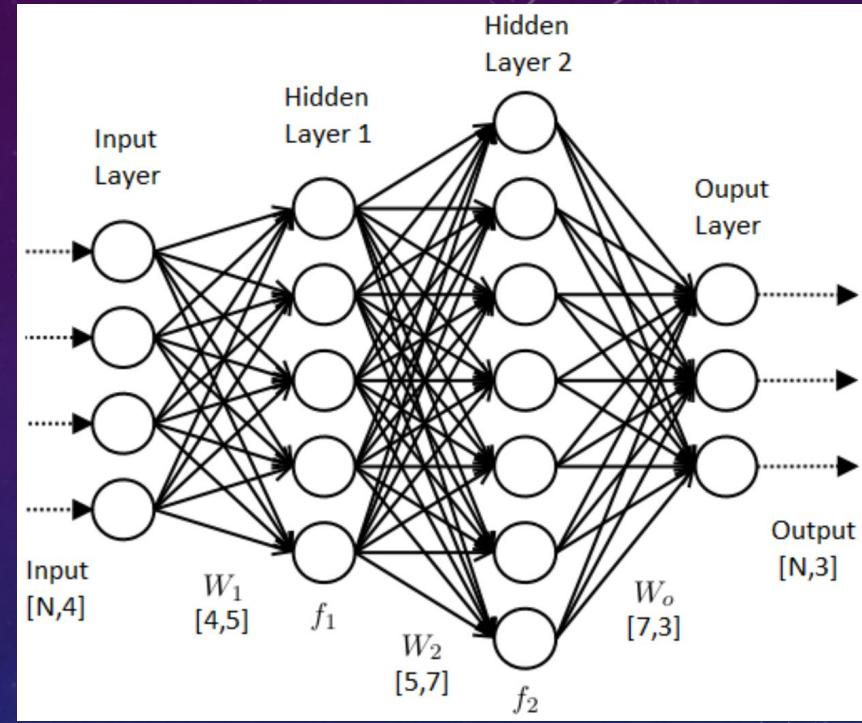
It makes
mistakes.
It **learns**
from them.

Be like a
neural network.



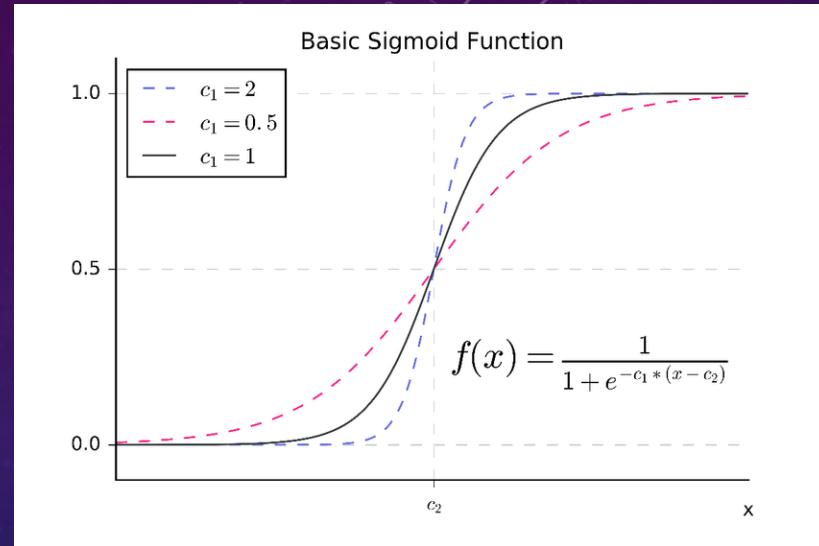
NEURAL NETWORKS... WHAT ARE THEY?

- Neuron: stores an "activation" value within the unit interval
- Neural Network: complex connection of networks
 - First and Last layers correspond to some aspect of input and output
 - Middle Layers: black box with unknown connections from layer to layer
 - Goal: have each layer separating inputs by some determining characteristics



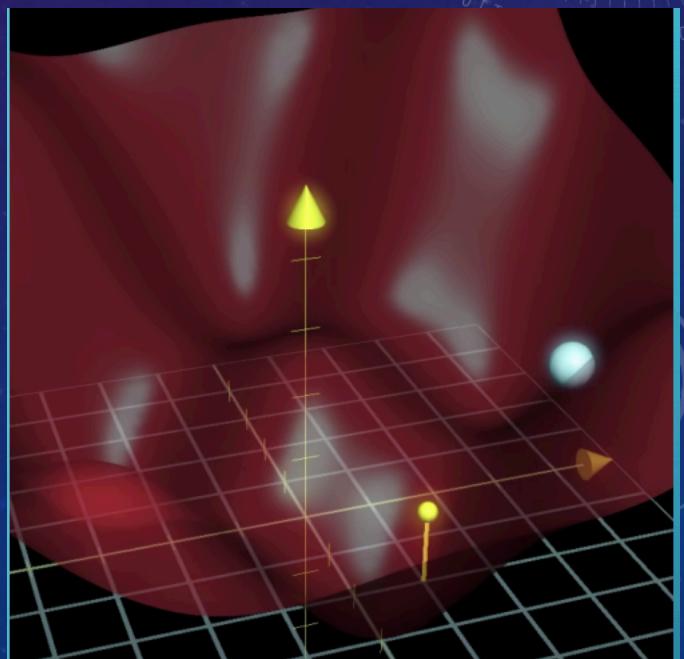
CONNECTIONS, CONNECTIONS, CONNECTIONS

- Weighted average of connections from previous layer's neurons
- Sigmoid Function: transform weighted average to be within the unit interval
- Bias: constant added to the weighted average (for each neuron)
- Goal: find weights and biases to allow the network to be successful



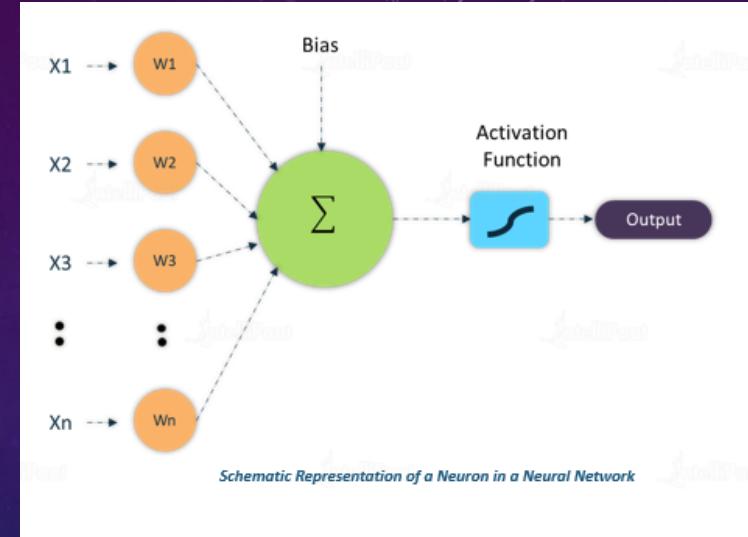
WEIGHING OUT YOUR OPTIONS

- Initialization: random weights, random biases
- Cost (error): square of differences in performance of weights/biases
- Goal: find weights and biases to minimize cost function
- Gradient: direction of steepest increase
- Idea: take step toward (local) minimum and repeat until reached



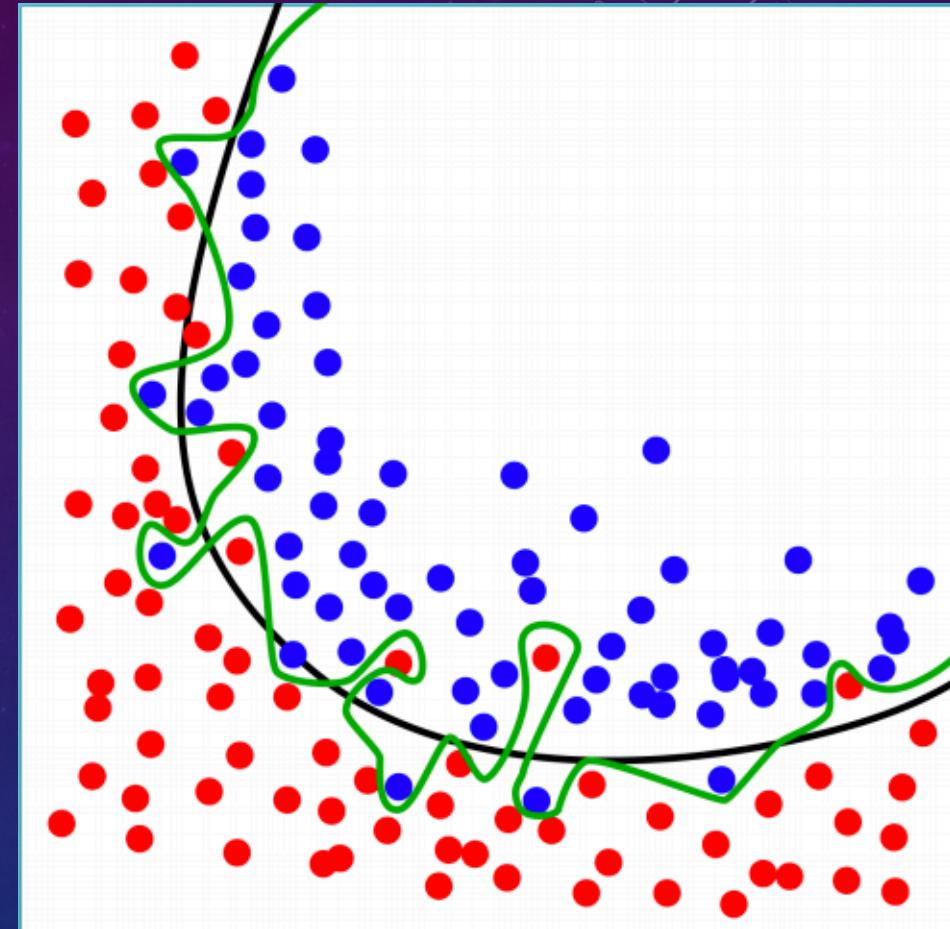
PUT IT IN REVERSE

- Given the gradient, adjust based on error function
- 3 Options: bias, weights, and activations (focus on stronger connections)
- For activations, recursively apply to previous layers
- Sum each neuron of last layer to backwards propagate to previous layer



TRAIN, TRAIN, TRAIN

- First Iteration: bad performance
- Adjust based on results of cost function
- Rerunning test data should result in better performance
- Repeat until performance plateaus
- Beware! Overfitting = model works for only one set of data

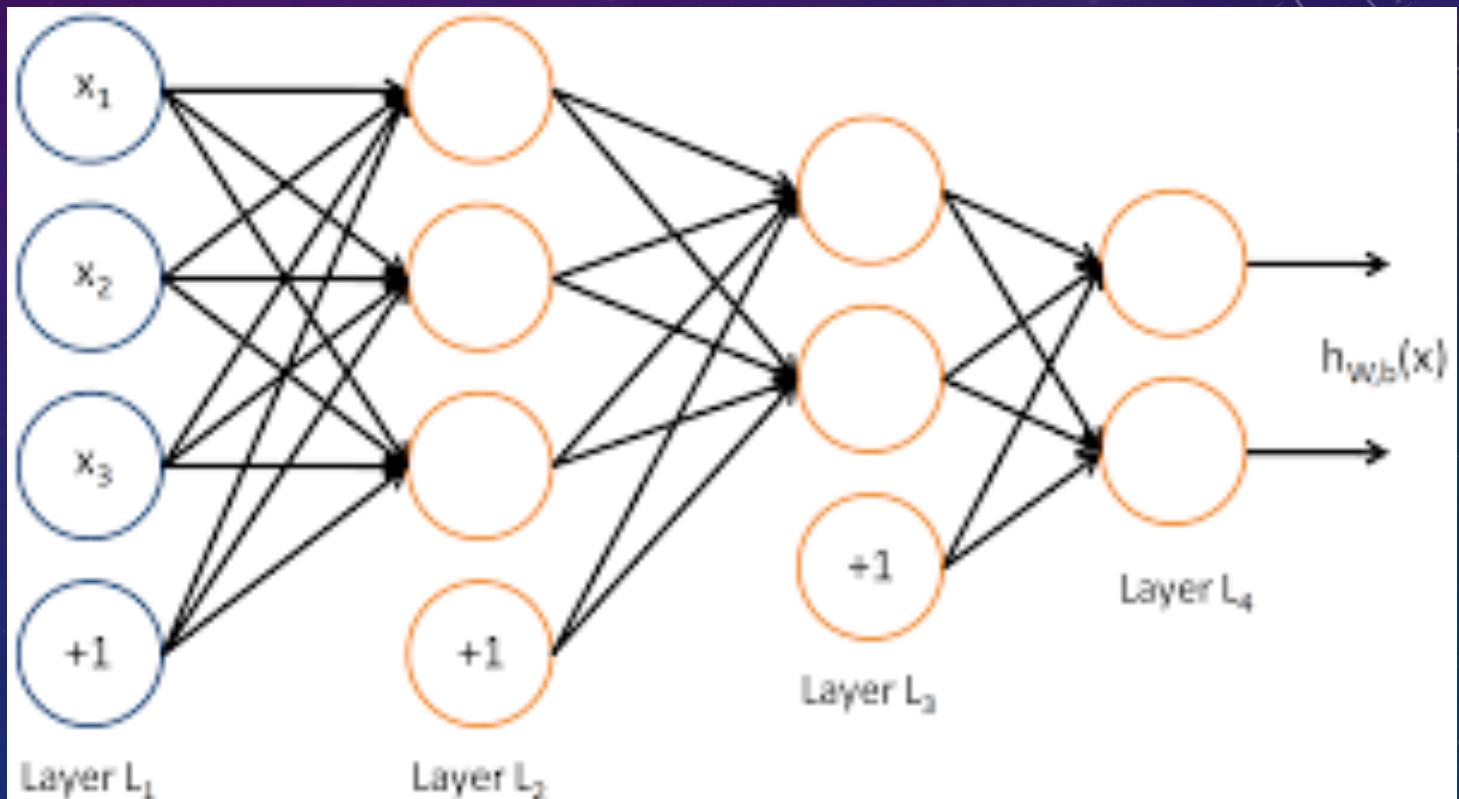


USE CASES

- Almost anything that can identify a finite set of inputs and outputs
- Note that performance may differ based on difficulty of the task
- Model will not explain what features were used to determine output (black box)

WHAT DO THE LAYERS OF A NEURAL NETWORK SYMBOLIZE?

- First Layer
- Middle Layer(s)
- Last Layer



HOW DO WE MINIMIZE THE COST FUNCTION? WHY IS THIS IMPORTANT?

WHAT ADJUSTMENTS CAN WE MAKE TO MAKE THIS MINIMIZATION?

PROJECT SPRINT 1 WEEK 2

- Perform Daily Standup in groups (ideally, document this)
- Project Time! :)

