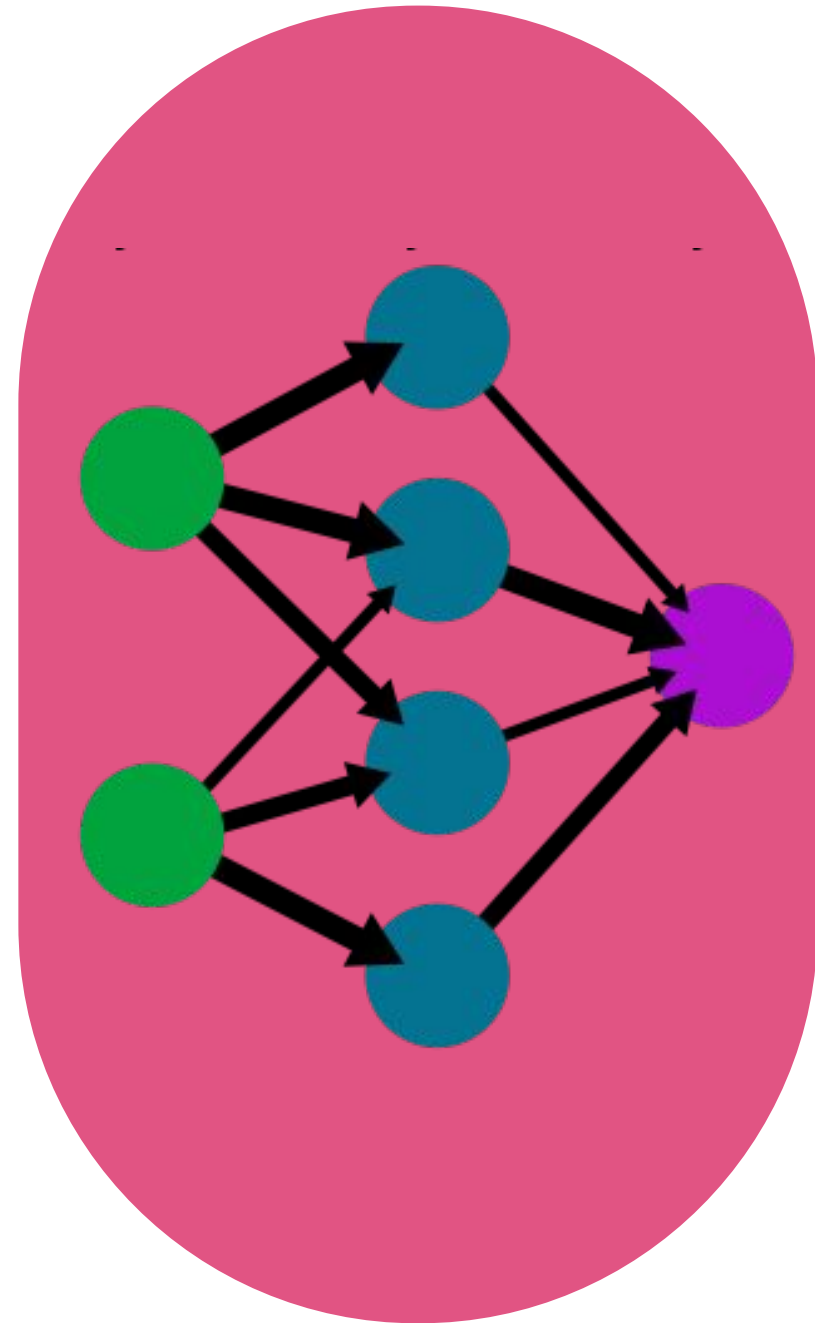


NEURAL NETWORKS

Liam, Lyuba, Jovani



Starter

- Go to <https://quickdraw.withgoogle.com/>
- Post in the Slack: What do you think of this neural network's performance? Was it able to guess all of your drawings?

What is a Neural Net?

- An artificial intelligence algorithm inspired by how the human brain works.

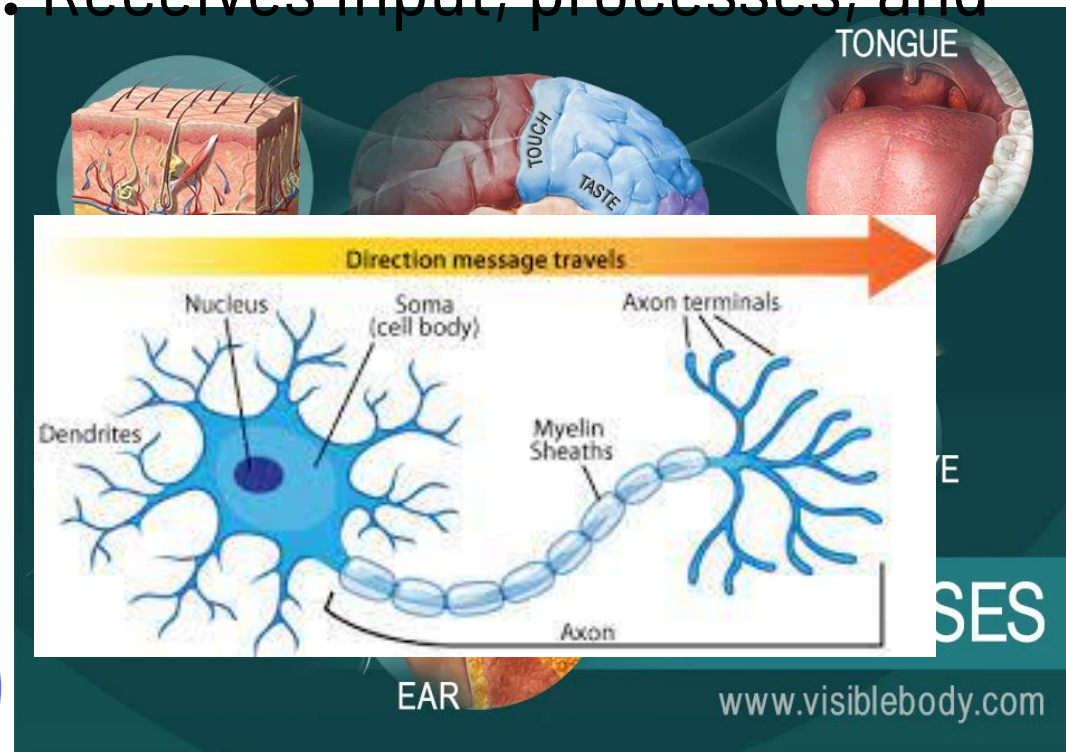
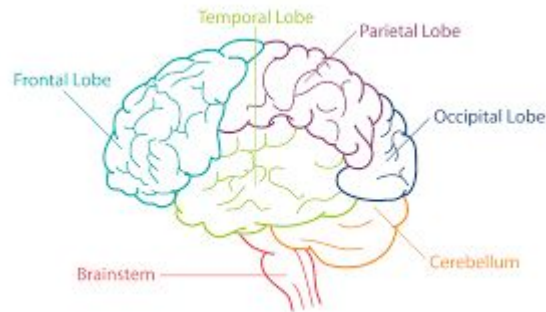
Neural Network Playground - Post in the Slack on a scale of 1 to 5 how confused are you?

1 - I am a neural net PhD

5 -???

The “Neuro” Behind Neural Nets

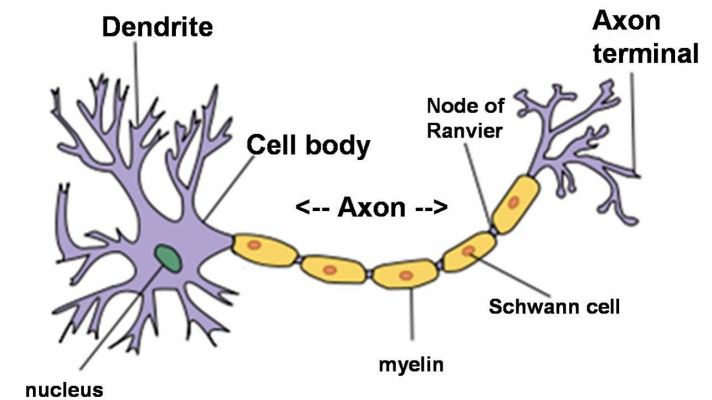
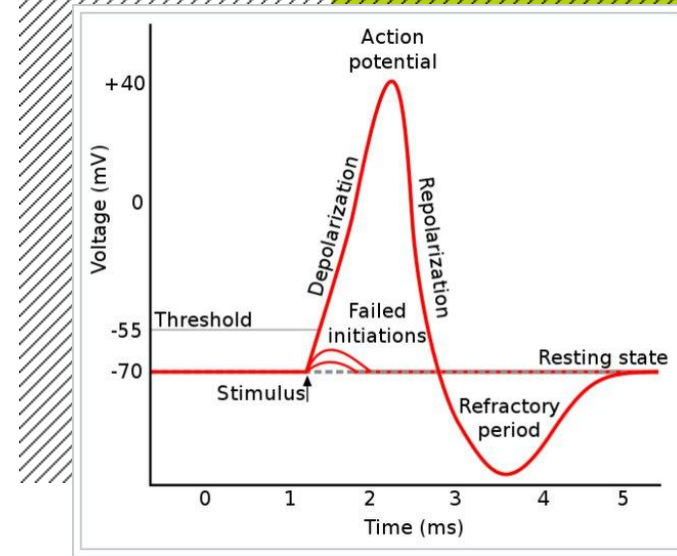
- Brain processes information with neurons not processes information
- Neurons in brain cells
- **Basic Function:** Receives input, processes, and delivers output.



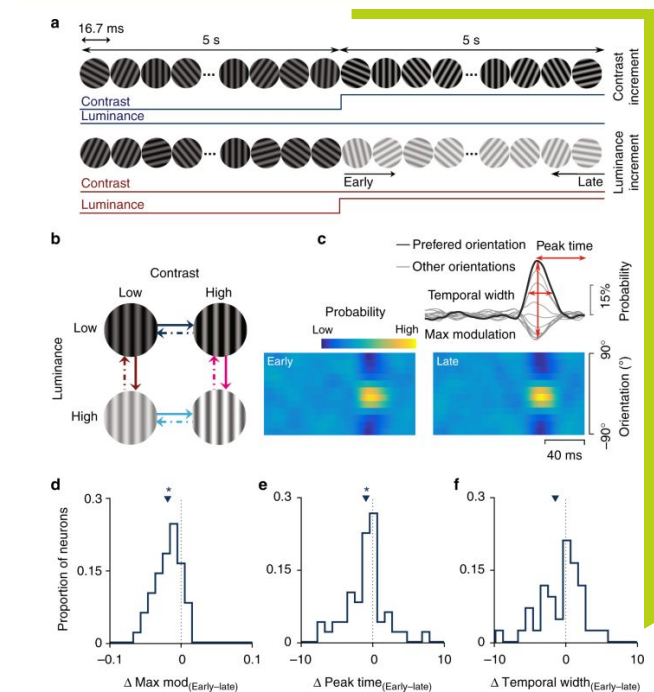
The “Neuro” Behind Neural Nets

Neuronal Output

- Only occurs if **action potential threshold** is reached.
- Output can be sent to 1 or multiple neurons.
- Output can help next neuron reach threshold, or hinder it from activating

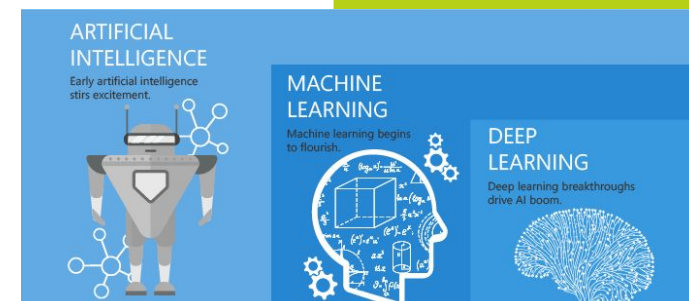


- SLIDESHMANIA.COM



Why Neural Nets?

- Brains are great at pattern recognition.
- Children can quickly identify cats at young ages.
- If children confuse cat with a dog, they can be taught differences.
- Brains adjust at the neuron level.
- Traditional AI's are not so good at this.
- Neural Nets emulate the brain's processing making them better at pattern recognition.



Why Neural Nets?

- Waterfall:
 - Type into the slack any characteristics you can think of that would help someone identify a cat if they have never seen one.

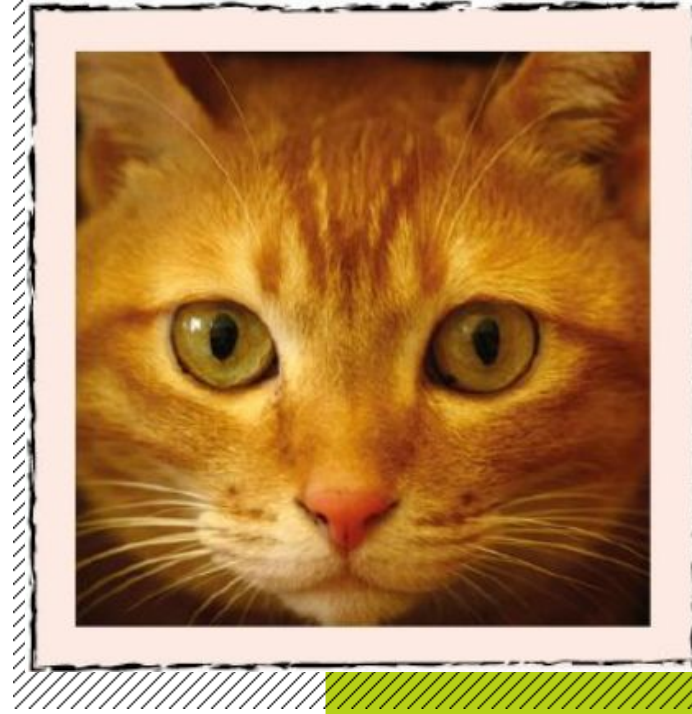


Image Source: Rashid

Why Neural Nets?

Traditional AI

A Cat Has

- Pointy ears
- Fur
- Whiskers
- Upside-down triangle nose

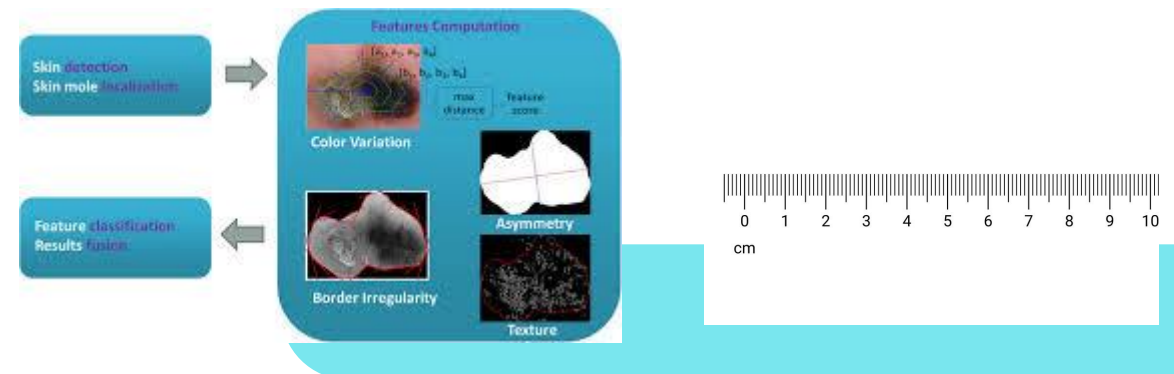
Requires “cat experts”

Neural Net

Here are some pictures. Figure out if they are of cats.

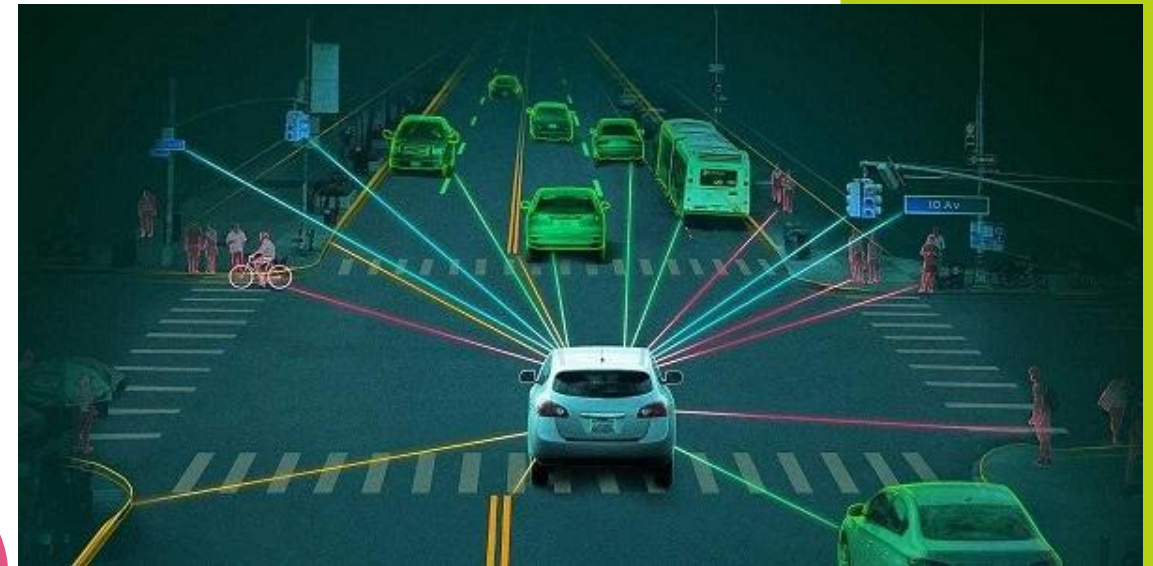
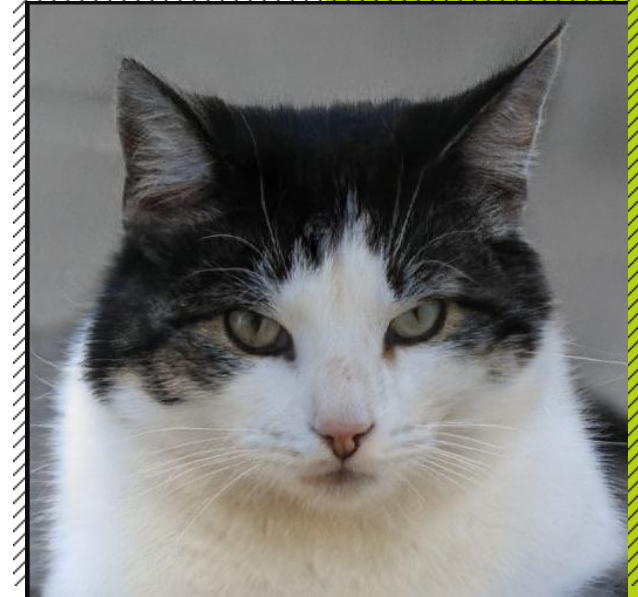
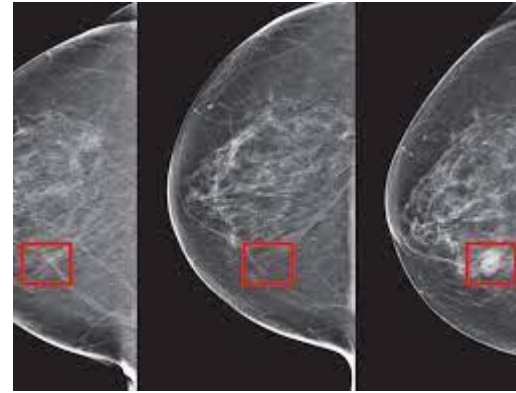
No expertise required!

<https://thiscatdoesnotexist.com/>



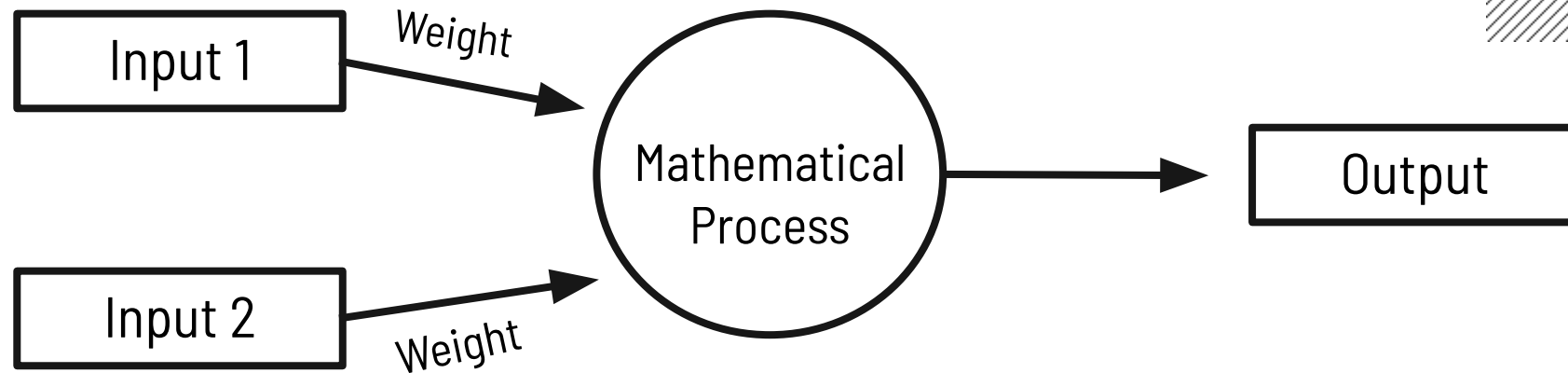
Applications

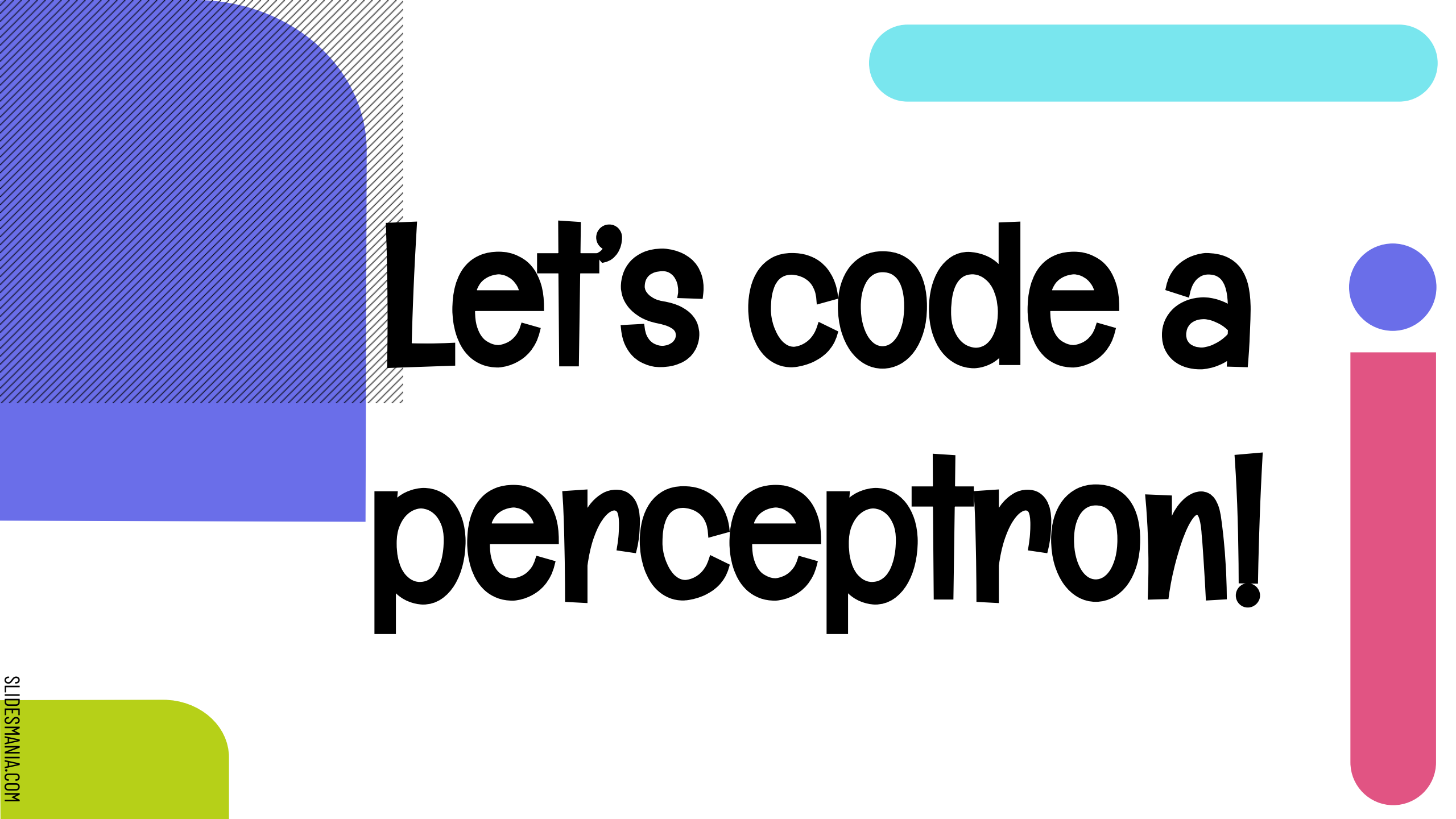
- Identification of animals
- Healthcare
- Self-driving cars
- More in async!



Building a Neural Net: Perceptron

- A perceptron is the simplest version of a neural network = Only one neuron



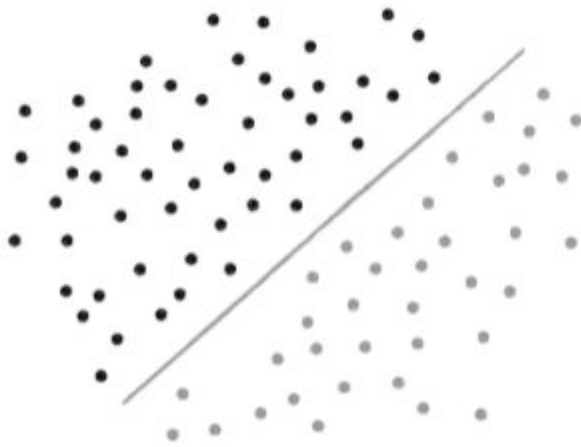


**Let's code a
perceptron!**

Limitations of Perceptron

- Can only solve linear separable problems

Linear Separable



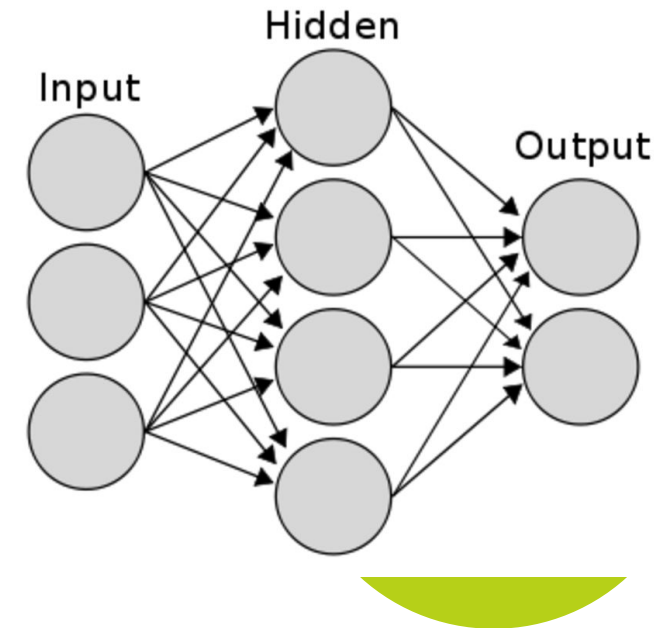
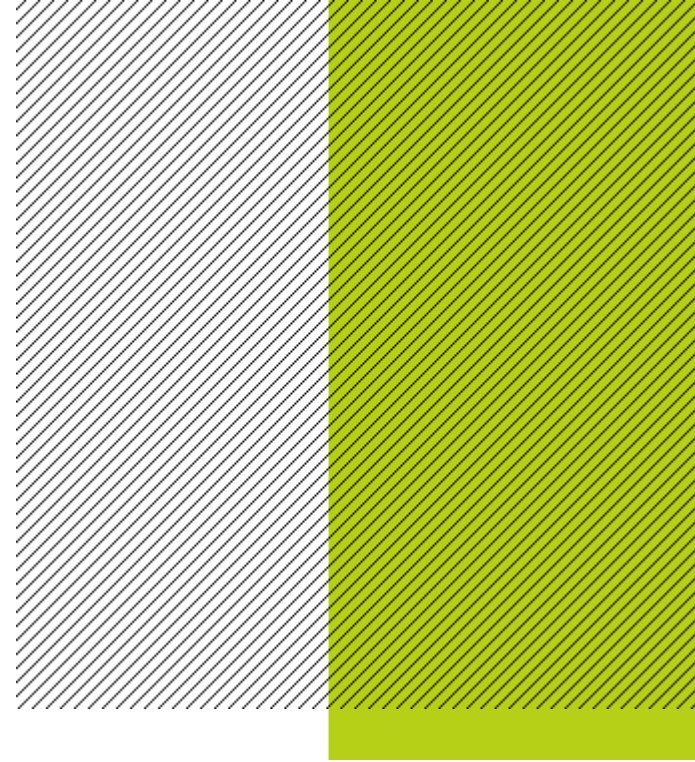
Non-Linear Separable



Image source: The Nature of Code

Building a Neural Net: Multi-Layer

- Neural Network - multiple nodes (like perceptrons) working together in parallel through multiple layers to arrive at an output.
- Network layers (Input, hidden, output)
- Each node in each layer is connected to each node in the next layer. Each connection has a weight which will control the strength of connections between each node.



Building a Neural Net: Algorithms

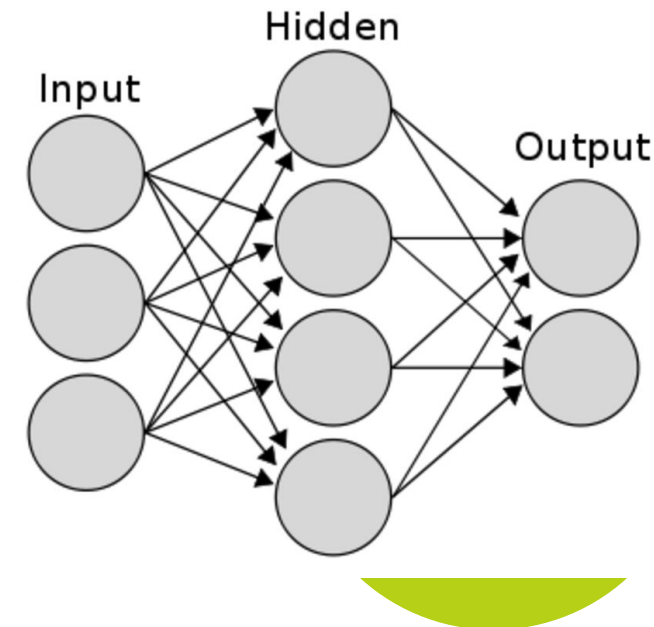
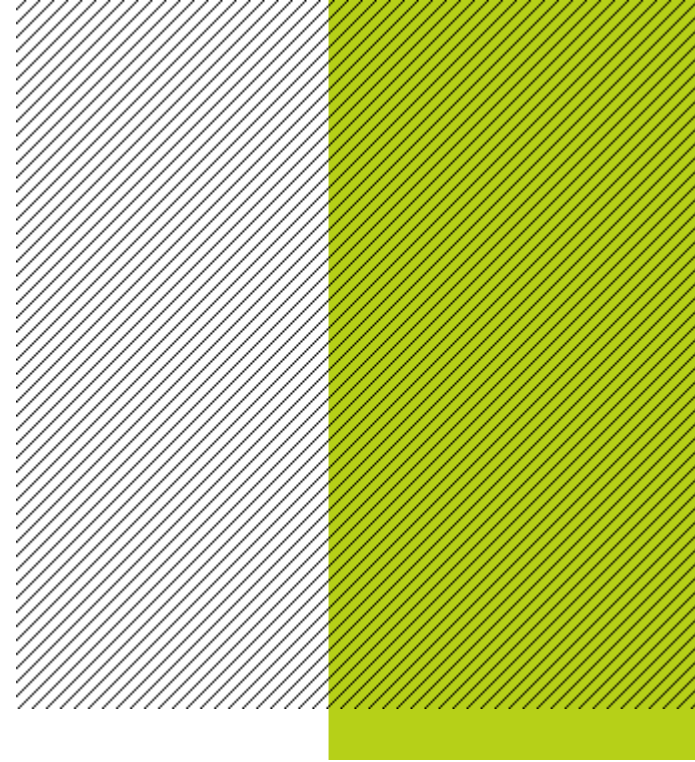
- **Feed Forward** - Sending inputs through the network of nodes, being affected by the weights assigned to connections between each node of each layer
- **Activation Functions** - Something that will decide whether or not a neuron should trigger an output.
- **Backwards Propagation** - Calculating error between guess and desired output. Sends error calculation backwards through network to adjust the input weights accordingly.

Building a Neural Net: Math

- **Matrix math** - To calculate multiple layers of multiple nodes, the data is processed in matrices (think n-dimensional arrays). This requires matrix math which can be done using libraries like NumPy or Math.js
- **Gradient Descent** - The calculus concept for backwards propagation of multi-layer networks.

Building a Neural Net: Training

- Neural networks require data in order to learn how to solve a problem. The network is provided with inputs and will make a output prediction based on patterns it begins to recognize in the data.
- **Supervised Learning**- A method for training the network with inputs where you already know the desired output.
- Data needs to be labeled before being fed to the neural network, so the predicted output of the network can be calculated against the correct label of the data.
 - Correct output = keep doing what you're doing
 - Incorrect output = you are wrong, change something



Neural Net Libraries

- TensorFlow - in Python and JS
 - Handwritten Digit Recognition
- ML5.JS Neural Network

Neural Net Takeaways

Back to the [Playground](#)

Post in the Slack:

- 2 concepts about this playground that you now understand better than you did at the beginning of this session.
- Any questions you still have about Neural Nets

Homework:

Login to your p5 editor account:

<https://editor.p5js.org/>

- Open the homework starter code.
- In the Perceptron class complete the **train** function. Use the algorithm provided to guide you. Scaffolded code provided as well.

Async: Neural Net Applications

- Research ways that Neural Networks are used in the real world to solve problems. Choose 1 article describing a real-life application of Neural Networks.
- Consider if using a Neural Net to solve this problem is necessary, ethical, helpful vs harmful, effective etc. Summarize your thoughts on this question and post in the Slack async channel, along with a link to the article you found.
- Respond to posts from at least 3 of our classmates.

Sources:

- [The Nature of Code](#) by Daniel Schiffman
- [Make Your Own Neural Network](#) by Tariq Rashid
- [Neural Networks: The Nature of Code](#) (YouTube playlist)
- [Deep Learning Illustrated](#) by Jon Krohn and Grant Beyleveld