

How Do Machines Learn?

An investigation of neural
networks

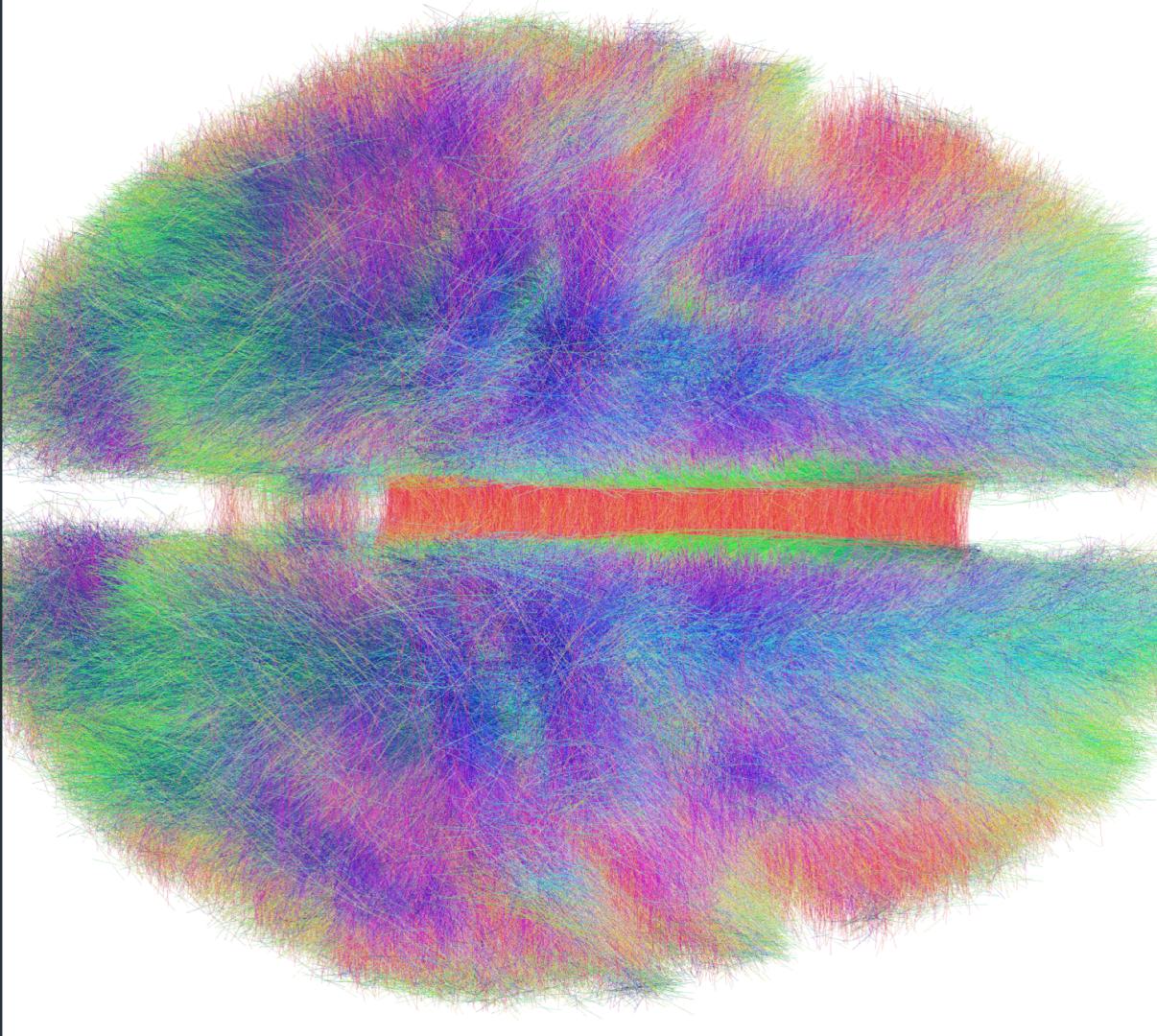
Brains are complex

86 000 000 000 neurons in a human brain + more in our body

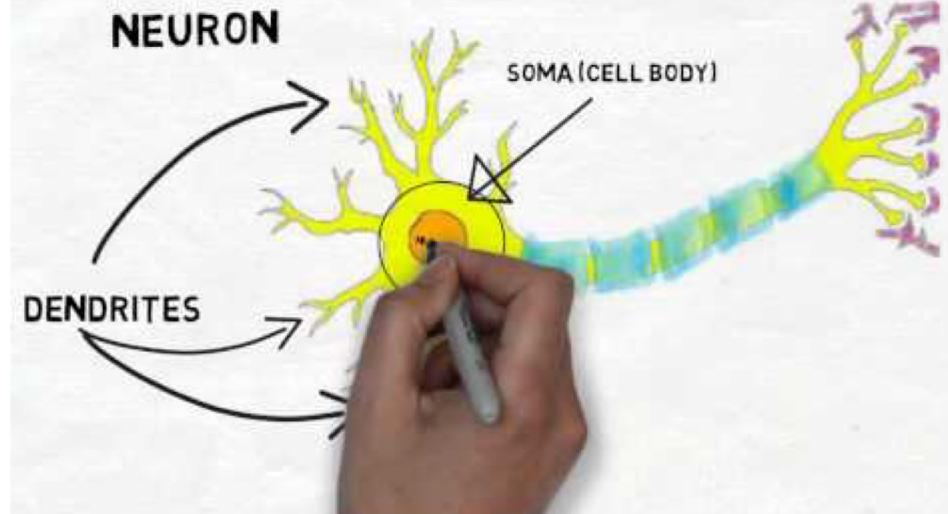
As we learn, our brains develop and strengthen new neural connections

We keep learning through our life

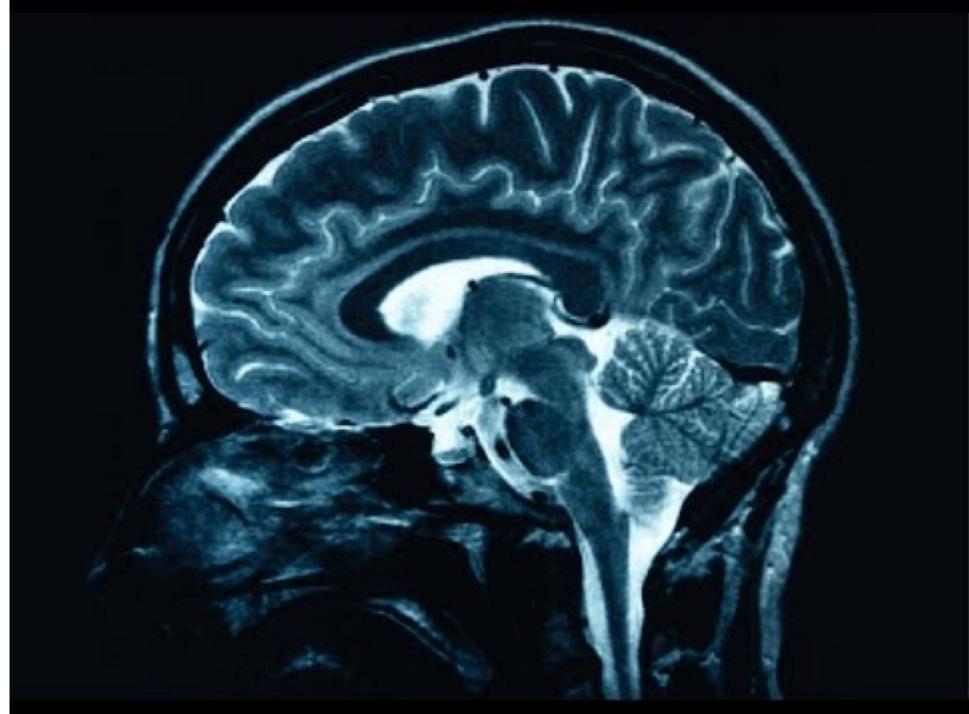
- But we can also "forget"
- What is forgetting?



2 minute neuroscience



3D Visualisation



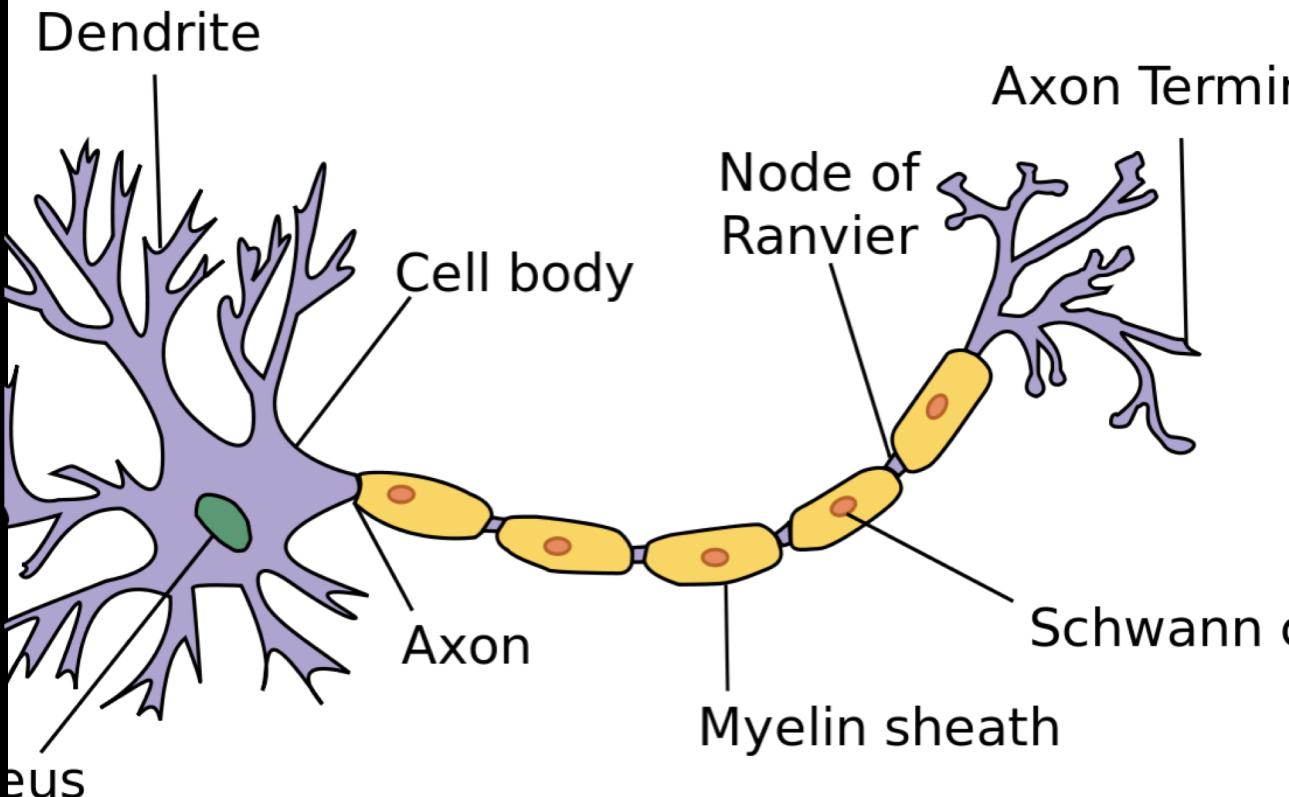
What is a neuron?

A special type of cell

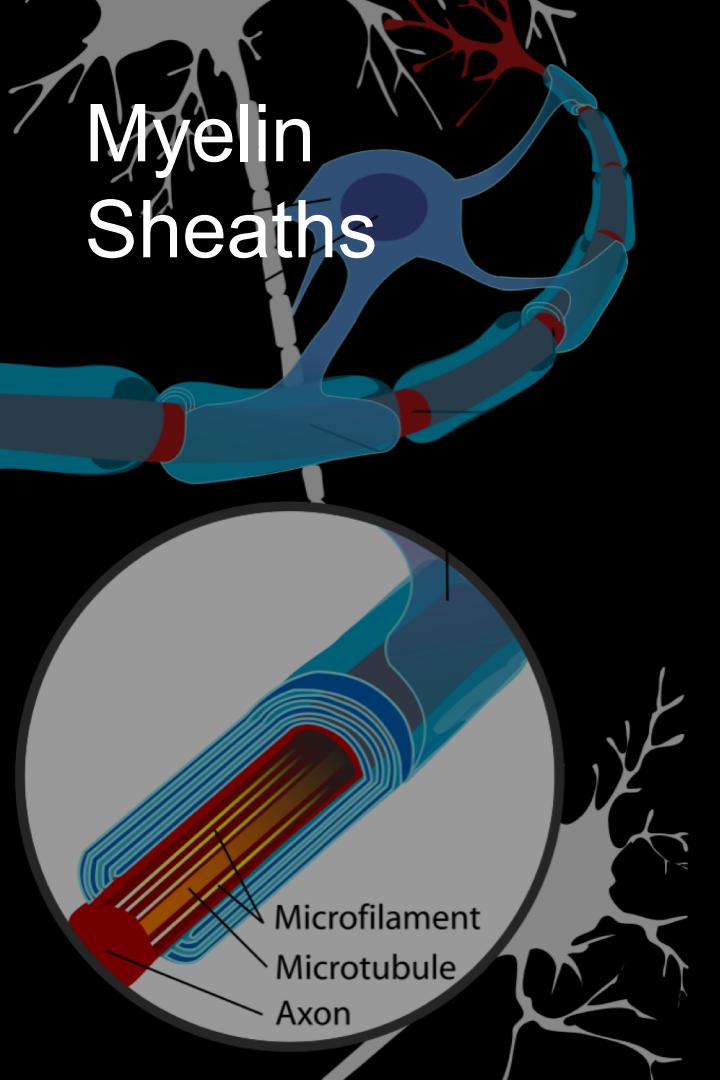
Long-lived!

They can communicate

There are different types of neurons



Myelin Sheaths



Grey Matter - No myelin on the axon means a weaker connection

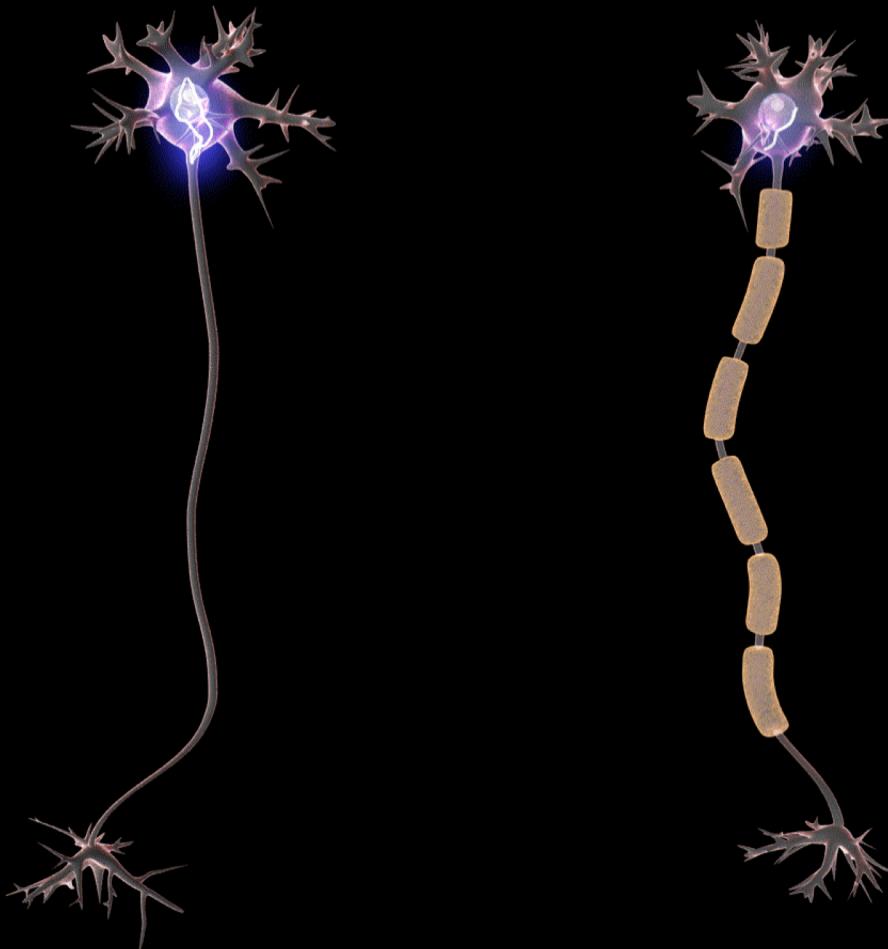
White Matter - Myelin on the axon means a stronger connection

The process starts before birth, but rapidly accelerates during infancy - when babies are learning to walk and talk

It continues throughout life

How this may work:

This animation illustrates how myelin sheaths help strengthen a neural pathway - making a better - stronger - more effective connection between neurons



Biological Learning is complex

- "Short Term Memory" holds information for a brief period
- Repetition helps transfer to "Long Term Memory"
- There is no physical part of your brain which holds short term memory
- Information (in general) is "remembered" in the cerebral cortex

We don't fully understand how this works - there is still a lot of research to be done

Myelination is a part of the process!

It is really difficult to "see" a living brain in action

There are so many neurons and connections - it is very difficult to model

Can Machines Learn?

One way of getting machines to learn is to copy the way brains learn.

Computer scientists have created artificial neural networks to mimic the process of human learning



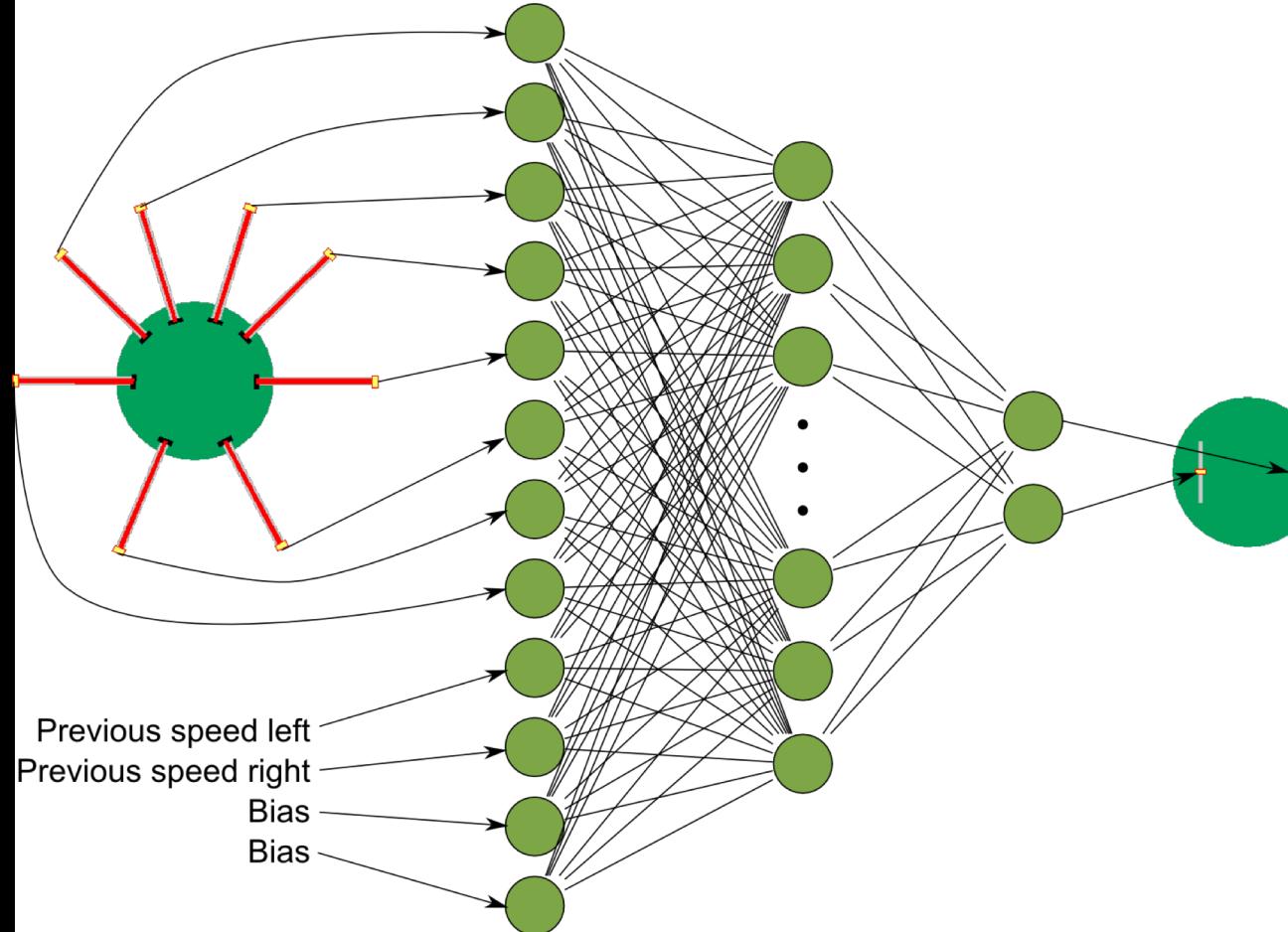
Artificial Neural Networks

A mathematical model which has "nodes" and connections.

Each connection has a different weight.

Input data is fed into the starter nodes

The data values are "traced" through the network, creating a "weighted sum" of the inputs



Training the Network

The network is "trained" through exposure to lots of data

The weights are adjusted to fit the classification of the input data for the things we are classifying:

- This is a cat



- This is a dog





Adjusting the weights

Training the network adjusts the weights from node to node

This changes how input data is classified by the system

We have to be very, very careful about which data and categories the system has been trained with

What does the system understand????

Using a trained network

Once trained - we can ask the network to classify input data

The machine can do the work of recognition for us

Neuron City

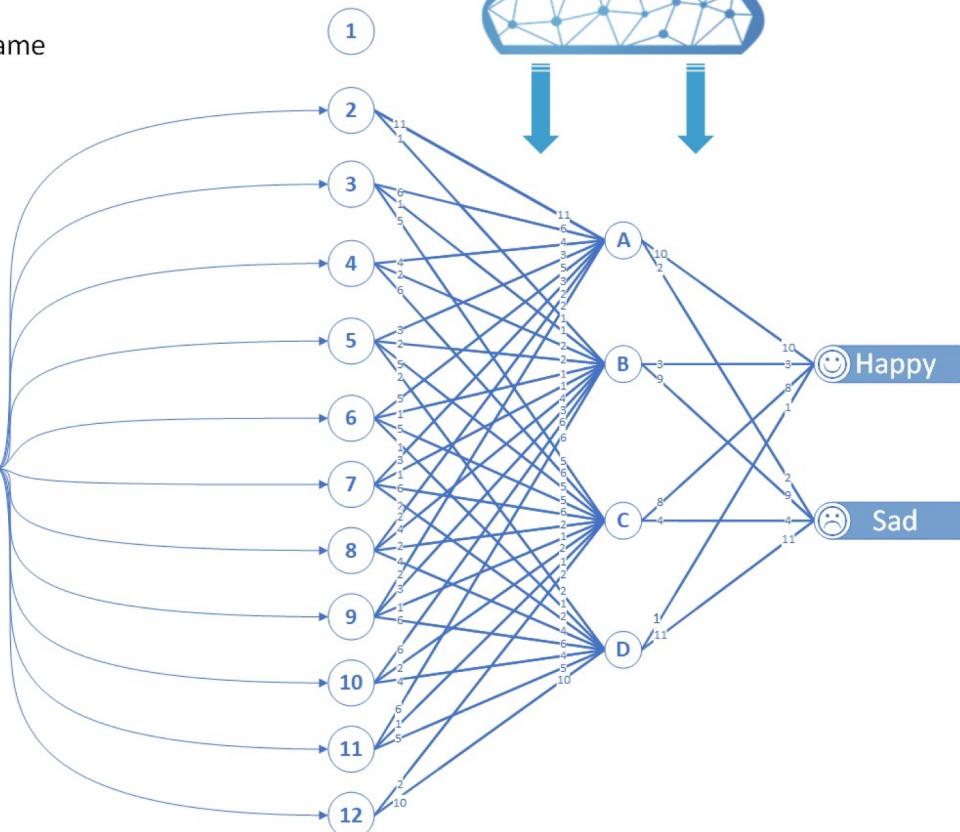
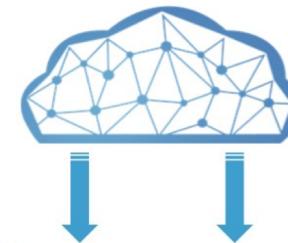
How to Play:

- Roll 2 dice and sum the numbers
- Use the dice roll sum to select the input node on the network
- Follow all pathways from this node to the middle layer
 - There may be 2, 3 or 4 paths
- Follow pathways from middle layer to output layer
 - There will always be 2 paths
- Add the 2 numbers for all pathways found
 - A maximum of $4 * 2 = 8$ paths
- The "highest" path result is the "outcome" - which will be "happy" or "sad"



Neuron City

The Machine learning series:
The Neural Network Board Game



MaDaBotics
A learning board game by
Matthew Phillips and Danny Bettay



Neuron City

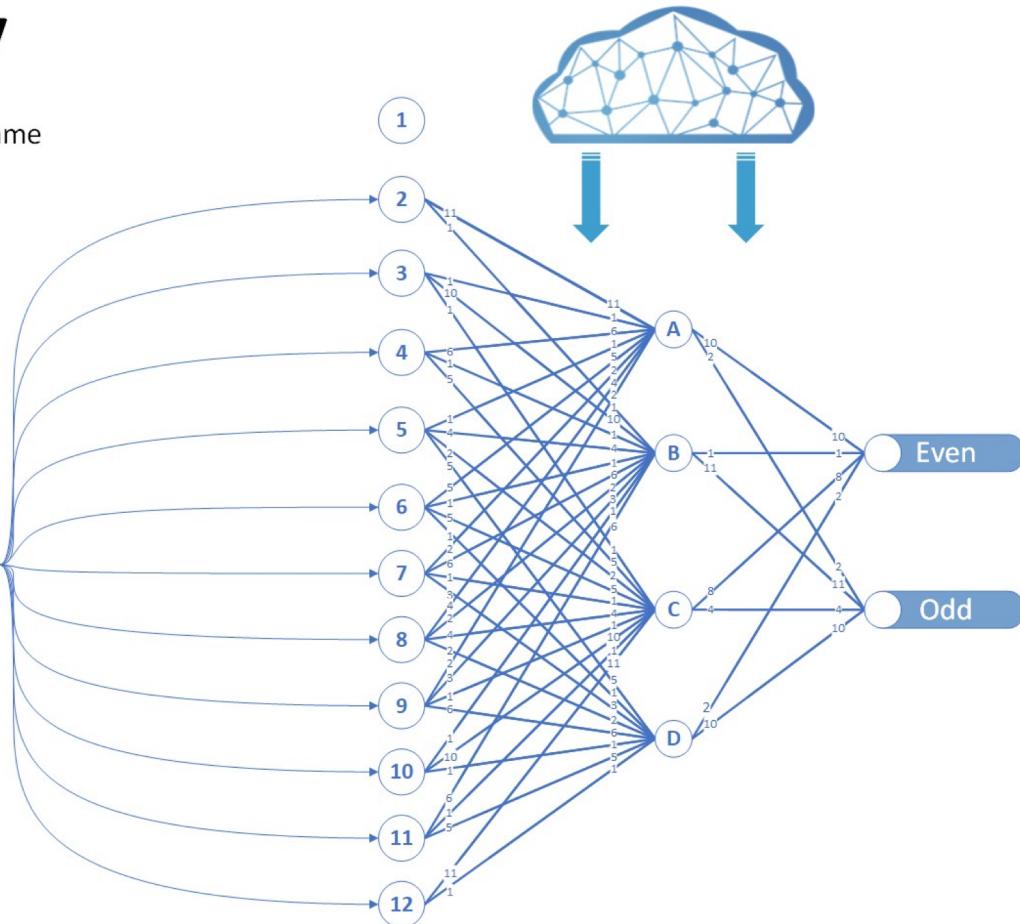
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Dice Area



Evaluation area



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