Machine Learning

Session 5 - Introduction to neural networks


hadrien.salem@centralelille.fr


introduction-to-data-science

Introduction

What did we do last time?

Course outline

Machine learning course

Session 1: Regression

Session 2: Supervised classification

Session 3: Clustering

Session 4: Decision trees and ensemble methods

Session 5: Introduction to neural networks

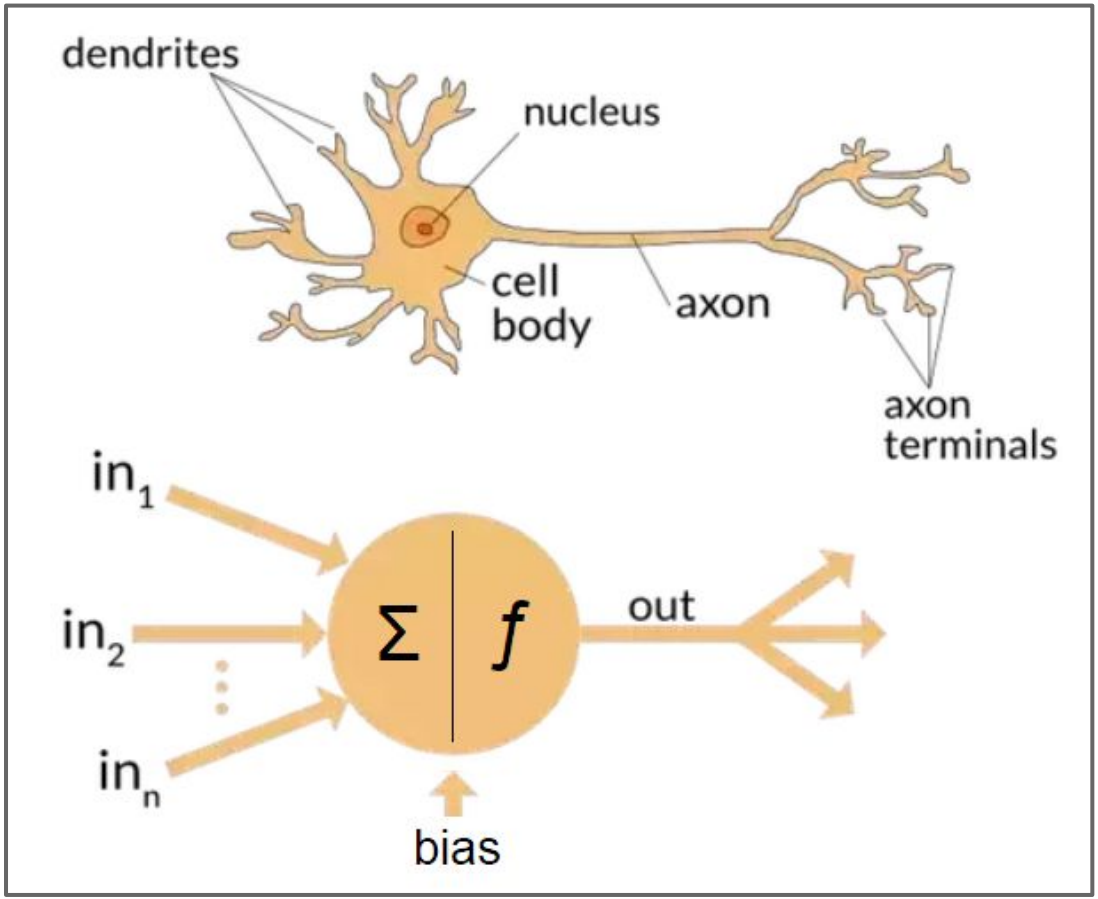
Session 6: Advanced neural networks

Session 7: Introduction to reinforcement learning

Session 8: Reading science papers

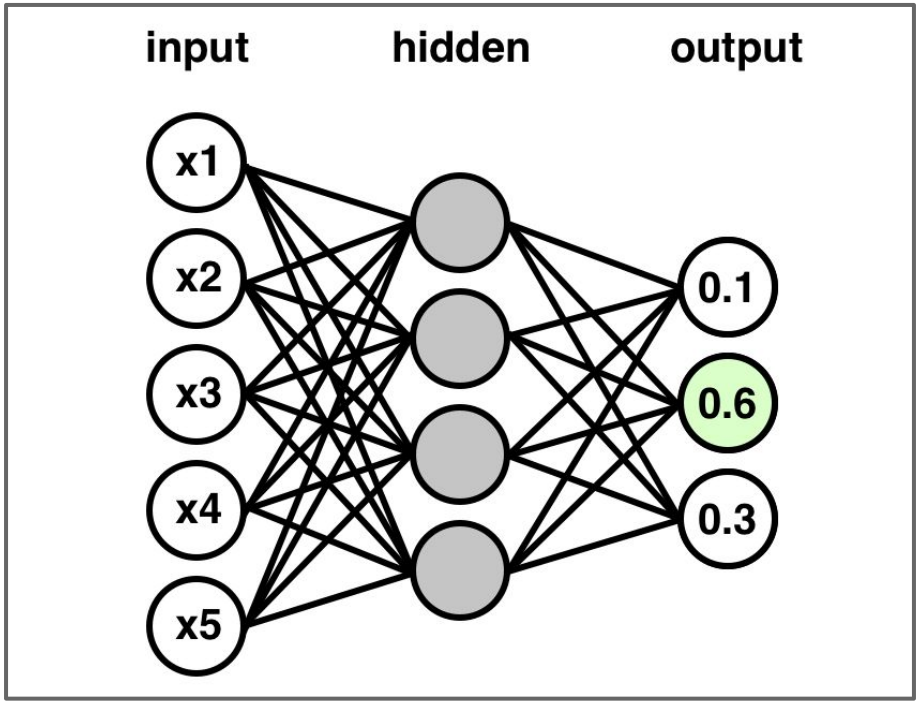
Project

What are artificial neural networks?

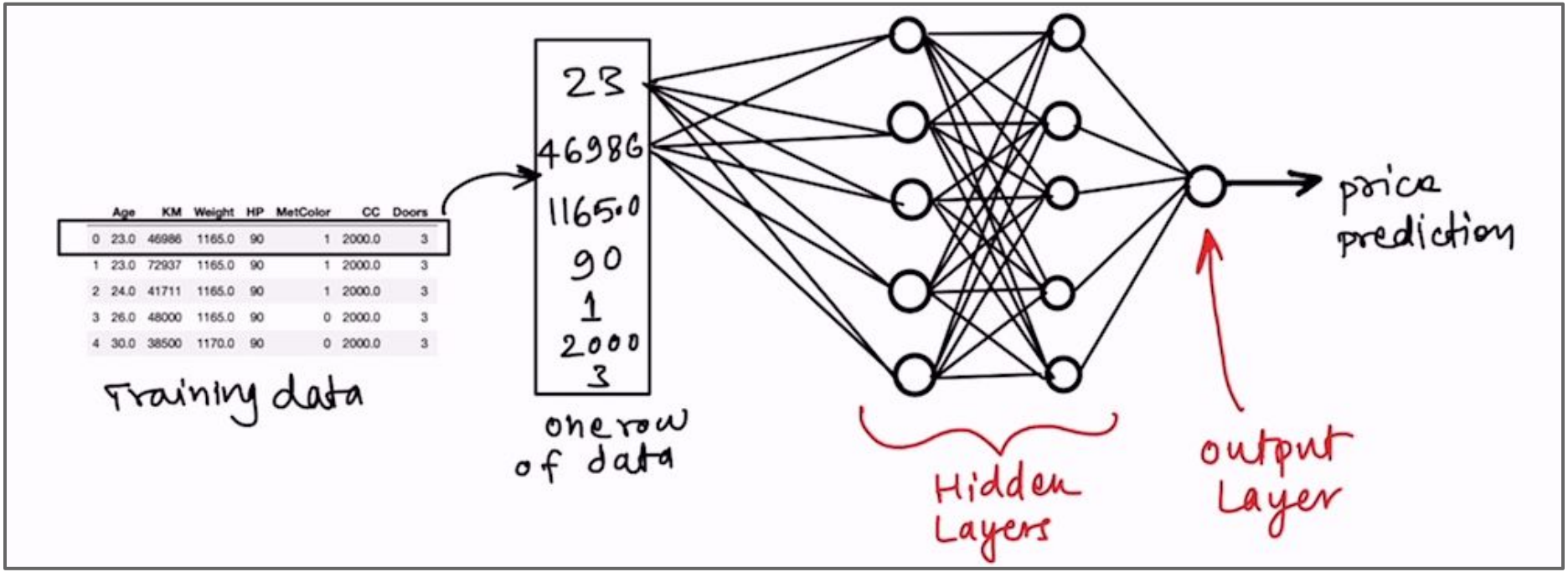


Neural networks are named after an analogy with the human brain

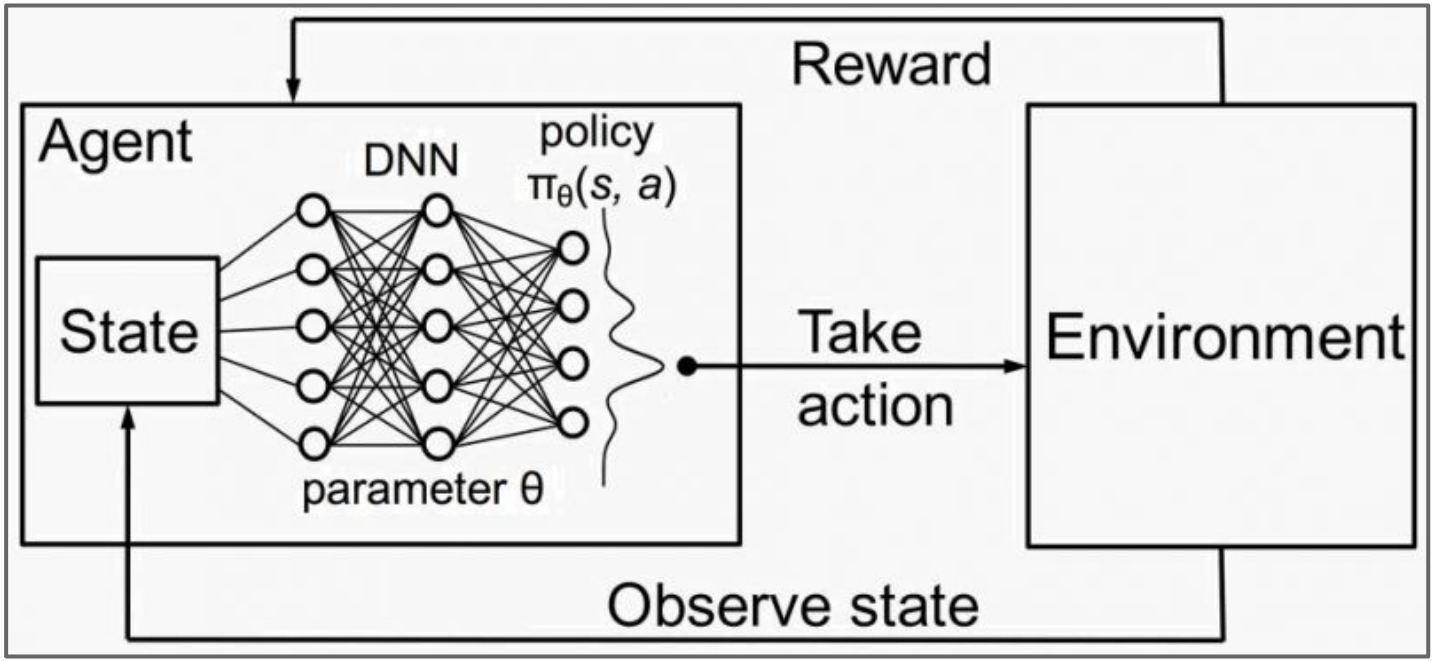
Image source



The network outputs the probability for the sample to belong to each class



The network outputs the predicted value



The network learns the best action to execute in a certain state

Image source

Strength and weaknesses of neural networks

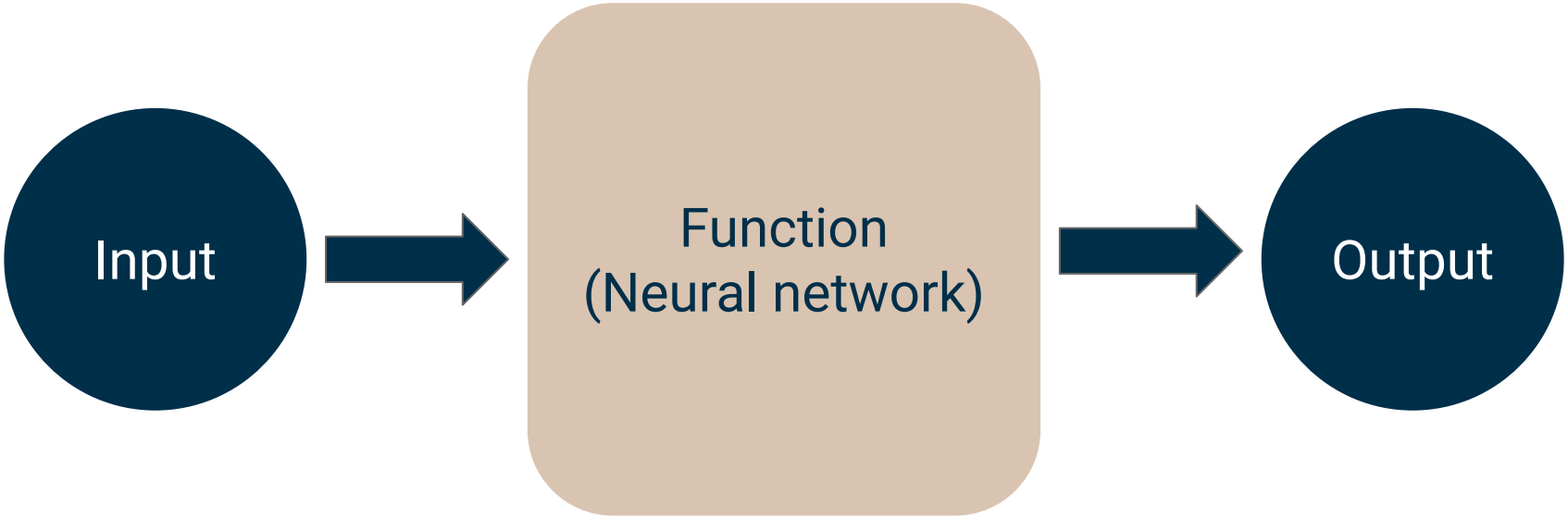
Strengths

- Extremely flexible
- Learns nonlinear functions
- Fast predictions once trained
- Scalable to large datasets

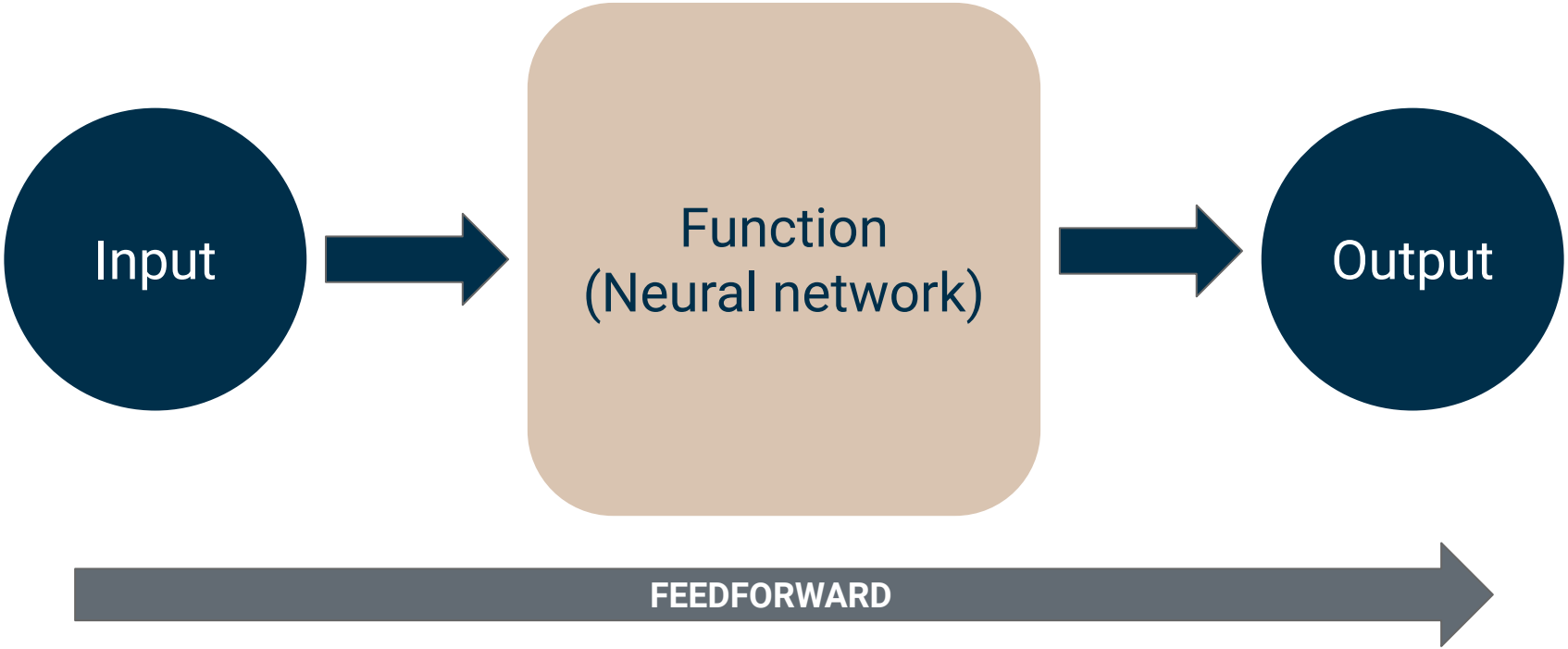
Weaknesses

- Very difficult to interpret
- Computationally expensive
- Very slow training without GPUs

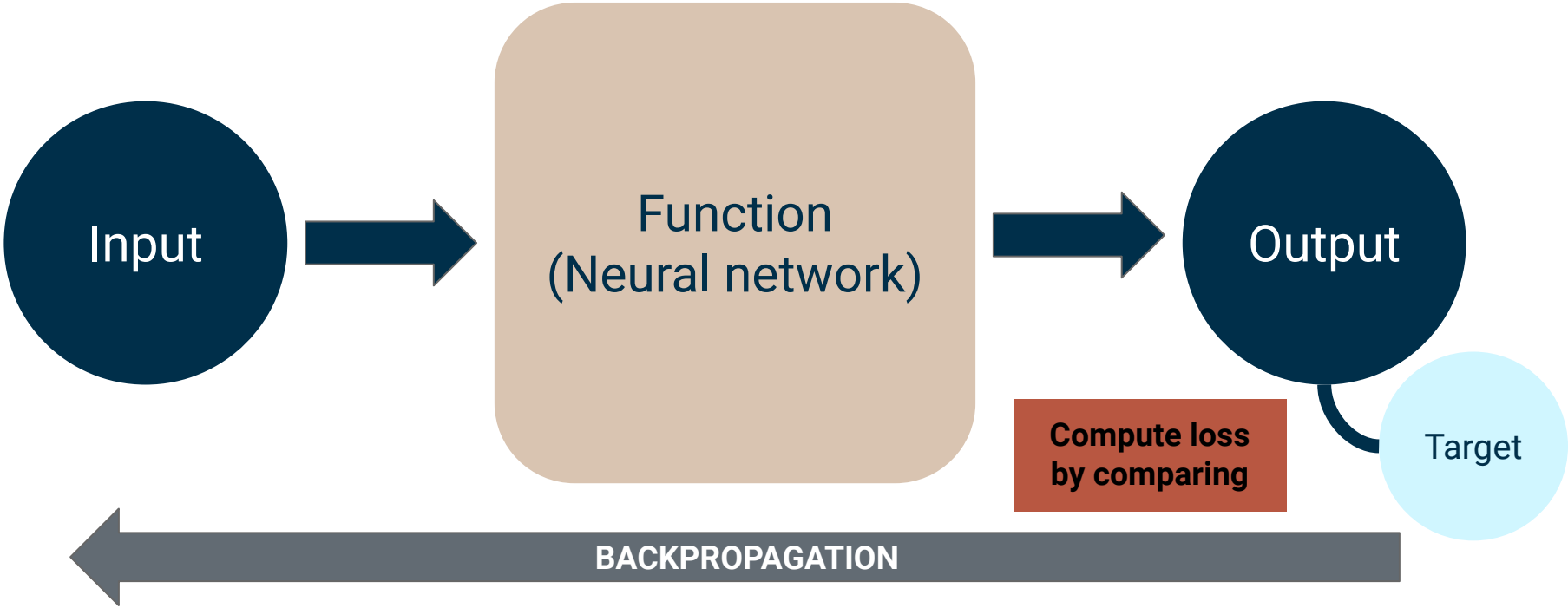
How do ANNs work?



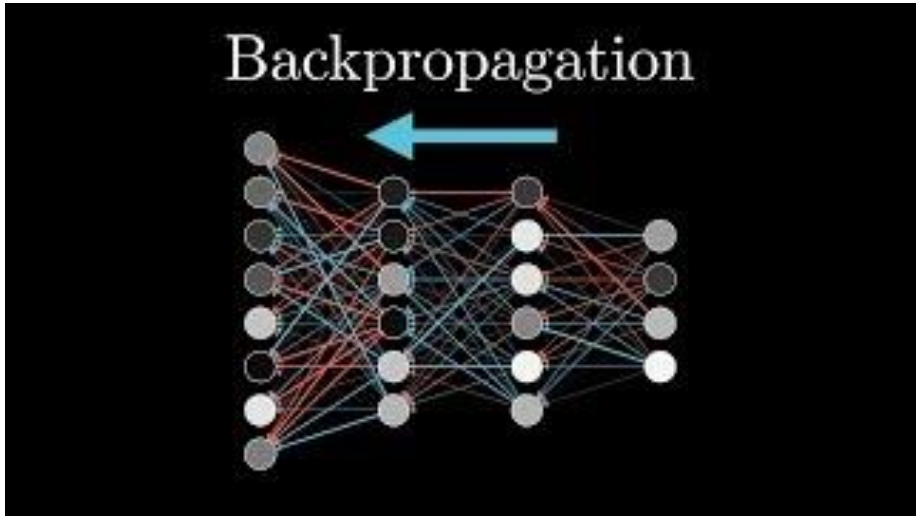
Neural networks are algorithms that learn a function linking input and output

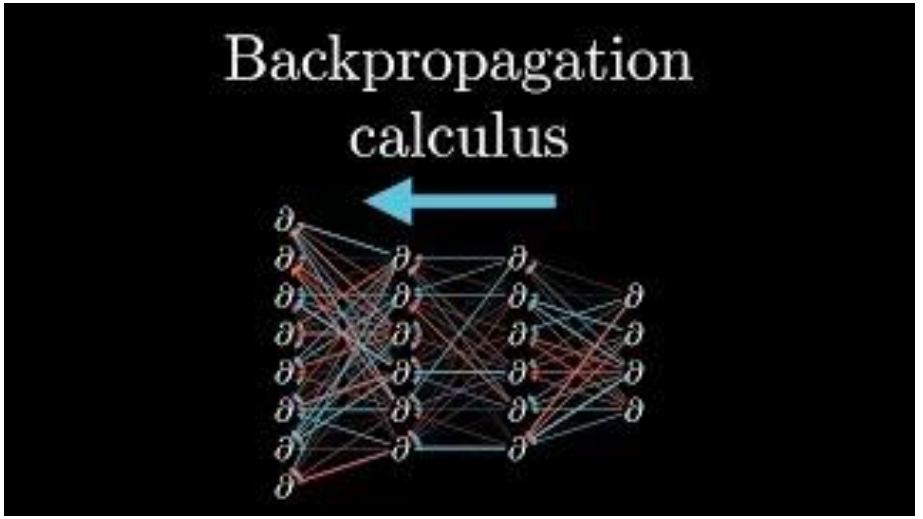


In order to train the model, inputs are “fed forward” into the network, and outputs are computed



The loss is computed, and the error is propagated back into the network to adjust weights





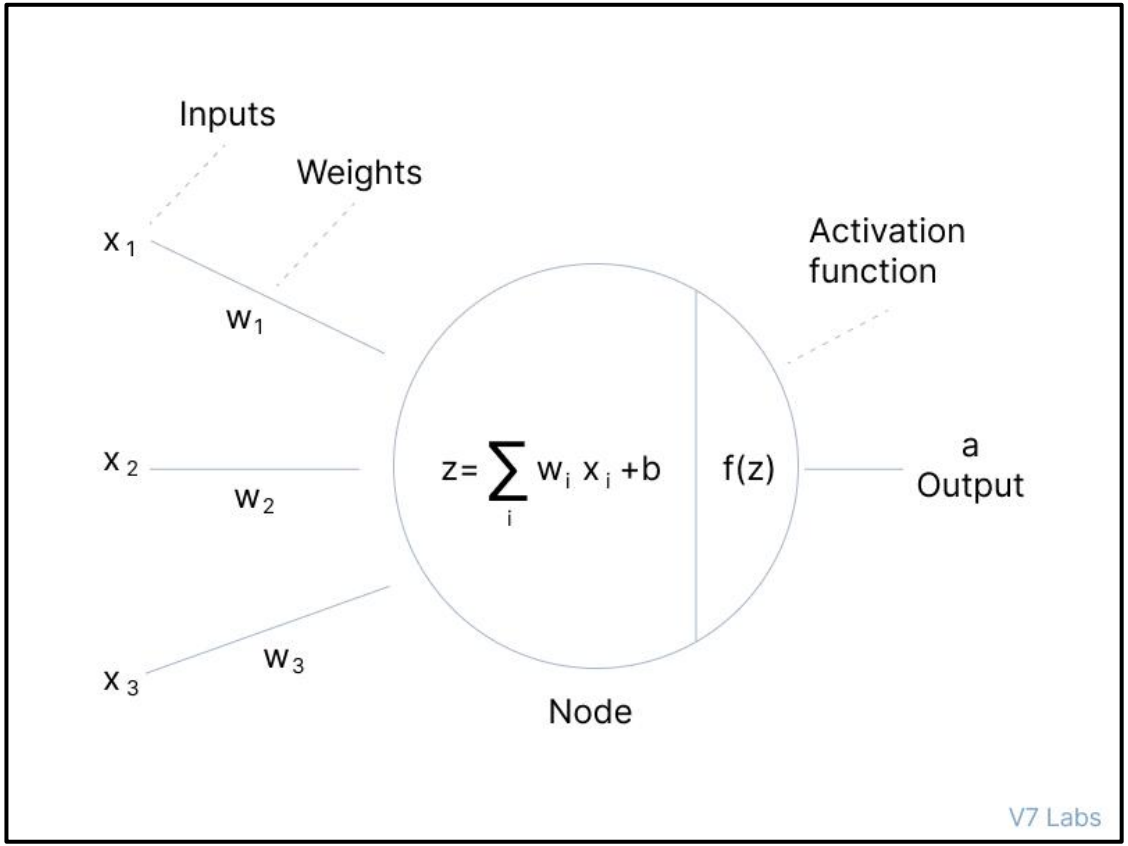
https://www.youtube.com/watch?v=Ilg3gGewQ5U

https://www.youtube.com/watch?v=tIeHLnjs5U8

If you are interested in the math behind it, check out these excellent videos on the subject!
In short: backpropagation is adjusting the network's weights to reduce the loss

Backpropagation is performed with stochastic gradient descent

What are ANNs made of?

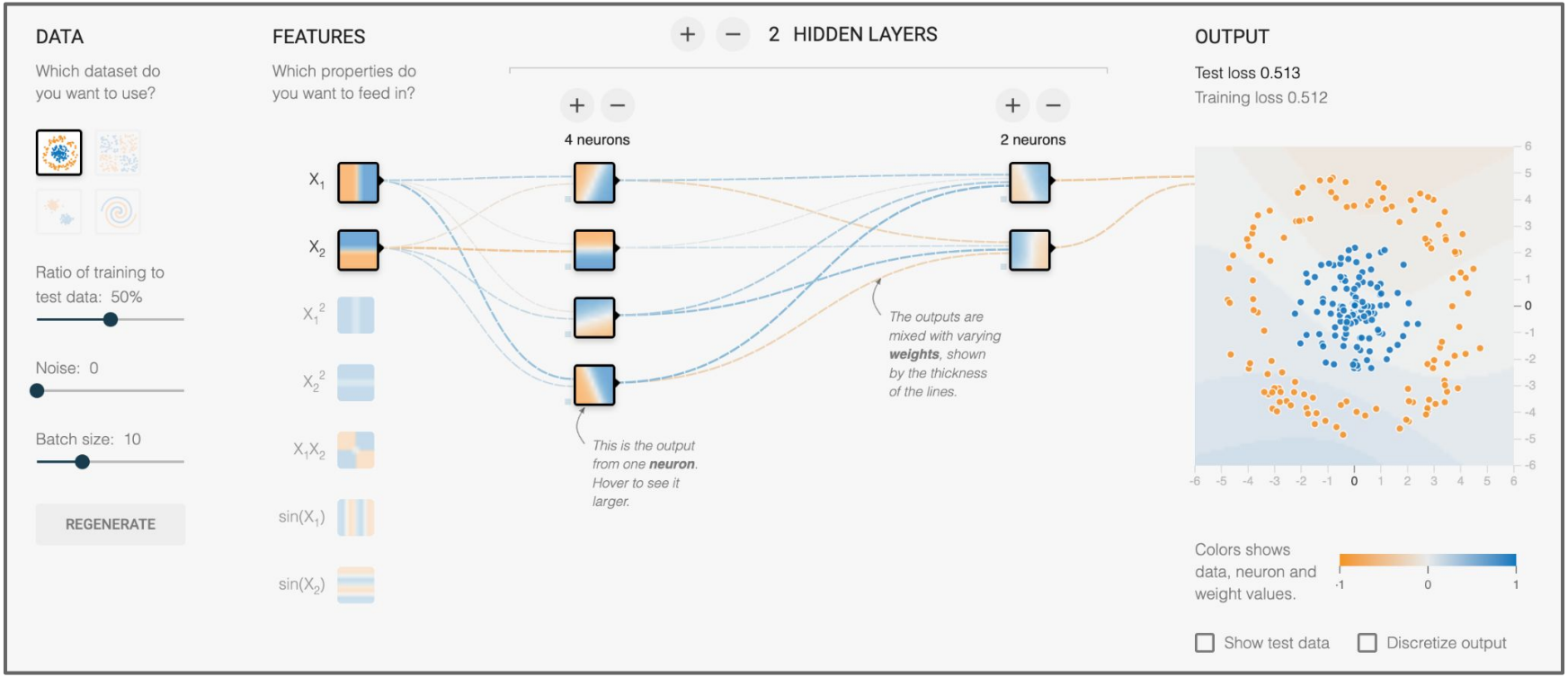


Weights are the **parameters** of the algorithm. They are adjusted during the learning process.

The **activation function** introduces nonlinearity in the network. This means the model can learn complex functions.

Neurons are the base unit of ANNs

Image source



https://playground.tensorflow.org/

Input, output and hidden layers

Practical work

The notebook contains all the necessary instructions

Debrief

Debrief

What did we learn today?

What could we have done better?

What are we doing next time?