Neural Network

Lameck Mbangula Amugongo
Department of Computer Science

Outline

- Introduction
- Machine Learning
- Why go Deep?
- Neural Network

Introduction

- Computational model
    - Inspired by how our brain works (process information)
- Breakthroughs,
    - Speech Recognition
    - Computer Vision
    - Natural Language Processing

Machine Learning

- What is this?
- How will a computer classify this?

Machine Learning

- Input: Picture of different landscapes
- Goal: Classify [Desert, Forest, Water]
- Solution: Average pixel colour and threshold

Red > $\theta^1 r$

Green > $\theta^2 g$

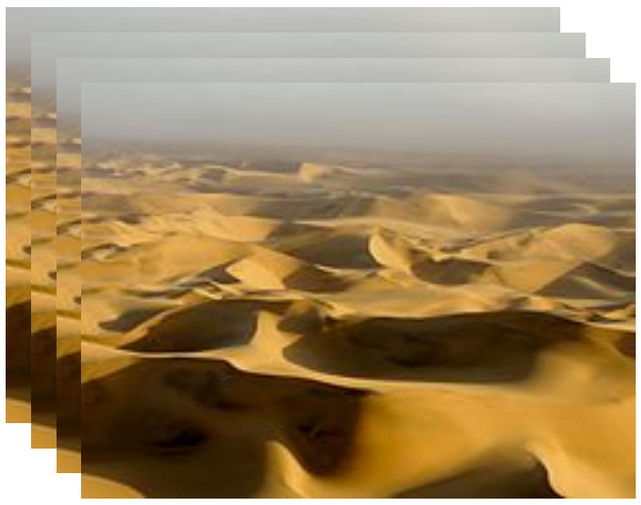
Red > $\theta^3 r$
Green > $\theta^3 g$
Blue > $\theta^3 b$

Machine Learning
AKA learning function parameters

```
def classifyImage(I, t1, t2, t3, t4, t5): //5 threshold t1 to t5
    theta_r, theta_g, theta_b = averageChannels(I)
    if theta_r > t1 and theta_g > t2 and theta_b > t3:
        return Water
    else if theta_g > t4:
        return Forest
    else if theta_r > t5:
        return Desert
    else
        Return Unkown
```

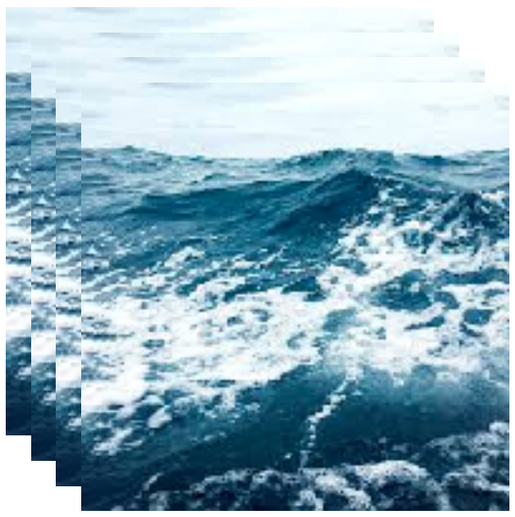
Machine Learning

- Input: Picture of different landscapes
- Goal: Classify [Desert, Forest, Water]
- Solution: Average pixel colour and threshold
- Problem: How do we set the thresholds? ← **With DATA**



$\theta^1 r, \theta^1 g, \theta^1 b$

$\theta^2 r, \theta^2 g, \theta^2 b$



$\theta^3 r, \theta^3 g, \theta^3 b$

Machine Learning
AKA learning function parameters

- Input: Picture
- Goal: Classify into 5000 classes
- Solution: Neural network with > 1 000 000 parameters

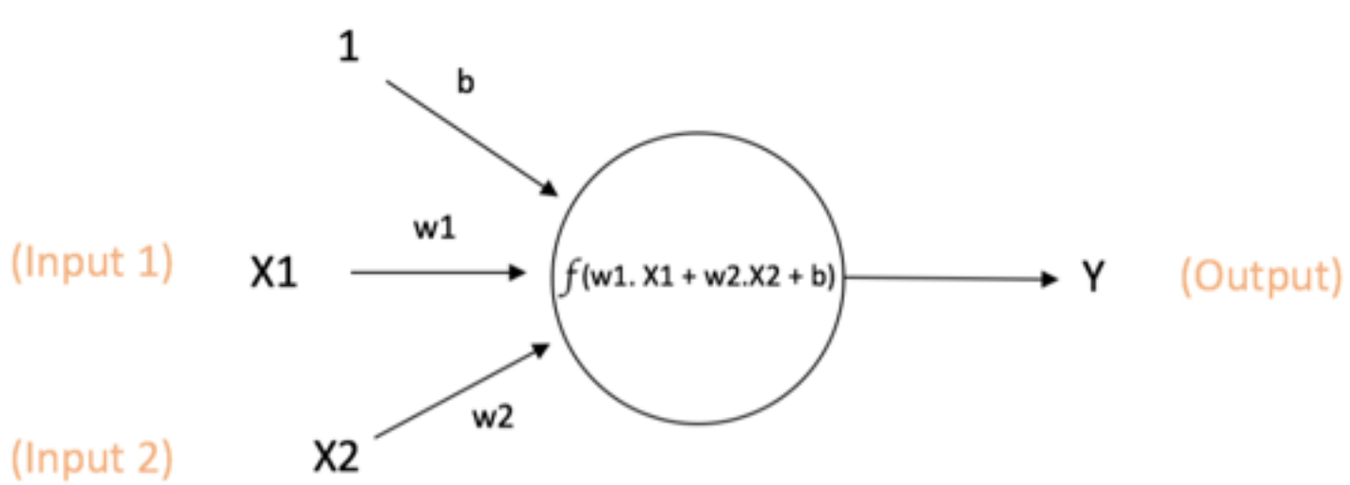
Model

- Given a Program with Free Parameters,
- Machine Learning is used to set the Parameters from Data

Learning

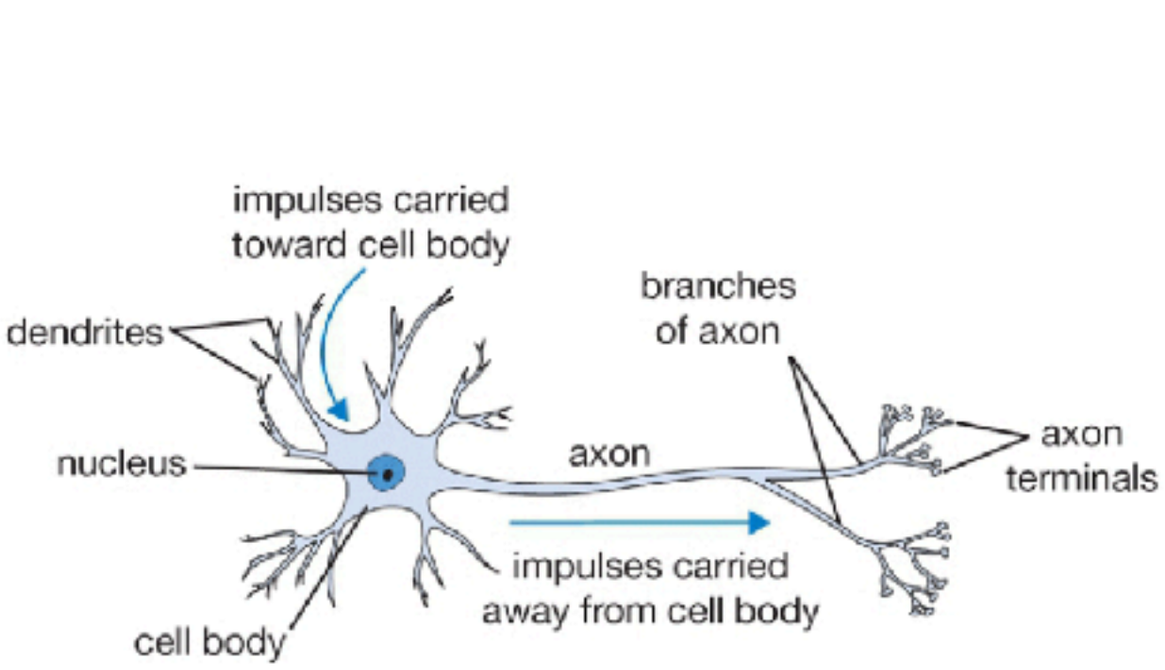
Neuron

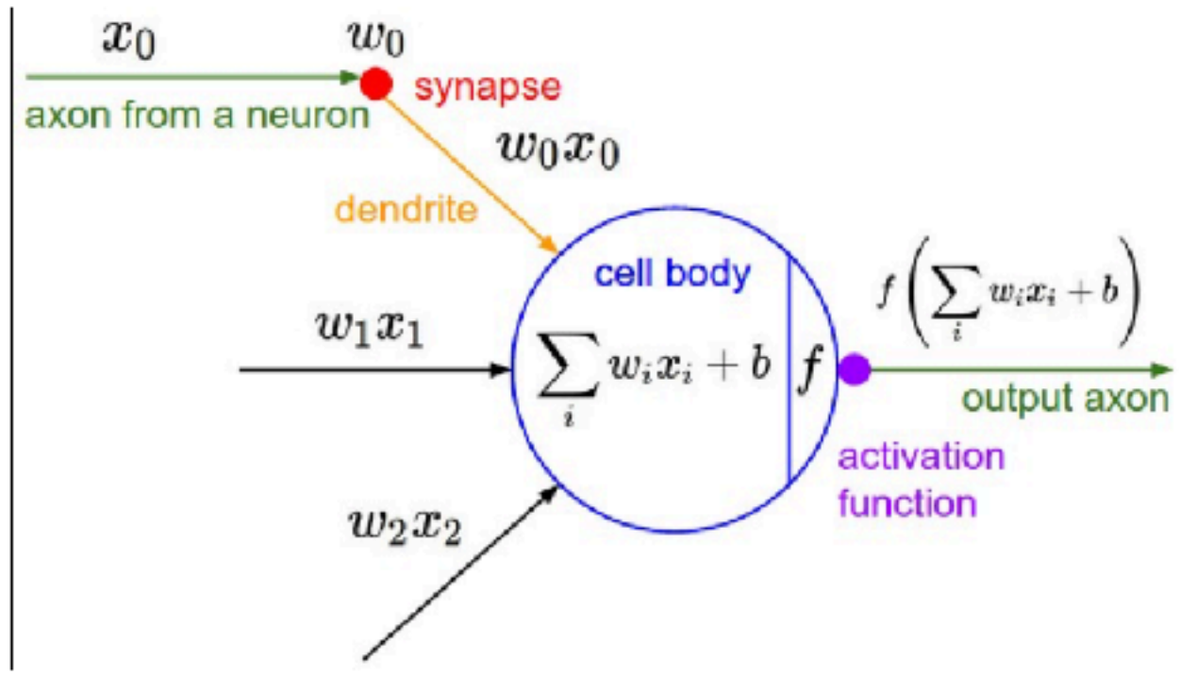
- Basic computation unit in a neural network.
- Activation function
    - Defines the output of that node given an input or set of inputs



Output of neuron = Y= f(w1. X1 + w2.X2 + b)

Neuron





A cartoon drawing of a biological neuron (left) and its mathematical model (right).

Why more Neuron?

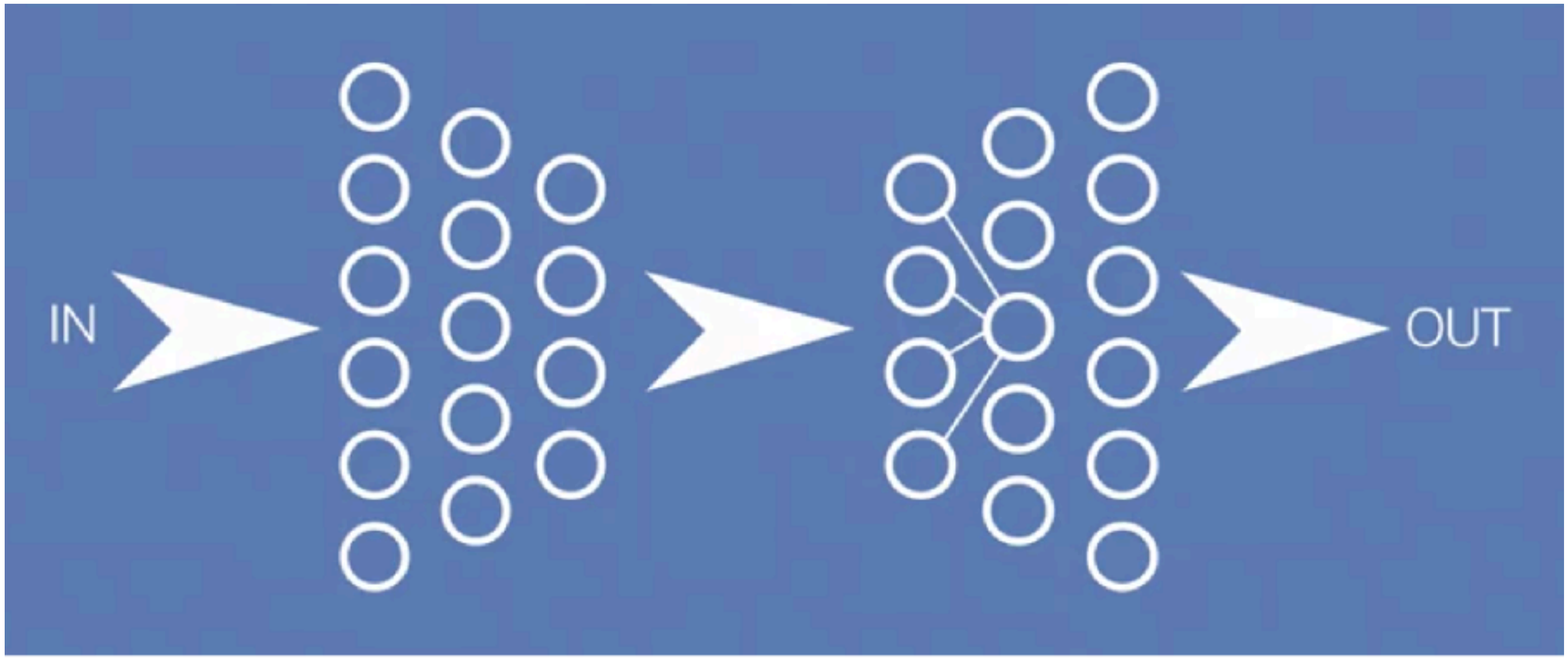
- Do more layers or more neurons mean better performance?

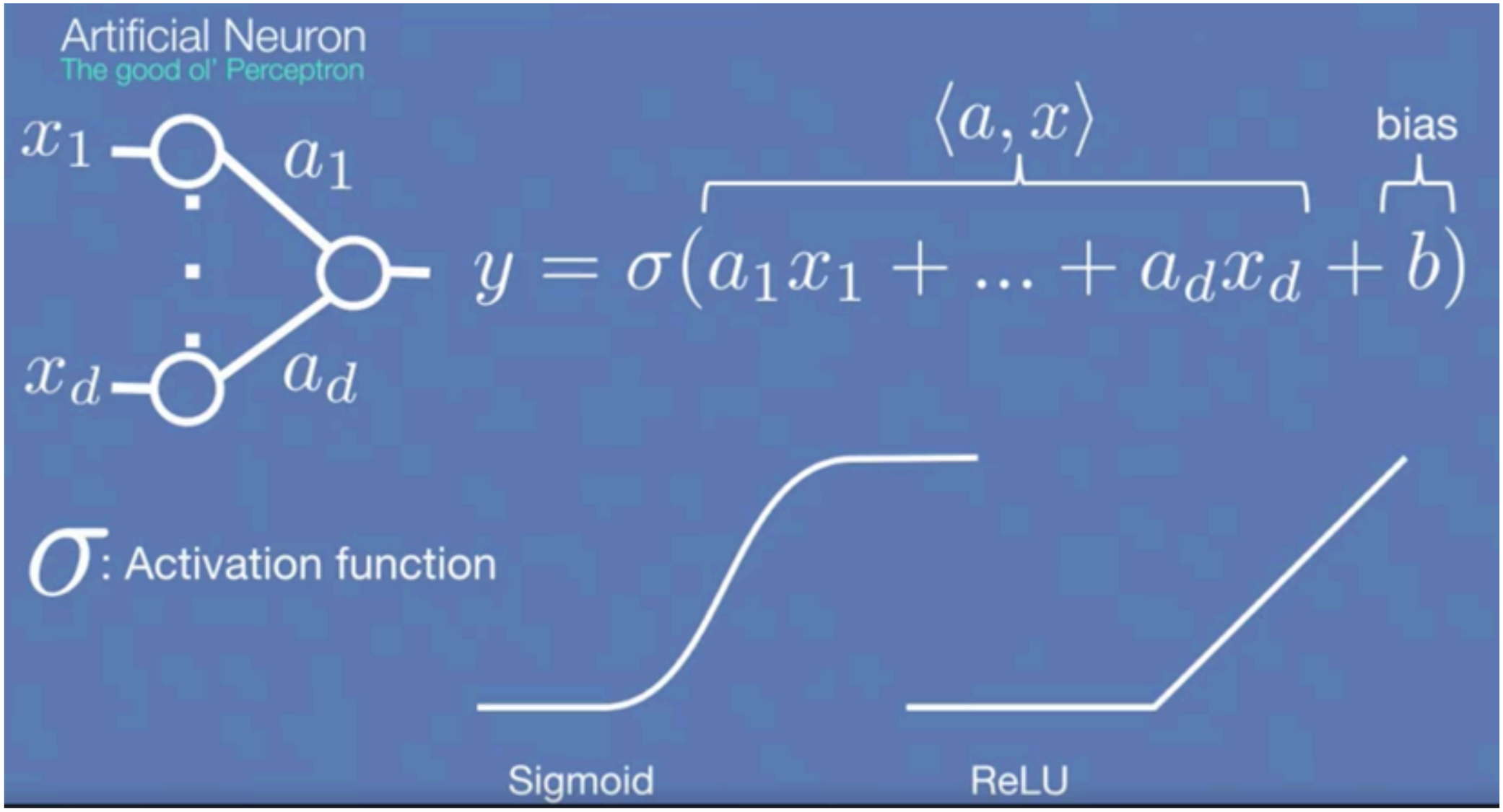
Neural Network

- Simulation of a biological brain.
- Purpose: Learn to recognise patterns in data.
- Make predictions based on similarities.

Types of Neural Network

- Feed Forward neural network
- Redial basis function Neural Network
- Kohonen Self Organising Neural Network
- Recurrent Neural Network
- Convolutional Neural Network
- Modula Neural Network

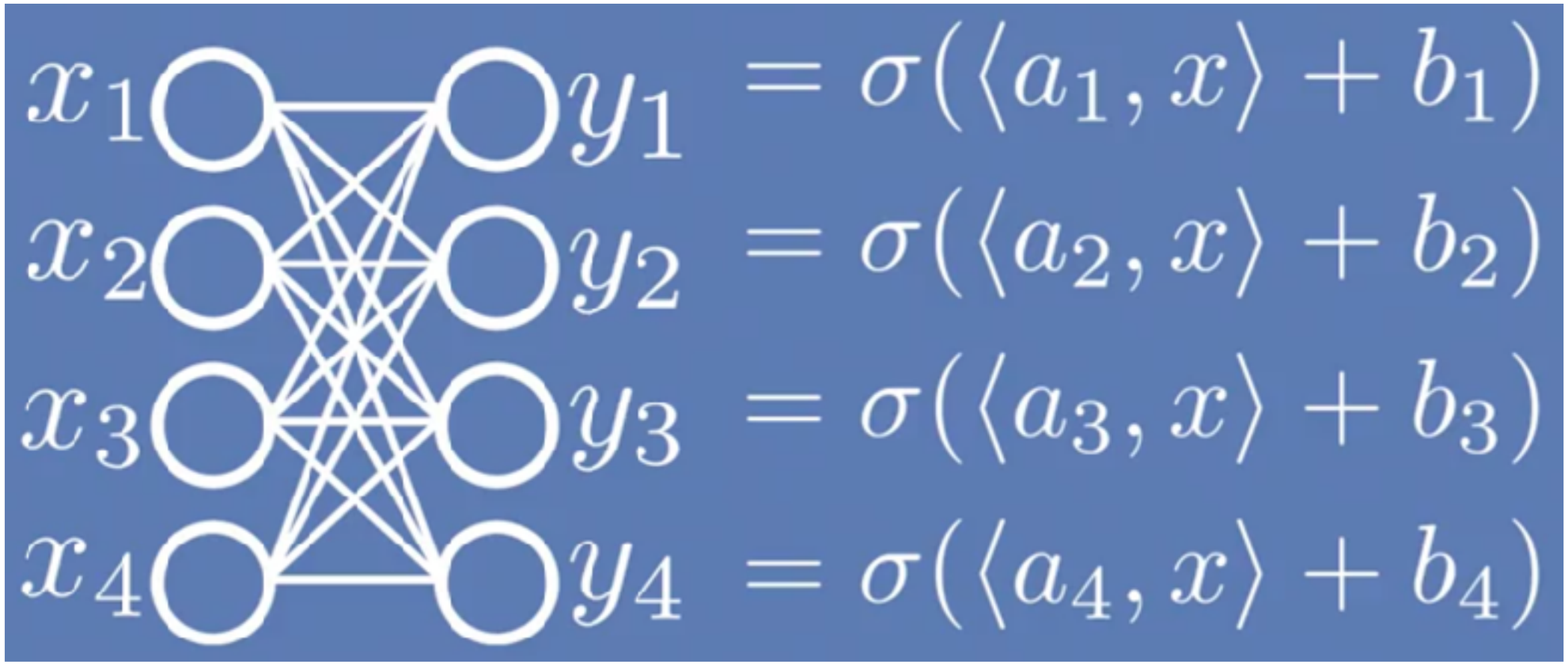

IN
OUT



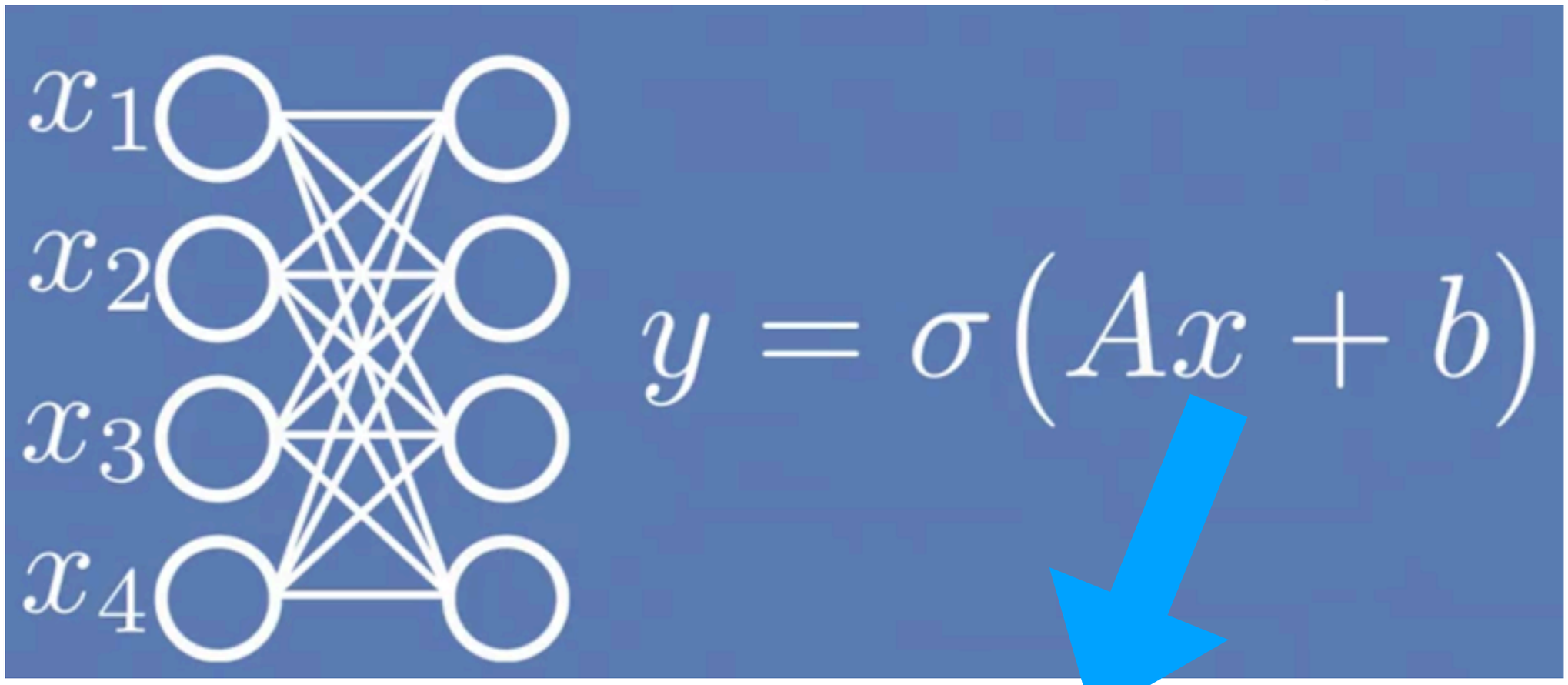
Facebook AI Masterclass 2017

Hidden Layer

A set of neutrons with shared inputs.



Hidden Layer



Operation faster on GPUs (x100 speed-up).

Forward Pass

```
# set some inputs
x = -2; y = 5; z = -4

# perform the forward pass
q = x + y # q becomes 3
f = q * z # f becomes -12
```

Output of a layer becomes the input of the next layer.

Summary

- Neural Networks has originally been primarily inspired by the goal of modeling biological neural systems,
- but has since diverged and become a matter of engineering and achieving good results in Machine Learning tasks.

Reference

- Facebook AI Masterclass series.
- http://cs231n.github.io/neural-networks-1
- http://neuralnetworksanddeeplearning.com/index.html