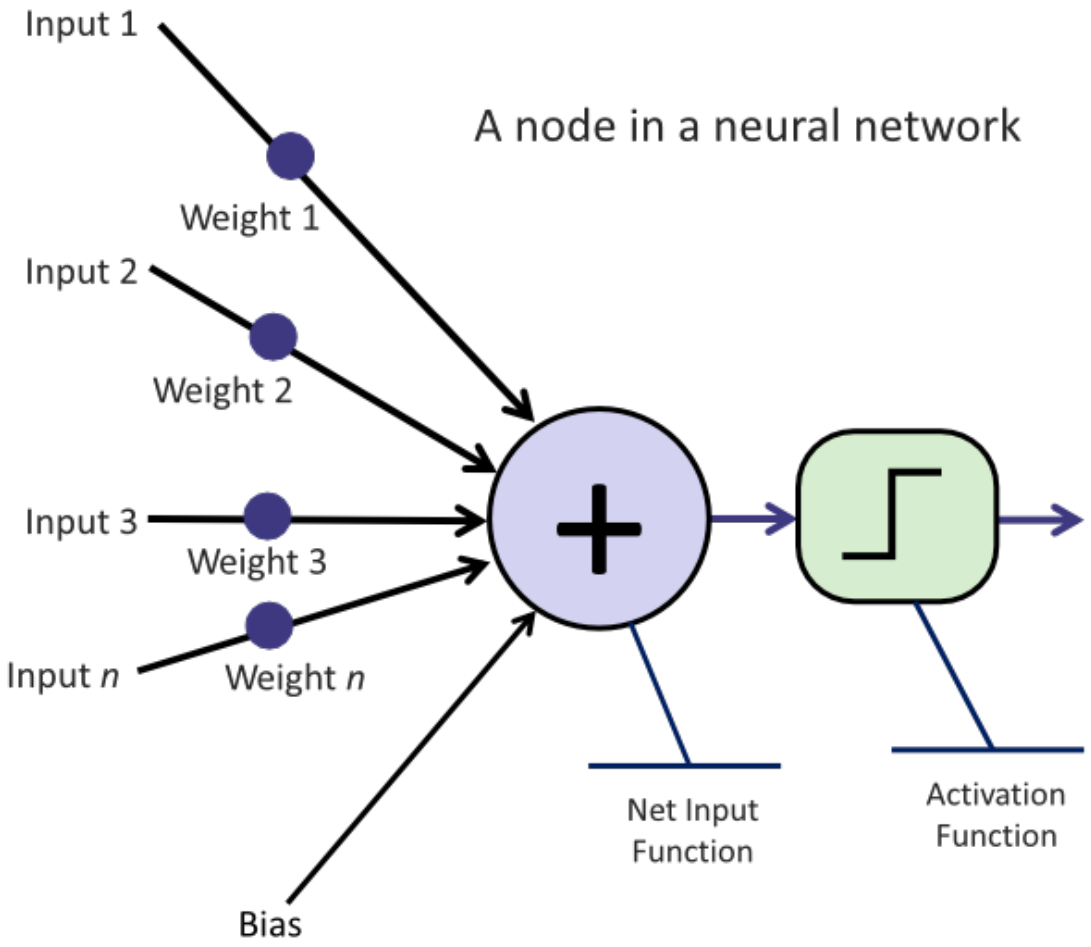
Neural Network: Advanced

Module 2 Objectives

1. Describe the basis of a neural network (neuron).
2. Identify and describe an artificial neuron (perceptron).
3. Discuss bias and weights.
4. Describe and identify activation functions.
5. Describe and simulate image processing in a small neural network.
6. Implement and train a perceptron using TensorFlow.

Neural Network Neurons

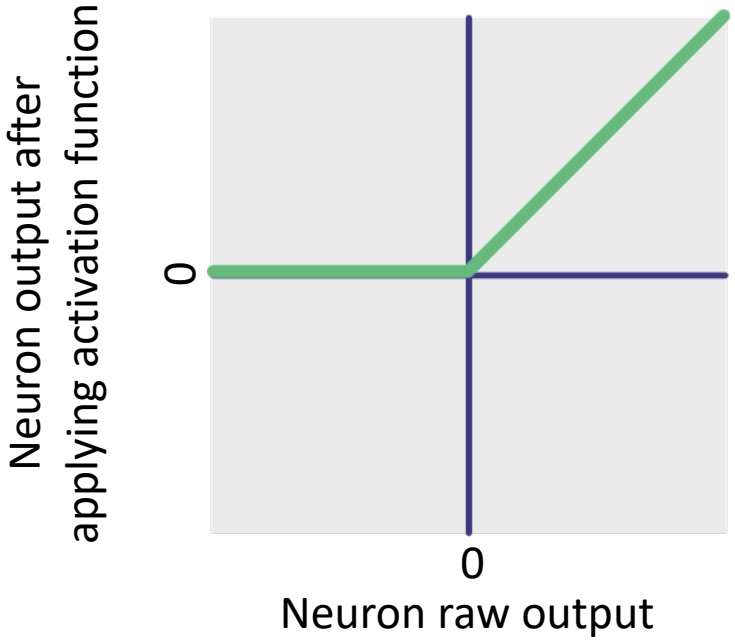
Remember The Node?



1. Linear Transformation

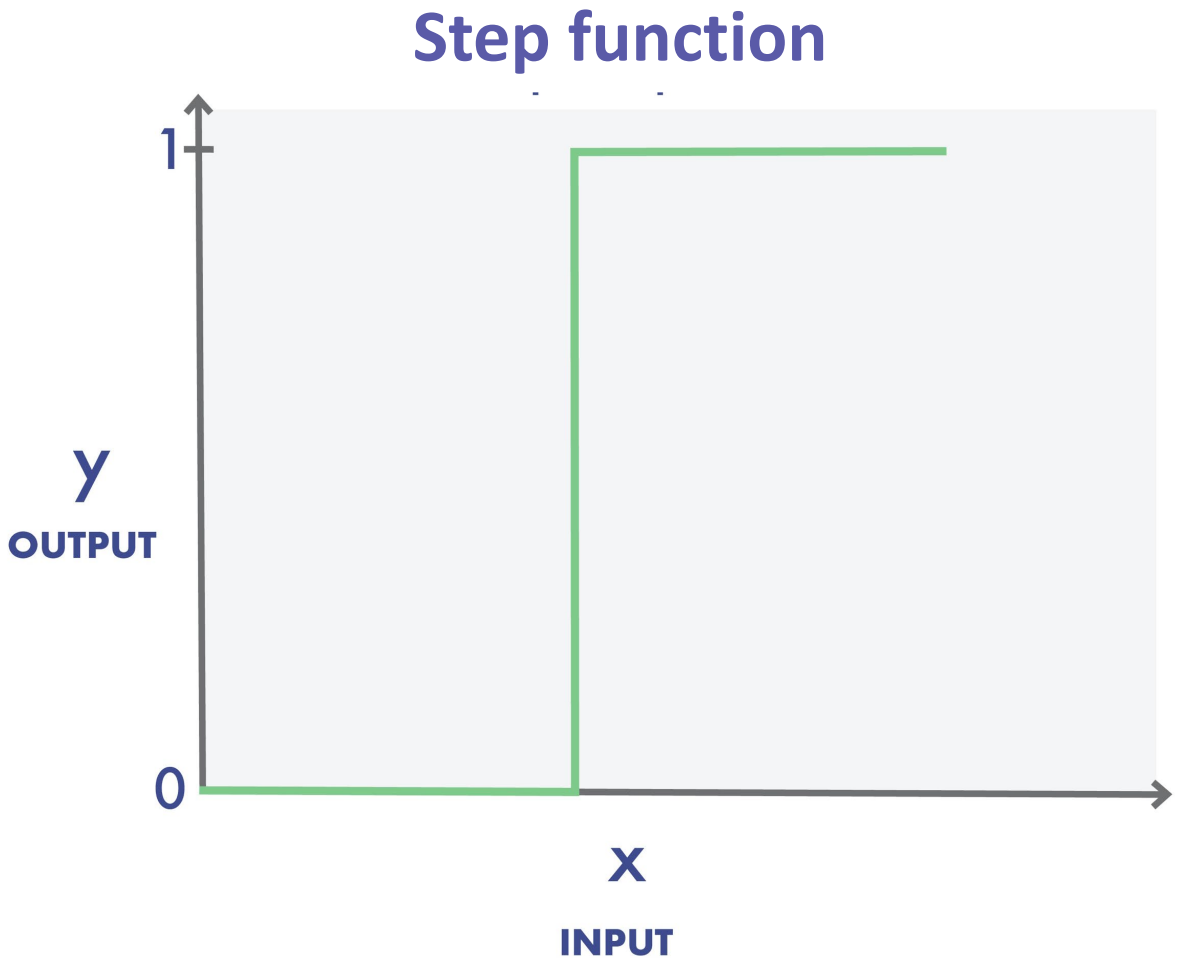
$$Sum = w_1 \times x_1 + w_2 \times x_2 + \cdots + w_n \times x_n + bias$$

2. Activation Function

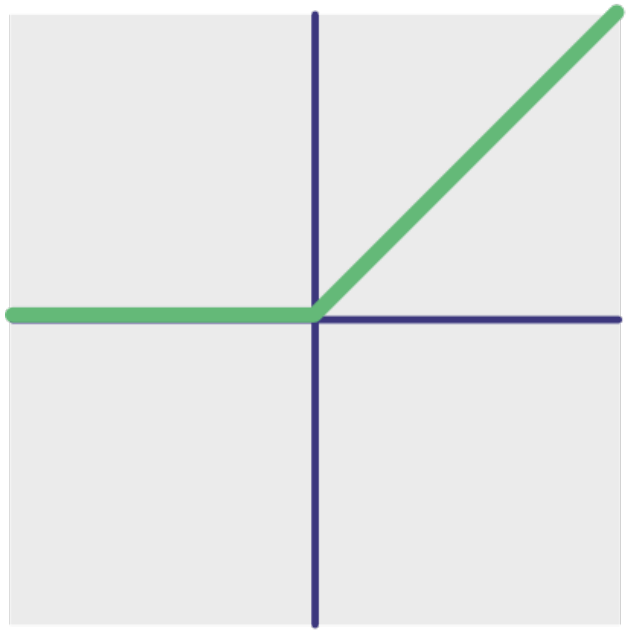


Functions, ACTIVATE!

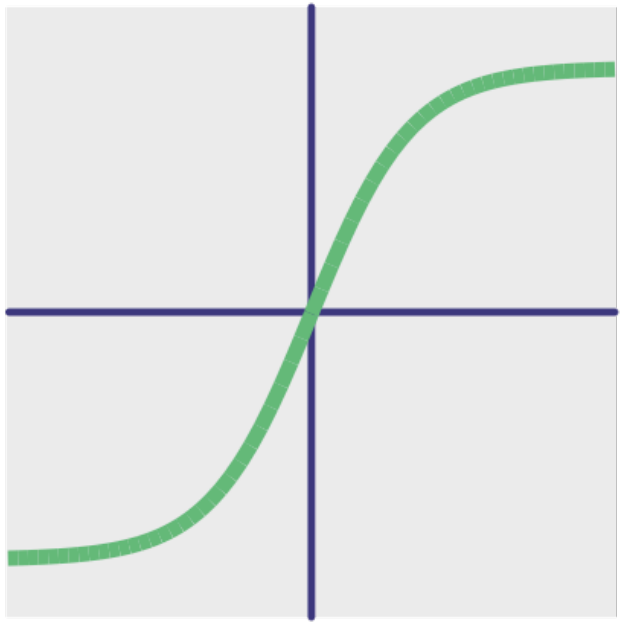
What do Activation Functions do?



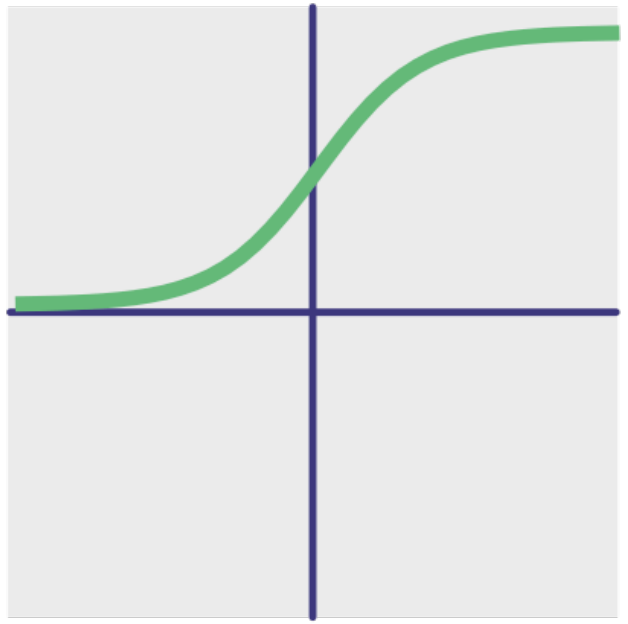
Common Activation Functions



ReLU
(Rectified Linear Unit)



tanh
(Hyperbolic tangent)



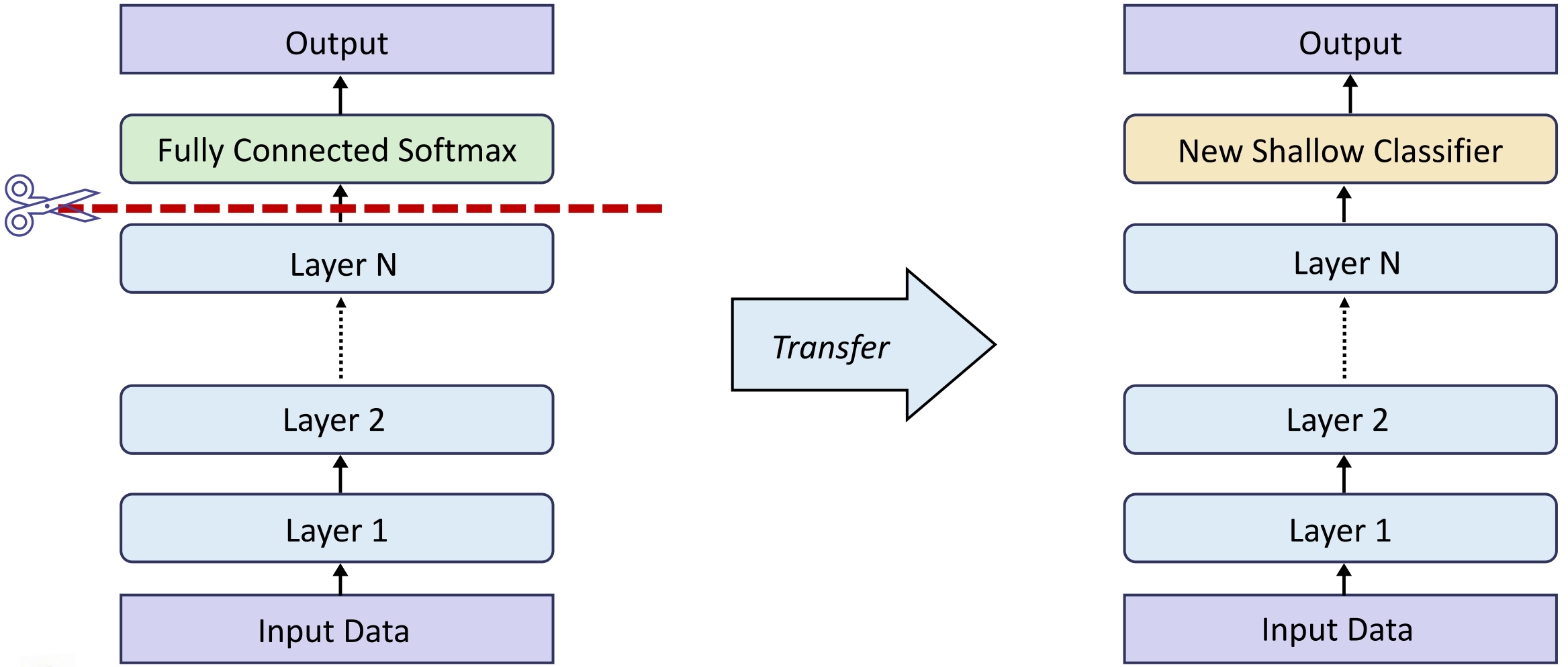
Sigmoid

Where Do Initial Weights and Biases Come From?

They’re Random (Usually…)

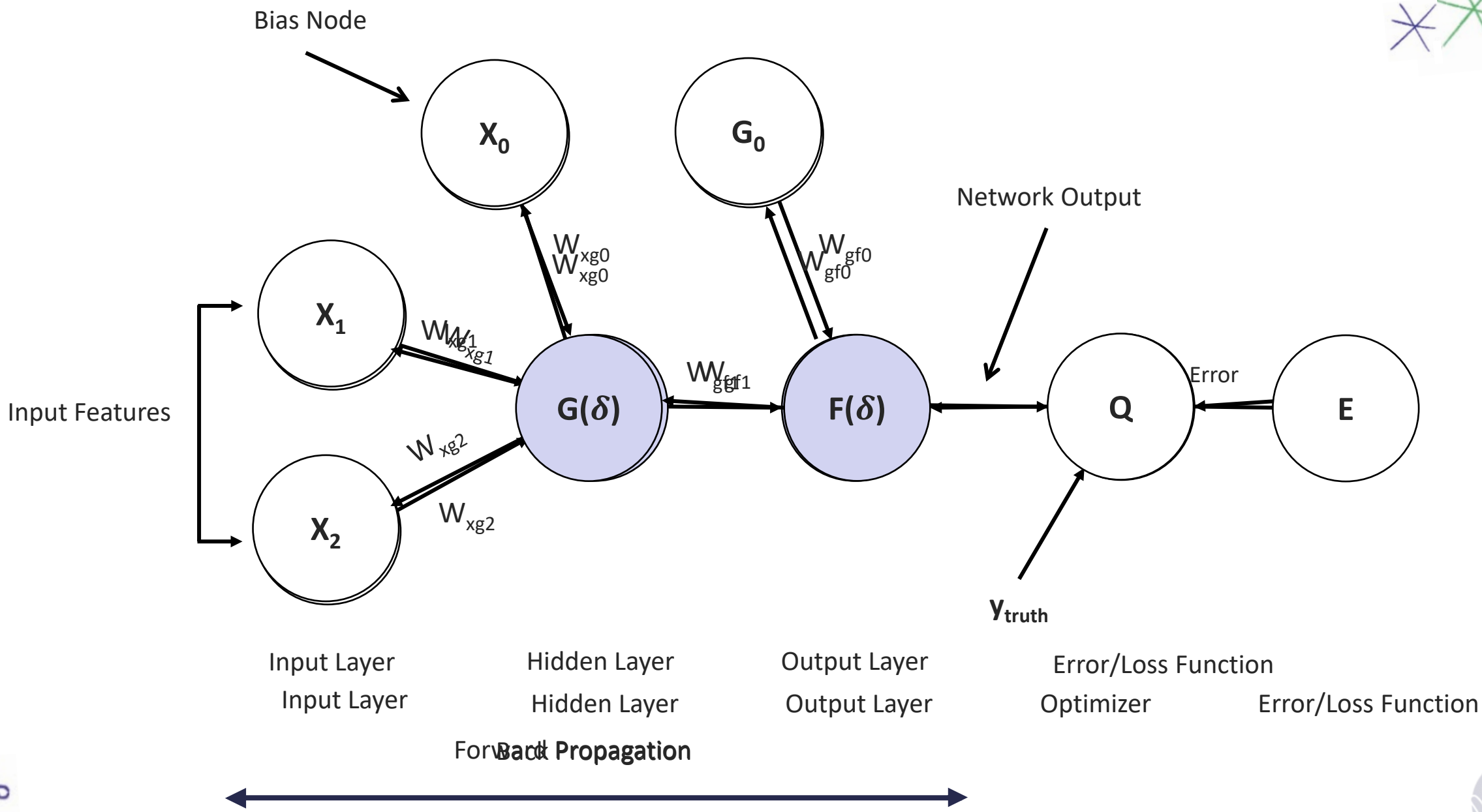
This image was generated using AI tools

We Can Also Use What We've "Learned"

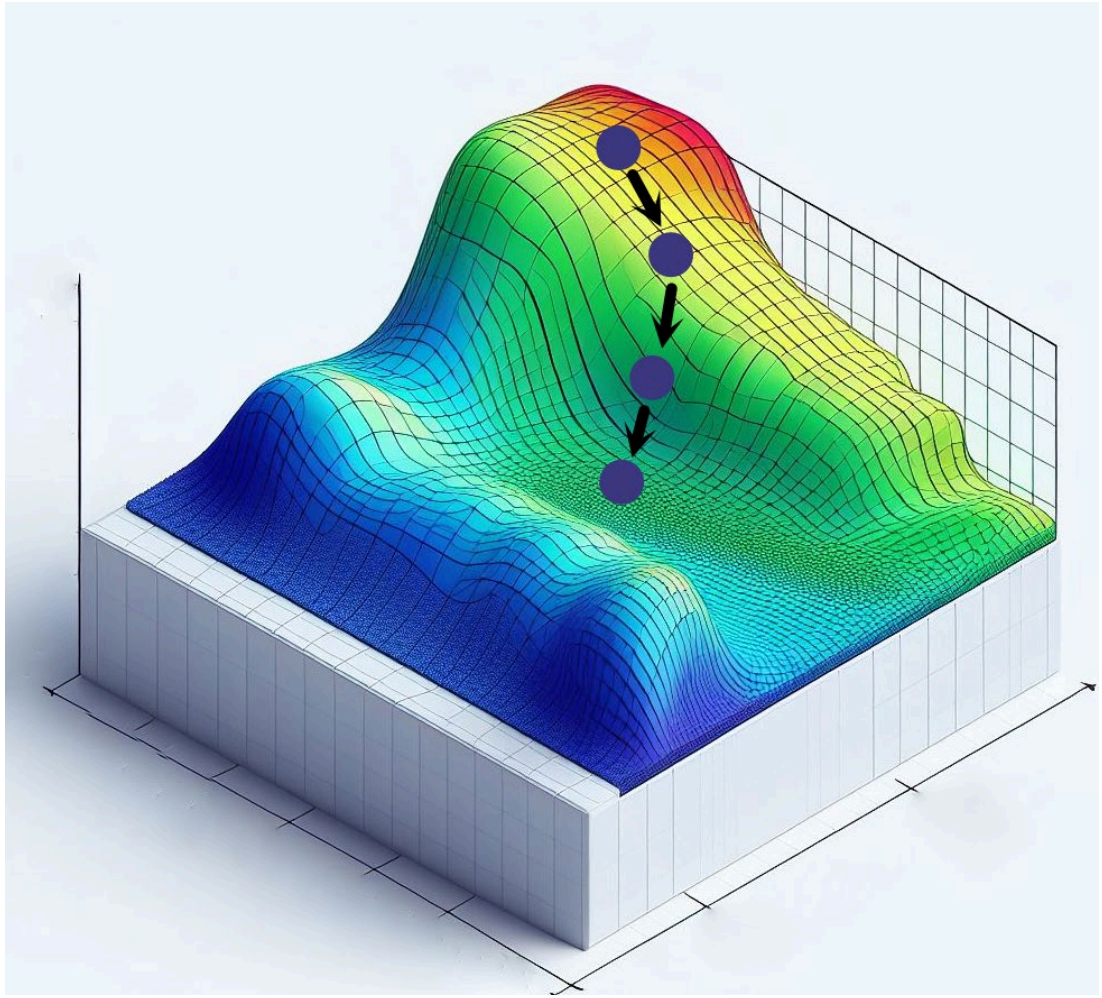


Source: Sarkar, D, et al. (2018). *Hands-on transfer learning with Python.* Birmingham, UK: Packt Publishing. (Chapter 4)

A Closer Look at The Training Process


Bias Node
X_0
G_0
Network Output
W_{xg0}
W_{gf0}
X_1
W_{xg1}
W_{gf1}
Error
Input Features
G(δ)
F(δ)
Q
E
W_{xg2}
X_2
y_{truth}
Input Layer
Hidden Layer
Output Layer
Error/Loss Function
Input Layer
Hidden Layer
Output Layer
Optimizer
Error/Loss Function
Forward Propagation
Back Propagation

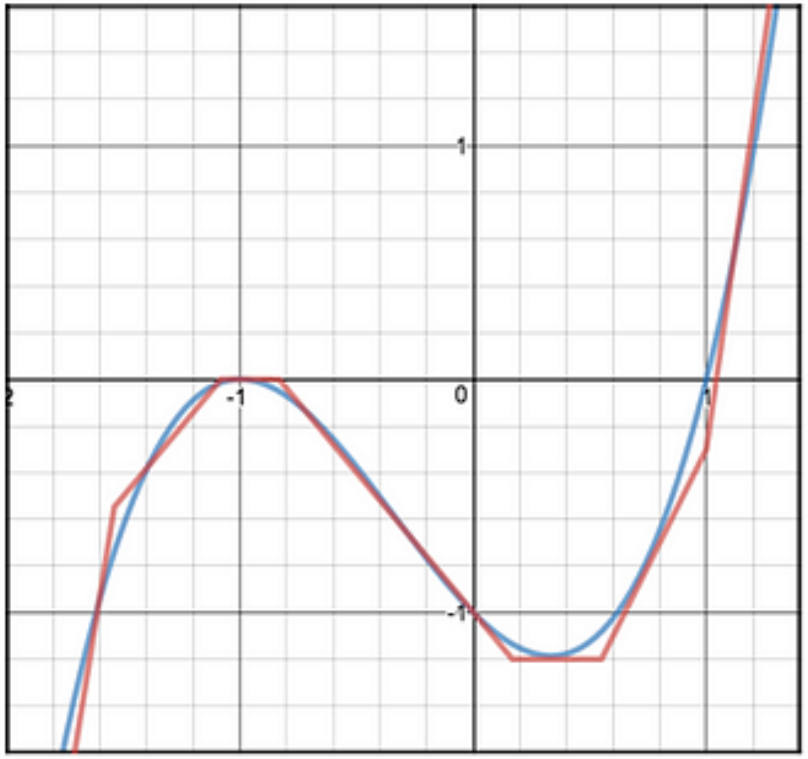
The Low Down



This image was generated using AI tools

WHY do we use Neural Networks?

Universal Approximation!



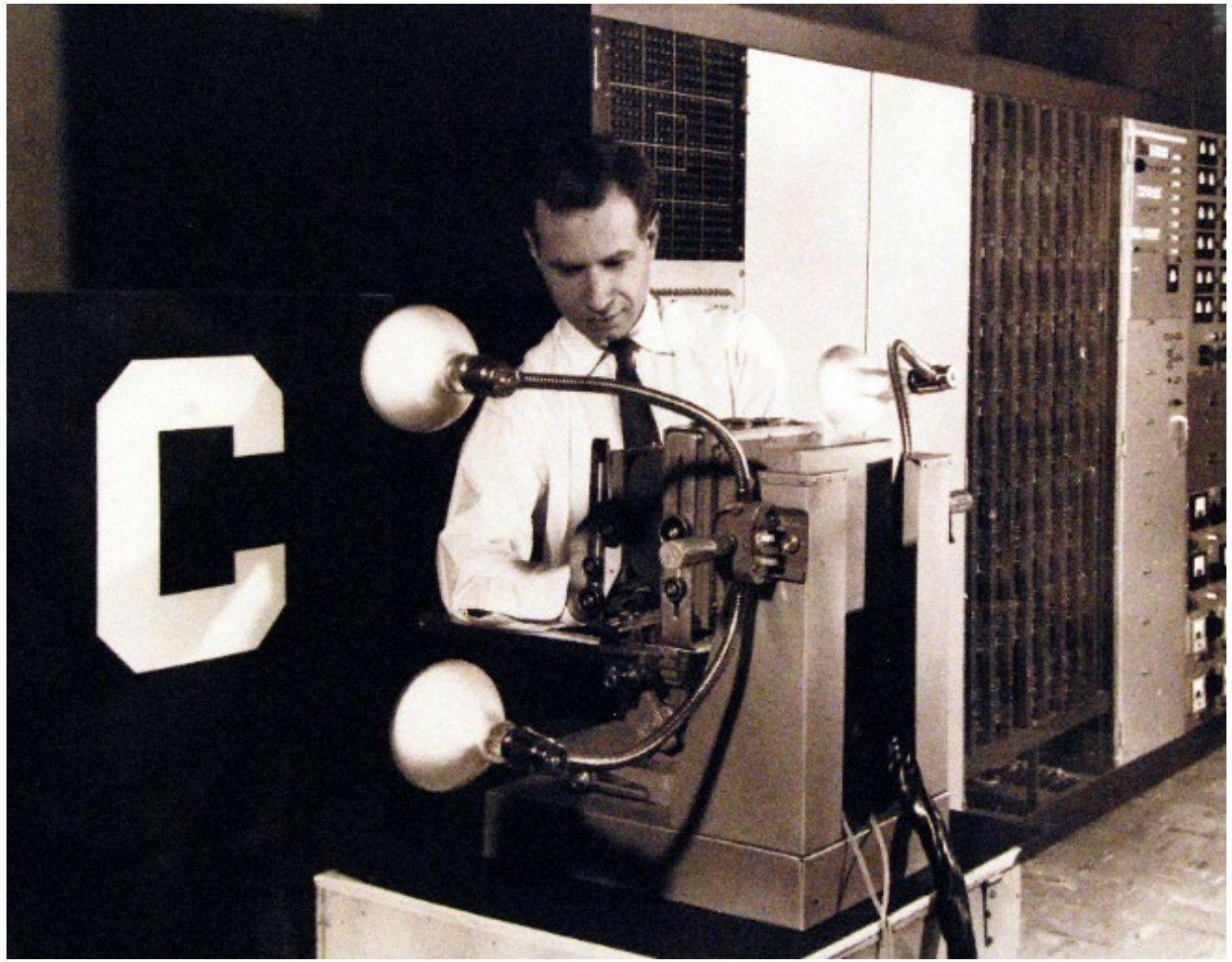
$$n_1(x) = Relu(-5x - 7.7)$$
$$n_2(x) = Relu(-1.2x - 1.3)$$
$$n_3(x) = Relu(1.2x + 1)$$
$$n_4(x) = Relu(1.2x - .2)$$
$$n_5(x) = Relu(2x - 1.1)$$
$$n_6(x) = Relu(5x - 5)$$

$$Z(x) = -n_1(x) - n_2(x) - n_3(x) + n_4(x) + n_5(x) + n_6(x)$$

Source: Fortuner, B (2017). *Can neural networks solve any problem?* Medium.com: Towards Data Science

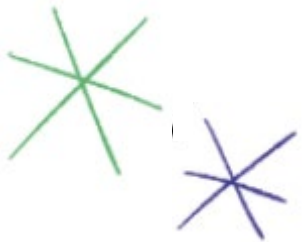
The Perceptron
or
AI’s Humble Beginnings

The Lonely Node



Source: Fortuner, B (2017). *Can neural networks solve any problem?* Medium.com: Towards Data Science

Exercise



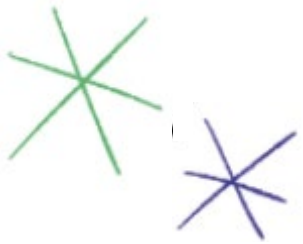
The Perceptron

02_code_a_perceptron.ipynb

This notebook will walk you through building and training your own binary classification model, then using it to make predictions!

Network Capacity

Exercise



Look at This

03_mnist_classifier.ipynb

This notebook will walk you through training an image classification model using a full neural network.

Questions?

(QR CODE FOR SURVEY!)