

# Neural Networks for Data Professionals: A Comprehensive Introduction

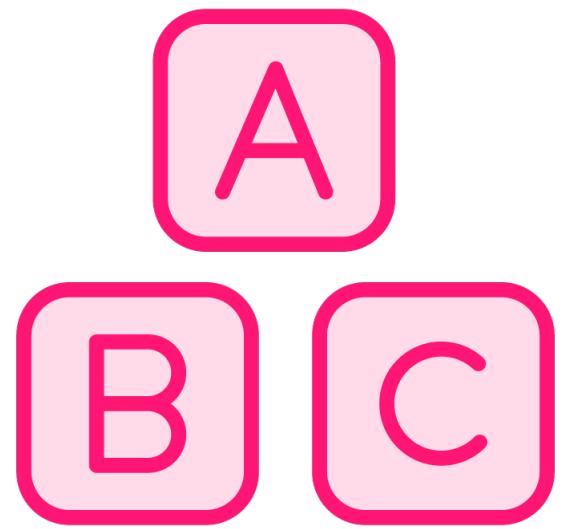
## Foundations of Neural Networks



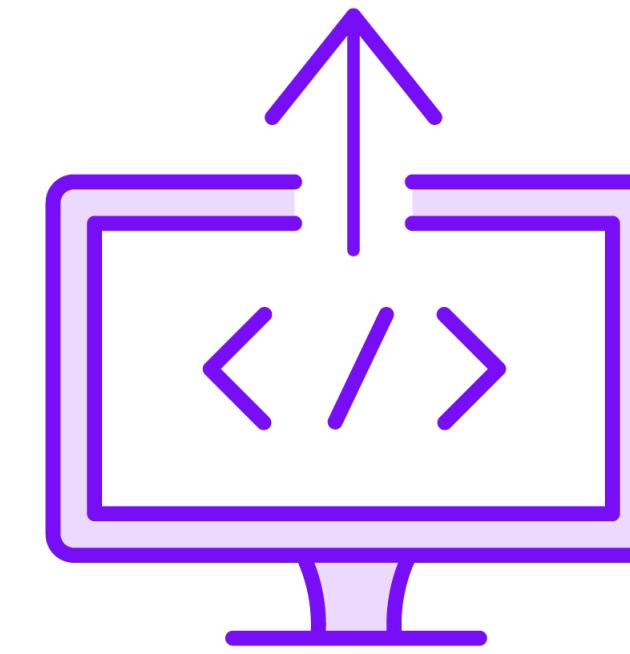
**Pratheerth Padman**

Data Scientist

# Course Outline



**Foundations of neural networks**



**Deploying and optimizing  
neural networks**





# Introduction to Neural Networks



# History of Neural Networks

**1940 – 1950s**

**McCulloch and Pitts**  
McCulloch-Pitts neuron

**1960 – 1970s**

**AI Winters**

**2000s – Present**

**Modern Neural  
Networks**

**1957**

**Frank Rosenblatt**  
Perceptron

**1980s**

**Rumelhart, Hinton,  
and Williams**  
Backpropagation



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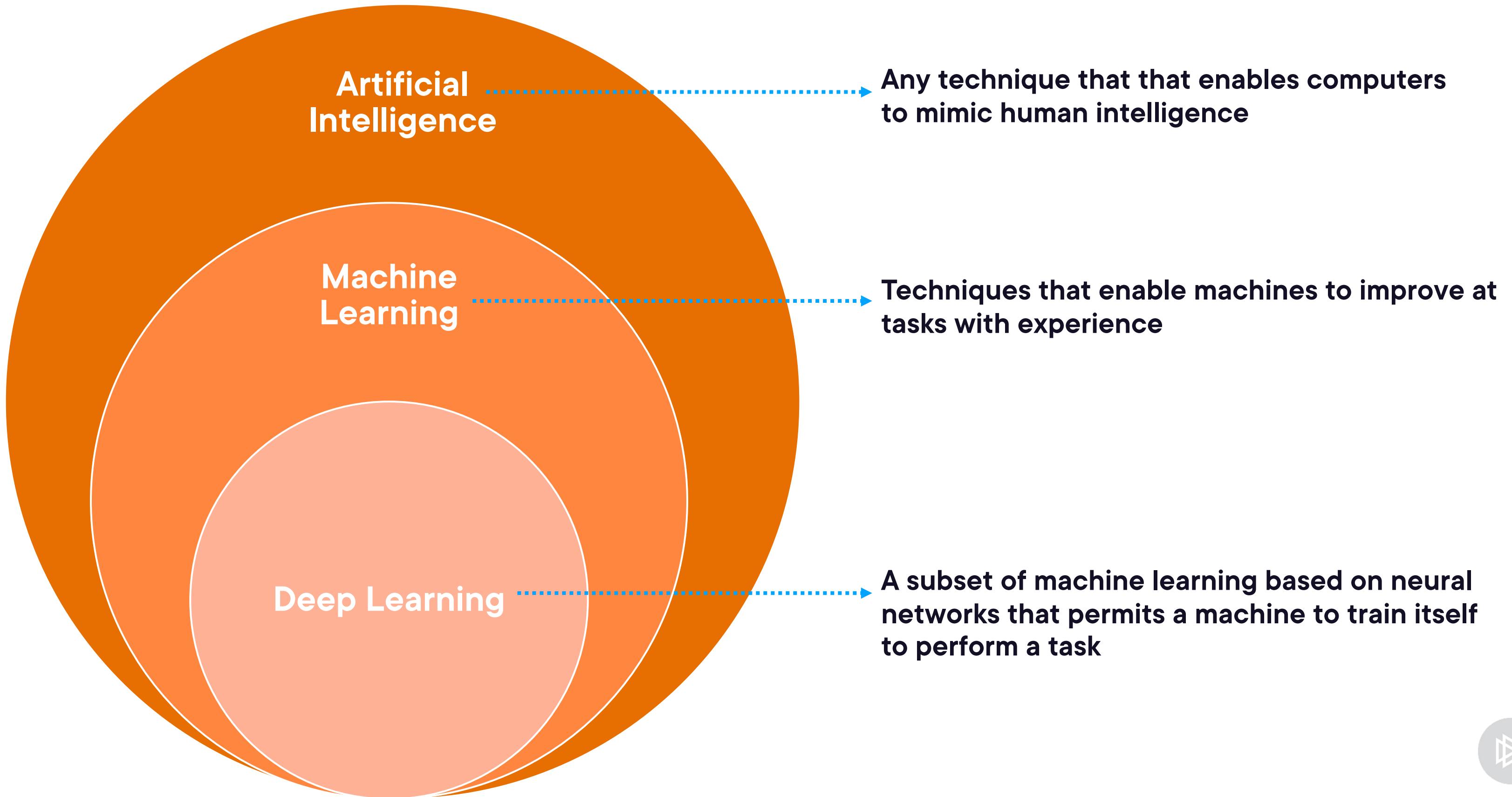
**1980s**

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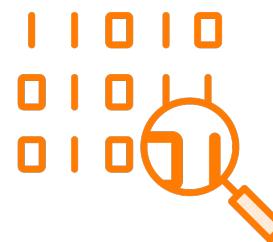
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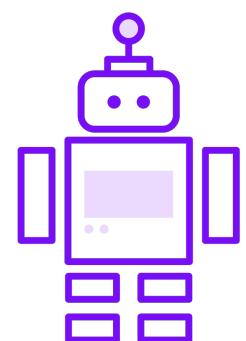
# What Is Deep Learning?



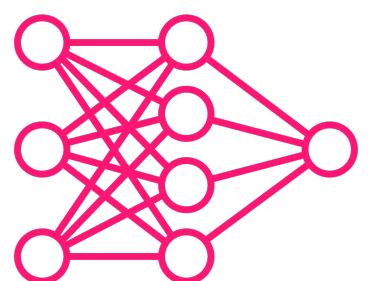
# Significance of Neural Networks



**They have an unparalleled ability to learn from vast amounts of data**



**They recognize patterns, and make decisions with minimal human intervention**



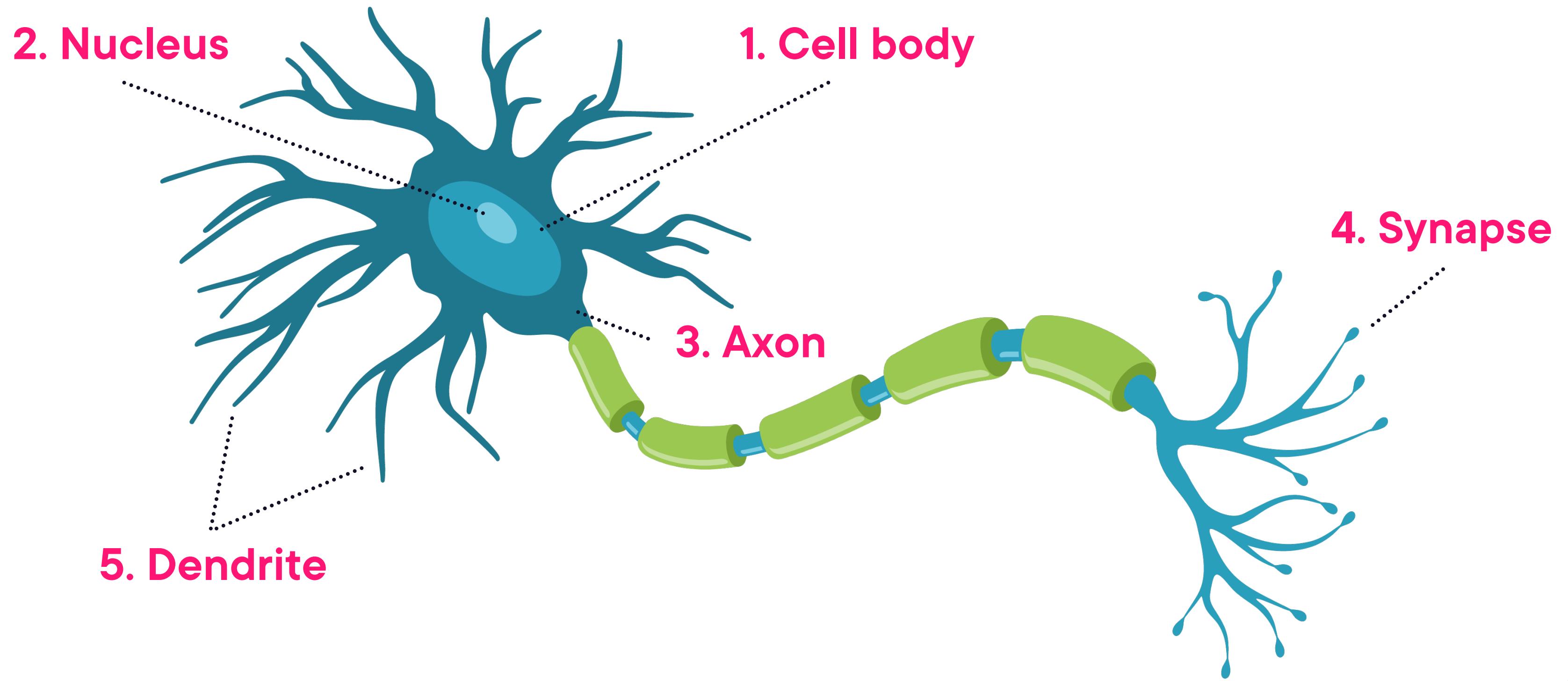
**From powering complex recommendation systems in e-commerce to enabling self-driving cars, neural networks are reshaping industries and our daily lives**



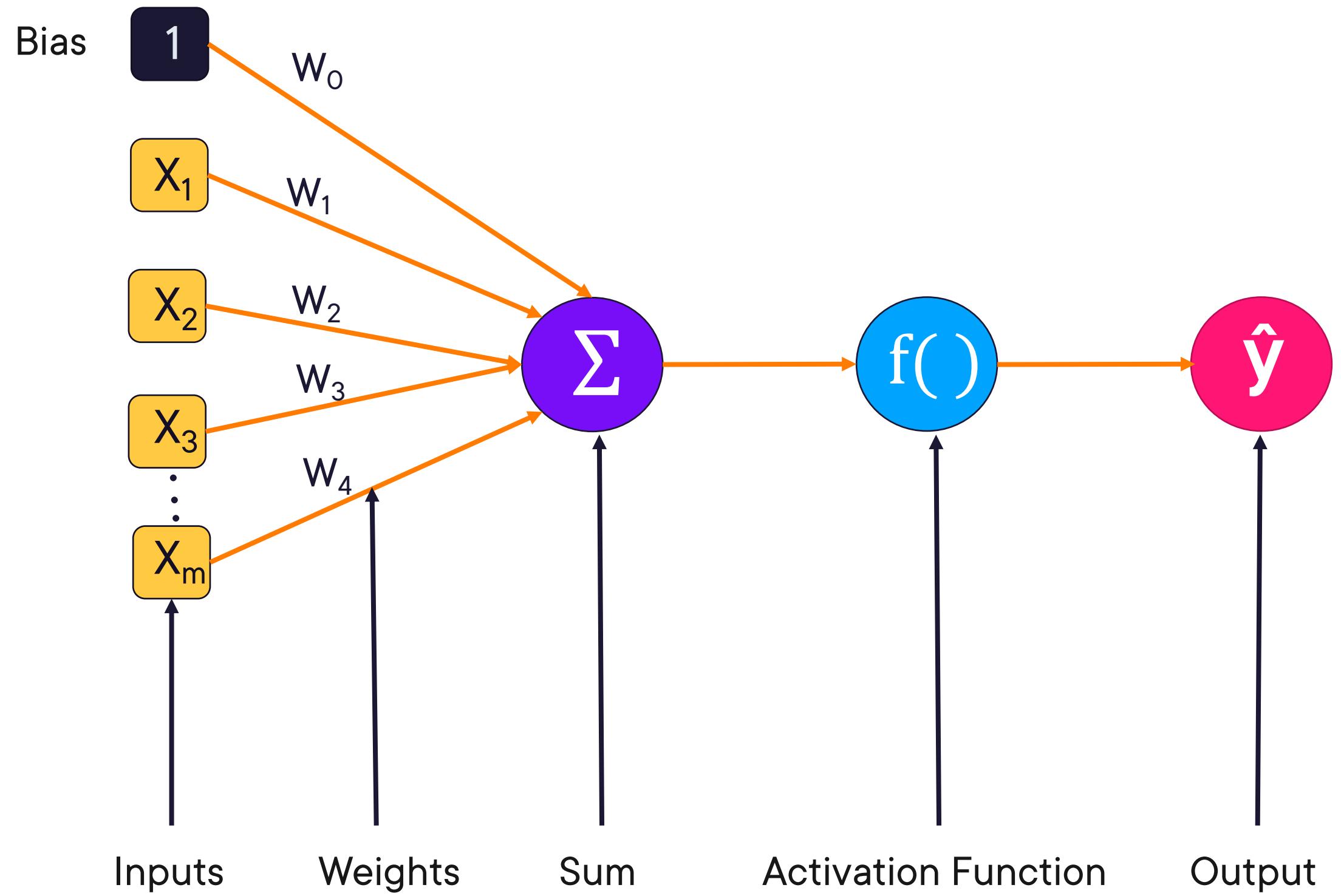
# The Perceptron: From Biological to Artificial Neurons



# Biological Neuron



# Artificial Neuron or Perceptron



$$\hat{y} = f(w_0 + \sum_{i=1}^m x_i w_i)$$

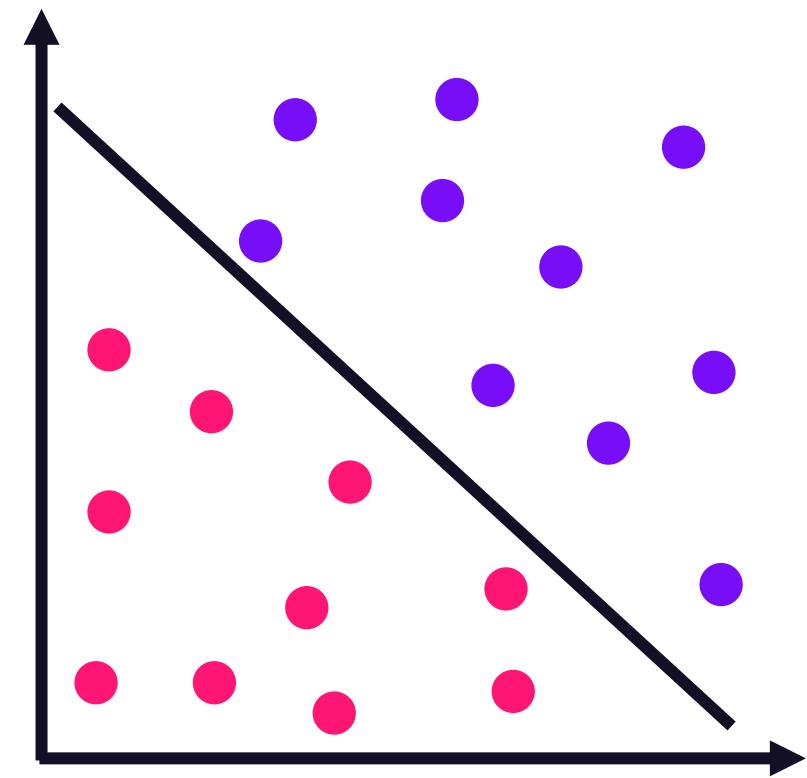




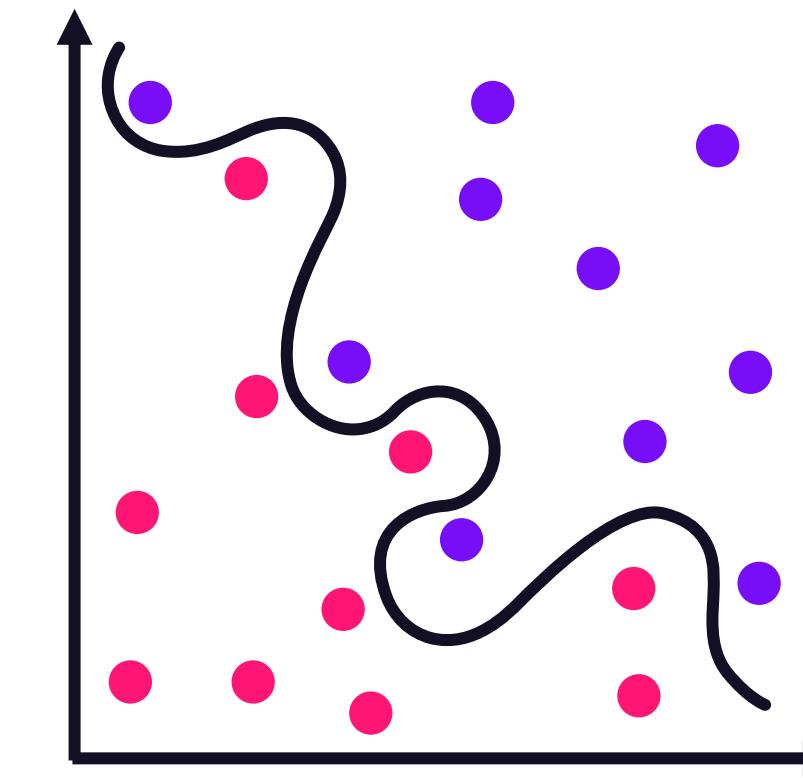
# Activation Functions



# Data Separability



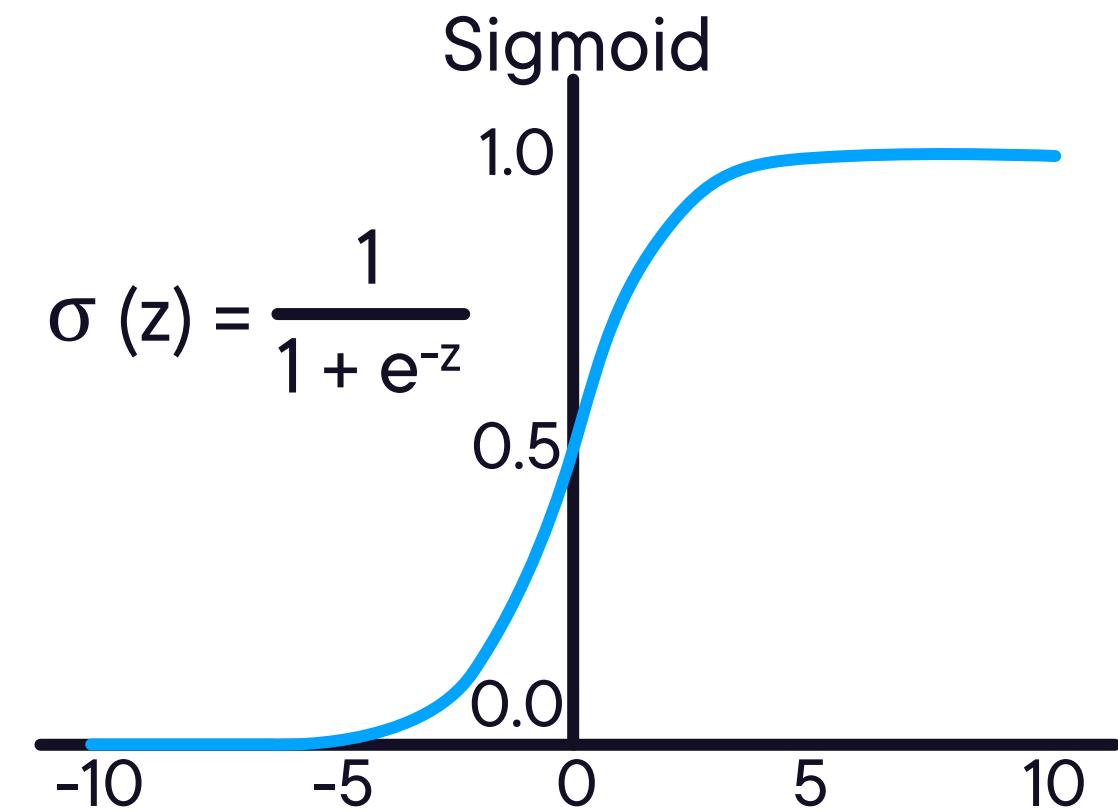
Linearly separable



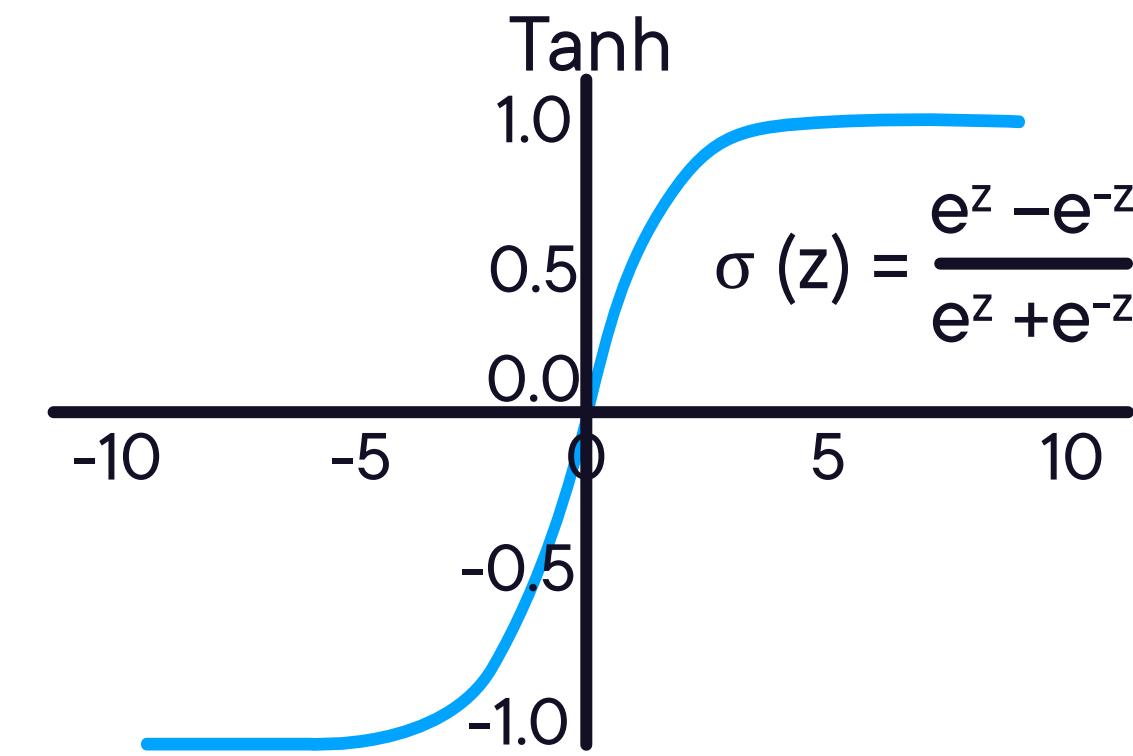
Non-linearly separable

**The activation function does the non-linear transformation to the input, making it capable to learn and perform more complex tasks.**

# Non-linear Activation Function



**Sigmoid Activation Function**

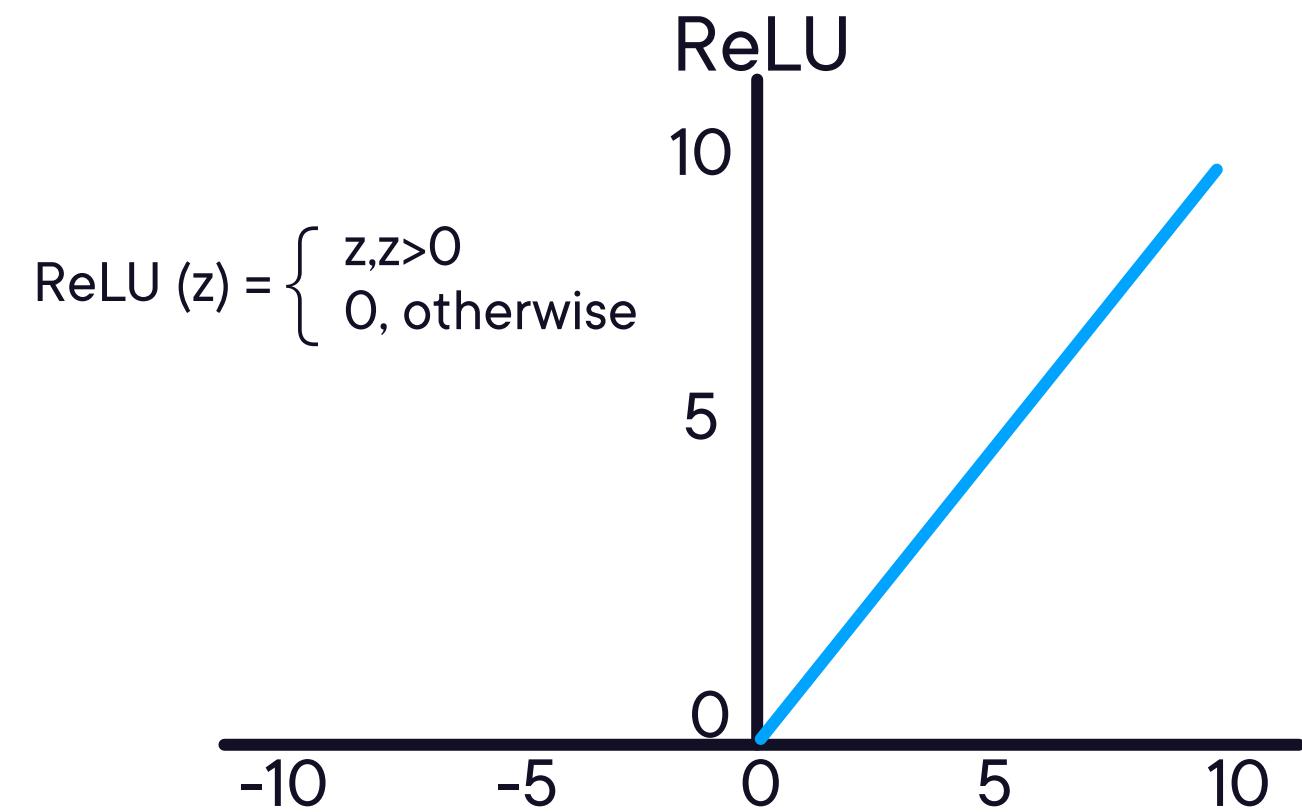


**Tanh Activation Function**

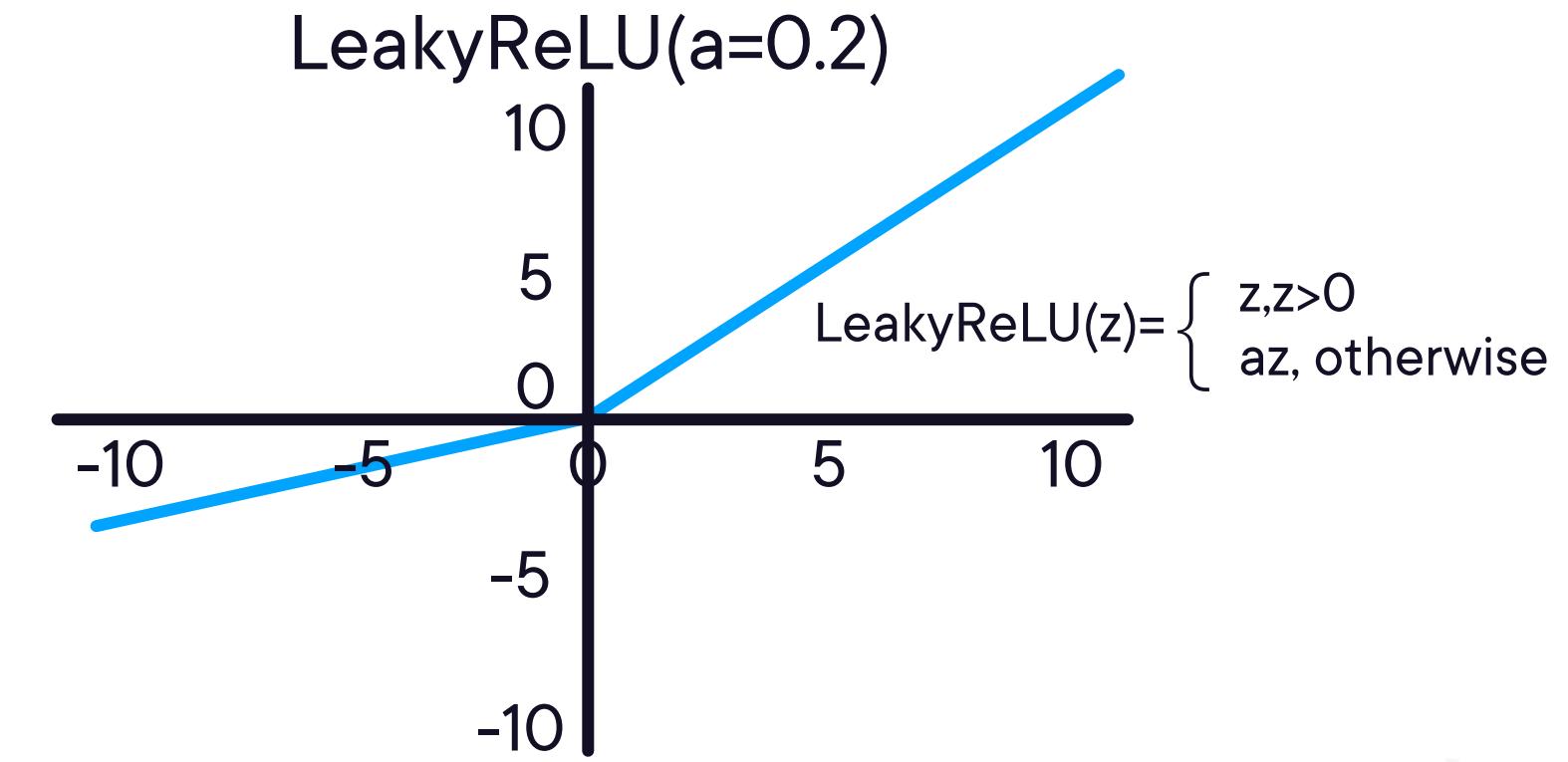
Image Citation - Feng, Junxi & He, Xiaohai & Teng, Qizhi & Ren, Chao & Chen, Honggang & Li, Yang. (2019). Reconstruction of porous media from extremely limited information using conditional generative adversarial networks.



# Non-linear Activation Function



**ReLU Activation Function**



**Leaky ReLU Activation Function**

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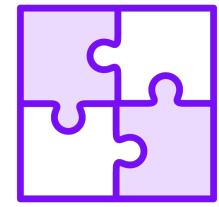
**Choosing an activation function depends on several factors, including the prediction type, the layer in the network, and the overall architecture.**



# The Design and Working of a Neural Network



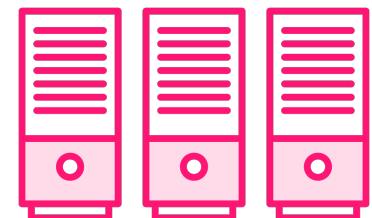
# Considerations While Designing a Neural Network



**Problem at hand**



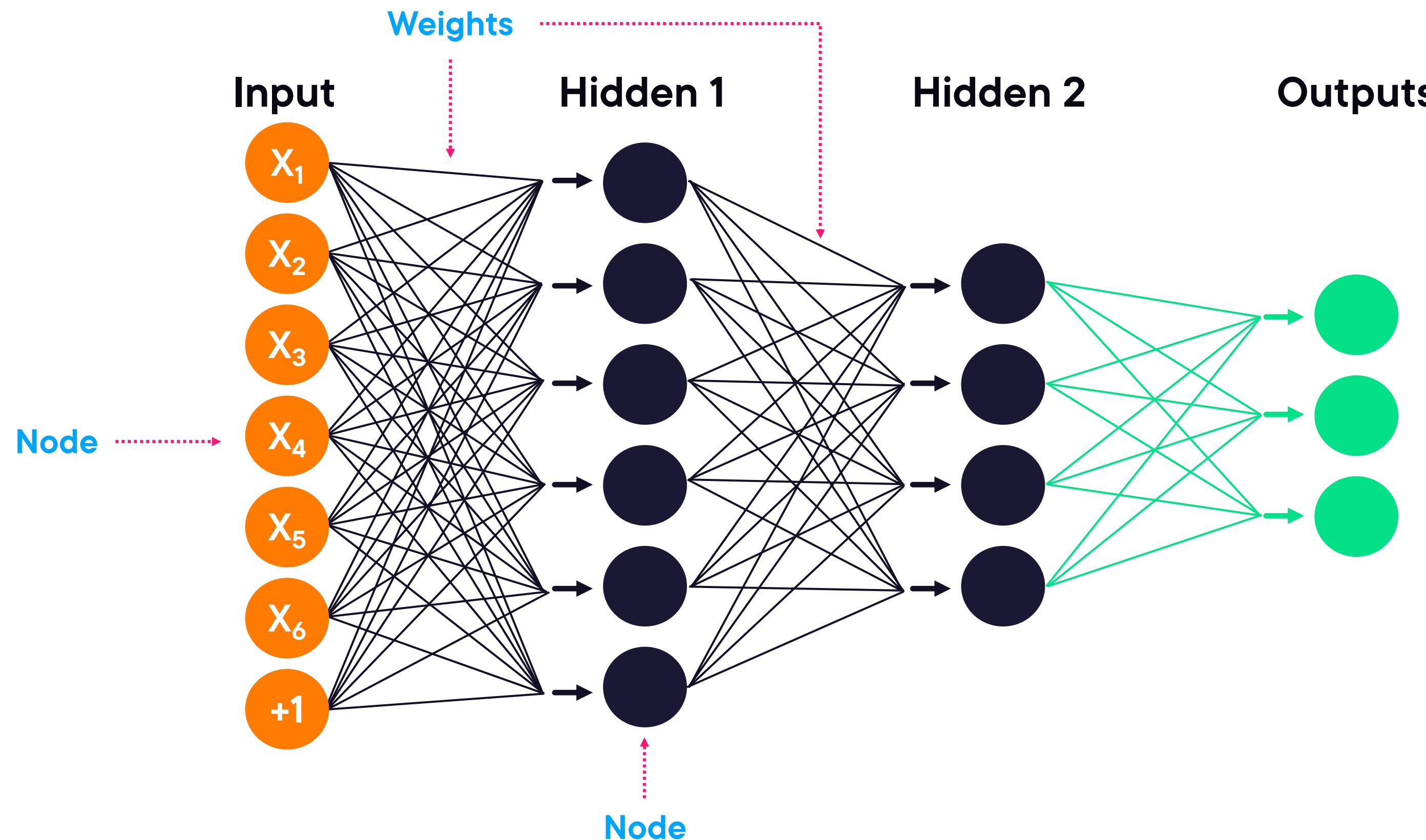
**Size and quality of your dataset**



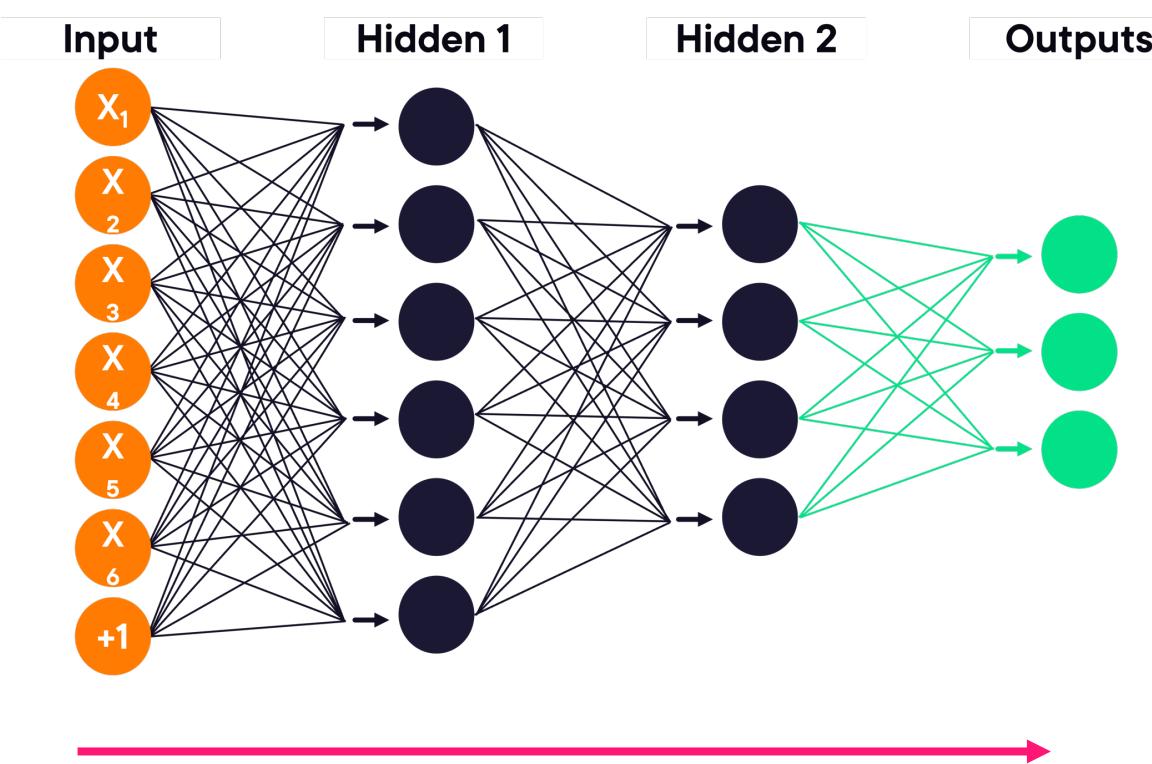
**Computational resources needed**



# Artificial Neural Network



# Forward Propagation



**Random initialization of weights**

**Data at the input layer is multiplied by these weights**

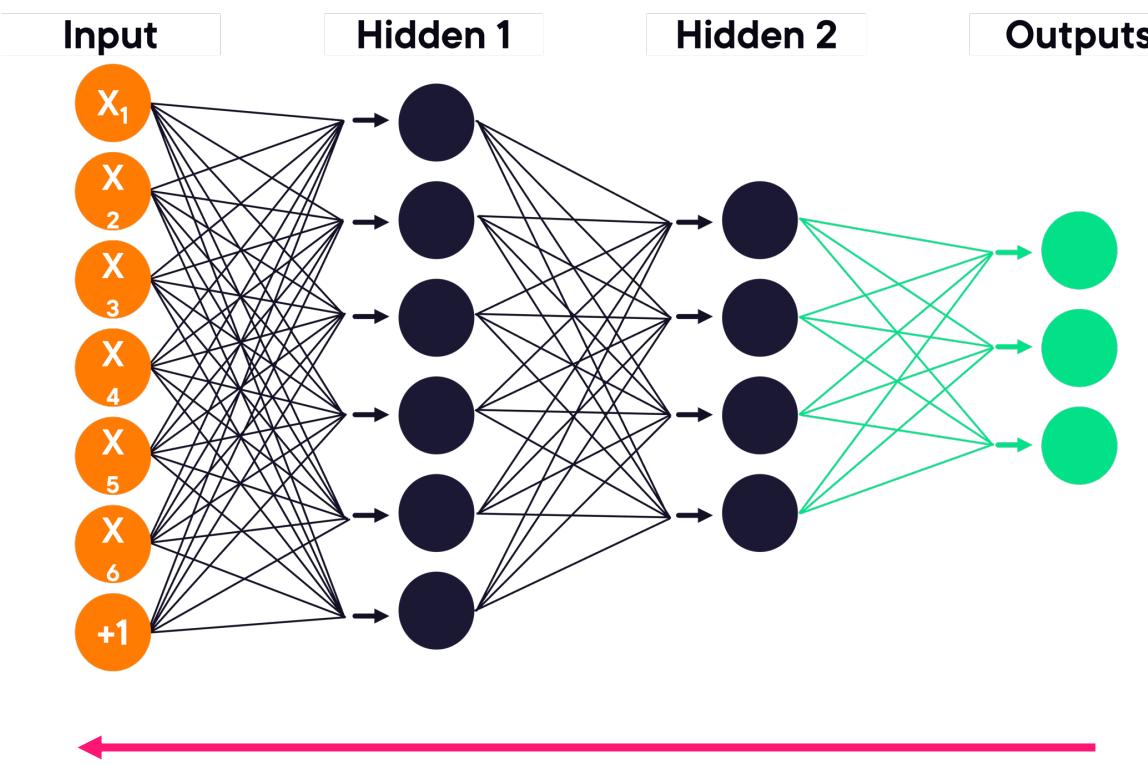
**Passed to the hidden layer**

**Each node sums the inputs and applies an activation function**

**Passed to the output layer**



# Backpropagation



Involves adjusting the weights based on the network's performance

Predicted vs. actual output comparison

Predicted guess found to be different

Weights adjusted based on difference

Adjustment done using chain rule in differential calculus

Forward propagation & backpropagation are performed multiple times

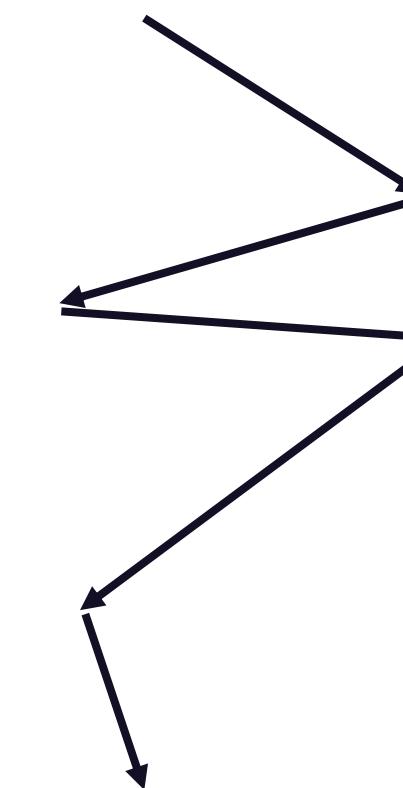
Until acceptable accuracy



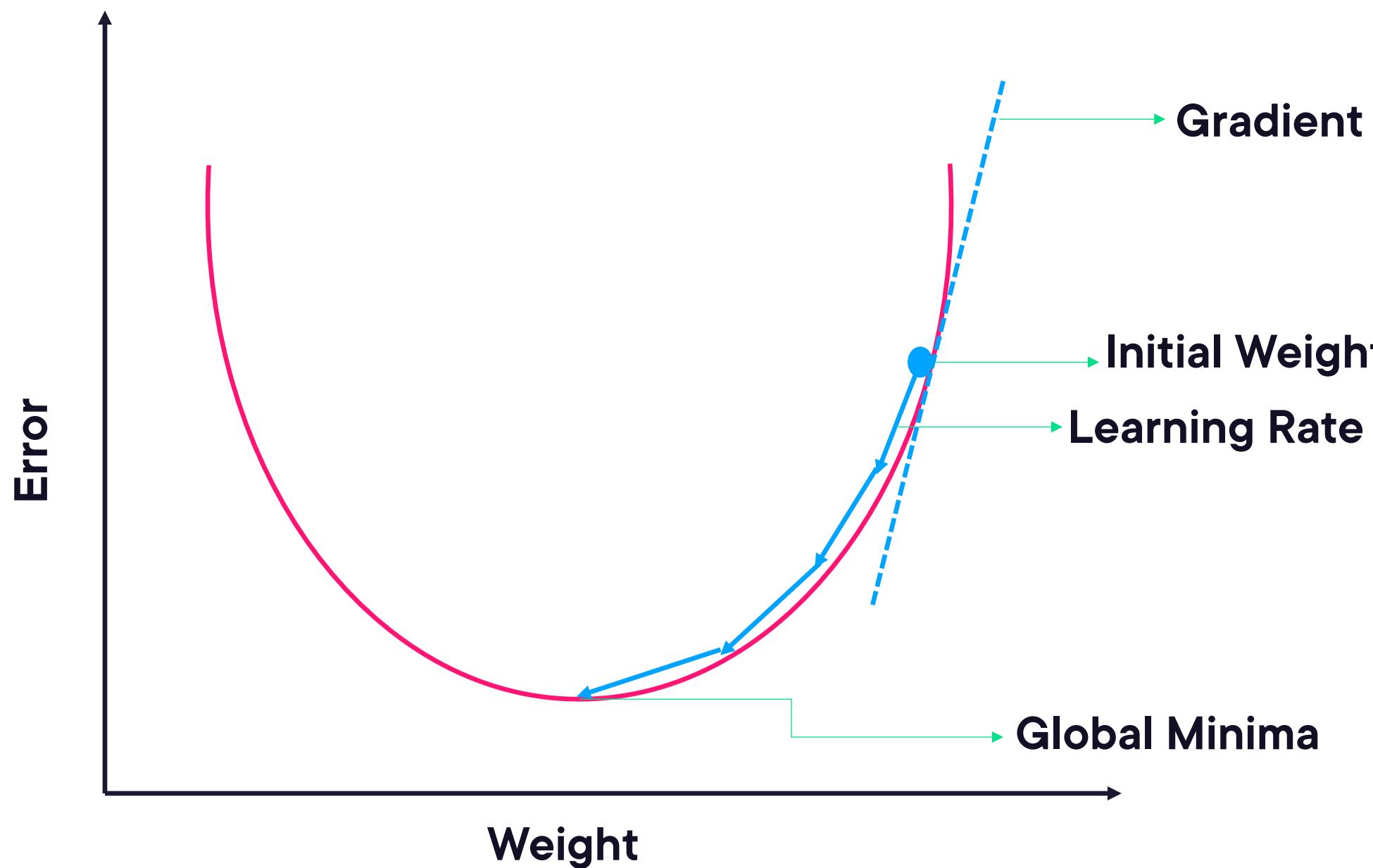
# Gradient Descent



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**Demo**



**Virtual neural network simulator**

