



Fuzzy Logic & Neural Networks (CS-514)

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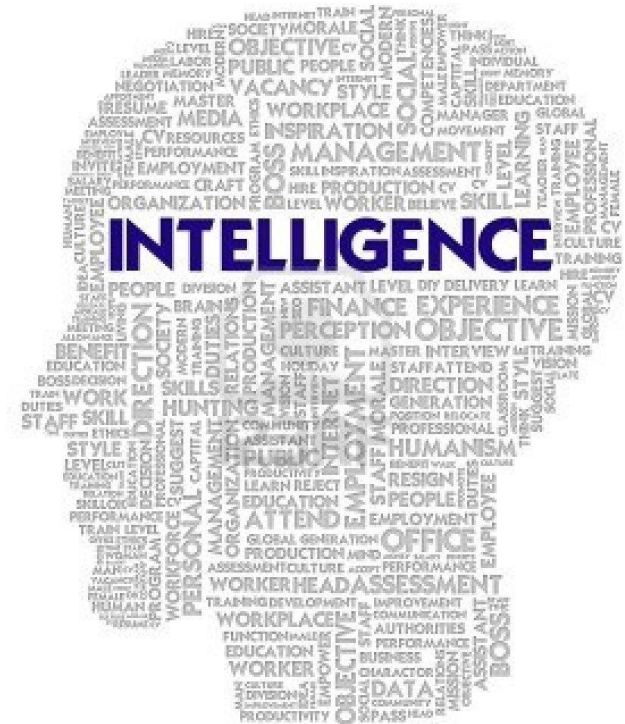
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Introduction

What is Intelligence?

The Ability to:

- Learn,
- Understand,
- Reason,
- Plan,
- Solve Problems, and
- Adapt to New Situations.



Introduction

What is Artificial Intelligence?

An attempt to bring Intelligence into Machines through:

- Programming,
- Information Exchange and
- Interactions

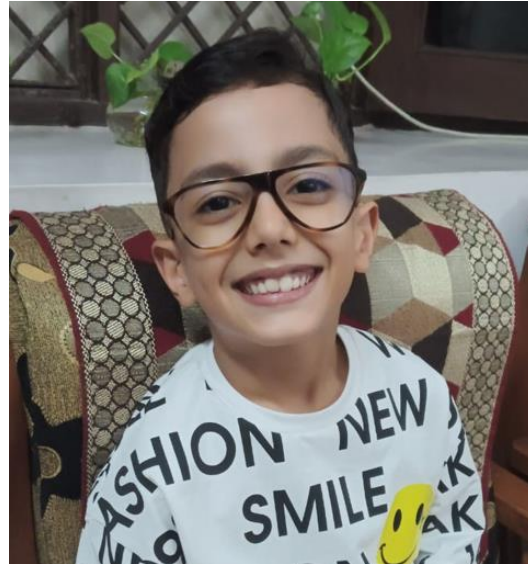


Introduction

Why Intelligence is difficult to implement artificially ?

“Because it is unexplainable”

Example:
Who is he?



Example:
Who is he?

Introduction

What is Learning?

“The ability to retain knowledge which is gained through experience”

Introduction

What is Machine Learning?

“A type of AI that enables self learning through data and interactions without human intervention”

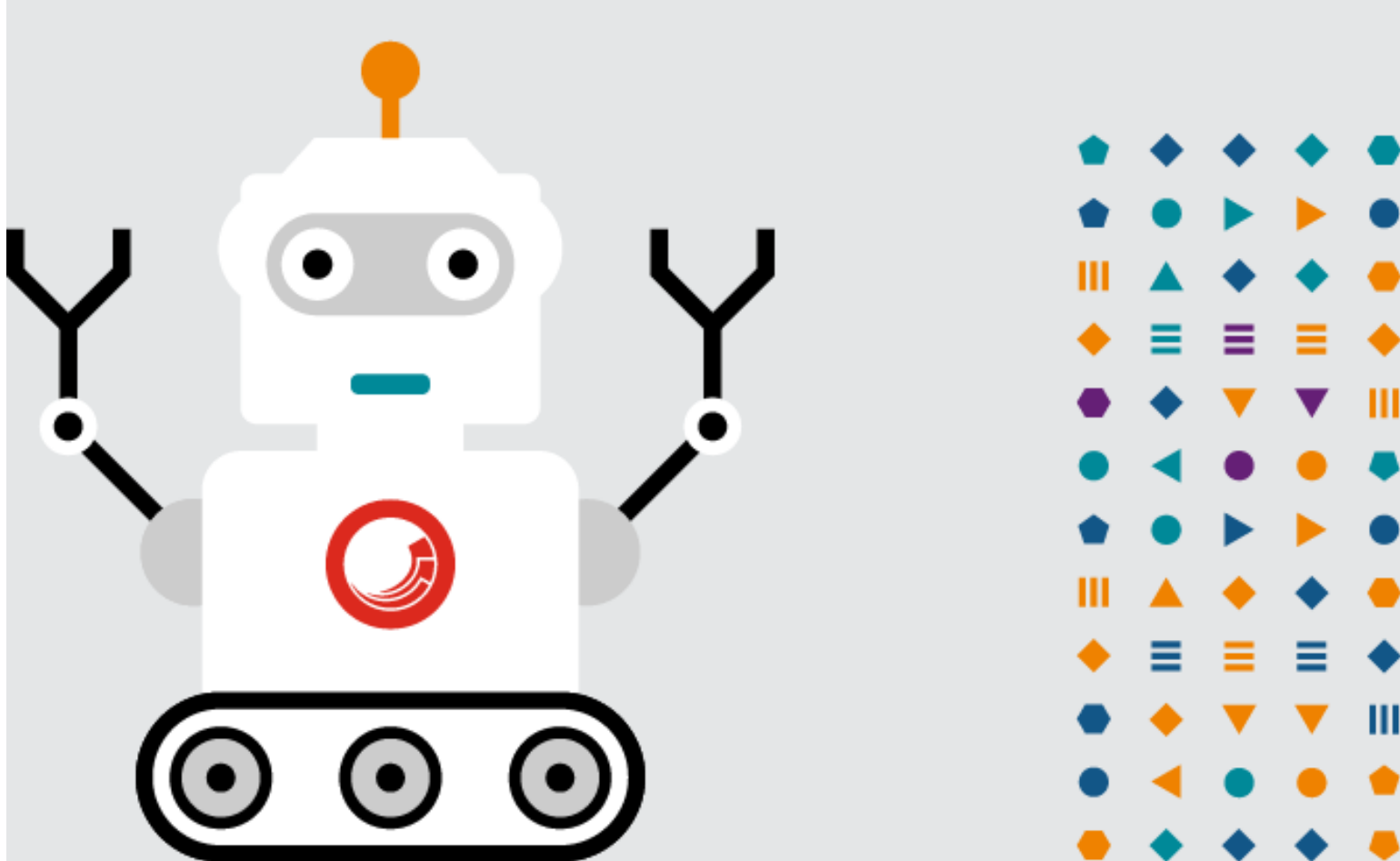
Introduction

Types of Machine Learning

- **Supervised (inductive) Learning**
 - Training data includes desired outputs
- **Unsupervised Learning**
 - Training data does not include desired outputs
- **Semi-supervised Learning**
 - Training data includes a few desired outputs
- **Reinforcement Learning**
 - Rewards from the sequence of actions

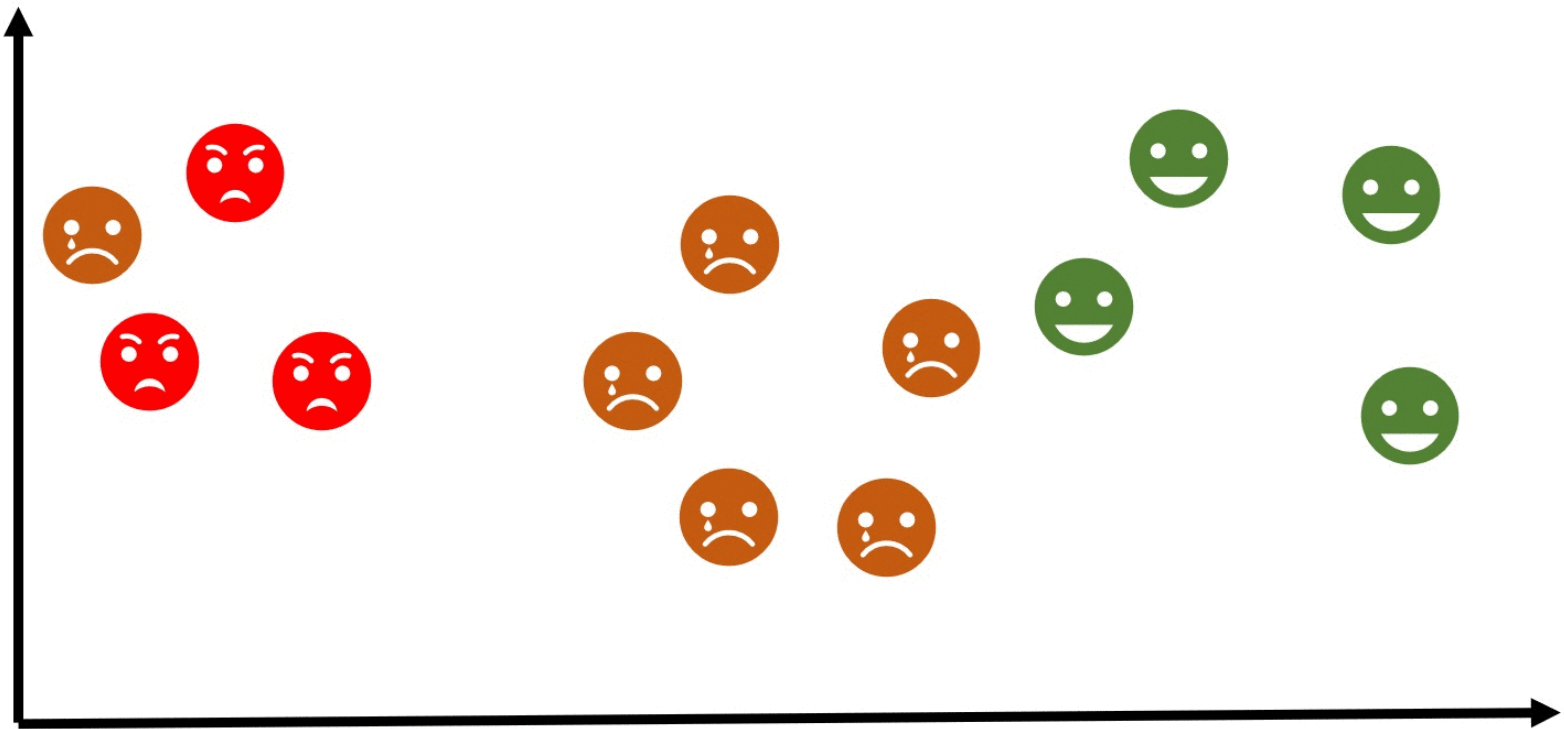
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Supervised Learning



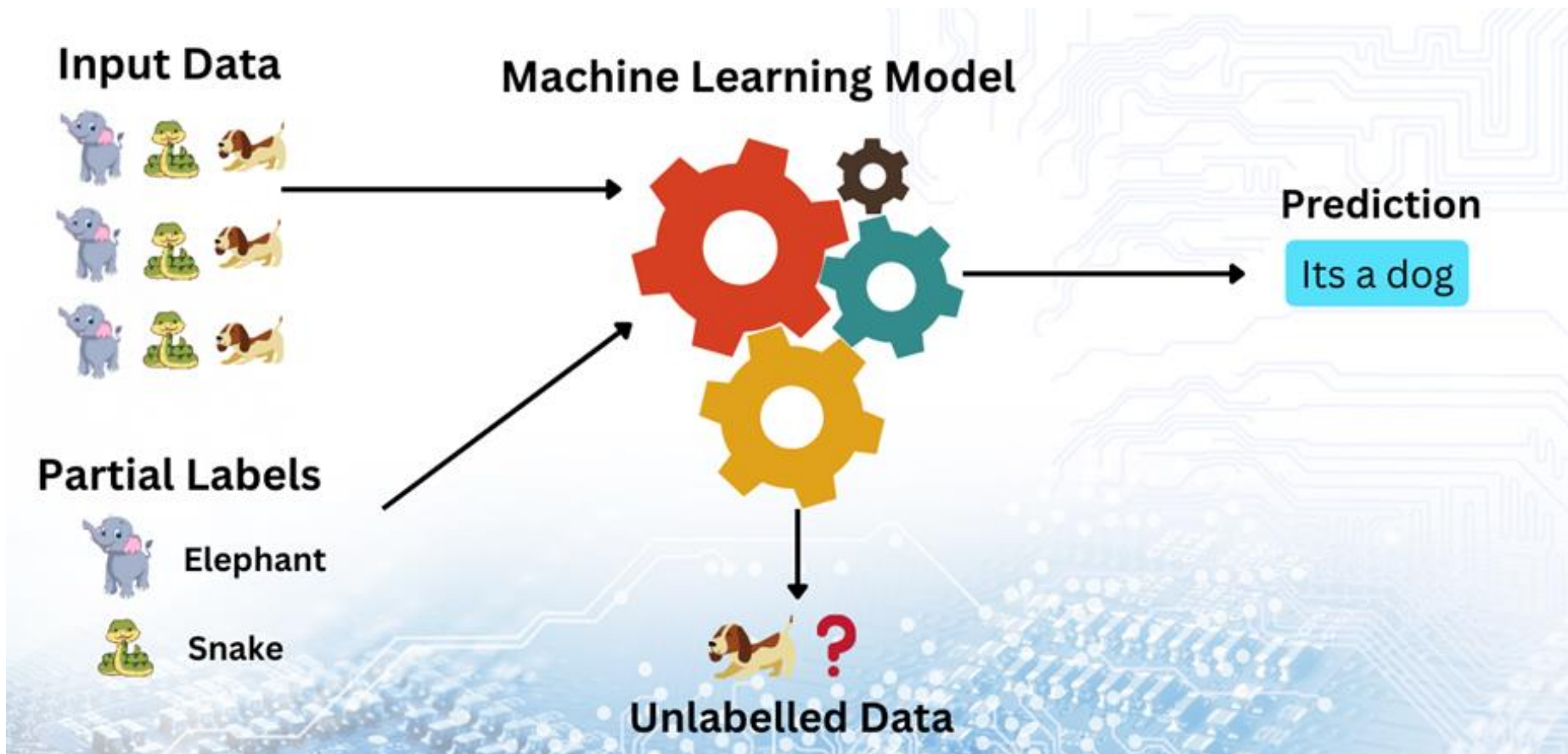
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Unsupervised Learning



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Semi-supervised Learning

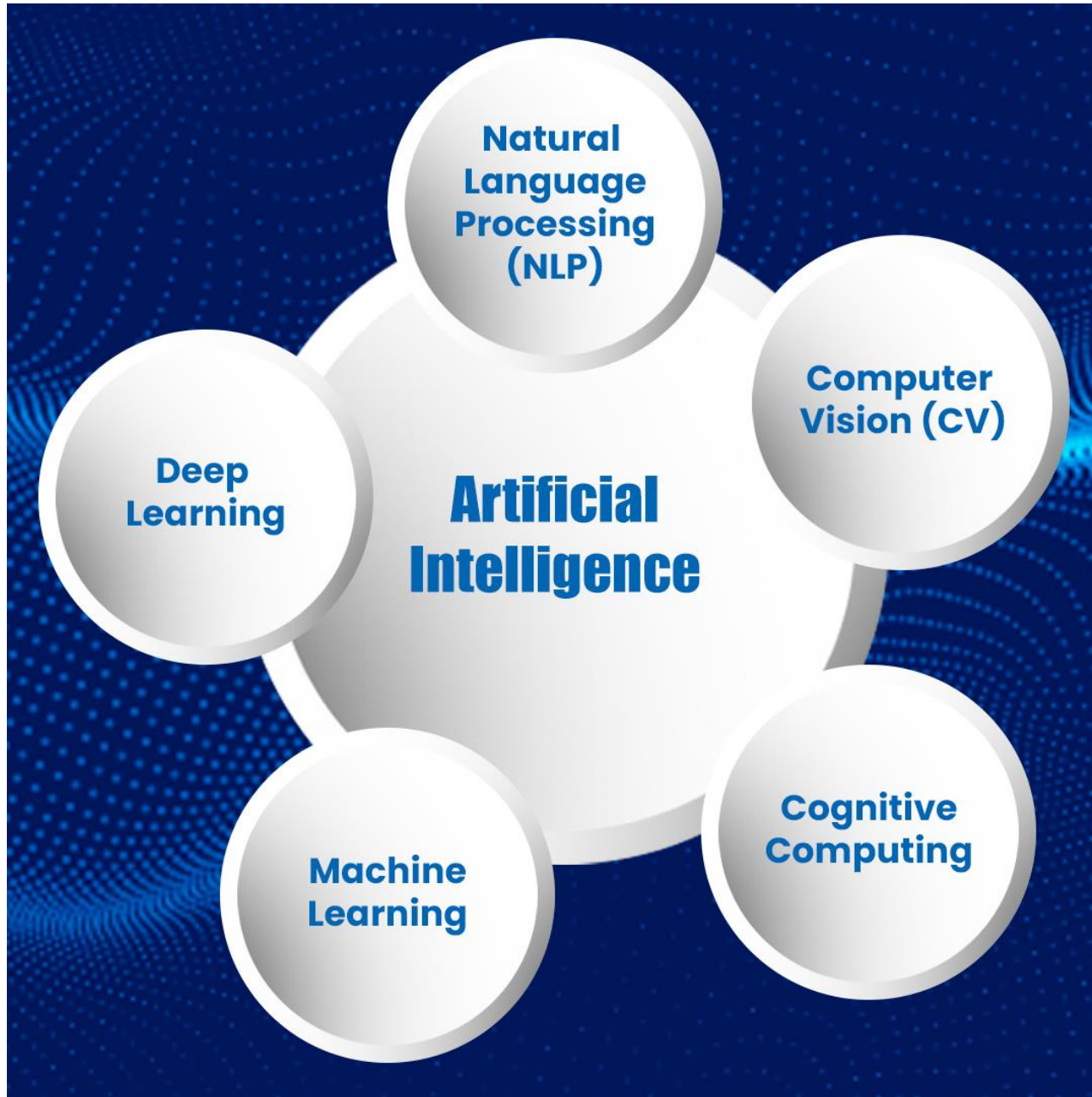


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Reinforcement Learning



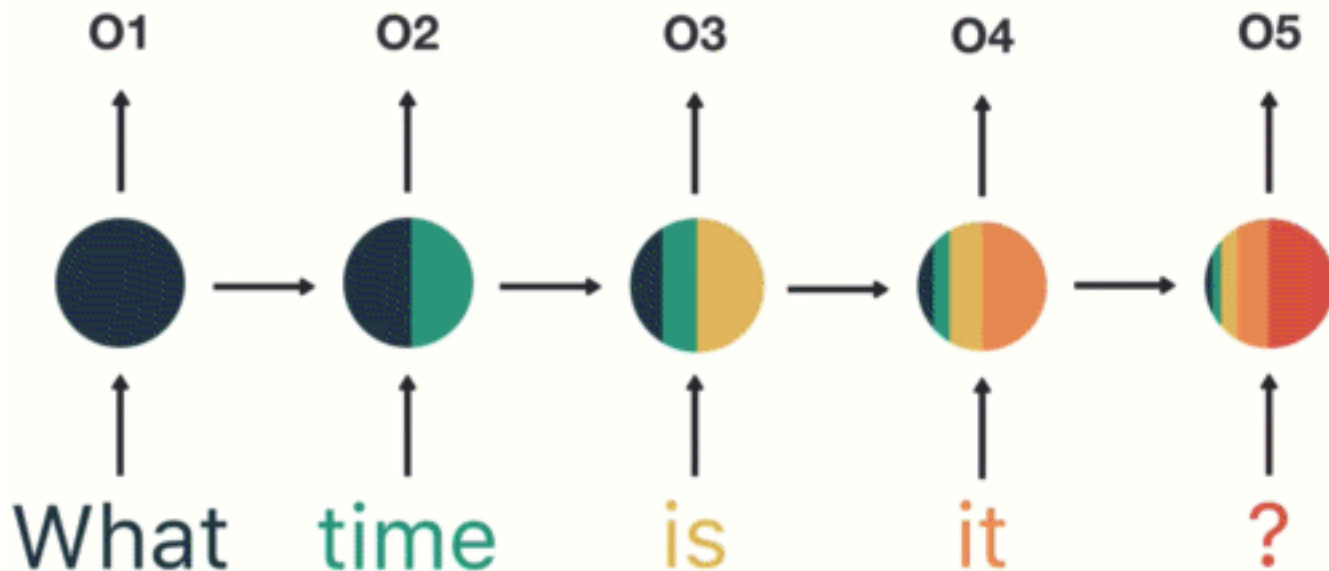
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Introduction

AI Techniques: NLP

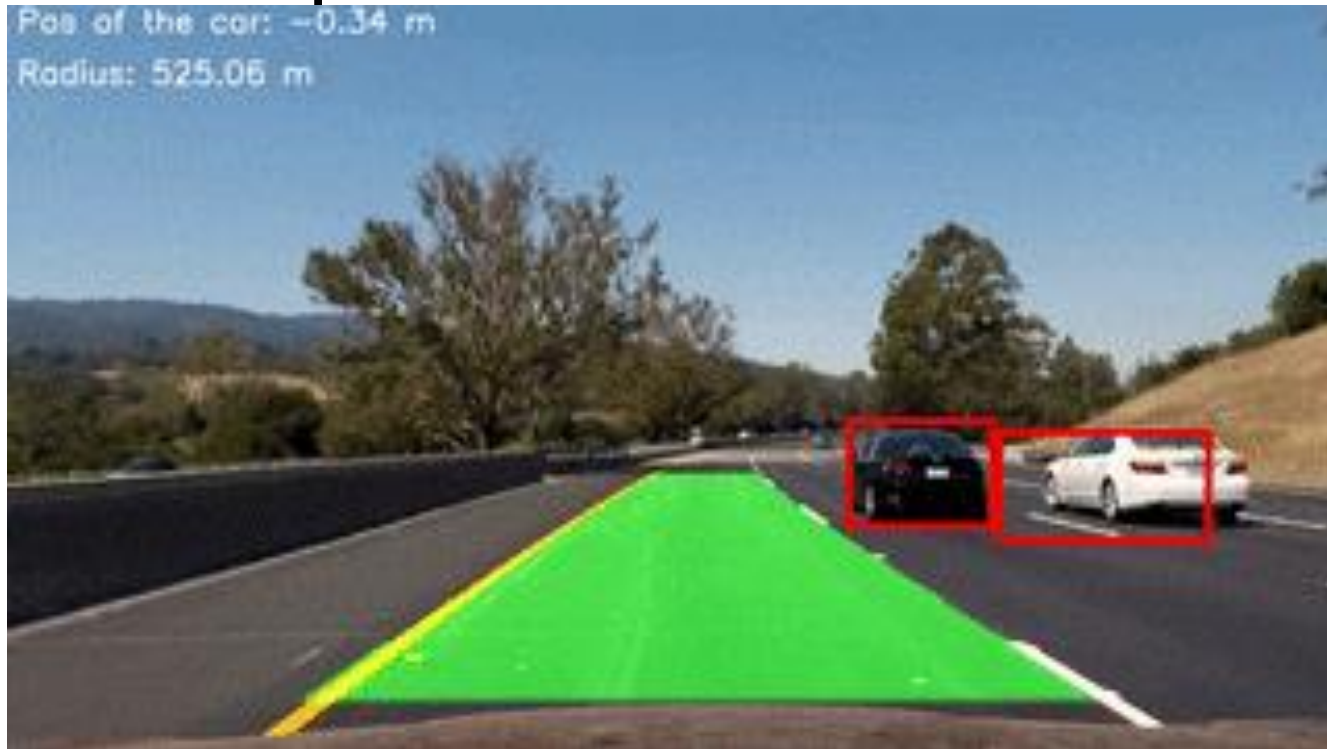
“NLP is the type of artificial intelligence which analyze text and speech in a way that's similar to how humans do”



Introduction

AI Techniques: Computer Vision

“Computer vision is a field of AI that teaches computers to understand and interpret visual information”



Introduction

AI Techniques: Cognitive Computing

“Cognitive computing is a type of AI that uses machines to simulate human thought processes”

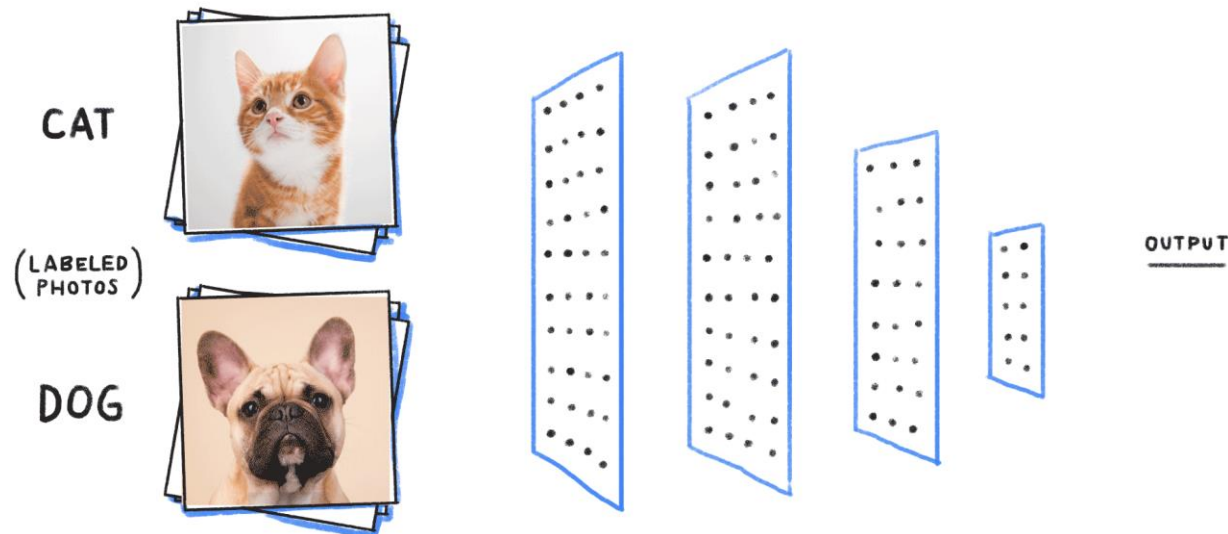


The horse charges
the man wearing a hat.

Introduction

AI Techniques: Deep Learning

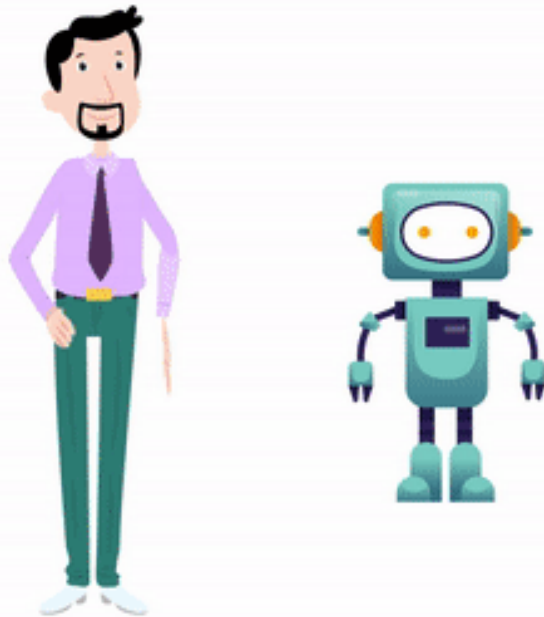
“Deep learning is a type of AI that uses artificial neural networks to teach computers how to process data in a way that resembles the human brain”



Introduction

AI Techniques: Machine Learning

“A type of AI that enables self learning through data and interactions without human intervention”



Introduction

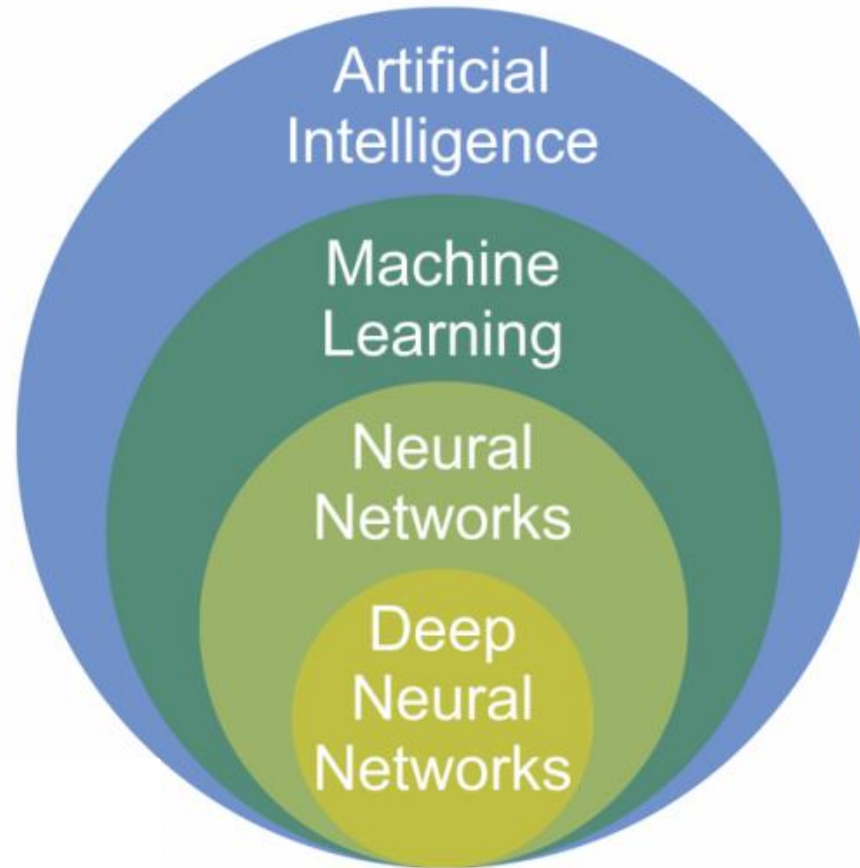


Fig: Neural Network as a subfield of Artificial Intelligence

Introduction

Brief Evolution of Neural Networks:

- Neural Network was introduced in the 1940s.
- How to train it remained a mystery for 20 years.
- The concept of backpropagation came in the 1960s.
- Neural Networks got attention somewhere around 2010.
- Neural Networks have used for image captioning, language translation, audio and video synthesis, and more.
- In addition, more challenging problems like self-driving cars, calculating risk, detecting fraud, and early cancer detections etc. became feasible.

Introduction

Biological Neuron

The most basic information-processing unit in the human brain.

Neuron

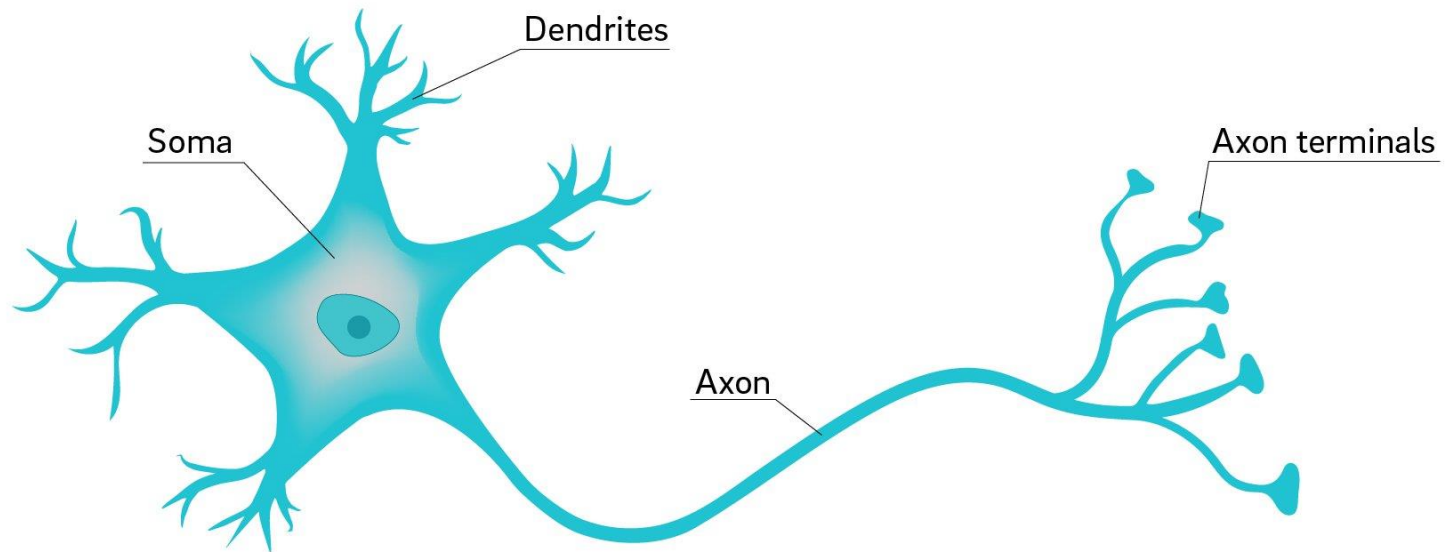


Fig: A biological neuron.

Introduction

What is Artificial Neuron?

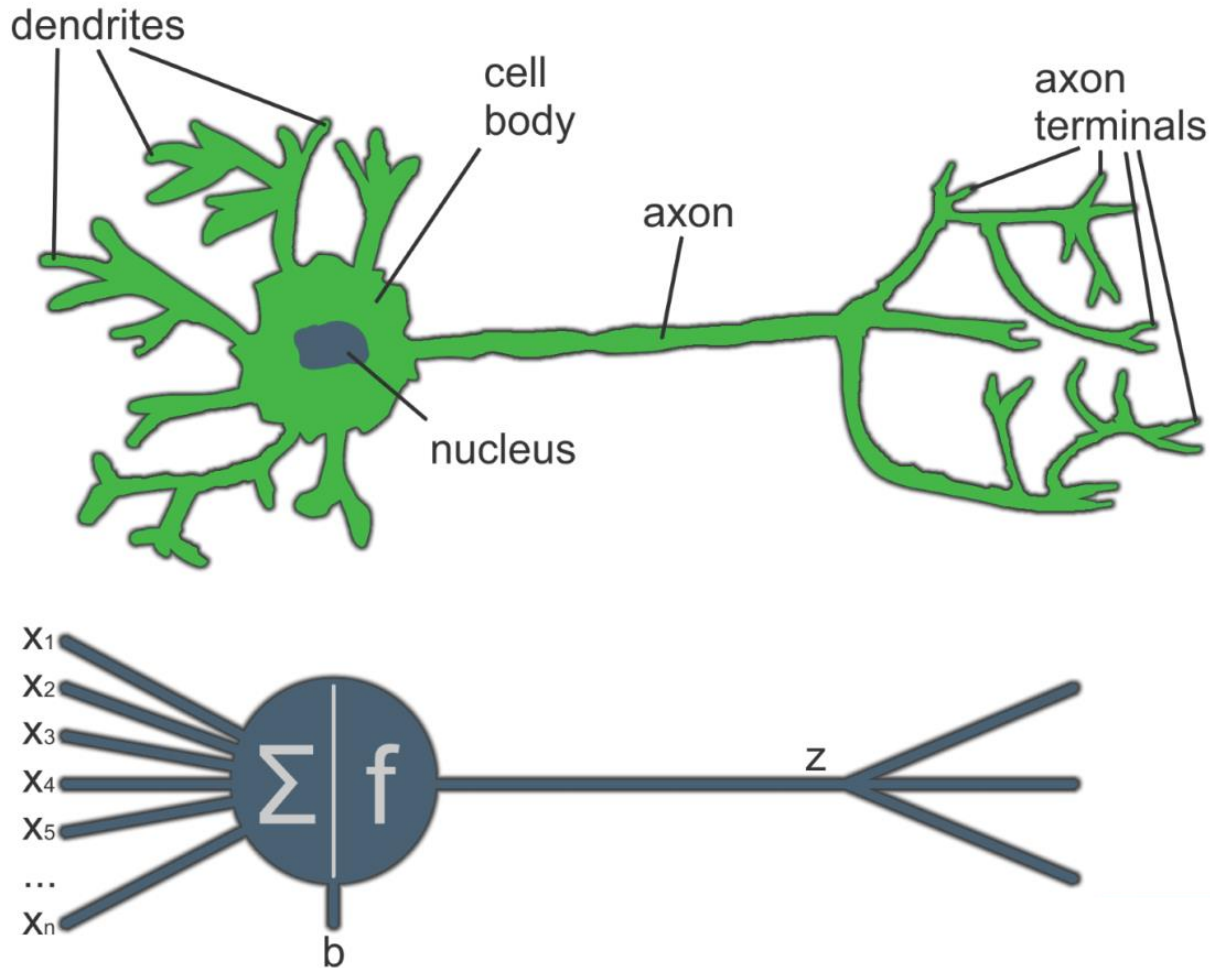


Fig: Comparing a biological neuron to an artificial neuron.

Introduction

Neural Network

A Neural Network is a parallel distributed system made up of simple processing units, known as neurons, which has a natural tendency of storing experiential knowledge and making it available for use.

It resembles the brain in two respects:

1. Knowledge is acquired through the learning process.
2. Inter-neuron connection weights, are used to store the acquired knowledge.

Introduction

Example Neural Networks

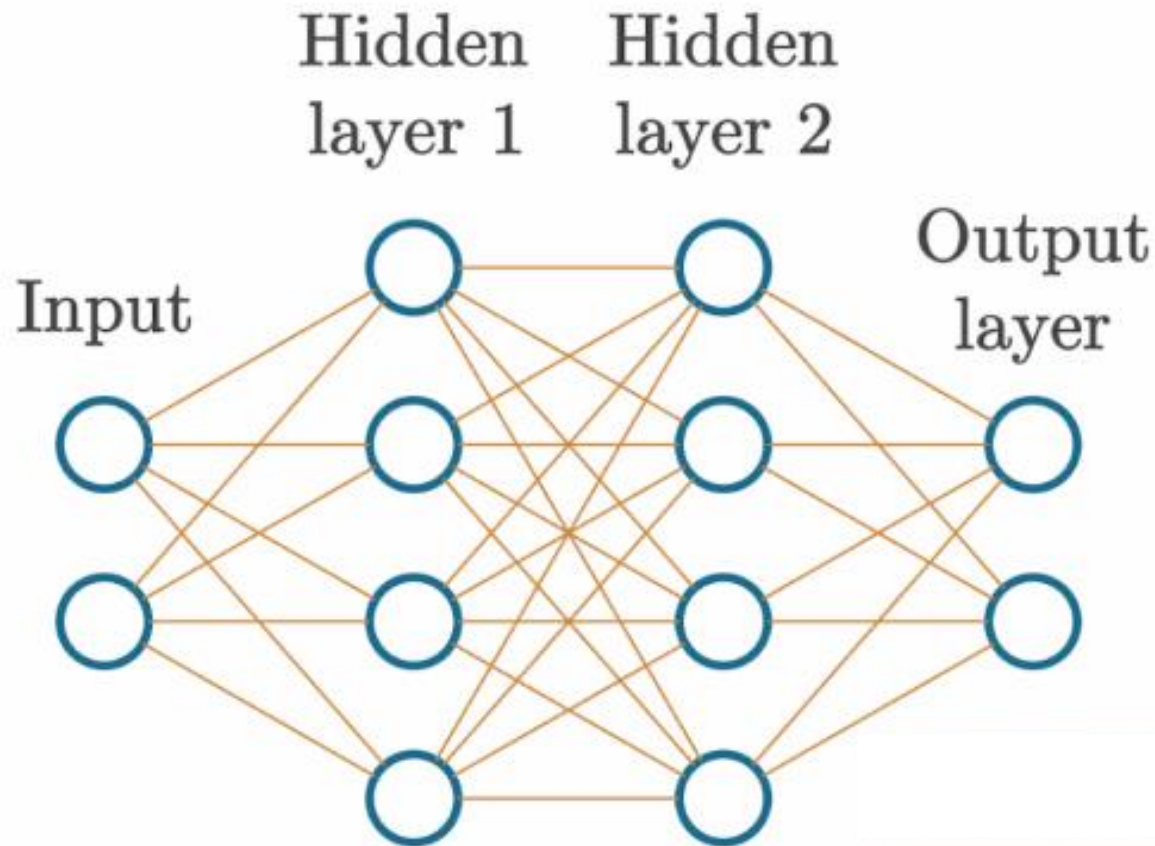


Fig : Example basic neural network.

Introduction

Example Neural Networks

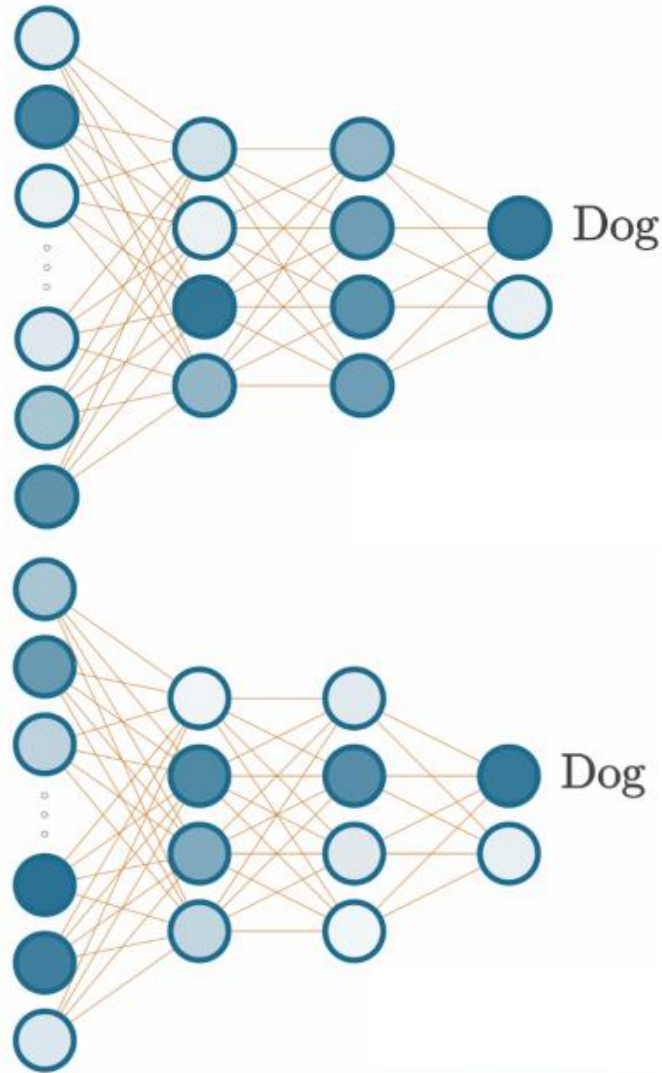


Fig : Visual depiction of passing image data through a neural network, getting a classification
Source: Google Images

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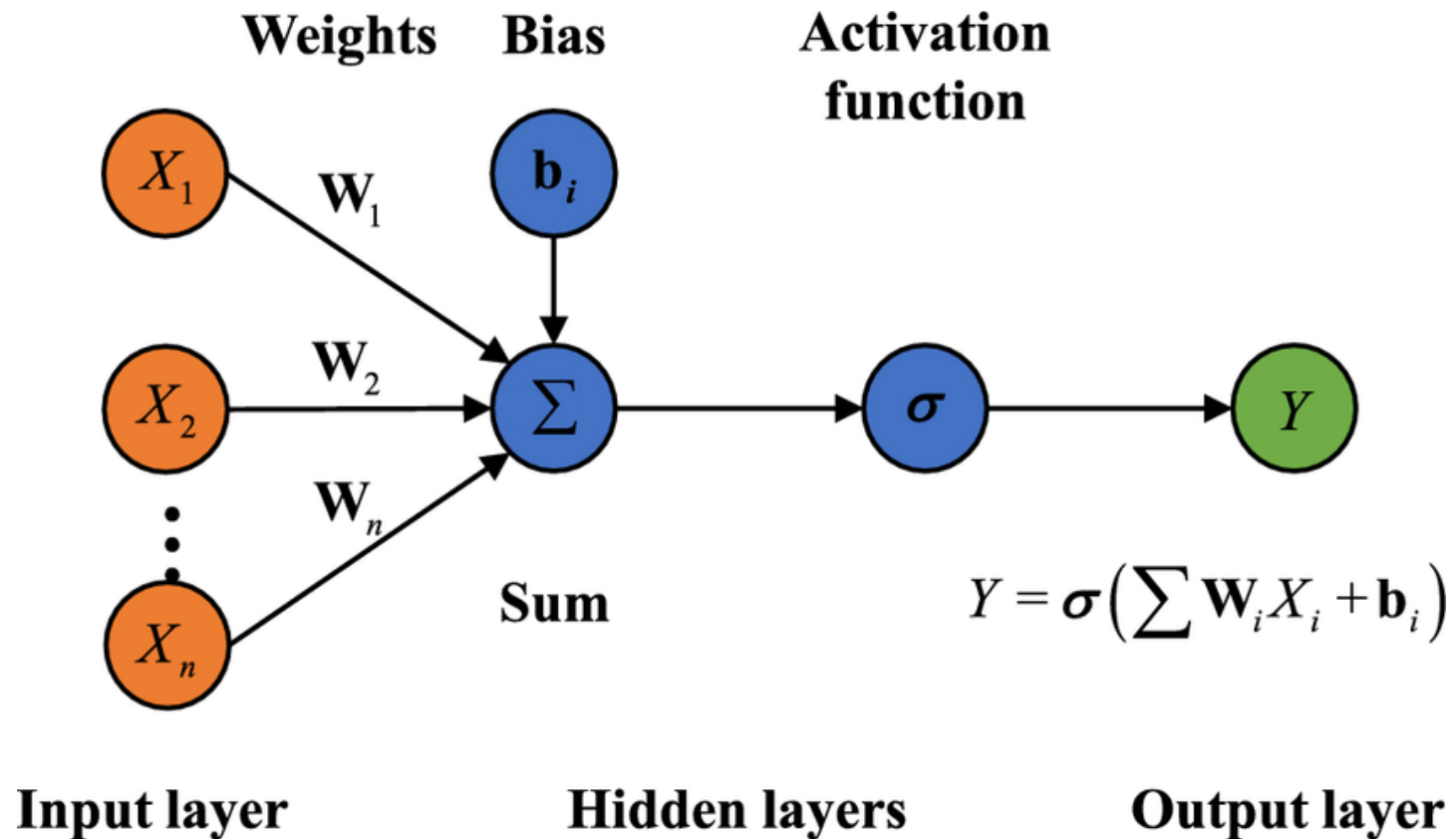
Example Neural Networks

<https://nnfs.io>

<https://www.youtube.com/watch?v=fXSRfzhHPm0>

Artificial Neuron Model

Model of an artificial neuron



Artificial Neuron Model

Simplest model of an artificial neuron

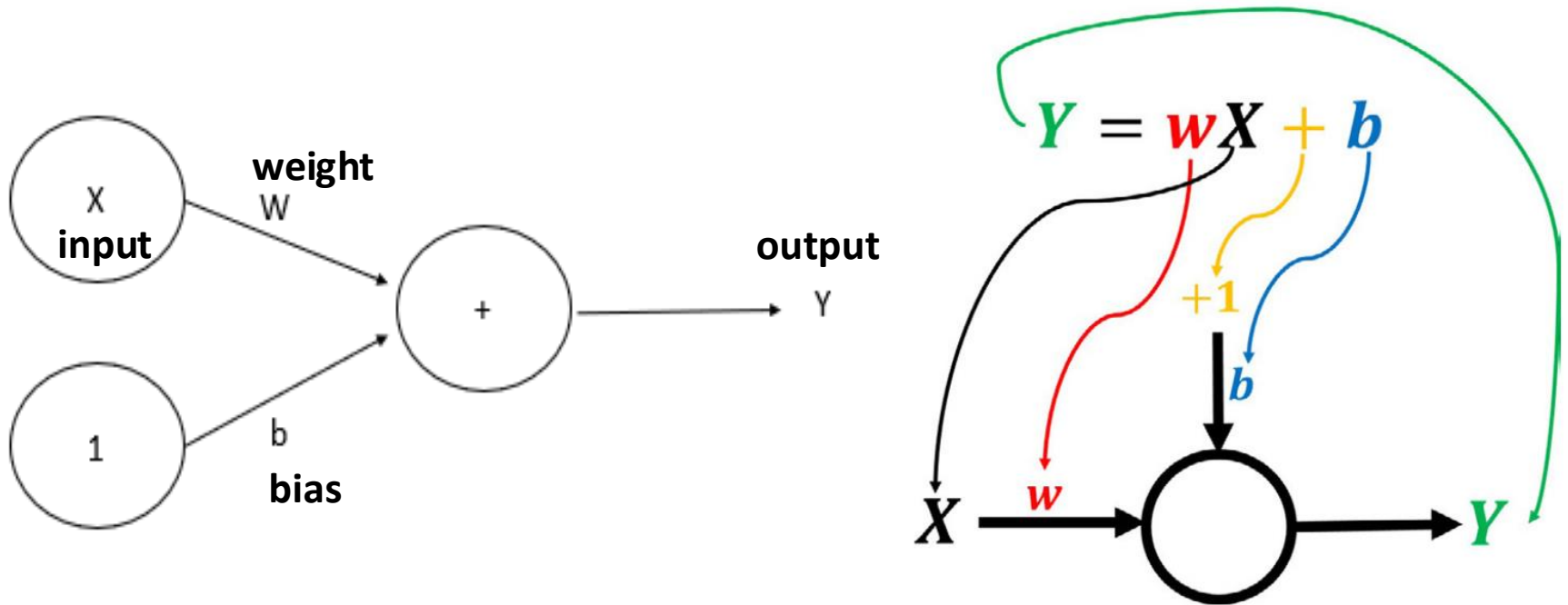


Fig. Graphical representation of a neuron with single input

$$Y = W.X + b$$

$$y = m.x + c$$

Artificial Neuron Model

Simple model of an artificial neuron

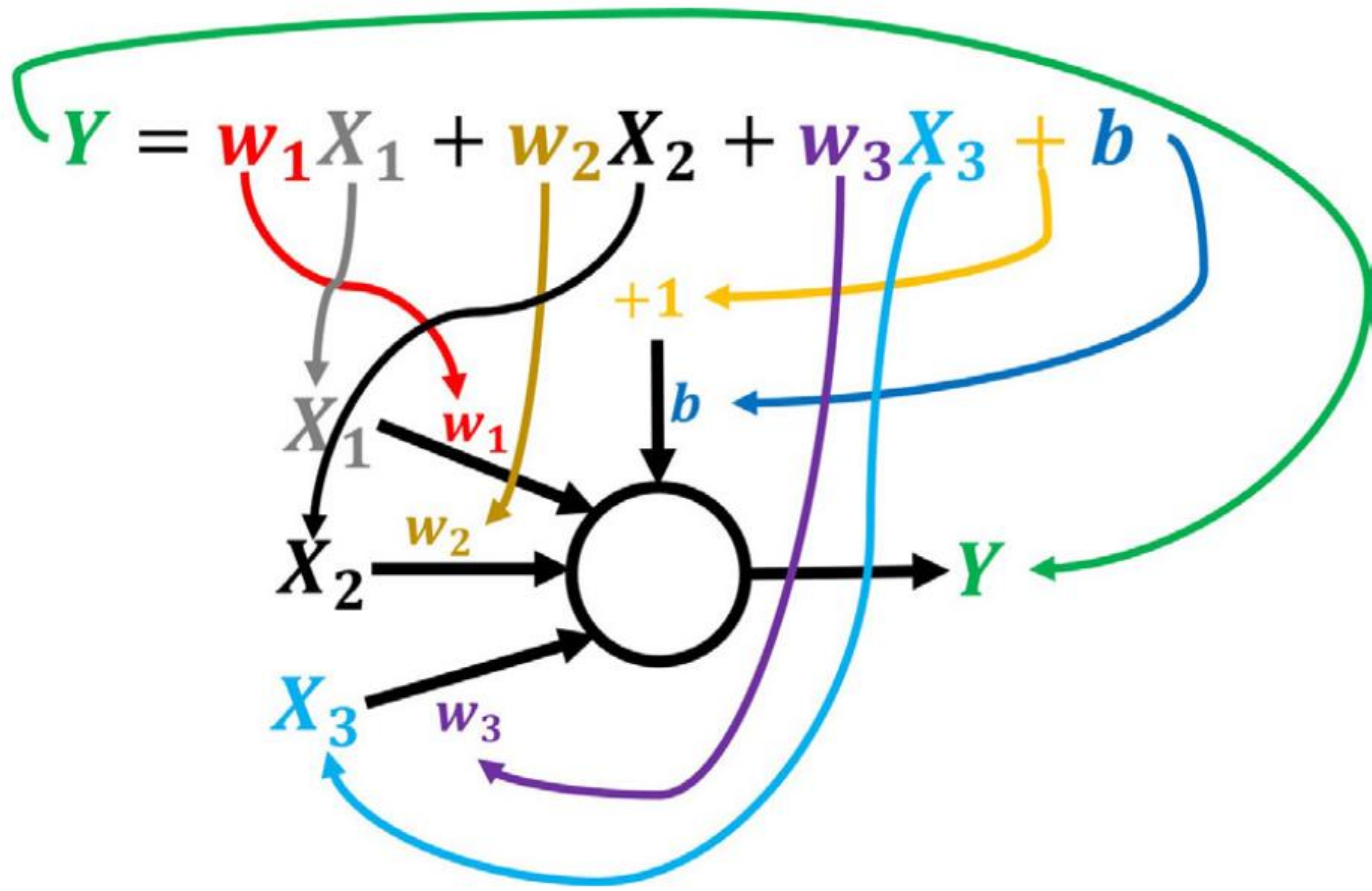


Fig. Graphical representation of a neuron with multiple inputs

Artificial Neuron Model

Simple model of an artificial neuron

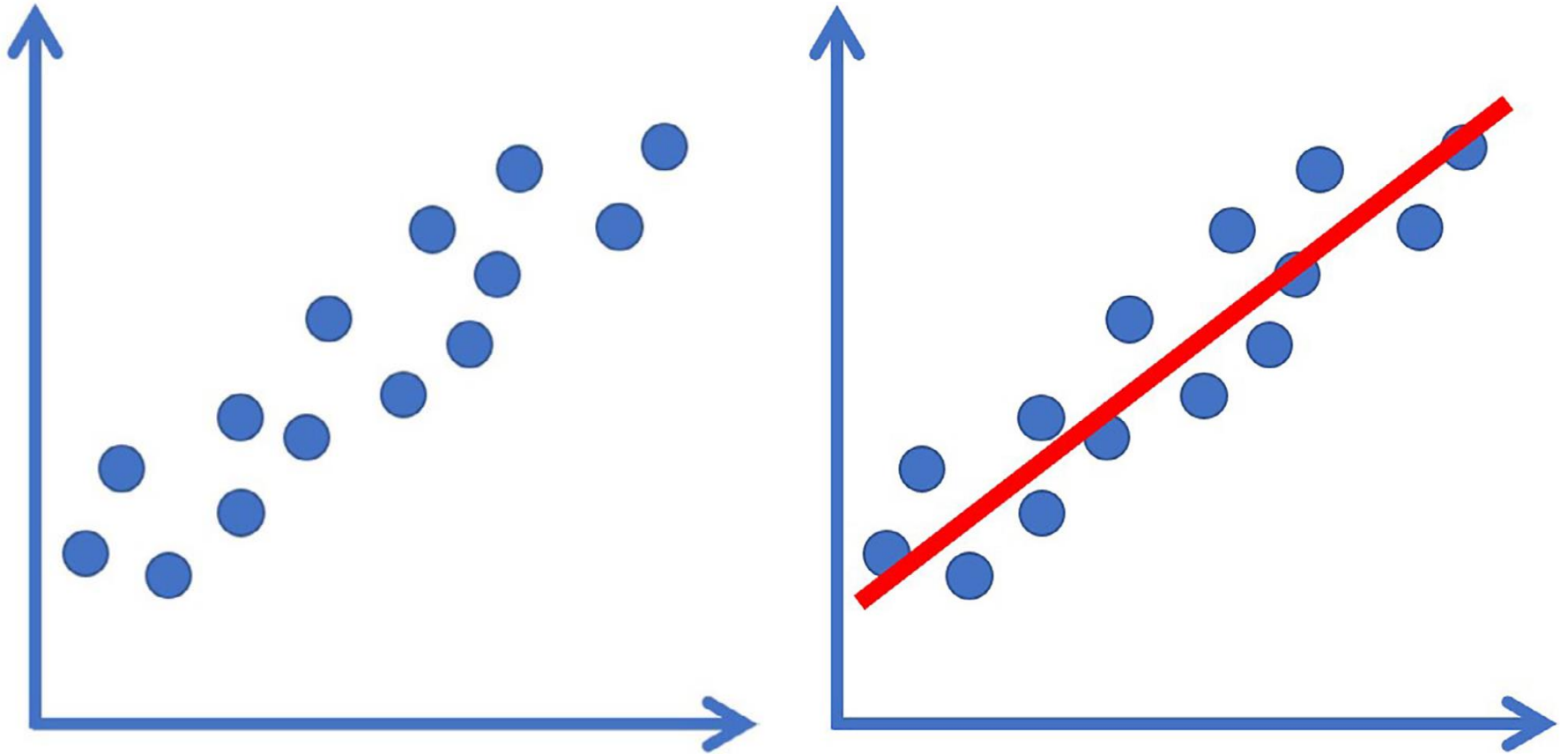


Fig. Fitting a Linear Model

Artificial Neuron Model

Model of an Artificial Neural Network

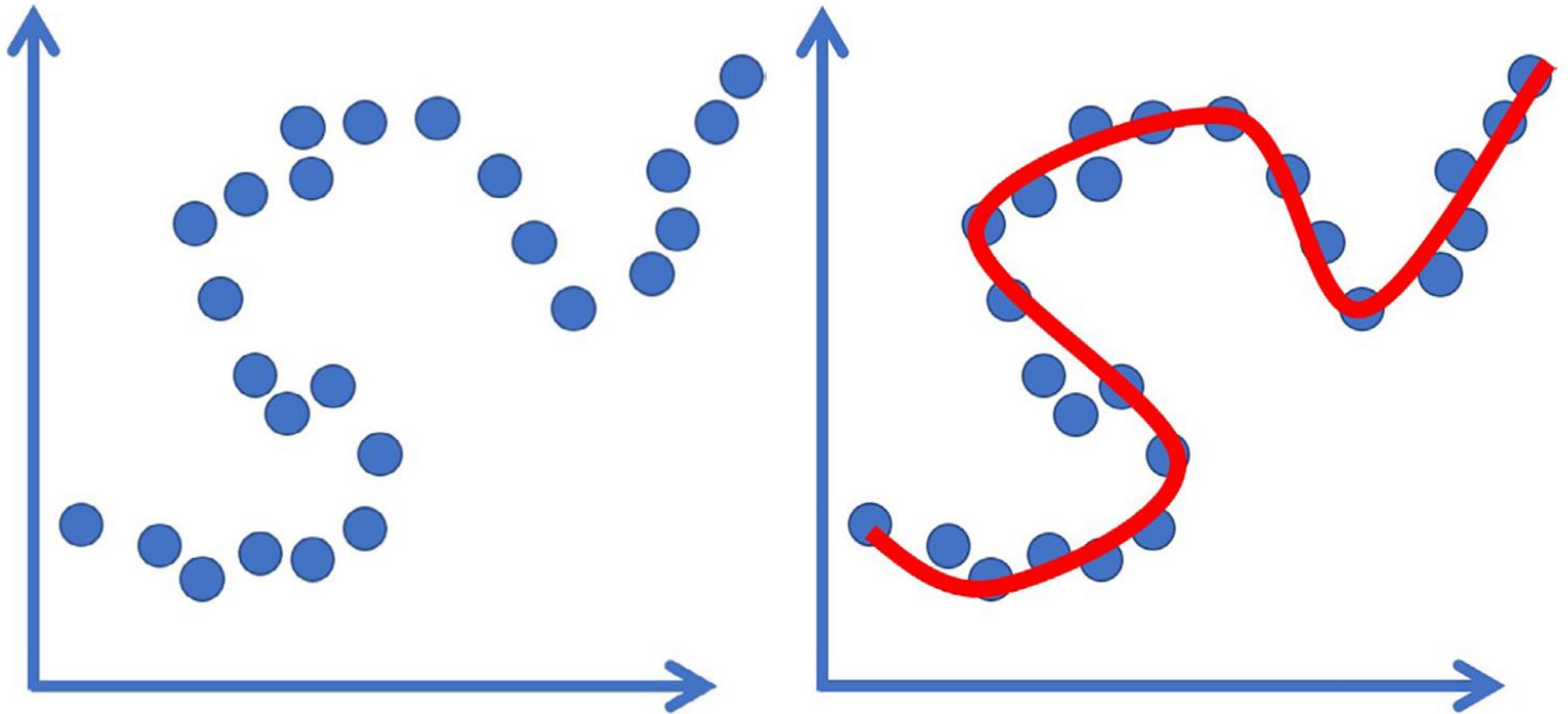


Fig. Fitting a Non-Linear Model

Artificial Neuron Model

Simplest model of an artificial neuron

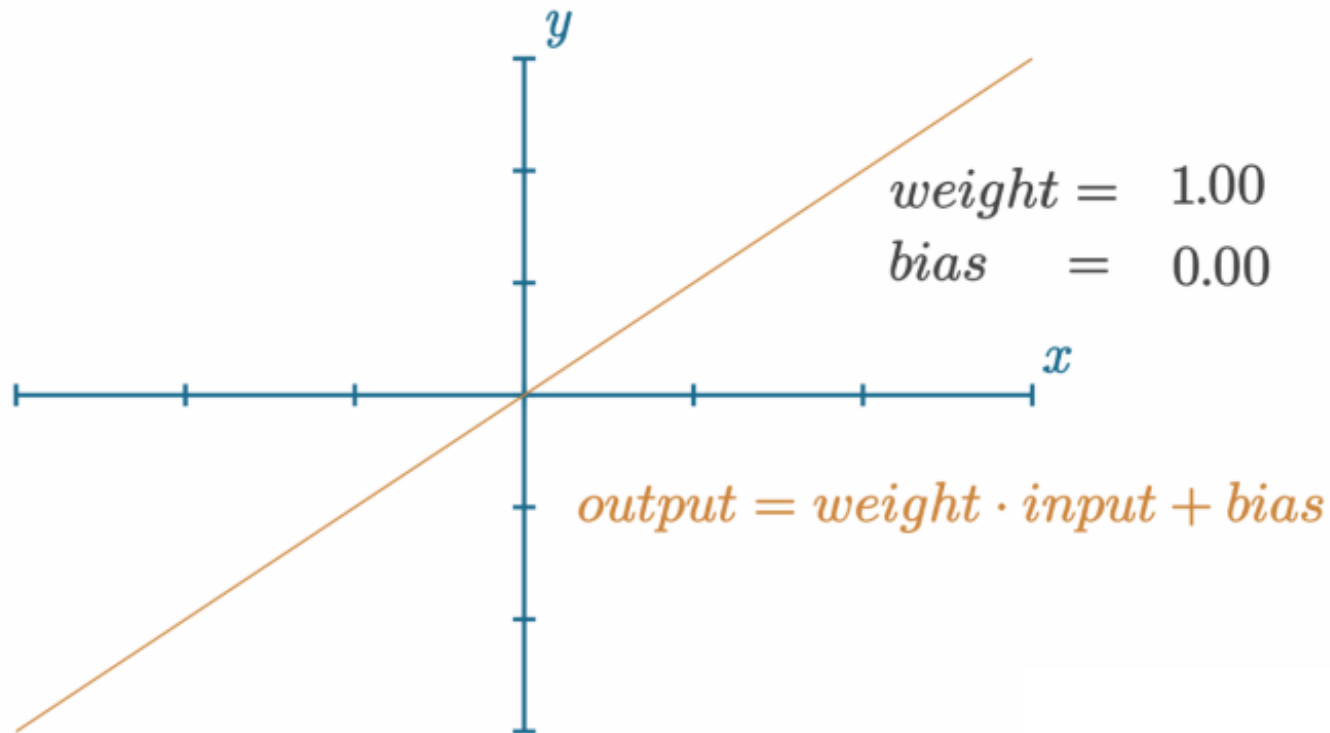


Fig: Graph of a single-input neuron's output with a weight of 1, bias of 0 and input x

Artificial Neuron Model

Simplest model of an artificial neuron

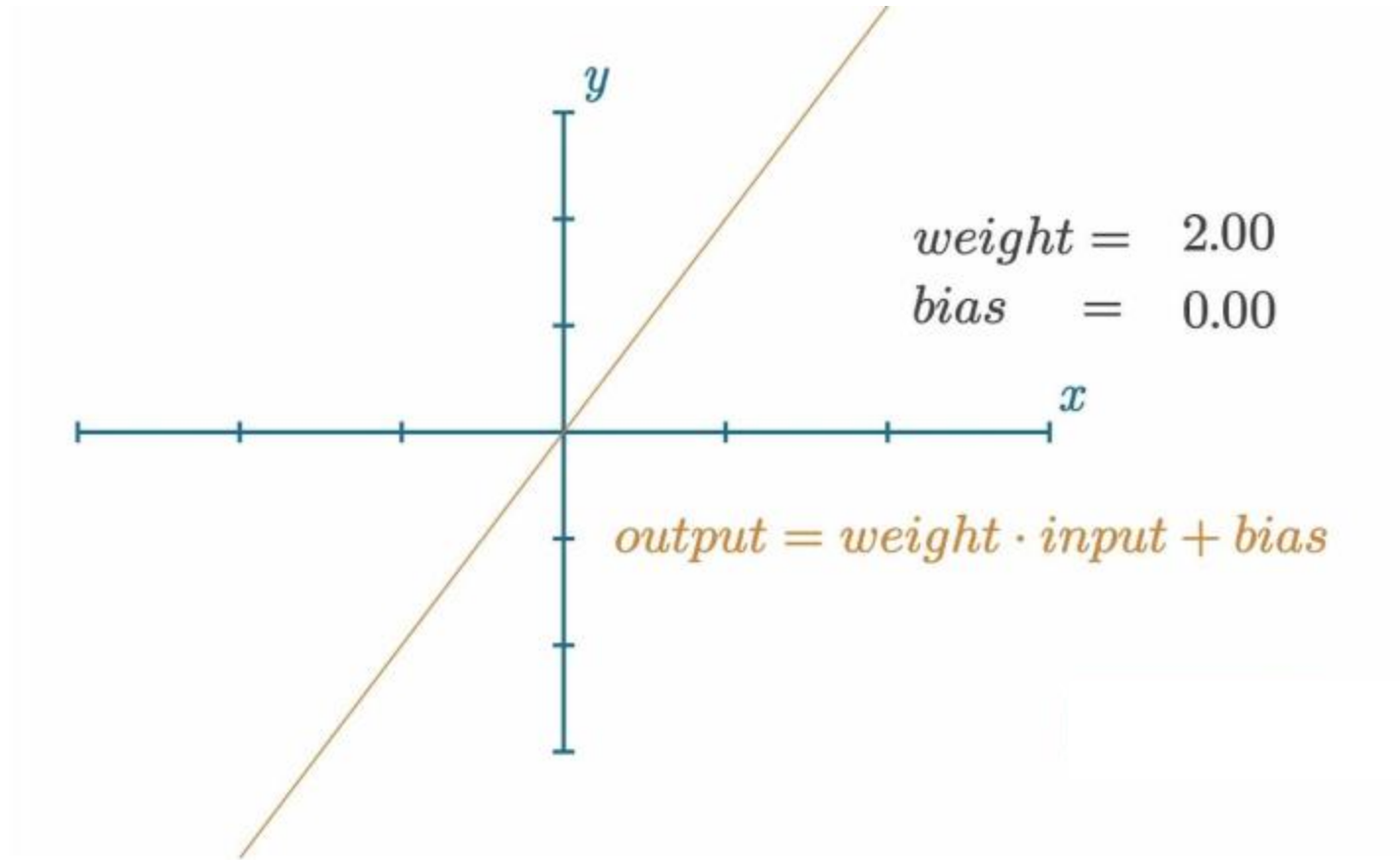


Fig: Graph of a single-input neuron's output with a given weight, bias and input x

Artificial Neuron Model

Simplest model of an artificial neuron

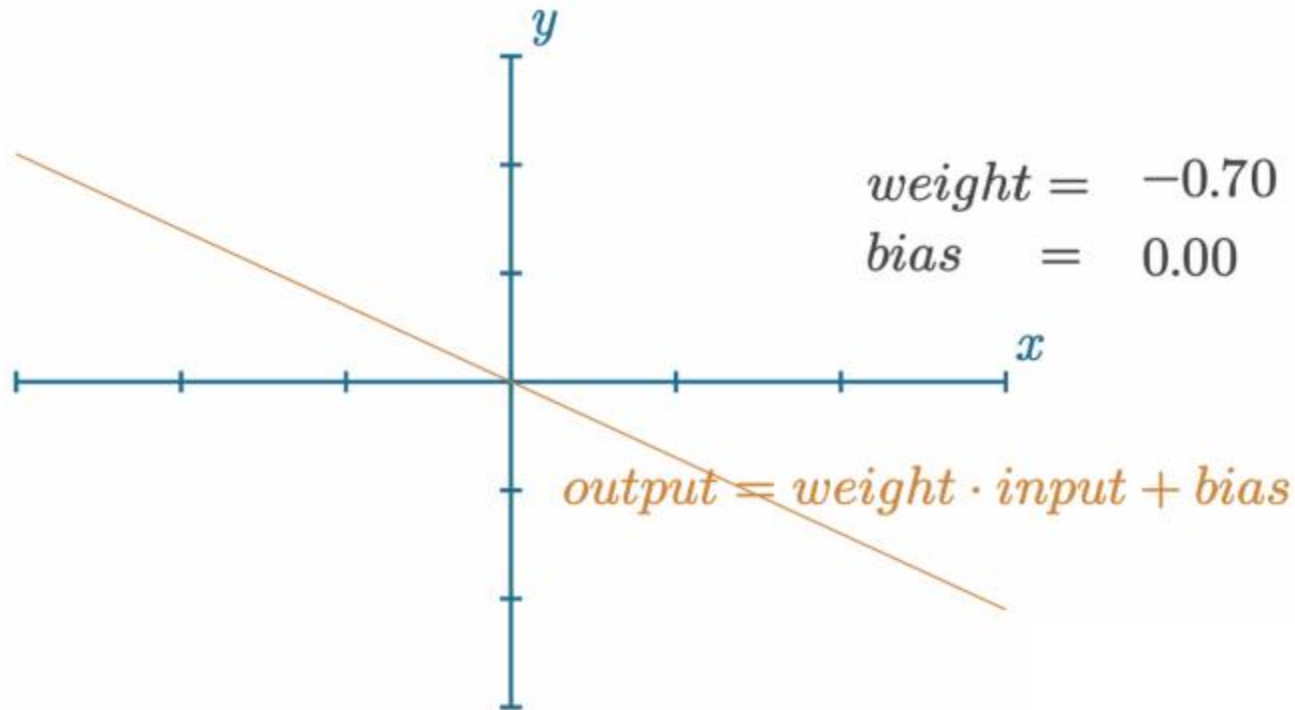


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Artificial Neuron Model

Simplest model of an artificial neuron

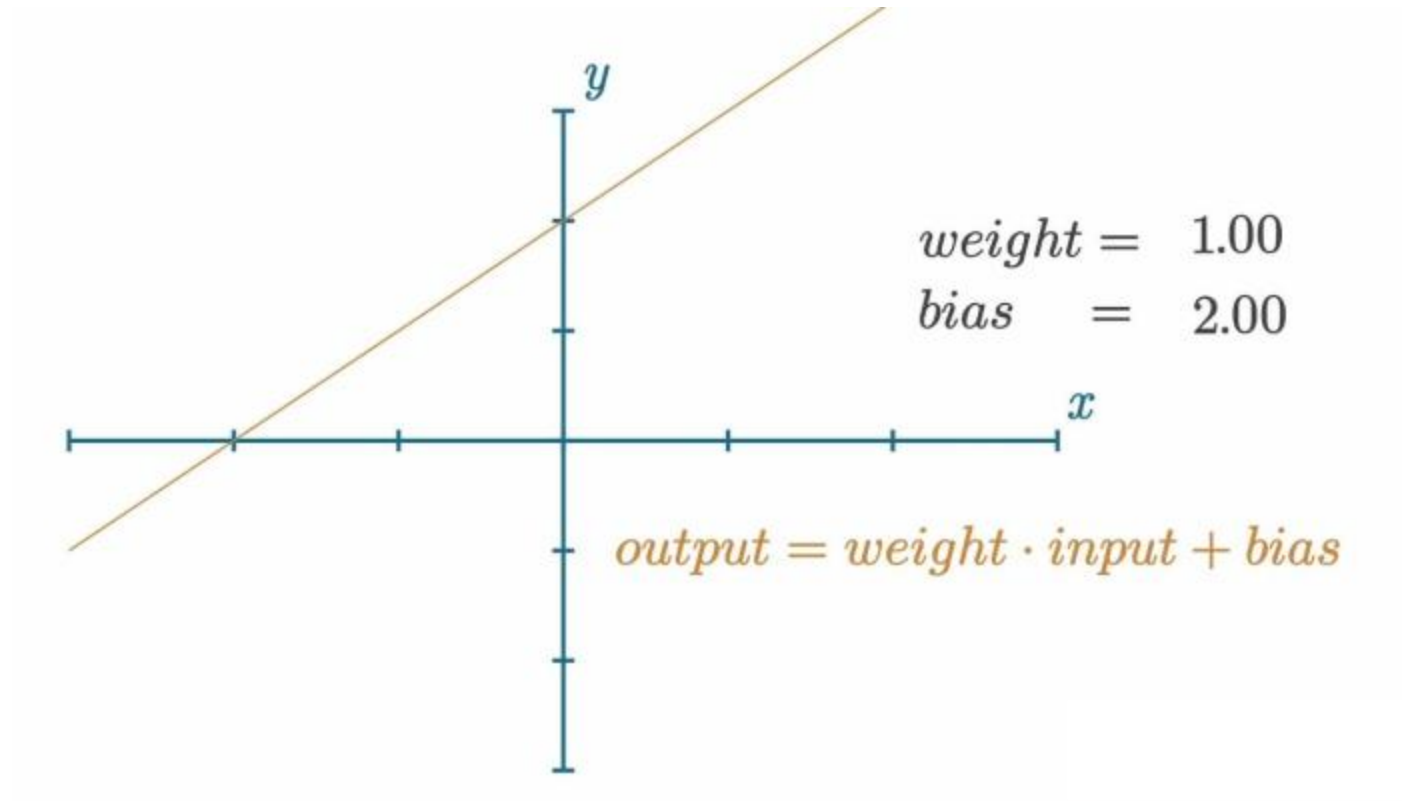


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Artificial Neuron Model

Simplest model of an artificial neuron

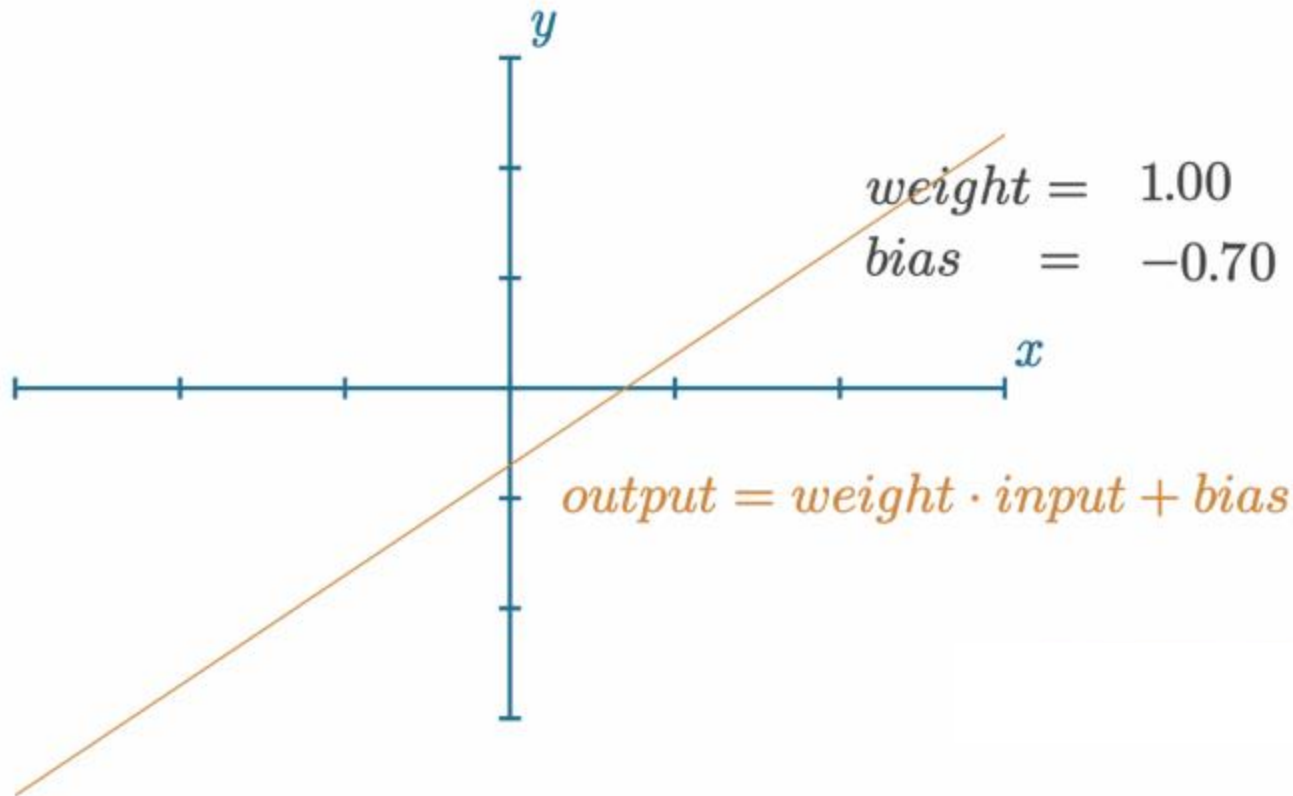


Fig: Graph of a single-input neuron's output with a given weight, bias and input x