Topic - 04
Introduction to Deep Learning
Part: 01

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Introduction

Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans: learn by example. Deep learning is a key technology behind driverless cars, enabling them to recognize a stop sign, or to distinguish a pedestrian from a lamppost. It is the key to voice control in consumer devices like phones, tablets, TVs, and hands-free speakers. Deep learning is getting lots of attention lately and for good reason. It’s achieving results that were not possible before.

In deep learning, a computer model learns to perform classification tasks directly from images, text, or sound. Deep learning models can achieve state-of-the-art accuracy, sometimes exceeding human-level performance. Models are trained by using a large set of labeled data and neural network architectures that contain many layers.

Why Deep Learning - How does it attain such impressive results?

In a word, accuracy. Deep learning achieves recognition accuracy at higher levels than ever before. This helps consumer electronics meet user expectations, and it is crucial for safety-critical applications like driverless cars. Recent advances in deep learning have improved to the point where deep learning outperforms humans in some tasks like classifying objects in images.

While deep learning was first theorized in the 1980s, there are two main reasons it has only recently become useful:

- Labelled Data
- Computing Power

Deep Learning Example

Deep learning applications are used in industries from automated driving to medical devices.

Automated Driving: Automotive researchers are using deep learning to automatically detect objects such as stop signs and traffic lights. In addition, deep learning is used to detect pedestrians, which helps decrease accidents.

Aerospace and Defense: Deep learning is used to identify objects from satellites that locate areas of interest, and identify safe or unsafe zones for troops.

Medical Research: Cancer researchers are using deep learning to automatically detect cancer cells. Teams at UCLA built an advanced microscope that yields a high-dimensional data set used to train a deep learning application to accurately identify cancer cells.

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Deep Learning Example – Cont.

Industrial Automation: Deep learning is helping to improve worker safety around heavy machinery by automatically detecting when people or objects are within an unsafe distance of machines.

Electronics: Deep learning is being used in automated hearing and speech translation. For example, home assistance devices that respond to your voice and know your preferences are powered by deep learning applications.

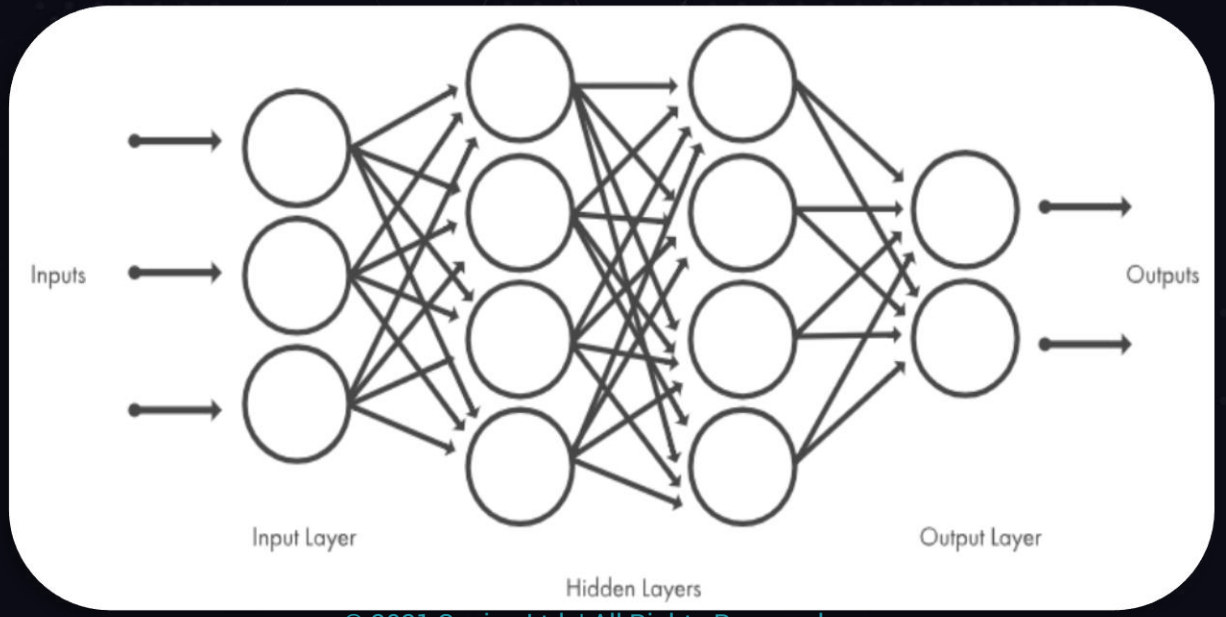
Forecasting: In order to do any kinds of Forecasting, Deep Learning is widely used in all around the world. For example – Stock Exchange Pricing, Forecasting Weather and others.

How Deep Learning Works

Most deep learning methods use neural network architectures, which is why deep learning models are often referred to as deep neural networks. The term “deep” usually refers to the number of hidden layers in the neural network.

Traditional neural networks only contain 2-3 hidden layers, while deep networks can have 150.

Deep learning models are trained by using large sets of labeled data and neural network architectures that learn features directly from the data without the need for manual feature extraction.



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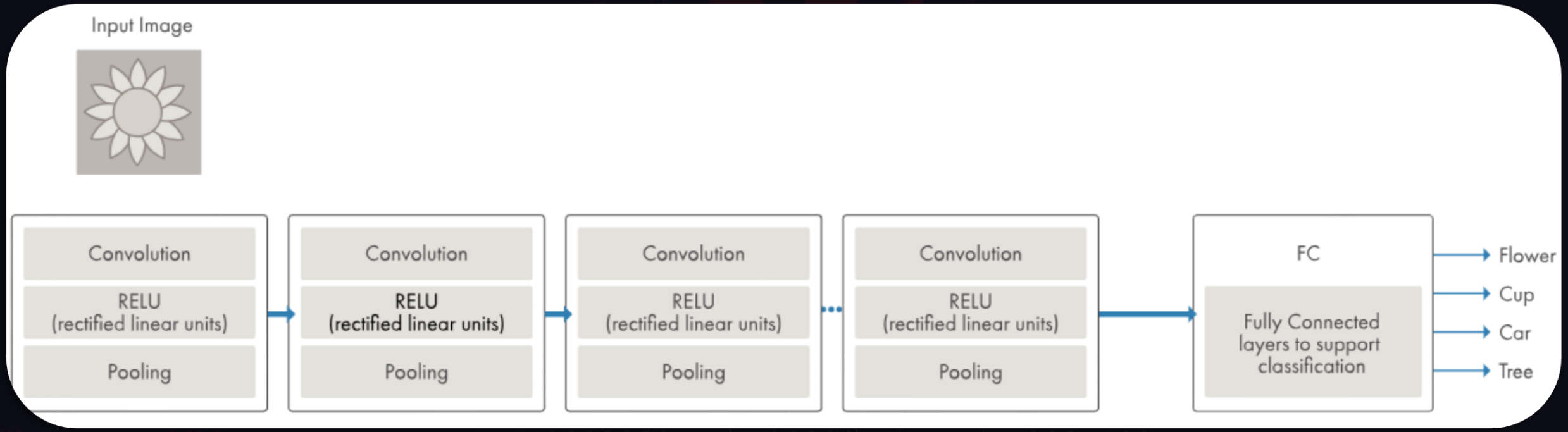
How Deep Learning Works - Image



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Don’t be Afraid if you Don’t Understand the First Time

Deep Learning is like a Black Box. On the first go, if you try to understand what is actually happening, there is a high chance that you may not understand it very well.

Specially what is happening inside of it. Think of it as a Genie of Alladin.

Inside each Node, many operations take place. If you try to visualize all the dimensions and everything, you will get lost!

But fortunately, this Genie can actually grant many wishes, as many as needed in different places.

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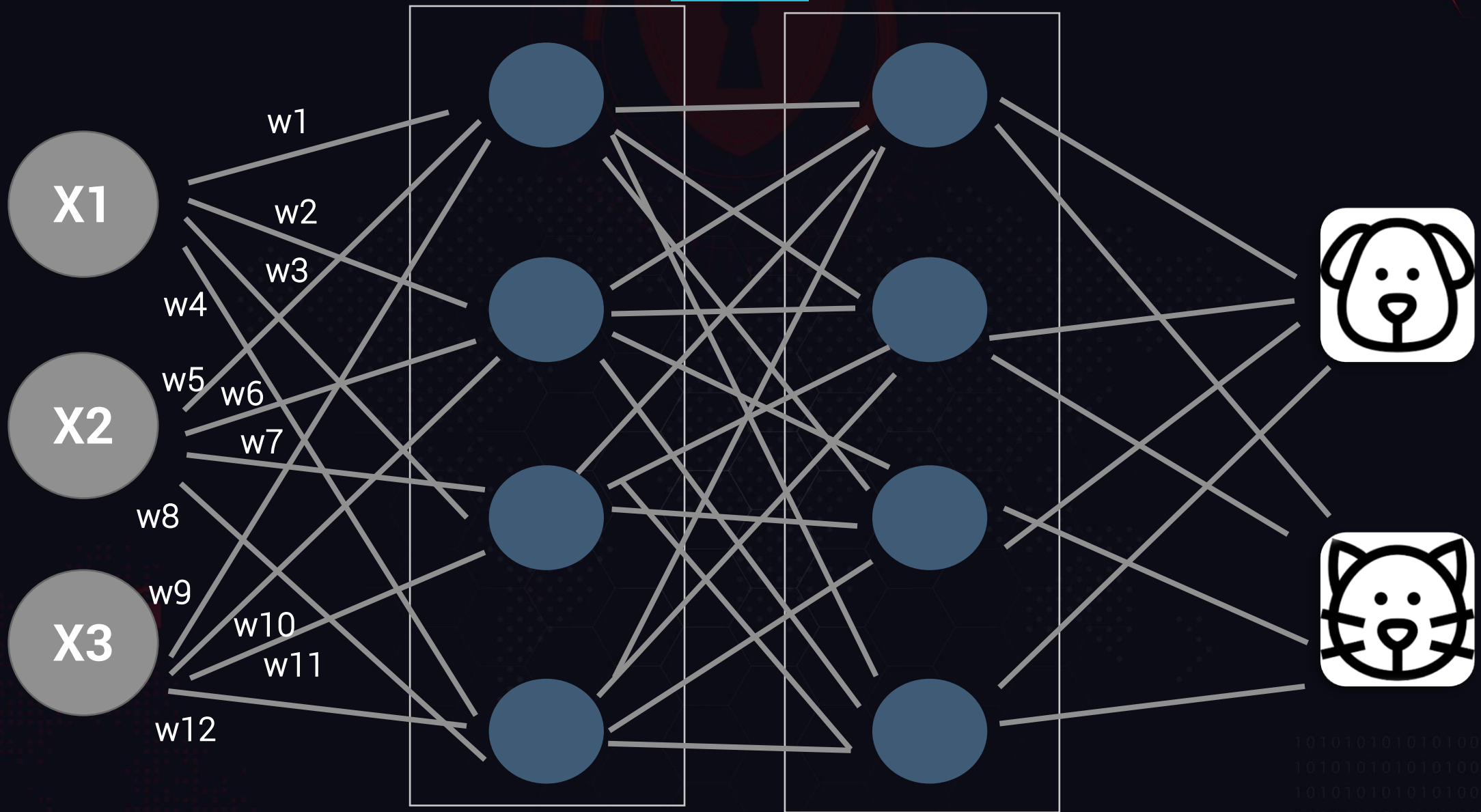
How Deep Learning Works – In Details



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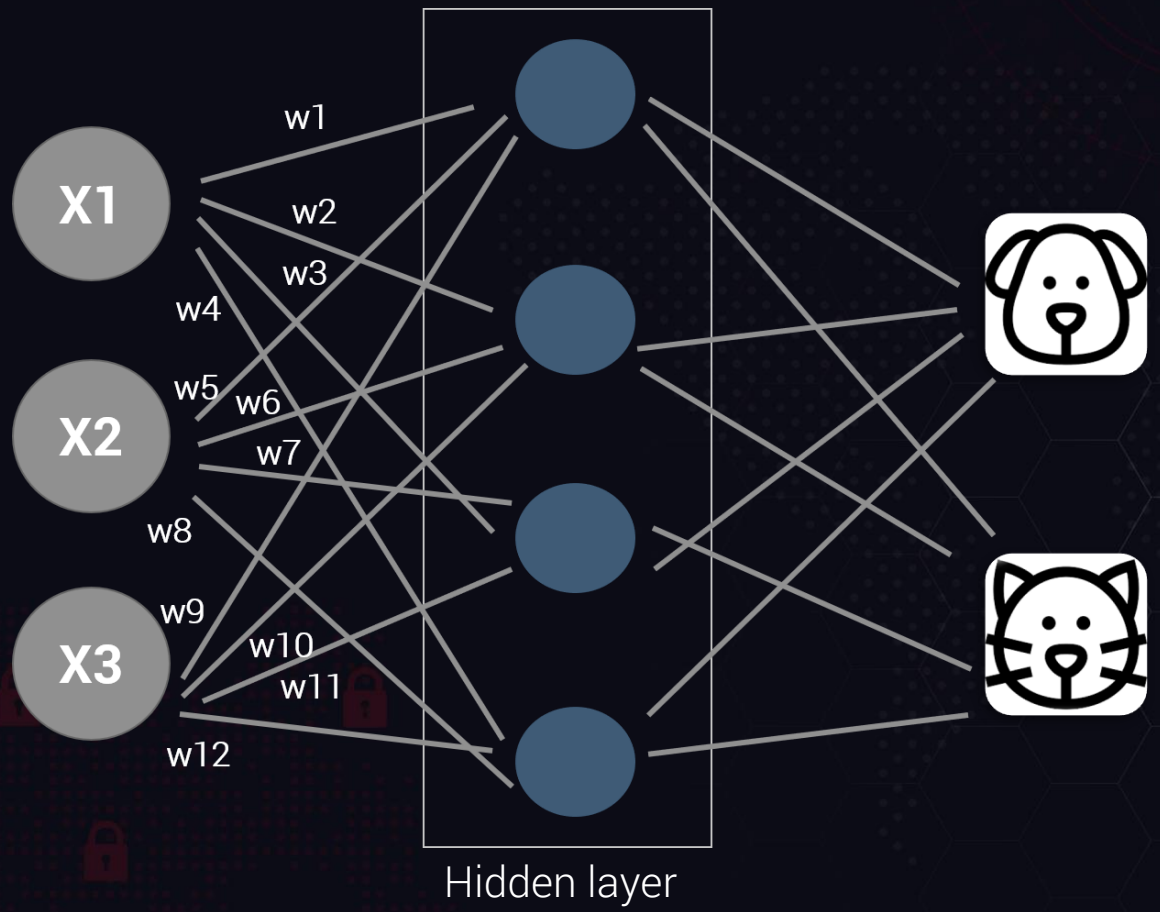
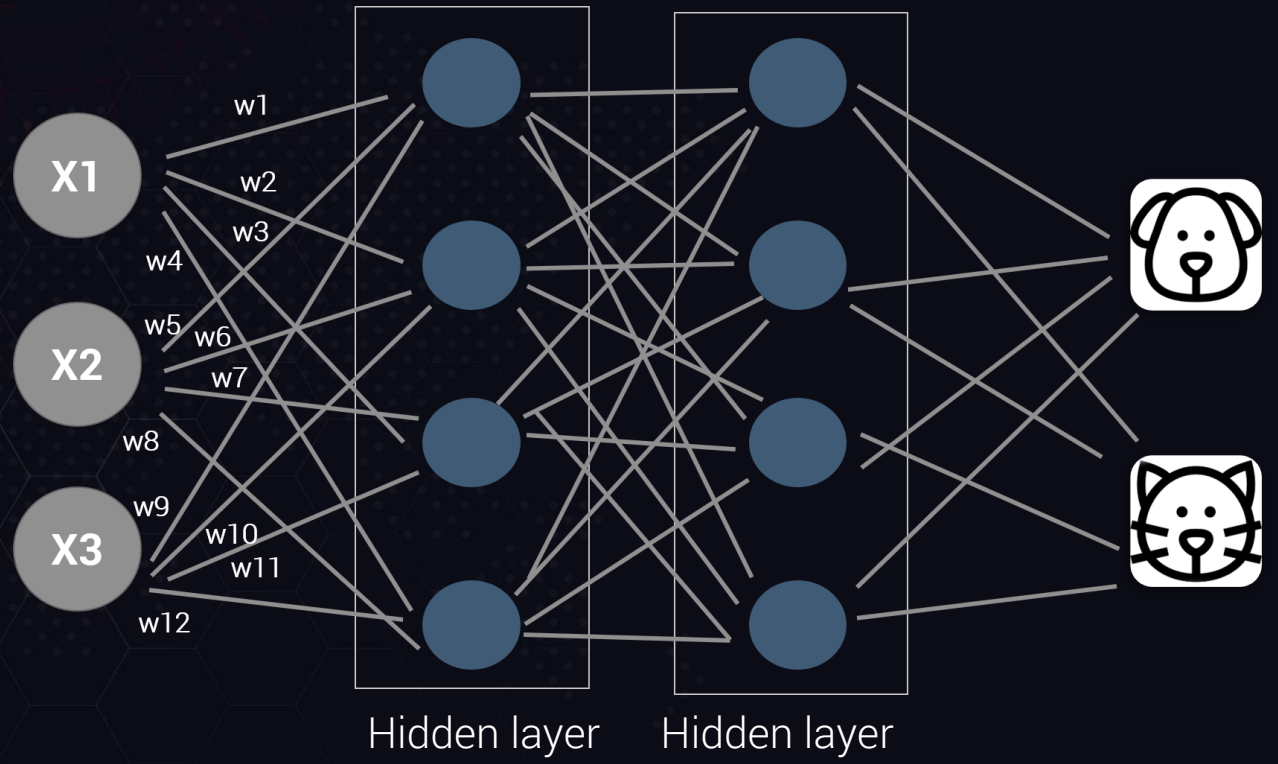
Neural Network vs Deep Neural Network





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Deep Learning vs Traditional Machine Learning (Shallow Learning)

Deep learning is a specialized form of machine learning. A machine learning workflow starts with relevant features being manually extracted from images. The features are then used to create a model that categorizes the objects in the image.

With a deep learning workflow, relevant features are automatically extracted from images. In addition, deep learning performs “end-to-end learning” – where a network is given raw data and a task to perform, such as classification, and it learns how to do this automatically.

Another key difference is deep learning algorithms scale with data, whereas shallow learning converges. Shallow learning refers to machine learning methods that plateau at a certain level of performance when you add more examples and training data to the network.

A key advantage of deep learning networks is that they often continue to improve as the size of your data increases.

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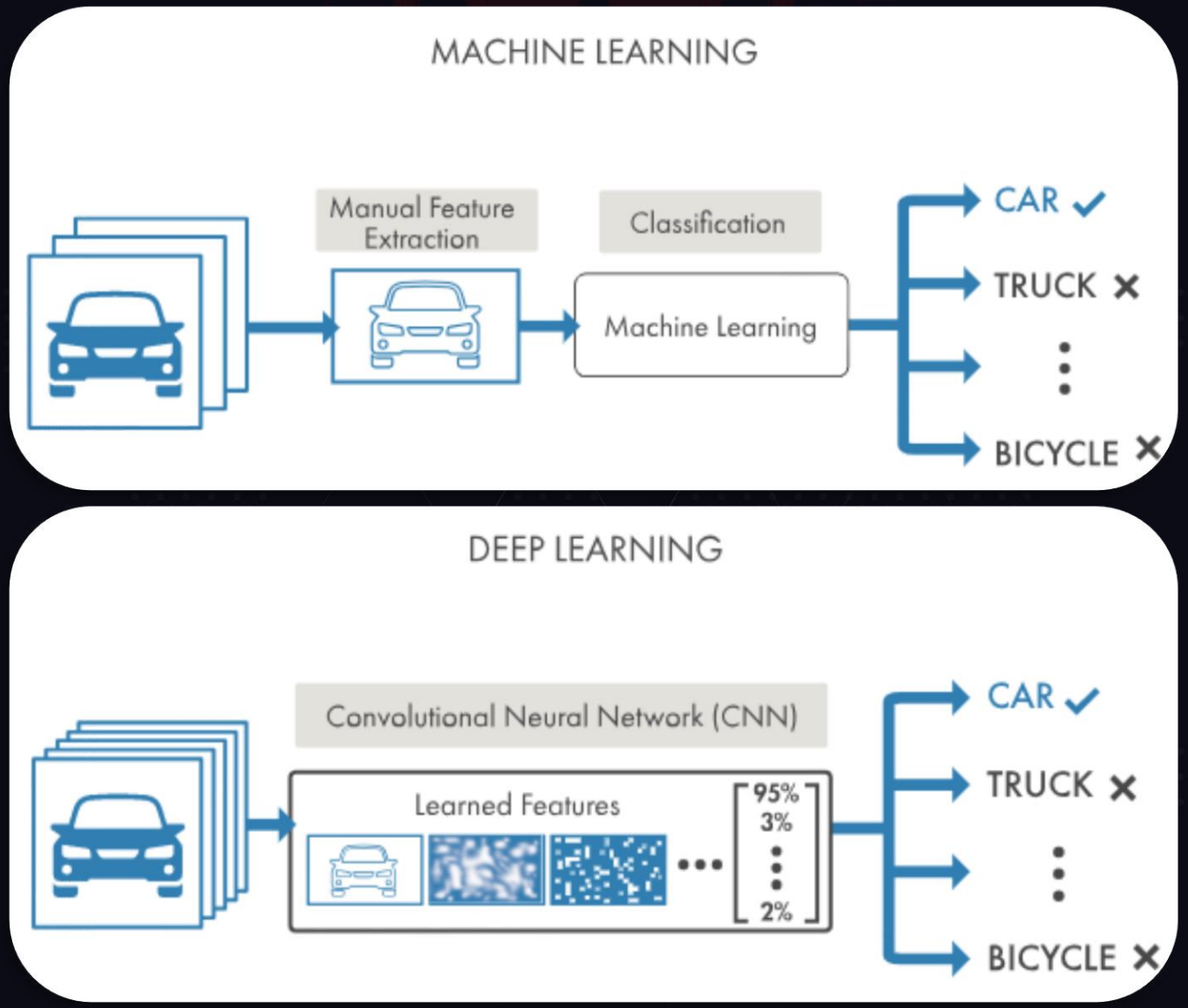
Deep Learning vs Traditional Machine Learning – Visual Representation



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Deep Learning Example – CNN

One of the most popular types of deep neural networks is known as convolutional neural networks (CNN or ConvNet). A CNN convolves learned features with input data, and uses 2D convolutional layers, making this architecture well suited to processing 2D data, such as images.

CNNs eliminate the need for manual feature extraction, so you do not need to identify features used to classify images. The CNN works by extracting features directly from images. The relevant features are not pretrained; they are learned while the network trains on a collection of images. This automated feature extraction makes deep learning models highly accurate for computer vision tasks such as object classification.

Deep Dive Into CNN

Image Recognition

64 x 64 x 3

Is it Cat?
0 or 1

Object Detection

Neural Style Transfer

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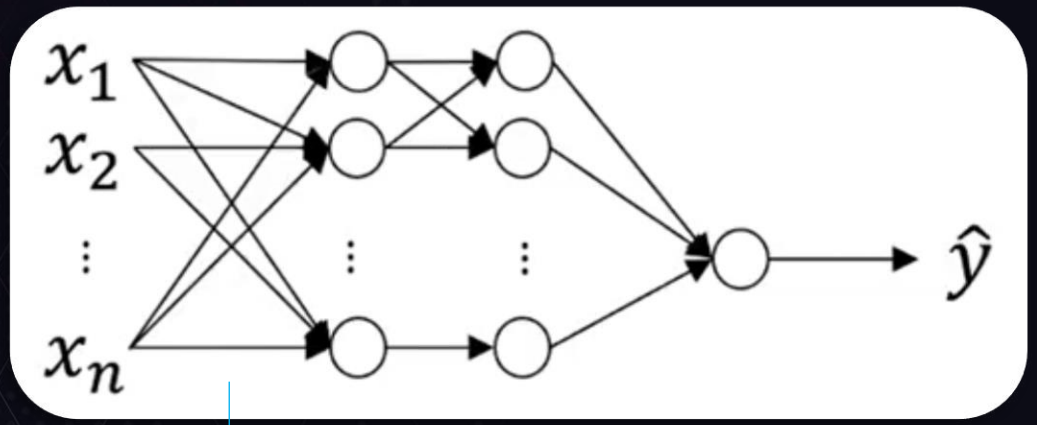
Deep Learning into Larger Images

Image Recognition

1000 x 1000 x 3 = 3M

Is it Cat?
0 or 1

h1 = 1000 x 3M



x = 3M

w[i] = 3B

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