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Deep Learning

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ABSTRACT

In the contemporary world, deep learning is a platform that is beginning to take off. Deep learning has had considerable success recently across a variety of platforms, including computer vision and natural language processing. Deep learning has a stronger learning approach than the older machine learning techniques, and it can employ future data extractions. Artificial neural networks are trained to learn from data in deep learning, a branch of machine learning. It uses a layered method to process information and is inspired by the structure and operation of the human brain. Additionally, it has to deal with issues like prejudice, overfitting, and ethical dilemmas. Deep learning has grown significantly over the past several years and is now one of the most popular areas of research in artificial intelligence.

I. INTRODUCTION

Deep learning is a sub-field of machine learning that involves training artificial neural networks with a large amount of data to recognize patterns and make predictions. The term deep refers to the number of layers in a neural network which can range from a few to hundreds or even thousands.

The basic building block of a neural network is a neuron, which takes input, process them, and produces an output. A neural network consists of multiple layers of interconnected neurons, with each layer performing a specific type of computation and the output layer produces the final result.

Deep Learning has gained popularity as a method for a variety of tasks, including audio and picture identification, natural language processing, and even gaming. Deep Learning has also been utilized in the financial industry for fraud detection and risk assessment, in healthcare for medical picture analysis and medication discovery, and self-driving cars for object detection and decision-making.

To minimize the error between the anticipated output and the actual output, a deep neural network must be trained by supplying it with a significant amount of data and altering its parameters. Backpropagation, which enables the network to learn from its errors and enhance its predictions, is this process.

II. History of Deep Learning

Year	Milestones
1943	**McCulloch and Pitts propose a model of artificial neurons**
1958	**Rosenblatt develops the Perceptron algorithm for supervised learning**
1960	**The backpropagation algorithm for training neural networks is developed**

1980	**Backpropagation falls out of favor due to difficulty in training deep networks**
1990	**Support vector machines (SVMs) become popular for supervised learning**
2006	**Hinton and Salakhutdinov introduce Deep Belief Networks (DBNs) and unsupervised pretraining**
2010	**ImageNet dataset is introduced, catalyzing the use of deep convolutional neural networks (CNNs) for image recognition**
2012	**Hinton and his team win the ImageNet challenge with deep CNN**
2014	**Google DeepMind uses deep CNN to beat human performance on Atari games**
2015	**Generative adversarial networks (GANs) are introduced for unsupervised learning**
2020	**GPT-3, a large language model with 175 billion parameters, is introduced by OpenAI**

III. Artificial Neural Networks

A form of machine learning technique called artificial neural networks (ANNs) is motivated by the structure and operation of the human brain. Neurons, which are interconnected nodes that process and send information, make up ANNs.

Convolutional Neural Networks (CNN)

For image and video recognition applications, convolutional neural networks (CNNs) are a typical type of neural network. CNNs process images and videos similarly to how the human visual system does to recognize patterns in them.

Recurrent Neural Network

A sort of neural network called a recurrent neural network (RNN) is made to process sequential data. RNNs have loops that enable information to survive and be transmitted between steps in the sequence, in contrast to conventional feedforward neural networks.

IV. WHY Deep Learning becomes Mainstream

1. Access to enormous datasets: The amount of data available has greatly increased as a result of the development of the internet, social media, and other digital technologies. This data offers a comprehensive source of knowledge for deep learning model training.
2. Hardware improvements: Deep learning demands a lot of computational power, which was previously only possible with more expensive devices like GPUs and specialty processors. Deep learning is now more accessible to a wider range of consumers because of the emergence of more affordable and accessible hardware.
3. Algorithm improvements: Over the years, deep learning algorithms have been developed and optimized, leading to higher performance and more effective training. Deep learning may now be used for a larger variety of applications thanks to this.

1. Improvement in Algorithms:

Over time, deep learning algorithms have undergone constant improvement and optimization, which has enhanced performance and increased training effectiveness. Deep learning may now be used for a larger variety of applications thanks to this.

2. Success in High-Profile applications:

In several high-profile applications, including image identification, speech recognition, and gaming, deep learning has produced amazing results. These accomplishments have greatly increased interest in deep learning and contributed to making the technique more widely used.

3. Availability of Open-Source Tools:

It is now simpler for researchers and developers to experiment with and create deep learning models because of the availability of open-source deep learning tools like TensorFlow, PyTorch, and Keras. The deep learning community has largely embraced these tools because they offer a high-level interface for creating and refining models.

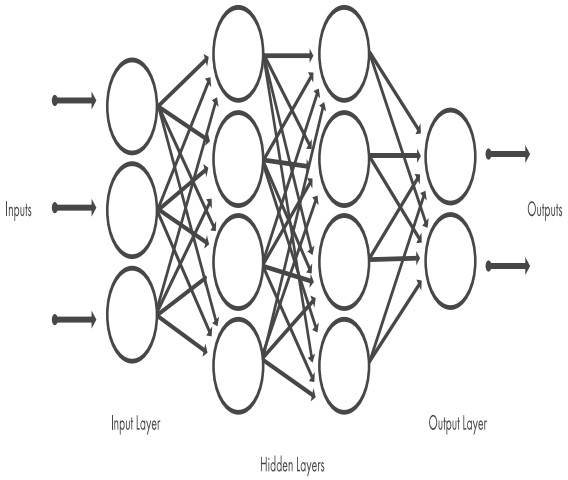
V. How does deep learning work? :

Deep learning techniques are frequently referred to as "deep neural networks" since they frequently make use of neural network structures.

The number of neural network layers that are buried typically indicates how "deep" a network is. While deep networks have up to 150 hidden layers, conventional neural networks only have two or three.

Large datasets of labeled data and neural network topologies that automatically extract features from the data while learning them directly from the data are used to train deep learning models.

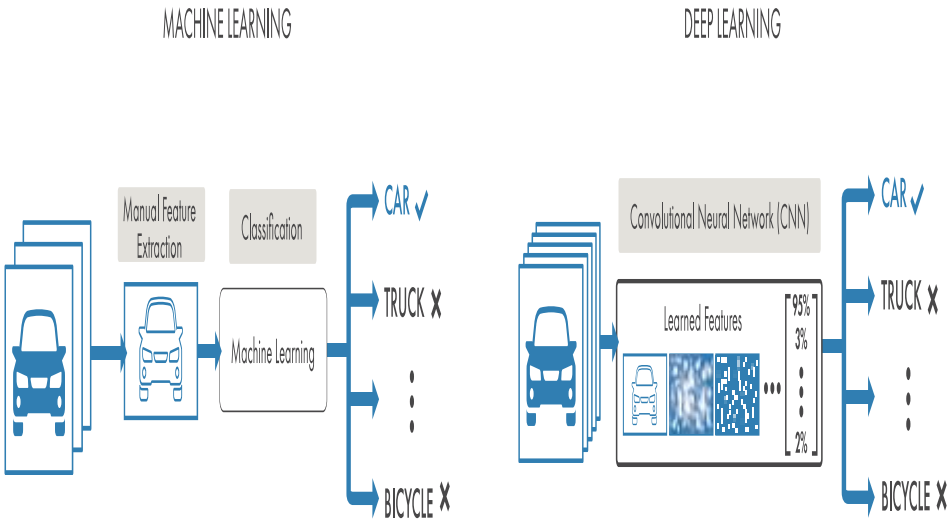
Neural Networks



VI. Difference between Machine Learning and Deep Learning

A particular type of machine literacy is deep literacy. A machine literacy system begins with manually rooting material features from prints. A model that classifies the particulars in the image is also developed using the features. Applicable features are automatically recaptured from prints using a deep literacy approach. Deep literacy also carries out" end-to-end literacy" in which a network is given undressed data and a task to complete, similar to a bracket, and it learns how to negotiate this automatically. Another significant distinction is that while shallow literacy converges, deep literacy styles gauge with data. Machine literacy ways known as" shallow literacy" reach a performance ceiling when you add further exemplifications and training data to the network.

Comparing Machine Learning and Deep Learning



VII. Choosing between Machine Learning and Deep Learning:

Depending on your application, the volume of data you're processing, and the kind of problem you're trying to address, machine learning offers a range of approaches and models from which to pick. The model must be trained on hundreds of photos, and a good deep learning application needs GPUs, or graphics processing units, to analyze data quickly.

When deciding between machine learning and deep learning, take into account your high-performance GPU and the amount of labeled data you have available. Machine learning may be more advantageous than deep learning if you lack either of those resources. To acquire accurate results with deep learning, you'll need at least a few thousand photos. The model will process all those photos faster if it has a high-performance GPU.

How to Create and Train Deep Learning Models:

The three most typical applications of deep learning for object classification are as follows:

Training from the Ground Up

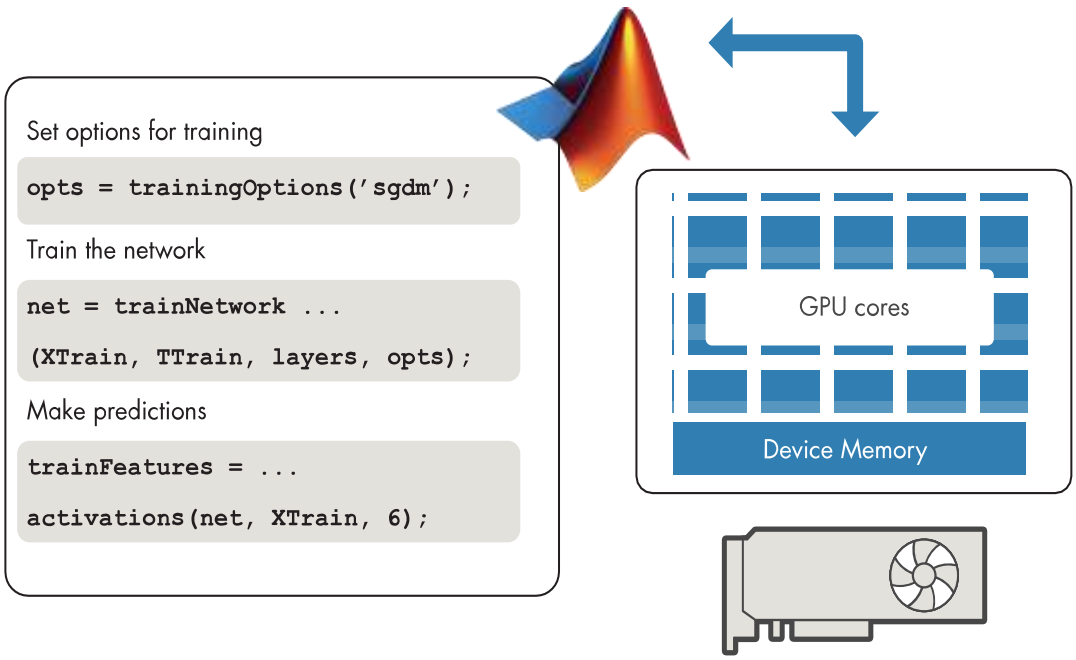
You need a sizable labeled data set and a network architecture that will learn the features and model to train a deep network from scratch. This is advantageous for newly developed apps or applications with numerous output categories. This is a less frequent strategy because these networks often take days or weeks to train because of the massive volume of data and rate of learning.

Extraction of Features

Using the network as a feature extractor for deep learning is a little less popular, more specialized method. We can remove these characteristics from the network at any point throughout the training process because all the layers are tasked with learning certain features from images. These features can then be fed into a support vector machine (SVM) model for machine learning.

VIII. Accelerating Deep Learning Models with GPU

It can take days or indeed weeks to train a deep literacy model. GPU acceleration can greatly speed up the procedure. The quantum of time demanded to train a network can be dropped by using MATLAB and a GPU, going from days to hours for an image bracket challenge. When GPUs are available, MATLAB leverages them to train deep literacy models without explicitly taking that you know how to program them.



Deep Learning Toolbox commands for training your own CNN from scratch

IX. CONCLUSION

In conclusion, a kind of machine knowledge called deep knowledge uses a lot of data to train artificial neural networks to spot patterns and predict the future. With their several layers, the deep neural networks used in deep knowledge can learn farther intricate representations of the input data, producing more accurate prognostications. Deep knowledge has revolutionized the field of artificial intelligence and has been used in a wide range of operations, including speech and a picture identification, natural language processing, and indeed gaming. Deep neural network training is a resource-ferocious procedure because it calls for a lot of data and processing power. Despite this, Deep Learning is still developing snappily and has the implicit to revise numerous professions and sectors.

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