Introduction to Deep Learning

Rahul Rai,

Student,
Department Of MCA,
Vivekanand Education Society's Institute of Technology (VESIT), Mumbai, India.

Abstract: **Deep Learning is a subset of machine learning which is concerned with algorithms inspired by the structure and function of the brain called artificial neural networks (ANN).it is a machine learning technique that instructs PCs to do what falls into place without any issues for people. In this, a computer model learns to perform classification tasks directly from images, text, or sound. These models can achieve state-of-the-art accuracy. This is done by training the model using a large set of labeled data and neural network architectures that contain many layers.**

So deep learning is a concept or technology that enables computer models to take decisions like human beings

INTRODUCTION

● Deep learning is a subfield of machine learning which teaches computers to make decisions like the human brain does. This is done with the help of Artificial Neural networks (ANN).

● An ANN is the piece of a computing system designed to simulate the way the human brain analyzes and processes information.

● It is a key technology used to distinguish a pedestrian from a lamppost,in driverless cars and enabling them to recognize a stop sign.

● It is an artificial intelligence (AI) function that imitates the workings of the human brain in processing data and creating patterns for use in decision making.

● It is a form of machine learning, which can be used to help detect fraud or money laundering etc.

● It has aided image classification, language translation, and speech recognition. It can be used to solve any pattern recognition problems without human intervention.

Why Deep Learning Matters

● Deep learning achieves recognition accuracy at higher levels than ever before which helps consumer electronics to meet end users expectations, as it is crucial for safety-critical applications like driverless cars.

● With recent advances, Deep learning has improved to the point where it outperforms humans in some tasks like classifying objects in images.

● Recently it is used more for two main reasons :

1. It requires large amounts of labeled data. For example, driverless car development requires millions of images and thousands of hours of video.

2. It requires substantial computing power. High-performance GPUs have a parallel architecture that is efficient for deep learning.

How Deep Learning works

● Deep learning methods use neural network architectures that is why deep learning models are often referred to as deep neural networks.

● The word "deep" 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 as many as 150.

● These 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.
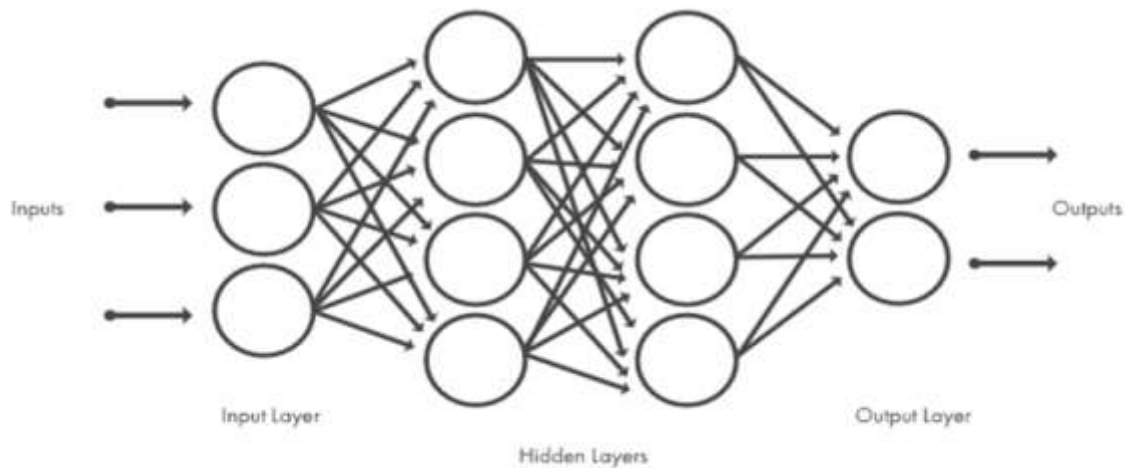
Fig 1: Neural networks - organized in layers consisting of a set of interconnected nodes

Most popular types of deep neural networks is known as convolutional neural networks (CNN or ConvNet). CNN is one of the main categories that can do images recognition, images classifications. Objects detections, recognition faces etc.
CNNs eliminate the need to identify features used to classify images and manual feature extraction is eliminated. It works by extracting features directly from images and relevant features are not pretrained. They are learned while the network trains on a collection of images.
Because of this kind of automated feature extraction, Deep learning models are highly accurate for tasks such as object classification. Technically, CNN models to train and test, each input image will pass it through a series of convolution layers with filters (Kernals), and Convolutional layers are the major building blocks used in CNN.

APPLICATION OF DEEP LEARNING

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

Medical Research: Deep learning is used by Cancer researchers to automatically detect cancer cells. An advanced microscope is built by teams at UCLA that yields a high-dimensional data set used to train a deep learning application to accurately identify cancer cells.

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

Electronics: Automated hearing and speech translation are built based on deep learning. For example, home assistance devices that respond to your voice and know your preferences are powered by deep learning applications.

Machine learning Vs Deep learning

1) This is most basic difference. Machine learning is a subset of Artificial intelligence while Deep Learning is a subset of Machine learning

2) **Data Dependencies:** Traditional machine learning can work on small amount of data or small data sets. Ofcourse the more data model is more perfect. But the performance of machine learning model is good even with small data set. For deep learning, we require a large amount of data or large. if dataset is small then its performance is poor.

3) **Hardware Dependencies**: Traditional Machine learning models can work on low-end machines. Contradiction to this, deep learning algorithms requires high-end machines. Deep learning algorithms requires GPU because they perform large amount of matrix multiplication process which GPU supports well.

4) **Feature Engineering** : In Machine learning, Most of the applied features are needed to be manually identified by an expert and then hand coded it based on domain and data type.In Deep Learning, algorithms try to learn high-level features from data itself which is a very distinctive feature.

5) **Problem solving approach**: In machine learning, approach used for problem solving is that it breaks the problem into sub - problems or into small pieces and solve them individually and combine the results. While in deep learning, problem is solved from end to end without breaking the problem

6) **Execution Time**: comparing machine learning and deep learning, deep learning models requires more time to train because number of parameters are more in deep learning. Its contrast in testing, deep learning algorithm runs fast in testing while machine learning algorithm takes time. It is not true for all machine learning algorithm as some of them has small testing time.

7) **Interpretability**: Consider example of giving automated scores to essays, Deep learning gives more accurate results sometimes near to human performance. But it do not give reason why it has given that score. Machine learning results will not be that much accurate but it gives a reason why the score is given (how it has calculated the score). This happens because it uses algorithms like decision tree and linear regression.

Advantages of Deep learning

1)   **Unstructured Data**: most data in organizations are unstructured i.e it exists in different type of formats like image and text. Machine learning is not efficient in analzing the unstructured data. We can use deep learning on unstructured data and also obtain the insights which are related to purpose.it uses maximum utilization of unstructured data as compared to machine learning

2)   **Eliminating the need of feature engineering**: Deep learning automatically extracts the features from the data itself. Features are not need to identified by the experts.

3)   **Ability to deliver high quality results**: deep learning uses ANN models for the analysis purpose. Therefore the accuracy of results is very accurate sometimes near to human performance. Humans can get hungry and make mistakes but it is not like with computer models.'

4)   **Eliminating the need of data labelling**: Data labelling are very costly and time-consuming. With the help of deep learning, the need of data labelling is very obsolete as it is excellent in learning without any guideline.

5)   **Architecture**: Its architecture can be used in solving the new problems like Vision, time series, languages etc relatively easily.

6)   **Performance**: Deep learning algorithms are best in class performance and significantly outperforms other solutions in multiple domains.

7)   **Eliminating the unnecessary costs**: Machine learning algorithms are not that much efficient in detecting small defects. In organizations, recalls are very expensive and sometimes costs in millions of dollars. Deep learning can easily detect small defects and there will be less chances of recall which saves the unnecessary costs

REFERENCES

https://www.analyticsvidhya.com/blog/2017/04/comparison-between-deep-learning-machine-learning/

https://www.investopedia.com/terms/d/deep-learning.asp

https://machinelearningmastery.com/what-is-deep-learning/

https://www.mathworks.com/discovery/deep-learning.html

https://magnimindacademy.com/deep-learning-and-its-5-advantages/

http://quora.com/What-are-the-advantages-and-disadvantages-of-deep-learning-Can-you-compare-it-with-the-statistical-learning-theory