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Deep Learning challenges in Retail Sector

Ms.M.Prithi[1], Dr.Tamizharasi[2]

[1] Assistant Professor, Marudhar kesari Jain College for women, vaniyambadi, Tamilnadu

[2] Guest Lecturer , Periyar University Arts and Science College, Idappadi, Tamilnadu

Abstract: Deep learning models are ideal for procure perception into the user experience in customer service reciprocity. Deep learning can predict the sentiment of the customer during customer service reciprocity which is crucial for improving the customer adventure. Automated customer service systems are great for reducing phone queues efficiently solving simple problems but when the customer is stressed with a large problem, most people want to speak to a human operator. The traditional solution to this would be to invest in a more refined automated service or invest in more human operators. With deep learning, these costs can be avoided by adeptly allocating the human operators' time to problems where human interaction is necessary. Customer service phone calls can also be analysed using speech-to-text technology to analyze what the customer is saying, in combination with analyzing the audio directly to understand how the customer is saying it. Customer behavior analysis is an essential issue for retailers, allowing for optimized store performance, enhanced customer experience, reduced operational costs, and consequently higher profitability. Nevertheless, not much attention has been given to computer vision approaches to automatically extract relevant information from images that could be of great value to retailers. In this paper, we present a low-cost deep learning approach to estimate the number of people in retail stores in real-time and to detect and visualize hot spots. For this purpose, only an inexpensive RGB camera, such as a surveillance camera, is required. To solve the people counting problem, we employ a supervised learning approach based on a Convolutional Neural Network (CNN) regression model.

Keywords -Deep learning, CNN, Supervised learning

INTRODUCTION

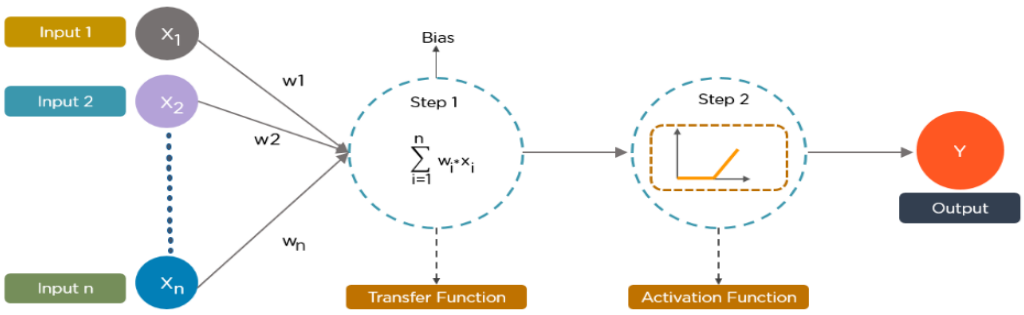
What is Deep Learning?

Deep learning can be considered as a subset of machine learning. It is a field that is based on learning and improving on its own by examining computer algorithms. While machine learning uses simpler concepts, deep learning works with artificial neural networks, which are designed to imitate how humans think and learn. Until recently, neural networks were limited by computing power and thus were limited in complexity. However, advancements in Big Data analytics have permitted larger, sophisticated neural networks, allowing computers to observe, learn, and react to complex situations faster than humans. Deep learning has aided image classification, language translation, speech recognition. It can be used to solve any pattern recognition problem and without human intervention. Artificial neural networks, comprising many layers, drive deep learning. Deep Neural Networks (DNNs) are such types of networks where each layer can perform complex operations such as representation and abstraction that make sense of images, sound, and text. Considered the fastest-growing field in machine learning, deep learning represents a truly disruptive digital technology, and it is being used by increasingly more companies to create new business models.

Defining Neural Networks

A neural network is structured like the human brain and consists of artificial neurons, also known as nodes. These nodes are stacked next to each other in three layers:

- ✓ The input layer
- ✓ The hidden layer(s)
- ✓ The output layer



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In other words, Deep learning utilizes layers of neural network algorithms to discover more significant level data dependent on raw input data. The neural network algorithms discover the data patterns through a process that simulates in a manner of how a human brain works.

Neural networks help in clustering the data points from a large set of data points based upon the similarities of the features. These systems are known as Artificial Neural Networks.

As more and more data were fed to the models, deep learning algorithms proved out to be more productive and provide better results than the rest of the algorithms. Deep Learning algorithms are used for various problems like image recognition, speech recognition, fraud detection, computer vision etc.

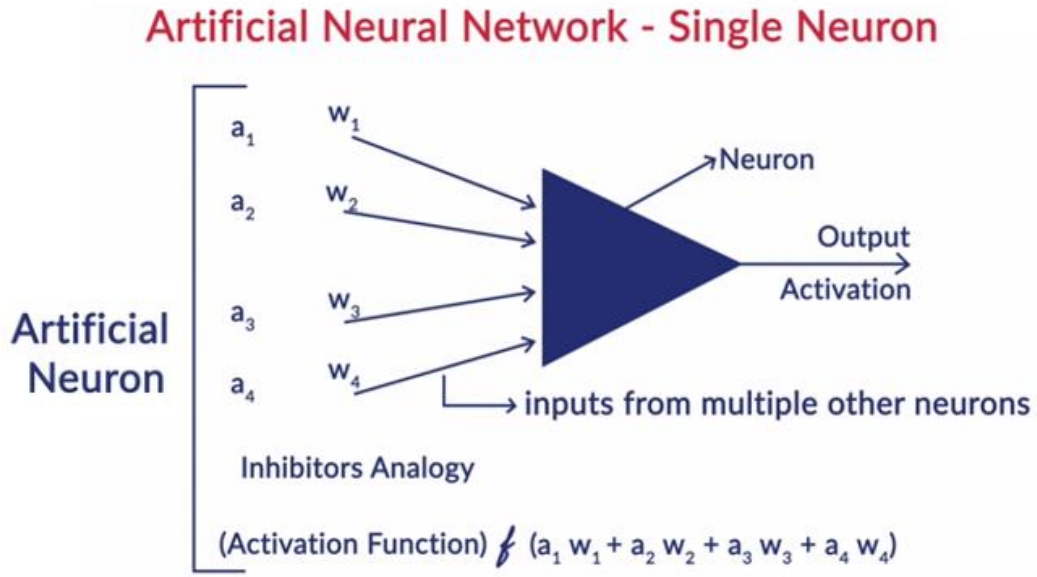
COMPONENTS OF NEURAL NETWORK

1. Network Topology – Network Topology refers to the structure of the neural network. It includes the number of hidden layers in the network, number of neurons in each layer including the input and output layer etc.
2. Input Layer – Input Layer is the entry point of the neural network. The number of neurons in the input layer should be equal to the number of attributes in the input data.
3. Output Layer – Output Layer is the exit point of the neural network. The number of neurons in the output layer should be equal to the number of classes in the target variable (For classification problem). For regression problem, the number of neurons in the output layer will be 1 as the output would be a numeric variable.
4. Activation functions – Activation functions are mathematical equations that are applies to the sum of weighted inputs of a neuron. It helps in determining whether the neuron should be triggered or not. There are many activation functions like sigmoid function, Rectified Linear Unit (ReLU) , Leaky ReLU, Hyperbolic Tangent, Softmax function etc.
5. Weights – Every interconnection between the neurons in the consecutive layers have a weight associated to it. It indicates the significance of the connection between the neurons in discovering some data pattern which helps in predicting the outcome of the neural network.

GENERAL WORKING OF A NEURON

Deep Learning works with Artificial Neural Networks (ANNs) to imitate the working of human brains and to learn in a way human does. Neurons in the Artificial neural networks are arranged in layers. The first and the last layer are called the input and output layers. The layers in between these two layers are called as hidden layers.

Each neuron in the layer consists of its own bias and there is a weight associated for every interconnection between the neurons from previous layer to the next layer. Each input is multiplied by the weight associated with the interconnection. The weighted sum of inputs is calculated for each of the neuron in the layers. An activation function is applied to this weighted sum of input and added with bias of the neuron to produce the output of the neuron. This output serves as an input to the connections of that neuron in the next layer and so on.This process is called as feedforwarding. The outcome of the output layer serves as the final decision made by the model. The training of the neural networks is done on the basis of weight of every interconnection between the neurons and the bias of every neuron. After the final outcome is predicted by the model, it calculates the total loss which is a function of the weights and biases.



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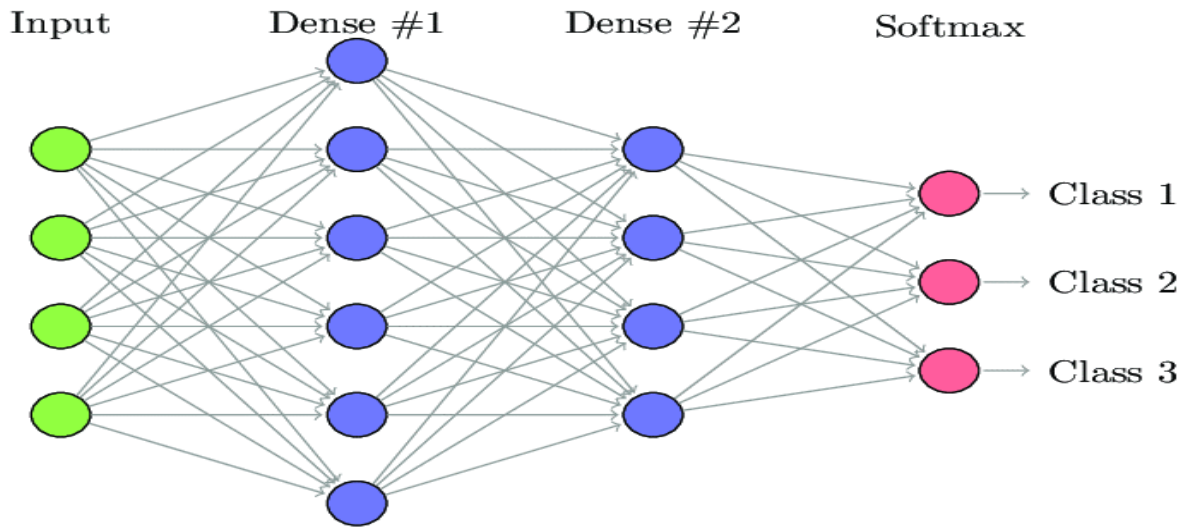
DIFFERENT DEEP LEARNING ALGORITHMS

1. Fully Connected Neural Network

In Fully Connected Neural Network (FCNNs), each neuron in one layer is connected to every other neuron in the next layer. These layers are referred to as Dense layers for the very same reason. These layers are very expensive computationally as every neuron connects with all the other neurons.

It is preferred to use this algorithm when the number of neurons in the layers are less, otherwise it would require a lot of computational power and time to perform the operations. It may also lead to overfitting due to its full connectivity.



2. Convolutional Neural Network (CNNs)

The Convolutional Neural Network (CNNs) are a class of neural networks which are designed to work with the visual data. i.e. images and videos. Thus, it is used for many image processing tasks like Optical Character Recognition (OCR), Object Localization etc. CNNs can also be used for video, text, and audio recognition.

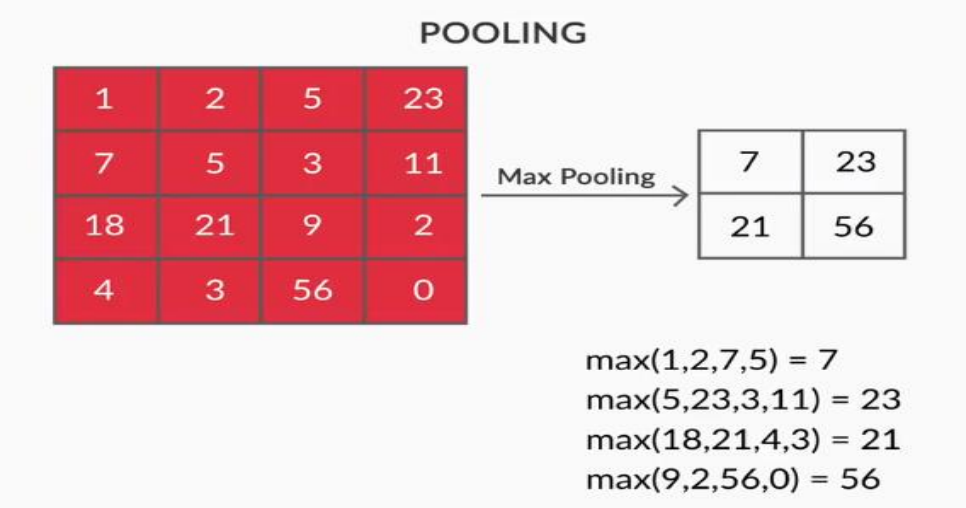
There is hierarchy in the layers of the CNN. The first layer tries to extract the raw features of the images like horizontal or vertical edges. The second layers extract more insights from the features that are extracted by the first layer. The subsequent layers would then dive deeper into the specifics to identify certain parts of an image such as hair, skin, nose etc. Finally, the last layer would classify the input image as human, cat, dog etc.

VGGNet Architecture – One of the widely used CNNs

There are three important terminologies in the CNNs:

Convolutions – Convolutions is the summation of element wise product of the two matrices. One matrix is a part of input data and the other matrix is a filter which is used to extract features from the image.

Pooling Layers – The aggregation of the extracted features is done by Pooling Layers. These layers generally compute an aggregate statistic (max, average etc) and makes the network invariant to the local transformations.



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Feature Maps – A neuron is CNN is basically a filter whose weights are learnt during its training. Each neuron looks at a particular region in the input which is known as its receptive field. A Feature Map is a collection of such neurons which look at different regions of the image with same weights. All the neurons in a feature map try to extract same feature but from different regions of the image.

3. Recurrent Neural Networks (RNNs)

Recurrent Neural Networks are designed to deal with sequential data. Sequential data means data that has some connection with the previous data such as text (sequence of words, sentences etc) or videos (sequence of images), speech etc.

The main difference between the normal neural networks and recurrent neural networks is that the input data flows along two dimensions – time (along the length of the sequence to extract features out of it) and depth (normal neural layers). There are different types of RNNs and their structure changes accordingly.

Many to One RNN: – In this architecture, the input fed to the network is a sequence and the output is a single entity. This architecture is used in tackling problems like sentiment classification or to predict the sentiment score of the input data (Regression problem). It can also be used to classify videos into certain categories.

Many to Many RNN: – Both, the input and the output are sequences in this architecture. It can be further classified on the basis of the length of the input and output.

Same length: – The network produces an output at each timestep. There is a one to one correspondence between the input and output at each timestep. This architecture can be used as a part of speech tagger where each word of the sequence in the input is tagged with its part of speech as output at every timestep.

Different length: – In this case, the length of the input is not equal to the length of the output. One of the uses of this architecture is language translation. The length of a sentence in English can be different from the corresponding Hindi sentence.

CONCLUSION:

Several experiments were conducted to validate, evaluate and compare our approach using a dataset comprised of ideos that were collected from a surveillance camera placed in a real shoe retail store. Results revealed that our approach is sufficiently robust to be used in real world situations and outperforms straightforward CNN approaches. The article gave a brief introduction to the Deep Learning domain, the components used in the neural networks, the idea of deep learning algorithms, assumptions made to simplify the neural networks, etc. This article provides a restricted list of deep learning algorithms as there are a lot of different algorithms which are constantly being created to overcome the limitations of existing algorithms.

Deep Learning algorithms have revolutionized the way of processing videos, images, text etc. and they can be easily implemented by importing the required packages. Lastly, for all the Deep Learners, Infinity is the limit.

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