# Deep learning algorithm and two examples of its application

## 1. Abstract:

The role of Deep learning in our lives is increasing day by day. It made a huge impact in the fields of big data, speech recognition, image processing, computer vision, cancer recognition, and self-driving cars. Deep learning overcomes the limitation of networks that have an abstraction of representation of multi-dimensional training data and prevented effective training. All these depend upon the complexity of the problem. A deep Neutral Network which is also called a Conventional Neutral Network uses deep layers of units with highly optimized architecture and algorithm. In this report, we will discuss an algorithm of deep learning that is a Conventional Neutral Network. We will also discuss applications of Conventional Neutral Networks.

## 2. Introduction:

Deep learning has very important in our daily life and for the enhancement of technology. In this report, we will discuss a conventional neural network which is an algorithm of deep learning. Conventional neural networks are used in the field of big data, speech recognition, image processing, computer vision, medical diagnosis, cancer recognition, and self-driving cars. The term 'Conventional' means mathematical term. It is derived from the integration of two different terms. It describes how others' functions impact the shape of one function. Conventional neural networks consist of four different layers. Which are the convolution layer, rectified linear unit layer, pooling layer, and connected layer. A conventional neural network is a very powerful algorithm in computer vision or image processing. There are three different types of matrices in RGB images. Matrixes contain pixels and each matrix describes what color that pixel displays. We can do this by defining three components which are red, green, and blue color. Conventional neural networks are also used in medical diagnosis. By using this technology the cost will reduce and also gives more accurate results. The clinical workload would be reduced efficiently and the process of exploring different symptoms' correlation at the same time could provide a robust conventional neural network-based diagnosis support system. Convolution neural networks have the following primary tasks:

- Classify visual content
- Recognize object
- Gather recognized objects into a cluster

## 3. Deep learning:

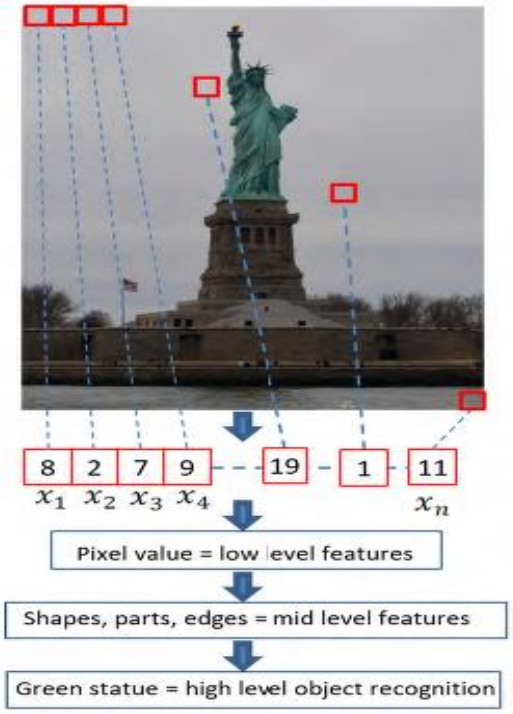
Deep learning is a highly effective algorithm for the analysis of images. This can be done by passing through the neural network layers. It is based on Artificial intelligence neural networks. Deep learning is a key technology behind image processing and computer vision. Deep learning educates the computer program to perform specific tasks. Computers are trained with the help of large data sets. With the help of deep learning, we can achieve a higher level of accuracy. In a

lot of tasks deep learning performs like a human, especially in image processing. Deep learning has a lot of applications in many fields like medical research and defense.

**4. Neural network:**

A neural network is a technique of machine learning which is inspired by the structure of the brain and its resemblance to the human nervous system. It consists of processing units which are input layers, output layers, and hidden layers. These units are connected to nodes in adjacent layers. Each connection has a weight value. Respective weight is multiplied by the inputs and summed at each unit. The Transmission base on the activation function gets the sum which is mostly the tan hyperbolic, sigmoid function, and rectified linear unit. This function makes it easier to compute partial derivatives of error delta. These functions are also used because they are highly favorable in mathematical derivatives. Sigmoid and tan functions have an input range from 0 and 1 or -1 and +1 respectively. The input of the next layer is the output from the last layer. The solution to the problem is from the output of the last layer. Neural networks are used in a variety of problems. These problems include classification, clustering, pattern recognition, natural language processing (NLP), computer vision, and image processing. The Deep neural networks are also called conventional networks as shown in the figure below. These are trained with the algorithms to learn representation from data sets. The following steps are included in the implementation of neural networks:

- Acquire training and testing data set
- Train the network
- Make predictions with test data



### 4.1. Classification of Neutral Networks:

Neutral networks are classified into the following different categories:

- Modular neural network
- Kohonen's self-organizing neural network
- Radial basis function neural network
- Recurrent neural network
- Feed-forward neural network
- Conventional neural network

The first neural network which is a modular neural network breaks large networks into smaller independent neural networks. Smaller networks perform specified tasks. After that, all these tasks are combined into a single output of the network. Kohonen uses unsupervised learning for the self-organizing of the network model into input data [1].

Kohonen's self-organizing neural network consists of two types of layers, first is the input layer and the second one is the output layer. The output layer is organized into a two-dimensional grid. The attributes of the output layer do not have any activation function [2].

Radial basis function neural networks are used in function approximation, time series production problems, and classification. It consists of an input layer, an output layer, and a hidden layer. Radial basis functions are included in the hidden layer. The cluster function is represented by each of its nodes. The output of the radial basis function is determined by the input and output layers. Weight parameters are used to perform classification [3].

The processing unit of the recurrent neural network forms a cycle. In this network output from the layer forms the input of the next layer. Thus this process forms a feedback loop. This process allows the networks to have a memory of the previous state. Recurrent takes the series of input and generate the sequence of outputs. Those applications that require a sequence of time use a recurrent neural network.

In feed-forward neural networks, information flows from the input to the output layer. Information flows only in one direction. They do not form loops or circles.

And at the last, there is a conventional neural network. A conventional neural network is based on the human visual cortex. It has a lot of applications in computer vision (image processing). It is also used in video recognition, natural language processing, and drug discovery. The main focus of this report is on the conventional neural network which is an algorithm of deep learning. Detailed explanations and his applications in various fields are given below:

#### 4.1.1. Conventional Neural Network:

Conventional neural networks are an algorithm of deep learning. It has a lot of applications in computer vision (image processing), video recognition, natural language processing, and drug

discovery. The term 'Conventional' means mathematical term. It is derived from the integration of two different terms. It describes how others' functions impact the shape of one function. We can also say that it is a relation between elements and their operation. Convolution neural networks have the following primary tasks:

- Classify visual content
- Recognize object
- Gather recognized objects into a cluster

Another important application of the conventional neural network is that it is used for different types of data analysis. A conventional neural network is also applied to the spoken word to get transcribe and recognize.

#### 4.1.2. How do conventional neural networks work?

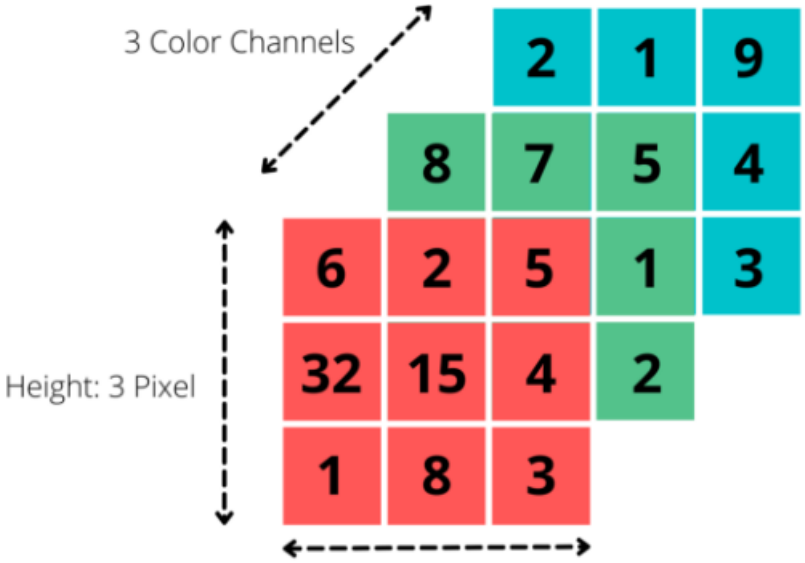
Conventional neural networks consist of four different layers. Which are the convolution layer, rectified linear unit layer, pooling layer, and connected layer.

The series of multiple convolution layers perform progressively more refined feature extraction at every layer moving from input to output layers. Fully connected layers that perform classification follow the convolution layers. Subsampling or pooling layers are often inserted between each convolution layer. CNN takes a 2D ***n*** x ***n*** pixelated image as input. Each layer consists of groups of 2D neurons called filters or kernels. Unlike other neural networks, neurons in each feature extraction layer of CNN are not connected to all neurons in the adjacent layers. Instead, they are only connected to the spatially mapped fixed-sized and partially overlapping neurons in the previous layer's input image or feature map. This region in the input is called the local receptive field. The lowered number of connections reduces training time and chances of overfitting. All neurons in a filter are connected to the same number of neurons in the previous input layer (or feature map) and are constrained to have the same sequence of weights and biases. These factors speed up learning and reduce the memory requirements for the network. Thus, each neuron in a specific filter looks for the same pattern but in different parts of the input image. Sub-sampling layers reduce the size of the network. In addition, along with local receptive fields and shared weights, it effectively reduces the network's susceptibility to shifts, scale, and distortions of images. Max/mean pooling or local averaging filters are used often to achieve sub-sampling. The final layers of CNN are responsible for the actual classifications, where neurons between the layers are fully connected. Deep CNN can be implemented with multiple series of weight-sharing convolution layers and sub-sampling layers. The deep nature of the CNN results in high-quality representations while maintaining locality, reduced parameters, and invariance to minor variations in the input image.

#### 4.1.3. Conventional neural networks in image processing:

A conventional neural network is a very powerful algorithm in computer vision or image processing. There are three different types of matrices in RGB images. Matrixes contain pixels and each matrix describes what color that pixel displays. We can do this by defining three

components which are red, green, and blue color. If we have an image of 3x3 pixels it means that it contains 3x3 matrixes.




We put each pixel as the input of the network for image processing. For example, if the size of the image is 100*100*3. We have to provide 30000 input neurons. The size of each matrix is 100 by 100 pixels so 100*100 total entries. For each red, green, and blue, matrixes exist three times. Each neuron weighs 10000 from the input layer. This is a big problem in the hidden layer. In the hidden layer, if we increase the number of neurons this means that the number of parameters would increase quickly. If we want more pixels and colors for large images this problem will increase. For these reasons convolution, neural networks work on a different approach. For example, if we see an image we will automatically divide it into parts. After that, we analyze them one by one. By assembling these images we interpret and process the image. All these processes also happen in the layers of convolution neural networks.

Firstly this happens in the conventional layer. To determine how large the partial images we defined the filter. For example, if we want to reduce the image with the dimension of 4x4x3. For this process, we will define a filter with the dimension of 2x2. This 2x2 dimension is for each color. The filter moves forward one pixel after each calculation. This process will not produce many dimensions. What happens if we migrate the 4x4 matrix with 2x2? This convolution layer will produce the output of 3x3. We can calculate the value of each matrix by scalar product.

The pooling layer is the next step of the process. The same thing is happen in the pooling layer as in the convolution layer. The main difference in the pooling layer is that we take the maximum value from the output. From the convolution layer, the pooling layer takes its input. According to

the previous one 3x3 is the input for the pooling layer. The pooling layer additionally takes the main features of the image and tries to reduce the dimensionality. The output of this layer is 2x2. To get this output we need to divide the input into all 2x2 matrixes. We would calculate the average of four fields by using the average pooling layer. The pooling layer also has a feature that it can remove noises from the images.

And at the last, there is the connected layer. The connected layer does what we needed from the image. We create a matrix of 2x2 and connect it to other neurons. This gives the main dimension. Finally, this connected layer learns which part of the image needs to be classified. For example, if we have larger images of 5x5x3. By setting the pooling layer and conventional layer in a row we can make it possible. We need to do this before going to the connected layer.

#### 4.1.4. Conventional neural networks in medical diagnosis:

Conventional neural networks are also used in medical diagnosis. By using this technology the cost will reduce and also gives more accurate results. The clinical workload would be reduced efficiently and the process of exploring different symptoms' correlation at the same time could provide a robust conventional neural network-based diagnosis support system. The conventional neural network model is used to subdivide the selected correlated attributes discovered in the hidden layer. Additionally, undetected regular correlated readings are found by extracting the regular behavior of the correlated health factors.

From the collected Electronic health record factors, it is found that there are some regularity-related health statuses. Regularity means that a certain disease may result in a change in specific health-related parameters for a specific period and this may provide an important insight into a person's health status. Therefore, exploring regular factor behavior is a major issue in analyzing health records. For example, supposing disease X results in increases in body temperature and heart rate three times within one month, recording and analyzing this notable occurrence may help in preventing some sort of heart attack related to this patient. Therefore, detecting the strong correlation between health factors and understanding the regular characteristics of the collected data would help in exploring more knowledge that is not due to random occurrences. To enable reporting only the regular behavior of health parameters, we use a conventional neural network Algorithm to calculate the periodicity of each pattern based on the user-defined regularity threshold value.

## 5. Methodology:

We have discussed two different applications of conventional neural networks. For image processing, conventional neural networks use different types of layers. Which are the convolution layer, rectified linear unit layer, pooling layer, and connected layer. There are three different types of matrices in RGB images. Matrixes contain pixels and each matrix describes what color that pixel displays. We can do this by defining three components which are red, green, and blue color. It is also a powerful technology in the field of medical diagnosis. Detecting the strong correlation between health factors and understanding the regular characteristics of the collected

data would help in exploring more knowledge. To enable reporting only the regular behavior of health parameters, we use a conventional neural network Algorithm.

## 6. Conclusion:

A neural network is a technique of machine learning which is inspired by the structure of the brain and its resemblance to the human nervous system. It consists of processing units which are input layers, output layers, and hidden layers. For image processing and medical diagnosis conventional neural network performs better than any other conventional modular-based approaches. In image processing, neural layers perform step by step. In the medical field, critical health decisions are required to help patients attend to their health status. A conventional neural network is proposed to analyze the health parameters.

## 7. References:

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