SNS COLLEGE OF TECHNOLOGY
An Autonomous Institution
Coimbatore-35

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT303-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

III YEAR/ V SEMESTER

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UNIT 5 – DEEP LEARNING

5.1 Convolutional Networks

Convolutional Networks

•It is a type of machine learning and artificial intelligence (AI) that imitates the way humans gain certain types of knowledge.

•Deep learning models can be taught to perform classification tasks and recognize patterns in photos, text, audio and other various data.
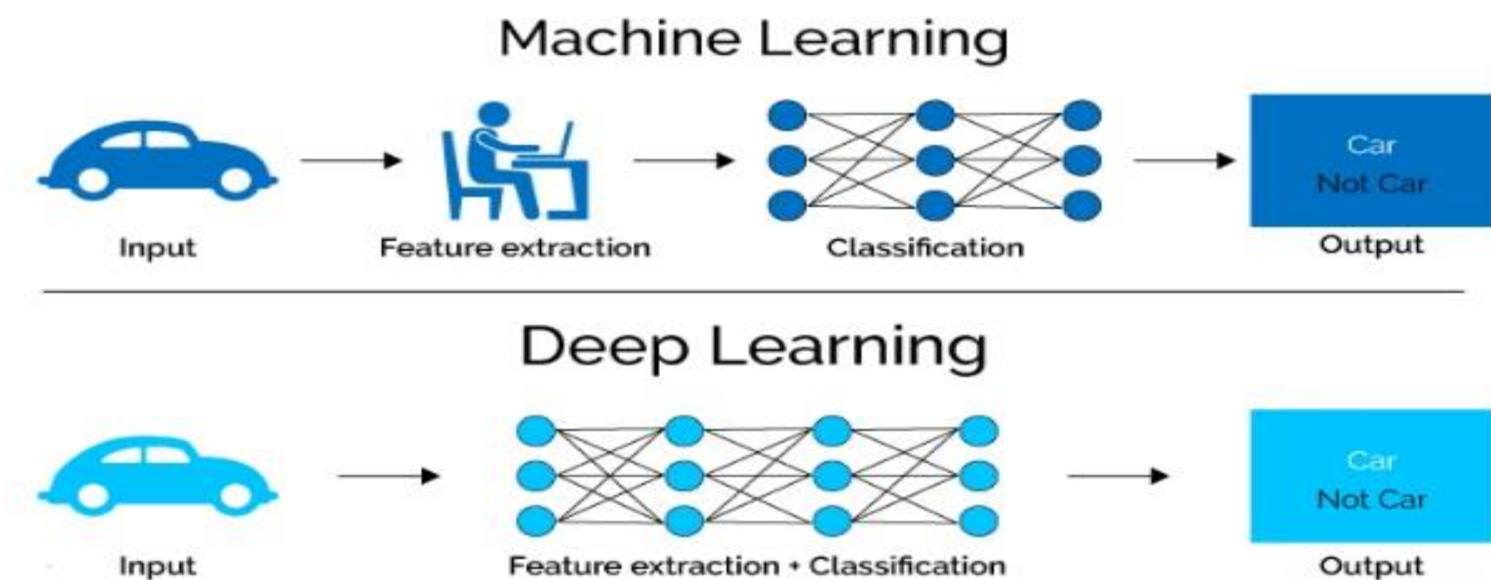
•Examples of deep learning

A neural network attempts to model the human brain's behaviour by learning from large data sets.

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Three types

1. CNNs or Convolutional Neural Networks,

2. RNNs or Recurrent Neural Networks (RNNs).

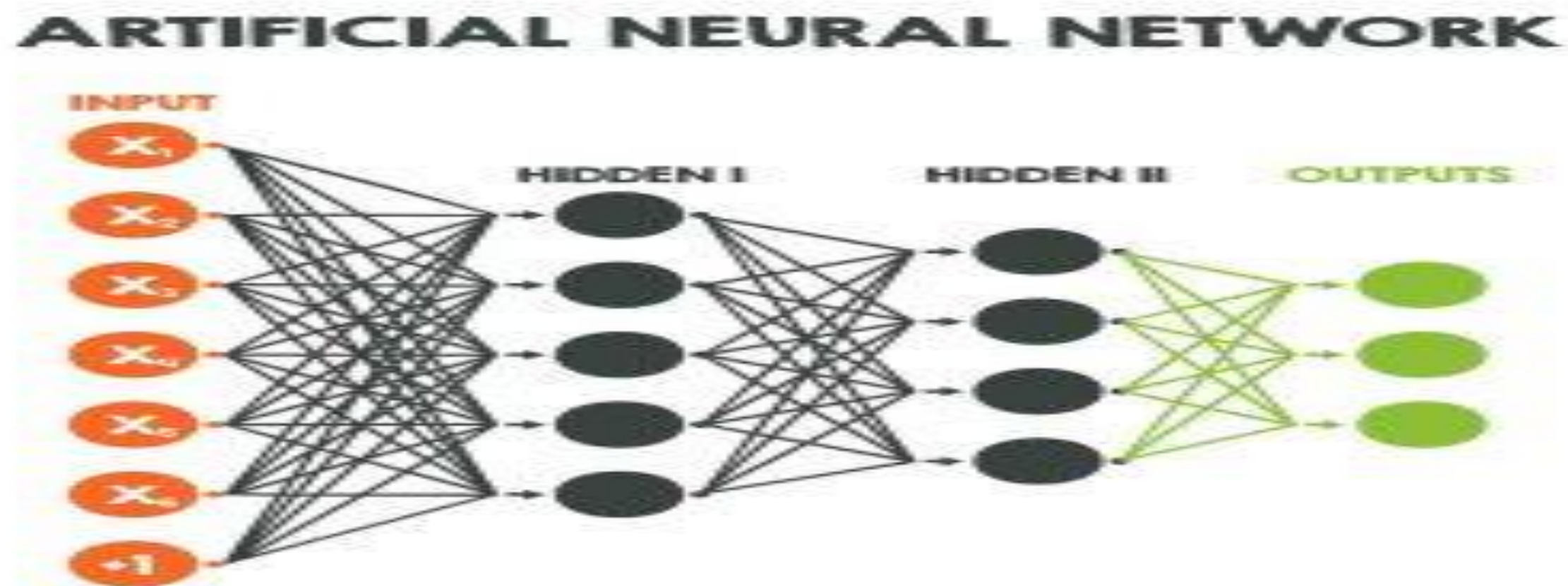3. LSTMs or Long Short Term Memory Networks

Convolutional Networks

- subset of machine learning.

- based on learning and improving on its own by examining computer algorithms.

CNN is a type of artificial neural network, which is widely used for image/object recognition and classification.
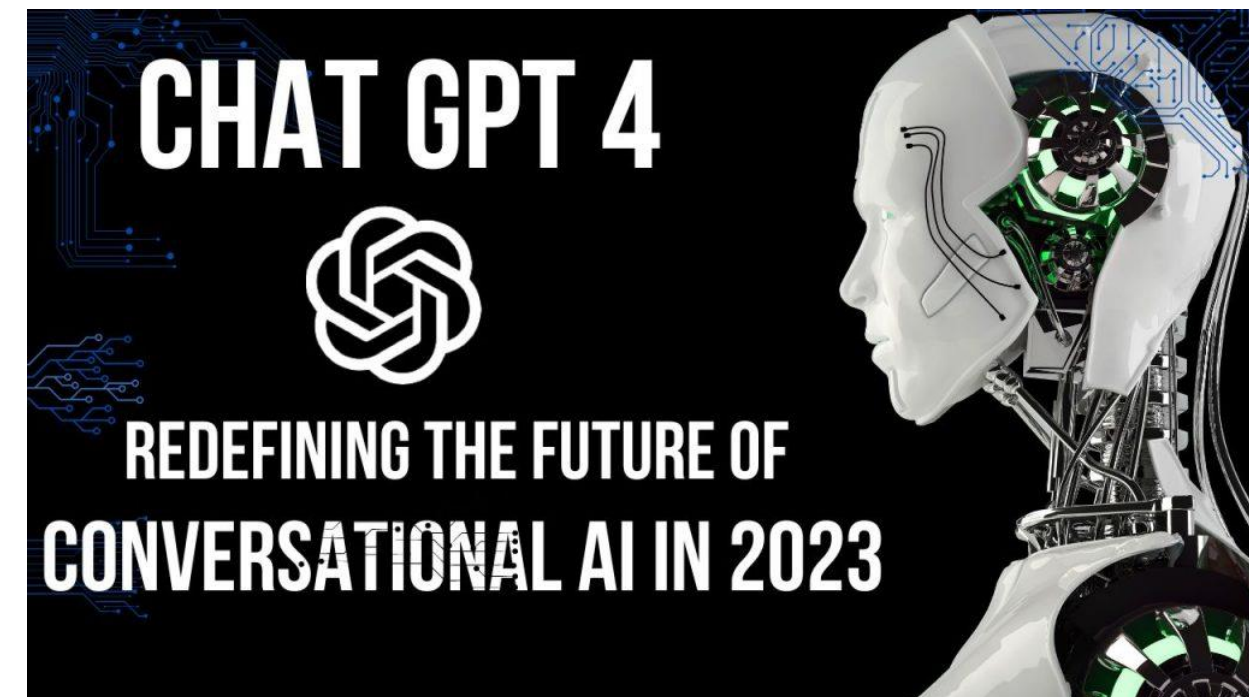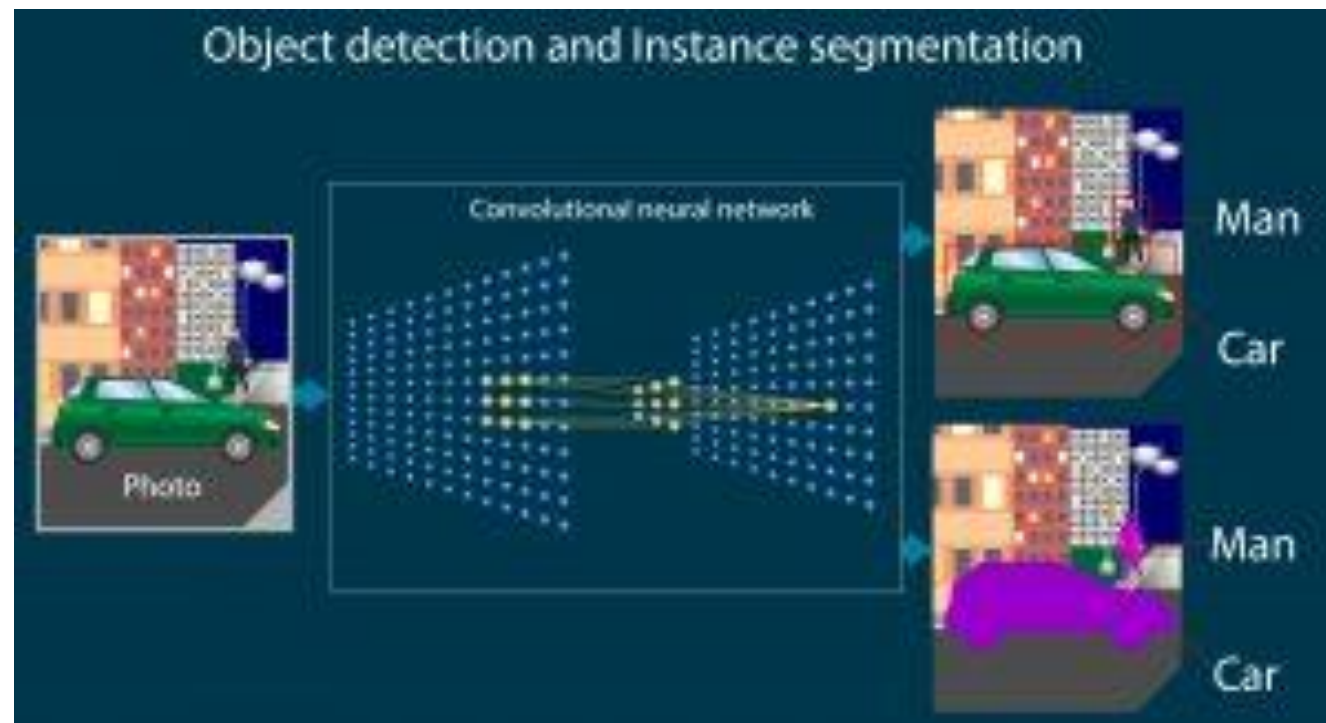
Convolutional Networks

Generative Pre-trained Transformers, are a family of neural network models that uses the transformer architecture and is a key advancement in artificial intelligence (AI) powering generative AI applications such **as ChatGPT.**

Neural networks reflect the behavior of the human brain, allowing computer programs to recognize patterns and solve common problems in the fields of AI, machine learning, and deep learning.

Convolutional Networks

A CNN is a Deep Learning Algorithm that takes an image as an input, assigns various weights and biases to various parts of the image such that they are differentiable from each other.

Once they become differentiable, using various activation functions the CNN Model can perform several tasks in the Image Processing domain including Image Recognition, Image Classification, Object and Face Detection, etc.

The fundamental of a CNN Model is that it receives an input image.

The input image can be either labelled (such as cat, dog, lion, etc.) or unlabelled.
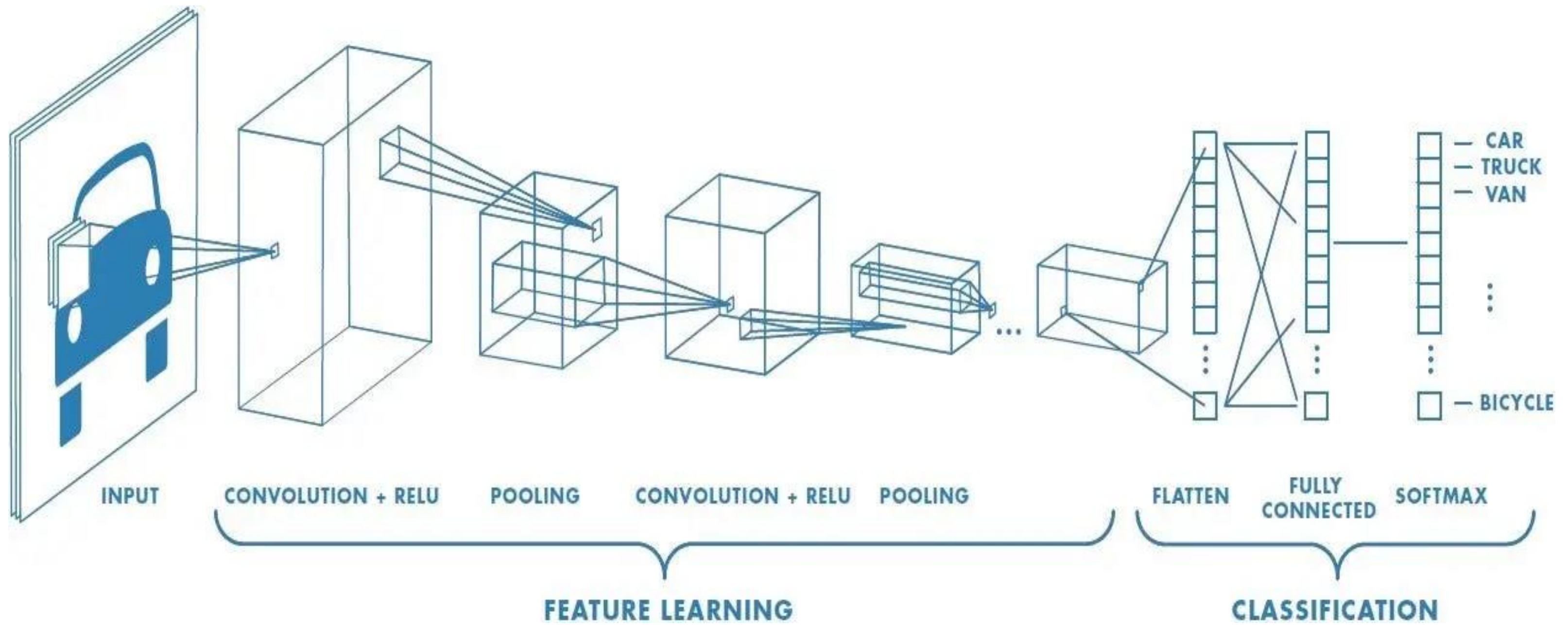
Two types

1. Supervised Algorithms where the images are labelled

2. Unsupervised Algorithms where the images are not given any particular label.

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Convolutional Networks

INPUT — CONVOLUTION + RELU — POOLING — CONVOLUTION + RELU — POOLING — FLATTEN — FULLY CONNECTED — SOFTMAX

CAR
TRUCK
VAN
BICYCLE
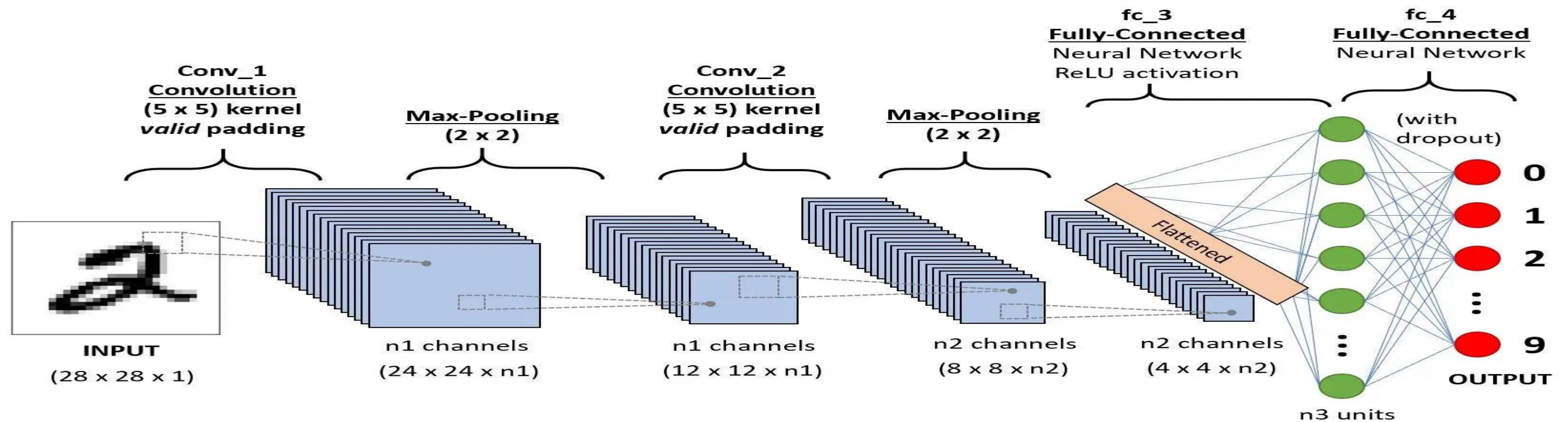
FEATURE LEARNING — CLASSIFICATION

Convolutional Networks

To the computer machine, the input image is seen as an array of pixels, more often in the form of a matrix. Images are mostly of the form

• h x w x d (Where h = Height, w = Width, d = Dimension).

• For example, an image of size 28 x 28 x 1 matrix array denotes an RGB Image (3 stands for the RGB values).

Layers of Convolutional Neural Network

•CNN Model consists of several layers through which the input images undergo pre-processing to get the output.

• Basically, these layers are differentiated into two parts –

•The first three layers including the Input Layer, Convolution Layer and the Pooling layer which acts as the feature extraction tool to derive the base level features from the images fed into the model.

•The final Fully Connected Layer and the Output Layer makes use of the output of the feature extraction layers and predicts a class for the image depending upon the features extracted.

•The first layer is the **Input Layer where the image is fed into the CNN Model in the form of an array of matrix**

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•**i.e., 28 x 28 x 1,**

•**where 1 denotes that the image is an RGB image with an equal height and width of 28 pixels.**

•**these input images pass through the Convolutional Layer where the mathematical operation of Convolution is performed.**

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Convolutional Networks

The input image is convolved with another square matrix known as the **kernel or filter.**

By sliding the kernel one by one over the pixels of the input image, we obtain the output image known as the **feature map** which provides information about the base level features of the image such as edges and lines

Convolutional Layer is followed by the **Pooling layer whose aim is to reduce the size of the feature map to reduce computational cost.**

This is done by several types of pooling such as Max Pooling, Average Pooling and Sum Pooling.

The Fully Connected **(FC)** Layer is the penultimate layer of the Convolutional Neural Network Model where the layers are **flattened and fed to the FC layer.**

Here, by using activation functions such as the **Sigmoid, ReLU and tanH** functions, the label prediction takes place and is given out in the final Output Layer.

Convolutional Networks

Where the CNNs Fall Short

•CNN in visual image data, the CNNs have a small disadvantage in that they do not work well with a sequence of images (videos) and fail in interpreting the temporal information & blocks of text.

•In order to deal with temporal or sequential data such as the sentences, we require algorithms that learn from the past data and also the future data in the sequence.

•Luckily, the Recurrent Neural Networks do just that.

•image/object recognition and classification

Sofa
0.01%

Clock
0.04%

Bouquet
0.02%

Girl
0.94%