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Department of Computer Science and Engineering



**A Seminar Report on**

**“INTODUCTION TO CNN”**

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**Abstract:** The field of data science and machine learning has taken dramatic twists in the recent times, with the rise of ANN (Artificial Neural Networks). These biologically inspired computational models are able to far exceed the performance of previous forms of artiﬁcial intelligence in common machine learning tasks. One of the most impressive forms of ANN architecture is that of the Convolutional Neural Network (CNN). CNNs are primarily

used to solve difﬁcult image-driven pattern recognition tasks and with

their precise yet simple architecture, offers a simpliﬁed method of getting

started with ANNs.

Introduction: (ANNs) are computational processing systems of

**Introduction:** ANNs are computational processing systems which are heavily inspired by way biological nervous systems. CNN is a type of neural network model which allows us to extract higher representations for the image content. Unlike the classical image recognition where you define the image features yourself, CNN takes the image’s raw pixel data, trains the model, then extracts the features automatically for better classification. (CNNs) are analogous to traditional ANNs. CNNs are analogous to traditional ANNs in that they are comprised of neurons that self-optimise through learning.

**Theory:** A Convolutional neural network (CNN) is a neural network that has one or more convolutional layers and are used mainly for image processing, classification, segmentation and also for other auto correlated data. A convolution is essentially sliding a filter over the input.

The most common use for CNNs is image classification, for example identifying satellite images that contain roads or classifying hand written letters and digits. There are other quite mainstream tasks such as image segmentation and signal processing, for which CNNs perform well at.

**Classical Image Classification:**

In the past, image classification models used raw pixels to classify the images.

For example You can classify cats by color histogram and edge detection which allows you to classify cats by color and ear shape. This method has been successful but until the method encounters more complex variants. That’s where the classical image recognition fails because the model does not account for other features. To overcome this problem CNN was used. CNN is a type of neural network model which allows us to extract higher representations for the image content. Unlike the classical image recognition where you define the image features yourself, CNN takes the image’s raw pixel data, trains the model, then extracts the features automatically for better classification.

**Convolutional kernels:**

Each convolutional layer contains a series of filters known as convolutional kernels. The filter is a matrix of integers that are used on a subset of the input pixel values, the same size as the kernel. Each pixel is multiplied by the corresponding value in the kernel, then the result is summed up for a single value for simplicity representing a grid cell, like a pixel, in the output channel/feature map. The input is often a 3 channel RGB image. For simplicity, if we take a grey scale image that has one channel (a two-dimensional matrix) and a 3x3 convolutional kernel (a two-dimensional matrix). The kernel strides over the input matrix of numbers moving horizontally column by column, sliding/scanning over the first rows in the matrix containing the images pixel values. Then the kernel strides down vertically to subsequent rows. Note, the filter may stride over one or several pixels at a time.

**Padding:**

To handle the edge pixels there are several approaches:

* Losing the edge pixels
* Padding with zero value pixels
* Reflection padding

Reflection padding is by far the best approach. Here the number of pixels needed for the convolutional kernel to process the edge pixels are added onto the outside copying the pixels from the edge of the image. For a 3x3 kernel, one pixel needs to be added around the outside, for a 7x7 kernel then three pixels would be reflected around the outside. The pixels added around each side is the dimension, halved and rounded down.

**Many Kernels:**

In CNN models there are often there are many more than three convolutional kernels, 16 kernels or even 64 kernels in a convolutional layer is common. These different convolution kernels each act as a different filter creating a channel/feature map representing something different. For example, kernels could be filtering top edges, bottom edges, diagonal lines and so on. In much deeper networks these kernels could be filtering to animal features such as eyes or bird wings. Having a higher number of convolutional kernels creates a higher number of channels/feature maps and a growing amount of data and this uses more memory.

**Advantages:**

The main advantage of CNN compared to its predecessors is that it automatically detects the important features without any human supervision. For example, given many pictures of cats and dogs it learns distinctive features for each class by itself. CNN is also computationally efficient.

**Disadvantages:**

High computational cost. If we don't have a good GPU they are quite slow to train (for complex tasks).They use to need a lot of training data.

**Conclusion:** Convolutional neural networks (CNNs) have accomplished astonishing achievements across a variety of domains, including medical research, and an increasing interest has emerged in radiology.

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