Enterprise AI

Convolutional Neural Network and its Latest Use Cases

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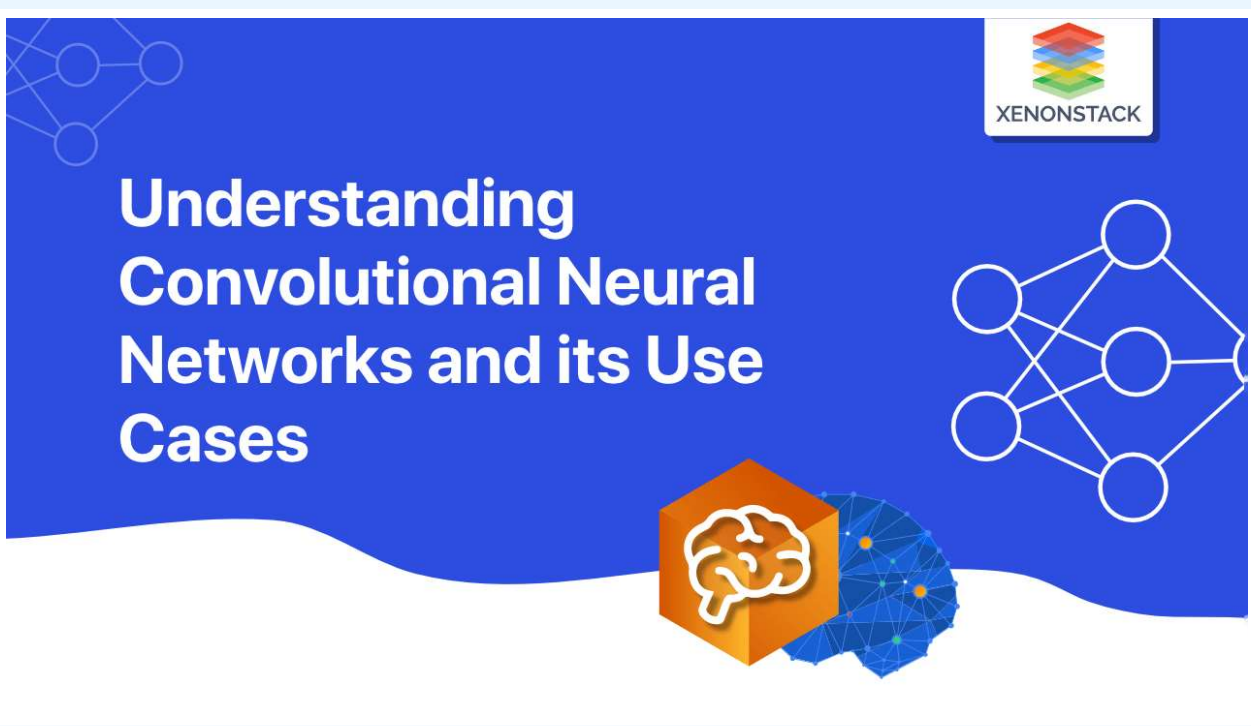

Introduction to Convolutional Neural Network

AI has moved far beyond what a human can imagine a decade ago. The outputs which ML models produce are many times a black box's work for a normal human being and even for Data scientists sometimes. Though AI technology is achieving better and more significant goals than a human being can in many fields, the results for image processing still do not match human abilities.

The working of the human brain is very complex. Its cognition and rendering mechanisms are still a mystery. A human brain consists of many layers of interconnected neurons, and AI is trying to mimic this structure with artificial neurons to achieve better or at least similar results as the brain. In the mid-20s, scientists developed the concept of artificial neural networks, which

An extra edge to choose a specific framework for a particular task from different frameworks available. Click to explore Virtual Network Functions

What is Convolutional Neural Network (CNN)?

Convolutional Neural Network (CNN) is an artificial neural network with multiple input and output layers, mainly used for computer vision.

According to Wikipedia In mathematics, convolution is a mathematical operation on two functions that produces a third function that expresses how the shape of one is modified by the other. The term convolution refers to both the result function and the computing process. This concept breaks the image into multiple parts and analyzes them independently.

CNN is layers based system, and the different layers are different mathematical compositions. The main types of layers are convolution, pooling, and fully connected layers.

- Convolutional layers are the features in an input image in a summarized view. At this stage, different mathematical operations work, and the output for the image pixels gets stored in the grid format, called a kernel. The output of this layer is location sensitive.
- A pooling layer is an approach with a down-sampling feature in patches. An optimizable feature extractor is work at each image position to make it highly efficient. Two common pooling methods are average pooling(the average) and max pooling(most activated).
- Finally, the fully connected layer combines the previous layer's output and predicts the best possible results.

In this layer system, one layer's output is input for the other layer, and the complexity increases layer by layer.

What are the different types of Convolutional Neural Network (CNN) Architectures?

The various types of CNN Architectures are listed below:

LeNet

LeNet is among the first successful CNN projects. This method is also recommended to beginners as the "Hello World" code. In 1998 the first use case for this deep

gradients, the training was not easy for this model, which was later compensated with "Max-pooling" as a connection layer between convolutional layers. This made the training easy by preventing overfitting.

AlexNet (Ilsvrc 2012 winner)

The concept of "Max-pooling" was accepted to the extent that this new AlexNet network combines 5 max-pooling layers,3 fully connected and two dropouts.

Though this architecture is quite similar to LeNet, but much deeper stacked layers. This could accumulate around 60 million features.

ZF Net (Ilsvrc 2013 winner)

The ZF CNN architecture uses other layers between CNN, known as deconvolutional layers, which makes it more efficient than AlexNet.

GoogLeNet

GoogLeNet is the architecture used by Google in the 2014 event of ILSVRC.
It has models with a reduced error rate in comparison with previous winners. Street view house number detection was the most recognized use case.

VGGNet

VGGNet can work on 4096 convolutional features, with 16-layers CNN with up to 95 million parameters, which can be trained on over one billion images.
This is too expensive to train and needs huge data.

ResNet(Ilsvrc 2015 winner)

ResNet architecture is the most profound network with 152 layers, which can take more months to train, and 32 GPU power. ResNet used CNN successfully to solve natural language processing problems like sentence building or machine comprehension.

Microsoft's machine comprehension system is one of the use cases of ResNet. These networks can be scaled up or down, considering the computational power of GPUs.

MobileNets

MobileNets has made CNNs possible for a mobile device for image processing and low latency.

Engineering

Implementation of Convolutional Neural Networks

Implementing a convolutional neural network (ConvNet) consists of several steps.

1. **Data Preprocessing:** Input data is prepared for use in ConvNet. This includes data normalization, scaling, and resizing.
2. **Constructing the ConvNet Architecture:** This includes defining the convolutional layers, the size and number of filters, the type of activation function to use, and the pooling layers. You may also want to define fully connected layers for your final output.
3. **ConvNet Training:** Using the training data set to update the ConvNet weights and biases using an optimization algorithm such as Stochastic Gradient Descent (SGD) or Adam.
4. A loss function measures the error between predicted and actual output.
5. **Evaluate ConvNet:** This evaluates the performance of the trained ConvNet using a validation or test data set. Standard metrics are accuracy, precision, recall, and F1 score.
6. **Deployment:** The final step is to deploy ConvNet into a working environment. Integrate into your mobile application or host it on your server for real-time predictions.

It is important to note that implementation details such as exact architectures, optimization algorithms, and loss functions can vary greatly depending on the type of task and input data.

What are the Applications of Convolutional Neural Network?

Convolutional Neural Networks (CNNs) are widely used in various applications such as:

1. **Object Detection:** CNN can detect and locate objects in images or videos.
2. **Image Segmentation:** CNNs can segment images into different regions and tag each region with a semantic class.
3. **Create Images:** CNNs can create new images or manipulate existing ones.
4. **Video Analytics:** CNNs can be used for action detection, object tracking, and video scene segmentation.

6. **Autonomous Systems:** CNNs can be used in autonomous systems such as self-driving cars for lane detection, obstacle detection, and traffic sign recognition.

> A division of unsupervised learning which makes it more handful because it can also handle unsupervised learning which is itself a big plus. Click to explore here about Generative Adversarial Networks Applications

What are the Use Cases of Convolutional Neural Network?

Businesses such as Facebook, Google, Pinterest, Instagram, and others have started using CNNs to help enterprises in growth. As a result, five major applications have been discovered that people encounter daily:

Decoding Facial Recognition

One of the main applications of this architecture is facial recognition. Using this technique, facial images are broken down into multiple components. The significant components are separating facial features from external features like light or pose and unique facial features.

Document rendering

The documents, including handwritten materials, can be analyzed using CNN architectures. The error rate of comparison of documents with available content is reduced to near zero. Thousands of simultaneous commands run to analyze the handwritten content using CNN, which is very difficult otherwise.

Recognition of Speech

Besides Image processing, neuron networks are also useful for recognizing speech with a huge range of vocabulary and phonics. Emotional detection using CNN is also a focus area for researchers.

Video Processing

Video events like fire or other unusual events can be detected using CNN characteristics. The spatial and temporal information present in videos are the main features when working with Video analysis.

this, the information moves in only one direction, forward from the input nodes, through the hidden nodes, and to the output nodes. There are no cycles in the network.

Heart Disease Detection

Convolutional neural networks (CNNs) can detect heart disease by analyzing medical images such as electrocardiogram signals, MRI, and CT scans. You can train a CNN on a large dataset of images to learn the features of healthy and unhealthy heart images. During inference, the model can classify new images as healthy or indicate the presence of heart disease. This helps in the early detection of heart disease, which is essential for effective treatment. However, it is important to note that CNNs should not be used as the sole tool for detecting heart disease, and a physician should always confirm results.

Video Games

Convolutional neural networks (CNNs) can predict customer lifetime value (CLV) in the video game industry. CLV measures the value a customer brings to a company over their lifetime. In the video game industry, CLV can be influenced by player behavior, consumer behavior, and game interaction.

CNNs can be trained using historical player data such as in-game behavior, consumption patterns, and demographics to learn patterns that indicate players with high CLV. The model can predict a new player's CLV during inference, allowing gaming companies to prioritize efforts to retain and monetize quality players. It's important to note that CLV forecasting is a complex undertaking and requires a thorough understanding of the video game industry, player behavior, and spending patterns. CNN should be used with other statistical techniques and industry knowledge to make informed decisions about player monetization and retention strategies.
Ethical Concerns Related to convolutional neural networks

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Conclusion

version LeNet 1998. With improvements, new use cases arise, reducing errors and providing more accurate results.

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