**ANN vs CNN vs RNN**

**What is deep learning?**

Deep learning is the subdivision of machine learning which helps the computer learn new things without human intervention. It is based on various neural networks.

**What are Neural Networks?**

Neural networks are symbolized as the brain of deep learning. Like in a human brain, a message is transmitted with the help of neurons; the neural networks are also designed to work as the biological neuron to pass signals onto each other. It can find hidden patterns and correlations in raw data, cluster them, and classify them using numerous algorithms.

**Different types of neural networks**

There are three major categories of neural networks, namely, Artificial Neural Network, Convolution Neural Network, and Recurrent Neural Network. All of these form by the pre-trained models in deep learning. Let us discuss ANN vs. CNN vs. RNN.

Also see, [Artificial Intelligence in Education](https://www.naukri.com/code360/library/artificial-intelligence-in-education)

**Artificial neural networks**

An artificial neural network is the simplest, as it passes information through multiple neurons until it generates an output. It is also known as a feed-forward neural network because the inputs are processed only in a forward direction.

As you can see in the image, ANN consists of three layers. The input layer inputs the variables, after which the hidden layer performs all the formulas and various expressions to process the output.

**Advantages and disadvantages of ANN**

|  |  |
| --- | --- |
| Advantages of Artificial Neural Network | Disadvantages of Artificial Neural Network |
| It has a distributed memory; that’s why it can store incomplete information and learn a nonlinear function. Therefore, it is also known as Universal Function Approximators. ANN can run smoothly without interruptions, even if there is a failure in one or more components. | ANN is a hardware-dependent feature. One major drawback of ANN is that the algorithm stores the 2-dimensional image in a 1-dimensional vector space when used in image classification before training the model. Due to which at the time of output, the size of the training set increases drastically, and ANN loses the arrangements of pixels of the image, which could sometimes distort the image. |

**Convolution Neural Network**

Convolution Neural Network is a sort of Deep Learning algorithm that takes an image as input and learns the various features of the image through filters, also known as kernels. This allows the model to learn and catch up with the different objects present in the picture. For example, CNN will learn the features of apple that differ from orange so that when we provide apple input, it can differentiate between the two.

Now let us see how does the CNN algorithm work.

As shown in the image, the first layer inputs the image dimensions, then in the hidden layers, the model learns various image features. Finally, the image classifier is ready for use.

**Advantages and disadvantages of CNN**

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| --- | --- |
| Advantages of Convolution Neural Network | Disadvantages of Convolution Neural Network |
| One of the essential features of CNN is its capability to pre-process the data by itself without any human supervision. This deep learning model is accurate in image classification and image recognition problems. | As in ANN, CNN does not encode the position and orientation of images, and for training, a tremendous amount of training data is required. |

**Recurrent Neural Network**

An RNN is a category of neural network where there is a connection between the nodes along a temporary sequence. The temporary sequence is the data that transitions over time. The most used example of RNN is Google assistance and Apple’s Siri. It is the algorithm that remembers and stores the input in internal memory, due to which this algorithm can solve all the problems having sequential data.

Each node in the RNN model acts as a memory cell, saves the previous node’s output, and feeds the results rather than moving in a forwarding direction to give an output. If the model’s prediction is incorrect, it learns itself and continues working towards a better prognosis during backpropagation.

**Advantages and disadvantages of RNN**

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| --- | --- |
| Advantages of Recurrent Neural Network | Disadvantages of Recurrent Neural Network |
| The fact that RNN saves the memory of every cell is the cause of significant benefit as this algorithm can be used for time series prediction as well. Also, it reduces the number of parameters to check because RNN shares the parameters at different steps. | RNN stores memory at every step, acquiring much space. Also, it requires a massive amount of training data, due to which training the model is complex. |

**ANN vs. CNN vs. RNN**

Here is a table of comparison ANN vs. CNN vs. RNN:

|  |  |  |  |
| --- | --- | --- | --- |
|  | ANN | RNN | CNN |
| Data | Tabular data | Sequence data | Image data |
| Recurrent Connections | No | Yes | No |
| Parameter sharing | No | Yes | Yes |
| Spatial relationship | No | No | Yes |
| Vanishing and exploding gradient | Yes | Yes | Yes |
| Loss Function | J=∑(youtput-ypredicted) | J=∑J(ŷ,y) | J(C,G)=1/2|a[l](C)-a[l](G)|2 |
| Gradient Function | ∑∂J/∂W | ∂J/∂W = ∑∂J(T)/∂W | ∂E/∂W = ∑∂ET/∂W |

**Frequently Asked Questions**

**1. Why should we choose deep learning rather than machine learning?**

**Ans.** There are two primary reasons to select a model building process. They are feature extraction and feature selection. In feature extraction, we extract all the necessary features of our problem statement, whereas, in feature selection, we select the essential features that improve the performance of our model. However, extracting all the features manually requires more substantial knowledge of the subject and domain, and it is also time-consuming. Nevertheless, deep learning models are built to do these tasks faster. Therefore, people generally prefer deep learning rather than machine learning.

**2. Why is CNN preferred more than RNN for image processing?**

**Ans.**Recurrent Neural Network comprises less feature compatibility when compared to Convolution Neural Networks. CNN takes fixed-size inputs and generates fixed-sized outputs. RNN can handle arbitrary information or output lengths. CNN is ideal for images and video processing

**3. Are Artificial Neural Networks part of Supervised Learning?**

**Ans.** Artificial Neural Network is a category of deep learning which works just as a neuron in a human brain and learns from past experiences.