

The role of technology with Neural Networks

Author: Nyasha Ziwewe . July 2020

Neural networks are mathematical models that use learning algorithms inspired by the brain to store information. Since neural networks are used in machines, they are collectively called an ‘artificial neural network.’ Nowadays, the term machine learning is often used in this field and is the scientific discipline that is concerned with the design and development of algorithms that allow computers to learn, based on data, such as from sensor data or databases. A major focus of machine-learning research is to automatically learn to recognize complex patterns and make intelligent decisions based on data. Hence, machine learning is closely related to fields such as statistics, data mining, pattern recognition, and artificial intelligence. Neural networks are a popular framework to perform machine learning.

Neural networks are computing systems with interconnected nodes that work much like neurons in the human brain. Using algorithms, they can recognize hidden patterns and correlations in raw data, cluster and classify it, and over time continuously learn and improve. A *training algorithm* is the method that can be used to execute the neural network’s learning process. As there are a huge number of training algorithms available, each consisting of varied characteristics and performance capabilities, different algorithms can be used to accomplish different goals.

Neural networks have a unique ability to extract meaning from imprecise or complex data to find patterns and detect trends that are too convoluted for the human brain or for other computer techniques. Neural networks have provided with greater convenience in numerous ways, including through ridesharing apps, Gmail smart sorting, and suggestions on Amazon. The most ground breaking aspect of neural networks is that once trained, they learn on their own. In this way, they emulate human brains, which are made up of neurons, the fundamental building block of both human and neural network information transmission.

Neural networks’ human-like attributes and ability to complete tasks in infinite permutations and combinations make them uniquely suited to today’s big data-based applications. Because neural networks also have the unique capacity (known as *fuzzy logic*) to make sense of ambiguous, contradictory, or incomplete data, they are able to use controlled processes when no exact models are available.

There are various important aspects of neural networks as mentioned below.

- **Ability to learn and model non-linear and complex relationships** - Artificial neuro networks have the ability to learn and model non-linear and complex relationships, which is really important because in real-life, many of the relationships between inputs and outputs are non-linear as well as complex.
- **Ability to generalize** - Artificial neuro networks can generalize, after learning from the initial inputs and their relationships, it can infer unseen relationships on unseen data as well, thus

making the model generalize and predict on unseen data.

- **Capability of processing highly volatile data** - Unlike many other prediction techniques, artificial neuro networks does not impose any restrictions on the input variables like how they should be distributed. Additionally, many studies have shown that they can better model heteroscedasticity that data with high volatility and non-constant variance, given its ability to learn hidden relationships in the data without imposing any fixed relationships in the data. This is something very useful in financial time series forecasting such as stock prices where data volatility is very high.

Applications of neural networks

Neural networks can be applied in subjects like classification, recognition, assessment, forecasting and prediction.

- **Classification** - in marketing, it is used in pattern classification. This will help business managers to make informed decisions in target marketing, niches and differentiation. In medicine, it is used in ultrasound, medical diagnosis and electrocardiogram image classification. Defense forces also uses artificial neuro networks in radar and sonar image classification. In the agriculture field, that is farming and fishing, it is used in fruit and catch grading respectively.
- **Recognition and prediction** - In computing and telecommunication, artificial neuro-networks can be used in speech, vision and handwriting recognition. Signature verification can also be applied in the field of finance. Image Processing and Character recognition, given its ability to take in a lot of inputs, process them to infer hidden as well as complex, non-linear relationships, artificial neuro networks are playing a big role in image and character recognition. Character recognition like handwriting has lot of applications in fraud detection, bank fraud as an example and even national security assessments. Image recognition is an ever-growing field with widespread applications from facial recognition in social media, cancer detection in medicine to satellite imagery processing for agricultural and defense usage. The research on artificial neuro networks now has paved the way for deep neural networks that forms the basis of deep learning and which has now opened up all the exciting and transformational innovations in computer vision, speech recognition, natural language processing such as in self-driving cars.
- **Forecasting** - Forecasting is required extensively in everyday business decisions for example sales, financial allocation between products, capacity utilization, in economic and monetary policy, in finance and stock market. More often, forecasting problems are complex, for example, predicting stock prices is a complex problem with a lot of underlying factors. Traditional forecasting models throw up limitations in terms of taking into account these complex, non-linear relationships. Artificial neuro networks, applied in the right way, can provide robust alternative, given its ability to model and extract unseen features and relationships. Also, unlike these traditional models, ARTIFICIAL NEURO NETWORKS doesn't impose any restriction on input and residual distributions.
- **Assessment** – Quality engineers can use artificial neuro networks in product inspection monitoring in the field of engineering. Target tracking can be achieved through the use of artificial neuro networks in the field of defense. Security mechanisms can employ artificial neuro networks in motion detection and in fingerprinting matching.

Nyasha D Ziwewe is a Business Consultant and Systems developer at Industrial Psychology Consultants. Email: nyasha@ipccconsultants.com. Mobile 0783462251. LinkedIn: [Nyasha D Ziwewe](#)

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