ANN (Artificial Neural Networks): A basic guide

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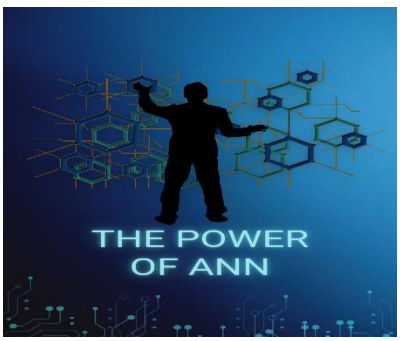
ABSTRACT An Artificial Neural Network (ANN) mimics the structure and functions of the human brain. A natural brain can pick up new skills and adjust to a changing environment and so does ANN models. It learns from its past and adjusts by itself without explicitly programming. In this article, we shall discuss ANN, its architecture, its applications and its future prospect.

KEYWORDS artificial neural networks, natural language processing, robots, emotional intelligence, artificial intelligence, programs.

I. INTRODUCTION

Artificial neural networks, or ANNs, are a technical marvel that draws inspiration from the intricate workings of the human brain. It continues to be the foundation of contemporary artificial intelligence because of their ability to recognize, alter, and interpret information similarly to the human brain. This article explores artificial neural networks (ANNs), looking at its design, uses across a range of sectors, and their bright future in industry transformation.



II. WHAT IS ANN?

Computational models known as Artificial Neural Networks are used to simulate the structure and operation of biological neurons in the human brain. It is made up of a web of linked neurons, often referred to as clusters or neurons, arranged in layers so as to process and learn from information. An essential component of artificial intelligence and machine learning, ANNs are utilized for tasks including pattern recognition, classification, regression, and decision making.

ANN continue to be a fundamental and developing idea. These networks, which are inspired by the neural network of the human brain, have transformed machine learning and allowed computers to mimic mental processes and make deft judgments.

III. ANN ARCHITECTURE

The ANN architecture comprises of 3 layers, namely- the input layer, the hidden layer(s) and the output layer. Let us go about each one of them.

- The input layer: The fundamental layer that takes in unprocessed data or qualities from the outside world is known as the input layer. The number of nodes in the input layer is equal to the number of input features, and each node in the layer represents one input variable or feature.

- The hidden layer: From the incoming data, hidden layers extract features and carry out computations. These layers may have one or more hidden layers, with several nodes or neurons in each. The intricacy of the issue and the network's capacity for learning determine how many nodes are in each hidden layer.
- The output layer: The kind of task determines how many nodes are in the output layer. In binary classification, probabilities may be output by a single node (e.g., 0 or 1). In multi-class classification, the anticipated class is indicated by the node with the greatest value, where each node represents a distinct class.
  The output nodes might represent continuous values in regression tasks.

  Given below is a figure depicting the ANN architecture.

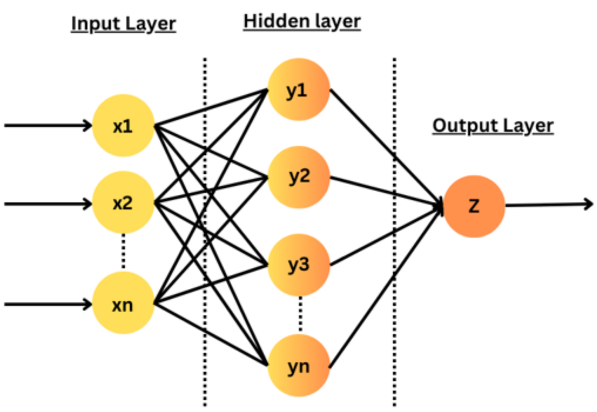


Figure 1: ANN Architecture

All nodes in a layer are connected to all other nodes in the layer below it, i.e., nodes in neighboring levels are completely connected (in feedforward neural networks). Shallow architectures contain fewer hidden layers than deep architectures, which are networks with many hidden levels. The network can learn intricate representations from the data thanks to deep architectures. The kind of issue, the intricacy of the data, and the intended network performance all influence the particular design, which includes factors like the number of layers, nodes in each layer, and connection patterns. In order to capture complicated patterns without overfitting or underfitting the data, designing an appropriate architecture requires striking a balance between complexity.

IV. APPLICATIONS

Pattern Recognition (PR): ANN applies its understanding of how human brain systems process information to PR problems. The NNs (Neural Network) are specifically well-suited for pattern correlation.[6] In terms of functionality, ANN offers a paradigm for achieving PR, which calls for extensive networks of simple, nonlinear components known as neural nets. ANN, particularly in audio, picture, natural language processing, and other domains, are very good at pattern identification by automatically extracting characteristics from input.

Recommendation Systems: ANNs may provide recommendation engines that offer customers customized recommendations in the context of e-commerce and content platforms. These systems provide suggestions based on past data, user activity, and preferences that are customized to each user's interests. It greatly improve user experience and engagement by learning about user habits and preferences. This increases the chance of user happiness and retention.

Chemical Engineering: ANN have been applied in a wide range of chemical engineering applications and offer a strong new set of approaches for handling issues in sensor data processing, fault detection, process identification, and control. Its broad uses includes the following areas: fuel and energy, petrochemicals, biotechnology, cellular industry, oil and gas, environment, health and safety, mineral, nanotechnology, pharmaceutical, and polymer industries.[7]

Healthcare: ANNs play a significant role in the diagnosis of illnesses by analyzing medical imagery including X-rays, MRIs, and CT scans. It aids radiologists in identifying anomalies or understanding the course of illness, leading to more precise and effective diagnosis.

V. FUTURE PROSPECT

Artificial neural networks have a bright future ahead, full of opportunities for industry transformation and constant advancement. Even while ANNs perform better than any other system in intricate tasks, their fuzziness frequently prompts concerns about the decision-making process. Future initiatives thus aim to increase ANNs' transparency so that people may comprehend the thinking behind their products. This will be especially crucial in applications where confidence and openness are play a vital role like health, finance, and policy actions.

Furthermore, ANNs will leverage their capacity for ongoing learning and adaptability in the future. A lifelong learning paradigm aims to allow ANNs to learn from fresh input while maintaining previously acquired data, allowing them to gain knowledge over time. They will be able to grow and improve their comprehension thanks to these adaptive networks, which will allow them to change with the times without losing track of what they have already learned. Efficiency and computation will be made possible, opening up new possibilities for AI and analytics applications[8-12].

VI. CONCLUSIONS

Positioned at the forefront of technological advancement, artificial intelligence holds immense potential to revolutionize industries and shape the course of future technological advancements. The prospect of imitating the cognitive functions of the human brain presents immense opportunities for advancements in self-care systems, finance, healthcare, and other fields. The development of ANNs will improve interpretation and transparency, fostering a sense of trust and confidence in their decision-making procedures—particularly in vital domains like finance and healthcare. Furthermore, as the world embraces AI and analytics and the ANN approach to time being innovative, efficient, and showing limitless possibilities, the continuous learning and adaptability of ANNs promises unprecedented improvements, allowing these networks to evolve, learn, and improve over time without forgetting prior knowledge.

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