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Research Article

Artificial Neural Network Modelling Implication

Dr. Shaheen

Assistant Professor, Institute of public enterprise

Abstract

An Artificial Neural Network (ANN) is an information processing model inspired by the way biological nervous systems "the brain" processing information, a brain transmit a signal from one neuron to another and process information, similar to the neurons in brain an ANN is designed with a collection of connected units or nodes called artificial neuron, this can receive a signal and process it, then signals other artificial neurons connected in the network, the key element of this model is the new structure of the information processing system, which is composed of a large number of highly interconnected processing elements (artificial neurons) working in unison to solve specific problems, The original goal of the ANN approach was to solve problems in the same way a human brain would process information, However, over time the attention moved to performing specific tasks and application such as pattern recognition or data classification through a learning process, This paper gives an overview of Artificial Neural Network, its operation design and also briefs the application and advantages of ANN.

Keywords: *Neuron, unsupervised, supervised, conventional computer, Feed-Forward ANN, Feedback ANN.*

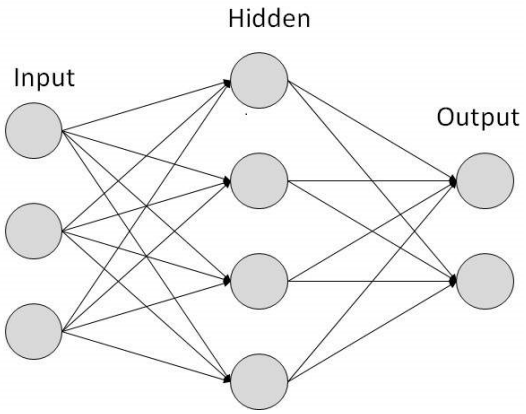
INTRODUCTION

The Artificial neural networks are relatively crude electronic networks of "neurons" based on the neural structure of the brain, the attempt of ANNs is based on the confidence of human brain working, In an ANN too with the right connections using silicon and wires imitating living neurons and dendrites, It process the records one at a time, and "learn" by comparing their prediction of the record with the known actual record. However, to bring proper results, neural networks require correct data pre-processing, architecture selection and network training. In general terms, an artificial neural network consists of a large number of simple processing units, linked by weighted connections. Each unit receives inputs from many other units and generates a single output. The output acts as an input to other processing units.

An artificial neural network is nonlinear in nature and represents an exceptionally powerful method of analysing real-world data that allows modelling extremely difficult dependencies. Neural nets have proven to be among the best methods of detecting hidden relations in a dataset.

WORKING

Neural networks take a different approach to problem solving than that of conventional computers. Conventional computers use an algorithmic approach i.e. the computer follows a set of instructions in order to solve a problem. Unless the specific steps that the computer needs to follow are known the computer cannot solve the problem.



In the Figure 1.1, each arrow represents a connection between two neurons and indicates the pathway for the flow of information. Each connection has a weight, an integer number that controls the signal between the two neurons.If the network generates a “good or desired” output, there is no need to adjust the weights. However, if the network generates a “poor or undesired” output or an error, then the system alters the weights in order to improve subsequent results.

Once a network has been structured for a particular application and the network is ready to be trained. The initial weights are chosen randomly, then the training or learning begins. There are two approaches to training - supervised, unsupervised and reinforced learning. Supervised training involves a mechanism for providing the network with the desired output either by manually "grading" the network's performance or by providing the desired outputs with the inputs. Unsupervised training is where the network has to make sense of the inputs without outside help, the vast majority of networks utilize supervised training.In unsupervised training, the network is provided with inputs but not with desired outputs. The system itself decide what features it will use to group the input data, this is often referred to as self-organization or adaption.

Reinforcement Learning - This training is based on observation, The ANN makes a decision by observing its environment. If the observation is negative, the network adjusts its weights to make a different decision the next time.

NEURAL NETWORK VS. COMPUTATIONAL COMPUTER

Neural networks process information similar to the way human brain does. The network is composed of a large number of highly interconnected processing elements (neurons) working in parallel to solve a specific problem. They cannot be programmed to perform a general task, the examples must be selected carefully otherwise useful time is wasted or even the network might function incorrectly. The disadvantage is the network finds out how to solve the problem by itself, its operation can be unpredictable. On the other hand, conventional computers use a cognitive approach to problem solving, the way the problem is to solved will be known and stated in small unambiguous instructions. These instructions are then converted to a high level language program and then into machine code that the computer can understand. These machines are totally predictable. Neural networks and conventional algorithmic computers are not in competition but complement each other.

WHY IS ARTIFICIAL NEURAL NETWORK

Advances in biological research promise an initial understanding of the natural thinking mechanism, This research shows that brains store information as patterns and these patterns are very complicated and allows the ability to recognize individual faces from different angles, This process of storing information as patterns, utilizing those patterns, and then solving problems developed into a

new field of computing. In the area of semantic, the network utilizes words differently from traditional computing, example words like behave, react, self-organize, learn, generalize, and forget are select based on ANN.

In an ANN architecture hundreds of simple processing units which are wired together in a complex communication network. Each unit or node is a simplified model of real neuron which sends off a new signal or fires if it receives a sufficiently strong Input signal from the other nodes to which it is connected, ANN is used in mathematical model or computational model, In an information processing model, ANN is used for speech recognition, image analysis, adaptive control etc. These applications are done through a learning process, like learning in biological system, which involves the adjustment between neurones through synaptic connection. After a neural network has analysed your dataset, it can make predictions and perform pattern recognition and categorization based on the found hidden dependencies[1].

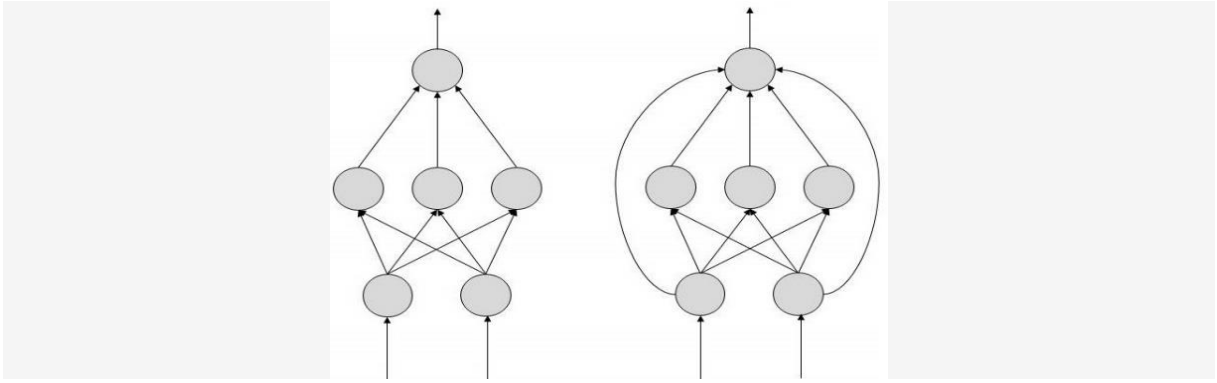
TYPES OF ARTIFICIAL NEURAL NETWORK

There are multiple types of neural network, each of which come with their own specific use cases and levels of complexity.

Two basic Artificial Neural Network topologies are Feed-Forward and Feedback.

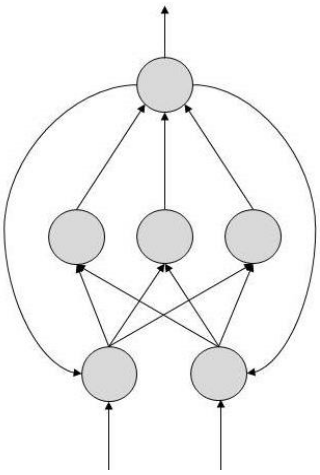
Feed-Forward ANN

The most basic type of neural net is something called a feed forward neural network, in which information travels in only one direction from input to output, A unit sends information to other unit from which it does not receive any information. There are no feedback loops. They are used in pattern generation/recognition/classification. They have fixed inputs and outputs.



Feedback ANN

A more widely used type of network is the recurrent neural network or feedback ANN, in which data can flow in multiple directions. These neural networks possess greater learning abilities and are widely employed for more complex tasks such as learning handwriting or language recognition. Here, feedback loops are allowed. They are used in content addressable memories.



There are also convolutional neural networks, Boltzmann machine networks, Hopfield networks, and a variety of others. Picking the right network for your task depends on the data you have to train it with, and the specific application you have in mind. In some cases, it may be desirable to use multiple approaches, such as would be the case with a challenging task like voice recognition.

APPLICATION

The various real time application of Artificial Neural Network are as follows:

1. Function approximation, or regression analysis, including time series prediction and modelling.

2. Call control- answer an incoming call (speaker-ON) with a wave of the hand while driving.

3. Classification, including pattern and sequence recognition, novelty detection and sequential decision making.

4. Skip tracks or control volume on your media player using simple hand motions- lean back, and with no need to shift to the device- control what you watch/ listen to.

5. Data processing, including filtering, clustering, blind signal separation and compression.

6. Scroll Web Pages, or within an eBook with simple left and right hand gestures, this is ideal when touching the device is a barrier such as wet hands are wet, with gloves, dirty etc.

7. Application areas of ANNs include system identification and control (vehicle control, process control), game-playing and decision making (backgammon, chess, racing), pattern recognition (radar systems, face identification, object recognition, etc.), sequence recognition (gesture, speech, handwritten text recognition), medical diagnosis, financial applications, data mining (or knowledge discovery in databases, "KDD").

8. Another interesting use case is when using the Smartphone as a media hub, a user can dock the device to the TV and watch content from the device- while controlling the content in a touch-free manner from afar.

9. If your hands are dirty or a person hates smudges, touch-free controls are a benefit.

APPLICATIONS OF NEURAL NETWORKS

- **Aerospace**-Autopilot aircrafts, aircraft fault detection.
- **Automotive -**Automobile guidance systems.

- **Military**-Weapon orientation and steering, target tracking, object discrimination, facial recognition, signal/image identification.
- **Electronics** -Code sequence prediction, IC chip layout, chip failure analysis, machine vision, voice synthesis.
- **Financial** -Real estate appraisal, loan advisor, mortgage screening, corporate bond rating, portfolio trading program, corporate financial analysis, currency value prediction, document readers, credit application evaluators.
- **Industrial** -Manufacturing process control, product design and analysis, quality inspection systems, welding quality analysis, paper quality prediction, chemical product design analysis, dynamic modelling of chemical process systems, machine maintenance analysis, project bidding, planning, and management.
- **Medical** -Cancer cell analysis, EEG and ECG analysis, prosthetic design, transplant time optimizer.
- **Speech** -Speech recognition, speech classification, text to speech conversion.
- **Telecommunications** -Image and data compression, automated information services, real-time spoken language translation.
- **Transportation** -Truck Brake system diagnosis, vehicle scheduling, routing systems.
- **Software** -Pattern Recognition in facial recognition, optical character recognition, etc.
- **Time Series Prediction** -ANNs are used to make predictions on stocks and natural calamities.
- **Signal Processing** -Neural networks can be trained to process an audio signal and filter it appropriately in the hearing aids.
- **Control** -ANNs are often used to make steering decisions of physical vehicles.
- **Anomaly Detection** -As ANNs are expert at recognizing patterns, they can also be trained to generate an output when something unusual occurs that misfits the pattern.

ADVANTAGES

Other advantages include:

1. Adaptive learning: An ability to learn how to do tasks based on the data given for training or initial experience.

2. Self-Organisation: An ANN can create its own organisation or representation of the information it receives during learning time.

3. Real Time Operation: ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.

5. Fault Tolerance via Redundant Information Coding: Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage.

6. Pattern recognition is a powerful technique for harnessing the information in the data and generalizing about it. Neural nets learn to recognize the patterns which exist in the data set.

7. The system is developed through learning rather than programming.. Neural nets teach themselves the patterns in the data freeing the analyst for more interesting work.

8. Neural networks are flexible in a changing environment. Although neural networks may take some time to learn a sudden drastic change they are excellent at adapting to constantly changing information.

9. Neural networks can build informative models whenever conventional approaches fail. Because neural networks can handle very complex interactions they can easily model data which is too difficult to model with traditional approaches such as inferential statistics or programming logic.

10. Performance of neural networks is at least as good as classical statistical modelling, and better on most problems. The neural networks build models that are more reflective of the structure of the data in significantly less time.

CONCLUSION

ANNs are considered nonlinear statistical data modelling tools where the complex relationships between inputs and outputs are modelled or patterns are found. Information that flows through the network affects the structure of the ANN because a neural network changes - or learns, in a sense - based on that input and output.

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