EDUZONE: International Peer Reviewed/Refereed Multidisciplinary Journal (EIPRMJ), ISSN: 2319-5045
Volume 11, Issue 2, July-December, 2022, Available online at: www.eduzonejournal.com

"Neural Network: Basics and Application"

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ABSTRACT

Artificial Intelligence deals with various methods of developing systems which display different aspects of intelligent behaviour. These systems are designed and developed to imitate the human capabilities of sensing and thinking. Among the truly successful types of AI are Neural Networks. A neural network is a sequence of set of rules that endeavours to identify underlying associations in a set of data through a procedure that mimics the manner the human brain operates. In this sense, neural networks mention to systems of neurons; either organic or non-natural in nature.There are types of Neural Networks which are mentioned in brief in this study. The research paper contributes a notion to the readers/audience about basics of Neural Network, its use in healthcare & future of Neural Network in commerce & other zones. Further the advantages & disadvantages of Neural Network have been brought forward.The paper is theoretical and based on collected data from secondary sources of information.The nature of this study is qualitative & the novelist endorses there are numerous conceivable ways of research in Neural Network which can be supportive for the progress of the business organizations around the world.

Keywords: Neural Network, systems, research, study

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Artificial Intelligence deals with various methods of developing systems which display different aspects of intelligent behaviour. These systems are designed and developed to imitate the human capabilities of sensing and thinking.

According to various textbooks, AI is "the design and study of Intelligent Agents, where an Intelligent Agent is a system which perceives its environment and takes actions that maximize its probability of success".

The Characteristics of Artificial Intelligence Systems are as follows:

1. Symbolic Processing

In Artificial Intelligence applications, computer systems process symbols rather than letters or numbers. Artificial Intelligence applications process strings of characters that represent real-world concepts or entities. Symbols can be arranged in structures such as lists, networks, or hierarchies. These structures show how symbols are related to each other.

2. Non-algorithmic Processing

Computer programs other than the Artificial Intelligence domain are programmed algorithms; that is, fully specified step-by-step procedures that give a solution to the problem. The actions of a knowledge-based Artificial Intelligence system depend to a far greater degree on the situation where it is applied.

The Field of Artificial Intelligence:

Artificial intelligence is a technology and science based on subjects such as computer science, psychology, biology, linguistics, engineering, and mathematics. The aim of Artificial Intelligence is to design and develop computer systems that can hear, see, think, talk, walk and feel. A major thrust of AI is the designing and developing of computer systems functions normally linked with intelligence, such as learning, reasoning and problem solving.

Major Branches of Artificial Intelligence :

- **Robotics**: Computer and Mechanical devices that perform different tasks with high accuracy.
- **Vision system**: Capture, store and manipulate the pictures and visual images.
- **Natural language processing**: Computer systems understand and react to the command and instructions to natural language like English.
- **Learning system**: Computer systems modifies how it functions or reacts to the feedback provided to it.
- **Neural system**: Computer systems that can simulate the functioning of the human brain or act like it.

- **Expert system**: Programming computer systems to take decisions in real life situations. (ex: expert systems help doctors in diagnosing the diseases)

Neural Network Basics

A neural network is sequences of processes that endeavours to diagnose causal relationships in a set of data through a procedure that mimics the mode the human mind operates. In this sense, neural networks mention to systems of neurons; either organic or non-natural in nature.

Firstly developed as mathematical theories of the info-processing activity of biotic nerve cells,the structural elements utilized to describe Artificial Neural Network are theoretically akin to those utilized in neuroscience, in spite of it fitting to a class of statistical processes.

Artificial Neural Networks can have single or manifold layers & comprise of treating units (nodes or neurons) that are interrelated by a set of amendable weights that consents signals to portable through the network in parallel & sequentially. Normally Artificial Neural Networks can be separated in to three layer of neurons: input (obtains information), hidden (accountable for mining patterns, accomplish most of inner processing), and output (crops & grants final network outputs).

Neural Computation is power-driven from the association of its neurons & that every neuron has weighted input, transfer function & a single output. The Neuron is actuated by the weighed sum of inputs it obtains & the activation signal passes through a transfer function to harvest a single output. The transfer functions, the learning rule & the architecture define the overall conduct of the neural network.

Artificial Neural Networks collect information by spotting patterns & relationships in data & "learn" through experience. An ANN absorbs by improving its interior unit contacts in order to diminish errors in the forecasts that it makes & to touch a preferred level of precision. New-fangled info can be inputted to the model one time the model has been trained & tested. Also denoted to as the generalized delta rule, back propagation mentions to how an ANN is taught or 'learns' based on the data. It utilizes an iterative process encompassing six steps:

1. Single case data is delivered to input later, output is delivered to the hidden layer & burgeoned by the first set of connection weights.
2. Incoming signals are summed, transmuted to output & delivered to second connection weight matrix.
3. Incoming signals are summed, renovated & network output is created.
4. Output value is deducted from known value for that case, error term is delivered backward through network.
5. Connection weights are accustomed in proportion to their error contribution.
6. Amended connection weights protected for next cycle, next case input set queued for next cycle.

The training or 'learning' method can be classified in ANN into three kinds: Supervised, unsupervised & reinforced learning. In supervised learning, every single input pattern utilized to train the network is concomitant with an output pattern. The error in calculated & desired outputs can be utilized to advance model performance. In unsupervised learning, the network acquires without acquaintance of desired ouput & by ascertaining & adjusting to features of the input patterns. In reinforcement learning, the network is delivered with feedback on if calculation performance without presenting the looked-for output.

Types of Neural Networks

The Neural Networks are divided into types based on the number of hidden layers they contain or how deep the network goes. Each type has its own levels of complexity and use cases. Few types of neural networks are Feed-forward neural network, Recurrent neural network(feed-back neural network) and Convolutional neural network.

- **Feed-forward neural network** are the basic type of neural networks. The information in this network travels in a unidirectional manner, that is, only from input to processing node to output. The hidden layers may or may not be present in this type, making it more explicable.e.g. Single layer perceptron, ADALINE, multi-layer perceptron and radial basis function networks.
- **Recurrent neural networks** are much more complex and most widely used networks. The data flows in multiple directions in this network. They store the output data of the processing nodes and learn to improve their functioning.e.g. Competitive Networks, Kohonen's self organizing maps and Hopfield networks.
- **Convolutional neural networks** are the ones that are popular today due to their specialty in being able to perform face recognition. They allow encoding attributes into the input, by assuming it to be an image.

Objective of Study

- The First objective of the study is to throw light on Artificial Intelligence and its sub-fields.
- The Second objective of the study is to know more about "Neural Network" in detail and all the facets associated with the same.
- The Third objective of the study is to give the audience an idea about Neural Network and its Application in Health sector and further suggesting a direction for future research in same.

Methodology of study

- The methodology of the research work is derived from the systematic and theoretical analysis of the methods to evaluate correct specific method for application. It constitutes qualitative techniques.
- This study is Qualitative in nature and is conducted based on the data collected from secondary sources of information such as published reports, journal articles, newspapers and magazines.

Neural Network & its Application

Uses of Artificial Neural Networks are in Cataloguing, forecast & identification. Instances of uses comprise grouping of data in health databases(i.e establishing or differentiating data by pertinent classes or concepts), utilizing a amalgam learning slant for programmed tissue recognition in wound imageries for precise wound assessments, and contrast of soft-computing methods for identification of heart settings by treating numerically recorded heart sound signals to mine time & frequency sorts connected to normal & abnormal heart conditons.Uses for forecast encompassed evolving a risk consultant model to forecast the likelihoods of diabetes obstacle according to alterations in risk aspects, detecting the optimum set of characteristics from a given set traits for identification of heart ailment ,exhibiting day-to-day patient onsets in the Emergency department. ANN can be applied for diagnosis of disease based on the sex, BMI, age, average BP & blood serum measurements, relating extrapolative accuracies of dissimilar kinds of ANN & statistical mock-ups for identification of coronary artery ailment, judgement & risk cluster assignment for pulmonary tuberculosis amid hospitalized patients, and non-invasive identification of initial risk in dengue patients. Other instances comprise discovering the probable utilize of mobile phones as a health promotional tool by tracing day-to-day exercise deeds of folks & using ANN to approximation a user's movement or utilizing ANN to detect aspects associated to treatment & aftermaths possibly impacting patient length of stay.

Micro-level uses of ANN comprise identification of pulmonary tuberculosis amid hospitalized patients by healthcare providers utilizing model established for cataloguing & risk group assignment, categorize Crohn's Disease medical imageries, examine recorded ECG signals to activate an alarm for patients & permit assortment & communication of patient info to healthcare providers.Meso-level uses comprise decision making amongst managers concerning cataloguing of fee, evolving a predicting model to backing healthcare management decision-making, amongst patients, providers & clinic managers in order to appraise the upshot of hospital worker motivation on patient contentment & forecasting the embracing of radio-frequency identification (RFID) technology espousal in clinical setting. Macro-level uses of ANN contain risk-alteration mock-ups for policy-makers of National Health Insurance Program, a worldwide association of the awareness of corruption in the healthcare segment, prototypical revenue generation for decision-makers to define best pointers of revenue generation in not-for-profit foundations backing hospitals of erratic sizes.

With the digitization of healthcare clinics are progressively able to amass huge expanses of data coped crosswise enormous information systems. With its capability to process large datasets, machine learning technology is well-matched for scrutinizing health data & providing active algorithms. Considering the established usage of health information systems & health databases, ANN have establish advantageous applications in bio-medical areas in diagnosis and disease monitoring.

In healthcare neural network mock-ups have been efficaciously used to forecast value causes (reaction, security, proficiency) influencing embracing of e-government services. With its capability to ascertain concealed knowledge & tenets ANN can mend care performance & smooth the embracing of 'Lean Thinking' or value based decision making in health sector.

An instance of ANN smoothing Lean thinking embracing in health sector milieus is its use to define 'info flow' amongst malignancy patients by exhibiting the relationship amid class of life appraisals made by pharmacists, patients & nurses. 'Flow' is a crucial notion in a Lean System & 'Info flow' is an indispensable enhancement goal to the fruitful operation of a health system utilizing a Lean approach.

Advantages of Neural Network

- Neural Networks have the ability to learn by themselves and produce the output that is not limited to the input provided to them.

- Even if a neuron is not responding or a piece of information is missing, the network can detect the fault and still produce the output.
- Stowage info on the whole network: Info such as in old-style programming is warehoused on the whole network, not on a database. The vanishing of a rare fragments of info in one place does not confine the network from working.
- The capability to toil with insufficient knowledge: After ANN training, the data may yield output even with partial info. The deficiency of performance here rest on on the significance of the omitted information.
- It has mistake forbearance: Corruption of one or an additional cell of ANN does not thwart it from producing output. This feature creates the networks fault-tolerant.
- Having a scattered memory: For ANN to be competent to learn, it is compulsory to define the instances & to explain the network according to the looked-for output by displaying these instances to the network. The network's development is directly proportionate to the selected instances, & if the event cannot be exposed to the network in all its facets, the network can yield incorrect output.
- Slow corruption: A network decelerates over time & undergoes relative dilapidation. The network problem does not instantaneously corrode.
- Capability to train machine: Artificial neural networks absorb events & make decisions by stating on alike events.
- Parallel processing capability: Artificial neural networks have statistical strength that can accomplish additional than one job at the same time.
- Consumers necessitate less formal statistical training & the networks are capable to identify complex non-linear relationships & interactions amid dependent & independent variables.
- ANN can pool & include literature-founded & experimental data to resolve problems.
- Relative to old-style predictive modelling techniques contain fast & simple operation due to squeezed representation of Knowledge (e.g weight & threshold value matrices).
- The capability to function with noisy or missing info & generalize to alike unseen data.
- The capability to absorb inductively from training data & process non-linear functionality perilous to dealing with real-world data.

Disadvantages of Neural Network

- Hardware dependence: Artificial neural networks entail processors with parallel processing power, by their assembly. For this purpose, the realization of the apparatus is dependent.
- Mysterious working of the network: This is the most significant problem of ANN. When ANN gives a inquisitive solution, it does not offer a clue as to why & how. This diminishes trust in the network.
- Guarantee of appropriate network structure: There is no explicit rule for defining the structure of artificial neural networks. The suitable network structure is attained through practise & trial and error.
- The trouble of display the problem to the network: ANNs can work with numerical information. Problems have to be converted into numerical values beforehand being presented to ANN. The exhibition mechanism to be determined here will directly impact the performance of the network. This rest on on the user's ability.
- The duration of the network is anonymous: The network is condensed to a firm value of the error on the example means that the training has been accomplished. This value does not offer us optimum fallouts.
- ANN are restricted in their capability to explicitly detect probable casual relationships,they are thought-provoking to utilize in the arena, they are disposed to over fitting, model development is experimental potentially demanding numerous attempts to ripen an acceptable model & there are methodological concerns linked to model development.
- ANN models are less apparent, and therefore can be extra problematic to converse & utilize. Even if published & made existing, the connection weight matrices utilized in ANN for training a data set may be outsized & tough to understand for others to make use of.

CONCLUSIONS AND FUTURE SCOPE

This Research Paper introduces Artificial Intelligence and its sub-fields. It explains the “Neural Network” in detail. Then it discusses its types, advantages and disadavantages. Further the research paper gives an idea about the application of Neural Network in Health Sector. It plays a major role in addressing the various aspects associated with Neural Network. There are advantages as well as disadvantages of Neural Network mentioned in this study. In my viewpoint I would like to state that it depends on the organization/individual how well it makes use of Neural Network so that he/she/organization can take maximum benefit from its advantages while simultaneously delicately handling the risks involved. This Research paper is theoretical in nature and data was collected from secondary sources such as thesis, research papers, magazines, reports etc. The research approach followed in this research

paper is qualitative. Further scope of research is also there where the theoretical framework can be proposed and tested by statistical tools and techniques.

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