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ARTIFICIAL INTELLIGENCE

Mr. Rohit Saini[1], Mr. Depeesh Gupta[2]
Department of Information Technology
Dronacharya College of Engineering, Gurgaon, Haryana

Abstract: Artificial intelligence is the study of how to make computers do things which at the moment, people do better. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems..It provides a good outline of what constitutes artificial intelligence. Artificial neural networks are generally presented as systems of interconnected neurons which can compute values from inputs, and are capable of machine learning as well as pattern recognition thanks to their adaptive nature. ANNs, like people, learn by example. as fields such as mathematics or physics became more advanced. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well. This paper gives ,if ai succeeds it can reduce itself to the empty set, overview of Artificial Neural Network, working & training of ANN. It also explain the application and advantages of ANN.
Keywords: AI (Artificial intelligence), pattern recognition.

I. INTRODUCTION

The study of the human brain is being done from the medieval time period. With the advent of modern electronics, it was only natural to try to harness this thinking process. Although, artificial intelligence is a very general term but defining it precisely is very difficult. And the design of an artificially intelligent agent totally depends on the fact how we define the term ‗Artificial Intelligence'. Possibly, the right definition can lead us to develop a successful intelligent artifact. There are a number of definitions to define artificial intelligence. As discussed in [1] the successful definitions are along two dimensions: firstly, whether it is with respect to reasoning (thought) or behavior (action) and secondly, whether it is with respect to human or ideal (i.e. rational) as shown in the fig-1. If we consider the category-1 or category3 definition of AI then we try to develop an artifact that can think like and can act like human being respectively. Further, if we consider category-2 or category-4 definition of AI then we try to develop an artifact that thinks or acts optimally respectively. Even development of optimal agents (based on definition from category-2 and category-4) could be really useful for solving problems and Category-4 definition (i.e. Acting Rationally) is the standard and modern definition of artificial agent [1]. That restricts the problem solving capability of conventional computers to problems that we already understand and know how to solve. But computers would be so much more useful if they could do things that we don't exactly know how to do. Neural networks process information in a similar way the 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. Neural networks learn by example. They cannot be programmed to perform a specific task. The examples must be selected carefully otherwise useful time is wasted or even worse the network might be functioning incorrectly. The disadvantage is that because 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 must 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; if anything goes wrong is due to a software or hardware fault. Neural networks and conventional algorithmic computers are not in competition but complement each other. There are tasks are more suited to an algorithmic approach like arithmetic operations and tasks that are more suited to neural networks.

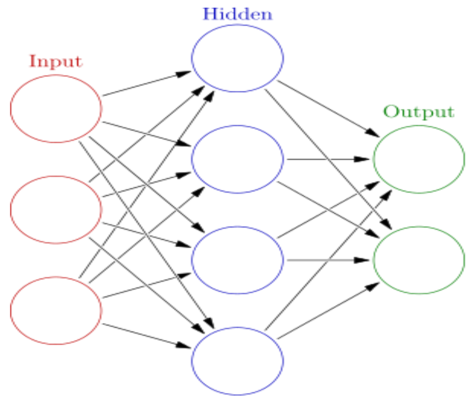


Figure 1:- A Simple Neural Network Diagram.

What is Artificial Neural Network?

Artificial Neural Networks are relatively crude electronic models based on the neural structure of the brain. The brain basically learns from experience. It is natural proof that some problems that are beyond the scope of current computers are indeed solvable by small energy efficient packages. This brain modeling also promises a less technical way to develop machine solutions. This new approach to computing also provides a more graceful degradation during system overload than its more traditional counterparts. These biologically inspired methods of computing are thought to be the next major advancement in the computing industry. Even simple animal brains are capable of functions that are currently impossible for computers. Computers do rote things well, like keeping ledgers or performing complex math. But computers have trouble recognizing even simple patterns much less generalizing those patterns of the past into actions of the future. Now, advances in biological research promise an initial understanding of the natural thinking mechanism. This research shows that brains store information as patterns. Some of these patterns are very complicated and allow us the ability to recognize individual faces from many different angles. This process of storing information as patterns, utilizing those patterns, and then solving problems encompasses a new field in computing. This field, as mentioned before, does not utilize traditional programming but involves the creation of massively parallel networks and the training of those networks to solve specific problems. This field also utilizes words very different from traditional computing, words like behave, react, self-organize, learn, generalize, and forget. The idea of Soft Computing was initiated in 1981 and was first discussed in [10] by Dr. Zadeh 1997. Dr Zadeh defined Soft Computing in its latest incarnation as the combination of the fields of Fuzzy Logic, Neuro-computing, Evolutionary and Genetic Computing, and Probabilistic Computing into one multidisciplinary system. The main goal of Soft Computing is to develop intelligent machines and to solve nonlinear and mathematically un-modeled system problems [11]. Out of these main five fields Neurocomputing, Evolutionary Computing and Genetic Computing are biologically inspired fields (i.e. they are developed on the basis of some biological phenomenon). Following paragraphs give a brief introduction of each field one by one. Neuro-Computing or Neural Networks As per discussion in [12] and [13] by Morton, ―Neural computing is the study of networks of adaptable nodes which, through a process of learning from task examples, store experiential knowledge and make it available for use‖. ANNs (Artificial Neural Networks) were actually realized in the 1940s. Warren McCulloch and Walter Pitts designed the first ANNs [14]. The first learning rule for ANNs was designed by Donald Hebb in McGill University [15]. Back-Propagation, Hopfield Nets, Neocognitron, and Boltzmann Machine were the most remarkable developments of that era [16]. Traditionally neural network was used to refer as network or circuit of biological neurons, but modern usage of the term often refers to ANN. ANN is mathematical model or computational model, an information processing paradigm i.e. inspired by the way biological nervous system, such as brain information system. ANN is made up of interconnecting artificial neurons which are programmed like to mimic the properties of m biological neurons. These neurons working in unison to solve specific problems. ANN is configured for solving artificial intelligence problems without creating a model of real biological system. 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. Same happen in the ANN.

Working of ANN:

The other parts of the ―art‖ of using neural networks revolve around the myriad of ways these individual neurons can be clustered together. This clustering occurs in the human mind in such a way that information can be processed in a dynamic, interactive, and self-organizing way. Biologically, neural networks are constructed in a three-dimensional world from microscopic components. These neurons seem capable of nearly unrestricted interconnections. That is not true of any proposed, or existing, man-made network. Integrated circuits, using current technology, are two dimensional devices with a limited number of layers for interconnection. This physical reality restrains the types, and scope, of artificial neural networks that can be implemented in silicon.

Currently, neural networks are the simple clustering of the primitive artificial neurons. This clustering occurs by creating layers which are then connected to one another. How these layers connect is the other part of the "art" of engineering networks to resolve real world problems.

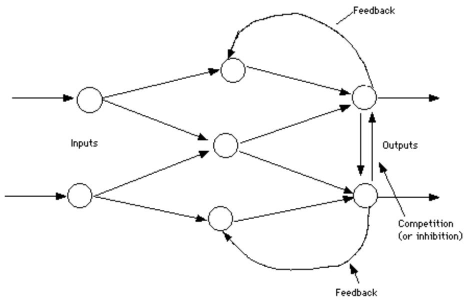
Basically, all artificial neural networks have a similar structure or topology as shown in Figure1. In that structure some of the neurons interfaces to the real world to receive its inputs. Other neurons provide the real world with the network's outputs. This output might be the particular character that the network thinks that it has scanned or the particular image it thinks is being viewed. All the rest of the neurons are hidden from view.

But a neural network is more than a bunch of neurons. Some early researchers tried to simply connect neurons in a random manner, without much success. Now, it is known that even the brains of snails are structured devices. One of the easiest ways to design a structure is to create layers of elements. It is the grouping of these neurons into layers, the connections between these layers, and the summation and transfer functions that comprises a functioning neural network. The general terms used to describe these characteristics are common to all networks.

In nature, evolution is mostly determined by natural selection or different individuals competing for resources in the environment. Those individuals that are better are more likely to survive and propagate their genetic material. The encoding for genetic information (genome) is done in a way that admits asexual reproduction, which results in offspring that are genetically identical to the parent. Sexual reproduction allows some exchange and reordering of chromosomes, producing offspring that contain a combination of information from each parent. This is the recombination operation, which is often referred to as crossover because of the way strands of chromosomes cross over during the exchange. The diversity in the population is achieved by mutation operation. Some networks want a neuron to inhibit the other neurons in the same layer. This is called lateral inhibition. The most common use of this is in the output layer. For example in text recognition if the probability of a character being a "P" is .85 and the probability of the character being an "F" is .65, the network wants to choose the highest probability and inhibit all the others. It can do that with lateral inhibition. This concept is also called competition.

Another type of connection is feedback. This is where the output of one layer routes back to a previous layer. An example of this is shown in Figure 2.

Figure 2:- Simple Network with Feedback and Competition.



The way that the neurons are connected to each other has a significant impacton the operation of the network. In the larger, more professional softwaredevelopment packages the user is allowed to add, delete, and control theseconnections at will. By "tweaking" parameters these connections can be made toeither excite or inhibit.

Training an Artificial Neural Network

Once a network has been structured for a particular application, that network is ready to be trained. To start this process the initial weights are chosen randomly. Then, the training, or learning, begins. There are two approaches to training - supervised and unsupervised. Supervised training involves a mechanism of 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 bulk of networks utilize supervised training. Unsupervised training is used to perform some initial characterization on inputs. However, in the full blown sense of being truly self learning, it is still just a shining promise that is not fully understood, does not completely work, and thus is relegated to the lab.

1. Supervised Training.

In supervised training, both the inputs and the outputs are provided. The network then processes the inputs and compares its resulting outputs against the desired outputs. Errors are then propagated back through the system, causing the system to adjust the weights which control the network. This process occurs over and over as the weights are continually tweaked. The set of data which enables the training is called the "training set." During the training of a network the same set of data is processed many times as the connection weights are ever refined. The current commercial network development packages provide tools to monitor how well an artificial neural network is converging on the ability to predict the right answer. These tools allow the training process to go on for days, stopping only when the system reaches some statistically desired point, or accuracy. However, some networks never learn. This could be because the input data does not contain the specific information from which the desired output is derived. Networks also don't converge if there is not enough data to enable complete learning. Ideally, there should be enough data so that part of the data can be held back as a test. Many layered networks with multiple nodes are capable of memorizing data. To monitor the network to determine if the system is simply memorizing its data in some non significant way, supervised training needs to hold back a set of data to be used to test the system after it has undergone its training.If a network simply can't solve the problem, the designer then has to review the input and outputs, the number of layers, the number of elements per layer, the connections between the layers, the summation, transfer, and training functions, and even the initial weights themselves. Those changes required to create a successful network constitute a process wherein the "art" of neural networking occurs. Another part of the designer's creativity governs the rules of training. There are many laws (algorithms) used to implement the adaptive feedback required to adjust the weights during training. The most common technique is backward-error propagation, more commonly known as back-propagation. These various learning techniques are explored in greater depth later in this report. Yet, training is not just a technique. It involves a "feel," and conscious analysis, to insure that the network is not over trained. Initially, an artificial neural network configures itself with the general statistical trends of the data. Later, it continues to "learn" about other aspects of the data which may be spurious from a general viewpoint. When finally the system has been correctly trained, and no further learning is needed, the weights can, if desired, be "frozen." In some systems this finalized network is then turned into hardware so that it can be fast. Other systems don't lock themselves in but continue to learn while in production use.

2. Unsupervised, or Adaptive Training.

Even a number of attempts has been made to design an intelligent artifact and some have been developed but with very limited functionally. They are generally used where complex computation, problem solving capability, formal decision taking is required. But, they can not be matched with human; even the way of solving problem is not as same as followed by human. Moreover, very few attempts have been made to develop a emotionally intelligent artifact. Now the question is: Are emotions play any role in human decision taking? The answer can easily be answered by natural phenomenon. A person feeling pain can't solve a problem as fast as a physically fit person. We can't solve a problem easily while we are either physically not feeling good or surroundings are not comfortable i.e. we are not emotionally fit e.g. a person cannot solve a problem easily when some bad-happening happens with him (or with someone close to him). The moral of this discussion is ―(possibly) emotions are connected with a person's problem solving capability.‖ Now the second question arises- Is there any relation between intelligence and emotion? There is a very common saying that IQ(Intelligent Quotient) depends upon EQ (Emotional Quotient) i.e. someone emotionally fit is expected to be more intelligent (more efficient at taking decision and actions) than the one not fit emotionally. This fact can also be demonstrated by natural phenomenon like discussed above.

II. APPLICATION

The utility of artificial neural network models lies in the fact that they can be used to infer a function from observations. This is particularly useful in applications where the complexity of the data or task makes the design of such a function by hand impractical.

Real-life applications

The tasks artificial neural networks are applied to tend to fall within the following broad categories:

Function approximation or regression analysis, including time series prediction, fitness approximation and modeling. Classification, including pattern and sequence recognition, novelty detection and sequential decision making. Data processing, including filtering, clustering, blind source separation and compression. Robotics, including directing manipulators, prosthesis. Control, including Computer numerical control. Application areas include the system identification and control (vehicle control, process control, natural resource management), quantum chemistry,game-playing and decision making backgammon, chess), pattern recognition (radar systems, face identification, object recognition and more), sequence recognition (gesture, speech, handwritten text recognition), medical diagnosis, financial applications, data mining (or knowledge discovery in databases, "KDD"), visualization and email spam filtering. Artificial neural networks have also been used to diagnose several cancers. An ANN based hybrid lung cancer detection system named HLND improves the accuracy of diagnosis and the speed of lung cancer radiology. These networks have also been used to diagnose prostate cancer. The diagnoses can be used to make specific models taken from a large group of patients compared to information of one given patient. The models do not depend on assumptions about correlations of different variables. Colorectal cancer has also been predicted using the neural networks. Neural networks could predict the outcome for a patient with colorectal cancer with more accuracy than the current clinical methods. After training, the networks could predict multiple patient outcomes from unrelated institution.

Neural networks and neuroscience[edit]

Theoretical and computational neuroscience is the field concerned with the theoretical analysis and the computational modeling of biological neural systems. Since neural systems are intimately related to cognitive processes and behavior, the field is closely related to cognitive and behavioral modeling.

The aim of the field is to create models of biological neural systems in order to understand how biological systems work. To gain this understanding, neuroscientists strive to make a link between observed biological processes (data), biologically plausible mechanisms for neural processing and learning (biological neural network models) and theory (statistical learning theory and information theory).

III. ADVANTAGES

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. 4. 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. 5. 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. 6. 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. 7. 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. 8. 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. Inheritable Neural Architecture is that part of neural architecture in an agent that is copied (after some mutation) into child during crossover. While, Non-Inheritable Neural Architecture is that part which is not copied to next generation and remains local to that generation only. In this paper I tried to present a new view of artificial intelligence from scratch. No doubt, the tradition view (rational agent approach) that we are following from very long time is also successful up to some extent, but it lacks the feel of actual intelligence. In this paper the main emphasis is given on two things. Firstly, emotions must be takes into account while developing an intelligent agent. Secondly, instead of inheriting only genes as a result of crossover as in Evolution Computing, we should inherit some part of neural architecture of the parent generation for applying evolutionary computing on artificial agents. At the core, this paper extends the concept of intelligence by augmenting it with emotions and extends the concept of Evolution Computing by augmenting it with neuralinheritance.

IV. CONCLUSION

In this paper. The neural networks build models that are more reflective of the structure of the data in significantly less time. Inheritable Neural Architecture is that part of neural architecture in an agent that is copied (after some mutation) into child during crossover. While, Non-Inheritable Neural Architecture is that part which is not copied to next generation and remains local to that generation only. In this paper I tried to present a new view of artificial intelligence from scratch. we discussed about the Artificial neural network, working of ANN. Also training phases of an ANN. There are various advantages of ANN over conventional approaches. Depending on the nature of the application and the strength of the internal data patterns you can generally expect a network to train quite well. This applies to problems where the relationships may be quite dynamic or non-linear. ANNs provide an analytical alternative to conventional techniques which are often limited by strict assumptions of normality, linearity, variable independence etc. Because an ANN can capture many kinds of relationships it allows the user to quickly and relatively easily model phenomena which otherwise may have been very difficult or imposible to explain otherwise. Today, neural networks discussions are occurring everywhere. Their promise seems very bright as nature itself is the proof that this kind of thing works. Yet, its future, indeed the very key to the whole technology, lies in hardware development.

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