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Conversion of Artificial Neural Networks (ANN) To Autonomous Neural Networks

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Abstract: *This article points out some serious drawbacks of Artificial Neural Networks, when compared to human brain. According to this article definitely there is a need for implementing Artificial Neural Networks with a change in underlying concepts. To do this a clear picture of brain learning mechanism, which is free from all the possible misconceptions is essential. So this article makes an attempt to notify the aspects that need to be considered in order to make neural networks 'autonomous bodies', just like human brain.*

Keywords: *ANN, Autonomous Neural networks, brain-like learning and Subsystem control theory.*

I. INTRODUCTION

The greatest drawback of the current models of artificial neural networks is that they are human- intervention systems. Also their learning algorithms need constant attention. These learning algorithms cannot be used in future robots or any other systems which are supposed to be autonomous. It is therefore impossible to build autonomous systems without having autonomous learning algorithms.

This article points out the important differences from Artificial Neural Networks and human brain. Also this article points out the immediate need to improve the standards of current neural networks so that they can be rendered "Self-learning" and "completely autonomous.

Artificial neural networks should be developed in such a way that one who uses ANN should feel he has actually employed a human being for addressing the given real time problem. ANN can be approximated to human brain by improving its standards of learning. We know that ANNs are derivatives of human brain. But if ANN are developed such that they are capable of taking decisions independently under all the conditions without any human intervention, then ANNs can be nearly approximated to human brains.

II. Brain Learning Mechanism

The brain is a wonderful creation in the entire nature. While the animals use it only for basic needs, human brains can perform wonderful tasks. Human brain has inspired many scientists and researchers to construct artificial neural networks.

Brain is a vast network comprising of millions of neurons and connectivities to various organs. Brain is like a central processing unit,which governs the body functions effectively. Human brain is almost an autonomous system which does not require outside processes for controlling its learning phenomena. Also the brain recollects the previous experiences and its own interpretations to take decisions in a particular issue.

Sometimes the brain is also influenced by the modes of action and the decisions are made according to one of the modes of action. The other interesting feature of the brain is that it achieves a good co-ordination between the functioning of various organs.

Two of the main functions of the brain are memory and learning. There are of course many categories of memory (short term, medium term, long term, working memory, episodic memory and so on) and of learning (supervised, unsupervised, inductive, reinforcement and so on). In order to characterize the learning behavior of the brain, it is necessary to distinguish between these two functions. Learning generally implies learning of rules from examples. Memory, on the other hand, implies simple storing of facts and information for later recall (e.g. an image, a scene, a song, an instruction). Sometimes memory is often confused with learning. But the processes of memorization are different from that of learning. So memory and learning are not the same.

III. Misconceptions About Human Brain

There are several concoctions about human brain. Many researchers say that human brain is inferior to Artificial Neural Network. In fact Artificial Neural Networks are themselves derivatives of human brain. Human brain has got unlimited potential, with which it can explore the finest aspects of any concept and arrive at the proper conclusion. If human brain is properly understood then Artificial Neural Networks may be designed with a difference so that their degree of resemblance with human brain increases. Despite of numerous advancements in the field of Artificial Neural Networks, ANNs can't be still regarded as "duplicate" of human brain. Therefore it is of utmost importance to improve the features of ANN, so that it develops the brain like capacity to address the real time problems.

Some of the misconceptions of human brain are:

- **"A human's knowledge is volatile and may not become permanent. There are several factors that cause brain cells to die and if they do, the information that is stored in that part is lost and we start to forget".** - which is not very true because brain has distributed memory system and the memory loss is a very rare case. On the other hand if brain is utilized effectively then knowledge is never lost.
- **"Brain is always provided with the learning parameters to address a problem"**- In order to seek a solution for the given problem or to generalize well, human brain should be able to decide upon the network parameters like number of layers, number of neurons per layer, connection strengths and so on. So the learning parameters and networks themselves do not come "readymade". Since the natures of problems differ, brain has to decide on the different network designs and network parameters internally.
- **"Brain does not store any information prior to learning and learns instantaneously"-** one may think that if there is no memory requirement then the system is very efficient, but it consumes more time for processing. In this respect, human brain is superior to ANN because it has a memory. Human brain never learns instantaneously but it happens based on the information collected prior to learning. This conception violates the very basic behavioral facts. Remembering relative facts and examples is a part of human learning.
- **"Human brain's speed of processing is less compared to that of Artificial Neural Networks"-** In fact human brain can imagine anything at a greater speed compared to that of air. Artificial Neural Networks have to be first trained and after the learning phase is over, their speed can be measured. Sometimes speed also refers to a proper decision taking capability of a system. Before taking a task for processing, if a processing system can set priorities for the tasks or find effective ways to solve it then the system is to have speeded up the processing. On the other hand if the system simply processes the task without taking into account its pros & cons then it is actually wasting the precious time.
- **"Each Neuron in the brain is an autonomous body". –** The notion that each neuron adjusts its weights solely based on its inputs and outputs is not supported by any neurobiological evidence. In fact external agents can also influence the synaptic adjustments. If backpropagation learning algorithm is considered, then we can notice that each cell stores information about the input, output, error in processing the task by the network and also the contribution of individual cell to this error. This implies that no other entity external to cell or neuron is allowed to change its connection strengths. But this is logically inconsistent.

IV. How To Turn ANN To Autonomous Neural Network

The field of Artificial Neural Networks developed several learning algorithms over the years that work well only when there is human intervention. In order to make ANN to work properly their learning rates need to be reset and readjusted, and also different network designs have to be tried so that they can generalize well. Everything needs to be relearned from scratch when there is catastrophic forgetting in the network. There is a long list of such drawbacks that need to be seriously considered. One of the founder of this field and a past president of the International Neural Network Society (INNS) confided that "the neuro-boom *is over."*But many other scholars have kept on fighting the arguments against the current science on brain-like learning.

Minsky and Papert not only showed the limitations of the the perceptrons, the simple neural networks and also raised the deeper question of computational complexity of learning algorithms. Despite all the deeper and more disturbing questions raised by thoughtful critics, the neural network field is moving heedlessly with its research agenda. Now faced with fundamental challenges to the assumptions behind their brain like learning algorithms, prominent researchers in the field are finally calling for a "shake up of the field of neural networks" and for its "rebirth."

Artificial Neural Networks can become autonomous bodies if they are embodied with various capabilities as listed below:

- **ANN should be equipped with memory**, so that it operates at greater speed.
- **ANN should be capable of taking decisions about the task selection and processing**: this means that ANN should be capable of setting priorities to the tasks and also deciding the best possible way of processing, instead of merely operating on a given task**.**
- **ANN should be able to aim and fix target for processing tasks** without which the processing of tasks would take more time.
- **ANN should not be problem specific** but should be able to address any problem.
- **ANN should be capable of adjusting both the weights of synaptic connections as well the structure itself.**
- **ANN should also be able to sense the "situations" in the surrounding environment and address the given problem** without the aid of external teacher. Taking the situations (requirements, rules etc.) into consideration, ANN should act in order to get the desired output.
- **ANN should be having flexibility to switch over to different modes of action.** For instance if we desire ANN to work in the mode of passion then ANN should permit for the same.
- **ANN should have subsystems within itself that can control other subsystems** because of which any external source can control the behavior of neuron. This is quite different from "local learning concept" of current ANN technology [10].

Artificial Neural Networks can achieve "brain-like learning" if they are equipped with all these abilities. Artificial Neural Networks should be a combination of various activation functions and different topologies to become autonomous bodies.

V. Conclusions

The greatest drawback of the existing theories of artificial neural networks is the characterization of an autonomous learning system such as the brain. Despite of the clear definitions of the internal mechanisms of the brain [12], no one has characterized in a similar manner the external behavioral characteristics that they are supposed to produce.

Consequently, the ANN underwent algorithm development keeping in view local, autonomous learning, memory less learning, and instantaneous learning rather than from the point of view of "external behavioral characteristics" of human learning. If that set of external characteristics cannot be reproduced by a certain conjecture about the internal mechanisms, than that conjecture is not a valid one.

The current article essentially points to some of the current notions of human learning and showed their logical inconsistencies. So there is definitely a need for some new ideas about the internal mechanisms of the brain.

It would be better if the current ANN systems inadvertently acknowledge the ideas listed in the previous section and the most important among them is the last one, which asks us to use the concept of "master or controlling subsystem" that designs networks and sets learning parameters for them. Very recently has such non local means of learning has been used effectively to develop powerful learning algorithms that can design and train networks in polynomial time complexity [2, 9, 10].In addition, this "subsystem control" framework resolves many of the problems and dilemmas of current ANNs. Under such a framework, learning need not be necessarily instantaneous, but can wait until some information is collected about the problem. Learning can always be invoked by a controlling subsystem at a later point in time. This would also facilitate understanding the complexity of the problem before it has to be actually tackled, from the information that has been collected and stored already. Such a framework would also resolve the network design dilemma and the problems of algorithmic efficiency that have been negatively influencing this field for so long [2,9,10].So one can argue strongly for theories like "subsystem control" that are related to human brain and make use of such concepts in designing ANNs. If ANNs are designed with due considerations to actual behavior of human brain then undoubtedly ANNs become Autonomous Neural Networks.

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