A NEW COGNITIVE SYSTEM MODELING WITH THE COMBINATION OF EXPERT AND NEURAL NETWORK SYSTEMS
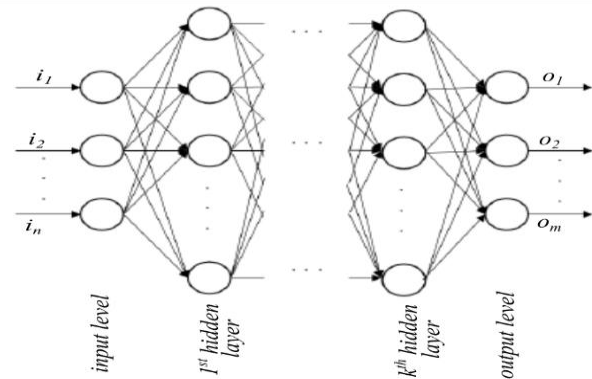
B. Alafi

Abstract— In this paper definition of cognitive systems and its operation principle are mentioned. As a sequence, combination of expert and artificial neural network (ANN) is introduced as a cognitive system. In this approach, decision is taken by human based expert and these expert based information is coded and presented to a neural network system as a learning system. The procedure to be followed is simply described in the context. Then the algorithms of making a neural network as a cognitive system by logics from a human expert – which is a cognitive system – system are announced.
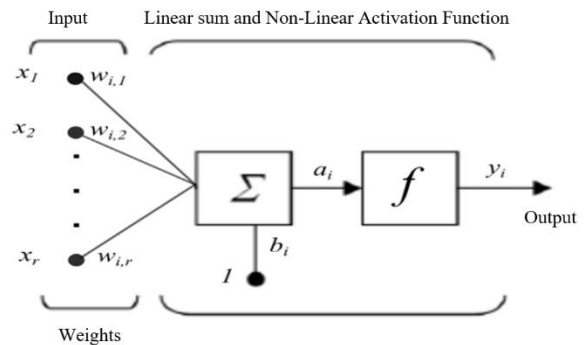
Keywords— *Cognitive system, Neural network, Expert networks, Rule based networks, Learning system*

1. INTRODUCTION

THE human based expert is a concept which is defined as cognitive system. Transferring knowledge and experts from human to programs or learning systems will construct a knowledge based system which is considered as a cognitive one. Cognitive systems are playing a pivotal role in recent generation of science and technology. Since cognitive systems are the systems which learns, and thinks like human, a human based expert results a cognition in learning system via learning algorithms and logics. In order to distinguish desired conditions, at first human brain should determine all conditions and then classify them in different categories based on each phenomena parameter [1, 3, 4, 5]. Then all conditional logics (*If condition1 Then do procedure number 1*) can be obtained from this classification. To model and imitate the human brain sensing and acting ability, a structure which can learn and classify is required. Neural network can be an appropriate candidate for this purpose. Neural networks are learning systems without any mathematical operation which have been employing to obtain relationships between input and output pairs. Neural network is a system with main blocks of neurons. Information between input and output levels is stored in weight factors as hidden layers. Relevant model will be caught via weighted inputs which are collected together. Input layer is specified by received information from the system and then weighted properly based on error propagation algorithm. There are hidden layers by the task of applying system function for the problem. Then the outputs via error propagation maps to the hidden layer [1-2]. Topology of neural network is shown as figure1.

Behnaz Alafi. is with Electrical Engineering Faculty Istanbul Technical University, Istanbul, Turkey, (e-mail: alafi18@itu.edu.tr). iD

(a)

(b)

Fig.1. Neural Network structure. (a) Neural Network Topology. (b) Neural Processing Element

By means of this general procedure neural network is assumed as a learning system. This learning ability can be changed by the main topology of system which is depending on Problem type, input and output sizes, hidden layers, error propagation. Applying the neural network as a human inspiring system will make a cognitive system.

2. COGNITIVE SYSTEM

Mental system of human being is consisting a lot of interrelated items of knowledge, believes, ideas etc. which control his/her actions and determine how human being deal with received information from around world [3-7]. This system is determined as cognitive system. Cognitive systems simulate the human cognition process to find solution in different situations. Cognitive systems do not define as only programmed system, actually they can learn at scale and logic through interaction with human naturally and their own experience from ambient. Generally, cognitive systems are probabilistic, and deterministic one which not only can solve the numerical

problems but also for prediction, meet argument, and recommendations about any type of information. The cognitive systems are probabilistic, it means they are programmed and designed to catch and figure out the type of huge amount of unstructured and complex data. Actually, programmable systems lead input information through some layers to reach the outputs. These systems are complex and powerful enough to catch the output via huge amount of input data and predict and determine the outcomes, but they are not capable to process unpredictable input. These systems act like human, as they can read text, see images, hear sounds, distinguish what they are reading, seeing, or hearing [6]. And through this procedure, they can organize and explain the received information. Despite these human liked abilities, they are not able to offer the definitive answers. They just are able to weigh received data from huge multiple sources and then process and offer hypothesis, or any other required data based on huge amount of information. To reach this purpose a cognitive topology is required. A cognitive topology is a kind of topology which overlaps with artificial intelligence technology which involves technologies such as expert systems, neural networks, robotics and virtual reality with the same base topology [3,5,6].

3. NEW DESIGN FOR COGNITIVE SYSTEM

Cognitive systems are not limited to a determined group of information sets; any system can be considered for this topology. Cognitive system achieved by human expert and neural network is described in this procedure; data coming from the system can be represented by means of the human based expert system – which acts as an operator – approach and then it is converted to "if … then … or if … and … then …" structure as a logical structure. This logical coding and then this data structure can be implemented to train the information through neural network. As a result, this new trained neural network plays the role of logic modeling. And this type of system can be used in engineering or any kind of systems as a cognitive system. A cognitive system algorithm flowchart is shown as figure2.
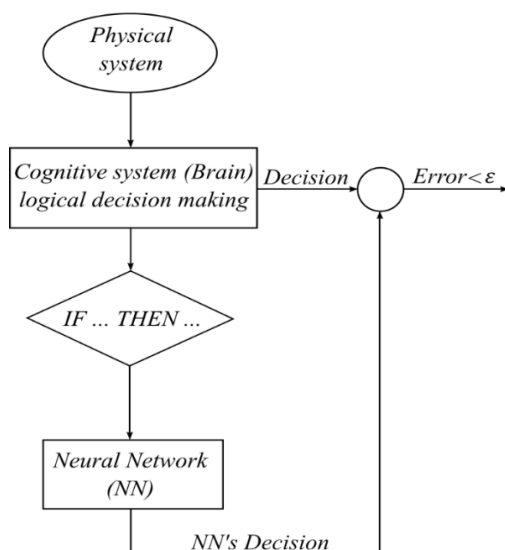

Fig.2. Cognitive system flowchart.

4. CONCLUSIONS

As shown in figure.2 the first block is related to cognitive or human based expert which is depending on the decision of the human based operator. The data can be coded in "if … then …" logics and it is represented by neural network. So its decision can be interpreted as a machine learning decision maker and assumed as a cognitive system.

REFERENCES

[1] D. Bayram Kara, and S. Seker, "An Artificial Neuro Detector and its Cognitive Interpretation for Engineering Systems", The Journal of Cognitive Systems, Vol. 3, No.1, 2018, pp. 5-8.

[2] A. Horiushkina, S. Seker, and U. Korkmaz, "A Cognitive Approach to Neural Network Model Based on The Communication System by an Information Criteria", The Journal of Cognitive Systems, Vol.3, No.1, 2018, pp.1-4.

[3] Y. Wang, "On Abstract Intelligence and Brain Informatics", International Journal of Cognitive Informatics and Natural Intelligence, Vol.6, No.4, 2012, pp.54-80.

[4] Y. Wang, "Cognitive Foundations of Knowledge Science and Deep Knowledge Learning by Cognitive Robots", 2017 IEEE 16th International Conference on Cognitive Informatics & Cognitive Computing (ICCI*CC), 2017, doi:10.1109/icci-cc.2017.8109802.

[5] Y. Wang, "Cognitive Informatics: Towards Future Generation Computers that Think and Feel", 2006 5th IEEE International Conference on Cognitive Informatics, 2006, doi:10.1109/coginf.2006.365666.

[6] Y. Wang, "Cognitive Computing and Machinable Thought", 2009 8th IEEE International Conference on Cognitive Informatics, 2009, doi:10.1109/coginf.2009.5250709.

[7] J. Breslavets, and A. Horiushkina, "Cognitive Design Methods for Computer Games Content", The Journal of Cognitive Systems, Vol.2, No.2, 2017, pp. 55-58.

[8] A. Schierwagen, "Complex Neuro-Cognitive Systems", Lecture Notes in Computer Science Foundations on Natural and Artificial Computation, 2011, pp.1-9. doi:10.1007/978-3-642-21344-1_1.

[9] R. Velik, "Cognitive Architectures as Building Energy Management System for Future Renewable Energy Scenarios; A Work in Progress Report", International Journal of Science and Engineering Investigations, Vol.2, No.17, 2013, pp.67-72.

BIOGRAPHIES

Behnaz Alafi obtained her BSc. degree in electrical engineering from Iran University of Science and Technology (IUST) in 2009, Tehran, Iran. MSc. student at Istanbul Technical University. She has experience on electrical systems of oil and gas and energy industry since 2009.