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A Study on Effective Algorithm for Medical Decision Making System

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Abstract-This research is to search for alternatives to the resolution of complex medical diagnosis where human knowledge should be apprehended in a general fashion. Successful application examples show that human diagnostic capabilities are significantly worse than the neural diagnostic system. Then, paradigm of artificial neural networks is shortly introduced and the main problems of medical data base and the basic approaches for training and testing a network by medical data are described. A lot of Applications tried to help human experts, offering a solution. In this research paper I have tried to accumulate few different theories prevailing regarding neural networks algorithms. All the different theories have a different aspect to consider and have a different idea to work on. Though all have different process of gathering weights, different variables and parameters and different points logics to esta blish, but one thing is common they all have used learning methods and have been successful in doing so. describes a optimal feed forward Back propagation algorithm. However, Traditional Back propagation algorithm has many shortcomings. Learning often takes long time to converge, and it may fall into local minima. One of the possible remedies to escape from local minima is by using a very small learning rate, which slows down the learning process. The proposed algorithm presented in this study used for training depends on a multilayer neural network with a very small learning rate, especially when using a large training set size. It can be applied in a generic manner for any network size that uses a back propagation algorithm through an optimal time (seen time).

Keywords-Artificial Neural Network, ,Medical Diagnosis, Naïve Bayes, Decision Tree, Fuzzy Logic.

I. INTRODUCTION

The health of population, which is based primarily on the result of medical research, has a strong impact upon all human activities. Among the most important medical aspects are considered the good interpretation of data and setting the diagnosis. But medical decision making becomes a very hard activity because the human experts, who have to make decisions, can hardly process the huge amounts of data. So they need a tool that should be able to help them to make a good decision. They could use some expert systems or artificial neural networks, which are part of artificial intelligence. Doctors use a combination of a patient's case history and current symptoms to reach a health diagnosis when a patient is ill. In order to recognize the combination of symptoms and history that points to a particular disease, the doctor's brain accesses memory of previous patients, as well as information that has been learned from books or other doctors. A neural network has the ability to mimic this type of decision-making process, and use a knowledge base of information, and a training set of practice cases, to learn to diagnose diseases.

The major problem in medical field is to diagnose disease. Human being always make mistake and because of their limitation, diagnosis would give the major issue of human expertise. One of the most important problems of medical diagnosis, in general, is the subjectivity of the specialist. It can be noted, in particular in pattern recognition activities, that the experience of the professional is closely related to the final diagnosis. This is due to the fact that the result does not depend on a systematized solution but on the interpretation of the patient's signal (Lanzarini and Giusti, 1999).

Brause(2001) highlighted that almost all the physicians are confronted during their formation by the task of learning to diagnose. Here, they have to solve the problem of deducing certain diseases or formulating a treatment based on more or less specified observations and knowledge. For this task, certain basic difficulties have to be taken into account:-

A. The basis for a valid diagnosis, a sufficient number of experienced cases, is reached only in the middle of a physician‟s career and is therefore not yet present at the end of the academic formation.

B. This is especially true for rare or new diseases where also experienced physicians are in the same situation as newcomers.

C. Principally, humans do not resemble statistic computers but pattern recognition systems. Humans can recognize patterns or

objects very easily but fail when probabilities have to be assigned to observations.

D. The quality of diagnosis is totally depends on the physician talent as well as his/her experiences.

E. Emotional problems and fatigue degrade the doctor‟s performance.

F. The training procedure of doctors, in particular specialists, is a lengthily and expensive one. So even in developed countries we may feel the lack of MDs.

G. Medical science is one of the most rapidly growing and changing fields of science. New results disqualify the older treats, new cures and new drugs are introduced day by day.

Regarding problems above and also many others, the question would be how computers can help in medical diagnosis. Since decades ago, computers have been employed widely in the medical sector. From local and global patient and medicine databases to emergency networks, or as digital archives, computers have served well in the medical sector. Meanwhile, in the case of medical diagnosis, regarding the complexity of the task, it has not been realistic yet to expect a fully automatic, computer-based, medical diagnosis system.

However, recent advances in the field of intelligent systems are going to materialize a wider usage of computers, armed with AI techniques, in that application. A computer system never gets tired or bored, can be updated easily in a matter of seconds, and is rather cheap and can be easily distributed. Again, a good percentage of visitors of a clinic are not sick or at least their problem is not serious, if an intelligent diagnosis system can refine that percentage, it will set the doctors free to focus on nuclear and more serious cases.

II. WHAT IS A ARTIFICIAL NEURAL NETWORK

Artificial neural networks are developed based on brain structure. Like the brain, artificial neural networks can recognize patterns, manage data and learn. They are made by artificial neurons which implement the essence of biological neurons.

A. It receives a number of inputs (from original data or from output of other related neurons). Each input comes via a connection, which is called synapses and which has a weight (coefficient of connectivity). A neuron also has a threshold value.

B. The activation signal produces the output of the neuron. This output can be the result of the problem or can be considered an input for another neuron. To create an artificial neural network is necessary to put together a number of neurons. They are arranged on layers. A network has to have an input layer (which carries the values of outside variables) and an output layer (the predictions or the result). Inputs and outputs correspond to sensory and motor nerves from human body There also can be hidden layer(s) of neurons, which play an internal role in the network.

III. HOW ARE USED NEURAL NETWORKS IN MEDICINE

A. ANNs are very useful for analyzing complex problems where the relationships between input and output data are not very well known, such as pattern and speech recognition, machine vision, robotics, signal processing and optimization. They are also useful in fields where there is a high degree of uncertainty, such as market analysis, analysis and control of industrial processes and medical diagnosis In the case of civil engineering, the ANNs have already begun to be used in problems of structural Diagnosis or work programming. The present work describes the preliminary results of a research effort aimed at investigating the potential of ANNs in the interpretation of data from Nondestructive Testing (NDT), Artificial neural networks could be used in every situation in which exists a relationship between some variables that can be considered inputs and other variables that can be predicted.

B. The most important advantages using artificial neural networks are that this kind of system solves problems that are too complex for conventional technologies, do not have an algorithmic solution or the solution is too complex to be used.

C. These characteristics have often appeared in medicine. Artificial neural networks have been successfully applied on various areas of medicine, such as: diagnostic systems, biomedical analysis, image analysis, drug development. Using artificial neural networks, it can be monitored a lot of health indices (respiration rate, blood pressure, glucose level) or can be predicted the patient response to a therapy. Artificial neural networks have a very important role in image analysis, too, being used together with processing of digital image in recognition and classification. They are used in pattern recognition because of their capacity to learn and to store knowledge. The medical image field is very important because it offers a lot of useful information for diagnosis and therapy the current work focuses on the fuzzification and defuzzification of patient data.

IV. RELATED WORKS

This section will present some approaches that have been developed and used in Medical Diagnosis. Rami J.Oweis et al., (2005) present the classification of biomedical data using neuro fuzzy approach, where it uses neural network's ability to learn, and membership degrees and functions of fuzzy logic, respectively. A training set is used to create and train the classifier system. The classes are represented as fuzzy sets with degrees of memberships. Each pixel is assigned a degree of membership for each of the three fuzzy subsets. Classified pixels are finally shown as three separate images each representing a set. The method showed high quality classification for images of simple components.

N.Benamrane et al., (2006) has proposed an approach for detection and specification of anomalies present in medical images. The idea is to combine three metaphors: Neural Networks, Fuzzy Logic and Genetic Algorithms in a hybrid system. The Neural Networks and Fuzzy Logic metaphors are coupled in one system called Fuzzy Neural Networks. The Genetic Algorithm adds to this hybridizing the property of total research like an initialization of the Fuzzy Neural Networks training algorithm which is based on an adapted version of the back propagation algorithm. After applying the growing region algorithm to extract regions, the Fuzzy Neural Network detects the suspect regions, which are interpreted by the Fuzzy Neural Network of specification. Ian Middleton et al., (2003) reports on the combined use of a neural network. Chin-Ming Hong et al., (2006) propose a novel neuro fuzzy network which cans efficiently reason fuzzy rules based on training data to solve the medical diagnosis problems. This study proposes a refined K-means clustering algorithm and a gradient-based learning rule to logically determine and adaptively tune the fuzzy membership functions for the employed neuro fuzzy network. In the meanwhile, this study also presents a feature reduction scheme based on the grey-relational analysis to simplify the fuzzy rules obtained from the employed neuro fuzzy network.

S. Shen et al., (2003) show the neighborhood attraction based on the traditional fuzzy c-means (FCM) clustering algorithm to improve the segmentation performance. In this algorithm, two factors of neighborhood attraction are considered; one is the feature difference between neighboring pixels in the image, the other is the relative location of neighboring pixels. The problem is formulated as distribution learning and relaxation labeling that may be particularly useful in quantifying and segmenting abnormal brain tissues where the distribution of each tissue type heavily overlaps. The new technique utilizes suitable statistical models for both the pixel and context images. The quantification is achieved by model-histogram fitting of probabilistic self-organizing mixtures and the segmentation by global consistency labeling through a probabilistic constraint relaxation network. Clarke et al., (1995) has surveyed and presented some segmentation methods that have been proposed in medical image community. The image techniques used for brain segmentation could be divided in the following groups: threshold-based segmentation, statistical methods for brain segmentation and region growing methods. For all these groups many methods have been proposed in the literature but no one has been widely accepted in order to be used as a general method in clinics. In the category of threshold-based segmentation, use of iterative thresholding, histogram analysis and morphological operations are proposed. Some of these techniques are followed by some refinement of the segmented zones. The segmentation problem widely encountered by researchers is the noise introduced with the acquisition of the image, the overlapping intensities (different brain structures have different tissue characteristics which results in various signal intensities and these intensities could overlap), the partial volume effect (when a pixel represents more than one kind of tissue type) and also some anatomical changes from one person to another. The blood vessels could also influence image that is taken and could introduce some noise. So, there are a lot of problems that researchers have to deal with in order to build an accurate segmentation system. Since all these techniques have their advantages and drawbacks, more research is demanded in this domain and maybe some combination of the already existing methods or some new techniques will lead to better results.

The current work focuses on the fuzzification and defuzzification of patient data. Since data from the patient are nothing but physiological measures, they are subjected to noise and uncertainty. The data from the patient such as height or weight data cannot always be trusted as they are subjected to the quality and accuracy of measuring units and the skill of the technician. Moreover, based on a single data, it would be highly uncertain to make an accurate decision about the future physiological state of the patient. So the patient data has been fuzzified with the objective of transformation of periodic measures into likelihoods that the Body Mass Index, blood glucose, urea, and creatinine, systolic and diastolic blood pressure of the patient is high, low or moderate.

V. PROPOSED APPROACH

In this section, the theoretical background of the Optimal Back propagation learning algorithm pertaining to our study is reviewed.

A. Decision Tree

One of the most powerful tools in data mining and knowledge discovery is the decision tree. In order to discover useful patterns decision trees has been used in the examination of large complex bulk of data. The basic decision tree algorithm is called ID3 (Iterative Dichotomizer).

The ID3 can handle only discrete values where as the successor C4.5 handles numeric values. For analyzing the categorical and continuous data set Classification and Regression Trees (CART) approach is considered to be best suited. Weka developed an implementation of ID3 Algorithm called J48. Different types of data like numeric, nominal, textual data are handled by it and it also processes the missing values.Since J48 presentation is easy to understand it can be implemented in data mining packages in diverse platforms and it shows high performance with small effort.

B. Naive Bayes

An important role is played by the Naive Bayes classification in the medical data mining. It is a probabilistic classification based on the Bayes theorem. Due to the measur of the high input is normally very practical. All the attributes are suggested independent iscalled as “naïve”. For the past 50 years machine learning method is being used in Bio-medical informatics. To estimate the parameter Naive Bayes needs only small dimensions of data set that is used for health care application. Naïve Bayes The highest posterior of class instance. Simplification of assumption and naïve design, naïve Bayes classifier resolves so many real world complex problems. Well performed Bayes classification in current approaches is:

1) Boosted trees
2) Random forests

C. Support Vector Machine

Linear and non-linear data can be efficiently performed by Support Vector Machine. In the year 1998,John Platt invented a method called Sequential Minimal Optimization at Microsoft Research. SMO is invented for solving optimization problem by using iterative algorithm.By default

1) It normalize all attributes
2) Replaces missing values
3) Transforms nominal attribute into binary ones.

D. Artificial Neural Networks

To solve variety of tasks the Artificial neural network is used which is very difficult to solve the problem is ordinary rules based programming that includes computer vision and speech recognition.A feed forward artificial neural network model is called Multilayer Perceptron (MLP) which maps input data set onto a appropriate output set.

E. Cervical Factors

A Mostly cancer occurs due to our daily activities in our life. Growing older will bounce us lot of diseases, chewing tobacco is very dangerous, certain chemicals can also lead to cancer, certain hormones by birth will tip to cancer, Family history of cancer customarily happens a lot, Alcohol, poor diet, Lack of physical activity etc. are the foremost reason for cancer. Smoking, chewing tobacco produces Carcinogenic agent in our body and it is more prominently points to cancer. Some of the factors analyzed are Education, Diet, Living area, Family history. More than 78% people who are uneducated are affected than educated persons. The diet they follow unbalanced lead to 67%. Living area mostly urban people are affected then rural.

F. Data Analysis Software

The popular machine learning software is Weka (Waikato Environment for Knowledge Analysis). Weka 3.7.9 is mainly used to analyze the data. Weka contains:

1) Collection of algorithm for data analysis
2) Predictive modeling
3) Easy function access with GUI

Data preprocessing, classification, clustering, association rules, visualization and feature selections are standard data mining tasks which is supported by the tool Weka. Weka has an enriched feature is Neural Networks are ideal in recognizing diseases using scans

since there is no need to provide a specific algorithm on how to identify the disease. Neural networks learn by example so the details of how to recognize the disease are not needed. What is needed is a group of examples that are representative of all the variations of the disease. The quantity of examples is not as important as the 'quality'. The example needs to be selected very carefully if the system is to perform consistently and efficiently.This Synopsis describes, a algorithm, the feed forward neural network (Back propagation algorithm) constructive algorithm for medical diagnosis.

G. The Reann Algorithm

The aim of this section is to introduce rule extraction algorithm REANN for understanding how an ANN solves a given problem. Although REANN is applied in medical domain in this work, it can be applied to other domain also. The aim of REANN is to search for simple rules with high predictive accuracy.

In comparison with other existing algorithms in the literature, the major advantages of REANN include: (i) it can determine near optimal ANN architectures automatically by using a constructive-pruning strategy; (ii) it uses an efficient method to discretize the output values of hidden nodes; (iii) it is computationally inexpensive; and (iv) it can extract rules that are concise, comprehensible, order insensitive and highly accurate.

H. Constructive Algorithm

One drawback of the traditional backpropagation algorithm is the need to determine the number of nodes in the hidden layer prior to training]. REANN uses a basic constructive algorithm based on dynamic node creation algorithm proposed.

I. Pruning Algorithm

Pruning techniques begin by training a larger than necessary network and then eliminate the weights and nodes that are deemed redundant . Since the nodes in the hidden layer are determined automatically in constructive fashion in REANN, the aim of pruning algorithm is to remove unnecessary connections and input nodes from the ANN obtained by the constructive algorithm. Typically, methods for removing connections from ANNs involve adding a penalty term to the error function. It is hoped that by adding a penalty term to the error function, unnecessary connections will have small weights, and therefore pruning can reduce the complexity of the ANN significantly. The simplest and most commonly used penalty term is the sum of the squared weights .

J. Learning Vector Quantization Algorithm

LVQ can be understood as a special case of an artificial neural network. It applies a winner-take-all Hebbian learning-based approach. The network has three layers, an input layer, a Kohonen classification layer, and a competitive output layer. The network is given by prototypes W=(w(i),...,w(n)). It changes the weights of the network in order to classify the data correctly. Learning Vector Quantization (LVQ) is a supervised version of vector quantization, similar to Selforganising Maps (SOM). As supervised method, LVQ uses known target outputclassifications for each input pattern of the form. It directly defines class boundaries based on prototypes, a nearest-neighbor rule and a winner-takes-it-all paradigm

K. Standard Back Propagation Algorithm

BP is one of the simplest and most general methods for the supervised training of MLP (Duda et al., 2001). The basic BP algorithm (Bishop, 1995; Duda et al., 2001) works as follows:

1) Initialize all the connection weights W with small random values from a pseudorandom sequence generator.

2) Repeat until convergence (either when the error E is below a preset value or until the gradient vE(t)/vW is smaller than a preset value).

a) Compute the update using

b) Update the weights with

c) Compute the error E(t+1).

L. Heuristic Clustering Algorithm

The process of grouping a set of physical or abstract objects into classes of similar objects is called clustering. A cluster is a collection of data or objects that are similar within the samecluster and dissimilar to data or objects in other clusters . A large number of clusteringalgorithms exist in the literature including k-means and k-medoids. The choice of clustering algorithm depends

both on the type of data available and on the particular purpose and application.After applying pruning algorithm in REANN, the ANN architecture produced by constructive algorithm contains only important connections and nodes. Nevertheless, rules are not readily extractable because the hidden node activation values are continuous. The discretization of these values paves the way for rule extraction.

M. Rule Extraction Algorithm (Rex)

Classification rules are sought in many areas from automatic knowledge acquisition to data mining . They should be explicit, understandable and verifiable by domain experts, and could be modified, extended and passed on as modular knowledge. The REx algorithm described in this section possesses the above mentioned quality and is composed of three major functions:

1) Rule Extraction- This function iteratively generates shortest rules and remove/marks the patterns covered by each rule until all patterns are covered by the rules;
2) Rule Clustering- Rules are clustered in terms of their class levels; and
3) Rule Pruning- Redundant or more specific rules in each cluster are removed.

N. Standard Back Propagation Algorithm

Back propagation neural networks employ one of the most popular neural network learning algorithms, the Back propagation (BP) algorithm. The back propagation algorithm trains a given feed-forward multilayer neural network for a given set of input patterns with known classifications. When each entry of the sample set is presented to the network, the network examines its output response to the sample input pattern.

The output response is then compared to the known and desired output and the error value is calculated. Based on the error, the connection weights are adjusted. The back propagation algorithm is based on Widrow-Hoff delta learning rule in which the weight adjustment is done through mean square error of the output response to the sample. The procedure of algorithm is Using a momentum term is the simplest method to avoid oscillation problems during the search for the minimum value on the error surface. The weight update in BP algorithm with a momentum term a is defined as follows:

The adaptive learning rate can also be adopted to speed up the convergence of the algorithm. For batch training strategy, the learning rate can be adjusted as follows Where ε is the amount for the forgetting, and sgn(x) is the sign function. The absolute value of connection weight is set to decrease by ε due to the second term on the right-hand side). In practice, some optimization algorithms are often used to improve the network convergence (Gill et al., 1981), such as the steepest descent method, the Newton method, In practice, some optimization algorithms are often used to improve the network convergence (Gill et al., 1981), such as the steepest descent method, the Newton method, the Quasi–Newton method, and the conjugate gradients method. In this study, the conjugate gradients method is adopted, as it has a low computation cost and exhibits good results (Polak, 1971). The connection weights thus can be expressed by:

O. Optimal Back Propagation Algorithm

In this section, the adjustment of the new algorithm OBP will be described at which it would improve the performance of the BP algorithm. The convergence speed of the learning process can be improved significantly by OBP through adjusting the error, which will be transmitted backward from the output layer to each unit in the intermediate layer. In BP, the error at a single output unit is defined as:

Where the subscript “P “refers to the pth training vector, and “K “refers to the kth output unit. In this case, Ypk is the desired output value, and Opk is the actual output from kth unit, then δpk will propagate backward to update the output-layer weights and the hidden-layer weights. There are two common training strategies: the incremental training strategy (Shigetoshi et al., 1995) and the batch training strategy (Jang et al., 1997). Usually, an incremental strategy is more efficient and also faster for systems with large training samples, as random disturbances can be induced to help the system to escape from a local minimum point.

VI. CONCLUSION

In this paper, we proposed a comparison of some techniques for build-ing decision making mechanisms in medical Decision Making System. We have proposed an efficient algorithm (optimal Back propagation) for medical diagnosis. The novelty of the optimal

Back propagation is that it can determine the number of nodes in a single hidden layer automatically. The training of an artificial neural network may be costly, as the number of hidden units has to be determined prior to training. Introducing constructive algorithms for feed forward networks eliminates the predetermination. As we were focusing at the optimal size of a network that performs the pattern classification with acceptable efficiency, we have ignored all the factors that improve the performance of back propagation algorithm.

The hidden layer of a neural network plays an important role for detecting the relevant features. Due to the existence of irrelevant and redundant attributes, by selecting only the relevant attributes, higher predictive accuracy can be achieved. For a particular input, any (or few) feature(s) may not be effective to the hidden layer or feature space. By extracting this (these) features we can minimize the training time. In near future, we will try to extend the algorithm for improving back propagation using Feature selection.

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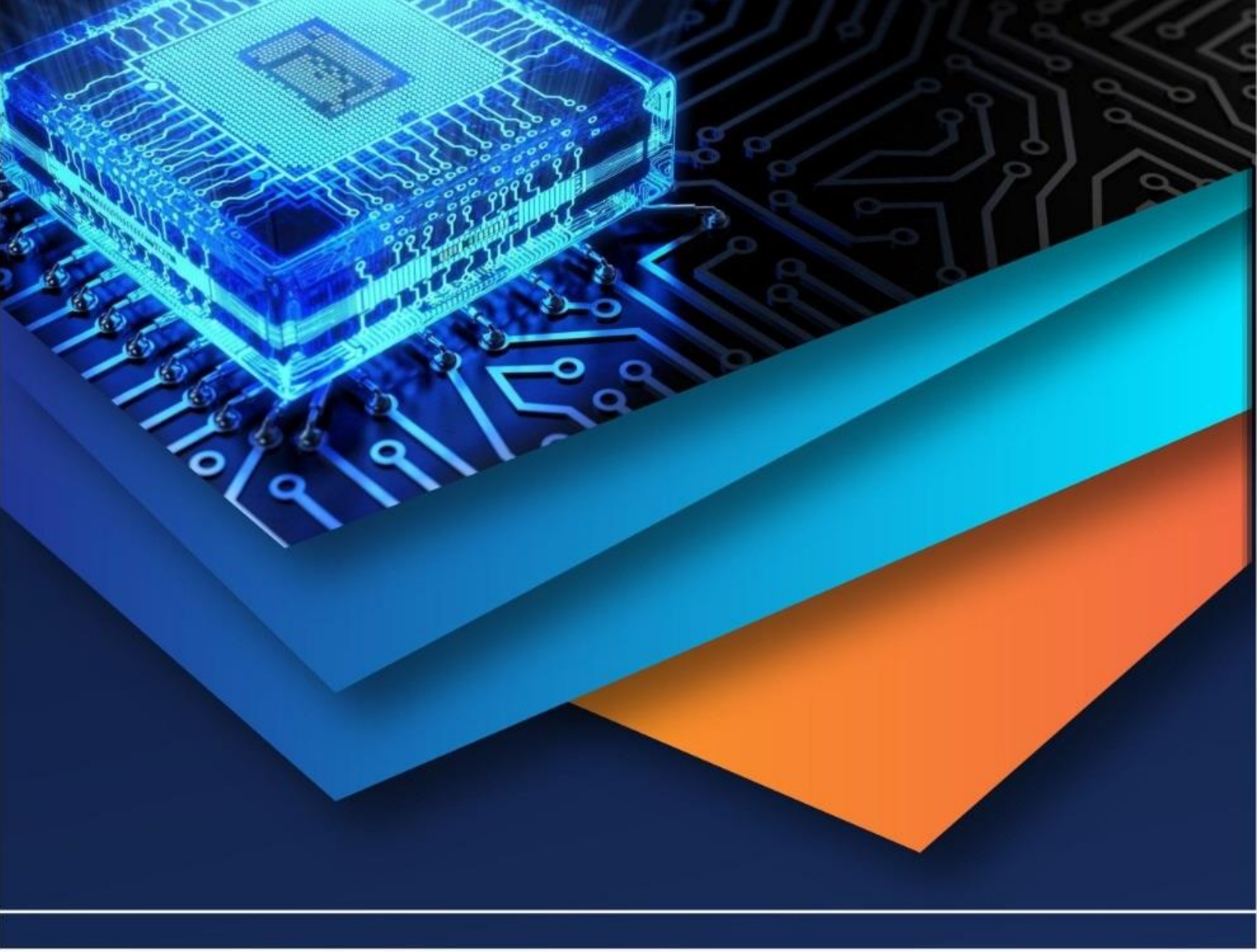

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