TERM PAPER

ON

APPLICATIONS OF ARTIFICIAL NEURAL NETWORK IN HEALTH CARE

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NOIDA

Declaration

I, Rittik Rana, student of B. Tech. (CSE), hereby declare that the project titled "Applications of artificial neural network in health care" which is submitted by me to Department of Computer Science and Engineering, Amity School of Engineering Technology, Noida, Amity University Uttar Pradesh in partial fulfilment of requirement for the award of the degree of Bachelor of Technology in Computer Science and Engineering, has not been previously formed the basis for the award of any degree, diploma or other similar title or recognition.

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Place: Noida
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CERTIFICATE

On the basis of report submitted by Rittik Rana, student of B. Tech. (Computer Science and Engineering), I hereby certify that the report "Applications of artificial neural network in health care" which is submitted by him to Department of Computer Science and Engineering, Amity University Uttar Pradesh, Noida in partial fulfilment of requirement for the award of the degree of Bachelor of Technology in Computer Science and Engineering, is an original contribution with existing knowledge and faithful record of work carried out by her under my guidance and supervision.

To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

Noida

Date: 29.05.2020

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ACKNOWLEDGEMENT

At the onset would like to express my sincere gratitude to my faculty guide Dr. Achyut Shankar who gave me the golden opportunity to complete this project titled “Applications of Artificial Neural Network in Health Care”. His proper guidance avoided me to go wayward in project and moreover his time to time supervision saw to it that the efforts put in by all the students bear the fruitful results.

The project opened new avenues in the field of research for me and developed a keen sense of curiosity to know more.

Lastly, I would like to thank my parents and friends for their moral support. I also wish to thank all the persons who tangibly or intangibly motivated me in doing this project.

RITTIK RANA

CONTENT

Abstract

The area of artificial neural networks (ANNs) is probably the most emerging, fast developing fields in the technical world. The experiments going on health diagnosis done by various researchers have only one major purpose of building up perfect, fruitful, profitable and easily accessible approach or technique to support clinical experts. The main aim of this review is to evaluate the proof of healthcare advantage using ANN in the medical domains. I give a brief review highlighting the concept based on the computer-generated neural networks and their applications in health care. An overview of neural network is given and in application part, I discuss examples or cases to enlighten or give an insight view of neural networks application. A huge amount of data or information is available currently to clinical experts. All kinds of statistics and testimony help us by giving fruitful knowledges and scientific tips which should be analysed and fixed on a specific anatomy while diagnosis. For avoiding any type of misdiagnosis, ANN is beneficial. Those extensible training models is able to manage and combine various health information in classified outcomes. It is emphasized that the future is not far when a completely diagnostic equipment and system can be developed on the basis of the advanced technique in various domains like ECG, EEG, macroscopic-microscopic photo evaluation methods.

1. Introduction

The execution of brainpower of most intellectual creature in the world i.e. human in experimental tools is one and only purpose of researchers from the beginning of research and innovations and it is not an exception for health care or medicine field.

Artificial neural networks are extensively or universally applied in scientific world with various applications in diverse branches. For an example ANNs are applied in chemical kinetics predicting the nature or behaviour of industrial reactors and modelling kinetics of drug liberate [9].

In general, various types of data like categorization of biological objects or data of chemical kinetics or even clinical parameters can be easily manageable in the very same manner. Day by day, with the enhancement of new technology, the new systems developed like ANN uses various information which are utilized in past learning specified database for coming out with a consistent clinical result like the prediction of an assured anatomy or categorization of biological phenomenon [9].

With the enhancement of new computational techniques, structuring of more complexed ANN model and the action of elementary neural knot was explained.

Besides paying attention to the strength of applications of ANN, their limitations, probable inclination and further improvements based on it are also

evaluated. However, before discussing the applications of neural networks, it is very important to reflect the various existing systems or methods from artificial intelligence whose experience gives us a framework to evaluate or discuss more new approaches.

Neural network can be useful in health care i.e. in medicine in four fundamental fields which are mentioned in the flow chart given below.[7]

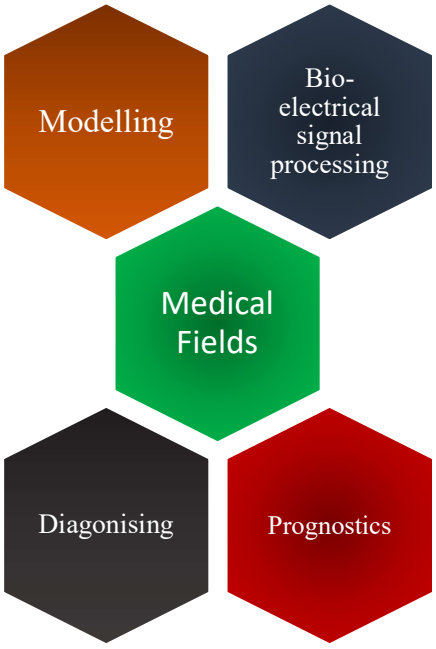

Figure:1

- **Modelling:** Modelling the structures and operations of the cerebrum and neurological units of body.
- **Signal processing:** Brainwave indicator purifying and analysis.

- **System control and checking:** Intellectual mannered instrument supervision and analysis on th basis of responses of brainwave systems transferred to any indicator.
- **Classification:** Elucidation of somatic and equipmental outcomes to attain more exact results.
- **Prognostics:** Neural networks gives anticipating data on the basis of the evaluation of retroactive variable.

1.1. Objective of the term paper

a) Give a brief idea about artificial neural network

b) How neural network works on back-propagation neural network

c) How they can be applicable in health welfare.

d) Possible trend and scope in future

2. Literature Review

2.1. Related Works

In 2019, Syed Javed *et al* [1] have worked on the artificial neural network to develop a replica for predicting post-streptococci mutation in tooth cavity on the basis of the pre-streptococci mutation applying ism app development. In order to solve this issue, they studied 45 primary moral

teeth cases. They did the caries excavation with carbides pericarp, polymeric pericarp and scoop digger and recorded the territory launching elements for pre- and post-streptococci mutation. The statistics collecting from various clinics were being utilized to build up the model. When the model was trained, they were tested with various clinical data applying different architectures. They proved that lookahead backward propagation model with the framework 4-5-1, prognostics post-streptococci mutation with great accuracy of 0.99033. Their research exhibits the utilization of ism app with integrated ANN model to predict the post-streptococci mutation in such efficient way.

Since 2015, Thakur Santosh *et al* [2] have focussed on an important challenge in ANN, i.e. minimizing the impact or effect of ague inhabitants specially in semi-equatorial area by developing an efficient disease prediction model based on ANN. In order to develop the prediction model, they collected data from various clinics and spacecraft information like downpour, saturation, hotness and greenery for a fixed time period. After collecting the required information or data, they started developing the model using feedforward ANN model and differentiate with the analysed information. In 2018, they came out with the result that the clinical information like the number of cases having clue or testimony and having no clue or testimony will help to enhance the accuracy level and they

considered that the prediction varies for different areas depending on the clinical and environmental variables. The mean delusion of the model varies from 18% to 117% when combined with environmental variable.

In 2018, Joao Baptista de Oliveria e *et al* [3] developed an ANN model for screening of the active pulmonary tuberculosis. They proposed a conclusion maintenance equipment for diagnosis of the pulmonic tuberculosis cases at a sub-ordinate level. They developed a tool consisting a flexible sonority replica to identify the danger category of patients and a multilayer perception ANN for categorizing cases like positive or negative pulmonic tuberculosis. They have proved that their tool reaches an accuracy of 92% and meticulosity of 58%. They showed that the tool proposed by them will provide a fast and low-cost pre-test of pulmonic tuberculosis. patients.

In 2017, Steven Walczak *et al* [4] have emphasized on developing forecast and lessen conclusion remorse for treating carcinoma utilizing ANN. They developed an ANN for prediction of 7-month survival of carcinoma cases and the final result can be utilized as an alternative origin of data to help clinical experts and victims in selecting of the therapy. They collected all confirmed cases of pancreatic cancer from midwestern hospital between 2000 to 2010 and built up data for learning and training

process of ANN model. They performed the testing of ANN model by histologic and anatomical analysis of each types by pattern recognition. The ANN model achieves over a 91% accuracy level and overall efficiency above 70%.

In 2016, Timothy Belliveau *et al* [5] focussed on the issue of developing mathematical models for the prediction of practical findings after discharging from traumatic vertebral column damage. They did the retrospective evaluation of information collected from the national and multi-centre spinal cord injury model system database. They proved that the model developed for prediction of ambulation status were highly efficient having accuracy of 85% and for non-ambulation, accuracy was moderately good (76% to 86%).

In 2015, Hsiao-Hsien Rau *et al*. [6] worked on an important issue that is useful to help clinical experts when consulting with diabetes patients. They developed a webcast hepatic cancer diagnosis replica to help the victims effected by type II diabetes with-in 6 years of treatment utilizing ANN. In order to do so, they used two data mining process, one of them is ANN and the other is logit reverting (LR). They obtained data from various sources covering almost 21 million people. Then they found out the new treated cases with type II diabetes having no prior cancer diagnosis. After

final selection of almost 3000 cases and assigning them to a case study, the database was classified in-to two categories: first one is training and the second one is test category. After utilizing 70% from selected data for the learning purpose of the ANN and remaining data for test purpose, the final outcome attained an accuracy of 75.7% predicting accurately to have further a hepatic cancer treatment in future.

2.2. Problem Statement

The literature has come out with various ANN models which can be applied to predict various life threaten disease. However, they require more developments due to lack of considering the current practical scenarios. The current researchers focussed on the development of ANN gradually lessen conclusion remorse. Clinical experts should utilize neural network with total consideration that wrong prognosis still happen having less than 29% of the time [4]. Earlier computer models were emphasized on general clinical evaluation rather than categorising different issues with the purpose to systematise the analysis of a specified domain based on possible scenarios [10]. Clinical experts have no reason to utilize computational equipment until they are useful for almost every patient in a general category of clinical conditions. This began a dilemma which is still present somewhere in our medical system. One issue that needs to be mentioned

for improving the performance of ANN models is the systematic approach for their development. Advance computing technology would help clinicians or physicians to focus or concentrate where they are much needed [10].

3. Methodologies for Neural Network Research

Before designing any ANN model, the problem statement and where the model will be used have to be defined. Receiving and measuring data or information is very difficult at the same time while working with bioelectrical signals. After obtaining the signals, they are immediately measured by routine diagnostic pre-processing system by specific parameters. This causes adaption in the real information [7].

After measuring the original signal, a training set has to be designed with enough database keeping the biological diversity in mind. A reference method should be utilized to calculate the required values. All samples are classified into two categorized: learning and testing group [7].

Definition and training of the neural networks to develop an ANN model for fixed purpose could be done with the convention growing component trading spreadsheet combination. Test set is as similar as training set containing different data. This is how an ANN model is developed [7].

4. Overview of Artificial Neural Network

ANN may be represented as an arithmetic algorithm which approaches all the features of very portable neuronal knot in a very basic way [7]. In other words, it can be defined as a statistical illustration of the human neuronal framework on the basis of the learning and generalization abilities [9]. In this brief overview, the focus is only on to the backward propagation ANN algorithm.

The simulated illustration of the human neuron (Figure 2) is called as the 'Processing Element' (PE). ANN is made of very small number of PEs ranges from ten to thousand. One PE consists of many insert ways called dendrites and extract ways called axons [7].

PEs are generally structured into three layers: Input Layer, Hidden Layer and Output layer. Data is obtained by the input layer from its surroundings and pass them into the first hidden layer by the weighted connection. Hidden layer locates among the input and output layer. In the hidden layer, input information is mathematically handled and the outcome is passed to the next layer.

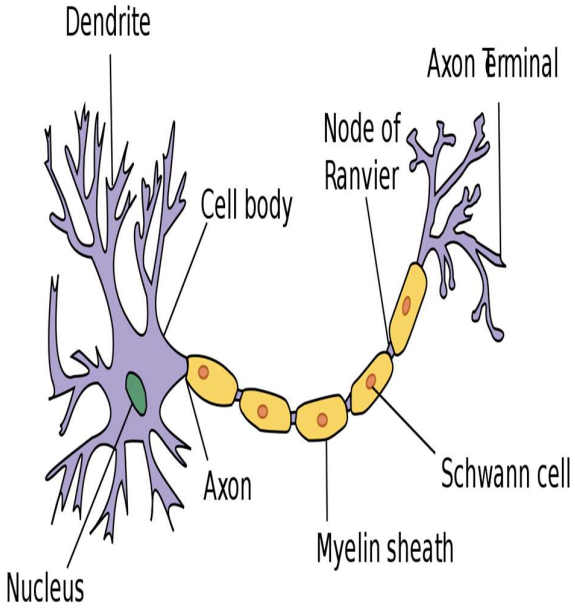

Fig 2

Finally, output layer creates a response for the given input. How many neurons will be in a layer and how many layers will be there a neural network totally depends on the complexity of the developing system [9].

4.1 Function of a Back Propagation Neural Networks

The operation or functionality of an ANN on the basis of the backward propagation algorithm is described in the following manner.

A. First information is collected by input layer. Then input information or data passes through the ANN to the last i.e. output layer. This is called forward-propagation. At the mean-time, the condition of each layer for each PE must be fixed.

$$x_j^{[s]} = f(I_j^{[s]}) = f\left(\sum_i (w_{ij}^{[s]} * x_i^{[s-1]})\right)$$

Where

$x_j^{[s]}$ stands for the state of present outcome of the j th PE in the present [s] layer,

$I_j^{[s]}$ signifies the weighted sum of the input information to the j th PE in the recent layer [s],

f is significantly the sigmoid function,

$w_{ij}^{[s]}$ denotes the weight of the connection between the i th PE in the current layer [s] and the j th PE in the previous layer [s-1]. [7]

B. Global mistake is found on the basis of the total difference of necessary and evaluated outcomes of each of the PE in the last layer.

$$E_g = 0{:}5^* \sum_{\kappa} ((r_k - o_k)^2)$$

Here

E_g stands for the global mistake.

$r_k - o_k$ signifies the difference between the necessary and evaluated final results. [7]

Scaled local mistake regarding each PE is calculated in the following manner in the output layer [7].

$$e_k^{(0)} = x_k^{[0]} * \left(1.0 - x_k^{[0]}\right) * \ (r_k - o_k)$$

C. For each PE, global mistake is backward processed by the network itself to find out local mistake values and delta weights. Delta weights are customized on the basis of Delta-rule which can strictly control fall of the synaptic strength of mainly those PEs which are mostly responsible for the global mistake [7].

$$e_j^{[s]} = x_j^{[s]} * (1.0\text{-}x_j^{[s]}) * \sum\nolimits_k (w_{kj}^{[s+1]} * e_k^{[s+1]})$$

Where

$e_j^{[s]}$ stands for the local mistake regarding the j th PE in the recent layer [s].

$$\Delta\ w_{ij}^{[s]} = locef * e_j^{[s]} * x_i^{[s-1]}$$

Here

$\Delta\ w_{ij}^{[s]}$ means delta weight of inter-connection in between the present PE ($Pe_j^{[s]}$) and the connecting PE ($x_i^{[s-1]}$). [7]

One of the training parameters, training co-efficient, is denoted by *locef.*

D. Synaptic weights, the strength of interneural connections, are modified by adding of delta and current weights. Positive synaptic weight amplifies neuronal indicator and provide much powerful effect at the connecting PE. No amplification in the indication flow is provided by zero weight. Negative weight signifies reluctance [7].

E. The learning procedure of the ANN is quite equivalent to the training function of our brain. The neural networks are trained with various samples. The final output and the given output during training are compared with each other. The difference in between the two outputs adjusts synaptic weight.

After completion of the training procedure, the neural network model is tested with different data. If result is not satisfactory, then neural networks or learning parameters of it will be modified. [7].

ANN research leads to various algorithms and many of them are recently utilized widely based on distinct situations. Backward propagation algorithm is one of the famous and world-wide adopted algorithms. Back-propagation is referred to the principle of evaluation of synaptic weight which proceeds towards reversed direction (from output to input layer). [7]

4.2 Applications of Artificial Neural Network in Health Care or Medicine

Detailed information of applications of artificial neural network in various medical field are discussed in the remaining of the paper.

A. Cardiology: The base of acute myocardial infarction (AMI) diagnostics is formed by the serum enzyme level analysis. In order to do the analysis of heart enzyme levels, a neural network is trained and after training and testing, the efficiency of diagnosis is 100% (8% false positive rate) [7]. Later the neural network was also trained EKG-phenomena and changes After administration of nitro-glycerine [7].

Farruggia et al. utilized ANN to control cardio-defibrillators. ANNs are utilized for replication of heart rate directive [7].

For the diagnosis of chest disease, LM learning statistics is utilized rather than BP with momentum learning statistics regarding MLNN structure [8]. The best accuracy for average classification in chest disease diagnosis achieved using PNN model [8]

B. Analysis of ECG: Clinical experts apply computational method to analyse ECG. The present system is made of rule based mathematical and statistical algorithm. Human evaluation of complex ECG signal is a time taking

procedure. An appropriately trained neural network can analyse complex ECG signals having 99.99% sensitivity [7].

C. **Gastroenterology:** Hepatectomy, gastroenterology and oncology are interconnected fields in health care. Hamamoto et al. developed an ANN model on the basis of back-propagation algorithm with clinical information of 54 patients; out of 54 patients, data of 11 were used during the test of ANN model and the final outcome is that the model has 100% accuracy. It is a great achievement in medical field [7].

D. **Pulmonology:** There are several attempts by pulmonologists and radiologists together to develop a system made of neural network for categorizing solitary pulmonary nodules. They have come of some interesting result. The accuracy or efficiency of neural network is more than two well-trained clinical experts for the diagnosis of pulmonary embolism of 1064 patients [7].

E. **Oncology:** We have various models in our hand for the screening and selecting therapeutic treatment to cure breast cancer. Depending on the various parameters like size of tumor, number of tangible apathetic bud, receiver estimation of tumor hormone etc., an ANN model predicted the probable repetition rate of tumor accurately of 960 out of 1008 cases [7].

Fogel showed that identification of breast cancer and analysis of mammographic, embryological and endemic findings in a decision-making model by neural network is proved as fruitful for screening and diagnosis [7].

F. Neurology: It is sometimes difficult to do different screening between presenile dementia and vascular disease and artificial neural network can be beneficial here by analysing cerebrum SPECT image data. In a research, it achieved 86% sensitivity [7].

G. EEG analysis: Various neuronal diseases are diagnosed per day by analysing EEG pattern. To distinguish spontaneous HVS patterns (High Voltage spike-and-wave spindle0 in rats, a backward propagated ANN was trained and the network can recognize the existence of HVS in EEG for 12 hours at night with an accuracy of 93-99% [7].

Various ANN classifiers collect information from by pre-processing EEG data. Pfurtscheller et al. showed on their research that artificial neural network has 65-80% accuracy to classify EEG patterns (sleep stages) into 6 classes [7].

In Boston, neural network was used to study sleep pages using EOG (electrooculogram) and EMG (electromyogram) information along with EEG specimens. The research reached an accuracy of 93.3% [7].

H. Otorhinolaryngology: It has also been proved that neural network can be fruitful for modeling hearing effectively. This method can also be applied in the treatment of talking and hearing deterioration [7].

Hearing devices can be developed applying ANN for purifying noise and expansion of variable settings [7].

I. Obstetrics and Gynaecology: ANN was applied by Benesova et al. to find out the agent of prenatal superintended drugs. Neural network was also used by Lapeer et al. with an intention to find out prenatal specifications effecting weight of new born infant [7].

J. Ophthalmology: Maeda et al. developed an ANN model to video keratography pattern interpretation in the analysis of shape abnormalities of the cornea that relate to other abnormalities. Cornea maps were divided into two sets: one is training set and another one is test set. The model has 80% efficiency [7].

K. Radiology: To detect cold lesion and localize SPECT images, an ANN model was trained using various parameters like images with different size, noise levels etc. The network analysed the full image and distinguished alterations with high accuracy and with a few false positive errors [7].

We have also an ANN model accessible in our hand for classification of mammographic images. A backward propagation ANN was trained with a data collected from various sources classifying 14 features of mammographic images and it achieved a remarkable efficiency [7].

In another research, an ANN model was developed for the elucidation of breast carcinoma ultrasonographic images. The ANN was trained with database gained by characteristic separation pre-processing [7].

L. Pathology: For the grading of breast carcinoma, a neural network was trained by Dawson et al in laboratory. They analysed characteristics obtained from light microscopic images. The similar procedure applied for differentiation of tubular carcinoma from sclerosing adenosis [7].

Even neural network can evaluate spread of prostate cancer. An ANN model was designed by Kolles for grading astrocytoma on the basis of immunohistochemically and DNA microscopic images [7].

A neural network can be beneficial in breast cancer screening and estimating risk by the evaluation of DNA flow cytometric histograms [7].

M. Cytology: Most probably, PAPNET system has world-wide applications based on neural network in medicine and it is developed and utilized for automated cytological screening. It is proved by Boon that number of false

negative cases can be minimized applying PAPNET system. Research done by Brouwer showed that neural network can identify cervical cells [7].

N. Genetics: Errington and Graham developed an ANN model for the classification of chromosome and in order to do so, they trained the neural networks by pre-processed data with various parameters like the shape, size and banding of chromosomes [7].

There is a neural network model designed by Burstein et al. to study the whole territorial and corporeal embryogenesis and formation of genic design in Drosophila.

O. Clinical Chemistry: From the starting of new innovation and development, the main purpose or aim of several studies is intelligent analysis of the final outcomes from logical chemistry and to answer for unpredictable incidents. Efficiency of automated evaluation of electrophoretic patterns is increased. But there are some specific conditions created by neural network for automatic result [7].

P. Biochemistry: For superfamily classification of proteins, Protein Classification Artificial Neural Networks system (ProCANS) is implemented and an ANN model was developed with the help of the authorized protein order data collecting from various sources of identification of protein. The

efficiency of that model was quite impressive having 90% classification sensitivity and sequence rate is less than 0.1 second [7].

5. CONCLUSION

Several scientific equipments have been developed or implemented on the basis of artificial neural network which helps clinical experts or physicians for suitable diagnosis of various diseases. There are various advantages of ANN including [7]:

I. The capability of processing huge amount of information.
II. Consuming less diagnosis time which helps during specially any emergency.
III. Great accuracy of classification of similar data.
IV. Minimizing overlooking of relevant information.

The range of examples mentioned in the literature review showed the potentiality of artificial intelligent instruments for various prognostic and diagnostic circumference and to visualise high dimensional signal processing [10].

Besides their importance in decision making system to minimize information or data overload, they are also beneficial in investigative data evaluation [10].

However, inspite of their world-wide applications in modern or new diagnosis system, they must be regarded only as an equipment to make the final decision of an experts.

Future Scope on Artificial Neural Network

In future, computer-based technology will play a great role in health care ranging from patient management to data acquisition [10]. In global circumference of health care as a commodity, decision support system based on ANN will be an integrated part in medical domain rather than an optional one [10]. There is a huge possibility of being successful by applying ANN in pattern identification and categorization compared to ordinary traditional technology in near future. There will be rapid development or improvement in instrumentation, communication and data storage on the basis of ANN. But it has to be considered that they need more development keeping real-world problem in mind and their development and success highly depends on the clinical arrangement and awareness. With the advancement of technology, computing research has come out with various solutions regarding diverse real-life problems and in near future, it will reveal new skyline in health care.

6. References

1. Javed, Syed Ulla, et al. “Development of Artificial Neural Network Model for Prediction of Post-Streptococcus Mutans in Dental Caries.” *Computer Methods and Programs in Biomedicine*, vol. 186, 2020, pp. 105198–105213., doi: 10.1016/j.cmpb.2019.105198.

2. Thakur, Santosh, and Ramesh Dharavath. “Artificial Neural Network Based Prediction of Malaria Abundances Using Big Data: A Knowledge Capturing Approach.” *Clinical Epidemiology and Global Health*, vol. 7, no. 1, 2019, pp. 121–126., doi: 10.1016/j.cegh.2018.03.001.

3. João Baptista De Oliveira E Souza Filho, et al. “Screening for Active Pulmonary Tuberculosis: Development and Applicability of Artificial Neural Network Models.” *Tuberculosis*, vol. 111, 2018, pp. 94–101., doi: 10.1016/j.tube.2018.05.012.

4. Walczak, Steven, and Vic Velanovich. “Improving Prognosis and Reducing Decision Regret for Pancreatic Cancer Treatment Using Artificial Neural Networks.” *Decision Support Systems*, vol. 106, 2018, pp. 110–118., doi: 10.1016/j.dss.2017.12.007.

5. Belliveau, Timothy, et al. “Developing Artificial Neural Network Models to Predict Functioning One Year After Traumatic Spinal Cord Injury.” *Archives of Physical Medicine and Rehabilitation*, vol. 97, no. 10, 2016, doi: 10.1016/j.apmr.2016.04.014.

6. Rau, Hsiao-Hsien, et al. “Development of a Web-Based Liver Cancer Prediction Model for Type II Diabetes Patients by Using an Artificial Neural Network.” *Computer Methods and Programs in Biomedicine*, vol. 125, 2016, pp. 58–65., doi: 10.1016/j.cmpb.2015.11.009.

7. Papik, Kornel, et al. “Application of Neural Networks in Medicine — a Review.” *Diagnostics and Medical Technology*, vol. 4, no. 3, 1998, pp. 538–546.

8. Er, Orhan, et al. “Chest Diseases Diagnosis Using Artificial Neural Networks.” *Expert Systems with Applications*, vol. 37, no. 12, 2010, pp. 7648–7655., doi: 10.1016/j.eswa.2010.04.078.

9. Amato, Filippo María, et al. “Artificial Neural Networks in Medical Diagnosis.” *APPLIED BIOMEDICINE*, vol. 11, 7 Jan. 2013, pp. 47–58., doi:10.2478/v10136-012-0031-x.

10. Lisboa, P.J.G. “A Review of Evidence in Health Benefit from Artificial Neural Networks in Medicine Intervention.” *Neural Networks*, vol. 15, 2002, pp. 11–39.

APPENDIX

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