Efficiency of Machine Learning Applications in Medical Care Field

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Abstract —As artificial intelligence and machine learning have become hotbeds of research in recent years. Various applications in artificial intelligence and machine learning have evolved in recent years as these fields have become hotbeds of study. It exists not only as a scholastic boundary, but also as an integral element of our daily life. In this trend, medical care and machine learning are becoming increasingly linked. The recommendation made by the core idea also served to alleviate the current problem of unequal medical distribution and resource stress. This paper examines a number of machine learning and auxiliary tumor therapy applications in the process of allocating medical resources and suggests some novel application approaches to bring it closer to human levels. A good situation of reciprocal collaboration between the medical and computer industries has arisen in the age of artificial intelligence, benefiting both.

Keywords—machine learning; data mining; artificial intelligence; pathology; diagnostics

I. INTRODUCTION

1.1 The machine learning's wide-ranging condition

Machine learning (ML) is a branch of science that tries to make machines learn. After the renowned competition between Google's Alpha Go and Go player Li Sedol, which ended with a score of 4:1 in 2015, machine learning resurfaced in the public eye. And as a result of this incident, machine learning has become increasingly well-known, even among individuals who are unfamiliar with computer science, and it has sparked heated debate in related fields. Machine learning is not a new subject, despite the fact that it is a relatively new area of AI. ML is broadly defined as the application of certain computer algorithms to a set of data known to the event outcomes, The ability to learn from training data and predict future data based on learning outcomes is broadly characterized as the use of particular computer algorithms to a set of data known to the event outcomes. Instead of deductive reasoning, it relies on induction and summarization. Samuel, a computer scientist from the United States, built a chess programme that could learn by itself through continuous play in the early 1950s. This programme for the first time demonstrates a machine's capability, while also demonstrating the unpredictability of a machine's ability to learn. Machine learning, on the other hand, began to cool off as the research progressed. Up to the 1970s, It gradually made a comeback. Machine learning has become an important area, including data mining, pattern recognition, natural language processing, and so on, throughout this period of constant research and growth. It's also become an important part of AI. Machine learning is now classified into three types: supervised, semi-supervised, and unsupervised learning. It is a multidisciplinary area with numerous domains that can be researched in a variety of fields, including not only computer science but also medicine, finance, and economics. Other fields that can enhance their own performance by learning new skills and information while emulating human learning characteristics. Cross-disciplinary field with many domains and It may be investigated in a wide range of topics, not only in computer science, but also in medical, finance, and other disciplines, and it can improve its own performance by acquiring new knowledge and skills while emulating human learning behavior.

In today's society, Medical care issues have become a major topic in today's culture, with issues such as an unbalanced and insufficient allocation of medical resources becoming increasingly obvious. In this context, the use of machine learning has become an unavoidable trend in the current evolution of medical care. Artificial intelligence (ANN) algorithms have been used to judge abdominal pain since 1972, according to academics at the University of Leeds in the United Kingdom. Now, More and more scholars are now committed to combining machine learning and medical treatment. ML-based pathological diagnosis of tumors, lung cancer, and other diseases has gradually gained traction. Alibaba, Amazon, and Baidu, for example, have developed their own research teams to work on it. The use of machine learning in medical care has significantly reduced medical costs while also providing a new way for citizens to see a doctor and making people's lives easier. People's demand, on the other hand, gives a new drive for ML research and development, as well as for supporting its continual improvement.

1.2. The machine learning's key algorithm

(a) Artificial Neural Network (ANN)

The Artificial Neural Network (ANN) is an algorithm that mimics the learning process of the human brain. It is made up of numerous nodes, or neurons, that are connected to one another. Each node represents an activation function, which is a special function. Between two nodes, there is a weight value. Neural networks are classified into two types of computing models: forward networks and feedback networks. The neural network is trained and different weight values are updated using the training set's input, and nonlinear data is handled to meet the learning goal.

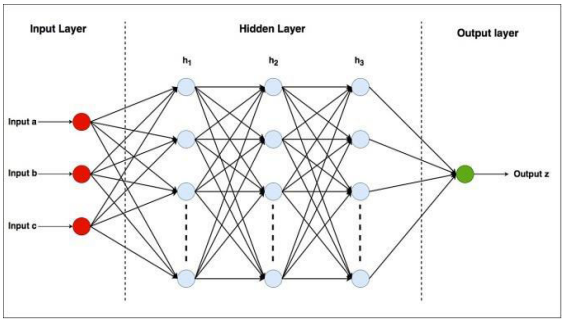

Fig.1. Artificial Neural Network model

(b) Methods Based on Decision Tree

The decision tree algorithm is a method for generating a decision tree from existing data and inputting the training set. The test results can be categorized based on the decision tree's growth direction. The primary concept behind a decision tree is to determine which characteristic is the best, how many branches can be formed, and when to cease splitting. The variable known as impurity, as well as various other mathematical methods, can be used to predict the outcome of this procession. However, because it is a greedy method, decision trees might sometimes prevent you from finding the ideal tree.

Some hot of them is Nearest neighbour classifier, Naive Bayes classifier, ANN (Artificial Neural Network), and SVM are some of the most used (Support Vector Machine). Among them, ANN has become one of the most popular algorithms, with many scientists debating its merits.

(c) Bayesian Belief Networks and Naïve Bayes

The Nave Bayes technique is a machine learning method based on probability theory. It determines the target object's prior probability and posterior probability using the assumption that vents are independent. The following is the formula.

$$P(B/A) = P(A/B)P(B)/(P(A)) \qquad (1)$$

Because the method's basis is relatively basic, and the prediction efficiency is good despite the rigorous restrictions, it is still frequently employed in the field of natural language recognition and other applications.

(d) Support Vector Machine (SVM)

SVM is a statistical learning theory that works by transforming input space into a high-dimensional space. The hyper plane and loss function are produced in the linear classification to solve the minimum of the agent's loss; the approach may be applied to the linear indivisible issue, and the method is utilized to segment the hyper surface with feature space. SVM is frequently employed in the analysis of medical conditions and the classification of benign and malignant tumors, but because it may require the calculation of high-order matrices, it is challenging to use in large-scale training samples

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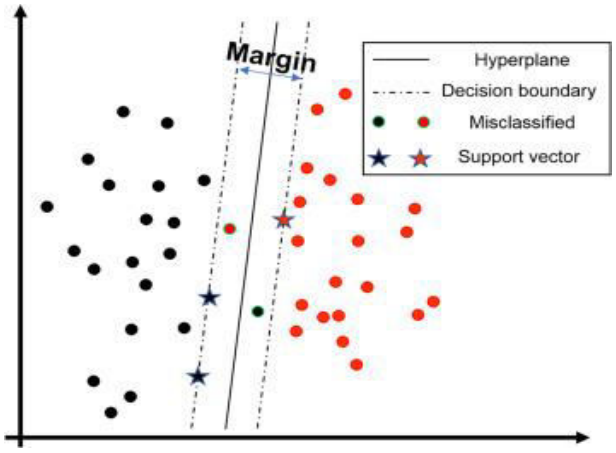


Fig. 2. Support Vector Machine Model

(e) K-means

The variable k is chosen by the actual scenario in this manner. It estimates the distance between every item and the primary centre of clusters after randomly selecting k objects as the primary centre of clusters, and then assigns the object to the closest cluster. The centroid of each cluster will be determined again until all items have been allocated. The procedure will be continued until the centroid remains constant. The algorithm is iterative, which makes programming easier.

II Efficiency of Machine Learning Applications in Medical Care Field

A. Supported Diagnosis For Tumor:

With the development of medical technology and artificial intelligence, ML has been researched for tumor prediction, follow-up treatment, and other applications as medical technology and artificial intelligence have advanced. Relevant research is now being conducted in the areas of breast cancer, lung cancer, and skin cancer. Other cancers are

continuously being researched by researchers.

Taking treatments of breast cancer for instance SVM is a common strategy for treating breast cancer. SVM divides tumors into benign and malignant types and then maps them in multidimensional space to ease difficult analysis in a two-dimensional space that is reasonably straightforward. It always selects the optimum hyperplane for splitting the data. By using SVM to mine 1150 chromosomal pictures, CHEN et al.[1] discovered that cancer nest characteristics, cancer nest cell density characteristic, and stromal cell structure characteristic were all highly important in the pathogenesis of breast cancer. For nuclear knowledge, Chen and his colleagues have a 99 percent accuracy rate. Jiang[2] used super hashing based on joint kernel via 3121 breast tissues to compensate for the semantic gap between low-level and high-level diagnosis. It differentiated benign cases in huge datasets, with retrieval accuracy of 88.1 percent and classification accuracy of 91.3 percent with a query time of 16.6 milliseconds. Jaworek[3] proposed a more reliable method for distinguishing melanoma in the field of skin cancer. He preprocessed skin photos using the Dermoscopic approach, removing portions that were not connected to skin problems. After that, he segmented and retrieved photos, as well as examining color attributes. He employed gray-level co-occurrence matrix texture rendering in the meanwhile. The degree of skin cancer is assessed, and the accuracy rate is 92 percent.

There are also numerous studies examining the topic from various aspects, including as clinical perspectives and DNA viral data. The prediction accuracy using ML is around 85%, and the findings are relatively accurate.

B . Medical Imaging Applications:

In today's world of limited medical resources, the efficiency of medical imaging examinations and the relevance of the results do not satisfy the majority of people. It means that if machine learning is utilized in medical imaging, it will save a lot of time and money. In recent years, medical practitioners have embraced ML for CT segmentation, MRI analysis, and other aspects of medical pictures.

In terms of ultrasound detection, Zhu[4] suggested in his article that an artificial neural network method may be utilized to distinguish between benign and malignant thyroid nodules. There were 618 individuals and 689 thyroid nodules in this study, with no history of thyroid disease, no history of neck radiotherapy, and ultrasound testing. They built a neural network using the shape, margin, echo, internal combination, calcification, halo sign, and color Doppler vascular features of each nodule, with 0 and 1 indicating benign and malignant, respectively. A total of 561 nodules took part in the study, which limited the aforementioned six eigen values and related properties to avoid overtraining. Calculating the difference between the two outputs The weight between neurons was modified based on the difference between the current value and the expected value. After all was said and done, the final outcome was 84.3 percent.

HUANG[5] proposes using a grey forecast model to reduce inaccuracy in MRI image segmentation. He developed an original sequence using the data he gathered and established the G(1,1) model using the formula:

$$d X_1(i)dt+a X_1(i)=þ \qquad (2)$$

The following equation, where is the control coefficient, an is the expansion factor, and (1) is the initial predicted value, may be solved using the least squares method:

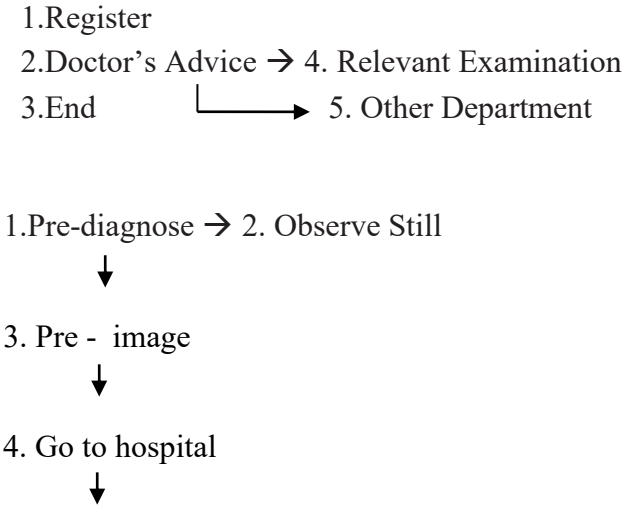
$$X_1(i) = \left[X_0(1) - \frac{\beta}{\alpha}\right] e^{-\alpha(i-1)} + \frac{\beta}{\alpha} \quad (3)$$

Through this method, The unpredictability of the original data may be decreased using this method, and the experiment demonstrated that it can roughly identify the tumor zone, reduce false positives, and enhance tumor segmentation accuracy. Sarraf[6] used a convolutional neural network (CNN) and the structure of LeNet-5 to classify MRI findings with Alzheimer's disease and normal brain, and evaluated 62335 images, of which 52507 belonged to Alzheimer's disease, with a high accuracy of 98.85 percent. Dou[7] used a three-dimensional complete convolutional network to identify brain micro bleeds (CBMs) (FCN).This result can reduce a large number of redundant calculations, and greatly speed up the detection speed With a sensitivity of up to 93.16 percent, this result can minimize a huge number of redundant calculations and greatly speed up detection performance. This procedure might theoretically be used for various medical examinations. Aside from the aforementioned uses, ML has conducted numerous studies on cancer-related liver fibre CT and MRI. The most frequent algorithms are ANN, SVM, and clustering algorithms. Researchers' scopes are gradually broadening as a result of these algorithms, which are derived from the basic ML algorithms Machine Learning

III Applications for Referral and Pre-Division

A . Medical care in new and traditional ways

Currently, the focus of ML research in medical care is primarily on the assessment of symptoms and the development of linked medical measures. Relevant study can undoubtedly lower the expenditure of medical resources while also avoiding subjective inaccuracy produced by human judgement. In light of current research and development, the conventional medical process must now be registered in the hospital, and once at the associated clinic, it is required to go through the department doctors' inquiries and inspections to receive a preliminary result. Transferring to another department is necessary in many instances. As a result, we may wish to consider a new concept, not only to save medical resources in the process, but also to analyze data from the pre-stage of medical treatment and classify patients by machine. Patients will no longer seek advise from their initial doctor after the assessment, instead going to the appropriate department. The conventional medical steps and intelligent medical steps are compared as follows:



5. Relevant examination → 6.Other department →

7. End

↓

8. Original Department

↓

9. End

Flow Chart . 1. traditional and new model of medical care

B. Information dealing

If we want to make sure that the patient's condition is as accurate as possible, we must first make sure that we have a database that contains as much relevant information as possible, then create a target data set, preprocess it (this process may consume 60 percent of the energy), and then go through data conversion to find useful data features, and finally go through data mining

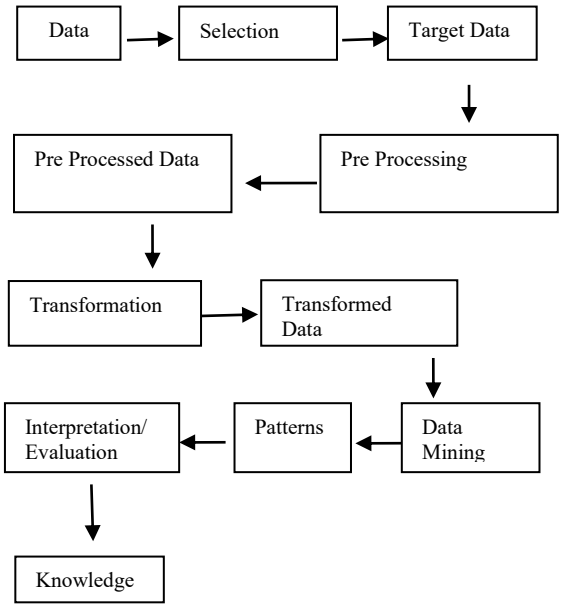


Fig. 3. Steps of data mining [8]

The historical symptoms and cases are initially entered into the database during the pre-processing of information. Because there may be some flaws in the cases, pre-processing is done using a decision tree technique that is not sensitive to missing data. Using the form of the entropy formula, use impurity to determine which node to separate:

$$E(t) = -\sum_{j} p(j|t) \log_2 p(j|t) \quad (4)$$

$$G_{split} = E(p) - \sum_{i=1}^{k} \frac{n_i}{n} E(i) \quad (5)$$

The current separation node has the highest G value out of all the nodes. The most appropriate node may be selected and categorized based on relevant qualities using this traversal. It may classify patients into different kinds during the examination and referral process, based on similarity and a high-dimensional data space that can be used to quantify similarity. The coefficient of Jaccard is used as a measurement standard here. The Jaccard similarity coefficient expresses the proportion of two sets' intersection to their union. An initial threshold s is chosen for the classification. The following is the formula:

$$J(A,B) = \frac{|A \cap B|}{|A \cup B|} \qquad (6)$$

The Jaccard is calculated as follows, followed by the formation of a similarity coefficient matrix from the similarity coefficient. The largest sum of each row of the similarity matrix coefficient is recorded as a variable called max, and the element on the line and the element greater than s are then searched for. Record the row number in the column where the element is situated, then split it as the row and column of the new matrix. Calculate the row again and again, then form a new matrix and judge the most recent matrix. If all of the elements are greater than s, the process returns to the beginning and begins again; otherwise, it begins with the sum of the second search matrix rows.

$$sim(i,j) = \frac{|A \cap B|}{|A \cap B| + |A \cap \bar{B}| + |\bar{A} \cap B|} \qquad (7)$$

$$\begin{pmatrix} sim_{11} & \cdots & sim_{1n} \\ \vdots & \ddots & \vdots \\ sim_{n1} & \cdots & sim_{nn} \end{pmatrix} \qquad (8)$$

The similarity matrix analysis method is used to classify the patient's sickness, and the relevant data is sent back to the patient and medical staff, which can effectively assist them in conducting intermediate referrals, saving time and money.

IV. Challenges for Problem

Machine learning has grown in popularity in recent years, and its applications in medicine have gradually expanded. Multiple variables, however, unavoidably limit it. The following are some of the most typical issues:

(I) Although the inaccuracy induced by the doctor'
subjective condition is avoided in medical image analysis, it is nevertheless limited by objective conditions, such as sounds, and other errors are still common.

(II) Despite the fact that machine learning has already invested in a number of studies and applications aimed at supporting tumor therapy, more funding and manpower are needed to conduct relevant research and development and put it into practice on a broad scale. It is still unable to achieve this condition at this time.

(III) While contemporary research has achieved advances in pathological analysis, it is still inapplicable to illnesses that necessitate the use of human resources, such as analgesia and fever, which are more widespread.

(IV) Learning about relevant material necessitates a significant amount of data and the creation of a comprehensive database for the patients. This is accompanied by a number of security issues. Doctors, patients, and the law are all involved in ensuring that the information is not disclosed

(V) Simple tasks can now be directly replaced by machines thanks to the introduction of the machine learning technology. It means that the job status of relevant employees as well as the educational level of the medical profession must both be enhanced at the same time.

V . CONCLUSION REMARKS

After discussing the history of machine learning in the medical profession and its contemporary application, this article analyses the main methods of machine learning and describes numerous sample applications. The most common concepts and algorithms are outlined. Simultaneously, a machine learning-based enhancement strategy for the visiting process is provided. This does not, however, imply that ML is flawless. It has some issues, whether in terms of technology, ethics, or legality. The resolution of these issues necessitates the use of technicians and legal counsel. Working together, and figuring out how to strike a balance between manpower and machine, is an issue that we all have to deal with.

REFERENCES

[1] Li F , Tran L , Thung K H , et al. A Robust Deep Model for Improved Classification of AD/MCI Patients[J]. IEEE Journal of Biomedical and Health Informatics, 2015, 19(5):1-1.

[2] Dou Q , Chen H , Yu L , et al. Automatic Detection of Cerebral Microbleeds from MR Images via 3D Convolutional Neural Networks[J]. IEEE Transactions on Medical Imaging, 2016:1-1

[3] Lu-Cheng, Zhu,Yun-Liang, Ye,Wen-Hua, Luo,Meng, Su,Hang-Ping, Wei,Xue-Bang, Zhang,Juan, Wei,Chang-Lin, Zou.A model to discriminate malignant from benign thyroid nodules using artificial neural network.[J].PloS one,2013,8(12):e82211.

[4] Bin Huang, Feng Liao, Yu-Feng Ye. Advances in machine learning in image analysis of nasopharyngeal carcinom[J]. International Journal of Medical Radiology, 2019(1).

[5] Sarraf S , Tofighi G . Classification of Alzheimer's Disease using fMRI Data and Deep Learning Convolutional Neural Networks[J]. 2016.

[6] Ke-Yang Zhao, Mu-Yue Yang, Jing-Yu Zhu, Ze-Qi Wang, Wei-Wei Shen. Machine learning AIDS in tumor dignosis[J]. Tumor, 2018, 38(10): 987-991.

[7] Jiang M, Zhang S, Huang J, et al. Scalable histopathological image analysis via supervised hashing with multiple features[J]. Medical Image Analysis, 2016, 34:3-12.

[8] Pang-ning Tan, Michael Steinbach, Vipin Kumar, Introduction to data mining, Beijing: Posts & Telecom Press, 2011

[9] Yu Q , Jiang T , Zhou A , et al. Computer-aided diagnosis of malignant or benign thyroid nodes based on ultrasound images[J]. European Archives of Oto-Rhino-Laryngology, 2017, 274(7):2891- 2897.

[10] Fei Liu, Jun-Ran Zhang, Hao Yang. Advances in medical images recoginition based on deep learning[J]. Chinese Journal of Biomedical Engineering, 2018.

[11] Joanna J K, Pawel K . Automatic Classification of Specific Melanocytic Lesions Using Artificial Intelligence[J]. BioMed Research International, 2016, 2016:1-17.

[12] Huang W C , Chang C P . Automatic Nasal Tumor Detection by grey prediction and Fuzzy C-Means clustering[C]// IEEE International Conference on Systems. IEEE, 2006.M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

[13] Xue-Hu WANG, Study Liver Segmtation Method from CT Images based on Deformation Optimization and Sparse Statistics[D]. Beijing Institute of Technology, 2015.

[14] G. Eason, B. Noble, and I.N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving

products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

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