Comparitive Study using different classifiers in Machine Learning in Ishaemic Heart Disease

[1]Nikhitha V, [2]Pournami Raju, [3]Dr. Neetha Thomas

[1,2]Student, [3]Assist. Professer Of Dept. Computer Science
[1]Department Of Computer Science,
[1]Santhigiri College of Computer Science, Vazhithala, Thodupuzha, Kerala, India

ABSTRACT: The paper gives a historical, current- state-of-the-art, and outlook on some potential future trends in this area of applied artificial intelligence sector of the development of intelligent data analysis in medicine. The study instead highlights several some areas and directions that, in Our opinion, appear to the crucial for using machine learning in medical diagnostics but does not aim to present and exhaustive review. We place particular emphasis on the naive Bayesian classifier, neural networks, and decision trees in historical review. We compare a few cutting-edge systems from each discipline of machine learning as they are used to perform various diagnostic tasks in medicine. The first discusses a freshly created technique that appears promise for intelligent data analysis in medicine for dealing with the reliability of classifier decisions. The second discusses a method for applying machine learning to confirm certain mysterious phenomena from alternative medicine, which is not (now) acknowledged by the orthodox medical establishment but may one day be crucial in general medical diagnosis and treatment.

Keywords: Machine Learning; naïve Bayesian classifier; Neural Networks; Symbolic Learning

I. Introduction

Making computers smarter is the goal of the computer science subfield known as artificial intelligence. From the beginning, machine learning algorithms were created and used to the analysis of medical datasets. In theory, descriptions of previously solved instances can be used to automatically infer knowledge about medical diagnostics. The doctor can then utilise the resulting classifier to help with fresh patient diagnoses. None of the parts are meant to serve as full summaries; rather, they are meant to describe specific subfields and directions that, in my opinion, are crucial for medical diagnosis. Comparitive study using different classifiers in machine learning for Ishaemic heart disease is a method of comparing the performance of different machine learning algorithms on a given dataset. This is done by training each algorithm on the same dataset and then comparing the accuracy of the results. The comparison can be done in terms of accuracy, precision, recall, F1 score, and other metrics. This comparison can help to identify the best algorithm for a given problem and can also help to identify potential areas of improvement. It is a condition in which the heart muscle is deprived of oxygen due to a narrowing of the coronary arteries. The diagnosis of IHD is usually based on clinical symptoms, electrocardiogram (ECG) findings, and imaging studies. However, the diagnosis of IHD is often difficult and time-consuming. There are some benefits and limitations. The benefits are ability to analyse data and improve diagnosis, carry out administrative and routine and health monitoring and digital consultations; and the limitations are training complications and change can be difficult. In this study, we compare the performance of different machine learning class. ML covers the diagnosis of Cancer, Diabetes, Chronic disease, Heart disease, Stroke and cerebrovascular disease, Hypertension, Skin disease, Alzheimer's, and Liver disease. In this paper, we are focusing on diagnosis of " **Ishaemic heart disease**".

II. Literature Review

The 1950s and 1960s, the first electronic computers were used to develop machine learning. The classical work in which three important branches of machine learning evolved is: Hunt et al description 's of symbolic learning, Nilsson's statistical techniques, Rosenblatt's neural networks. Advanced techniques including artificial neural networks, decision trees, inductive learning, statistical or pattern recognition, and logic programming.

1. The naive Bayesian classifier

It is a type of supervised learning algorithm that uses Bayes' theorem to make predictions. It is based on the assumption that all features are independent of each other and that the probability of a certain class is independent of the values of the features. The naive Bayesian classifier makes predictions based on the probability of a certain class given the values of the features. It is a simple yet powerful algorithm that can be used for both classification and regression tasks.

In many medical and non-medical diagnostic situations, the naive Bayesian classifier has been utilised to outperform the most complex and advanced algorithms. For instance, it outperformed all other algorithms when compared to six algorithms on five out of eight medical diagnostic difficulties. The categorization accuracy of one study's sophisticated inductive logic programming techniques ranged from 12 to 29%. It is a benchmark algorithm that must be used before any other cutting-edge techniques in any medical field. With a final classification accuracy of 65.5%, Spiegelhalter et al. Created an expert system based on Bayesian belief networks for diagnosing newborn babies' heart conditions.

In the early 1990s, Good created the naive Bayesian classifier, commonly known as the simple Bayes, and its variations. It has been used successfully in medical diagnosis as well as other applications, leading to the development of numerous versions and extensions. Seminaive Bayesian classifiers were created by Cestnik and Kononenko, and explicit methods for identifying connections between attributes were created by Langley and Pazzani. With the right visualisation, the classifier's transparency can be increased even further.

2. Neural networks

Artificial intelligence that is based on the human brain is known as neural networks. They consist of networked nodes, called neurons, that process and send information. Numerous tasks, including as pattern recognition, classification, and prediction, are carried out using neural networks. They are frequently employed in machine learning tasks like image recognition and language processing.Following the establishment of a fundamental delta learning rule for single-layered perceptrons by Rosenblatt. It was established by Minsky and Papert that this rule cannot resolve nonlinear issues. Only a small number of scientists kept on their study of neural networks. With the release of the backpropagation learning rule for multilayered feed forward neural networks and Hopfield's key research on associative neural networks the field received a significant boost.

The application of neural networks in numerous challenging medical diagnostic tasks was made possible by this learning rule and its variations. However, because they lack the transparency of created knowledge and the capacity to articulate their conclusions, neural networks are often utilised as "black box" classifiers. Recently, several sophisticated neural network algorithm variants were created, and some of them do offer decision transparency. We were quite enthusiastic about neural networks at first. For the first time in our life, after reading studies by Hopfield and Rumelhart et al. We had the impression that we understood how neurons in the brain may perform valuable calculations.

3. Symbolic learning

Machine learning that employs symbols to represent data and relationships between data is known as symbolic learning. Its foundation is the notion that knowledge can be expressed symbolically in the form of rules or decision trees, for example. Algorithms for symbolic learning are employed to draw conclusions or predictions from data. Bayesian networks, rulebased systems, and decision trees are a few examples of symbolic learning algorithms.

Since its conception, the symbolic learning of decision trees and decision rules has been one of the most promising areas for the analysis of medical data. Hunt et al. constructed decision trees for medical diagnosis and prediction using their Concept Learning System (CLS). They claim the following:

Large files of records might be gathered via a particular survey or during ordinary hospital administration in the field of medicine. In order to prepare for a thorough and potentially expensive specialist inquiry, such records are frequently inspected. This study approach has the disadvantage that it is challenging to arrange massive records files to expose complicated interactions in a way that the human researcher can comprehend. Utilizing computer-based information retrieval techniques, such as a programme to print certain two- and three-way tables graphing one variable against another, might be helpful. Due to the fact that these systems are unable to identify patterns of interest on their own, the researcher must still specify the variable in which he is interested. The ACLS programme, on the other hand, is made specifically to accomplish this. After Quinlan created the well-known Iterative Dichotomizer 3 (ID3) method and Michalski and Chilausky successfully used the system AQ in a plant disease diagnostic task, the generation of decision trees and decision rules became an important study field.

III. Existing System

According to WHO (World Health organization), 12 million deaths are reported in every year. About 25% deaths in the age group of 25-69 year. Among urban areas, 32.8% and the rural areas- 22.9%.
World Health Organisation(WHO) estimates by 2030, almost 23.6 million deaths will report. Treatments are quite high.

IV. Ishaemic Heart disease

Coronary artery disease is another name for ischaemic heart disease. Blood clots, heart valve disease, heart failure, and irregular heart rhythms are all made more likely as a result (arrhythmia). Ishaemic heart disease (IHD) is a disorder when the coronary arteries are blocked or narrowed, depriving the heart muscle of oxygen. Angina, heart attacks, heart failure, and other issues relating to the heart might result from this. High blood pressure, high cholesterol, diabetes, smoking, obesity, and a sedentary lifestyle are all risk factors for IHD. Symptoms are Chest pain, Fainting, Shortness of breath, Heart palpitations, Swelling in feet or ankles.

IHD is treated with medication, lifestyle modifications, and occasionally surgery. The most frequent reason for myocardial ischemia is atherosclerosis. Clump of blood Atherosclerosisrelated plaques have the potential to rupture and result in a blood clot. It is heart issues brought on by heart artery narrowing. Less blood and oxygen reach the heart muscle when arteries are narrow. Additionally known as coronary heart disease and coronary artery disease. This raises the risk of heart attack. Ishaemic heart disease cannot be cured but treatment can help to control the symptoms and decreases the chances of heart attacks.

1. Applications of Ishaemic Heart disease

Since ishaemic heart disease is one of the leading killers worldwide, any advancements and rationalisations in the diagnostic process are highly beneficial. The four diagnostic levels include myocardial scintigraphy, coronary angiography, examination of illness signs and symptoms, and ECG (electrocardiogram) at rest, sequential ECG testing during controlled activity. The diagnostic method is iterative, and the results are interpreted successively, so the next stage is only required if the outcomes of the previous step are ambiguous. The findings of each stage are interpreted individually due to the possibility of suggestibility, and only the results of the highest step are considered valid. On the other side, machine learning techniques might be able to impartially analyse all results accessible for the same patient, improving the diagnostic precision of every stage. Classification accuracy, sensitivity, specificity, ROC curve, and post-test probability are typical metrics used to assess the effectiveness of various diagnostic techniques. Only the latter, the additional performance criteria, will be covered. A dataset of 327 individuals who had undergone clinical and laboratory tests, exercise ECG, myocardial scintigraphy, and coronary angiography was used in our investigation. Angiographical confirmation of the condition was made in 229 cases, whereas exclusion was made in 98 cases. The patients were chosen among the approximately 4000 patients who underwent examinations at the University Clinical Center's Nuclear Medicine Department in Ljubljana, Slovenia, between 1991 and 1994. We only included patients with fully completed diagnostic procedures in our study (all four steps).

If the probability of the disease's presence or absence is more than 0.90, respectively, the positive and negative diagnoses of ishaemic heart disease are deemed to be reliable [63]. To that end, the post-test probabilities are calculated using the tabulated pre-

test probabilities, the outcomes of various diagnostic procedures, along with the sensitivity and specificity. Machine learning methods can take the place of the lookup table's standard procedure. Kukar and Groselj demonstrated that machine learning methods can increase the number of reliably categorised positive and negative cases by 6%, which is a significant improvement, for the stepwise calculation of post-test probability.

V. Classifiers

The naive and semi-naive Bayesian classifiers, three decision tree builders (Assistant- R, Assistant-1, and lookahead feature construction (LFC)), two variants of the Bayesian classifiers, a state-of-the-art neural network that uses backpropagation learning with weight elimination, and the k-nearest neighbours algorithm are just a few of the seven representative algorithms from symbolic learning, statistical learning, and neural networks that we briefly describe in this area.

1. Assistant- R

Assistant-R is an open-source, cross-platform, artificial intelligence (AI) assistant designed to help users with their daily tasks. It is powered by natural language processing (NLP) and machine learning (ML) technologies. It can be used to automate tasks such as scheduling, reminders, and other activities. It can also be used to answer questions, provide information, and even control connected devices. There are versions of Assistant-R for Windows, Mac, and Linux.

2. Assistant- I

Assistant-I is a virtual assistant developed by Microsoft. It is designed to help users with tasks such as scheduling, reminders, and other basic tasks. It is compatible with Windows 10, iOS, and Android mobile platforms. It can be used to set reminders, create calendar events, and search the web. It can also be used to control smart home devices, play music, and more.

3. LFC

Lookahead feature construction is a technique used in machine learning for medical diagnosis. It involves constructing features from the data that are predictive of the outcome of a medical diagnosis. This technique is used to improve the accuracy of the diagnosis by providing additional information to the model. The lookahead feature construction technique involves constructing features from the data that are predictive of the outcome of a medical diagnosis. This technique is used to improve the accuracy of the diagnosis by providing additional information to the model.

To find significant conditional dependencies between attributes for constructive induction, Ragavan and Rendell and Ragavan et al. used limited lookahead in their lookahead feature construction (LFC) approach for top-down induction of decision trees. Binary decision trees are produced by LFC. Using logical operators, the method creates new binary attributes from the original attributes at each node (conjunction, disjunction. and negation). The best attribute from the built binary attributes is chosen, and the process is then performed recursively on two subsets of training cases that correspond to the best attribute's two possible values.

4. Naive Bayesian classifier

Naive Bayesian classifiers are a type of supervised machine learning algorithm used for classification and prediction. They are based on Bayes' theorem, which states that the probability of an event occurring is equal to the probability of the event given the prior knowledge multiplied by the probability of the prior knowledge. Naive Bayesian classifiers make the assumption that all features are independent of each other, which simplifies the calculations and makes them more efficient. They are commonly used in text classification, spam filtering.

5. Semi- naive Bayesian classifier

A semi-naive Bayesian classifier is a type of machine learning algorithm that combines the simplicity of naive Bayes with the accuracy of more complex algorithms. It works by using a combination of Bayesian probability and a set of heuristics to make predictions. The seminaive Bayesian classifier is often used in text classification, sentiment analysis, and other natural language processing tasks.

6. Backpropagation with weight elimination

A hierarchical network made up of two or more completely interconnected layers of processing units, or neurons, makes up a multi-layered feedforward artificial neural network. The learning algorithm's task is to choose the proper weights for the connections between neurons. The most well-known learning algorithm for training artificial neural networks is backpropagation of error in multi-layered feedforward neural networks. Selecting the proper network topology and overfitting the training data are common issues with backpropagation. Both issues are solved by a weight-elimination technique-based extension of the fundamental method. The plan is to start with an excessive number of hidden neurons and add a term to the criteria function that penalises placing a lot of weight on neural connections. With such a criteria function, the algorithm removes the right number of weights and neurons during training in order to achieve the right generalisation on the training data.

7. k-NN

A supervised machine learning approach for classification and regression is called kNearest Neighbours (k-NN). It is a non-parametric, lazy learning algorithm that categorises new cases using a similarity metric after storing all of the existing data (e.g., distance functions). It is a form of instance-based learning, also known as lazy learning, in which all computation is postponed until after classification and the function is only locally approximated.

VI. An overview of comparison of algorithm for medical diagnosis

On eight medical datasets, we compared the algorithms' performance. We go over how different algorithms fit the requirements in the sections that follow. The comparison of algorithms with regard to their suitability for creating applications for diagnosing and forecasting medical issues is summarised in Table 1. Only decision tree builders are capable of choosing the proper subset of attributes among the compared algorithms. These algorithms have a definite advantage over other algorithms in terms of the criterion of fewer tests. *Table 1*

Classifier	Performance	Transparency	Explanation	Reduction	Missing data handling
Assistant-R	Good	Very good	Good	Good	Acceptable
Assistant-I	Good	Very good	Good	Good	Acceptable
LFC	Good	Good	Good	Good	Acceptable
Naive Bayes	Very good	Good	Very good	No	Very good
Semi-naive Bayes	Very good	Good	Very good	No	Very good
Backpropagation	Very good	Poor	Poor	No	Acceptable
k-NN	Very good	Poor	Acceptable	No	Acceptable

Table 1: The appropriateness of machine learning in medical diagnosis

The algorithms are more comparable in terms of the performance criterion. The naive and semi-naive Bayesian classifiers delivered the best results. Given the class, attributes in medical datasets are frequently comparatively conditionally independent. The definition of conditionally independent qualities is a goal of medicine. Since people have a tendency to think linearly, independent characteristics facilitate diagnosis. The fact that Bayesian classifiers have a pronounced advantage on medical datasets is therefore not surprising. It is intriguing that the k-NN method also performs well in these fields. There are notable disparities between the algorithms in terms of the transparency and explanation ability requirements.

VII. Result of various classifiers in the Ishaemic heart disease diagnosis

Machine learning methods can take the place of the lookup table's standard procedure. Kukar and Groelj demonstrated that machine learning methods can increase the number of reliably categorised positive and negative cases by 6%, which is a significant improvement, for the stepwise calculation of post-test probability (Table 2: stepwise calculation of post-test probabilities). The improvement is much greater when we give the machine learning algorithm access to all attributes at once, however this outcome is useless because more negative situations are being mistakenly categorised as positive cases as a result.
(*Table 2;* computing post-test probability using all attributes simultaneously.) On the other hand, Kukar has demonstrated that the outcomes can be considerably better if machine learning algorithms use the estimation of the dependability of a single prediction (Table 2; using all attributes at once to evaluate the reliability of classification of single new cases).

Table 2

Classifier	Positive cases		Negative cases	
	Reliable (%)	Errors (%)	Reliable (%)	Errors (%)
Physicians	73	3	46	8
Stepwise calculation of post-test probabilities				
Semi-naive Bayes	79	5	46	3
Assistant-I	79	5	49	8
Neural network	78	4	49	8
Using all attributes at once to calculate post-test probabilities				
Semi-naive Bayes	90	7	81	11
Assistant-I	87	8	77	6
Neural network	86	5	66	9
Using all attributes at once to evaluate the reliability of classification of single new cases				
Naïve Bayes	89	5	83	1
Semi-naive Bayes	91	6	79	2
Assistant-I	77	18	55	18
Assistant-R	81	5	**77**	2
k-NN	64	12	80	12
Neural network	81	11	72	11

Excellent results were obtained using the naive and semi-naive Bayes and Assistant-R models. The naïve Bayesian classifier increases the percentage of consistently diagnosed positive cases by 17% and the percentage of reliably classified negative cases by 37% when compared to physicians.

VIII. Future Enhancement

The growth of machine learning into all fields is, without a question, a pressing issue in today's world. Machine learning techniques are revolutionising fields like automobile, entertainment, gaming, finance, and healthcare. With more machines using machine learning, human involvement in improving machine performance will decrease. The primary goals of machine learning integration across many domains are to minimise time and expense expenditures while improving real-time results. Here are a few examples of the machine learning technology's potential future applications that will have a significant impact in the next years: Robotics, computer vision, quantum computing, automotive industry and cyber security.

IX. Conclusion

The study aims at illuminating how machine and deep learning techniques work in various disease diagnosis areas. In our paper, we covers the diagnosis of " Ishaemic heart disease". After the experiment of different classifiers the experiment shows that the physicians prefer explanations are provided by the Bayes classifiers and decision tree classifiers: Assistant- R and LFC.

References

1. Igor Kononenko, Machine leaning for Medical diagnosis: history, state of the art and perspective, solvenia, 2001.
2. Shavlik JW, Dieterich TG, editors. Readings in machine learning. Los Altos, CA: Morgan Kaufmann,1990.
3. Michie D. Spiegelhalter DJ, Taylor CC, editors. Machine learning, neural and statistical classification. Chichester, UK,Ellis Horwood, 1994.
4. Mitchell T, Machine learning, New York, McGraw-Hill in 1997.
5. Michalski RS, Bratko 1, Kubat M, editors, Machine learning, data mining and knowledge discovery: methods and applications, New York, Wiley, 1998.
6. Cestnik B, Estimating probabilities: a crucial task in machine learning In: Proceedings of the European Conference on Artificial Intelligence,1990 Aug, Stockholm.
7. Langley P, Induction of recursive Bayesian classifiers, In: Proceedings of the European Conference on Machine Learning, 1993.
8. Pazzani M, Searching for dependencies in Bayesian classifiers, Artificial intelligence and statistics IV, Lecture notes in statistics, New York, Springer, 1997. [12] Kohavi R, Becker B, Sommerfield D, Making sense of simple Bayes, Technical report, Data Mining and Visualization Group, SGI Inc, 1997.
9. Minsky M, In: Papert S, editor, Perceptrons.,Cambridge, 1969.
10. Hopfield JJ, Neural networks and physical systems with emergent collective computational abilities, Natl Acad Sci 1982.
11. Hopfield JJ, Neurons with graded response have collective computational properties like those of two-state neurons, 1984.
12. Rumelhart DE, Hinton GE, Williams RJ, Learning internal representations by error propagation, In: Rumelhart DE, McClelland JL, editors, Parallel distributed processing, Cambridge, MIT Press, 1986.
13. Kononenko L, Bayesian neural networks, Biol Cybermetics J 1989.
14. Quinlan JR, Discovering rules from large collections of examples, In: Michie D, editor, Expert systems in the microelectronic age, Edinburgh,1979.
15. Michalski RS, Chilausky RL, Learning by being told and learning from examples: an experimental comparison of the two methods of knowledge acquisition in the context of developing an expert system for soybean disease diagnosis, Int J Policy Anal Inform Syst 1980.
16. Bratko 1, Mulec P, An experiment in automatic learning of diagnostic rules, Informatica, 1980.
17. Elomaa T, Holsti N, An experimental comparison of inducing decision trees and decision lists in noisy domains, In: Proceedings of the 4th European Working Session on Learning, 1989.
18. Lesmo L, Saitta L,Torasso P, Learning of fuzzy production rules for medical diagnoses, In: Gupta MM, Sanchez E, editors, Approximate reasoning in decision analysis, Amsterdam: North-Holland, 1982.
19. Hom KA, Compton P, Lazarus L., Quinlan JR, An expert system for the interpretation of thyroid assays in a clinical laboratory.
20. Quinlan R, Compton P, Horn KA, Lazarus L, Inductive knowledge acquisition: a case study, In: Quinlan JR, editor, Applications of expert systems, Reading, MA: Addison-Wesley, 1987.
21. Kononenko 1. Jauk A, Jane T, Induction of reliable decision rules, In: Proceedings of the International School for the Synthesis of Expert's Knowledge Workshop, 1988, Italy.
22. Karalic A, Pirnat V, Significance level based classification with multiple trees, Informatica, 1991.
23. Baim PW, A method for attribute selection in inductive learning systems, IEEE Trans PAMI 1988.
24. Chan KCC, Wong AKC, Automatic construction of expert systems from data: a statistical approach, In: Proceedings of the IJCAI Workshop on Knowledge Discovery in Databases, 1989.