Prediction of Risk Factor of Heart Disease in a Diabetic Patient

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Abstract: Diabetes is a chronic and fast spreading disease. Due to the fast moving world and change in lifestyle such as consumption of fast food and street food, less time for work out and exercise there is a huge number of people suffering from it. Diabetes is not only a blood sugar problem, but brings along other complications as well, as per the Dr. Arun Bal, Diabetic food surgeon. Neural Networks are widely used in diagnoses and treatment of various diseases using various prediction algorithms. The benefit of using neural network is that, they are not affected by various factors such as emotional state and working conditions. The study of neural networks under medical diagnosis applications includes building the cardiovascular model of the patient and comparing with the real-time changes given as input. Here the prediction algorithm used is the feed-forward-back propagation algorithm which predicts the risk of heart disease for a diabetic patient given the changes in blood pressure, cholesterol, age, gender, family background and various other factors. And hence would provide the food items to be avoided to reduce the risk factor.

Index Terms— Feed Forward Back Propagation Algorithm, Data Mining, Neural Networks

1. Introduction

In cognitive science and machine learning, artificial neural networks are models inspired by the animal’s central nervous systems, in particular the brain that is biological neural networks. It is used to approximate or estimate functions that are generally unknown and depends on a large number of inputs. Artificial neural networks are presented generally as systems of interconnected “neurons” where the messages are exchanged between each other. The connections have numeric weights assigned which based on experience it can tuned; making it that is the neural nets adaptive to inputs and more importantly capable of learning. For example, handwriting recognition using neural networks is defined by a set of input neurons which may be activated by the pixels of an input image. After being weighted and transformed by a function (determined by the network’s designer), the activations of these neurons are then passed on to other neurons. This process is repeated until finally, an output neuron is activated in order to determine which character was read. Like other machine learning methods that are hard to solve using ordinary rule-based whereas some other methods - systems that learn from data - neural networks have been used to solve a wide variety of tasks, including computer vision and speech recognition.

Neural networks have been applied successfully in a wide range of unsupervised and supervised learning applications. This type of methods is not commonly used for data-mining tasks, however, because they often produce incomprehensible models and require long training times. Here we describe neural-network learning algorithms that are able to produce comprehensible models, and that do not require excessive training times. We specially discuss two classes of approaches for data mining with neural networks. The first type of approach, often called rule extraction, involves extracting symbolic models from trained neural networks. The second approach is to directly learn simple, easy-to-understand networks. We argue that, given the current state of the art, neural-network methods deserve a place in the tool boxes of data-mining specialists.

In today’s world, one of the major threats to human health is Diabetes Mellitus. Diabetes Mellitus is of two types, type1 or insulin dependent and type2 or non-insulin dependent. Type1 Diabetes is when a person suffers from the complete deficiency of insulin secretion by the pancreas. Type2 Diabetes is when the body does not produce sufficient amount of insulin or the cell fails to intake insulin due to various factors. In some cases of type2 Diabetes, there are no symptoms, which may cause the person to be unaware of the disease for an extended period of time and hence it is of importance to detect type2 Diabetes.

2. Literature Survey

[1] Neural network was traditionally referred to as a network of biological neurons. The usage of the
term in the modern world refers to as artificial neural network, which is composed of artificial neurons. Thus the term has two distinct usages, Artificial Neural Networks and Biological neural networks. Neural Networks hence are ideal in recognizing diseases basically using scans. There is no need to provide a specific algorithm to describe or on how to identify the diseases. It learns by example so details are not needed on how to identify the diseases.

[2] Various algorithms and techniques like Classification, Clustering, Regression, Artificial Intelligence, Neural Networks, Association Rules, Decision Trees, Genetic Algorithm, Nearest Neighbor method etc., are used for knowledge discovery from databases. Classification is the most commonly applied data mining technique, which employs a set of pre-classified examples to develop a model that can classify the population of records at large. Clustering can be said as identification of similar classes of objects. By using clustering techniques we can further identify dense and sparse regions in object space and can discover overall distribution pattern and correlations among data attributes. Regression technique can be used to model the relationship between one or more independent variables and dependent variables (prediction). Association and correlation is usually to find frequent item set findings among large data sets.

[3] This work projected a system that uses method called Information Gain and Adaptive Neuro-Fuzzy Inference System for heart disease diagnosis. The information gain method was proposed to calculate approximately superiority of each one attribute by means of the entropy by estimating the differentiation among the prior entropy and the post entropy. The information gain method is one of the simplest attribute ranking methods and is frequently used in text categorization. Adaptive Neural Fuzzy Inference System (ANFIS), projected by Jang in 1993, is a grouping of two machine learning approaches: Neural Network (NN) and Fuzzy Inference System (FIS).

[4] Fuzzy Expert System for Heart Disease Diagnosis designed with follow membership functions, input variables, output variables and rule base. Designed system has been tested with expert-doctor. Designing of this system with fuzzy base in comparison with classic designed improves results. Results have been shown from this system in compression with past time system are logical and more efficient. This system simulates the manner of expert-doctor. This system is designed in way that patient can use it himself. This fuzzy expert system that deals with diagnosis has been implemented. Experimental results showed that this system did quite better than non-expert urologist

[5] Here the system uses Mamdani inference method. The results obtained from designed system are compared with the data in upon database and observed results of designed system are correct in 94%. The system designed in Matlab software. The system can be viewed as an alternative for existing methods to distinguish of heart disease presence.

3. Related Work

3.1 Soft computing techniques-Data Mining

Data mining is a technique where Data is extracted for huge clinical data and segregated using various clustering techniques maintaining the Integrity of the Specifications. Here Data mining can be done where patients having similar symptoms and similar rates of diabetes parameters can be put in single cluster and the side effect can be observed and thus the rate on the heart can be predicted.

3.2 Fuzzy Interface System

Fuzzy logic, which are based on observations and expert knowledge have been in great demand in building decision making system. A lot of researches are currently persuading work in making applications of medical use using fuzzy systems. Intelligent systems can be used to predict or mine the important information for given data

3.3 Probabilistic reasoning

It combines the property of reasoning to handle uncertainty with the capacity of deriving logical systems. The problem with probabilistic reasoning is that it makes the system more complicated and costly it may also lead counter intuitive results.

3.4 Neural Network

Neural networks are simple networks made up of adaptive nodes and they learn the process of learning from task examples store knowledge and are available for use. It is an approach toward understanding and computing like human brains. They basically trained using various learning algorithm by giving which lead to particular outputs

4. Purpose of Neural Networks

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algorithm by giving inputs which lead to particular outputs.

4.1 Architecture of Neural Networks:

4.2 Working of Single Perceptron

Perceptron is a basic unit in Neural Networks. Neural networks work as a weighted graphs. A perceptron is a node from a weight-ed graph. The following figure shows the perceptron.

4.2.2 Learning Algorithm

4.2.2.1 Supervised Learning

Supervised learning is defined as one of the machine learning tasks of inferring a function from labeled training data where the training data consist of a set of training examples. In supervised learning, each example is a pair consisting of an input object which is typically a vector and a desired output value which is also called the supervisory signal). A supervised learning algorithm analyzes the training data and produces a function called inferred function, which can be used for producing new examples. An optimal scenario will allow for the algorithm to correctly determine the class labels for unseen instances. This requires the learning algorithm to generalize from the training data to unseen situations in a "reasonable" way.

In order to solve a given problem of supervised learning, below given steps are followed:

1. Determine the kind of training examples to be used. Initially the engineer has to decide what kind of data set or the training data is going to be used as an example. For instance, it might include a single handwritten character, or an entire handwritten word, or even an entire line of handwriting.

2. To gather training data set. The training set must represent the real-world which resembles the use of the function. Thus, human experts or from measurements a set of input objects are gathered and corresponding outputs are also gathered.

3. Determine the feature representation of the learned function which is the input. The accuracy defined by the learned function depends strongly on the representation of the input object. Typically, the feature vector is the transformed version of the input object, which contains a number of features that describes the object. Because of the curse of dimensionality, the number of features should not be too large; but must contain information that’s enough to accurately predict the output.

4. Determine what the structure of the learned function should be and its corresponding learning algorithm. For example, the engineer may choose to use decision trees or use support vector machines.

5. The Complete Design.

4.2.2.2 Unsupervised Learning

Unsupervised learning is defined has one of the machine learning tasks of inferring a function in order to describe hidden structure from unlabeled data. Since the examples that are given to the learner are unlabeled, there is no reward or error signal for a potential solution to be evaluated. Hence this differentiates unsupervised learning from reinforcement learning and supervised learning. In Statistics, this is related to the problem of density estimation. However unsupervised learning also encompasses and upholds many other techniques that seek to explain key features of the data and summarize as well. Most of the methods employed in unsupervised learning usually are based on data mining methods that are used to pre-process the data. Some of the unsupervised learning approaches include: clustering (e.g., mixture models, k-means, hierarchical clustering).

4.2.2.3 Reinforcement Learning

Reinforcement learning is another defined area of machine learning which is inspired by behaviorist
psychology, which is concerned with how software agents take actions in an environment in order to maximize some notion for cumulative reward. In many other disciplines, the problem due to its generality is studied such as control theory, game theory, information theory, operations research, simulation-based optimization, swarm intelligence, statistics, multi-agent systems and genetic algorithms. In the control literature and operations research, the field where in reinforcement learning methods are analyzed and studied is known as approximate dynamic programming. The problem has been identified and studied in the optimal control theory, though most studies are mostly concerned with the existence of solutions that are optimal and their characterization, and not with the approximation aspects or learning. In game theory and economics, reinforcement learning may be used to explain how equilibrium may arise under rationality that is bounded.

In machine learning concepts, the environment is typically set or formulated as a (MDP) Markov decision process as many algorithms that are reinforcement learning for this context make use of techniques that are derived from dynamic programming. The main difference between the reinforcement learning and classical techniques algorithms is that the latter do not need knowledge about the MDP and they target large MDPs where exact methods become infeasible.

Reinforcement learning differs from standard supervised learning in that correct input/output pairs are never presented, nor sub-optimal actions explicitly corrected. Further, there is a focus on online performance, which involves finding a balance between exploration (of uncharted territory) and exploitation (of current knowledge). The exploration vs. exploitation trade-off in reinforcement learning has been most thoroughly studied through the multi-armed bandit problem and in finite MDPs.

4.2.2.4 Feed Forward Back Propagation Algorithm

In this project we are considering 3 inputs that is the changes in level of cholesterol change in weight and family history we have considered 3 input nodes, 3 hidden nodes and a single output node as only a single output is expected that is if the person is at risk or no.

In the employment of the back propagation algorithm each iteration of training involves the following steps:

1) Applying Training set in forward direction
2) Error calculation
3) Changing weights accordingly in the backward direction
4) The entire set is repeated in the next training iteration until there is minimum error.

![Fig. 3 Feed Forward Neural Networks](image)

5. Mathematical Model

5.1 Notations and Preliminaries

System, S = {s, e, X, Y, success, failure, F}
Where,
- s = start state
- e = end state
- Y = set of outputs
- X = set of inputs
- success = Desired Output generated
- failure = desired output not generated

Let S’ = {s, e, X, Y, success, failure, F}
Where S’ is the solution to the given problem statement and S’ ∈ S

- s = start state = {init_val_regs | where init_val_regs is initial value of registers at power on}
- e = end state = fexit = exit(0)......normal exit
- Input = X = {X1, X2, X3}
  Where X is Training Set i.e., Cholesterol Change, Family history & Weight change
- Output = Y = {Y1, Y2, Y3}
  Where, Y1 = .Person is at Risk
  Y2 = Is at Risk then, suggest the food to avoid.
  Y3 = Internal Error occurred.
- F = {f1, f2}
  Where, F1 = Update() = updates the value at each node
  F2 = Generate() = generates the desired output for the given set of inputs
- Success = {Y1, Y2} ∈ Output
- Failure = {Y3} ∈ Output
6. Flow Of Algorithm

In the employment of the back propagation algorithm, each Iteration of training involves the following steps:

- Applying Training set in forward direction.
- Error calculation on output nodes.
- Changing weights accordingly in the backward direction.
- The entire set is repeated in the next training iteration until there is minimum error.

7. Results Obtained

Following are the Inputs provided:

- Change in weight of the person.
- Family History.
- Change in cholesterol level.

Following is the Output:

- Person is at increased risk or person is at reduced risk of heart disease.
- If the person has any risk of heart disease then suggest the food to be avoided so that the person can reduced the risk of an attack.

8. Conclusion

Finally, this design gives a basic idea of how exactly the talking neural network works and its usefulness to the people. This design also proposes a conceptual framework for use of intelligent neural networks. Thus with the study performed and methodology devised we can ensure the following.

Making people aware of the side effects of an unhealthy diet and an improper lifestyle. Helping people maintain a proper diet by avoiding the food stuff that can harm our body.

9. References


