A RULE BASED HYBRID EXPERT SYSTEM MODEL FOR DIAGNOSIS OF DIABETES

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Abstract

In the field of Artificial Intelligence, hybrid system is the combination of two methods .In this papers the combination of rule based system and neural network is proposed to diagnose diabetes. Hybrid system is very essential as it can overcome the disadvantages of the two approaches and can combine the advantages of the two. Diabetes is a serious, life-threatening, chronic disease which occurs due to high blood sugar level which occurs due to inadequate insulin production or the body does not respond on insulin. So it is very important to use correct method to diagnose the disease. So an expert system with Artificial Neural Networks that has artificial intelligence characteristics is proposed to create. There are number of approaches available. One such approach is by the use of a combination of rule based, neural networks. By means of this method, diagnosis of diabetes becomes simple for medical practitioners/physicians. This paper will discuss the design & proposed model involved in creating such a system to diagnose diabetes. Keywords: Neural network, Rule based system, expert system, feed forward architecture, Diabetes.

1. INTRODUCTION

Today Artificial Intelligence is used in every field. It is constantly growing and changing. Artificial Intelligence is a way to design a machine similar to the human brain. Artificial Intelligence solves complex problems with mathematics and algorithms. These machines are controlled by software inside them, so AI has a lot to do with intelligent software programs that control these machines. It is a science of finding theories and methodologies that can help machines understand the world and accordingly react to situations in the same way that humans do.AI is closely related to the study of human brain. Researchers believe that AI can be accomplished by understanding how the human brain works. By mimicking the way the human brain learns, thinks, and takes action, we can build a machine that can do the same. This can be used as a platform to develop intelligent systems that are capable of learning.

In the AI tradition rule-based systems and neural networks are two very different fields of research. Both approaches have their own merits and their own flaws. a neural net holds no semantics, while a knowledge base does contain explicit knowledge

A knowledge based system has difficulty dealing with continuous variables; a neural net can learn continuous probability distributions from examples. Neural networks ignore problem-specific theory (e.g. Features may be context dependent), while knowledge based systems are designed to deal with domain-specific reasoning. Knowledge based systems have difficulty acquiring new knowledge, while neural nets learn inductively by their nature. So combining the two could be fruitful: the network could be structured in such a way that knowledge is 'visible' in the architecture and the learning mechanism of the neural net could show if the rules and the data set are in accordance with each other. Medical diagnosis is a very active field as far as introduction of artificial intelligence methods is concerned. Expert systems (ESs) are used to perform diagnoses based on patient data, as they can represent the way expert's reason. Diagnosis of diabetes diseases is greatly

facilitated by the use of nuclear medicine methods, Expert systems technology is moving towards hybrid representations, that is integrations of more than one representation scheme. A promising integration is that of a symbolic representation, e.g. frames or rules, with a connectionist one, i.e. various artificial neural networks (ANNs),In this paper, we present a hybrid medical expert system, , which uses a hybrid representation of rule based system and neural network.

2. BACKGROUND OF THE TECHNIQUES

This section consist of the basic principles of both classical rule based systems and neural networks. The strengths and weaknesses of each system will be discussed.

2.1. Rule-Based Systems

Rule based systems consist of a rule base and a fact base. The rule base contains general knowledge about a certain subject area, while the fact base expresses specific knowledge of a particular case. The rules are used in the inference process to derive new facts from given ones. There are two basic reasoning methods: forward-chaining and backward-chaining. The first method starts with the known facts and applies rules in order to eventually reach the goal conclusion. The latter method starts with the goal. It recursively selects rules that would deduce a (sub) goal until the set of goals is completely resolved by given facts. Of course a bi-directional approach is also possible.

One way of dealing with uncertainty is the use of certainty factors. Each rule has been given a CF between -1 and 1. When a rule fires the conclusion of that rule is assigned the CF of the rule. When the premise is uncertain (CF<1) then the CF of the conclusion is adjusted to either the minimum of the premises (in case of a conjunction) or the maximum of the premises (disjunction).
E.g.:Rule1 if A and B then C (CF=0.8)
if CF(A)=0.8 and CF(B)=0.5 then CF(C)=0.4
Rule2 if A or B then C (CF=0.9)
ifCF(A)=0.7 and CF(B)=0.2 then CF(C)=0.63
The strength of a rule-based system is the high abstraction level. Knowledge can be declared in a very comprehensive manner, making it possible to easily verify the knowledge (rule) base with (human) domain experts. The system also gives explanations for the given answers in the form of inference traces.Typical weaknesses are dealing with incomplete, incorrect and uncertain knowledge, continuous variables and non-monotonic logic. A complete domain theory may require thousands of (possibly recursive) rules, which could lead to a very slow system . Also the system does not "learn" anything by itself.

2.2 Neural Networks

In an artificial neural network a number of neurons are connected with each other (see figure 1). We distinguish the input layer, the hidden layer(s) and the output layer. Each connection has a certain weight. Each node propagates a value calculated by a function taking the net sum of the weighted activation of all connections leading to that node as its input . A bias can be added by connecting a bias-node (that always has 1 as activation value) with the node. The weight of this connection is called the bias. In the training phase each input pattern is propagated through the network, after which the error (squared sum of the difference between the desired output and the actual output) is calculated. The weights are then adjusted using a back-propagation algorithm. The adjustment to each weight value is calculated by using the derivative of the error function: we want to minimize the error, so we choose the direction that gives the steepest descent. local optimum [6].
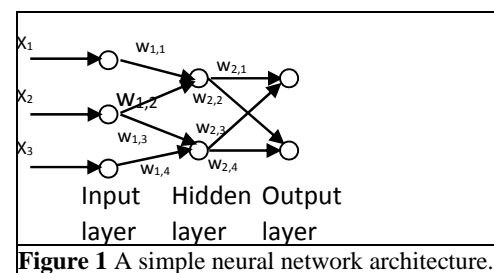

Figure 1 A simple neural network architecture.

The learning rate is a measure for the step size. Big learning rates give good results in the beginning, but often fail to find the optimum. A too small learning rate can cause the algorithm to run very slow or get caught in a neural net can learn from mere examples. In many domains it is far easier to collect a representative data set, than to construct a (complete) knowledge base. It does not suffer too much from noisy data and is not biased like human experts might be.

A big problem in neural networks is the choice of architecture: the only way to decide on a certain architecture is by trial-and-error. But the main weakness of a neural net is the lack of understand ability, i.e. It is impossible to extract any knowledge from a trained neural network. Also in complex domains large data sets are required which -if available- lead to lengthy training times.

2.3. Hybrid Systems

In the last decade researchers started to realize that rule based systems and neural networks are just two ends of a whole intelligence spectrum . A combination of these two approaches certainly sounds appealing, as many weaknesses mentioned above can be compensated. The hybrid approach considered in this article takes the domain knowledge as a starting point for the network architecture.

Knowledge Base	Neural Network
Final Conclusions	Output Units
Attributes	Input Units
Intermediate Conclusions	Hidden Units
Dependencies	Weighted Connections

Figure 3 The correspondence between a rule base and a neural net

From Rules to Network

Both systems start out with a (classical) knowledge base, consisting of a (not necessarily complete) set of rules. This domain theory has to be translated into a neural network. Each system has its own algorithm for this.

• The rules are rewritten in their conjunctive form.

• Data attributes are mapped into input units.

• Concepts (intermediate hypotheses) are mapped into hidden nodes.

• Final hypotheses are mapped into output units.

• Conjunction nodes that form a bridge between the condition nodes and the consequence node are added.

• The rule's CF is mapped into the weight of the corresponding connection between a conjunction unit and a consequence unit.

Connections between the non-conjunctive layers and the conjunctive layer are set to one.

The resulting network is in fact a neural network. The optimal weight vector we are looking for actually represents the set of certainty factors of the rule set. In order to maintain the conjunctive interpretation of the connection he added extra layers with nodes that propagates the minimum value of the incoming activations – in conformity with the certainty factors calculus mentioned in 2.1. The weights of the connections between the conditions and the conjunction nodes are always set to one, never to be changed. This is done to simplify the problem caused by the conjunction, which mathematically (and semantically) is hard to deal with.

DIABETES: Diabetes, known as diabetes mellitus, is a type of metabolic diseases in which the person has high blood glucose (blood sugar), either because insulin production is inadequate, or because the body's cells do not respond properly to insulin, or both. Patients with high blood sugar will typically experience polyuria (frequent urination), they will become increasingly thirsty (polydipsia) and hungry (polyphagia).

TYPES OF DIABETES

Type 1 Diabetes

It is an autoimmune condition. It occurs when the immune system mistakenly attacks and destroys the beta cells in the pancreas that produce insulin. This is the permanent damage.

Type 2 Diabetes

Type 2 diabetes starts as insulin resistance. The body can't use insulin efficiently.. Insulin production decreases, which leads to high blood sugar.The exact cause is unknown. Contributing factors may include genetics, lack of exercise, and being overweight. There may also be other health factors and environmental reasons.

Gestational diabetes

Gestational diabetes is a type which occurs during pregnancy. It is so because of insulin blocking hormones produced during pregnancy.

SYMPTOMS OF DIABETES

a) Frequent urination
b) Disproportionate thirst
c) Intense hunger
d) Weight gain
e) Unusual weight loss

f)   Increased fatigue

g)   Itchy skin

h)   Skin infection

i)   Gum disease/infection

Figure 2: Symptoms of Diabetes

3.   RULE BASED HYBRID EXPERT SYSTEM

It is a type of hybrid system which is a combination of rule based system and neural network. Rule based systems are good at making decisions. It is not good when domain knowledge is not present properly. To overcome this limitation another system's property is used which in combination with rule based works perfectly.
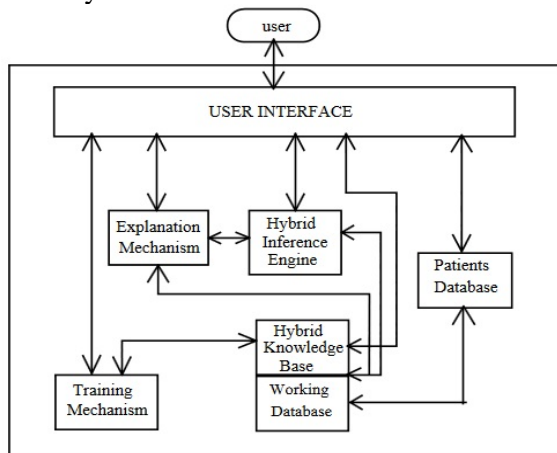

Figure 3

4.   CONCLUSION

Rule based system is used to solve problems using rules and stored in knowledge base which can be used later. This paper proposed a model known as rule based hybrid expert system model which can use the features of both methods and can cover the drawbacks. By using this method the symptoms of the patient can be stored in the knowledge base and based on the weight assigned the type of diabetes can be diagnosed.

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