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Fuzzy Verdict Reveal with Pruning and Rule Extraction

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Abstract: ***Fuzzy min-max is supervised neural network classifier that creates hyperboxes for classification. In FMM trying to enhance classification numerous hyperboxes are created in the network.For network modification, rule of extraction algorithm is newly added to the FMM confidence and threshold is used for calculation of each FMM hyperbox. User defined limit is used to prune the hyperboxes with very less confidence factor. The multiple hyperboxes are created in the network by adding some changes to enhance the execution of min-max. The smaller set of rules extract from FMM to define prediction on it. detecting fault and problem with classification a set of sensor is created from power plant is assessed utilizing FMM. Multi level fuzzy (MLF) min-max neural network classifier is known as system for supervised learning. MLF uses basic concept of the fuzzy min max strategy in multilevel design pattern this strategy uses separate classifier for smaller hyperboxes examples are found in area of overlapping. In this paper we proposed pruning and rule for extraction. Pruning reduces the size of decision tree and it is also used for classification. Rules for extraction are produce by using MLF algorithm.***

Keywords: Fuzzy min-max, classification, neural network, hyperbox, supervised learning

1. Introduction

Pattern classification is key component to multiple solution. Some framework will continuously used pattern classifier for determine relation between input and output like Control, Prediction, Tracking. The different variety of pattern classification and materialness is observed on an extraordinary arrangement [1][2]. In this paper neural network classifier is used to create classes by adding some fuzzy set in to class of fuzzy sets. Prior work can

Learn pattern classes in pass through information it contain new pattern classes new data is found in already defined classes and it utilizes straightforward operation that accept into account fast execution. Hyperboxes fuzzy sets are used to developed fuzzy min-max classification neural networks. A Hyperboxes is divided in to n-dimensional pattern space that each pattern has total class relation .A Hyperboxes is characterized as it's min point and max point, capacity is characterized depend on the min-max focuses of hyperboxes. The min-max set divided the characteristics of fuzzy set, Hyperboxes fuzzy set class are converted into structure of one fuzzy set class and ensuring this structure is commonly used by neural network structure. Thus this classification of fuzzy set is called as fuzzy min-max classification .Putting the Hyperboxes in to pattern space for acquiring the fuzzy min-max classification neural network. Fuzzy min-max review fuzzy union of enrollment capacity value created by each fuzzy set Hyperboxes. There are some properties of pattern classifier and each properties convinced as the part of the fuzzy min-max classifier of NN.

The proper solution is developed by using Artificial Neural Network (ANN) for classification and pattern reorganization [4]. ANN is helpful for tackle classification in various field e.g. In the field of medical it is used for medical diagnosis and determination mechanical flow discovery. To diagnose several diseases the ANN is executed as Decision support system (DSS) [5]. a symptomatic help framework for leukemia conclusion, depend on supervised learning algorithm, and was proposed the numerical framework is proposed in [6]. Incremental learning approach neural network and expert system of fuzzy enhance used for medical analysis. The another application of medical domain of ANN is obtainable in [7]. The cancer analysis was exhibited by using model selection system that utilizes SOM. In classification application and fault detection the ANNs to identify shortcoming and distinguished related reason [8]. Find framework for power transformer deficiency detection the broad network based model (ANM) is used. Wellbeing related issue in alternative model of ANNs in medical application [8]. The different ANN model to differentiate issue and ordinary operation was exhausted.

This paper is composed further as: Section II talks about related work studied till now. Problem Definition is described in section III. Section IV presents implementation details, algorithms used, mathematical model and experimental setup tended to by this paper. Section V depicts results and discussion part. Section VI draws conclusions and presents future work

2. Related Work

In FMM area numerous systems have been created in this area multiple method of this system is connected to system for their advancement, progress, benefit and limitation [7] [8]. The machine learning technique is called as Fuzzy Min-Max is proposed in 1992 with only single pass to the learning stage and stage is over [8].

This is used for cluster and classification this strategy in pattern space are convex box, hyperboxes are utilized this strategy. Hyperboxes used this approach for min max purpose. In 2000 General Fuzzy Min Max (GFMM) neural network is produced Gabrys also Bargiela [6]. The ability is expanded by revolutionize in to FMM. They established data pattern and pattern space like fuzzy hyperboxes are more fruitful. The enrollment capacities of fuzzy hyperboxes are changed in FMM. Clustering and classification is used for make it valuable by verifying marked information pattern is transformed. The process of GFMM NN preparing the parameter which is control by maximum hyperboxes, the size can be changed consequently. Fuzzy hyperbox classifiers are developed previously for inclusion/exclusion system.

The subject of wrapping overlap was trailed by making some changes in learning methodology. This strategy does not utilized compression for delete the overlaps. To increase the effectiveness some part of hyperbox is ignore. The combination of inclusion and exclusion of hyperboxes is used to handle the overlapping issue. The overlapping areas are handled by CN(Compression Node) which are like equal node EFC. The CN are separated in to two Cantonment Compensation Neuron (CCN) Overlap Compression neuron(OCN). The several region are handle by previous overlap. Data core-based fuzzy Min-Max Neural Network (DCFMN) system was produced by zhang et al [6]. Another capacity is used to consider qualities of information also as the impact of noise. The pattern from the overlap is grouped in to recent level of network by different classifier. Each node of network in propose system called as subnet is free classifier. This classifier is used to arrange the samples in specific area of space pattern. At the ending which node having more yield from among node that node is chosen as the network as the result. Fuzzy sets are methods of speaking and controlling information are not extracted [7]. Building linguistic the set of hypothesis is used likes "numerous","few","frequently","off"and "gain" it gave pattern classification and control the design capacity which pattern is available and circumstance was happing. The set of hypothesis occasion does or don't happen and there is no center ground. Fuzzy hypothesis is used to measure which hypothesis occasion is used. Conventional set use hypothesis to determine occasion will happen the circumstances like flip of coin and demise hypothesis assumes a part.These circumstances don't have large center ground. Many individual examine the mix fuzzy set and classification in [7] determine the relationship between fuzzy set and pattern classes and in same paper determine how the hyperplane are used to divided the fuzzy set. Number of experience are describes viable and productive fuzzy pattern classification. Fuzzy function for pattern classification in incredible stubs is consider by bezdek. Classifier of fuzzy k nearest neighbor that perform with different set of information that indicates fresh k-closest neighbor classifiers.

3. Problem Definition

A fuzzy Min-Max Neural Network with Pruning and Rule Extraction technique is wished-for evaluate the usefulness of customized FMM, The applicability of the customized FMM network is established by using a real-world classification problem for that apriori algorithm is used.

4. Implementation Details

A] System overview

Following Fig. 1 shows the proposed system architecture.
In the proposed system, Input Dataset is pass to the learning phase the first step is to learn dataset it is necessary to process dataset so we get cleaned data. After that we will train our dataset i.e. in training phase. After the FMM network is trained, the number of hyperboxes is reduced using a pruning strategy. Pruning the network structure can be done by removing excessive recognition categories and weights.

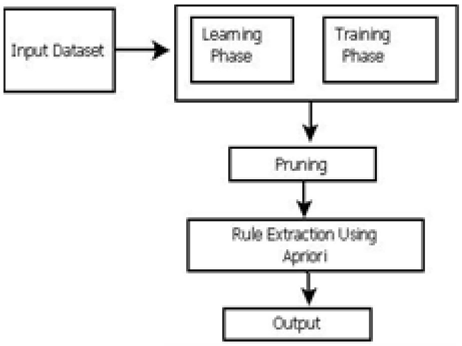

Figure 1: System Architecture

When the number of hyperboxes is reduced, the number of rules to be extracted is, too, condensed. Each fuzzy hyperbox is an n-dimensional box defined by a set of minimum and maximum points. The output of pruning is given to the input of Apriori algorithm it is used for rule extraction and Classification finally out put is transmitted to the next stage.

B] Algorithm

MLF Algorithm

This has strategy of classification and training of data sets. MLF is an algorithm for frequent item set mining and association rule learning over transactional databases. It proceeds by identifying the frequent individual items in the database and extending them to larger and larger item sets as long as those item sets ap-pear sufficiently often in the database. The frequent item sets determined by MLF can be used to determine association rules which highlight general trends in the database: this has applications in domains such as market basket analysis.

Pseudo of the MLF algorithm are as follows:

A] Training Pseudo Code:

Net = MLF-train (data, θ) {
1 :if (stop condition)
1.1 :return null;
2 :foreach (sample ∈ data)
2.1 :expand (hyperboxes, sample);
3 :foreach (i as a overlapped area)
3.1 :sdata = samples which inhabit
in i region;
3.2 :create an overlap-box as OL*i*
and add to OLS;
3.4 :subNet*i* = MLF-train (sdata, θ/γ);
3.5 :link OL*i* to subNet*i* with link e*i*;
}

[B] Classifying Pseudo Code:

Out = MLF-test (net, sample){
1 :foreach ol*i* as OL box in OLS
1.1 :if (sample is in ol*i*)
1.1.1 :out = MLF-test (subNet*i*, sample);
1.1.2 :return null;
2 :best-membership = −1;
3 :foreach *Bi* as hyperbox in HBS
3.1 :if (Best-membership ≤ *bi* (sample))
3.2 :out = B*i*.class;
}

C] Mathematical Model

Let, System S is represented as: S = {L,T,P,R}
A. Learning Phase :
Consider, L is a set for learning dataset L = {l1,l2….}
Where, l1,l2,… are the learn data.
B. Training Phase:
Let T be the set for training phase
T = {t1,t2,t3…}
where, t1,t2,.. are the trained data.
C. Pruning Phase:
Let P is a set for pruning hyperbox
P = {p1,p2,p3,……}
where, p1,p2 are the number of data form after pruning step.
D. Rule Extraction:
Let R is set for extracting rules
R = {r1,r2,r3,…..}
where, r1,r2, are the number of rules which gets extracted.

5. Methodology

The Methodology is divided into three major modules:

1) Hyperbox Formation

The training set *V* consists of a set of M ordered pairs *{Xh,dh}*, where *X h = (Xhl,Xh2,"',Xhn)* E *In* is the input pattern and *dh* E {I, 2, ... *,m}* is the index of one of the m classes. The fuzzy min-max classification learning algorithm is a three-step process:

a) Expansion: Identify the hyperbox that can expand and expand it. If an expandable hyperbox cannot be found, add a new hyperbox for that class.

For the hyperbox *Bj* to expand to include $X_{h,}$, the following constraint must be met

$$n\theta \geq \sum_{i=1}^{n} (\max(w_{ji}, x_{hi}) - \min(v_{ji}, x_{hi})).$$

If the expansion criterion has been met for hyperbox *Bj*, the main point of the hyperbox is adjusted using the equation.

$$v_{ji}^{new} = \min(v_{ji}^{old}, x_{hi}) \qquad \forall\, i = 1, 2, \cdots, n,$$

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$$w_{ji}^{new} = \max(w_{ji}^{old}, x_{hi}) \qquad \forall\, i = 1, 2, \cdots, n.$$

b)Overlap Test: Determine if any overlap exists between hyperboxes from different classes. To determine if this expansion created any overlap, a dimension by dimension comparison between hyperboxes is performed. If $\boldsymbol{\sigma}^{0ld}$ - $\boldsymbol{\sigma}^{new}$> 0, then Δ= i and $\boldsymbol{\sigma}^{0ld}$ = 8^{new}, signifying that there was overlap for the Δ^{th} dimension and overlap testing will proceed with the next dimension.

c) Contraction: If Δ >0, Δ^{th} then Δ^{th} dimensions of the two hyperboxes are adjusted. To determine the proper adjustment to make, the same four cases are examined. To determine the proper adjustment to make, the same four cases are examined.

2) Pruning:

In this phase, the number of hyper boxes is reduced using pruning. In this phase the confidence factor is calculated. The data set is divided into three phases: Training set, prediction set and test set. The confidence factor can be evaluated as

$$CF_j=(1-\gamma)U_j + \gamma A_j \quad \ldots\ldots\ldots \qquad (4)$$

where U_i is the usage of hyperbox j, A_j the accuracy ofhyperbox j and γ∈[0, 1] is a weighing factorHyperboxes with a confidence factor lower than a user defined threshold is pruned. The confidence factor is tagged to each fuzzy if–then rule that is extracted from the corresponding hyperbox.
After pruning the hyper-boxes with low confidence factors fuzzy if–then rules are extracted from the remaining hyper-boxes. The quantization of the minimum and maximum values of the hyperboxes is conducted. A quantization level Q is equal to the number of feature values in the quantized rule. Quantization is done by the round-off method, in which the interval [0, 1] is divided into Q intervals and assigned to quantization points evenly with one at each end point using:
V_q = q-1/Q-1 where q= 1, …..Q
The fuzzy if–then rules extracted are in the following form
Rule Rj: IF x_{1} is A_q and …………… x_{pm} is A_q
Then X_p is class c_j with CF=CF_j
j=1,2,……..Nwhere N is the number of hyperboxes x_p = ($x_{p1,\ldots\ldots,}x_{pn}$) is an n dimensional pattern vector,
A_q the antecedent feature value and CF_j is the confidence factor of the corresponding hyperbox.

3) Prediction

The membership functions of all the hyperbox new input pattern is calculated. The hyperbox with membership function greater than threshold (User defined) are selected. The Euclidean distance between the input pattern and the centroid of the hyperbox is exploited. In modified FMM, the centroids of all input patterns falling in each hyperbox is recorded as follows:

$$C_{ji} = C_{ji} + \frac{|\, a_{hi} - C_{ji} \,|}{N_j}$$

where C_{ij} is the centroid of the j^{th} hyperbox in the i_{th} dimension, N_j is the number of patterns included in the j^{th} hyperbox.

E]Experimental Setup and Implementation

The system is built using Java framework (version jdk 6) on Windows platform. The Netbeans (version 6.9) is used as a development tool. The system does't requires any specific hardware to run; any standard machine is capable of running the application.

F] Data Set

The PID data set contained 768 cases that belonged to twoclasses, in which 268 cases (35%) were from patients diagnosedas diabetic and the remaining as healthy. The data set wasdivided into three subsets: 50% for training, 30% for prediction,and 20% for test.

6. Experimental System

Following table shows training time table. Initially Hyperboxes are formed using training dataset. The size of a hyperbox is controlled by θ that is varied between 0 and 1. Once θ is small, more hyperboxes are created. When is large, the number of hyperboxes is small. Confidence Factor (CF) is used to prune hyperbox i.e. CF of all hyperbox are calculated then hyperbox with CF less then threshold are pruned. Confidence Factor (CF) is used to prune hyperbox i.e. CF of all hyperbox are calculated then hyperbox with CF less than threshold are Pruned.

Sr. No	θ	Total hyperbox created	Total hyperbox after pruning
1	0.2	29	16
2	0.3	12	7
3	0.5	10	6
4	0.9	10	6

Then during prediction stage the membership function and the Euclidean distance for FMM to predict its target output. Hyperboxes that have high membership function values is then selected. The number of hyperboxes preferred can be based on a user-defined threshold, e.g. the highest 10 percent membership function values. After that, the Euclidean distances between the selected hyperboxes and the input pattern are computed, and the hyperbox with the shortest Euclidean distance is most preferred, and the input pattern belongs to class represented by the hyperbox.

Rules	1	2	3	4	5	6	7	8	Class	CF
Rule1	2-3	3--5	3-4	1	1-3	2-4	1-3	1	1-3	0.8
Rule2	2-3	2-3	1-4	1-2	1	1-4	1-2	1-4	0	0.67
Rule3	1-2	1-4	3-4	1-3	1-2	2-3	1-2	1-5	0	1
Rule4	1	4	1	1	1	4	1-2	1	1	0.52
Rule5	1	5	4	2-4	1	4-5	1-5	1	1	0.52

7. Result and Discussion

While building system we created hyperboxes and classified them fig.2 and then pruning is used to reduce extra hyperboxes. Fig.3.then rules are generated .We can compared and show graphically how proposed system is efficient by considering parameters like time, accuracy, number of hyperbox created.

Figure 2: Hyperbox Classifications

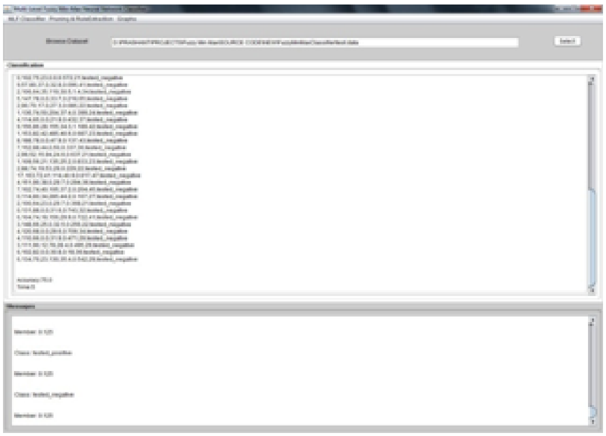

Figure 3: Classification after pruning

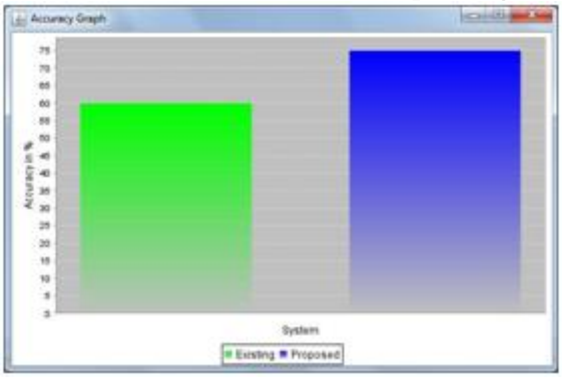

Figure 4: Accuracy Graph

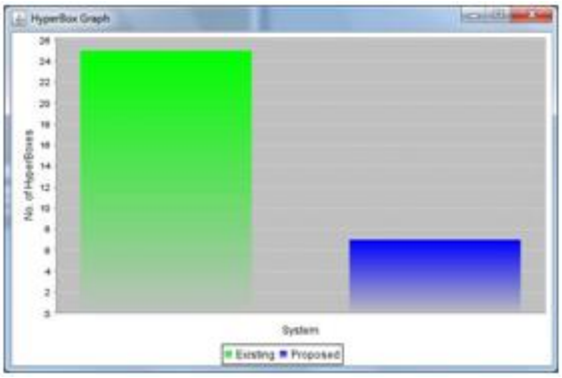

Figure 5: Hyperbox Graph

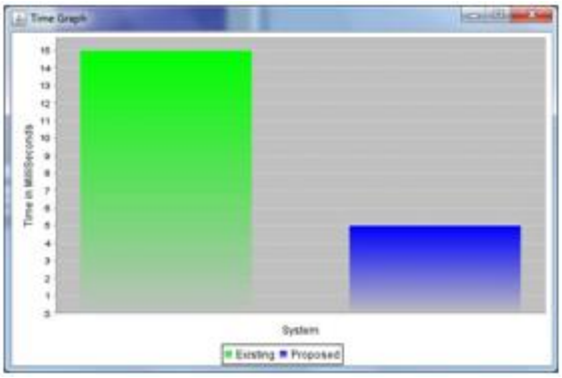

Figure 6: Time Graph

8. Conclusion & Future Scope

Fuzzy set of min-max hyperboxes exist in to fuzzy positioned classes and it is used by NN classifier. Previous information can be used by apriori algorithm. Some cases are used to discover the competence of fuzzy min-max classification neural network to demonstrate boundary in covering classes , learn very nonlinear choice limits, also give comes about on a standard information set that was comparable to other neural and customary classifiers. fuzzy min max neural network is created in this work. At first the information set is separated into two stages i.e. training and testing. The prepared dataset is situated to hyperbox development and after that set to pruning. In future, one can use the maximum hyperbox effects of θ on classification accuracy. Even we plan to apply MLF to application areas such as text classification and speech recognition, which have high dimensional feature spaces with complicated class boundaries.

9. Acknowledgment

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