Balancing Neural Trees to Improve Classification Performance

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Introduction

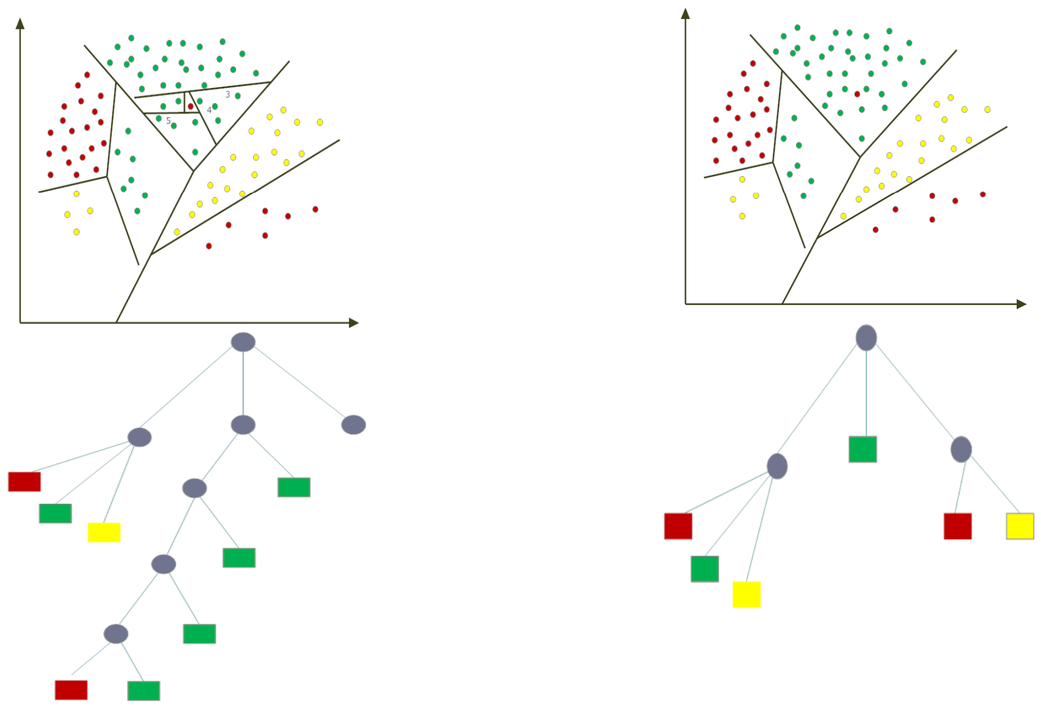
NEURAL TREES (NTs) were introduced for pattern classification in an attempt to combine the advantages of decision trees (DTs) and neural networks (NNs). In this work a balancing Neural Tree is proposed to Improve the Classification Performance. A new concept for making a balanced tree is applied in the learning algorithm of the tree.

Balancing the tree in learning phase

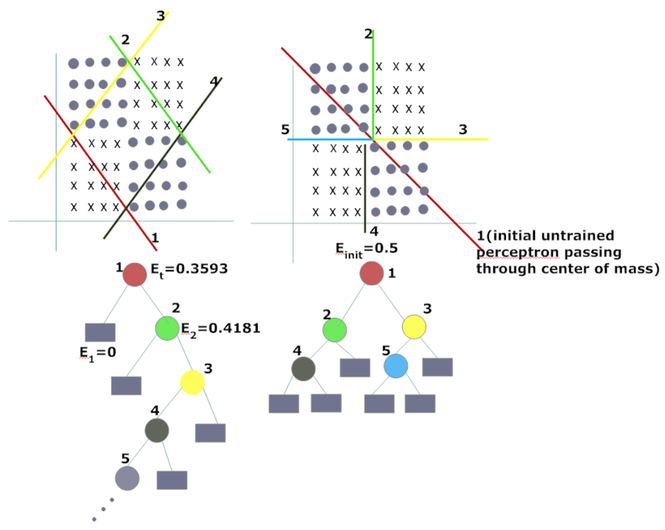
Behavior of a preceptron is noticed at each node and if the classification done by this is not good enough and unbalanced then it is replaced by such a preceptron that separates the training set in such a way that almost equal number of patterns fall into each of the classes. Moreover a perceptron learns only for the classes which are present at respective node and ignore other classes. Splitting nodes are employed into the neural tree architecture to divide the training set when the current perceptron node repeats the same classification of the parent node. A new error threshold based on the depth of tree is introduced to reduce the computational time.

Learning (standard vs. Proposed)

➢If 95% to 100% patterns belong to the same class, this node is set as leaf node (uniformity).



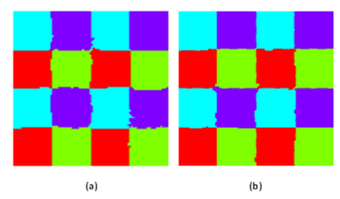
➢If the classification done by a perceptron at any node is not pretty good and unbalanced, its weights are replaced by the initial weights which divides the training set with the hyperplane passing through the center of mass resulting in a balanced distribution of patterns among classes.



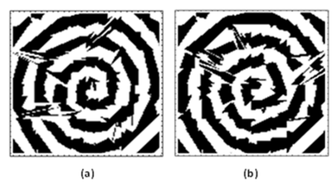
➢The new error function is defined as $(1/N^m)$, where N is the number of classes and m is the current depth of tree. If the error is reached below this threshold, the perceptron stops learning.

Experimental Results for synthetic datasets

➢Classification of the four-class chessboard dataset using
(a) Standard NT[1](97.61%)
(b) Proposed NT(98.80%)



➢Classification of the two-class spiral dataset using
(a) Standard NT[1](87.41%)
(b) Proposed NT(88.81%)



Experimental Results for real datasets

Classification accuracy of different algorithms for letter database[2].

Algorithm	Classification accuracy(%)
Proposed NT	83.60
Standard NT	Not converged
NNTree	82.9
MLP	67.2
C4.5	86.6

Classification accuracy of different algorithms for satellite image database[2].

Algorithm	Classification accuracy(%)
Proposed NT	85.25
Standard NT	Not converged
NNTree	87.1
MLP	77.5
C4.5	85.2

Conclusion and Future work

Results are encouraging as the classification accuracy obtained is similar or better than the existing algorithms. The novelity of the algorithm is the use of simple perceptron, so like MLP there is no need of deciding a network in advance and the tree obtained are more generalized. For future there is a plan to integrate other classifiers in tree structure.

References

[1] G. L. Foresti and C. Micheloni, Generalized neural trees for pattern classification, *IEEE Trans. Neural Networks, vol. 13, pp. 1540–1547,* Nov. 2002.
[2] P. Maji, Efficient design of neural network tree using a new splitting criterion, Neurocomputing , Vol. 71 , pp. 787–800, 2008.

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