Extracting both MofN rules and if-then rules from the training neural networks

Norbert Tsopze[1,4] **- Engelbert Mephu Nguifo**[2,3] **- Gilbert Tindo**[1]
[1] Department of Computer Science - Faculty of Science - University of Yaounde I, Cameroon
[2] Clermont Université, Université Blaise Pascal, LIMOS, BP 10448, F-63000 Clermont-Ferrand, France
[3] CNRS, UMR 6158, LIMOS, F-63173 Aubiére, France
[4] CRIL-CNRS UMR 8188, Université Lille-Nord de France, Artois, SP 16, F-62307 Lens, France

1 Introduction

Artificial Neural Networks classifiers have many advantages such as: noise tolerance, possibility of parallelization, better training with a small quantity of data .... Coupling neural networks with an explanation component will increase its usage for those applications. The explanation capacity of neural networks is solved by extracting knowledge incorporated in the trained network [Andrews *et al.*, 1995]. We consider a single neuron (or perceptron) with Heaviside map as activation function ($f(x) = 0\,if\,x < 0\,else\,1$). For a given perceptron with the connection weights vector W and the threshold θ, this means finding the different states where the neuron is active (wich could be reduced to the Knapsack problem.

With the existing algorithms, two forms of rules are reported in the literature : 'If $(condition)$ then $conclusion$' form noted 'if then' rules, 'If (m of a set of $conditions$) then $conclusion$' form noted '$MofN$'

The intermediate structures that we introduce are called MaxSubset list and generator list. The MaxSubset is a minimal structure used to represent the if-then rules while the generator list is some selected MaxSubsets from which we can derive all MaxSubsets and all MofN rules. We introduce heuristics to prune and reduce the candidate search space. These heuristics consist of sorting the incoming links according to the descending order, and then pruning the search space using the subset cardinality bounded by some determined values.

2 The MaxSubsets and generators Rules extraction approach

The general form of a MofN rule is 'if $m_1\ of\ N_1\ \wedge\ m_2\ of\ N_2 \wedge ... \wedge m_p\ of\ N_p$ then conclusion' or '$\bigwedge_i (m_i\ of\ N_i)$ then conclusion'; for each subset N_i of the inputs set, if m_i elements are verified, the conclusion is true.

The common limit of previous approaches is the exclusive form of the extracted rules. Thus we introduce a novel approach called MaxSubset from which it is possible to generate both forms of rules. The MaxSubset approach follows operations (3), (4) and (5) of figure 1; while the existing known algorithms follow the path (1) for the if-then rules and (2) for the MofN rules. The processes (3), (4) and (5) of the figure 1 are described as follows: (3) MaxSubsets and generators extraction; (4) generation of if-then rules from the MaxSubsets list and (5) generation of MofN rules from the generators list. An extended version of this work is described in [Tsopze *et al.*, 2011].

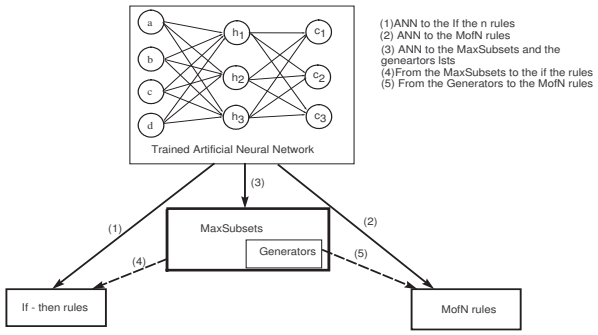

Figure 1: Rules extraction process:

3 Conclusion

This approach consists in extracting a minimal list of elements called MaxSubset list, and then generating rules in one of the standard forms : if-then or MofN. To our knowledge, it is the first approach which is able to propose to the user a generic representation of rules from which it is possible to derive both forms of rules.

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References

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