G-Prop-III: Global Optimization of Multilayer Perceptrons using an Evolutionary Algorithm

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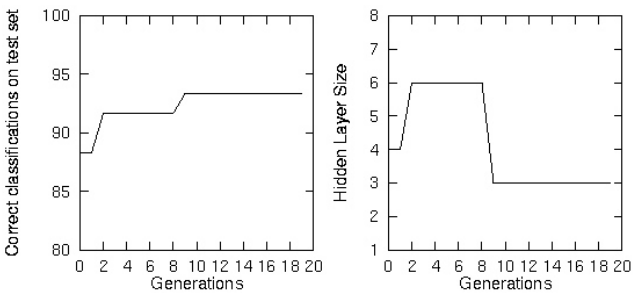
Abstract

This paper proposes a new version of a method that attempts to solve the problem of finding appropriate size, initial weights and learning parameters for a single hidden layer Multilayer Perceptron (MLP) by combining a genetic algorithm and backpropagation. The GA selects the initial weights and the learning rate of the network, includes BP training as a mutation operator., and changes the number of neurons in the hidden layer through the application of specific genetic operators. The application of the G-Prop-III algorithm to several real-world and benchmark problems shows that MLPs evolved using G-Prop-III are smaller and achieve a higher level of generalization than other perceptron training algorithms, such as QuickPropagation or RPROP, and other evolutive algorithms, such as G-LVQ. It also shows some improvement over previous versions of the algorithm.

1 DYNAMICS OF G-Prop-III

The evolution of classification error and hidden layer size



during a typical run are shown in figure 1.

Figure 1: Evolution of the classification error and hidden layer size during a typical run.

Each of these quantities is optimized in turn: classification error is optimized first, since it is given higher priority in fitness evaluation; then, while keeping the same classification accuracy, G-Prop-III optimizes size.

2 RESULTS

Table 1: Results Obtained on the Helicases benchmark.

Helicases	Error ± σ	Size ± σ	Learning ± σ
QP	5 ± 1	5	0.177
G-Prop-III	3 ± 2	5 ± 2	0.17 ± 0.08
G-Prop-II	4 ± 2	1.9 ± 0.7	0.05 ± 0.02
G-Prop	6 ± 3	7 ± 4	0.04 ± 0.03
SA-Prop	5 ± 3	7	0.16 ± 0.06
20 g	18 ± 2	2.3 ± 0.4	-
G-LVQ 50 g	13 ± 3	2.2 ± 0.3	-
100 g	15 ± 5	2.2 ± 0.3	-

Table 2: Results Obtained on the Cancer benchmark.

Cancer	Error ± σ	Size ± σ	Learning ± σ
QP	4 ± 1	4	0.08
G-Prop-III	2.7 ± 0.6	4 ± 2	0.06 ± 0.05
G-Prop-II	2.7 ± 0.8	5 ± 2	0.04 ± 0.02
G-Prop	2.8 ± 0.5	5 ± 2	-
SA-Prop	2.8 ± 0.7	9	0.14 ± 0.08
Prechelt	3.065	9	-

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More information and the complete paper can be found at: *http://krypton.ugr.es/~pedro/G-Prop.htm*