USE OF GENETIC ALGORITHMS
IN NEURAL NETWORKS DEFINITION

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ABSTRACT

At present, there is not a general methodology for neural network definition. In this work we propose an algorithm highly inspired on biological concepts for generating neural networks oriented to solve particular problems given on terms of input and output. With this algorithm we pretend to specify formal tools of general use for network definition, and to disclose underlying processing structures of the living organisms.

I. INTRODUCTION AND APPROACHES

The main problem an artificial neural networks designer has in his work is that there are not standard tools to develop networks oriented to solve specific problems; in other words, the designer has no methodology to work with.

The biological neural networks are a good example of solving a particular problem: the survival. Provided that living organisms are forerunners in networks definition, and that most significant advances on neural networks theory came from biological influence (physiology, anatomy, etc.), we think that this field will still inspire new models and paradigms.

The method used to obtain this biological networks is natural selection, which has implicit some mechanisms as network coding and decoding, mutation and crossover of this codes, and performance evaluation of these networks in the environment they will work. This subject has been well raised from the genetic algorithms that define the necessary operators to implement a search method starting with a genetic code, a decoder algorithm and a fitness function.

This selective process implies that the best neural networks we obtain are given by accumulating little bit changes, that will be accepted or suppressed depending on whether they favour or damage respectively their capacity for a specific task.
The genetic code is the necessary information to obtain a neural network with a decoder algorithm. Each feature of the network is expressed in the genes, that are the meaning units into the code.

The concepts of genetic code, embryogenesis and evolution are the main keys in the development of the algorithm we propose.

II. ALGORITHM CONSIDERATIONS

As we pretend to do a model of the strategy that living organisms follow in searching solutions, we divided the process into the following blocks:

1. Specifications of the problem:
   - Input set
   - Output set
   - Input/Output relations
   - Performance required
2. Random generation of the genetic codes
3. Development of each code to obtain the neural networks
4. Gross adjustment of the network in the phase of synaptic plasticity
5. Weights adjustment in a non supervised way
6. Fitness evaluation of each network with the controlled sample
7. Stop if we get a network with the required performance
8. To obtain the next codes from the best networks we have got
9. Go to 3

This algorithm implements a genetic search method that constitutes the natural selection process we need; steps 3 to 5 carry on the main biological processes to generate coherent networks.

The main characteristics of these processes are:

A) Embryologic Development

Living organisms carry on an embryologic period in which they form an organism starting from a single cell containing the genetic code that specifies the way to follow. The main processes implicated in this period are cellular bipartition and a gradual specialization of the obtained cells. When this phase is finished we have a feasible solution to the problem we want to solve.

A blast, cell capable to be divided, through bipartition generates two new cells. These could be final cells that will specialize in their own function, or new blasts that will generate more cells in the same way.

In our model we work with three kinds of cells:

1. **Input cells** which have connections with the input of the system
2. **Output cells** that give an output to the system
3. **Neurons** that process information