Evolving Agent Aggregates using Cellular Genetic Algorithms

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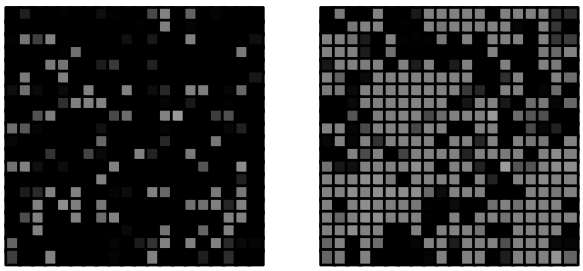
This work presents how agent hierarchical aggregations can solve real-world classification problems. The classification problems we are interested in, are defined by a set of examples. Each example is defined as a set of real valued features.

Simple agents are the *building blocks* of the solution to the classification problem. The ideas presented in GENIFER (Llorà,1999) system are the basis of simple agents. They use matching functions based on *Nearest Neighbor* policies. The aim of each agent is to describe a classification region in the $\Re^n$ space defined by the features of the problem. Each agent represents a *significant point* of this space, linked to one classification class. Merging *significant points* and *nearest neighbor* policies, the $\Re^n$ can be splitted into classification regions.

From the above definition, it follows that a simple agent (*significant point*) is not able to solve a classification problem all alone. It is here where *ALife* (Langton:97) ideas point out the direction to be taken. The main idea is obtaining emergence through aggregation. The final aim is that the solution emerges from simple agents aggregation. If agents can stick together, they need a defined aggregation structure. The structure proposed for the aggregate is based on hierarchies. This hierarchical aggregation also defines a hierarchical classification matching procedure.

CGA is a fine-grain parallel genetic algorithm inspired by 2D *Cellular Automata*. Each cell of the board holds either a simple agent or an aggregate. The surrounding neighborhood information defines the behavior of the CGA genetic operators. In CGA, the neighbor radius is fixed to one, so for each cell eight neighbors are present. The agent fitness is based on the classification accuracy (percentage of correctly classified examples).

The pictures present the 2D distribution of agents and aggregates. They print the fitness of the agent/aggregate of each cell. Darker values indicates poor performance. This pictures are taken from the preliminary runs of CGA on a medical domain classification problem: the diagnosis of breast cancer using mammograms. Preliminary results indicate a good classification performance, improving previous results obtained in (Llora,1999).



(a) Iteration 0 (b) Iteration 4

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