A Note on Participatory Genetic Algorithms

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In most applications of genetic algorithms the objective function is externally provided and the processes of selection, crossover and mutation are used to try to obtain an optimal solution. The benefits of each of these operations is clearly documented in the literature. In this perspective the objective function can be seen as the representation of some "skill" required by nature, the better an agent at this skill the more it is preferred. The objective function provides a measure of the reproductive suitability of an element in the population

In the real world survival of the fittest saga there appears to be an additional process going. In particular, the objective function in addition to be determined by some external requirement is often strongly effected by the population itself. That is the current population also participates in determining the properties desired for reproductive suitability. This observation leads one to think about the possibility of constructing genetic algorithms in which the current population plays a role in determining or modifying the objective function. That is their is some kind of learning of the objective function. One further observation is that in the natural environment often the effect of the populations participation in the crafting of the objective function is to try to make the objective function more like itself.

One possible use of this idea of population participation in the construction of the objective function in the framework of genetic algorithms can be in situations in which the objective function is not precisely defined

enough to make clear distinctions between the elements in the population regarding their suitability for reproduction. Here we may use the elements in the population to sharpen the objective function. As a simple example consider the situation in which our imposed/external objective are a collection of 10 binary criteria we want an desirable agent to have. We then evaluate the suitability of an object for reproduction by counting how many of the criteria it satisfies. This objective function effectively partitions the population into ten categories, those satisfying n criteria, this partitioning may be to gross. We can now consider a modification or sharpening of the objective function by attributing weights to each of the criteria. Clearly a weighted evaluation of criteria satisfaction is more discriminatory. We can consider the following participatory process for determining weights associated with each criteria. At each stage of the algorithm iteration we count how many times each of the criteria is satisfied by members of the population, n_j being the members in the population satisfying criteria j. We then use these scores to modify the weights associated with each criteria.

While the above provides but one example of the potential use of population participation in the genetic algorithm process I sure other ones can be envisioned.

In passing we note that closely related ideas appear in our work on participatory learning [1-3]

[1]. Yager, R. R., "A model of participatory learning," IEEE Transactions on Systems, Man and Cybernetics 20, 1229-1234, 1990.

[2]. Yager, R. R., Ford, K. and Agnew, N., "A formal constructionist model of knowledge revision," International Journal of Expert Systems 5, 157-168, 1992.

[3]. Yager, R. R. and Filev, D. P., "Modeling participatory learning as a control mechanism," International Journal of Intelligent Systems 8, 431-450, 1993.