



Chapter XIV

On an Evolutionary Approach to Language

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Abstract

The focus of this chapter is the explanation of a method for allowing languages to emerge within a multi-agent system. The need for such a method tends to be in larger multi-agent systems that focus either on large domains or span across multiple domains. This method can also be adapted for interfacing multi-agent systems with humans through natural languages. Also addressed in this chapter are the necessary requirements for a multi-agent system to utilize an evolving communication system. A specification of an evolving vocabulary is presented along with an explanation of results from an experiment that contains an implementation of these specifications.

Evolutionary Algorithms

The purpose of this section is to introduce the evolutionary algorithms (EA), as a base for elaboration of our approach in this chapter.

Evolutionary algorithms are an area of artificial intelligence that draws its inspiration from natural evolution. “Natural evolution has been powerful enough to bring about biological phenomena as complex as mammalian organisms and human consciousness” (Banzhaf, Nordin, Keller, & Francone, 1998, p.). Although, just as artificial neural networks are vastly simplified versions of biological neural networks, evolutionary algorithms have only a few of the features of natural evolution. The three points that come from natural evolution, which are the core of most evolutionary algorithms as noted by Spector (2004) are assessment, selection, and variation. Each of these points will be addressed in the context of a general EA-based system, which will be later described in more depth in the context of genetic algorithms.

The initial step of an EA system is the generation of a population of potential solutions. These potential solutions can be generated by any method available, in many cases this is, in fact, done by random generation. The population can be of any size, but a key idea to note is that the larger the population the more spread out the possible solutions over the total space of solutions. However, the larger the population the more the computational complexity is increased. The necessary initial population size tends to be defined by the problem and the size of the solution space. The main failing of an EA with an insufficiently sized initial population is the convergence to locally optimal solutions. However, it is easy to get the feel for the correct initial configurations by trial and error. The following three steps, those inspired by natural evolution, are repeated until an adequate result is achieved. This is the portion of an EA that, if the initial configuration is sufficient, will result in a solution to the problem at hand.

The loop steps through the three phases until in the assessment phase an accurate solution is revealed, and the loop is broken. The assessment phase evaluates the potential solutions according to a predefined evaluation function. In many cases the evaluation function is also designed to rank the potential solutions on a continuum, which proves advantageous in some circumstances in the selection and variation phases. The selection phase selects potential solutions from the population then in the variation phase modifies them. There are many different approaches that are used for both selection and variation, some specific examples of these approaches will be addressed later on when this evolutionary approach is used to describe an evolving language system for multi-agent systems.

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