Chapter VIII

Beyond the GA: Extensions and Alternatives

Introduction

The last two chapters introduced the standard genetic algorithm (GA), presented an example case study, and explored some of the potential pitfalls in using evolutionary methods. This chapter focuses on a number of extensions and variations of the standard GA. While there is not room to cover them all, many extensions to GAs have been proposed usually in response to situations in which the simple GA does not perform particularly well. Two such situations are:

1. Deceptive problems
2. Changing environments

In this chapter we will first describe these particular problems before presenting some GA variants which may be able to deal more successfully with them.
Deceptive Problems

Much recent research has been in the area of deceptive problems. The simplest deceptive problem is as follows.

Consider a population in which the string ‘11’ is most fit and the following conditions characterise the fitness landscape:

\[ f(11) > f(00) \]
\[ f(11) > f(01) \]
\[ f(11) > f(10) \]
\[ f(*0) > f(*1) \text{ or } f(0*) > f(1*) \]

Then the order 1 schemata do not contain the optimal string 11 as an instance and lead the GA away from 11. Now in this simple example, the structure of the problem itself occasioned the deception; however, the nonlinearity in crossover and mutation, the finiteness of population sizes, and poor problem representation have all been shown to contribute to deception in a problem. These are hard problems for the simple GA to solve and so attempts have been made to modify the simple GA.

A particular type of deceptive problem is known as a trap function which is based on the unitation or number of 1s in the representation of the problem. Let the unitation of a string of length \( l \) be \( u \). Then define the fitness of a chromosome with \( u \) unitation as,

\[ \text{Figure 1. A fitness function which is deceptive. The basin of attraction of the maximum at } a \text{ is much larger (dependent on } z \text{ and } l \text{) than that of the maximum at } b. \]
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