CS 678 Machine Learning
Programming Assignment #4b

Constrained Function Optimization using Evolutionary Learning

Specification

The goal is to utilize a form of evolutionary learning, a genetic algorithm, to find the minima of a function given certain constraints. The function to be optimized is the 2-variable Goldstein-Price function.

Optimization Problem

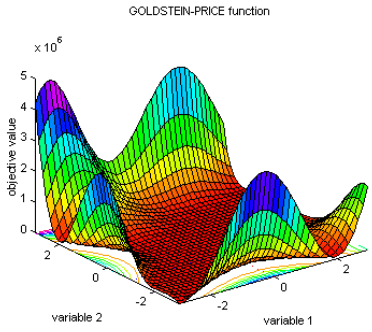
Genetic algorithms can effectively be used to find the maxima/minima of a function, by searching the function variable space to find the global optimum. The particular function to optimize in this test is the Goldstein-Price function, defined as:

$$f(x,y) = \left((x+y+1)^2(19-14x+3x^2-14y+6xy+3y^2)+1\right)\left((2x-3y)^2(18-32x+12x^2+48y-36xy+27y^2)+30\right)$$

The function is subject to the following constraints:

$$-2.0 \le x \le 2.0, \quad -2.0 \le y \le 2.0$$

Below is a visualization of the function in the defined range. Note the presence of several local minima, and one global minimum:



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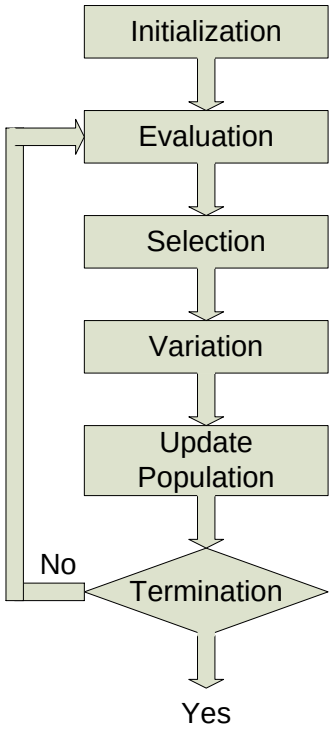
Algorithm

Idea: simulate natural selection:



The Fitness function is obvious: plug in x and y values and evaluate the Goldstein-Price equation. The key is determining how to encode the x,y real number values into a chromosome. Consider a scaling function that represents a number in the constraint range as a bit string (e.g. the range -2.0...2.0 becomes 0...4.0).

Requirements:

As usual, your program can be written in any language. Submit a written analysis of your project and be prepared to present your solution to the class:

- Describe any interesting experiments, configuration details, problems, etc.
- Demonstrate the effectiveness of your program in finding the optimum.
- Include a discussion/analysis of your results.