TJHSST Computer Systems Lab Senior Research Project
Research Paper Draft 1
Applications of Genetic Algorithms
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Abstract

The purpose of this project is to explore the applications of Genetic Algorithms, an evolutionary computation search technique, to find approximate solutions to optimization problems. This project will focus on computing the minimum point on a three dimensional graph. The goal is to find the minimum point without testing every single point on the graph, a very computational intensive process.

Keywords: genetic algorithms, machine learning, OpenGL

1 Introduction

1.1 Scope of Study

The program will require a good knowledge of OpenGL 3D graphing, and programming in C for genetic algorithms. The research that will be required is how to optimize the genetic algorithm to get the best results when running many trials.

I will start by coding a visual display of an optimizing genetic algorithm. Once I have that, I will implement an autmated testing unit. Then, I will code it to work with graphs with local minimums. Later, I will change it to include random mutations and test the effectiveness of them.

1.2 Expected results

I expect the results to approximate the exact result obtained using calculus. The results will be analyzed by seeding the random number generator differently and running different tests.

I hope to learn more about genetic algorithms and how to optimize the parameters to obtain the most accurate and precise results.

2 Theory

2.1 Definition

A genetic algorithm is a theory used to compute approximate solutions in fewer iterations than other search techniques. It is based upon a structured evolutionary biology, with a "population" containing "individuals."

2.2 Set up

The population in this genetic algorithm is composed of points ("individuals").

2.3 Selection

The fitness function determines which points are the "best." In this case the fitness function will determine the lowest points by evaluating the known function and assigning a value (z value) to each point in the population.

A set number of the population will be killed off in each iteration. The fitness function determines which individuals of the population will be killed off, which will always be the members with the highest fitness function value.

2.4 Crossover

A crossover point was chosen within the population of points. The new individuals in the population were chosen based on an algorithm of duplicating, cutting, and slicing the existing population.

2.5 Mutation

The random mutation helps maintain genetic diversity in the population from one generation to the next. This factor can be important to avoid becoming trapped in a local minimum instead of the absolute minimum.

3 Procedures and Methodology

I am using C with OpenGL to write my program. I currently have the OpenGL component (3D graphing) completed and I am writing my genetic algorithm in C.

The graph of $z = x^2 + y^2$ appears on the screen in a gradient of points. Eight randomly-generated yellow points appear on the screen. They consist of the population.

1. Page down is pressed. The four worst points (as determined by the fitness function) are highlighted in white and enlarged.

2. Page down is pressed again. Those four points have been deleted, because this is the selection process.

3. When page down is pressed the third time, new points appear (in this version of the program, they happen to be the points that were deleted, but in the future they will be new points chosen based upon a breeding algorithm).

4. The fourth time page down is pressed, the points stay the same but become the permanent new population.

When the page down button is continued to be pressed, the cycle repeats according to the steps above.

4 Expected Results

I expect to see results that approximate the exact answer to the minimum point of the graph. I will show the genetic algorithm trial using a 3D graph - and I will analyze the results of many trials using a Ruby script. The Ruby program my also have a visual displaying how well the various trials worked when the random number seed was changed.