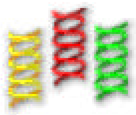


Matlab Implementation of Genetic Algorithms

Introduction

As a tool to implement the Genetic Algorithms I had choosen Matlab. In this short introduction, I would like to show some of these examples. Starting from a simple function, let us navigate through this small experiment to try to minimize a complex terrain with many local minimas. Probably, this would further deepen our insight into the capabilities of GAs.

In the end, I would also like to give a general outlook to the tool, I propose to use. This tool is a Genetic Algorithm toolbox for Matlab, written by Hartmut Polhiem of the Universität Ilmenau.

Ok, let me stop all this stuff, and let us dive into the ocean of examples.

Example 1

As the simplest of all the examples, let us try to solve the minimization of the function,

Now let us define our genetic algorithm for finding the minima for the following figure.

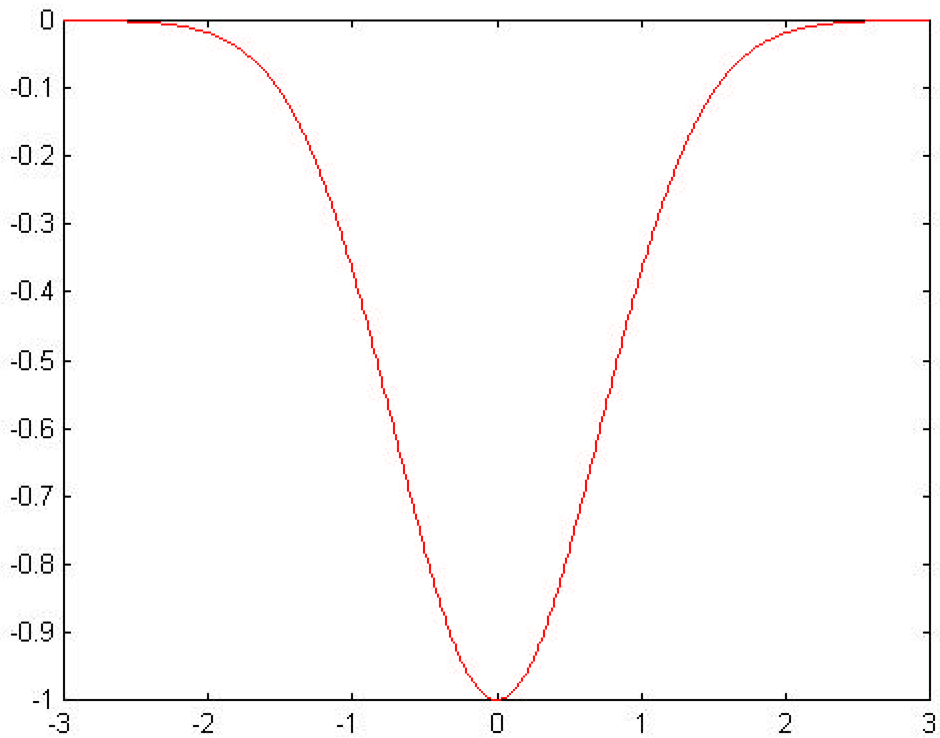
Objective function : y = -exp($-x^2$);

Range = [-3, 3];

Probability of mutation P_m = 0.01;

Probability of crossover P_c = 0.9;

Number of Generations N_{gen}= 50;



After evaluation the function for 50 Generations, the result was found to be

```
ans = 0.026625742
```

Though clearly, we could see that the minima exists, at exactly 0 the result was not so, hence we should either increase the number of generations or change the crossover and mutation probabilities.

Changing the number of generations to 100, we obtain the following result,

```
ans = 0.004
```

This could give us a basic insight into the algorithm. I had choosen single point crossover with a single population instead of maintaining multiple populations. I hope that the result would get enhanced, if multiple populations were used.

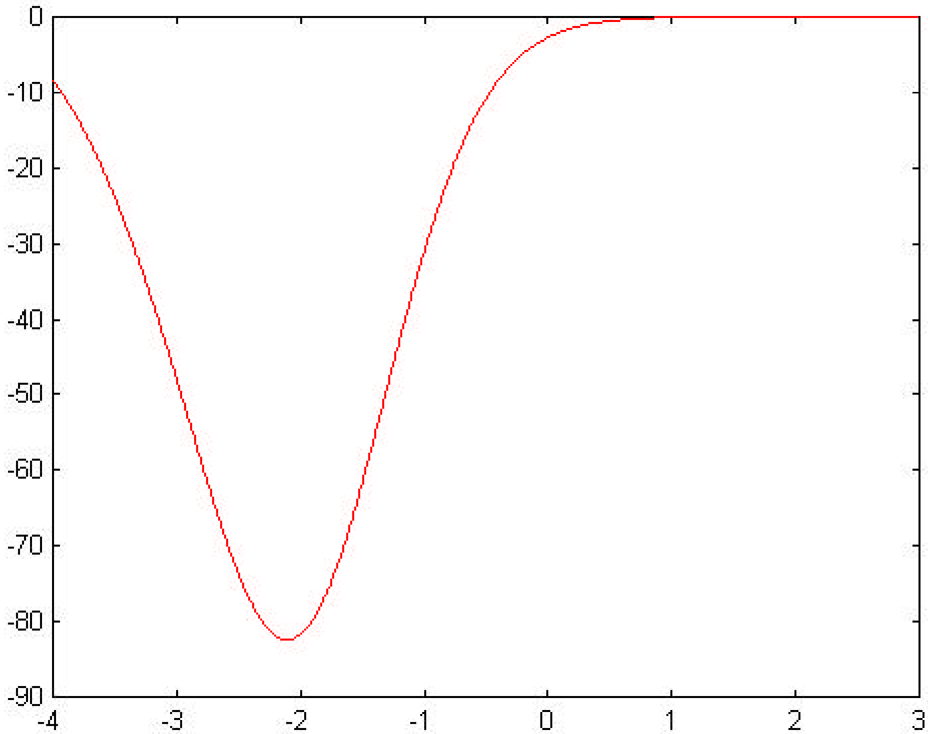
Example 2

Now as the second step, let us look at another example, with a shifted minima.

```
y = - exp(-x.^2- 4*x + exp( sin(x)) );

Range = [-4,3];
```

Retaining the same parameters for the previous example,



We obtain the answer as

```
ans = -2.1085
```

(I hope that this is quite in agreement with our observation).

<u>Example 3</u>

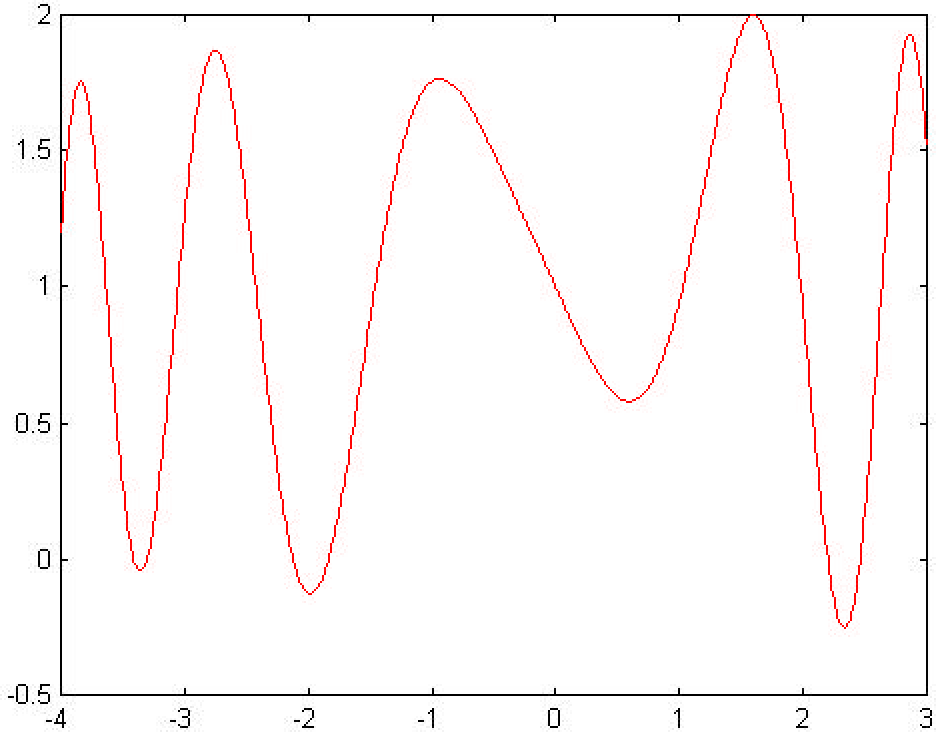
Both these above figures did not have a local minima, and hence let us now look at a function which has a few local minimas and a global minima.

```
objective function y = sin(x).^2 + cos(x).^4 +sin(x.^2 -sin(x)) ;
     Range = [-3, 3];
```

Mutation Probability P_m= 0.01;

Crossover probability P_c= 0.87;

Number of generations N_{gen} = 100;



After execution of the function for 100 generations the following was the result obtained.

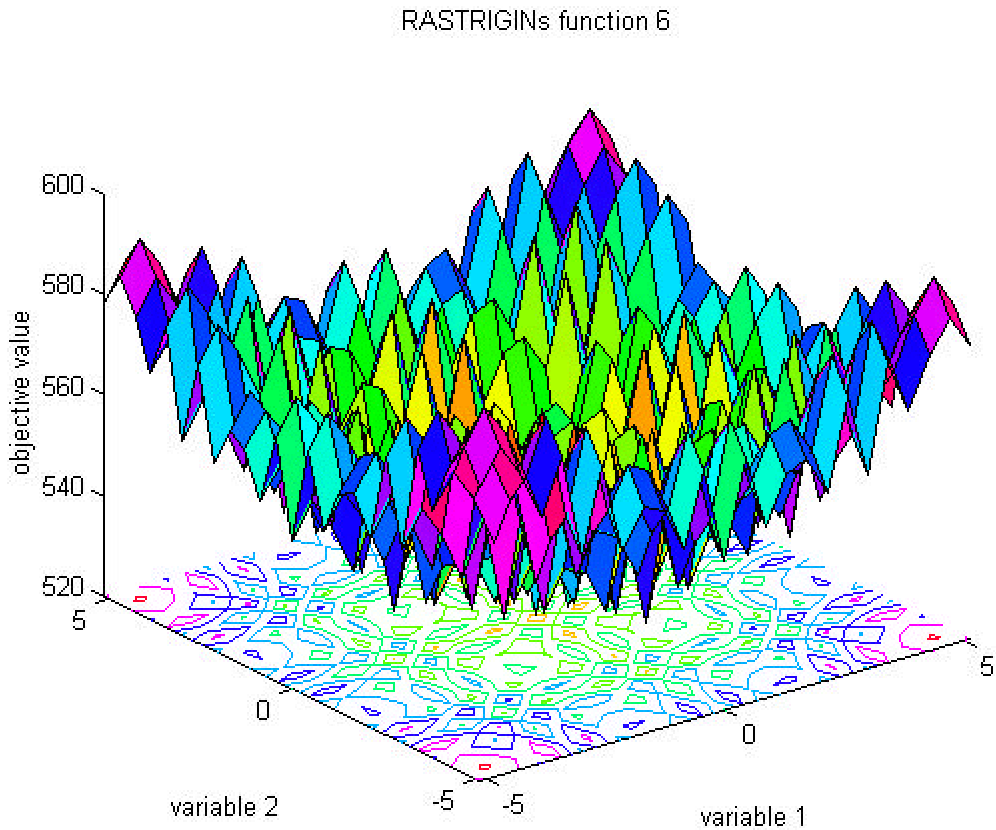
ans = 2.3332

GATbx : The toolbox for Genetic Algorithms

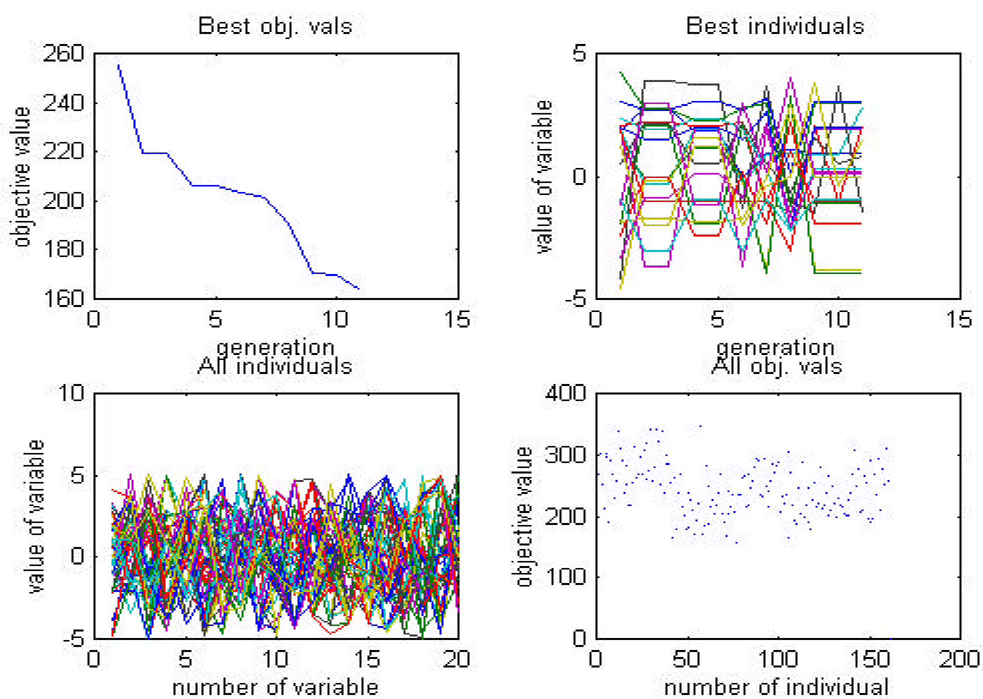
The following was the toolbox obtained from the web. It has a good genetic algorithms demo and a lot of functions to be implemented. This toolbox supports both single population and multipulation functions.

Selection could be implemented through other techniques other than roulette wheel selection (like local selection, truncation selection etal.,.) Also crossover could be single point or multipoint crossover.

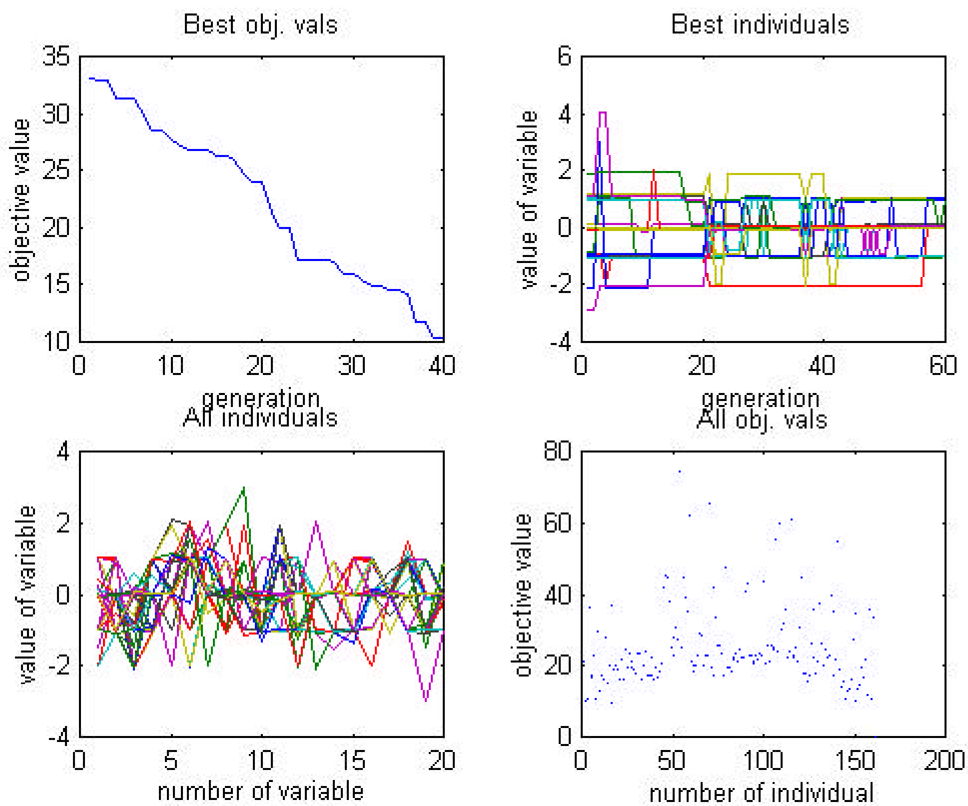
I have run the demo of the programme and the following is the result for a optimization function.



On start of the simulation the following were the graphs displayed.



Towards the middle of the simulation the following was the result for the multidimension figure.



The programme is capable of having multidimensional functions too as functions for optimization.

Conclusion:

This short function minization was intended to give a shor overview to the implementation of GAs. In fact, one has to compare the fuctioning of this technique in higher dimensions in order to properly get a feeling of its capability. Also the problem of getting trapped in a local minima is to be considered too.

I hope that the following short introduction was capable of giving an insight into the operation and implementation of GAs.

References:

1. Eva Pärt Enander, Bo Melin *et al*., *The Matlab Handbook*, Addison û Weseley, 1996.
2. Hartmut Pohlheim , *GEATbx: Genetic and Evolutionary Algorithm Toolbox for use with MATLAB*, Version 1.91, July 1997.

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