



Observing the Effect of Elitism on the Performance of GA

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Abstract— Genetic algorithm is searching and optimization technique based on the theory of evolution. Genetic algorithm based upon the principle of survival of fittest. More fit individual has more chance to select for mating. Researcher has done a lot of work in selection phase of Genetic algorithm. In this paper researcher has compare the performance of two selection technique i.e. roulette wheel selection and elitism on the dejong function. A lot of improvement has been observed by selecting the individuals by elitism.

Keywords— Genetic algorithm, Selection, Chromosome, Mating pool.

I. INTRODUCTION

Genetic Algorithms are the heuristic search and optimization techniques that mimic the process of natural evolution. Genetic algorithms also implement the optimization strategies by simulating evolution of species through natural selection [1]. Genetic algorithm (GA) is generally composed of two processes. The first process is selection of individuals for the production of the next generation and the second process is manipulation of the selected individuals to form the next generation by crossover and mutation techniques. [2]The selection mechanism determines which individuals are chosen for mating (reproduction) and how many offspring each selected individual produces. The main principle of selection strategy is “the better is an individual; the higher is its chance of being parent.”

The basic procedure of GA is

Procedure GA

```
{
  t = 1;
  Initialize Population (t);
  While (Max number of Generation)
  {
    Evaluate fitness of Population (t);
    Parents (t) = Select Parents (Population (t));
    Offspring (t) = Reproduction operator (Parents (t));
    Population=Generational replacement (offspring)
    t = t + 1;
  }
}
```

Genetic algorithms [4] typically maintain a constant-sized population of individuals which represent samples of the space to be searched. Each individual is evaluated on the basis of its overall fitness with respect to the given application domain. New individuals (samples of the search space) are produced by selecting high performing individuals to produce "offspring" which retain many of the features of their "parents". This eventually leads to a population that has improved fitness with respect to the given goal. In this paper elitism selection method was used to select the parent and the performance was compared with roulette wheel selection. In section II, related work in the domain was discussed followed by section III where the propose work was discussed. In the section IV implementation was carried out and results were discussed.

II. RELATED WORK

Rajamani, lakishmi et. al. has introduced an improved selection operator for genetic algorithm. This paper proposed a modified RWS method to increase the gain of resources, reliability and diversity; and decrease the uncertainty in [5] selection process. In RWS the size of each individual interval corresponds to the fitness value of the associated individual.

Vafai, Haleh et. al. proposed a Feature Selection Methods: Genetic Algorithms vs. Greedy-like Search [6]. This paper presents a comparison between two feature selection methods, the Importance Score (IS) which is based on a greedy-like search and a genetic algorithm-based (GA) method, in order to better understand their strengths and limitations and their area of application.

Elnima Ali, Dr.Elgasim Elamin presents a new selection [7] method for genetic algorithms. In this research a new method is tested and compared with the Geometric selection method. The proposed selection method is simple to implement, and it has notable ability to reduce the effected of premature convergence compared to other method. Sivaraj, R et. al. [8] proposed a Review of Selection Methods in Genetic Algorithm. This paper presents a various selection methods that deserve a special position in Genetic algorithm since it is the one which mainly determines the evolutionary search spaces. It is used to improve the chances of the survival of the fittest individuals. Gupta, Deepti et.al. [9] Present an Overview of methods maintaining Diversity in Genetic Algorithms. This research maintains diversity in genetic algorithm. Genetic algorithm is based on the principle of natural selection for reproduction and various evolutionary operations as crossover and mutation.

Alabsi, Firas et. al. has introduced a Comparison of Selection Methods and Crossover Operations using Steady State Genetic Based Intrusion Detection System. The Main purpose of this paper is to compare different types of genetic operators and monitor their [10] performance in Intrusion Detection System, to determine the Selection type and Crossover type to be worked together and perform better. Intrusion Detection Systems are systems built to detect the unwanted attacks. Genetic Algorithm is a method that mimics the process of natural evolution; it was used to support the Intrusion Detection Systems.

III. PROPOSED WORK

In this proposed work we introduced an elitism selection method. Elitism is used to enforce the preservation of best solution found so far unless a new best individual is discovered. Elitism is implemented by copying the best individual of a generation into the next generation without any change. In natural selection the best traits are usually inherited from parents to offspring. Elitism is a kind of selection in which the best individual passed to the next generation as such without any modification. Elitism prevents the best individual to undergo the reproduction process so as to pass them without any modification into next generation.

Procedure for this proposed work:-

Procedure MA (Fitfxn, Psize, Pc, Pm)

Fitfxn - fitness function to evaluate chromosome

Psize – size of population in each generation

Pc – Crossover probability

Pm – mutation probability

Mxzn – maximum number of generations

- 1) encode solution space
- 2) p = Initialize population
- 3) gen = 1

While gen<= Mxzn

```
{
  // find best individual from population
  King= min (Fitfxn (p))
  Mate pool = Selection (p)
  If (rnd (0, 1) <=Pc)
  {
    Child = crossover (mate pool)
  }
  If (rnd (0, 1) <=Pm)
  {
    mchild = mutation (child)
  }
  S = replace (mchild)
  // Insert best individual by replacing it with
  Worst one in next generation.

  S_worst = worst(s)
  s_worst = king
  P = s
```

Gen = gen+1

}

4) Return best chromosomes

In natural selection the best traits are usually inherited from parents to offspring. Elitism is a kind of selection in which the best individual passed to the next generation as such without any modification. Elitism prevents the best individual to undergo the reproduction process so as to pass them without any modification into next generation.

IV. IMPLEMENTATION & OBSERVATION

In this section of paper Matlab code has been developed for dejong's function by roulette wheel selection as well as elitism selection method. The problem which the author discusses is dejong function which is one of the NP hard problems often used as a benchmark for optimization. The code has been developed for dejong function like axis parallel hyper-ellipsoid function, Rastrigin's function. In this implementation author compare the result of two selection methods by graphs and tables.

Dejong's function 2:- The axis parallel hyper-ellipsoid is similar to De Jong's function 1(sphere model). It is also known as the weighted sphere model. Again, it is continuous, convex and unimodal.

Function definition:

$$f_{1a}(x) = \sum_{i=1}^n i \cdot x_i^2 \quad -5.12 \leq x_i \leq 5.12$$

$f_1(x) = \text{sum}(i \cdot x(i)^2)$,

$i=1:n, -5.12 \leq x(i) \leq 5.12$.

Global minimum: $f_1(x) = 0; x(i) = 0, i=1:n$.

Dejong's function 6:- Dejong function 6 is also known as Rastrigin's function. Rastrigin's function is based on function 1 with the addition of cosine modulation to produce many local minima. Thus, the test function is highly multimodal. However, the location of the minima is regularly distributed.

Function definition:

$$f_6(x) = 10 \cdot n + \sum_{i=1}^n (x_i^2 - 10 \cdot \cos(2 \cdot \pi \cdot x_i)) \quad -5.12 \leq x_i \leq 5.12$$

$f_6(x) = 10 \cdot n + \text{sum}(x(i)^2 - 10 \cdot \cos(2 \cdot \pi \cdot x(i)))$, $i=1:n, -5.12 \leq x(i) \leq 5.12$.

Global minimum:

$f_6(x) = 0; x(i) = 0, i=1:n$.

Parameters used for implementation are:-

- 1) Encoding: Real value encoding
- 2) Selection: roulette wheel and elitism selection
- 3) Crossover operator :Arithmetic operator
- 4) Mutation operator: Uniform mutation
- 5) Replacement: generational update
- 6) $P_c=0.6$
- 7) $P_m=0.01$
- 8) Termination criteria=Maximum number of generation

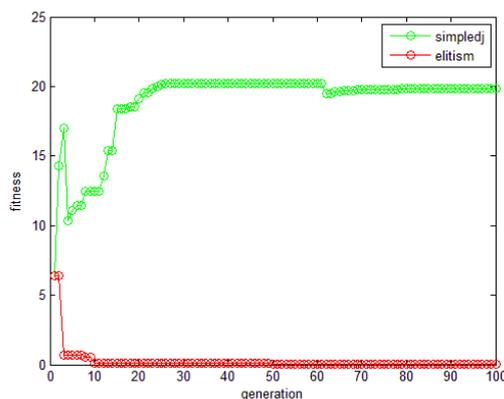


Figure 1- Dejong function2 (100 generation)

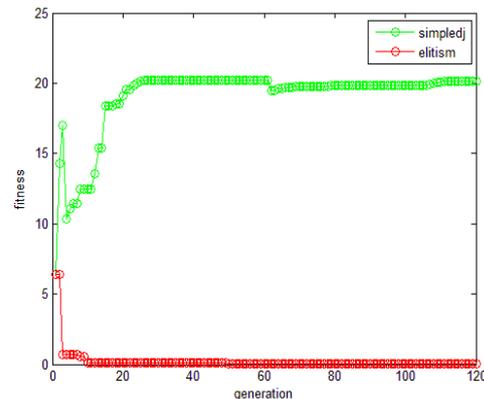


Figure 2-Dejong function 2(120 generation)

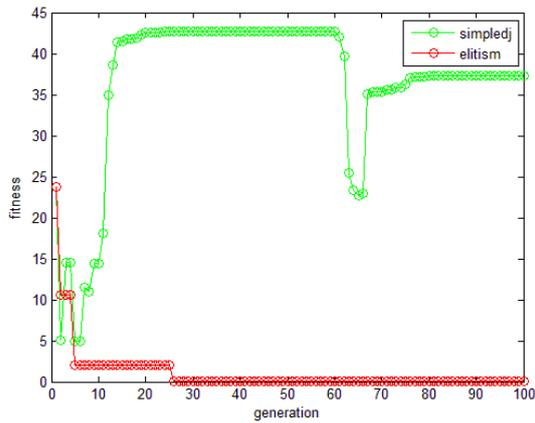


Figure 3-Dejong function6 (100 generation)

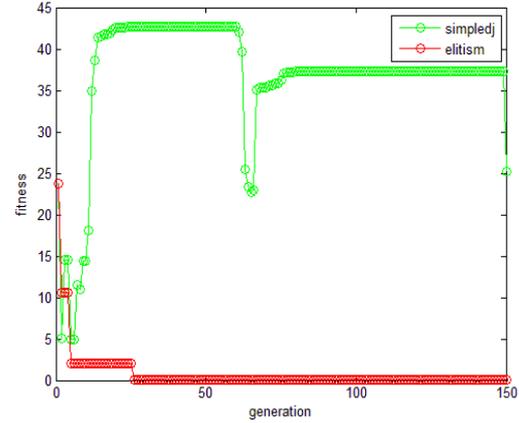


Figure 4- Dejong function 6(150 generation)

Table- 1

Dejong function 2		
	100 generation	120 generation
Simple dejong function by roulette wheel	6.428	6.428
Dejong function by Elitism selection	0.1404	0.01205

Table-2

Dejong function 6		
	100 generation	150 generation
Simple Dejong function by roulette wheel	4.899	2.064
Dejong function by Elitism selection	0.1026	0.1026

V CONCLUSION & FUTURE WORK

Genetic algorithms are based on evolutionary ideas of natural selection and genetics. In genetic algorithm a number of selection operators have been used in the past like roulette wheel selection, ranked selection etc. Roulette wheel selection uses exploitation technique. There is no guarantee that good individuals will find their way into next generation. But elitism is used to enforce the preservation of best solution found so far unless a new best individual is discovered. Elitism is implemented by copying the best individual of a generation into the next generation without any change. The elitism solution has been implemented on Dejong’s problem but in the authors are of the opinion that work should be carried out in future on other NP Hard problems like travelling salesman problem, knapsack problem etc. to further substantiate the results.

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