

# Search Best of Chromosome with Genetic Algorithm

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## I. Abstract

### 1.1 Background

The rapid development of technology, especially development in the IT world makes every job more effective and efficient. These developments include the development of the use of computer programs.

Genetic Algorithms are one example of an algorithm that can be applied in a program and can find solutions to certain cases or problems. One of the cases or problems is finding the best chromosome in a population where the chromosome has gone through several processes.

### 1.2 Goals

The purpose for this report is :

1. To find best chromosome with some program and used genetic algorithm.
2. As one of the fulfillment of assignments in artificial intelligence courses.

### 1.3 Problem Boundaries

In order to make the contents of the report more directed, the authors determine the following problem boundaries:

1. The dataset is an integer number that will become a chromosome, the length of the chromosome must be even. The number of chromosomes must be greater than the length of the chromosomes
2. The programming languages and IDEs used are Python and Spyder

## 2. Theoretical Basis

### 2.1 Genetic Algorithm

genetic algorithm is a heuristic search method used in artificial intelligence and computing. It is used for finding optimized solutions to search problems based on the theory of natural selection and evolutionary biology. Genetic algorithms are excellent for searching through large and complex data sets. They are considered capable of finding reasonable solutions to complex issues as they are highly capable of solving unconstrained and constrained optimization issues.

- The stages of the Genetic algorithm process are as follows:
  1. Make a population consisting of several chromosomes
  2. Calculate the phenotype value that is on each chromosome
  3. Calculate the fitness value on each chromosome
  4. Do parent selection (tournament)
  5. Do crossover
  6. Do mutation
  7. Do survivor

phenotype

$$x = r_{min} + \frac{r_{max} - r_{min}}{\sum_{i=1}^N 9 * 10^{-i}} (g_1 * 10^{-1} + g_1 * 10^{-2} + \dots + g_N * 10^{-N})$$

- **rmin** : minimum value of chromosome
- **rmax** : maximal value of chromosome
- **g** : number of value in chromosome fitness


$$f(x_1, x_2) = \left(4 - 2.1x_1^2 + \frac{x_1^4}{3}\right)x_1^2 + x_1x_2 + (-4 + 4x_2^2)x_2^2$$

- **x1 & x2** : number of phenotype  
 $2^{-H}$  : **H** is value  $f(x_1, x_2)$

### 3. Program Implementation

The implementation of this program is made using the Python programming language. There are several stages of the program used to determine the best chromosome including the following:

1. Running program with Spyder
2. Called function `output(cro,length)` with following step :

- Run program with run button 
- In [44]:

In that line write  
“output(cro,length)”

Note : without quotation mark

**cro** : total of chromosome that we want to creat in population

**length** : length of each chromosome

**cro** must be larger than **length**

3. After that input how many generation that we want
4. Program will show the best chromosome and show phenotype value for each best chromosome

In [93]: output(1024,16)

Input how many generation ? 17

```

===== Best Chromosome =====
Generation 1
1 . [-1, -2, -2, 0, 0, 0, -3, 3, -2, -2, -2, 2, -2, -1, 0, 1]
x1= -0.0849632333333321 x2= 0.8152160466666668
2 . [-1, -2, 1, 2, 0, 2, 1, -1, -2, -2, -2, 2, 1, -2, 0, -2]
x1= -0.0817608733333319 x2= 0.8152450166666668

===== Best Chromosome =====
Generation 2
1 . [-1, -3, 0, -2, 0, 0, -2, 0, -2, -2, -2, 0, 2, -1, 2]
x1= -0.0931631633333322 x2= 0.8148389566666667
2 . [-1, -2, -3, 0, -2, -1, -3, -1, -2, -2, -1, 0, -1, 2, -2, 0]
x1= -0.0859842733333321 x2= 0.8160288366666668

===== Best Chromosome =====
Generation 3
1 . [-2, 3, 3, 2, 1, 2, 3, -3, -2, -2, -2, 0, 2, -1, -2, -2]
x1= -0.129750693333332 x2= 0.8150558166666668
2 . [-1, 0, -2, -1, 3, 1, 0, 1, -2, -2, -1, -1, 1, 1, 0, 0]
x1= -0.0650319533333321 x2= 0.8159480366666668

===== Best Chromosome =====
Generation 4
1 . [-1, -1, 1, -1, -1, 1, 2, -2, -2, -2, -2, -1, 2, -1, -1, -2]
x1= -0.072071783333332 x2= 0.8149559166666668
2 . [-2, 3, -1, 0, 0, -2, 0, -2, -2, -2, -2, 0, -2, -1, -2, 1]
x1= -0.1339651633333322 x2= 0.8150158466666668

```

Gambar 1 the result of output function

### 4. Conclusion

Base on implementation program we can concluded that :

1. Genetic algorithm can search best chromosome for each generation
2. Genetic algorithm only need chromosome value and length of chromosome

### 5. Reference

- [1] <https://www.techopedia.com/definition/17137/genetic-algorithm>