

Liceria & Co.

# Genetic Algorithms

"AI is a tool. The choice about  
how it gets deployed is ours."

by - Oren Etzioni

# What are Genetic Algorithms ?

**Genetic Algorithm(GA) is a class of random-based classical algorithms based on Charles Darwin's theory of evolution. It is also regarded as a process of solving optimization problems by method of natural selection.**



**GENETIC  
ALGORITHMS**

- Optimization
- Classification (GBML)
- Human Comparable Design

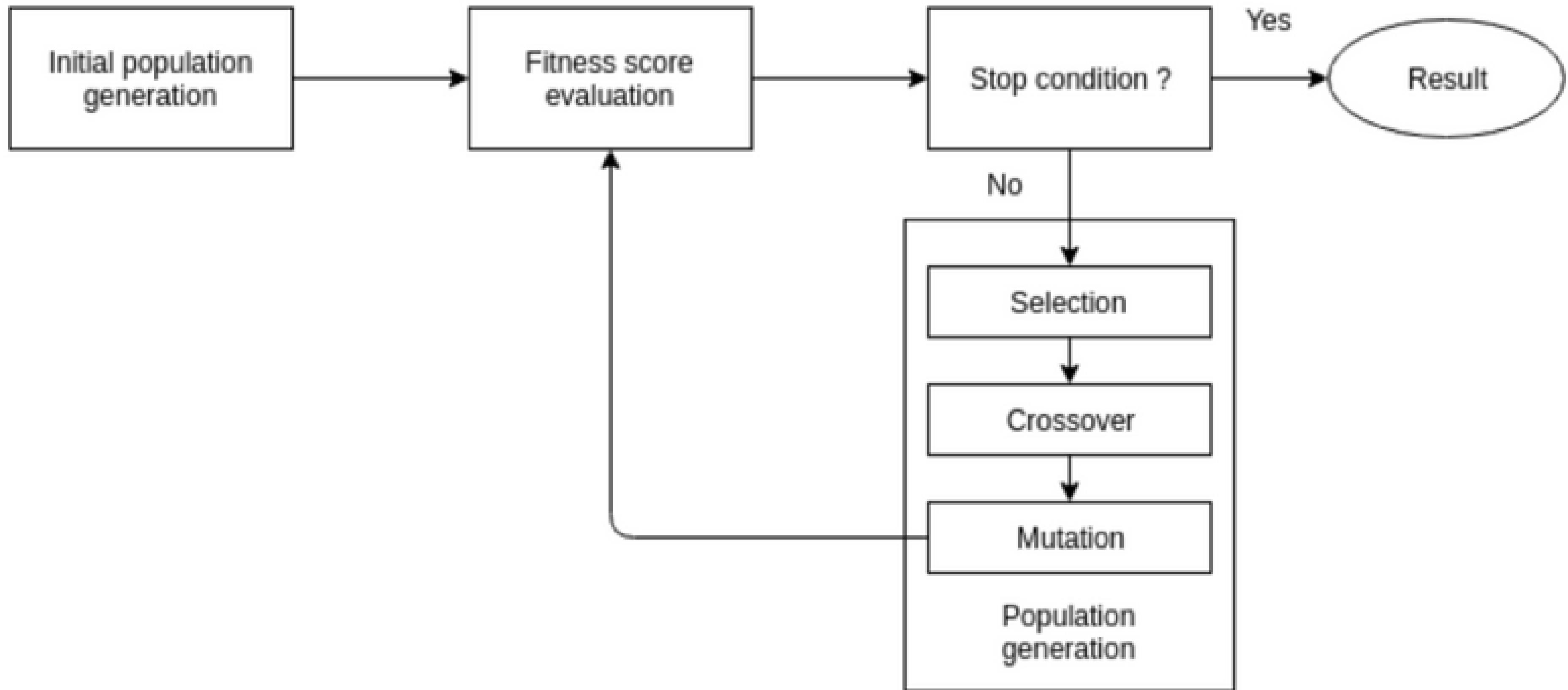
# Genetic Algorithm Structure

It is an evolutive process that maintains a population of chromosomes (potential solutions). Each chromosome is composed of several characteristics called genes. The all process has 5 main steps:

- Initial population generation:
- Fitness score evaluation
- Selection
- Crossover
- Mutation

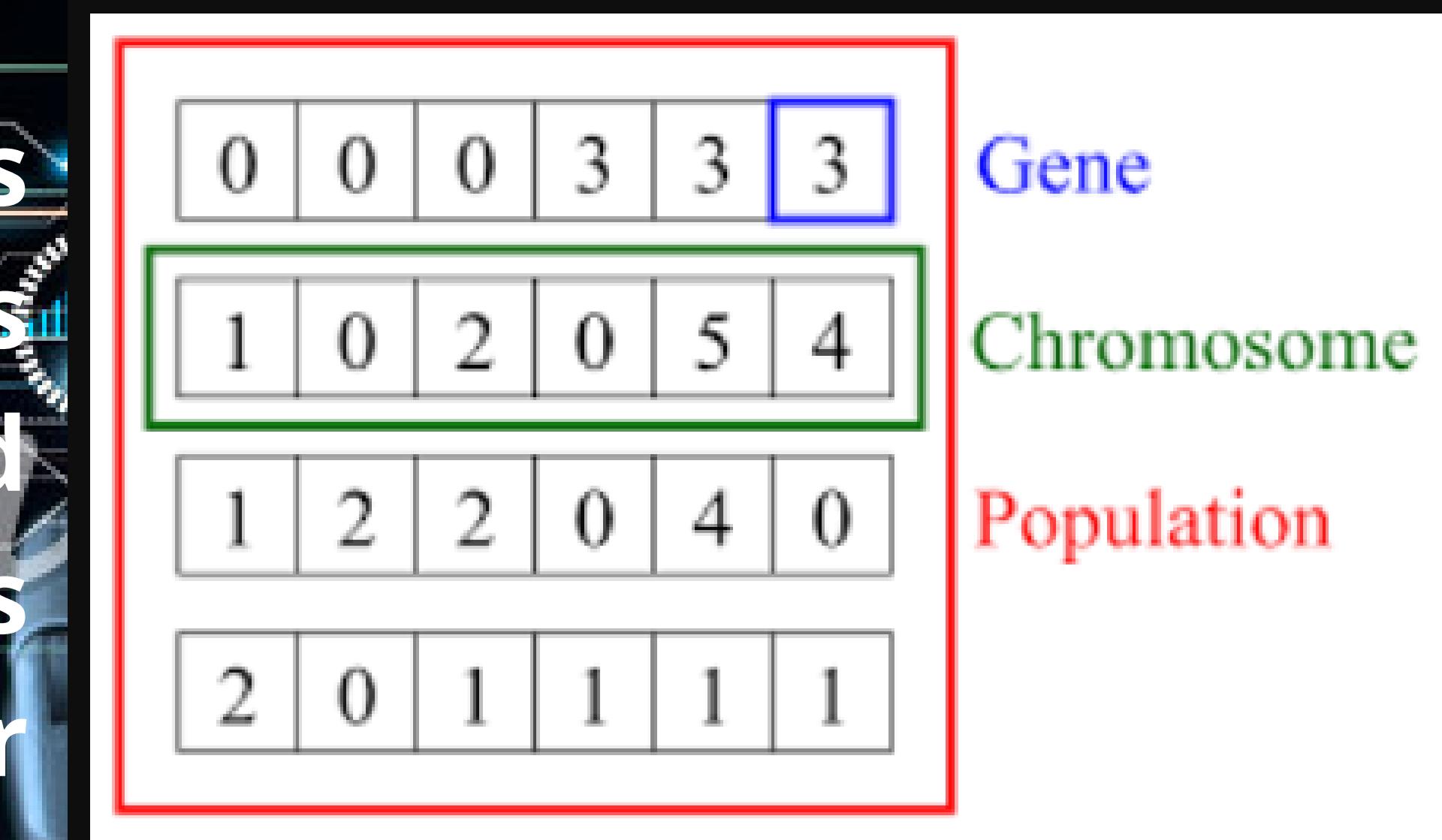


# *Genetic Algorithm Structure*



# Initial Population Generation

It is the first step in the GAs structure. It usually has fixed size and generated randomly. Population size is an important parameter for GAs.



# Fitness Score Evaluation

The probability that a chromosome will be used for reproduction is based on the its score in fitness. Better the solution, better will be the fitness score.

Item Number	0   1   2   3   4   5   6
Chromosome	0   1   0   1   1   0   1
Profit Values	2   9   8   5   4   0   2
Weight Values	7   5   3   1   5   9   8

Knapsack capacity = 15  
Total associated profit = 18  
Last item not picked as it exceeds knapsack capacity

# Selection

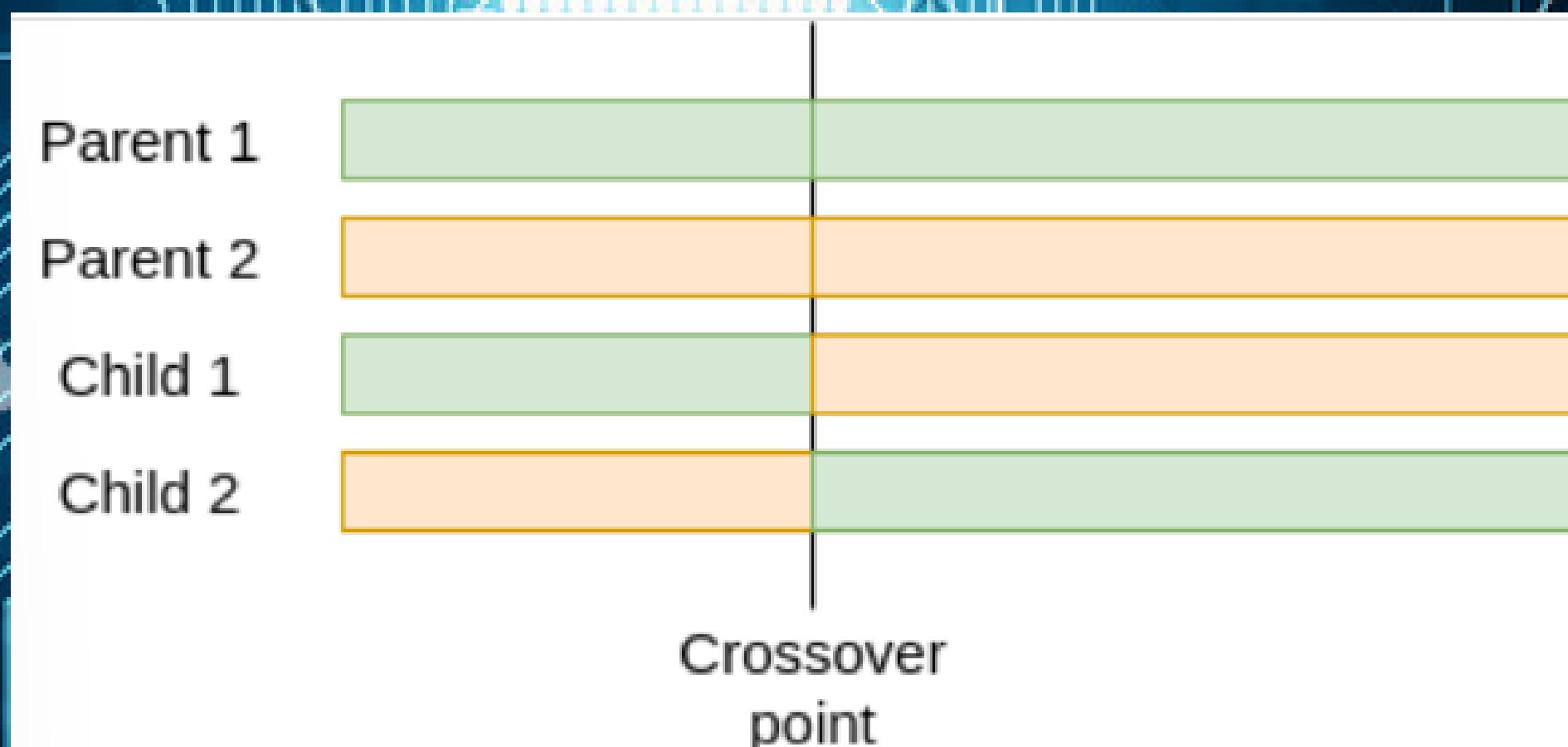
Those who have a high percentage of reproduction are selected.

The second important parameter is that of the Crossover rate. It represents the percentage of population selected from Generation  $t$  and  $t+1$  for reproduction.



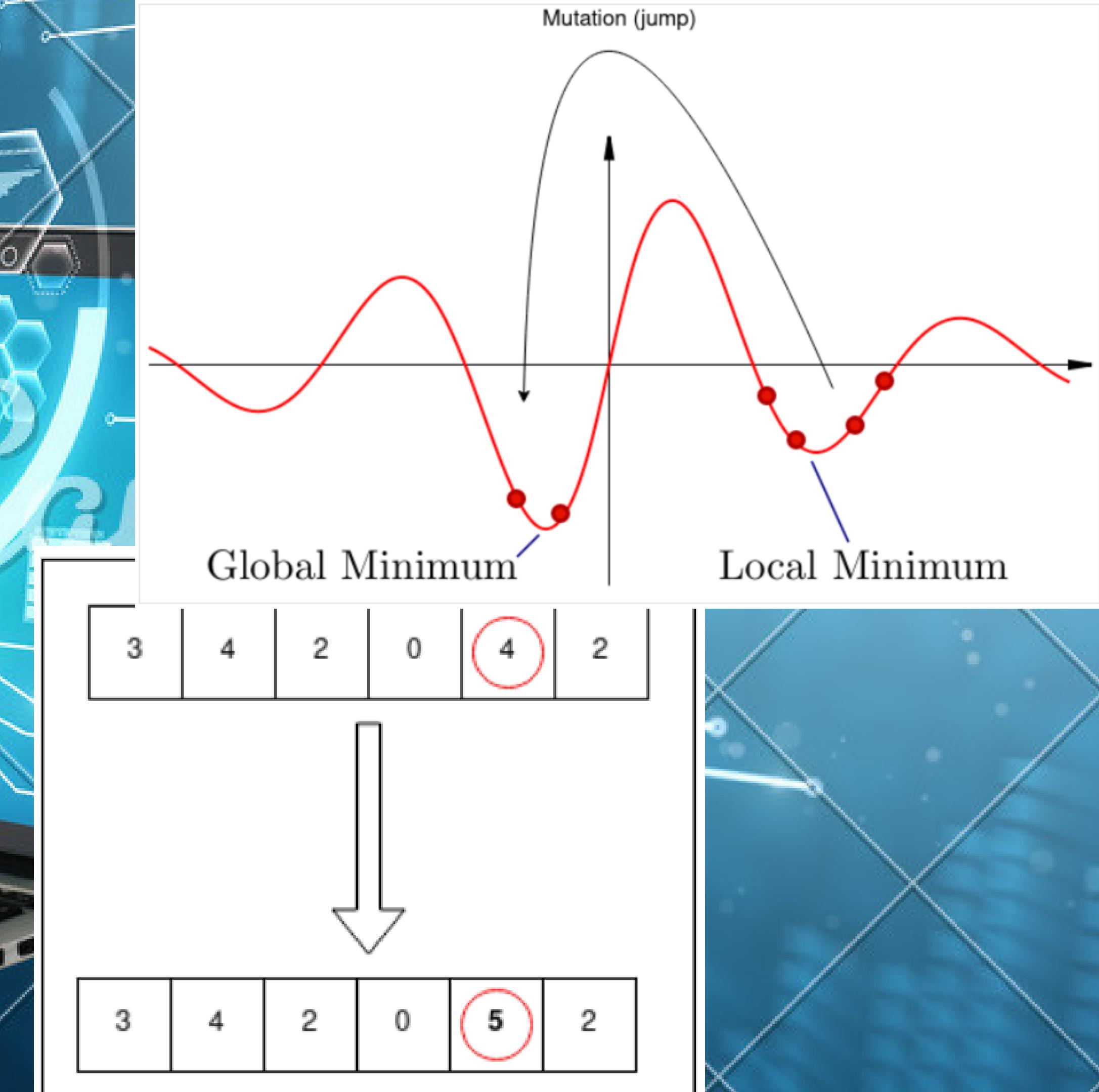
# Crossover

The crossover step is the most related to biological reproduction. New chromosomes are generated until the population is complete [population number reaches]. The bigger the crossover rate, the fewer new chromosomes are generated.



# Mutation

The **mutation rate** is another important parameter: it represents the probability that a **chromosome** mutates. This step is very important to obtain good results. Indeed, a Genetic Algorithm can be stuck in a local minimum [maximum]. The mutation is a "jump" to another point in the solution space.



# Hyper- Parameters

A Genetic Algorithm has several parameters that are tuned to obtain better results. The set of parameters is called Hyper-parameters.

The most important hyper-parameters are:

- Population Size
- Crossover Rate
- Mutation Rate
- Generation Number

# Conclusion

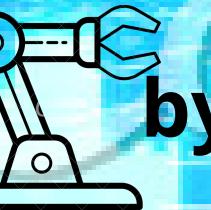
**It is not possible to be sure that the algorithm gives the best possible solution.** Though it had given an solution but it may be possible that it may had not searched an area that is not in its solution space. **It is important to test different Hyper-parameter sets.**

**They work well and produce good results with medium-sized dataset.**  
**It is not like deep-learning algorithm that requires a lot of data.**

**For eg.: there exist several methods for selection step [tournament selection,.....] or the crossover step.7**



# Thank You!



by - Navya Shah

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