**About Genetic Algorithms**

[ READ FULL HERE: <https://medium.com/@byanalytixlabs/a-complete-guide-to-genetic-algorithm-advantages-limitations-more-738e87427dbb> ]

**What is Genetic Algorithm?**

Genetic Algorithms are heuristic search algorithms that solve constrained and unconstrained optimization problems using the concepts of natural selection — a famous discipline in biological evolution.

**Key Terminologies**

*Population*: It refers to the subset of all possible solutions to a problem.

*Chromosome aka. Solution aka. Individual :*

1. An individual solution is referred to as a chromosome.
2. A chromosome is a finite-length vector of variable components.

*Gene:* Each variable component is referred to as a gene. Thereby, a collection of genes forms a chromosome

A screenshot of a computer

Description automatically generated

*Selection:* A stage where the optimal solution is selected for the next iteration for breeding (crossover).

*Crossover:* Recombination of genetic information to generate new solutions.

*Mutation:*

* A process to maintain genetic diversity in a population is achieved by randomly editing certain solutions.
* This is typically achieved by flipping an arbitrary bit in a genetic sequence

A diagram of a number of letters

Description automatically generated with medium confidence

*Allele:* Within a particular chromosome, it refers to the value provided to a gene.

*Fitness Function:*

* The fitness function is the basis for determining each individual’s fitness in a population.
* It returns a fitness score for each individual based on their performance and ability to compete with other individuals.

*Genetic Operators:* The genetic operator changes the genetic composition of offspring, ensuring that the offspring is better than the parents.

*Search Space:* The search space is where the population is maintained, where each individual is a solution

**How Genetic Algorithm Work?**

A screenshot of a blue and white screen

Description automatically generated

**(1) Initial Population**

* Real Value Representation: float and real-valued numbers to represent genes.
* Integer Representation: Integers can be used to represent genes. For example, North, South, East, and West are represented by 1,2,3 and 4.
* Permutation Representation: They are typically used when there is order to the elements being represented. For example, the time consumed in distance traveling can be encoded, with 0 representing the lowest and 9 representing the maximum consumed time.

**(2) Fitness Function**

A fitness function is used to assess an individual’s fitness level. The function returns a fitness score for each individual, indicating the probability of being selected for reproduction.

**(3) Selection**

* Roulette Wheel Selection
* Stochastic Universal Sampling
* Tournament Selection
* Elitism Selection
* Random selection

A diagram of a selection method

Description automatically generated

* Survivor Selection

A diagram of a selection method

Description automatically generated

**(4) Crossover**

* One Point Crossover
* Two Point Crossover
* Uniform Crossover

A diagram of a company

Description automatically generated

**(5) Mutation**

Flip Bit mutation

Gaussian Mutation

Exchange/Swap Mutation

**(6) Termination**

The last step is when the process of selection, crossover, and mutation terminates. This is typically achieved in two ways-

* **Reaches the maximum number of generations**

The maximum number of iterations set by the user is reached.

* **Reaches a sufficient level of fitness**

The required or optimum solution is reached. This is typically determined by ensuring that one or more individuals in the population have achieved the desired fitness score and that the offspring are not significantly different and better than the previous generation.