

Evolutionaries - Genetic Algorithms

Evolutionary algorithms are a family of search, optimization, and learning techniques inspired by the principles of **natural evolution**.

- A **population** is a set of **individuals**;
- An **individual** is a **candidate solution** to the problem;
- An **individual** is represented by a **chromosome**;
- A **chromosome** is a **string of genes (alleles - variable values)**.

A **genetic algorithm** follows the following steps:

1. **Initialization** - create the initial population with **random individuals**;
 2. **Evaluation** - evaluate the fitness of each individual;
 3. **Selection** - select the best individuals;
 4. **Crossover** - create new individuals (**offsprings**) by combining the selected individuals;
 5. **Mutation** - mutate the new individuals;
 6. **Termination** - check if the termination criteria are met, otherwise go to step 2.
- The **fitness** of an individual is a **measure of quality** of the individual, and its generated using a **fitness function**;

Selection

There are several **selection methods**:

- **Roulette Wheel** - each individual has a probability of being selected proportional to its fitness;
- **Tournament** - select a random subset of the population and select the best individual from that subset;
- **Ranking** - sort the population by fitness and select the best individuals.
- **Elitism** - the best individuals are always selected.
- **Stochastic Universal Sampling** - select the best individuals, but with a fixed distance between them.

Crossover

There are several **crossover methods**:

- **One-point** - select a random point in the chromosome and swap the genes after that point;
- **Two-point** - select two random points in the chromosome and swap the genes between those points;
- **Uniform** - for each gene, select a random number and swap the genes if the number is below a threshold.