Genetic Algorithm

Genetic Algorithm are adaptive heuristic search algorithm based on the evolutionary ideas of natural selection and genetics.

It is a part of Evolutionary Computing, a rapidly growing area of artificial Intelligence. GAs are inspired by Darwin's theory about evolution - "Survival of the fittest."

Solving problems mean looking for solutions, which is best among others.

Finding the solution to a problem is often though :-

→ In Computer Science and AI, as a process of search through the space of possible solutions. The set of possible solutions defines the search space (state space) for a given problem. Solutions or partial solutions are viewed as point in the search space.

- In engineering and mathematics, as a process of optimization. The problems are first formulated as mathematical models expressed in the terms of functions and then to find a solution, discover the parameters that optimize the model or the function components that provide optimal system performance.

GAs are the main paradigm of evolutionary Computing. In nature Competition among individuals for scanty resources results in the fittest individuals dominating over the weaker ones.

→ GAs are the ways of solving problems by mimicking processes nature uses; i.e Selection, Crosses over, Mutation and Accepting, to evolve solution to a problem.

⇒ Genetic algorithm begins with a set of solutions (represented by Chromosomes) called the population.

- Solutions from one population are taken and used to form a new population. This is motivated by the possibility that the new population will be better than the old one.
- Solutions are selected according to their fitness to form new solutions; more suitable they are, more chances they have to reproduce.
- This is repeated until some condition (no. of population or improvement of the best solution) is satisfied.

Basic Genetic Algorithm:

1. [Start] Generate random population of n chromosomes (i,e suitable solutions for the problem).
2. [Fitness] : Evaluate the fitness $f(x)$ of each chromosome x in the population.
3. [New population] Create a new population by repeating following steps untill the new population is complete:-
   (a) [Selection] Select two parent chromosomes from population according to their fitness.
   (b) [Crossover] Cross over the parents to form new offspring (Children). If no crossover was performed offspring is the exact copy of parents
   (c) [Mutation] with a mutation probability, mulate new offspring at each position in chromosome.
   (d) [Accepting] Place new offspring in the new population.
4. [Replace] Use new generated population for a further run of the algorithm.
5. [Test] If the end condition ~~for a further~~ is satisfied, Stop, and return the best solution in current population.
6. [Loop] go to step 2.

Note: Crossover and mutation are two important part of GA.