Genetic Algorithm (GA)

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Genetic Algorithms are the heuristic search and optimization techniques that mimic the process of natural evolution.

- A genetic algorithm is a local search technique used to find approximate solutions to Optimisation and search problems.
- It is an efficient, and effective techniques for both optimization and machine learning applications.
- It is widely-used today in business, scientific and engineering disciplines.
- Genetic algorithms are one of the evolutionary algorithms that use techniques inspired by Darwin's theory
  about evolution such that inheritance, mutation, selection, and crossover.
- This algorithm is implemented as a computer program simulation in which a population of abstract representations (called as the **chromosomes**) of candidate solutions (called as the **individuals**) to an Optimisation problem evolves toward the better solutions.
- The genetic algorithm is started with a set of solutions (represented by chromosomes) called population.
- The solutions from one population are taken and used to form a new population. Each new population is called as a generation. This is motivated by a hope, that the new population will be better than the old one.
- In each generation, the fitness of the whole population is evaluated, multiple individuals are stochastically selected from the current population (based on their fitness) and modified (mutated or recombined) to form a new population.
- This process is repeated until some condition is satisfied.

Advantages/Benefits of Genetic Algorithm

1. The concept is easy to understand.
2. GA search from a population of points, not a single point.
3. GA use payoff (objective function) information, not derivatives.
4. GA supports multi-objective optimization.
5. GA use probabilistic transition rules, not deterministic rules.
6. GA is good for "noisy" environments.
7. GA is robust w.r.t. to local minima/maxima.
8. GA is easily parallelised.
9. GA can operate on various representation.
10. GA is stochastic.
11. GA work well on mixed discrete/continuous problem.

Disadvantages of Genetic Algorithm

1. GA implementation is still an art.
2. GA requires less information about the problem, but designing an objective function and getting the representation and operators right can be difficult.
3. GA is computationally expensive i.e. time-consuming.

Genetic algorithm has been applied in vast applications due to its advantage that able to deal with complex problem and various types of optimization. Genetic algorithm has been developed and modified in many variants to be applied in a wide range of optimization problems