Lecture – 03
Introduction to soft computing

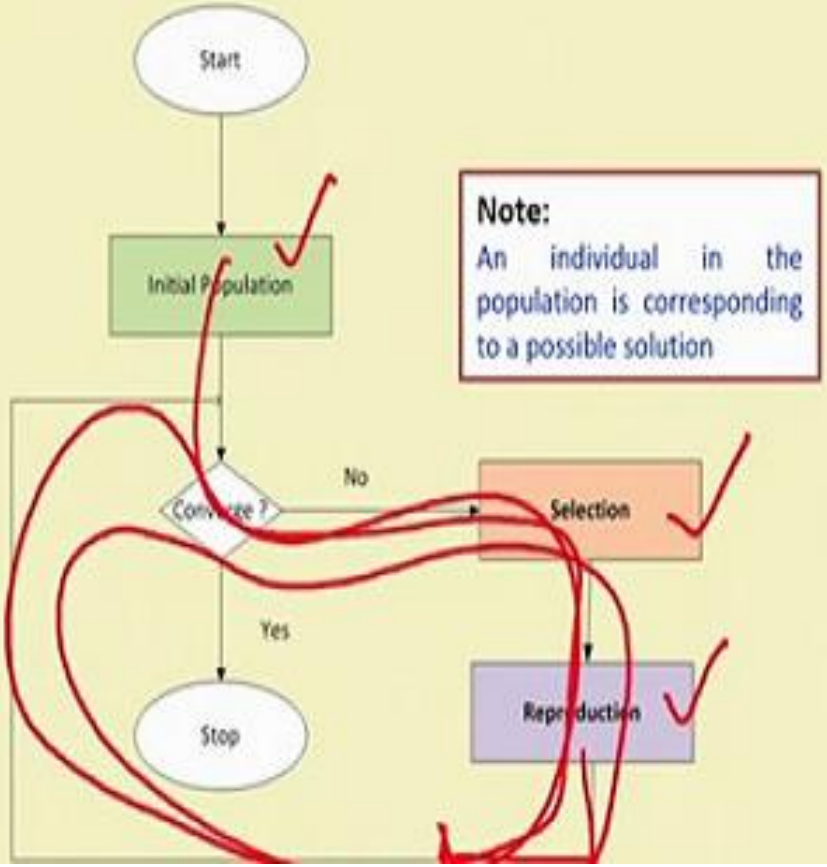
Dr. Ahmed Elngar
Faculty of Computers and Information
Beni-Suef University

Working of Genetic Algorithm

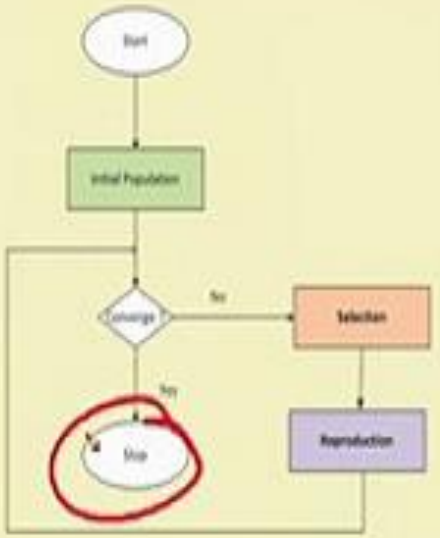
Definition of GA:

Genetic algorithm is a population-based probabilistic search and optimization techniques, which works based on the mechanisms of natural genetics and natural evaluation.

Framework of GA



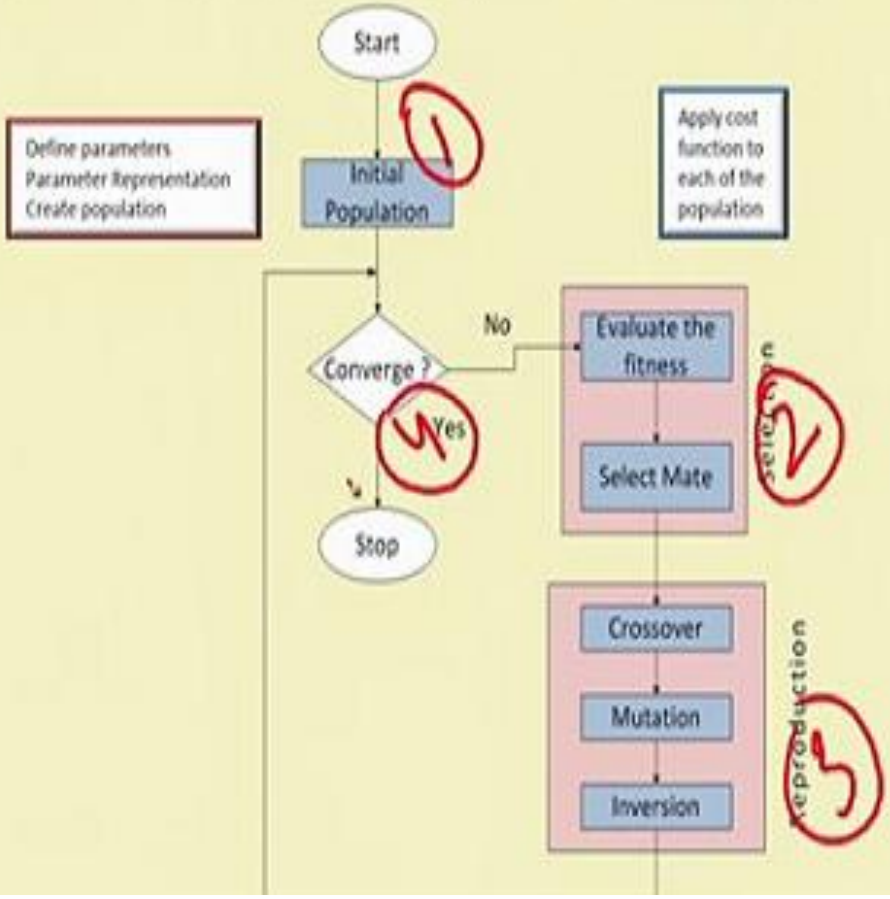
Working of Genetic Algorithm



Note:

1) GA is an iterative process.
2) It is a searching technique.
3) Working cycle with / without convergence.
4) Solution is not necessarily guaranteed. Usually, terminated with a local optima.

Framework of GA: A detail view



Optimization problem solving with GA

For the optimization problem, identify the following:

1) Objective function(s)
2) Constraint(s)
3) Input parameters
4) Fitness evaluation (it may be algorithm or mathematical formula)
5) Encoding
6) Decoding

GA Operators

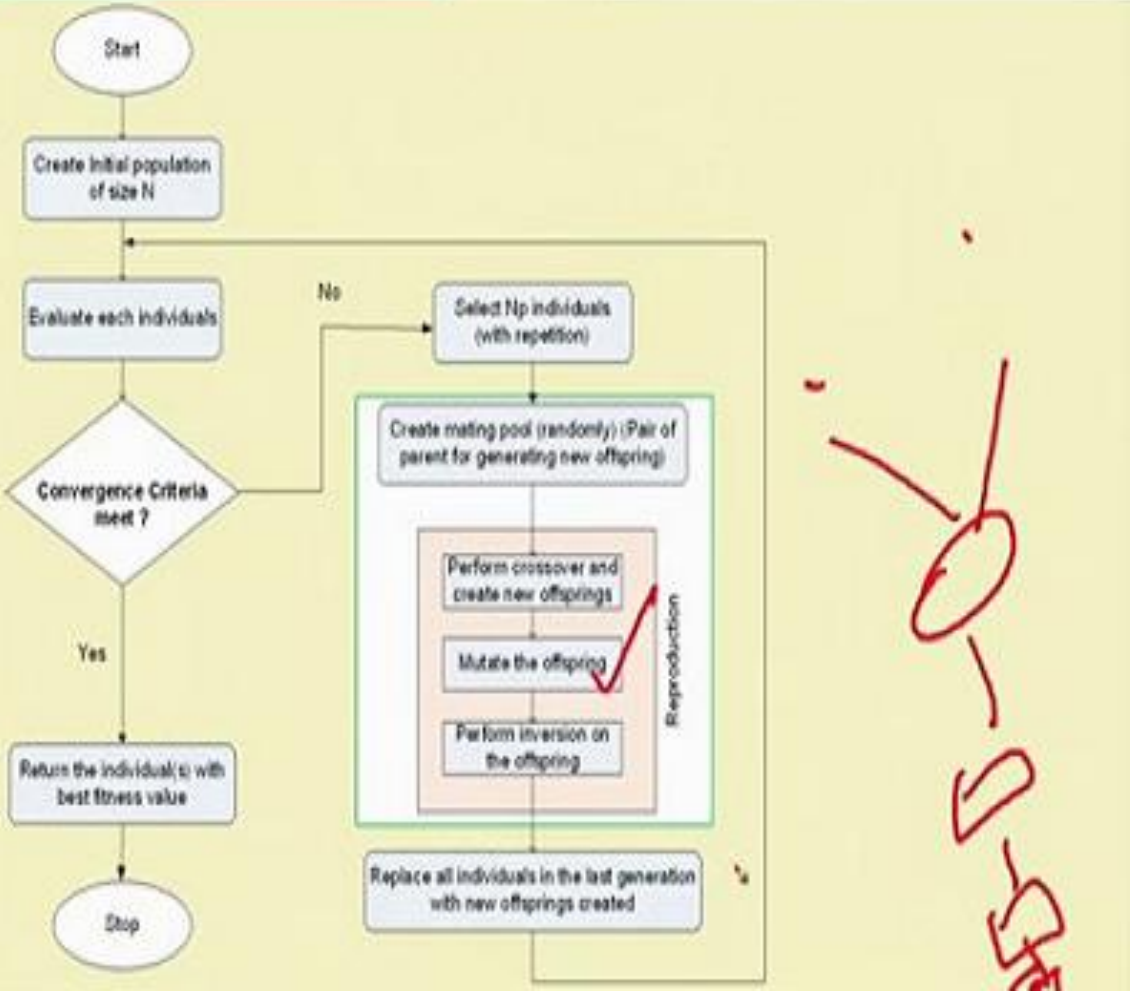
In fact, a GA implementation involved with the realization of the following operations.

1) **Encoding:** How to represent a solution to fit with GA framework.
2) **Convergence:** How to decide the termination criterion.
3) **Mating pool:** How to generate next solutions.
4) **Fitness Evaluation:** How to evaluate a solution.
5) **Crossover:** How to make the diverse set of next solutions.
6) **Mutation:** To explore other solution(s).
7) **Inversion:** To move from one optima to other.

Different GA Strategies

1) Simple Genetic Algorithm (SGA)
2) Steady State Genetic Algorithm (SSGA)
3) Messy Genetic Algorithm (MGA)

Simple GA


Start
Create initial population of size N
Evaluate each individuals
No
Select Np individuals (with repetition)
Convergence Criteria meet ?
Create mating pool (randomly) (Pair of parent for generating new offspring)
Perform crossover and create new offsprings
Mutate the offspring
Perform inversion on the offspring
Reproduction
Yes
Return the individual(s) with best fitness value
Replace all individuals in the last generation with new offsprings created
Stop

Important parameters involved in Simple GA

SGA Parameters

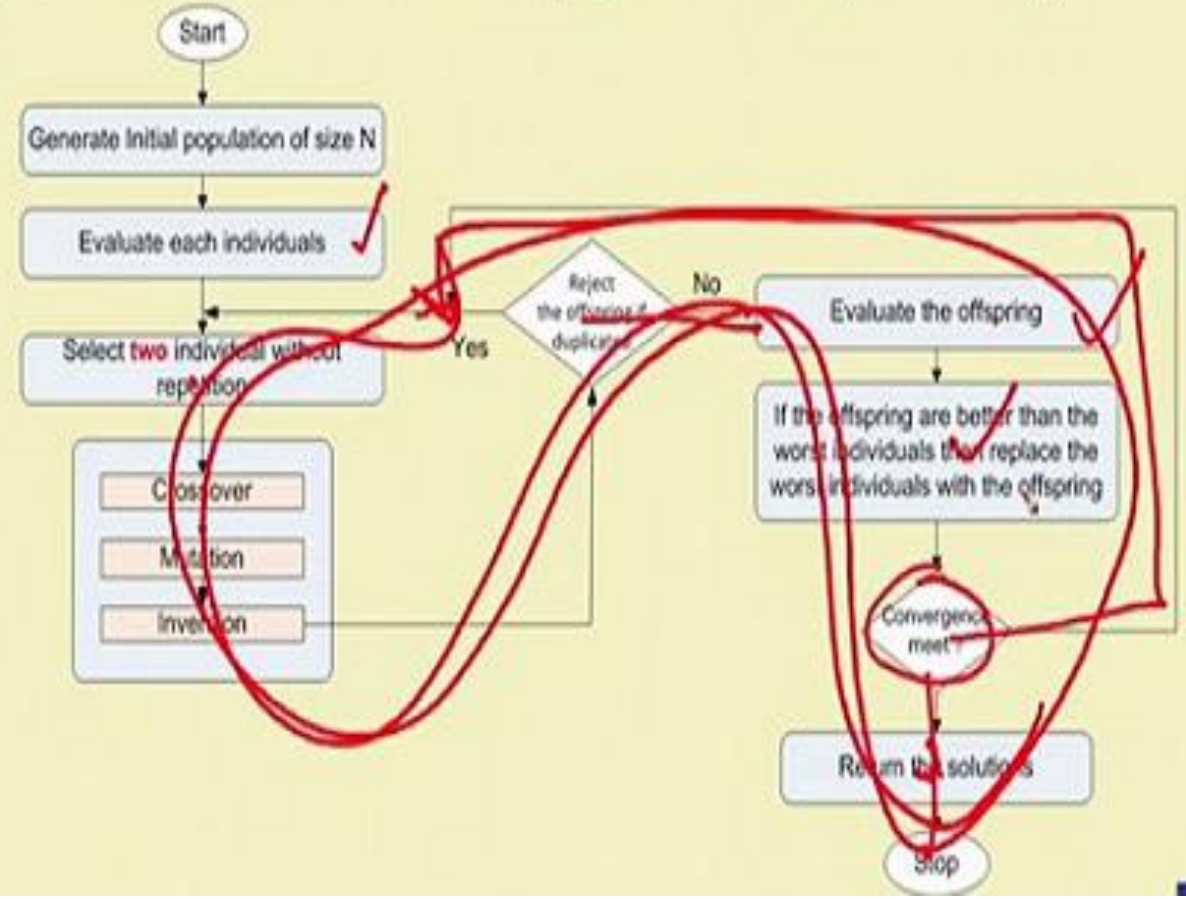
- ✓ Initial population size : N
- ✓ Size of mating pool, N_P: $N_P = P\%$ of N
- Convergence threshold δ
- Mutation μ
- Inversion η
- Crossover ρ

Salient features in SGA

Simple GA features:

- ✓ Have overlapping generation (Only fraction of individuals are replaced).
- ✓ Computationally expensive.
- ✓ Good when initial population size is large.
- ✓ In general, gives better results.
- ✓ Selection is biased toward more highly fit individuals; Hence, the average fitness (of overall population) is expected to increase in succession.
- ✓ The best individual may appear in any iteration.

Steady State Genetic Algorithm (SSGA)



Salient features in Steady-state GA

SSGA Features:

- ✓ Generation gap is small.
  Only two offspring are produced in one generation.
- ✓ It is applicable when
  - ➢ Population size is small
  - ➢ Chromosomes are of longer length
  - ➢ Evaluation operation is less computationally expensive (compare to duplicate checking)