**AI\_ASSIGNMENT(02)**

Submitted by:- Deonandini Singh , 2105118

* **How Cross Over was implemented :-**

REPRESENTATION:-

The individuals or solutions to be evolved are represented as chromosomes. These chromosomes can take different forms, depending on the problem, such as binary strings, real-valued vectors, permutations, or other data structures.

SELECTION:-

Initially, a population of individuals is created. Selection operators are used to choose individuals from this population for the crossover operation. Typically, individuals are selected based on their fitness, with fitter individuals having a higher chance of being selected.

CROSSOVER:-

Initially, a population of individuals is created. Selection operators are used to choose individuals from this population for the crossover operation. Typically, individuals are selected based on their fitness, with fitter individuals having a higher chance of being selected.

OFFSPRING:-

After crossover is applied, new individuals (offspring) are created and added to the population.

TERMINATION:-

The process of selection, crossover, and mutation (another genetic operator) is repeated for multiple generations until a termination condition is met, such as a maximum number of generations or convergence to a satisfactory solution.

The process of selection, crossover, and mutation (another genetic operator) is repeated for multiple generations until a termination condition is met, such as a maximum number of generations or convergence to a satisfactory solution.

**How mutation was implemented:-**

REPRESENTATION:-

Similar to crossover, the individuals or solutions in the population are represented as chromosomes. The specific representation depends on the problem at hand, and it can be binary strings, real-valued vectors, permutations, or other data structures.

SELECTION:-

Before mutation is applied, individuals are selected from the population using a selection process. The selection process is often based on the fitness of the individuals, with fitter individuals having a higher chance of being selected.

MUTATION OPERATOR:-

The mutation operator introduces small random changes to the selected individuals' chromosomes. The nature of the mutation depends on the representation.

MUTATION RATE:-

The mutation rate is a critical parameter that controls how often mutation is applied. It represents the probability of mutation for each gene or element in an individual. A low mutation rate means that mutations occur infrequently, while a high mutation rate results in more frequent mutations.

OFFSPRING:-

After the mutation operation is applied, new individuals (offspring) are created and added to the population.

TERMINATION:-

The process of selection, crossover, and mutation is repeated for multiple generations until a termination condition is met, such as a maximum number of generations, convergence, or reaching a satisfactory solution.

Mutation is crucial for maintaining diversity within the population and ensuring that the algorithm can explore a wide range of potential solutions. It complements the crossover operator, which combines genetic information from parents, by introducing randomness and unpredictability. The choice of mutation rate and mutation operator depends on the specific problem and should be carefully tuned to balance exploration and exploitation in the search process.

**How selection was implemented:-**

REPRESENTATION:-

Individuals in the population are represented as chromosomes, which can take various forms, depending on the problem. This representation can be binary strings, real-valued vectors, permutations, or other data structures.

EVALUATION:-

Each individual's fitness is evaluated based on the problem's objective function. The objective function quantifies how well a solution performs, and higher values typically indicate better solutions. In some cases, the objective function may need to be maximized, while in others, it may need to be minimized.

SELECTION MECHANISM:-

There are several methods for implementing the selection process:

a. **Roulette Wheel Selection (Fitness Proportionate Selection):** In this method, each individual's probability of being selected as a parent is proportional to their fitness. The more fit an individual is, the higher the chance of being selected. This approach is akin to spinning a roulette wheel, with each slot representing an individual.

b. **Tournament Selection**: In tournament selection, a random subset of individuals (a "tournament") is created, and the individual with the highest fitness within the tournament is selected as a parent. This process is repeated for a set number of tournaments to select multiple parents.

c. **Rank-Based Selection**: Individuals are ranked based on their fitness, and selection is performed by choosing individuals with higher ranks. This method reduces the influence of extreme fitness values and is more stable than roulette wheel selection.

d. **Stochastic Universal Sampling**: This is a variation of roulette wheel selection that selects multiple parents at once. It uses a single spin of the wheel and selects individuals at evenly spaced intervals around the wheel, which reduces the bias towards the fittest individuals.

e. **Boltzmann Selection**: This selection method is inspired by the Boltzmann distribution in physics. It incorporates a temperature parameter to control the selection pressure, allowing for more exploration or exploitation.

SELECTION PRESSURE:-

The selection pressure is a parameter that influences how strongly the selection mechanism favors fitter individuals. Higher selection pressure leads to a stronger bias toward fitter individuals, which can lead to faster convergence but may reduce diversity.

ELITISM:-

Some selection processes include elitism, where the best individual(s) from the current generation are directly carried over to the next generation. This ensures that the best solutions are preserved.

REPLACEMENT:-

After the selection process, the selected individuals (parents) are used to create the next generation through genetic operators like crossover and mutation. The new generation replaces the current generation.

Selection is a critical component of evolutionary algorithms, as it determines how genetic material is passed from one generation to the next. The choice of selection mechanism and parameters should be carefully tuned to balance the exploration and exploitation of the solution space, depending on the problem's characteristics and requirements.

**IMPLEMENTATION:-**







