**Note on the comparison of performance for the four methods:**

The four methods are:

1. Genetic Algorithm
2. Cultural Algorithm
3. Particle Swarm Optimization
4. Ant Colony Optimization

(1) Genetic Algorithm:

Algorithm:

1. Randomly initialize populations p
2. Determine fitness of population
3. Until convergence repeat:
   1. Select parents from population
   2. Crossover and generate new population
   3. Perform mutation on new population
   4. Calculate fitness for new population

Performance of Genetic algorithm:

The performance of this algorithm has been demonstrated efficiently and effectively which is related with some problem parameters. It provides a solution for improving the efficiency.

(2)Cultural Algorithm:

Algorithm:

1. Initialization the population and belief spaces.
2. Evaluate the fitness of each candidate solution in the population space using the fitness function. The fitness function measures the quality of each solution based on the problem's objectives.
3. Use the belief space to guide the population towards better solutions.
4. The algorithm updates the solutions in the population space using local search operators.
5. The algorithm selects the best solutions from the population space to create a new population for the next generation
6. To terminate the search process based on a stopping criterion. This criterion can be a fixed number of generations or a threshold value for the fitness function.

Overall, the Cultural Algorithm combines the population-based search strategy with the cultural evolution strategy to guide the search process towards finding better solutions. The algorithm has been applied successfully to a wide range of optimization problems, including neural network weight optimization, and it has shown promising results in terms of convergence speed and solution quality.

Performance of cultural algorithm:

The performance of the CA algorithm in neural network weight optimization can be compared to other optimization algorithms such as gradient descent, genetic algorithm, particle swarm optimization, and ant colony optimization. the performance of the CA algorithm in neural network weight optimization depends on several factors such as the size of the problem, the complexity of the neural network architecture, the fitness function, and the selection of the algorithm's parameters.

(3) Particle Swarm Optimization:

Algorithm:

1. A swarm is initialized with N number of particles. Each particle has random position and velocity constants.
2. The paths of the particles are optimized after comparing them with the best paths.
3. If the path of the particle is shorter than its local best path, then the path of particle is updated as the new local best path. Then the comparisons are made with global best path.
4. Positions and velocities of particles are updated according to equations 1 and 2.
5. The steps are followed until the minimum required path is obtained.

(4) Ant Colony Optimisation:

Algorithm:

1. An artificial ant is a simple computational agent that searches for good solutions to a given optimization problem.
2. To apply an ant colony algorithm, the optimization problem needs to be converted into the problem of finding the [shortest path](https://en.wikipedia.org/wiki/Shortest_path_problem) on a weighted graph.
3. In the first step of each iteration, each ant stochastically constructs a solution, i.e. the order in which the edges in the graph should be followed.
4. In the second step, the paths found by the different ants are compared.
5. The last step consists of updating the pheromone levels on each edge.

Comparing pso and aco:

Both the algorithms were tested on a model requirement where the blind ants /swarm particles had to go in the most effective manner. Results show that ACO attains global minima in lesser number of iterations and to a lower value when compared with PSO. Thus it can be concluded that ACO gives better performance than PSO for distance optimization problems.Whereas the ACO is more applicable for problems where source and destination are predefined and specific. At the same time PSO is a clustering algorithm in the areas of dynamic optimization and constraint handling. The ACO is more applicable for problems that requires crisp results. PSO approach leads to higher model accuracies. Furthermore, the ACO approach enables the targeting of hyper parameter optimization within a given layer type rather than optimizing at the overall architecture level.

Research papers used :

<https://thesai.org/Downloads/Volume11No6/Paper_13-Cultural_Algorithm_Initializes_Weights_of_Neural_Network.pdf>

<https://link.springer.com/chapter/10.1007/978-1-4471-0951-8_7>

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