Report

1. **formalize the problem: Modeling**
2. **Components of the Evolutionary Algorithm:**
   - **Representation (Definition of Individuals):**In this algorithm, individuals are represented as the weights of neural network models. Each individual consists of a set of weights for each layer in the neural network architecture.
   - **Evaluation Function (Fitness Function)**:The fitness of each individual (neural network) is evaluated based on its performance on the training data. Specifically, the fitness function computes the loss (categorical cross-entropy) and accuracy of each individual on the training set.
   - **Population**:The population consists of multiple individuals, where each individual represents a neural network with randomly initialized weights.
   - **Parent Selection Mechanism**:There isn't a specific parent selection mechanism defined explicitly in the code. However, the mutation process selects parent individuals randomly from the population to create mutated offspring.
   - **Variation Operators (Mutation and Recombination):**Mutation: Mutation is performed on individuals by randomly selecting three individuals from the population and applying a mutation operator to create a new individual with perturbed weights.
   - **Recombination**: Crossover is performed between the mutated individual and a target individual to produce a new individual with a combination of traits from both parents.
   - **Survivor Selection Mechanism (Replacement):**The survivor selection mechanism involves selecting the best individuals (neural networks) from the mutated and target individuals based on their performance (lower loss) on the training data. The best individual is selected to survive to the next generation.
   - **Initialization**:The population is initialized with a set number of individuals (neural networks) with randomly initialized weights.

- **Termination Condition(s):**The algorithm terminates if the best loss in a generation falls below a threshold value (0.15) and the accuracy exceeds another threshold value (0.9). This termination condition indicates that the algorithm has found a satisfactory solution.

3. **approaches to control/tune the parameters:**
    - **Population Size (ps):**The population size determines the diversity and exploration capabilities of the algorithm. A larger population size can lead to a more extensive search space exploration but might require more computational resources. Conversely, a smaller population size might converge faster but risks premature convergence to suboptimal solutions.
    - **Number of Generations (num_generation):**The number of generations determines the length of the evolutionary process. Increasing the number of generations allows for more iterations of selection, mutation, and crossover, potentially leading to better solutions. However, too many generations may result in unnecessary computational overhead if the algorithm converges quickly.
    - **Mutation Factor (F) and Crossover Probability (C**):These parameters control the balance between exploration and exploitation in the algorithm. The mutation factor (F) determines the extent of perturbation applied to the weights during mutation, influencing the diversity of the population. The crossover probability (C) determines the likelihood of traits being inherited from both parents during crossover. Tuning these parameters can help strike a balance between exploration and exploitation, leading to better convergence and solution quality.