Note for Assignment Report

In this implementation of the Genetic Algorithm (GA) for optimizing the Artificial Neural Network (ANN), I explored multiple crossover methodologies to evaluate their impact on performance. The following methods were tested:

1. **Crossover Between Parameters**:
   - In this approach, the crossover operation was performed at the **parameter level**, where each parameter (weight or threshold) was treated as a meaningful unit. The crossover point was selected between parameters, ensuring that the integrity of each parameter was preserved.
2. **Crossover for the Entire Gene (1176 Bits)**:
   - Here, the entire chromosome was treated as a single binary string of 1176 bits. The crossover operation was performed at the **bit level**, allowing for fine-grained mixing of genetic material.
3. **Crossover Between Parameters with srand(time(0))**:
   - This method was identical to Method 1 but used a dynamic random seed (**srand(time(0))**) to ensure a different sequence of random numbers for each run, introducing true randomness.
4. **Crossover for the Entire Gene (1176 Bits) with srand(time(0))**:
   - This method was identical to Method 2 but used a dynamic random seed (**srand(time(0))**) for true randomness.

Performance Results for New Test Inputs

The performance of the methods was evaluated based on the fitness of the best individual after a fixed number of generations. The results showed the following ranking in terms of performance:

1) **Crossover Between Parameters** (Method 1): Best performance (3 out of 4).

2) **Crossover for the Entire Gene (1176 Bits)** (Method 2): Slightly worse performance than Method 1. (2 out of 4)

3) **Crossover Between Parameters with srand(0)** (Method 3): Worse performance than Method 2. (1 out of 4)

4) **Crossover for the Entire Gene (1176 Bits) with srand(0)** (Method 4): Worst performance. (1 out of 4)

Justification for Using Method 1

After analyzing the results, I chose **Method 1 (Crossover Between Parameters)** for the final implementation due to the following reasons:

- **Preservation of Parameter Integrity**:
  - By performing crossover at the parameter level, the semantic meaning of each parameter (weight or threshold) was preserved. This ensured that the offspring inherited valid and meaningful parameters from their parents.
- **Better Performance**:
  - Method 1 consistently outperformed the other methods in terms of fitness, demonstrating its effectiveness in optimizing the ANN.
- **Alignment with Problem Requirements**:
  - The ANN requires weights and thresholds to remain valid and meaningful for proper functioning. Method 1 aligns with this requirement by treating parameters as indivisible units.

Deviation from Method 2

While Method 2 (Crossover for the Entire Gene) was taught as the standard GA methodology, I opted for Method 1 because:

- Method 1 better suits the specific requirements of the ANN optimization problem, where preserving the integrity of weights and thresholds is critical.
- The results clearly demonstrated that Method 1 achieved better performance, making it a more suitable choice for this application.

By providing this justification, I aim to highlight the rationale behind my choice and demonstrate that the decision was based on empirical evidence and alignment with the problem's requirements.

"These tests were conducted after the submission deadline of my assignment report. Therefore, the details of this crossover method, where the Genetic Algorithm performs crossover at the parameter level to preserve the integrity of weights and thresholds, are not included in the report."

"Additionally, the use of ***srand(time(0))*** *for dynamic randomness was implemented to ensure diversity in the population, but its impact on performance was also evaluated after the report submission."*