

Hyperparameter Optimization for Neural Networks:

Genetic Algorithms Approach.

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Introduction

Hyperparameter optimization is a crucial step in training neural networks, as it helps improve model performance. Common methods for hyperparameter tuning include grid search, random search, and Bayesian optimization. In this research, we will explore the use of Genetic Algorithms (GA) for optimizing hyperparameters such as batch size, learning rate, and the number of epochs.

Problem Statement

You are provided with a simple codebase to start with. Your task is to implement the necessary functions and improve the existing GA framework to optimize the hyperparameters of a neural network, specifically focusing on batch size, learning rate, and epochs. The aim is to enhance the performance by experimenting with different GA components and tuning the hyperparameters effectively.

Objective

- Implement a Genetic Algorithm for hyperparameter optimization.
- Focus on optimizing batch size, learning rate, and epochs.
- Experiment with GA components to improve performance.
- Document each step of the process and analyze the results.

Tasks for You

The tasks are designed to guide you through the implementation and enhancement of the GA:

1. Implement and enhance the GA functions to optimize hyperparameters.
2. Experiment with different strategies that may improve the GA's performance.
3. Document the steps you take to improve performance, along with the impact and results of each change.
4. Compare the GA approach with other hyperparameter optimization techniques like grid search and random search. Discuss when the GA is more suitable and when other methods should be preferred.

Rules and Restrictions

- You must primarily use the provided codebase for your implementations.
- External libraries are allowed for auxiliary tasks, but the core GA logic must be implemented manually.
- The use of Large Language Models (LLMs) for direct solutions is prohibited.
- Deliverables must reflect original work and align with the provided guidelines.

Deliverables

You must submit the following:

1. A detailed scientific report in LaTeX, including:
 - A description of each step you took to enhance performance.
 - The impact and results of each modification.
2. The enhanced GA implementation as a Jupyter Notebook.

Evaluation Criteria

Submissions will be assessed based on:

- **Correctness:** The accuracy of the optimized hyperparameters.
- **Clarity:** The organization and presentation of the LaTeX report.
- **Efficiency:** The scalability and runtime performance of the algorithm.
- **Innovation:** Novel strategies or insights introduced in the GA implementation.

Conclusion

This challenge allows you to gain hands-on experience with Genetic Algorithms in hyperparameter optimization. By exploring different strategies and analyzing their impact, you will develop a deeper understanding of optimization techniques and their practical applications. Good luck!