Adaptive Learning Rate Scheduling for Improved Neural Network Training Efficiency

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Abstract

This paper presents a novel adaptive learning rate scheduling algorithm that dynamically adjusts learning rates based on loss landscape curvature analysis. Our approach demonstrates significant improvements in training convergence speed while maintaining solution quality across multiple neural network architectures.

1 Introduction

Neural network training efficiency remains a critical bottleneck in deep learning applications. Traditional fixed learning rate schedules often lead to suboptimal convergence patterns, requiring extensive hyperparameter tuning.

2 Methodology

We propose an adaptive learning rate scheduler that monitors second-order gradient information to estimate local curvature and adjust learning rates accordingly.

$$\alpha_t = \alpha_0 \cdot \exp(-\beta \cdot \mathrm{curvature}_t) \tag{1}$$

3 Results

Experimental validation on standard benchmarks shows 20-30% reduction in training time with comparable final accuracy.

4 Conclusion

The proposed adaptive learning rate scheduling provides a mathematically principled approach to improving neural network training efficiency.