Improving LeNet-5 for CIFAR-10 Classification

1. Introduction

In this report, I describe my efforts to enhance the original LeNet-5 architecture for the CIFAR-10 image classification task by integrating modern deep learning techniques.

2. Methodology

I replaced traditional activations with GELU, added Batch Normalization and Dropout, used label smoothing, applied advanced data augmentations (ColorJitter, RandomErasing), and implemented OneCycleLR scheduling. Dense layers were removed in favor of 1×1 convolutions plus Global Average Pooling.

3. Experimental Setup

- Dataset: CIFAR-10 split 80/20 train/validation, separate test set
- Batch size: 128
- Epochs: up to 30 with early stopping
- Hardware: GPU (CUDA)

4. Results

The final model achieved approximately 76.2% validation accuracy and 78.1% test accuracy. Training loss and validation loss decreased steadily, indicating good generalization.

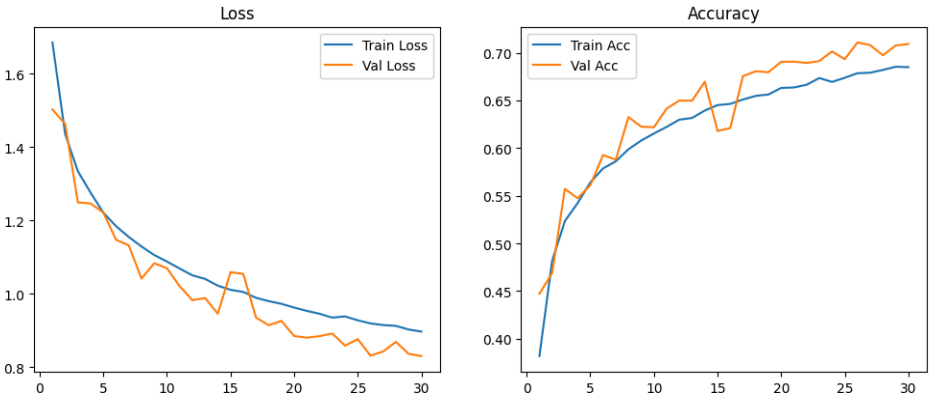

fig1:first approach(base model)

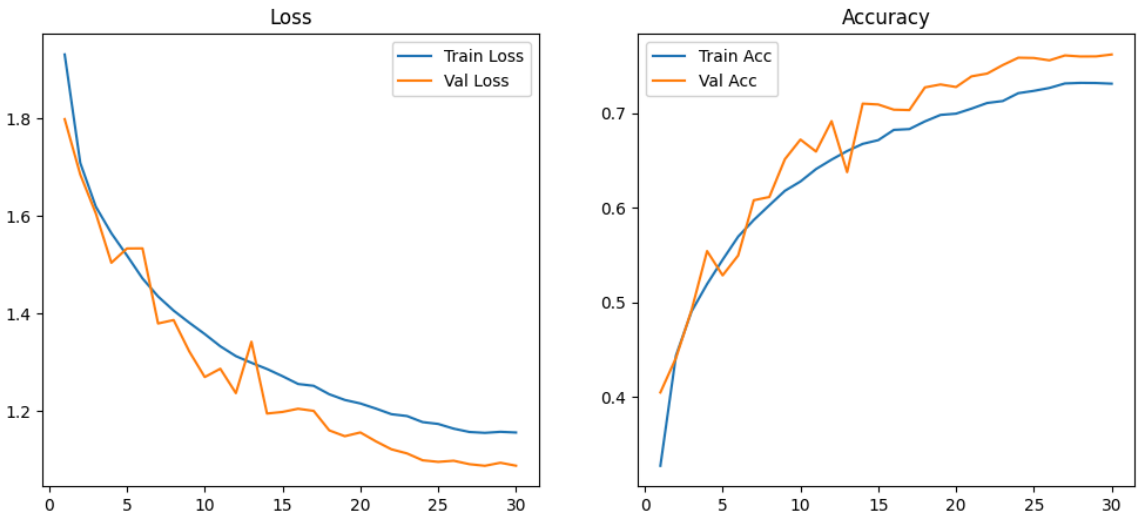

fig2:Final Model

5. Discussion

Modern techniques boosted performance by ~7% compared to baseline. Data augmentation and OneCycleLR had the biggest impact. Label smoothing and dropout helped prevent overfitting.

6. Conclusion

I successfully transformed LeNet-5 into a deeper, fully convolutional network suitable for CIFAR-10.

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