Exploring Dropout: A Powerful Strategy for Overfitting Prevention in Neural Networks

Ece Akdeniz 2004229
Ata Deniz Arslaner 2004040

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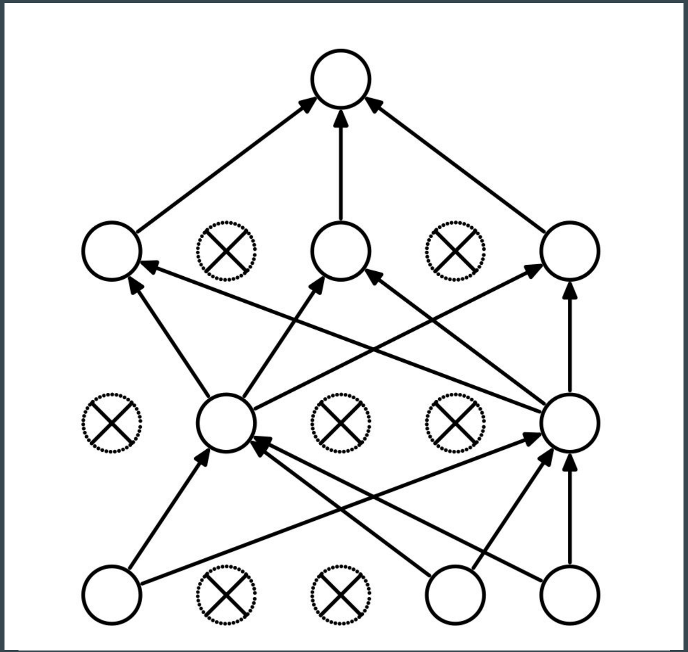
Introduction

- **Overfitting** in neural networks occurs when the model becomes **too complex** and **tightly fits** the training data, resulting in **poor generalization** to unseen data.
- The paper titled "Dropout: A Simple Way to Prevent Neural Networks from Overfitting" proposes a technique called **dropout** that addresses the problem of overfitting by randomly deactivating neurons during training.
- This project aims to:
  - **reproduce** the results of the paper on the CIFAR-10 dataset by implementing dropout
  - **compare** it with other benchmark regularization methods.



Before and After Dropout

Related Works

- **Batch normalization** normalizes the activations of intermediate layers within a mini-batch during training, reducing internal covariate shift and stabilizing the network.
- **Data augmentation** artificially increases the size of the training set by applying various transformations to introduce diversity and reduce overfitting.

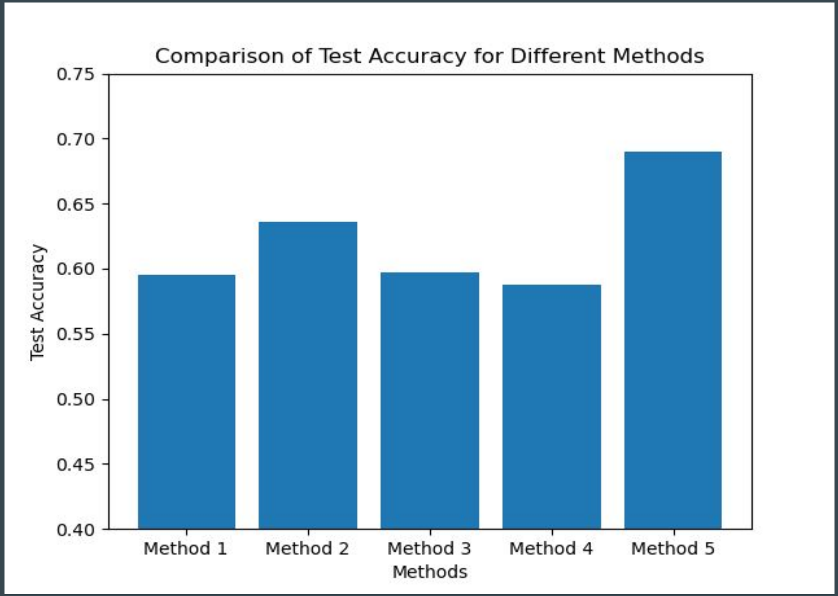
- However, these methods have limitations, such as increased computational overhead and task-dependence.

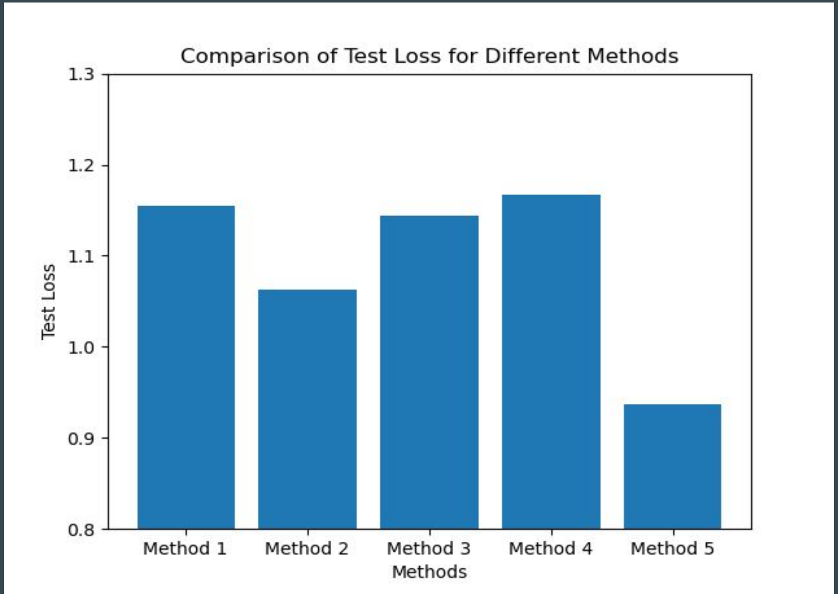
Material and Methods

- The model architecture used in the project follow the description in the paper.
- The CIFAR-10 dataset, which comprises 50,000 32x32 color images categorized into 10 classes, is used for training and testing.
- Stochastic gradient descent with backpropagation is used for training, and the evaluation metric used is likely accuracy.

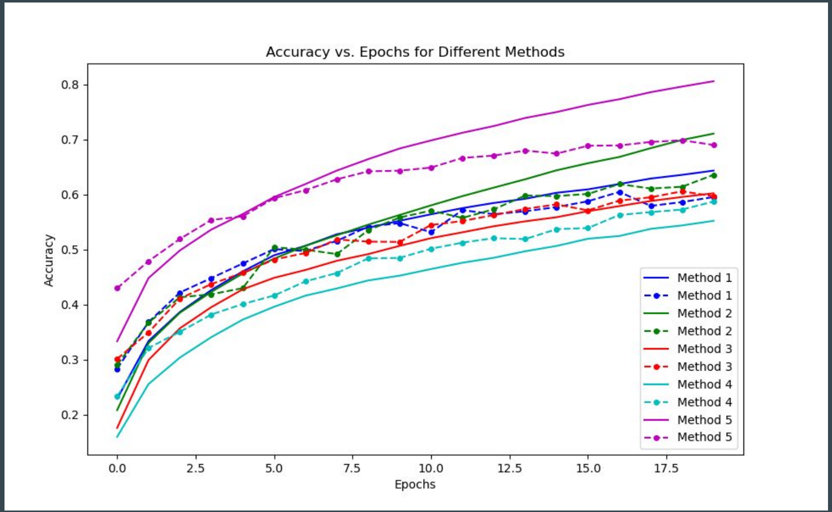
Method 1	CNN + Max Pooling
Method 2	CNN + Max Pooling
Method 3	CNN + Max Pooling + Dropout in Dense Layers
Method 4	CNN + Max Pooling + Dropout in All Layers
Method 5	CNN + Max Pooling + Maxout

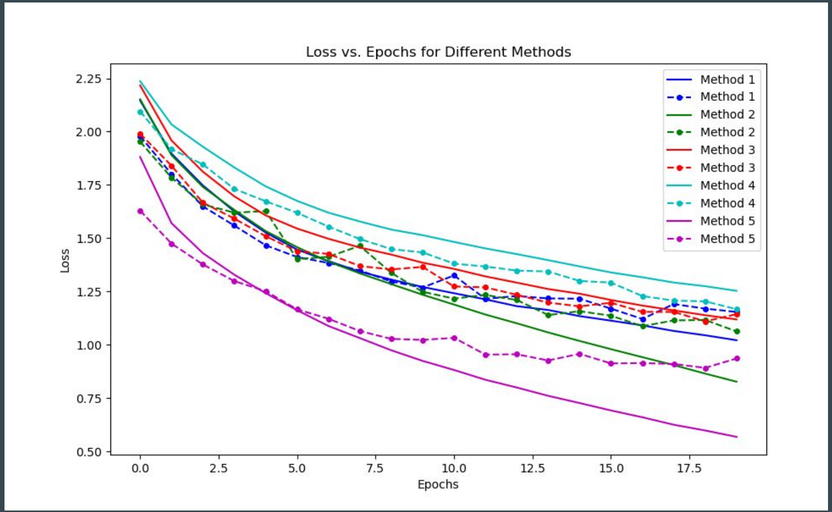
Results - Comparison of 5 Methods





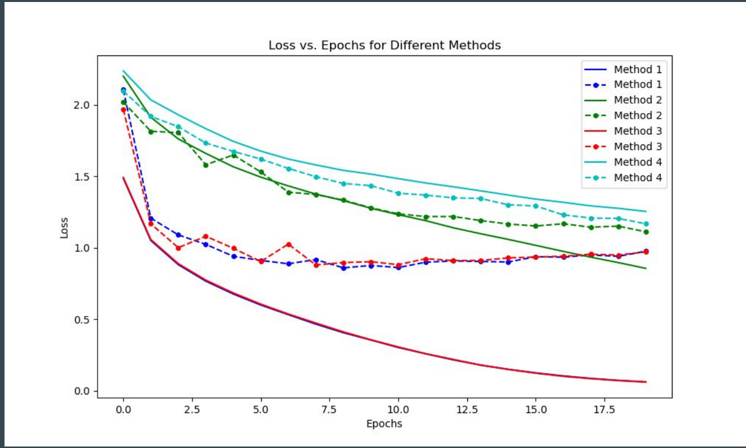
Results - Train vs. Validation Scores of Each Model

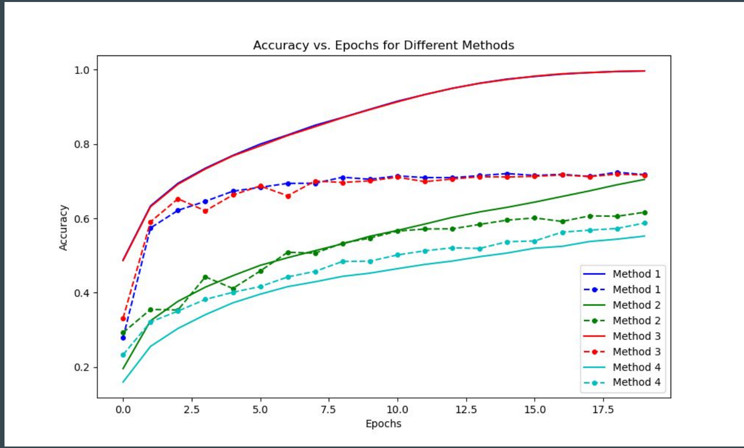




Results - Comparison of Other Regularization Methods

Method 1	Batch Normalization
Method 2	Data Augmentation
Method 3	Batch Normalization + Data Augmentation
Method 4	Dropout





Discussions

- The impact of dropout on neural network performance is analyzed.
- Dropout provides regularization without significantly increasing training time, striking a balance between regularization and efficiency.
- Dropout fosters diverse feature learning, improving the network's ability to handle unseen data.
- The limitations of dropout, such as increased randomness and reduced training capacity, are discussed.

Conclusion

- The project demonstrates the effectiveness of dropout in preventing overfitting in neural networks.
- Dropout consistently improves performance, reduces overfitting, and enhances generalization.
- Dropout strikes a balance between regularization and efficiency, providing practical and efficient regularization without significant training time overhead.
- Future research can explore extending dropout to other models or improving training time efficiency to further enhance neural network performance.

References

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Thank You!