Assignment 02 – Convolution

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Convolutional Neural Networks (CNN) Performance Analysis

1. Objective

The purpose of this report is to analyze the relationship between training sample size and the performance of convolutional neural networks (CNNs).

- A CNN trained from scratch
- A pretrained VGG16 model

2. Methodology

2.1. Dataset

- **Cats & Dogs** dataset
- Initial Training Set: 1000 images
- Validation Set: 500 images
- Test Set: 500 images
- Expanded Training Set: 2000 images (for further analysis)

2.2 Model Architectures

2.2.1. CNN from Scratch

- Four convolutional layers (32, 64, 128, 128 filters)
- Max pooling layers
- Fully connected layer (512 units)
- Activation: ReLU for hidden layers, Sigmoid for output
- Optimizer: Adam

2.2.2. Pretrained VGG16 Model:

- VGG16 base (frozen layers)
- Additional dense layer (256 units)
- Dropout (0.5) for regularization
- Activation: ReLU for hidden layers, Sigmoid for output
- Optimizer: Adam (learning rate = 0.0001)

2.3. Performance Metrics

- Accuracy on test data
- Loss during training and validation

3. Results

3.1. Initial Performance with 1000 Training Samples

Model	Test Accuracy	Training Epochs
CNN from Scratch	63.10%	20
Pretrained VGG16	84.50%	10

- CNN from Scratch - Slower convergence, prone to overfitting despite data augmentation.
- Pretrained VGG16 - Faster convergence with better generalization due to transfer learning.

3.2. Performance with Increased Training Sample (2000 Samples)

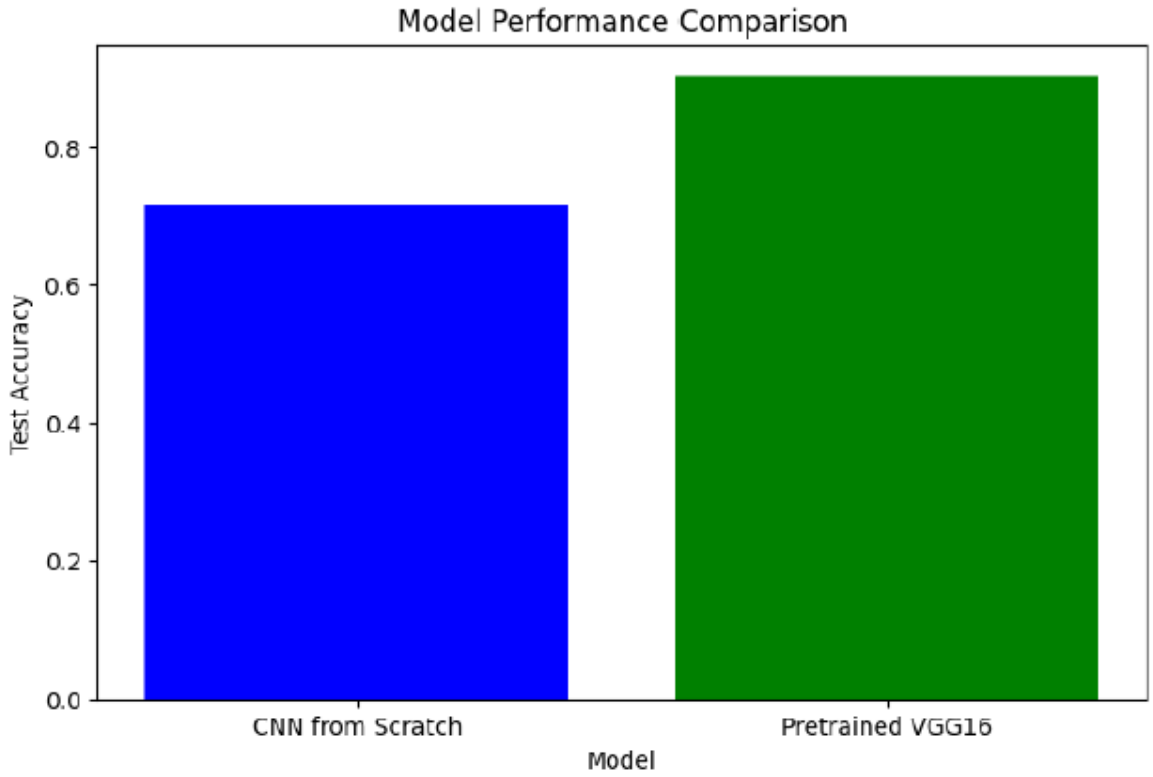
Model	Test Accuracy	Training Epochs
CNN from Scratch	71.60%	20
Pretrained VGG16	90.00%	10

- Increasing sample size improved accuracy for both models.
- The pretrained model still significantly outperformed the custom CNN.

3.3. Comparison of Techniques Across Sample Sizes

Sample Size	CNN from Scratch Accuracy	Pretrained VGG16 Accuracy
1000	63.10%	84.50%
2000	71.60%	90.00%

4. Graphical Representation



5. Conclusion

1. Pretrained models like VGG16 outperform custom CNNs when training data is limited due to transfer learning benefits.
2. Training from scratch requires more epochs and larger datasets to achieve comparable accuracy but still lags behind pretrained models.
3. Optimal approach: For small-to-medium datasets, using a pretrained network yields faster convergence and higher accuracy.