CNN Models Documentation

Farm Insects Classification Project

Model 1: LeNet-5 (From Scratch)

1. Data Preparation

- Resized all images to 32x32 pixels
- Converted images to grayscale (1 channel)
- Split data into training, validation, and test sets
- Batch size: 32

2. Model Architecture

- Feature extraction: 2 convolutional layers + 2 average pooling layers
- Classification: 3 fully connected layers
- Activation function: Tanh
- Total trainable parameters: ~61,706

3. Training Configuration

- Number of epochs: 10
- Learning rate: 0.0001
- Optimizer: Adam
- Loss function: Cross-Entropy Loss

4. Training Process

- Trained on training set
- Validated on validation set after each epoch
- Tracked loss and accuracy for both

5. Evaluation

- Tested on test set
- Calculated accuracy, precision, recall, and F1-score

Final Test Set Metrics:

- Accuracy: 0.1203
- Precision: 0.0874
- Recall: 0.1203
- F1-score: 0.0909

Model 2: AlexNet

1. Data Preparation

- Resized images to 224x224 pixels
- Kept RGB color (3 channels)
- Applied ImageNet normalization
- Batch size: 32

2. Model Architecture

- 5 convolutional layers with ReLU activation
- 3 max pooling layers
- 3 fully connected layers with dropout
- Started with random weights

3. Training Configuration

- Number of epochs: 10
- Learning rate: 0.0001
- Optimizer: Adam
- Loss function: Cross-Entropy Loss

4. Training Process

- Trained and validated each epoch
- Saved best model based on validation accuracy
- Loaded best model for testing

Final Test Set Metrics:

- Training Loss: 2.2228
- Training Accuracy: 0.2626
- Validation Loss: 2.3738
- Validation Accuracy: 21.74
- Final Test Accuracy: 0.2310

Model 3: VGG16 (From Scratch)

1. Data Preparation

- Resized images to 224x224 pixels
- Applied data augmentation for training:
    - Random horizontal flips
    - Random rotations (10 degrees)
- Used ImageNet normalization
- Batch size: 32

2. Model Architecture

- 13 convolutional layers (all 3x3 kernels)
- 5 max pooling layers
- 3 fully connected layers with dropout (0.5)
- ReLU activation throughout
- Started with random weights

3. Training Configuration

- Number of epochs: 5
- Learning rate: 0.00001 (1e-5)
- Optimizer: Adam
- Loss function: Cross-Entropy Loss

4. Training Process

- Trained on training set
- Monitored training loss per epoch
- Evaluated on test set after training

Final Test Set Metrics:

- Accuracy: 0.0751
- Precision: 0.0056
- Recall: 0.0751
- F1-score: 0.0105

Summary

Three CNN architectures were implemented and trained from scratch on a farm insects classification dataset:

1. **LeNet-5:** Simple architecture with ~61K parameters, trained for 10 epochs
2. **AlexNet:** Deeper model with more parameters, trained for 10 epochs
3. **VGG16:** Very deep model with 16 layers, trained for 5 epochs with lower learning rate