Documentation

Ashish Kumar - 23B1028, V Satwik - 23B0998

May 3, 2025

1 Introduction

This program implements a hand image classification system using Convolutional Neural Networks (CNNs). The system processes hand images from a dataset directory and classifies them into 8 distinct categories based on gender, hand orientation, and view type:

- Female-dorsal-right
- Female-dorsal-left
- Female-palmar-left
- Female-palmar-right
- Male-dorsal-right
- Male-dorsal-left
- Male-palmar-left
- Male-palmar-right

2 System Architecture

The system comprises four core components:

- `main.py`: Main execution script
- `dataset.py`: Data loading and preprocessing module
- `mynet.py`: Custom CNN implementation
- `resnet18.py`: Fine-tuned ResNet-18 implementation

3 Class Specifications

3.1 HandDataset Class

This class is used for data loading. It handles:

- Image loading from dataset directory
- Class label assignment from CSV metadata
- Image preprocessing operations:
  - Resizing conversion
  - Normalization

3.2 MyNet Class

This class contains CNN classifier modeled from scratch. Key components:

- Custom network layers architecture
- Forward propagation implementation
- Activation functions
- Dropout layers for regularization

3.3 ResNet18 Class

This class contains fine-tuned ResNet-18 network. Features:

- Pretrained ResNet-18 base model
- Custom final classification layer
- Gradient requirement configuration
- Softmax activation for NLL loss compatibility

4 Core Functions

4.1 train_model

Central training function handling:

- Optimizer (Adam) and scheduler configuration
- Epoch looping
- Training/validation phases
- Accuracy/loss calculations
- Final testing and evaluation

4.2 build_train_valid_test_subsets

Dataset partitioning function:

- Creates dataset subsets
- Implements random shuffling
- Handles data splits (train/validation/test)

4.3 data_loader

Batch processing function:

- Implements SubsetRandomSampler
- Configures batch size
- Manages multiprocessing (6 workers)

5 Global Configuration Parameters

Variable	Default	Description
RESNET	0	Model selection flag (0=MyNet, 1=ResNet18)
CSV_NAME	'HandInfo.csv'	Metadata file name
DATASET_NAME	'Hands'	Image directory name
VALIDATION	0.2	Validation set ratio
TEST	0.2	Test set ratio
SHUFFLE	True	Dataset shuffling flag
BATCH_SIZE	8	Training batch size
RANDOM_SEED	42	Reproducibility seed
EPOCH	11	Training epochs (+1)
LR	0.001	Learning rate
DEVICE	CUDA/CPU	Hardware acceleration selector

6 Execution and Outputs

- **Run Command:**

```
python3 main.py
```

- **Outputs:**
  - Loss/accuracy plots (training & validation)
  - Confusion matrix visualization
  - Real-time console metrics:
    - Epoch progress
    - Batch loss
    - Accuracy metrics

7 Conclusion

This system provides a flexible framework for hand image classification, supporting both custom CNN architectures and fine-tuned ResNet models. The modular design allows easy configuration through global parameters and produces comprehensive training diagnostics through visualizations and console outputs.