Handwritten Character Recognition on EMNIST with CNN

Objective

The goal of this project is to build, train, and improve a Convolutional Neural Network (CNN) for handwritten character recognition using the **EMNIST dataset**. You will also use **Weights & Biases (wandb)** to log experiments and perform hyperparameter tuning in order to optimize your model's performance.

Tasks

1. Data Preparation

- Download and load the EMNIST dataset.
- Preprocess the data: normalization, reshaping, and creating train/validation/test splits.
- Visualize some sample images to understand the dataset.

2. Baseline CNN Model

- Build a simple CNN architecture (a few convolution + pooling layers, followed by fully connected layers).
- Train the model with default hyperparameters.
- Evaluate the baseline accuracy on the test set.

3. Integrating wandb

- Set up **wandb** to log metrics such as training/validation loss and accuracy.
- Track different experiments with different settings.

4. Hyperparameter Tuning

Use **wandb sweeps** to systematically tune the following hyperparameters:

- Learning rate
- Optimizer (SGD, Adam)
- Batch size (8, 16, 32, 64, 128)
- Number of convolution filters
- Dropout rate
- Kernel size / number of layers

5. Reporting Results

- Compare the baseline model with the tuned model.
- Show accuracy, loss curves, and a **confusion matrix** for the final model.
- Write a short analysis of which hyperparameters had the biggest impact on performance.