EEG Classification Project Report

Project Overview

This project focuses on classifying EEG signals using two distinct approaches:

- **Logistic Regression** with log-variance features
- **EEGNet**, a compact deep learning architecture tailored for EEG data

The goal is to evaluate and compare their performance across multiple cross-validation folds.

Dataset & Preprocessing

- **Input shape**: EEG epochs of shape (N, C, T)
    - N: number of samples
    - C: number of channels
    - T: number of time points
- **Preprocessing**:
    - Band-pass filtering
    - Epoch extraction
    - Feature extraction (log-variance for Logistic Regression)

⚙️ **Models**

1. Logistic Regression

- Features: Log-variance across channels
- Optimizer: Momentum-based gradient descent
- Regularization: L2 penalty
- Hyperparameters:
    - Epochs: 1000
    - Learning rate: 0.01
    - Batch size: 8

    - L2: 1e-5

2. EEGNet

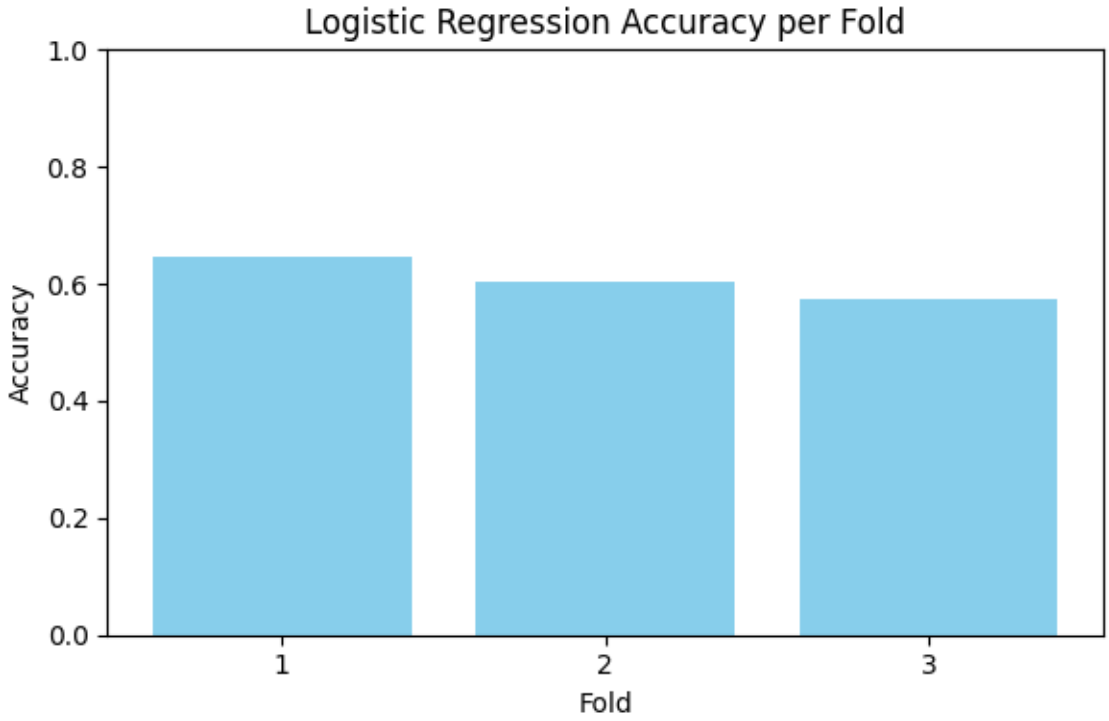
- Architecture: Depthwise and separable convolutions
- Input: Raw EEG epochs
- Optimizer: Adam
- Loss: CrossEntropy with label smoothing
- Hyperparameters:
    - Epochs: 100
    - Learning rate: 5e-4
    - Batch size: 32
    - Dropout: 0.0
    - Early stopping: Patience = 20

Results

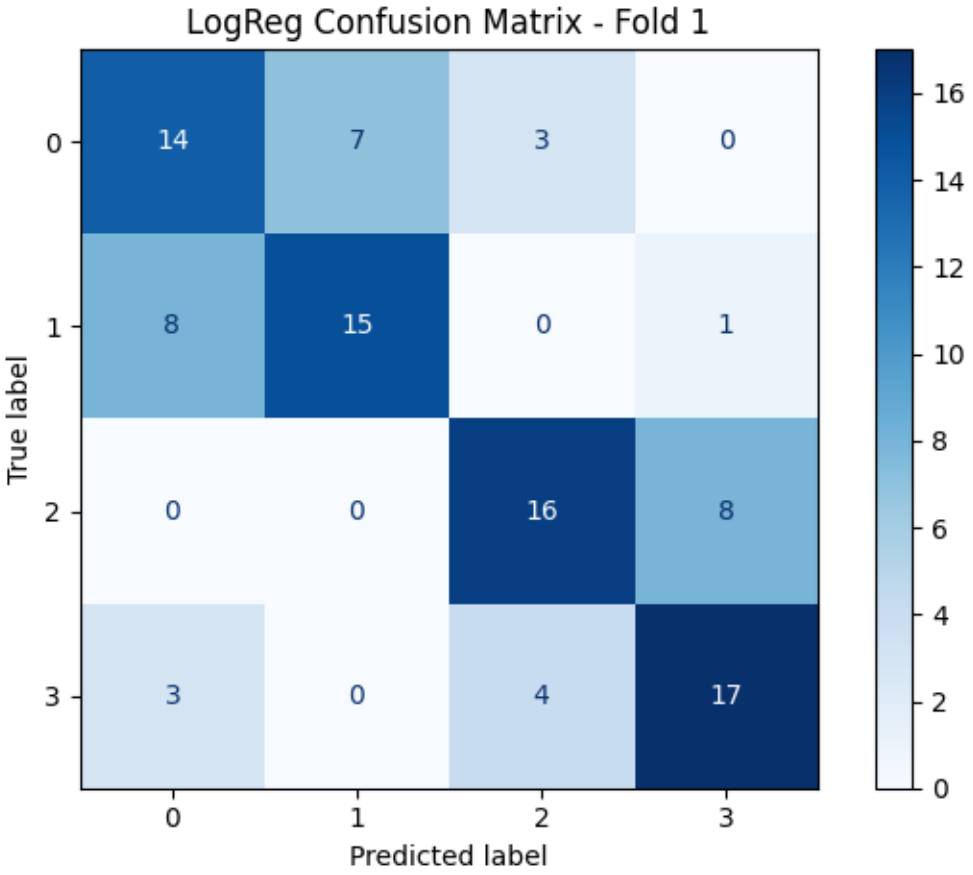
Logistic Regression

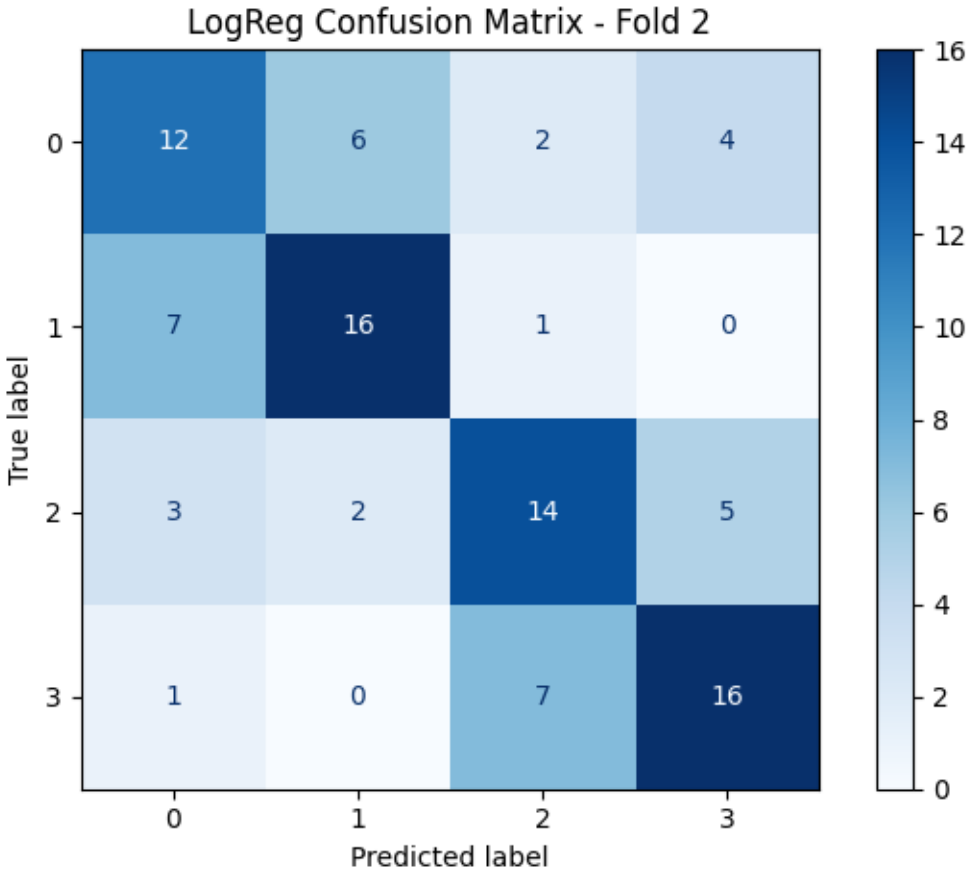
- **Mean Accuracy**: 0.6076 ± 0.0299

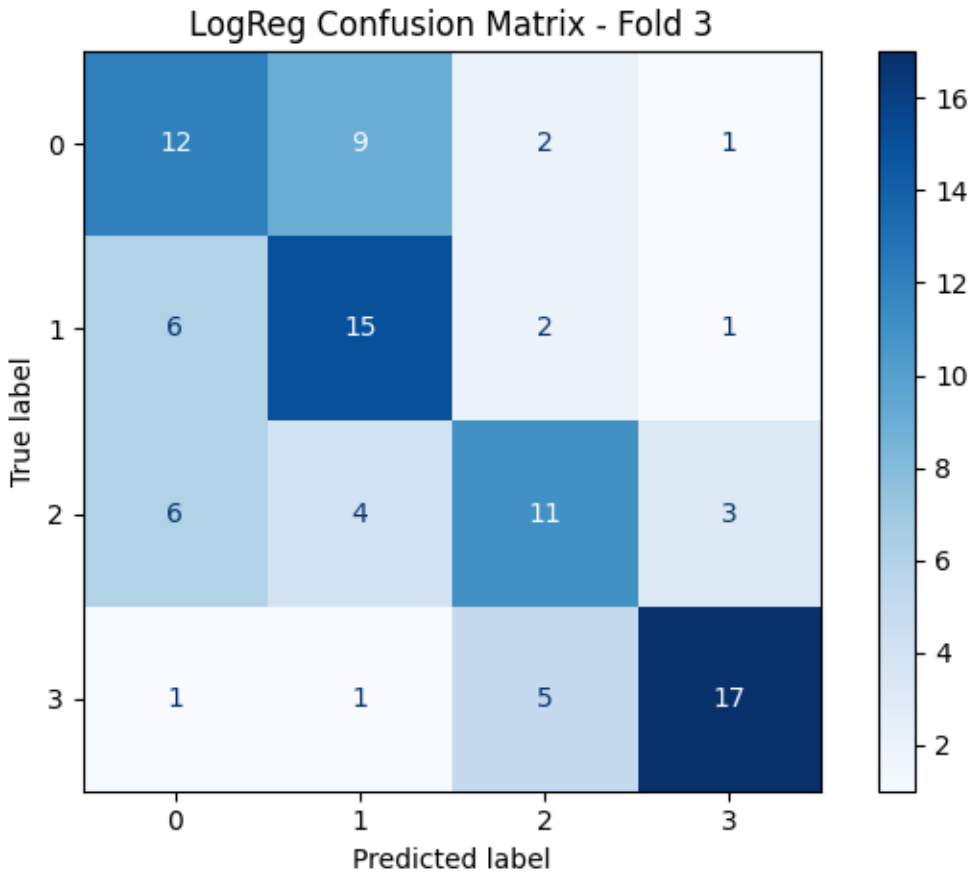
- **Accuracy per Fold**:



- **Confusion Matrices**:



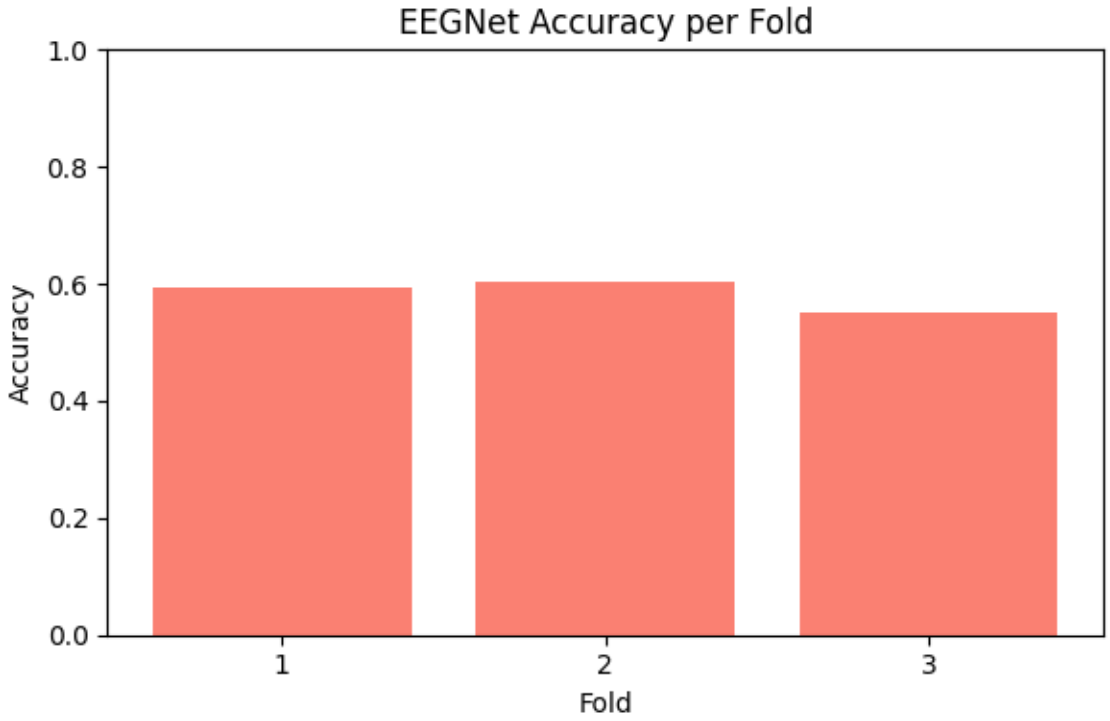

LogReg Confusion Matrix - Fold 2
True label
Predicted label
0
1
2
3
12
6
2
4
7
16
1
0
3
2
14
5
1
0
7
16
16
14
12
10
8
6
4
2
0



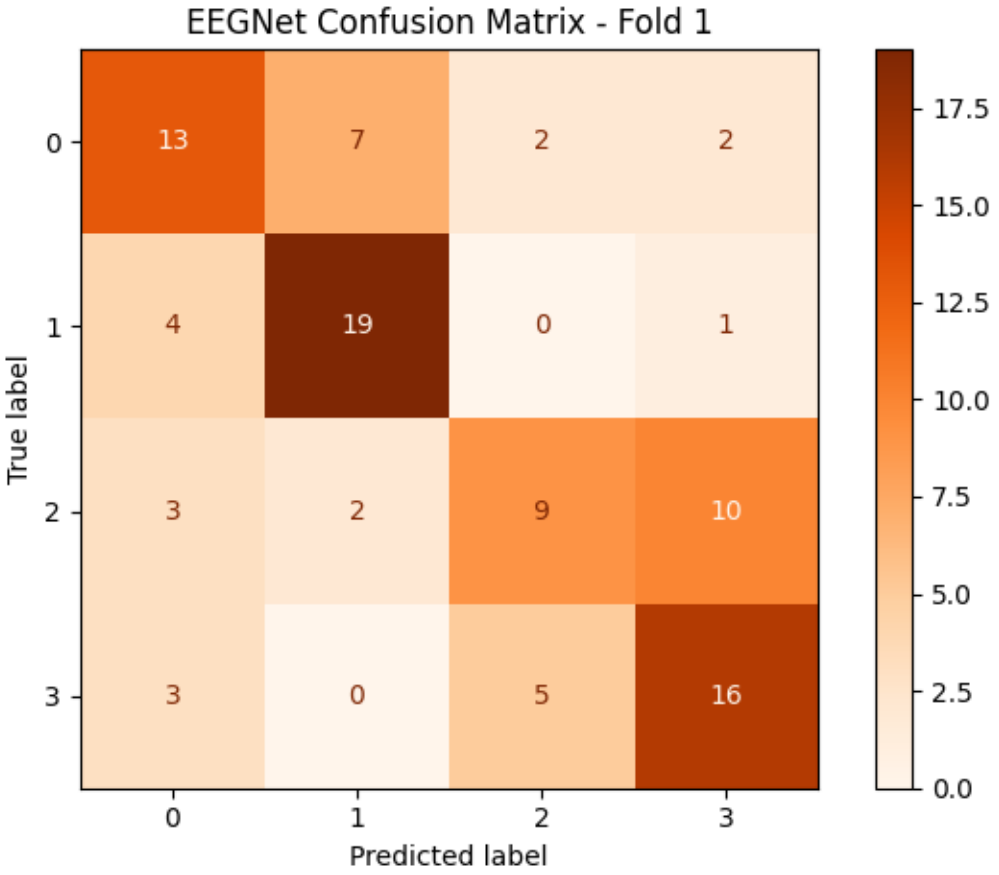
EEGNet

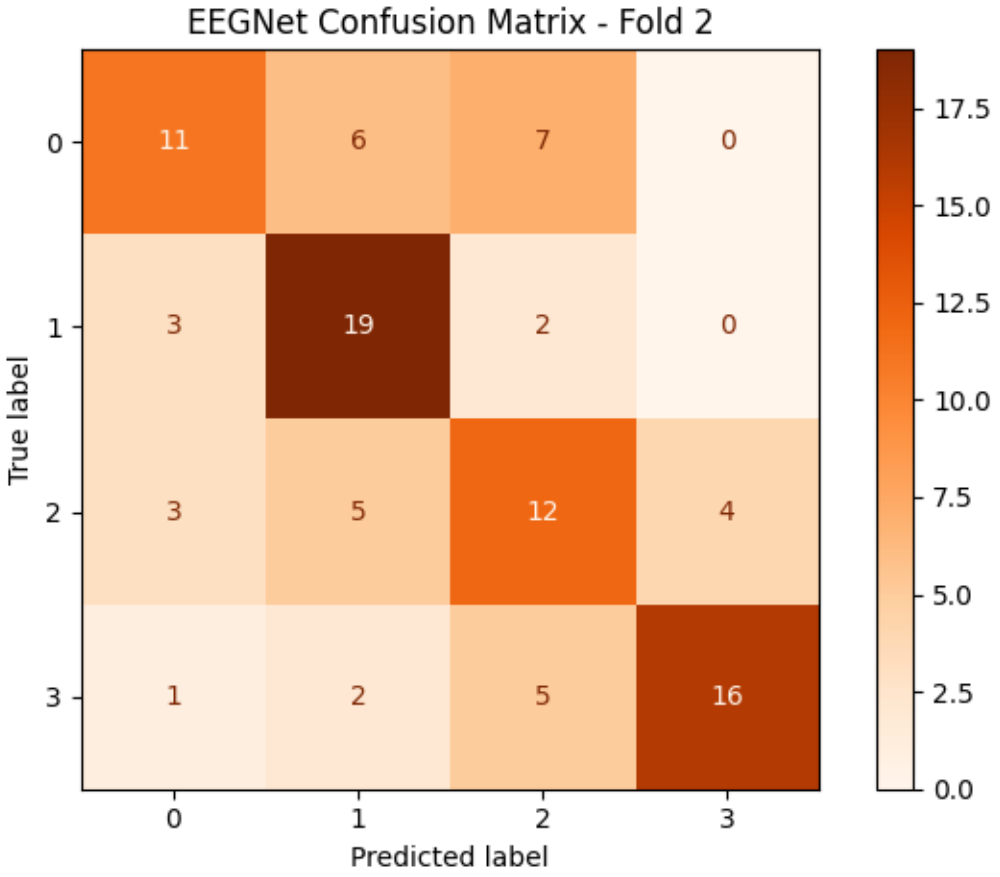
- **Mean Accuracy**: 0.5833 ± 0.0225

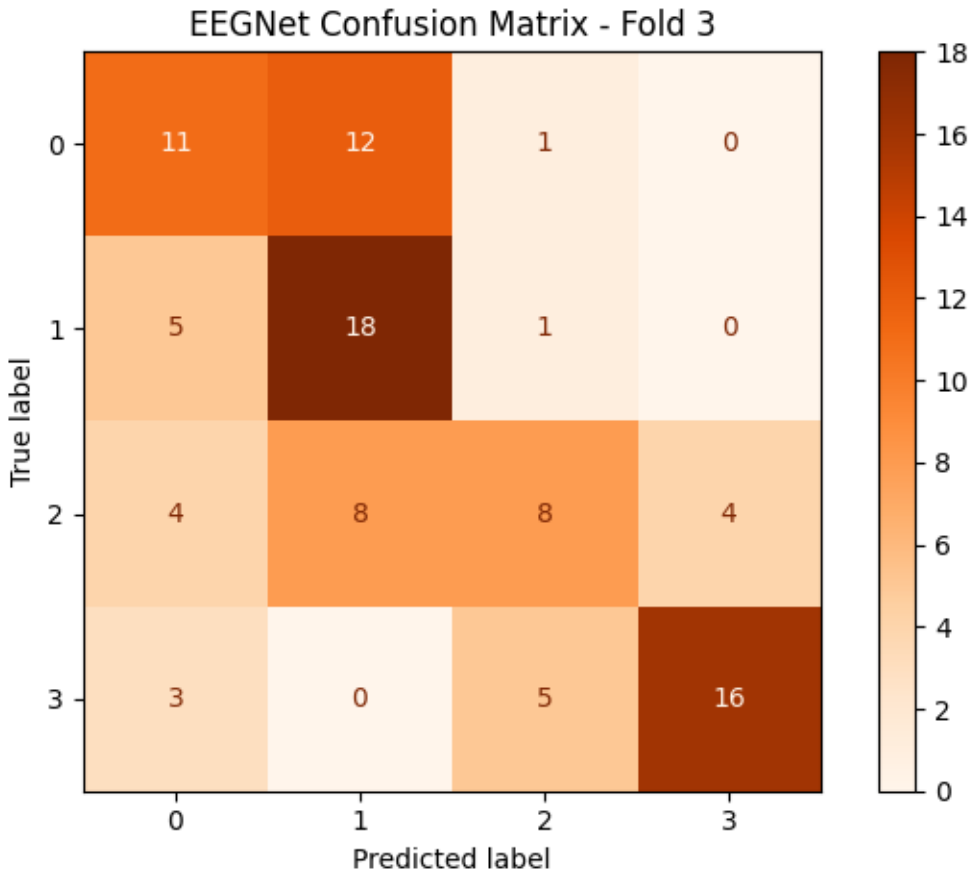
- **Accuracy per Fold**:



- **Confusion Matrices**:




EEGNet Confusion Matrix - Fold 2
True label
Predicted label
0
1
2
3
11
6
7
0
3
19
2
0
3
5
12
4
1
2
5
16
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0



Comparison & Insights

Model	Mean Accuracy	Training Time
Logistic Regression	0.6076 ± 0.0299	Fast
EEGNet	0.5833 ± 0.0225	Longer

- Logistic Regression is lightweight and interpretable.
- EEGNet captures temporal and spatial patterns more effectively.
