NeuroSentiment3: A Tri-Modal Deep Learning Framework Integrating EEG, MRI, and Text for Emotion and Cognitive State Recognition

1. Objective

This project aims to build a deep learning model that integrates EEG, MRI, and Text to classify emotions or cognitive states. It combines real-time brain signals (EEG), structural neuroimaging (MRI), and language input (Text) to develop a multimodal, interpretable sentiment/emotion classifier.

2. Dataset Selection

- LEMON Dataset (EEG + MRI): https://fcon_1000.projects.nitrc.org/indi/retro/MPI_LEMON.html
- OpenNeuro: https://openneuro.org (search EEG+T1w)
- IMDB or synthetic/generated text stimuli for sentiment alignment

3. Literature Review

- EEGNet: Lightweight EEG CNN encoder
- MedicalNet: Pretrained 3D CNNs for MRI
- Multimodal Transformers: Cross-attention across modalities
- LEMON Dataset: Shows EEG-MRI-psychometric links

4. Model Architecture

Inputs:

- EEG to CNN/LSTM to [B, 128]
- MRI to 3D CNN to [B, 128]
- Text to BERT to [B, 128]

Fusion:

- Cross-attention (EEG with Text, MRI with Text)
- Concatenation followed by Dense and Softmax

Output:

- Emotion class (e.g., Positive, Neutral, Negative)

5. Steps to Proceed

1. Download EEG and MRI from LEMON dataset
2. Preprocess EEG using MNE, MRI using NiBabel or Nilearn

3. Tokenize and encode text using BERT

4. Build separate encoders for each modality

5. Implement attention-based fusion model

6. Train and evaluate on labeled emotion classes

6. Tools and References

- MNE-Python: EEG preprocessing

- NiBabel: MRI data processing

- HuggingFace Transformers: BERT encoding

- PyTorch: Deep learning framework

- LEMON Dataset: EEG + MRI

7. Conclusion

NeuroSentiment3 is a novel approach combining neuroscience and language models. It has potential applications in emotion-aware AI, mental health monitoring, and cognitive state recognition. It demonstrates a new direction in deep multimodal understanding.