EEG Motor Imagery Neurotech ML Project – Beginner Checklist

This checklist is designed for beginners in neurotechnology and machine learning who want to build a real, portfolio■ready project using only their computer. Follow the steps in order. You do NOT need to understand everything immediately — learning happens as you go.

0. Project Goal & Mindset

- Write down the project goal in your own words.
- Understand that perfection is NOT the goal — completion is.
- Accept that confusion is normal when working with neural data.

1. Environment Setup

- Install Python (3.9 or newer).
- Install required packages: numpy, scipy, matplotlib, scikit-learn, mne.
- Create the project folder structure (data, notebooks, src, figures).
- Confirm you can import all libraries without errors.

2. Dataset Familiarization

- Read the BCI Competition IV Dataset 2a description.
- Identify number of EEG channels and sampling rate.
- Understand what motor imagery means (imagined movement).
- Write notes on why EEG signals are noisy.

3. Load Raw EEG Data

- Load one subject’s EEG file using MNE.
- Print and inspect metadata (raw.info).
- Plot raw EEG signals.
- Plot power spectral density (PSD).
- Write observations about signal noise and frequency content.

4. Preprocessing

- Apply bandpass filter (8–30 Hz).
- Understand why this frequency range matters.
- Extract event markers from the data.
- Identify left vs right hand motor imagery labels.

5. Epoching

- Segment continuous EEG into time windows (epochs).
- Choose a reasonable time window after cue onset.
- Confirm each epoch corresponds to one trial.
- Verify epoch shapes and counts.

6. Feature Extraction

- Compute power spectral density for each epoch.
- Extract band power features (alpha, beta).
- Assemble feature matrix X.
- Confirm feature dimensions match number of trials.

7. Machine Learning Preparation

- Create label vector y.
- Split data into training and testing sets.
- Normalize features.
- Understand what data leakage means.

8. Train ML Models

- Train a Logistic Regression model.
- Train an SVM model.
- Compare performance between models.
- Understand what chance-level accuracy is.

9. Evaluation & Interpretation

- Generate confusion matrix.
- Interpret false positives and false negatives.
- Reflect on why EEG decoding is difficult.
- Write down limitations of your model.

10. Visualization

- Plot EEG before and after filtering.
- Plot feature distributions.
- Plot model performance metrics.
- Save all figures.

11. README Writing

- Explain project goal in plain language.
- Describe dataset and preprocessing steps.
- Summarize ML methods used.

- Report results honestly.
- List future improvements.

12. Final Reflection

- Write what you learned about neurotechnology.
- Note which skills improved most.
- Prepare a 2–3 sentence project summary for LinkedIn or outreach.