Title: Systematic Review of the Literature on How Machine Learning is used to classify EEG signals/Brainwaves forms (Delta, Theta, Alpha, Beta, Gamma)

Level: Bachelor/Master

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The Electroencephalography (EEG) analysis has been an important tool in neuroscience's applications such as Brain Computer Interface (BCI) and even commercial applications. Many of the analytical tools used in EEG studies have used machine learning (ML) to uncover relevant information for neural classification and neuroimaging.

Recently, the availability of large EEG datasets and in advance ML have both led to the deployment of deep learning architectures, especially in the analysis of EEG signals and understanding of the information it may contain for brain functionality. The robust automatic categorisation of these signals is an important step towards making the use of EEG more practical in many applications**.**

Towards this goal, a systematic review of the literature on all machine learning and non-machine learning algorithms and applications that are used for EEG classifications is to be performed to address the following critical questions:

1. Which EEG classification tasks have been explored with machine learning and non-machine learning algorithms?
2. What input formulations have been used for training the machine learning algorithms and non-machine learning?
3. Are there specific machine learning or non-machine learning algorithms suitable for specific types of tasks?
4. Compare all suitable results on the classification of EEG signals
5. Finally, a framework will be proposed based on the systematic review of the literature which serves as a path for the classifications of EEG signals/brain waveforms.

Motivation: In the near future, we envision these techniques to enable early diagnosis systems for the detection of neurodegenerative diseases. We can also use them to show signature patterns in physiological data. This can range from spine injuries to heart disease or cancer. This could even change how we treat early diagnosis.

Some relevant literature:

[1] Yannick Roy, Hubert Banville, Isabela Albuquerque, Alexandre Gramfort "DEEP LEARNING-BASED ELECTROENCEPHALOGRAPHY ANALYSIS: A SYSTEMATIC REVIEW". Jan 2019. https://arxiv.org/pdf/1901.05498.pdf

[2] Craik A, He Y, Contreras-Vidal JL, "Deep learning for electroencephalogram (EEG) classification tasks: a review", J Neural Eng. 2019 Jun;16(3) https://www.ncbi.nlm.nih.gov/pubmed/30808014

[3] Laura Dubreuil, "How can we apply AI, Machine Learning or Deep Learning to EEG?", March 2018 (https://www.neuroelectrics.com/blog/from-ai-to-deep-learning-applied-to-eeg/)