

A decorative graphic on the left side of the slide consisting of two overlapping parallelograms. The front one is blue and the back one is light green. Both are tilted at an angle.

# EEG Classification

A Comparative Study



# Group Members

1. Thantham
2. Cedric
3. Arsha
4. M. Omer Farooq Bhatti



# Purpose

This project is based on Machine Learning and EEG signal processing implementation. Online resources are required to explore more about the BCI applications.

The aim of our group is to do comparative and explorative project for extending horizontal knowledge from previous (cited) studies. The aim of this study is not to find a better performing model (though it would be great if, with some luck, we could manage that). We are going to find reasons and alternative modeling procedures (Feature Engineering, different model constructions and synthetical exploration) for EEG Analysis.



# Roadmap

## Current tasks

- Search for related documentation, online resources, research papers and textbooks
- Search for established procedures of EEG signal analysis along with Machine Learning implementation
- Explore Sample code + Dataset from open-source material or tutorials and go through previous research to Find the gaps

## Current issues

- More knowledge required about EEG signal processing
- Difficulties in understanding other research/tutorials

## Future tasks (including expected, some tentative)

- Revise the gaps (recommendation) from previous studies
- List out and choose most appropriate ways to conduct analysis
- Implement and test the selected procedure as per previous studies suggestions
- Compare, Discuss and Explore the EEG signal processing using ML in several ways
- Conclude the project



# Literature Review

1. EEG-based Brain-Computer Interfaces (BCIs): A Survey of Recent Studies on Signal Sensing Technologies and Computational Intelligence Approaches and their Applications, Xiaotong Gu, Zehong Cao, Alireza Jolfaei, Peng Xu, Dongrui Wu, Tzyy-Ping Jung, Chin-Teng Lin (<https://arxiv.org/abs/2001.11337>)
2. Deep learning for electroencephalogram (EEG) classification tasks: a review, Alexander Craik, Yongtian He and Jose L Contreras-Vidal, Published 9 April 2019, Journal of Neural Engineering, Volume 16, Number 3 (<https://iopscience.iop.org/article/10.1088/1741-2552/ab0ab5>)

Date	Member	Article category	Article Title	Topic	Explanation	Link
7/10/2021	Thantham	Textbook	EEG signal processing and ML	General and overview of EEG, BCI	What is EEG, how to measure voltage, general result of electrode measurement	<a href="https://drive.google.com/file/d/1z1n5pypRhYUksgPDlnRXoDy7iew?usp=drivesdk">https://drive.google.com/file/d/1z1n5pypRhYUksgPDlnRXoDy7iew?usp=drivesdk</a>
8/10/2021	Thantham	Paper	Methods of EEG Signal Features Extraction Using Linear Analysis in Frequency and Time-Frequency Domains	EEG signal Feature extraction	Equation and comparison table for each method of feature extraction	<a href="https://www.hindawi.com/journal/2014/730218/">https://www.hindawi.com/journal/2014/730218/</a>
10/10/2021	Omer Farooq	Python MNE documentation	Overview of EEG Analysis with MNE-Python	Overview	How to install Python MNE, how to load a sample EEG Data file into Python MNE from Motor Imagery Dataset	<a href="https://mne.tools/stable/auto_tutorials/intro/10_overview.html#sphx-glr-tutorials-intro-10-overview-py">https://mne.tools/stable/auto_tutorials/intro/10_overview.html#sphx-glr-tutorials-intro-10-overview-py</a>
12/10/2021	Omer Farooq	Research Paper	EEG-based Brain-Computer Interfaces (BCIs): A Survey of Recent Studies on Signal Sensing Technologies and Computational Intelligence Approaches and their Applications	A Survey of Recent Studies on EEG based BCI	Signal Acquisition equipment, Signal Processing and Filtering techniques, Filtering and list of Artifact Handling Methods, Feature Engineering approaches, different tasks for EEG Analysis	<a href="https://arxiv.org/abs/2001.11337">https://arxiv.org/abs/2001.11337</a>
	Omer Farooq	Research Paper	Deep learning for electroencephalogram (EEG) classification tasks: a review	Deep Learning Approaches for	A survey of different Feature Selection and Deep Learning Algorithm approaches for classification of EEG signals and their results. e.g Calculated Features, raw Signal Values, Images for Input Features; and CNNs, RNNs, DBNs etc for Deep	



# Task Datasets

1. DEAP - Emotion Classification - <http://www.eecs.qmul.ac.uk/mmv/datasets/deap/>
2. BCI2000 - Motor Imagery - <https://www.physionet.org/content/eegmmidb/1.0.0/>



# EEG Classification Overview

1. EEG Signal Acquisition
2. Signal Pre-processing
3. Feature Extraction
4. Machine Learning





# EEG Signal Acquisition

1. Wet Sensor Technology
2. Dry Sensor Technology

10-20 Mapping



# Signal Pre-processing

1. Sampling
2. Filtering
3. Artifact Handling



# Feature Extraction

1. Raw Signal Values
2. Calculated Features
3. Image



# Machine Learning

1. Machine Learning
2. Convolutional Neural Networks
3. Recurrent Neural Networks
4. Deep Belief Networks
5. Other Approaches