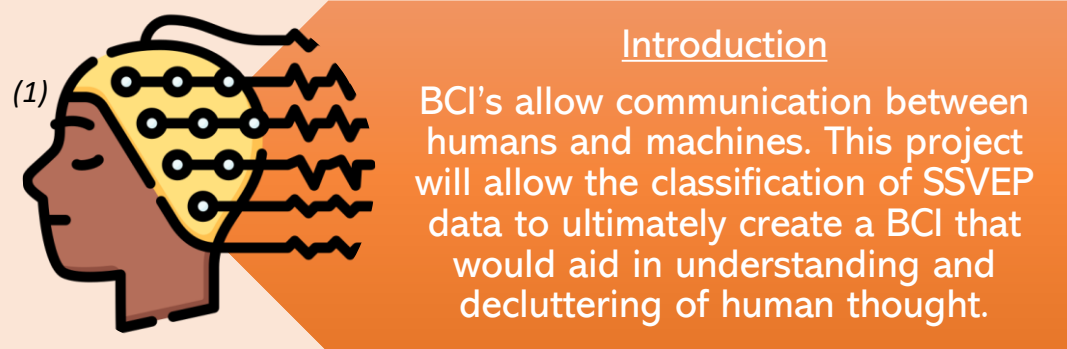


# Multi-Class Classification of EEG Signals Using a Fuzzy Based Rule System for Brain Computer Interfaces

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## Aims

- To develop a Multi-Class classification model using the ensemble method.
- To then use this model to predict new SSVEP data, classify them and evaluate its success.

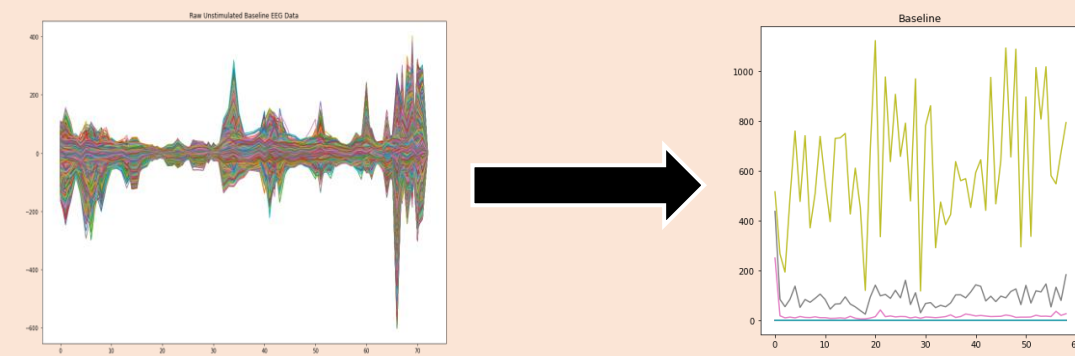


Figure 1: Conversion of Raw unstimulated baseline EEG data to SSVEP data

## Objectives

- Use ANFIS (adaptive neuro-fuzzy inference system) to develop a set of human interpretable rules which will then be tuned, creating an interpretable rule system than can improve as the model learns
- Use ANFIS to create a series of binary classifiers to predict new SSVEP data and merge them together using the OAO (One Against One [Ensemble Method]) approach to develop one single multiclass classifier with a higher predictive accuracy for new data.
- Compare the ANFIS to conventional Machine Learning, such as SVC and K – Neighbours via evaluation metrics, to establish whether this model was a success and improves upon traditional machine learning.

## Preliminary Results (Without Ensemble Method)

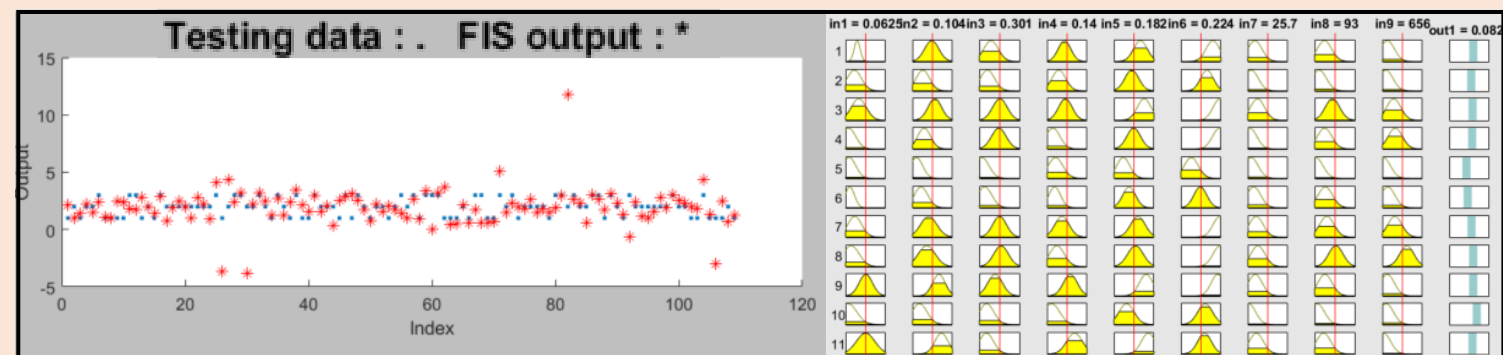


Figure 2: (Left) The ANFIS Model trained and tested against a set of SSVEP Data, (Right) Set of human interpretable rules created using ANFIS

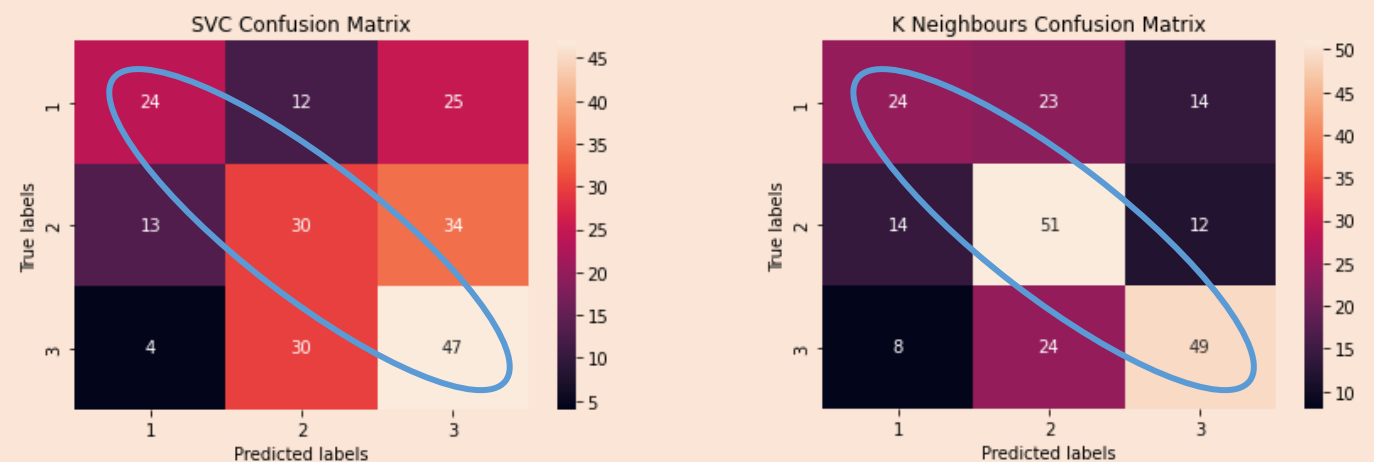
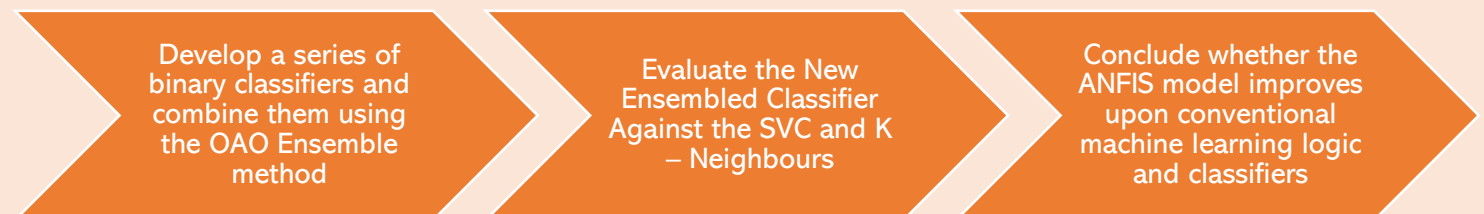


Figure 3: (Left) Confusion matrix of the SVC classifier (With the true positives circled), (Right) Confusion matrix of the K - Neighbours classifier (With the true positives circled)

## Next Steps



## SSVEP

Steady State Evoked Potential, has a better SNR than EEG and lower chance of artifacts (3) (Figure 1)

## AI

The capability of a machine to imitate intelligent human behaviour (2)

## Fuzzy Modelling

A set of mathematical rules, providing a "means of representing vagueness and imprecise information" (4)

## Ensemble Method

Used to create a series of Binary Classifiers and combine them, using the OAO approach, to create a Multi-Class Classifier