



# EEG Visualization

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# User & Tasks

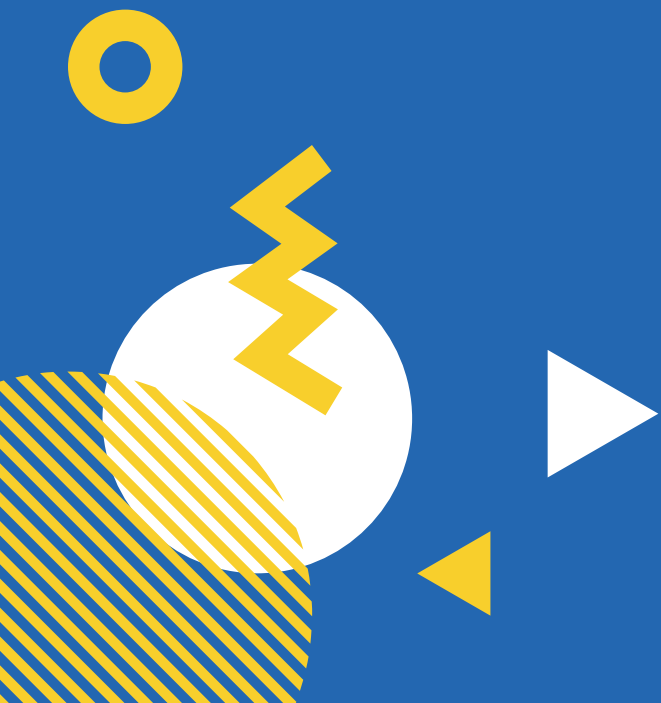
## User

Neuroscience / Psychology  
Researchers interested in:

- visualizing the electrical signals of the brain
- identifying brain waves and/or outliers

## Tasks

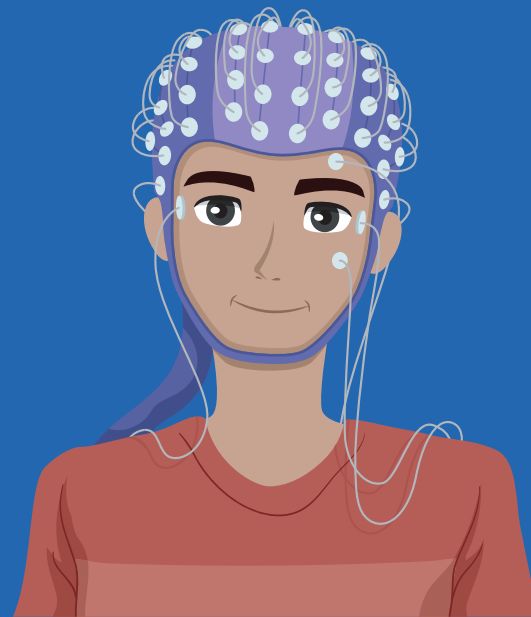
- Find and demonstrate clusters of channel activity over time
- Compare trends
- Locate channel outliers



# Dataset

## Data

- From Dr. Goldschen-Ohm, Neuroscience Professor
- EEG Data Containing
  - 640 Time Points (ms)
  - 64 Channels
  - 99 Trials



## What is an EEG?

An EEG, or electroencephalogram, is a test that records the electrical signals of the brain by using small metal discs (called electrodes) that are attached to your scalp.

## What is a channel?

A channel, or electrode, is a small metal disk that is part of an EEG system, which can contain up to 256 channels.

# Data Preprocessing

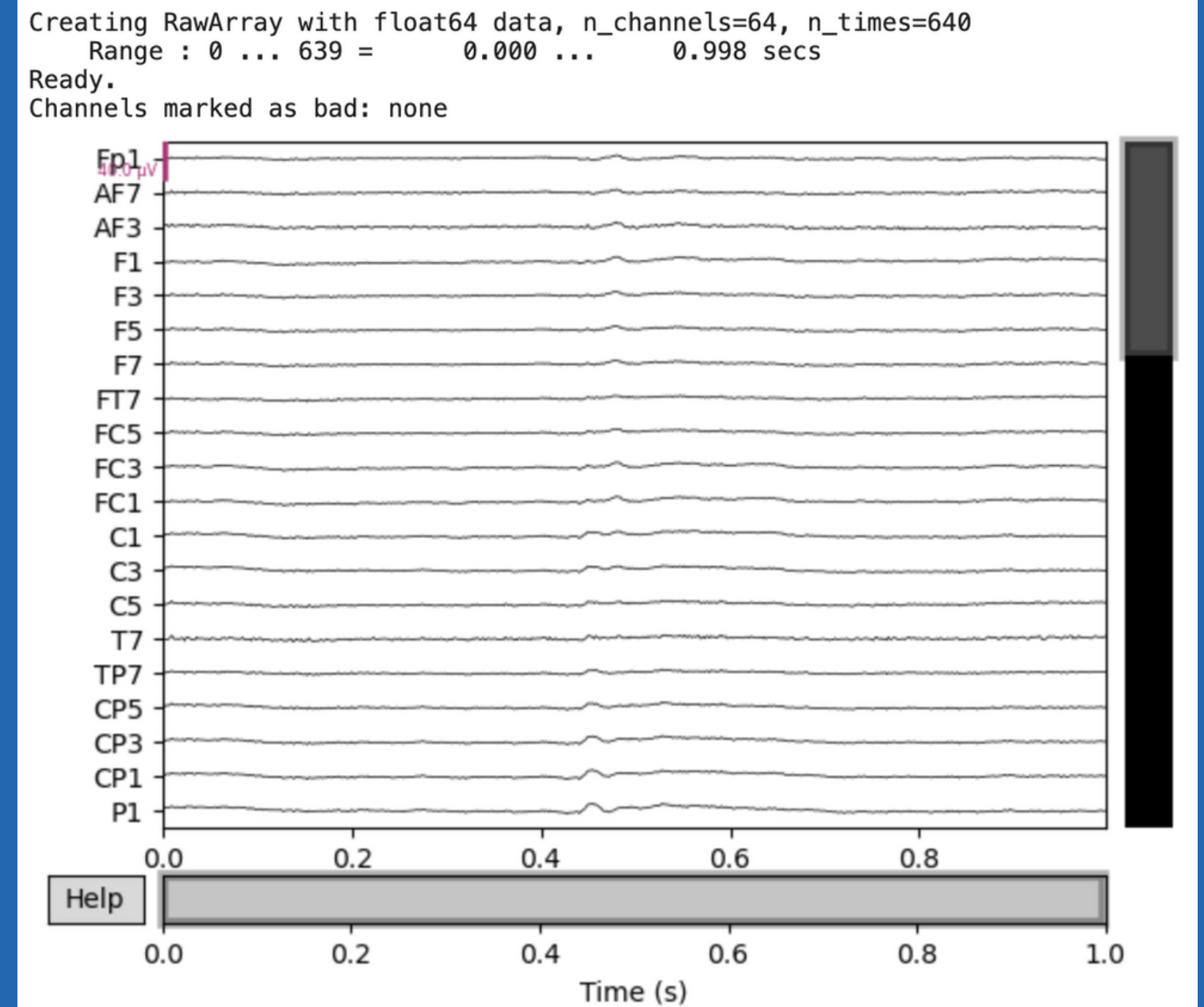
## Extracting EEG Data

Using `scipy.io.loadmat()`, the data was extracted from a .mat file into a list.

## Averaging Data Across Trials

To aggregate the data, all 99 trials within a channel were averaged.

MNE Package to check for "bad" Channels:



# Data Transformation

## Principal Component Analysis (PCA)

Principal Component Analysis was used in order to find the optimal amount of clusters.

6 principal components explain 95% of the variance.

## KMeans Clustering

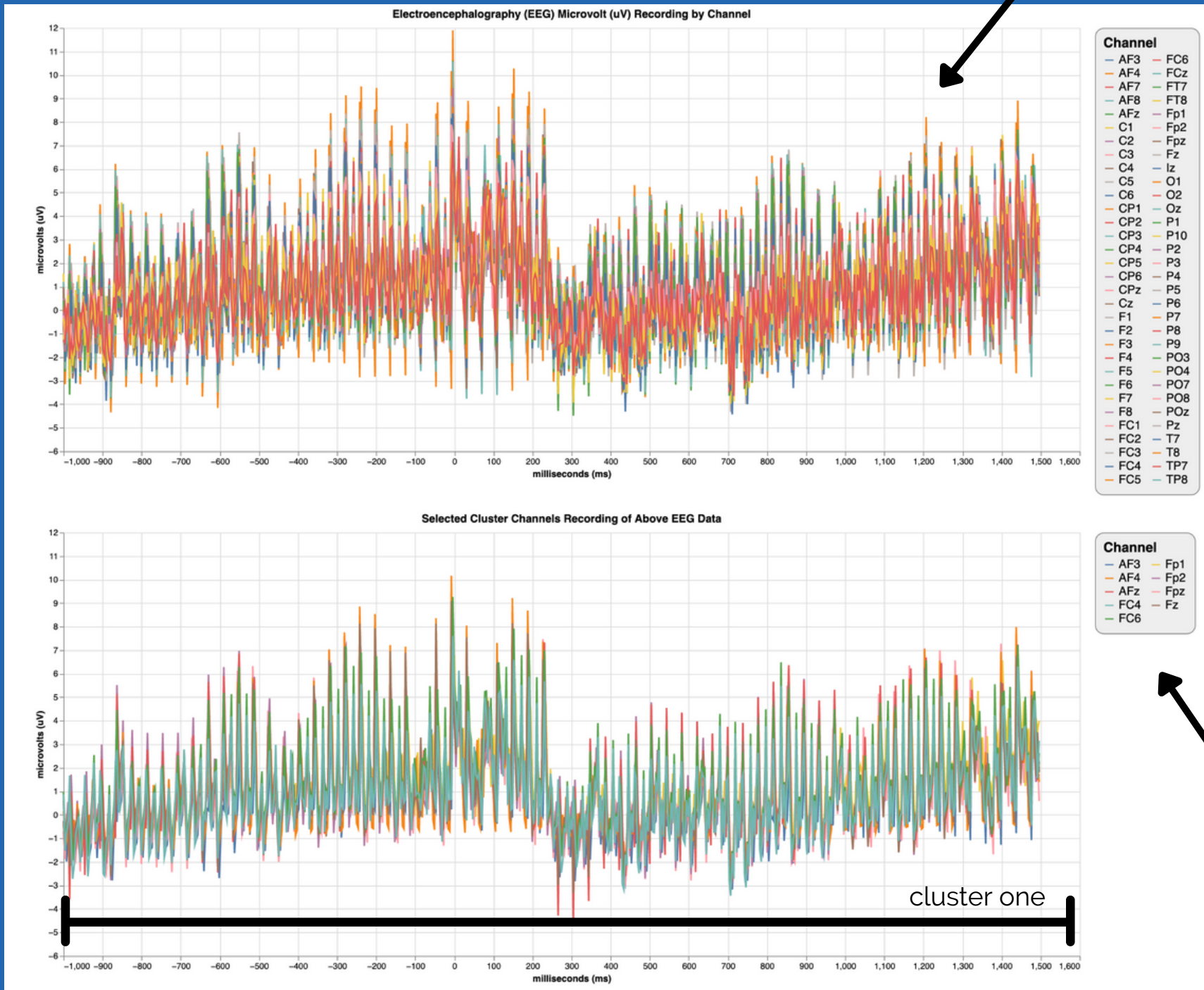
scikit-learn's KMeans clustering was used because it is simple to implement and scales to large datasets.

## Wide-Form to Long-Form Data

Altair works best with long-form data, so `pandas.melt()` was used to transform the data.

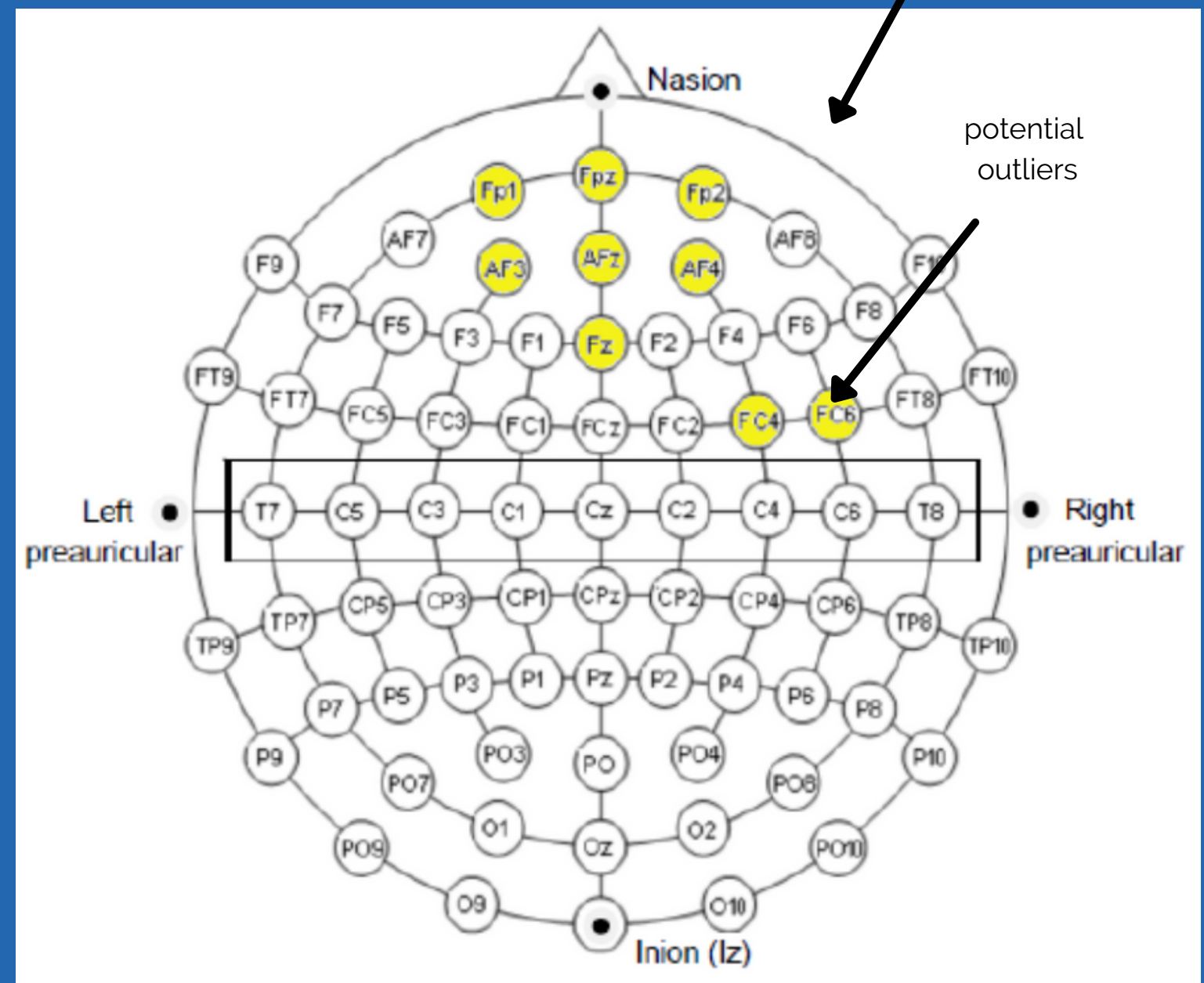
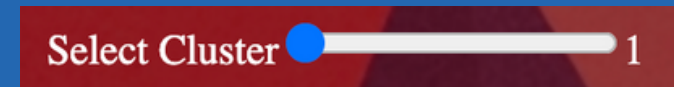
# Visualizations

## All Channel Recordings



## Cluster Channel Recordings

## Channel Slider



## Channel Locations

Even Numbers = Right Hemisphere  
Odd Numbers = Left Hemisphere

Fp = Pre-Frontal  
F = Frontal  
T = Temporal  
O = Occipital  
C = Center  
Z = Midplane ground points



# LIVE DEMO



# Lessons Learned

## How The Project Changed:

- Instead of focusing on different trials, the trials were all averaged out into their respective channel.

## Challenges

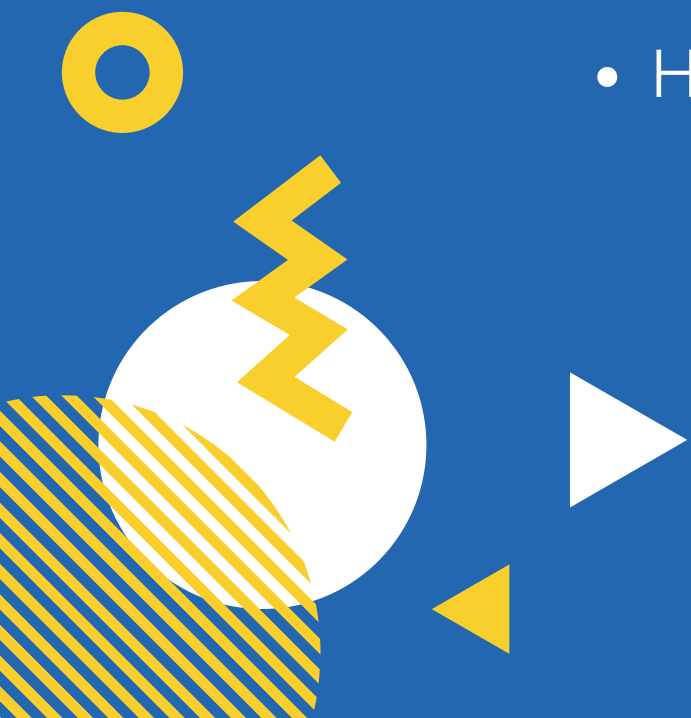
- Extracting EEG data from .mat file
- Conditional image display using Altair slider
- HTML Page

## Future Improvements:

- Fourier Transform

## Lessons Learned:

- Channels in an EEG can be considered "bad" so Python's MNE package was used to analyze the channel data.





The image features a solid blue background with the word "QUESTIONS?" centered in a bold, yellow, sans-serif font. The corners of the image are decorated with abstract geometric patterns. In the top-right and bottom-left corners, there are clusters of shapes including white circles, yellow circles, yellow triangles, and yellow zigzag lines, some of which are overlaid with diagonal yellow and white stripes. In the bottom-right corner, there is a small yellow circle. The overall design is modern and minimalist.

# QUESTIONS?

# References

- <https://www.mayoclinic.org/tests-procedures/eeg/about/pac-20393875>
- <http://neurosky.com/2015/07/multi-channel-eeg-bci-devices/>
- <https://docs.scipy.org/doc/scipy/reference/generated/scipy.io.loadmat.html>
- <http://learn.neurotechedu.com/preprocessing/>
- <https://mne.tools/stable/index.html>
- <https://scikit-learn.org/stable/modules/generated/sklearn.decomposition.PCA.html>
- <https://scikit-learn.org/stable/modules/generated/sklearn.cluster.KMeans.html>
- <https://pandas.pydata.org/docs/reference/api/pandas.melt.html>

