# EEG Visualization

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# User & Tasks

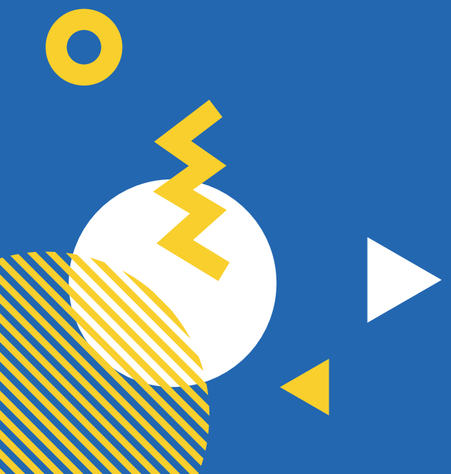
## User

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

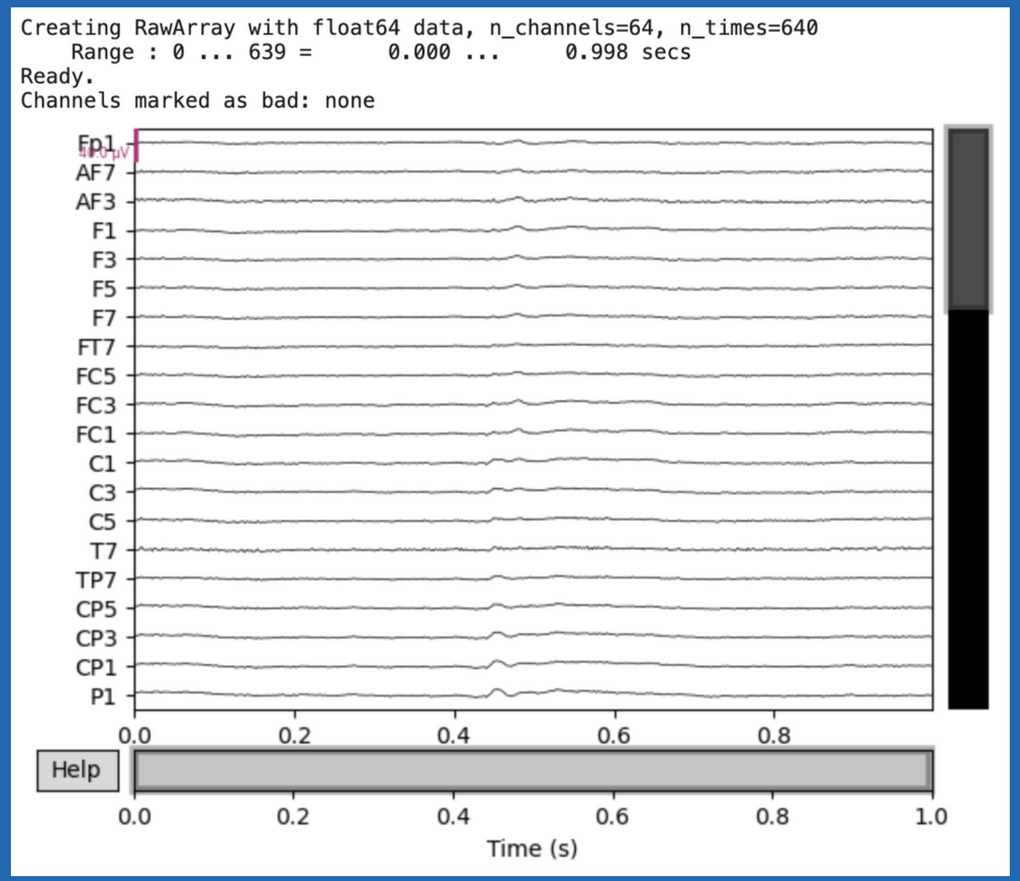
## Extracting EEG Data

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.

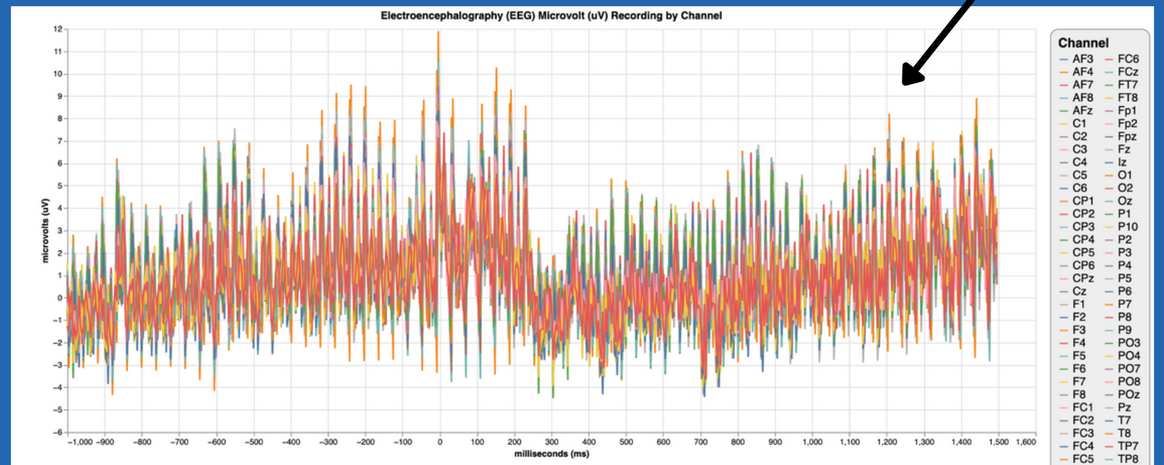
## Wide-Form to Long-Form Data

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

# Visualizations

64 channels, layered

## All Channel Recordings



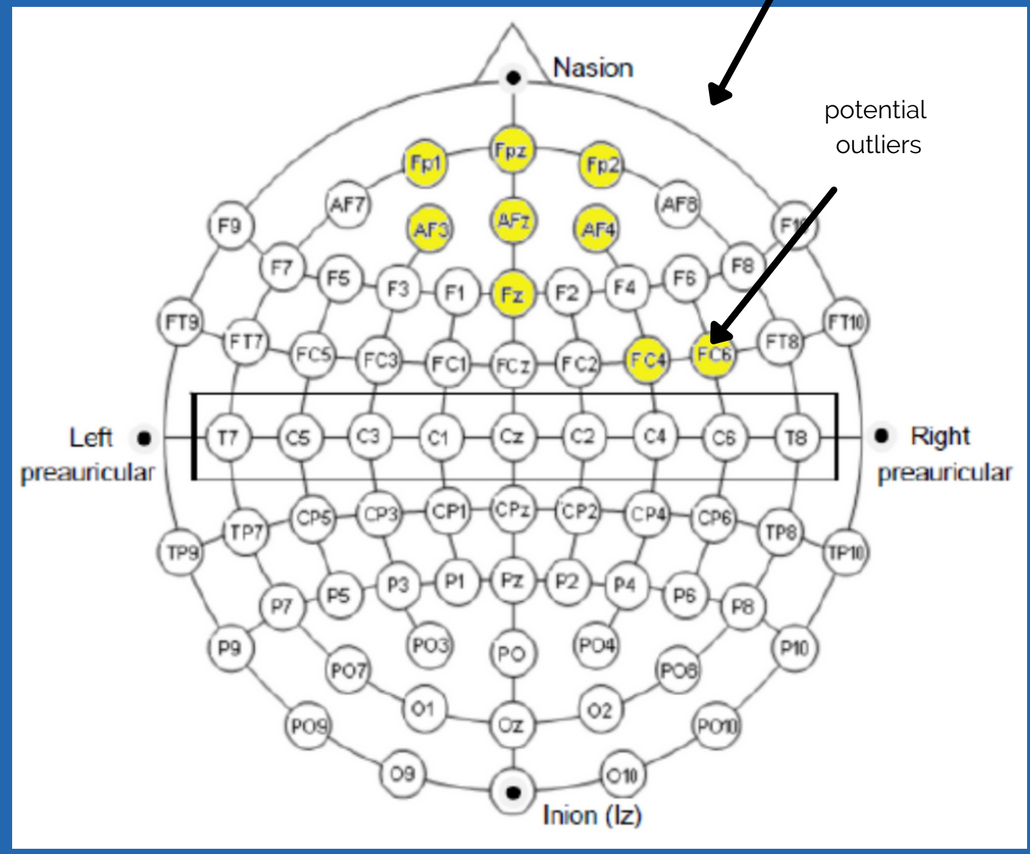

interactive legend

## Cluster Channel Recordings

## Channel Slider


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

potential outliers




## Channel Locations

Even Numbers = Right Hemisphere
Odd Numbers = Left Hemisphere

# Lessons Learned

How The Project Changed:

- Instead of focusing on different trials, the trials were all averged 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.

# 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