SimPL EEG Data Visualization

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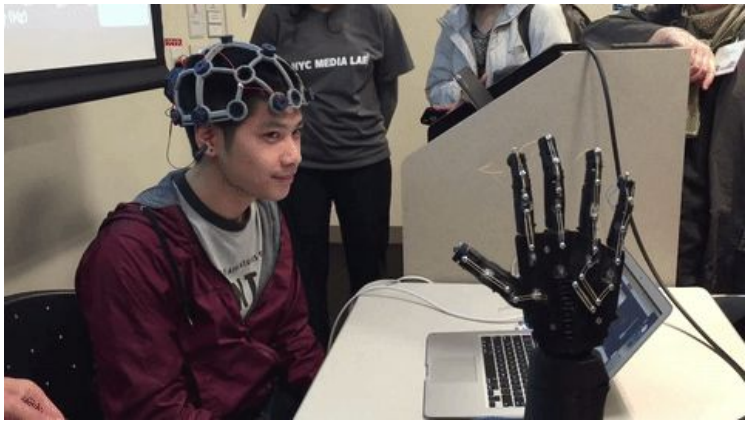
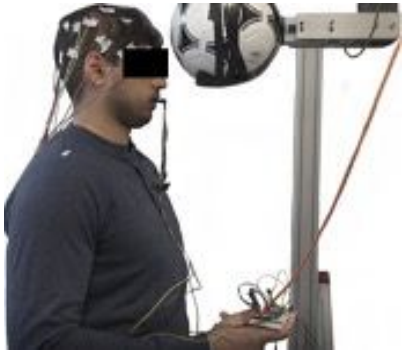
What is EEG?

- A set of external electrodes placed on top of the skull to measure electrical potential in the brain
- Unobtrusive and Cheap
- Good for measuring broad picture strokes of brain function (i.e. seizures)
- Older technology (dates back to the 1950s and beyond)



Our Capstone Partner

- **S**ensing **i**n Bio**m**echanical **P**rocesses **L**ab (**SimPL**) at UBC
- Develops advanced sensing and data analytics techniques
- Focused in sport head injuries
- Employed electroencephalograms (EEG) for analysis



Our Capstone Goals

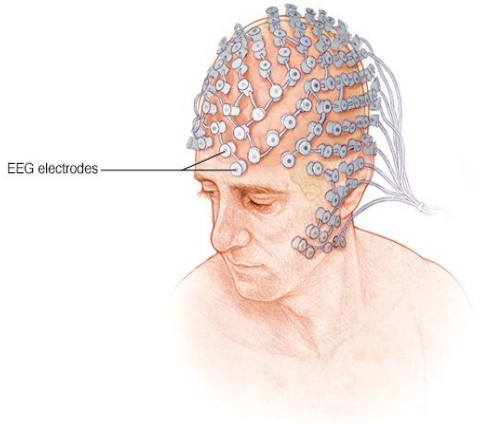
1) Python visualization and metrics package (main)

2) Interactive user interface using Streamlit (main)

3) Extend the Python package with preprocessing functions (stretch)

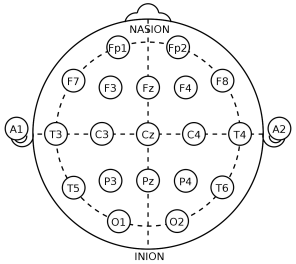
4) Data pipeline for unsupervised learning clustering (stretch)

SimPL



Data - EEG (electroencephalograms)

- The electrical activity of a brain detected by the electrode attached to the scalp
- 19 electrodes (19 channels)
- 33 impacts per experiment (measured in timestamps)
- Roughly 1.5 hours long per experiment



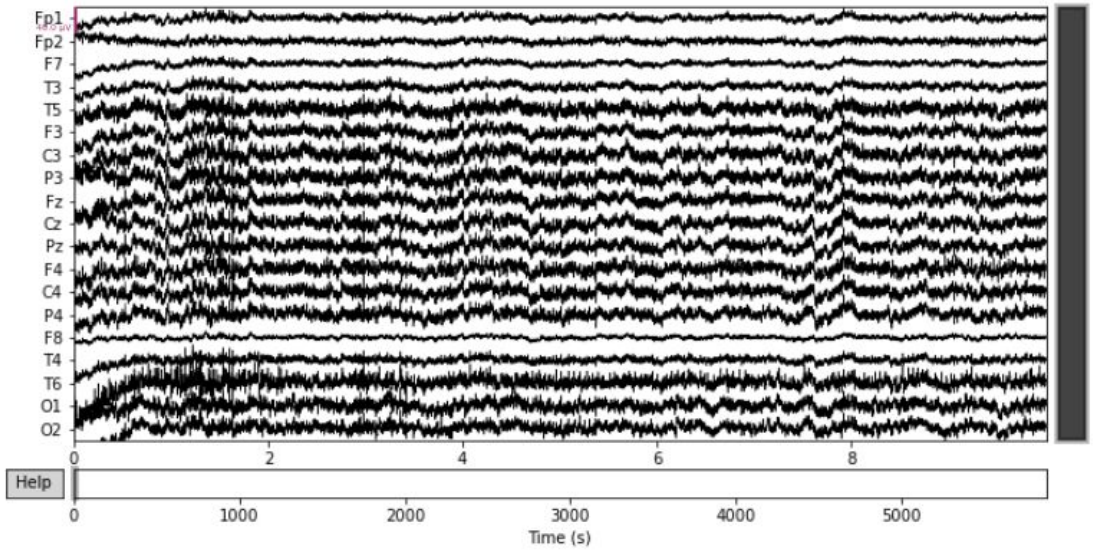
time	Fp1	Fp2	F7	T3	T5	F3	C3	P3	Fz	Cz	Pz	F4	C4	P4	F8	T4	T6	O1	O2
0	5.249967	6.655970	-4.434475	4.304095	17.676922	8.274990	5.277716	-5.298819	7.670161	-5.680321	2.303462	10.845702	1.906006	9.311716	-1.323244	6.466196	18.021606	4.767320	18.366028
0	5.278089	6.695436	-5.000164	4.084442	17.299467	8.143000	5.196838	-6.056608	7.656211	-5.643856	2.151131	11.066680	1.979347	9.305128	-1.577195	6.457521	17.939810	4.684548	18.176613
1	-0.704738	-2.400346	9.224086	4.510412	7.809945	4.485216	11.136824	20.472145	-2.422097	7.093482	12.430429	-1.899119	-0.629464	8.592073	1.141066	-2.306223	-2.914821	0.205369	-0.727486
1	-0.677084	-2.362067	8.752637	4.334788	7.497952	4.382829	11.066937	19.875942	-2.430228	7.118731	12.330954	-1.702163	-0.555030	8.585756	0.934380	-2.310043	-2.957141	0.150291	-0.842389
2	-0.871208	-3.770564	26.662954	4.588190	-3.349652	-3.055428	6.479112	19.816639	-6.230808	16.779474	15.611196	-6.215553	3.564851	10.873356	3.784559	-1.346608	-3.562572	3.920749	-6.992103
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
5414299	5.882370	6.417542	3.576848	2.278841	-0.690300	6.574977	5.391859	-0.303467	9.869918	10.660233	2.687029	13.076114	14.226103	7.042773	3.503975	4.731483	2.090857	2.236192	13.754395
5414299	4.810019	5.209940	-1.924309	0.210620	-2.272475	2.603113	1.964148	-0.239862	7.261303	11.247967	3.286069	11.544709	12.174756	7.065387	1.609997	4.573243	4.996539	1.130259	16.944593
5414300	2.618884	3.422156	-2.655280	0.714436	3.448523	0.809813	4.582190	2.913018	2.620033	8.231747	5.732580	11.546264	13.648458	5.206041	-0.061993	2.883816	3.326997	2.958239	16.004593
5414300	3.358315	3.451100	1.095874	2.892261	2.921138	4.362070	4.841438	5.190645	3.713583	7.304112	7.861675	9.032394	12.721871	7.915611	1.000668	3.539896	3.228356	2.785509	8.316413
5414301	4.449532	4.165589	7.794319	2.888578	4.594507	4.161007	2.859490	4.836564	6.169818	8.420313	3.841559	7.838594	10.758005	5.795454	3.288671	4.058389	0.845247	1.097919	-0.030489

Main Goal

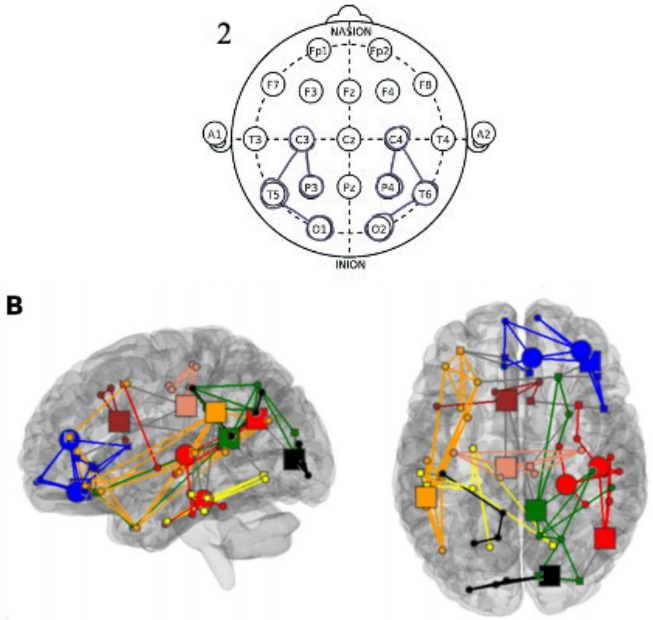
MNE
MEG + EEG ANALYSIS & VISUALIZATION

matplotlib
Version 3.4.1

- Python packages for EEG metrics and animated visualizations



Raw voltage values



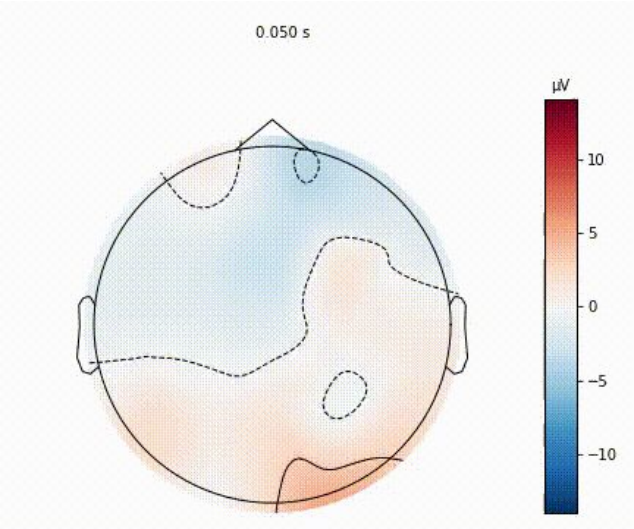
Connectivity

Main Goal

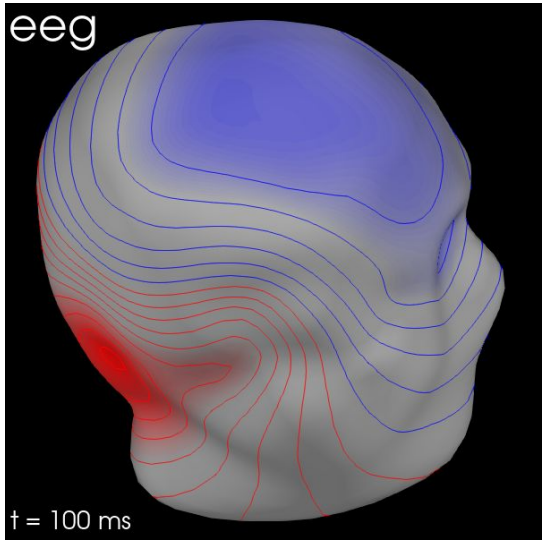
MNE
MEG + EEG ANALYSIS & VISUALIZATION

matplotlib
Version 3.4.1

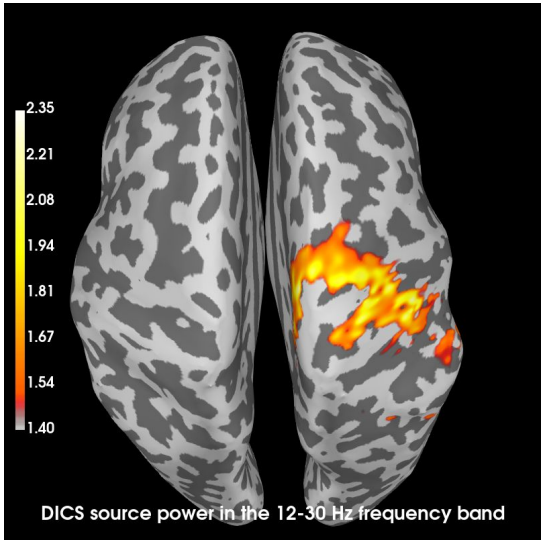
- Topographic visualizations



2D head map



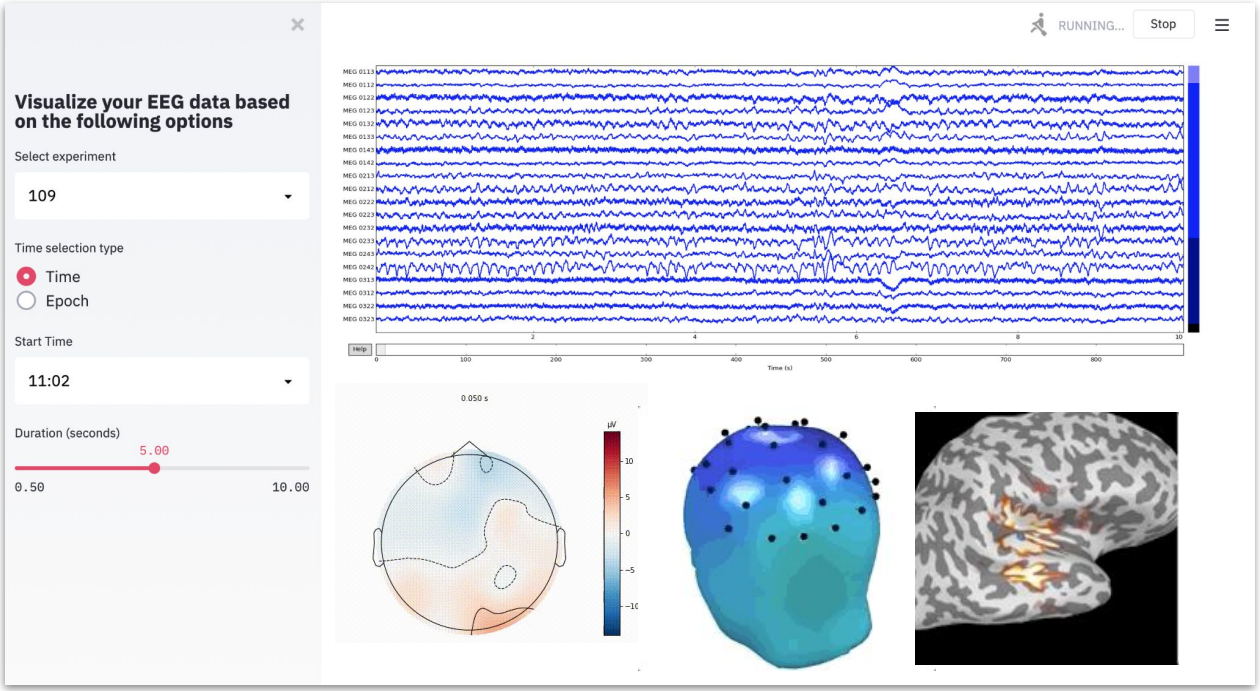
3D skull map



3D interpolated brain map

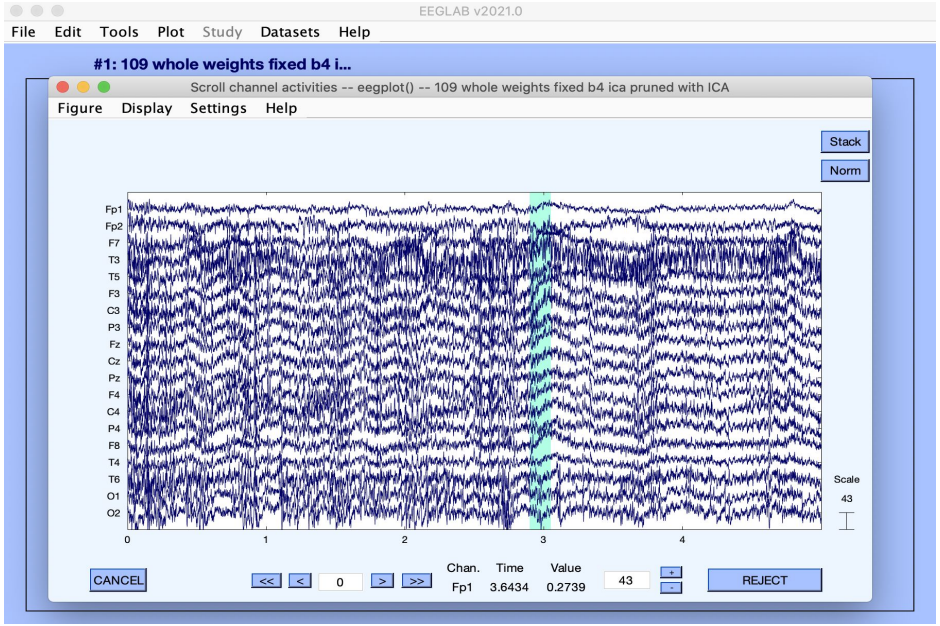
Main Goal

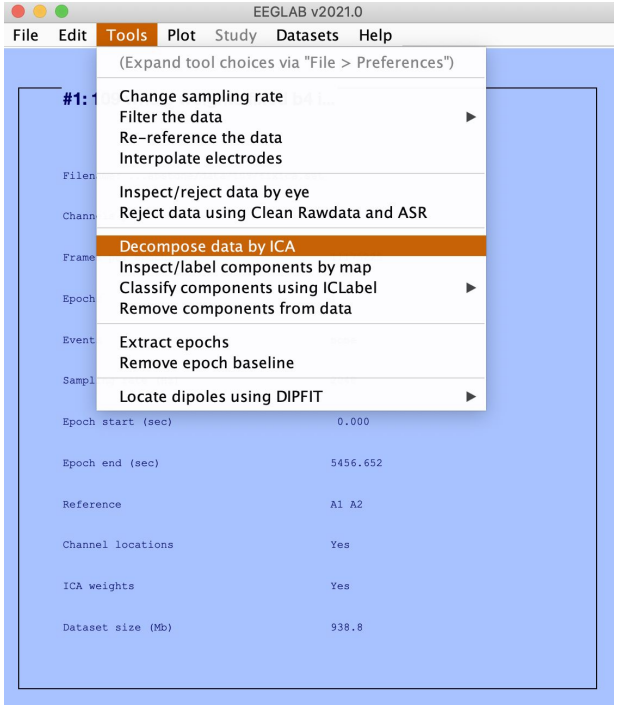
- Interactive User Interface using [Streamlit]



Possible Stretch Goal 1

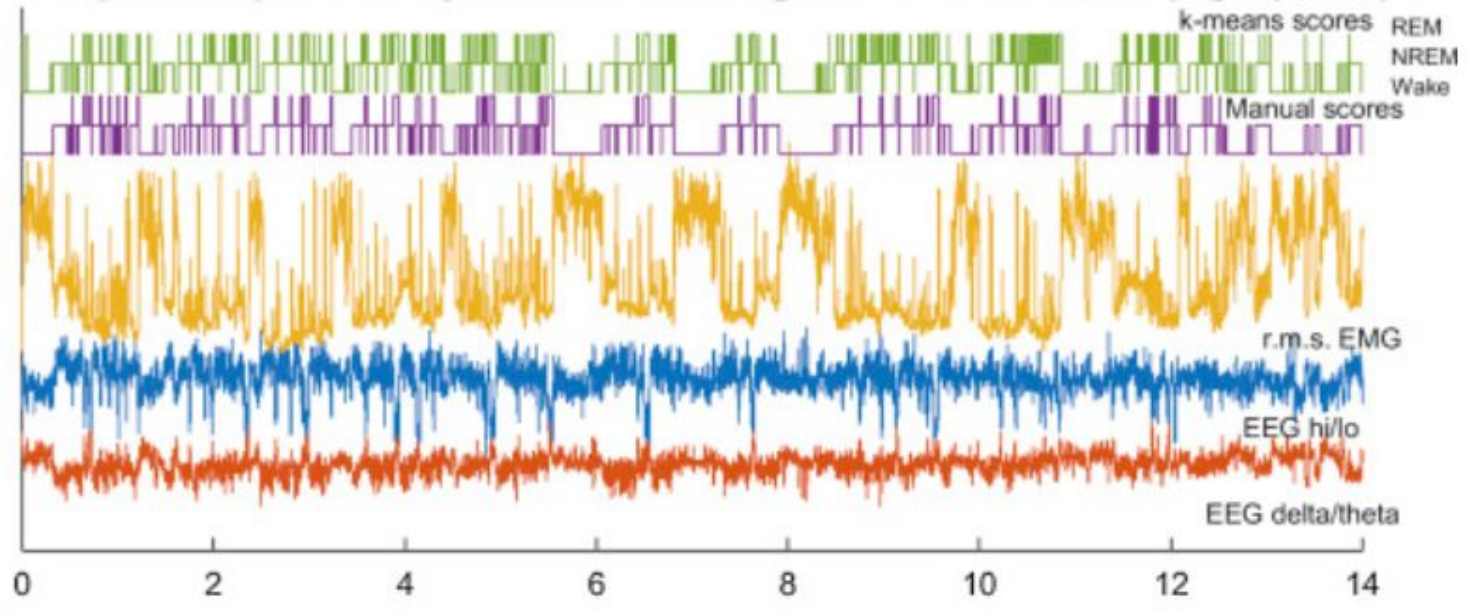
- Extend Python package with preprocessing functions
- Currently using EEGLAB manually





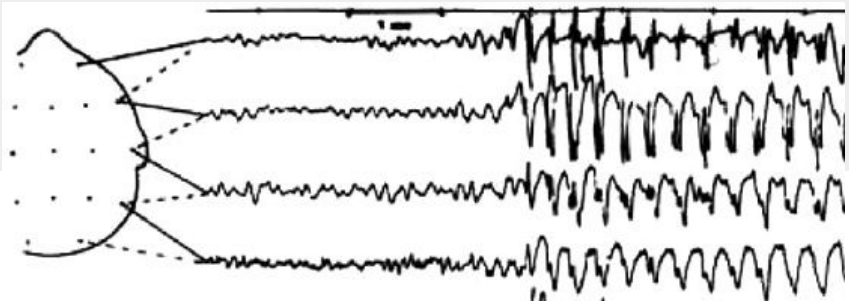
Possible Stretch Goal 2

- Identify potential patterns in EEG data with machine learning techniques

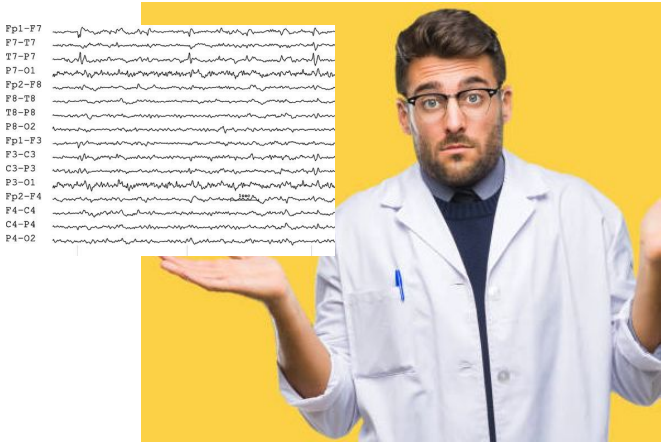


Source: https://www.sciencedirect.com/science/article/pii/S2215016116000108#fig0010

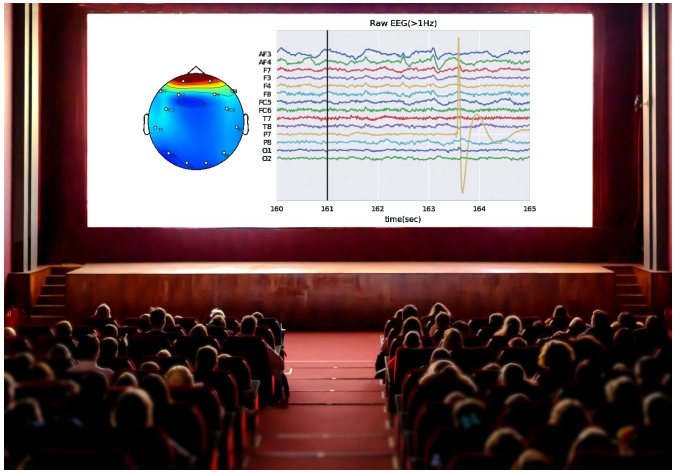
Possible Challenges



No significant results in our data
(example image of seizure is obvious)

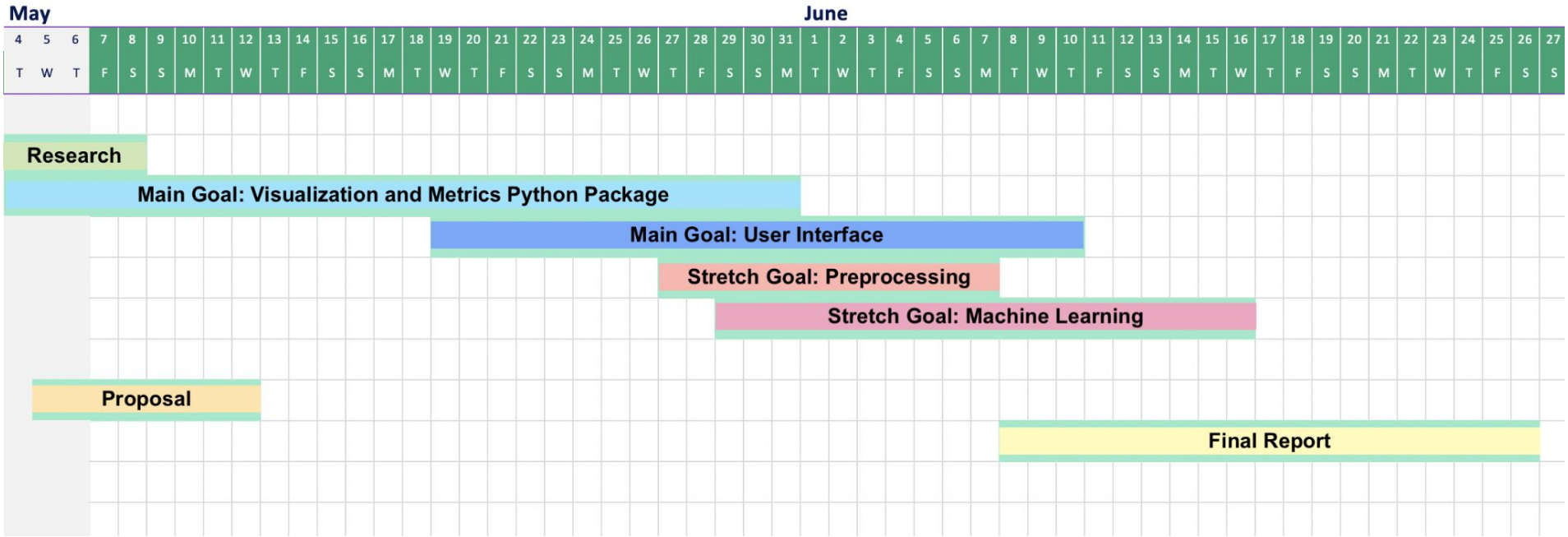


No background in EEG

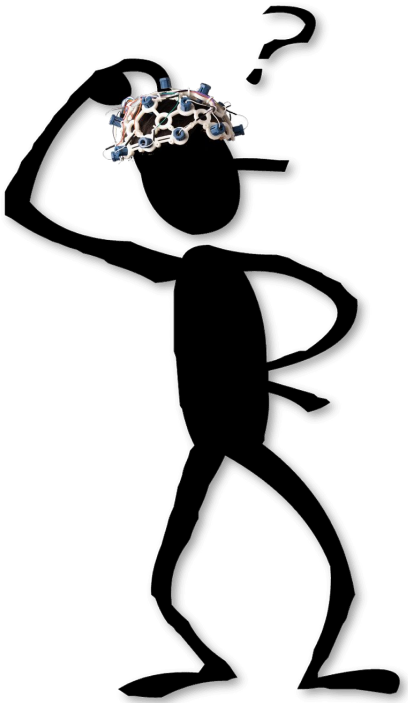


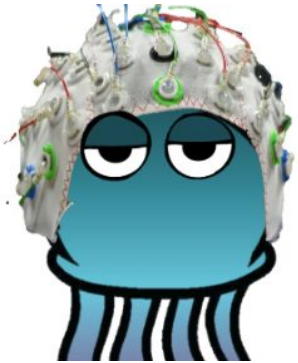
Dataset is 1GB for each patient with
19 nodes, 2048 Hz, 1.5 hours

Timeline


May
June
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S
Research
Main Goal: Visualization and Metrics Python Package
Main Goal: User Interface
Stretch Goal: Preprocessing
Stretch Goal: Machine Learning
Proposal
Final Report

Questions?





Attributions

- EEGLab
- MNE
- Netflix (Firm),. (2017). Stranger things: Season 1.
- Man moving hand with EEG
- Confused Scientist
- UBC SimPL Lab
- EEG Koala
- EEG Squid