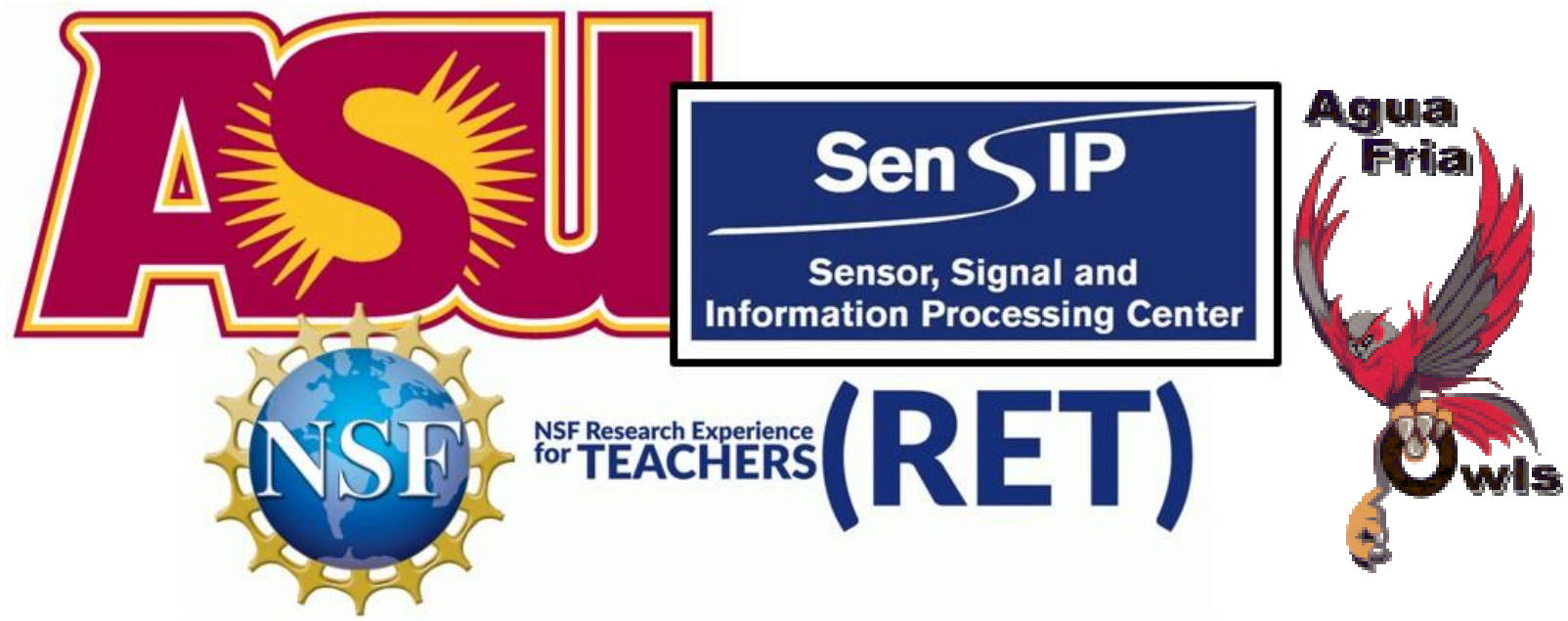


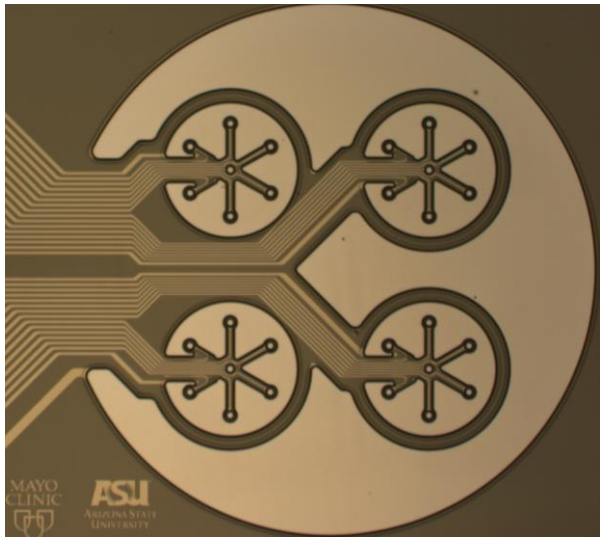
RET Project: Analyzing Noise Within Surface Level Neural Arrays

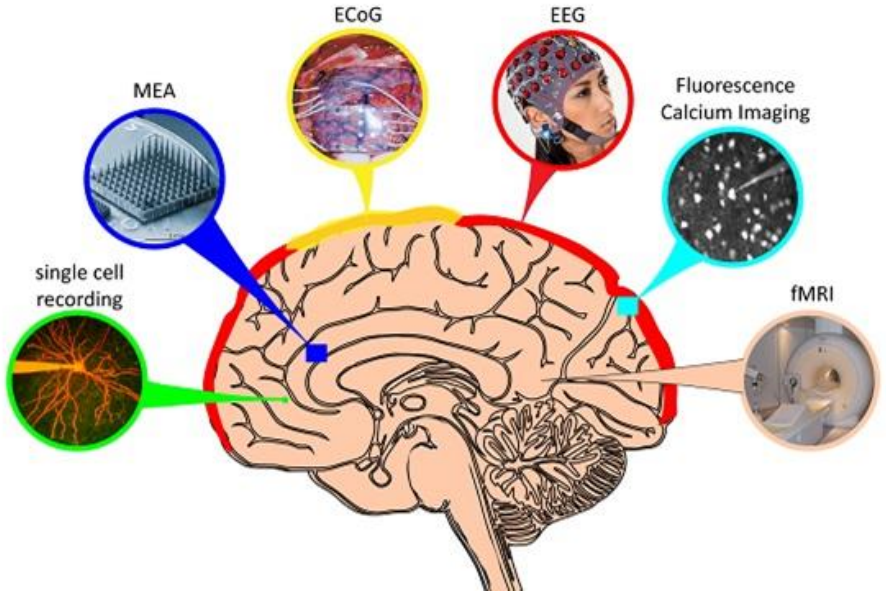
Azira Rivera

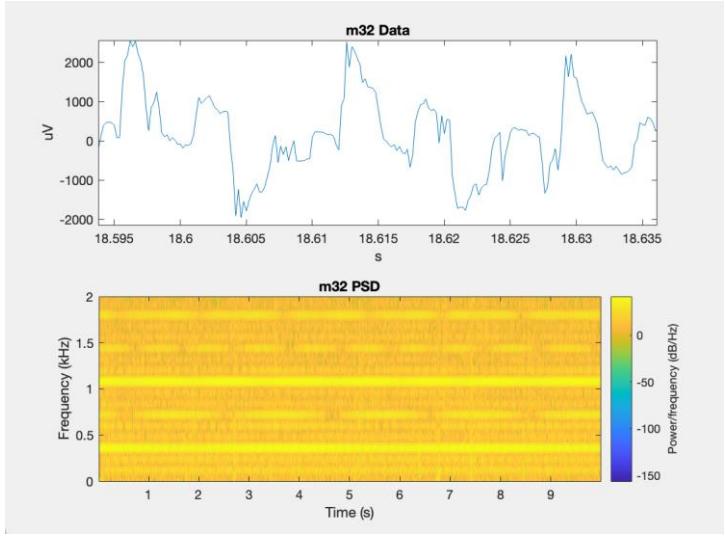
Mathematics
Agua Fria High School
Mentors: Daniel Gulick, Dr. Jennifer Blain Christen

NSF Award 1953745

https://sensip.engineering.asu.edu/ret/





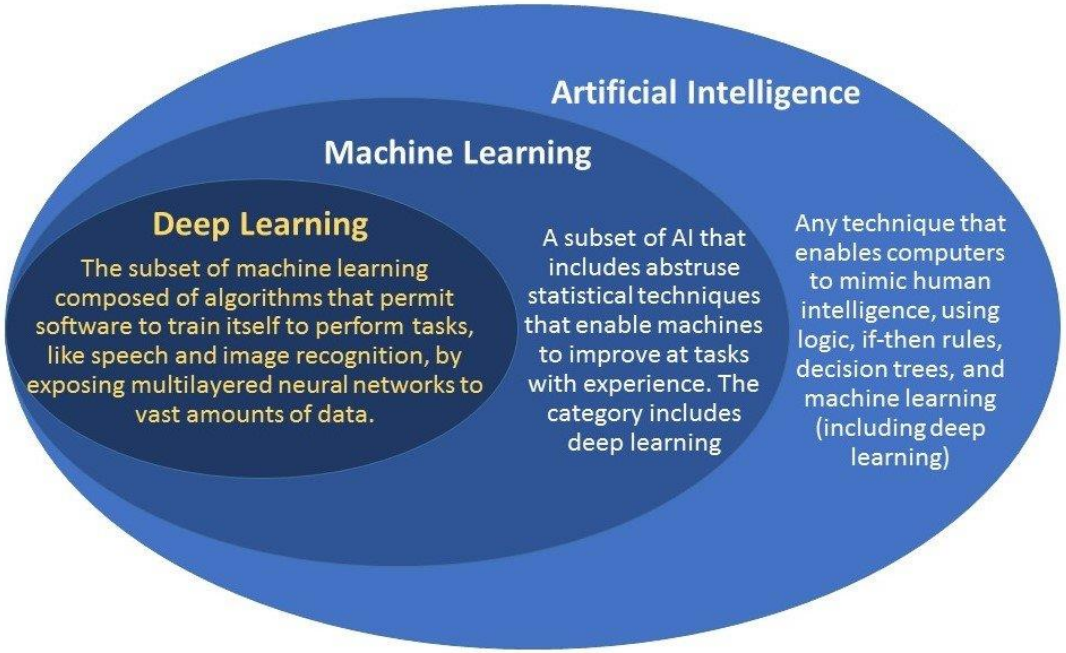


RET Research and Training

RET Schedule and Training

Hands On Technical Training

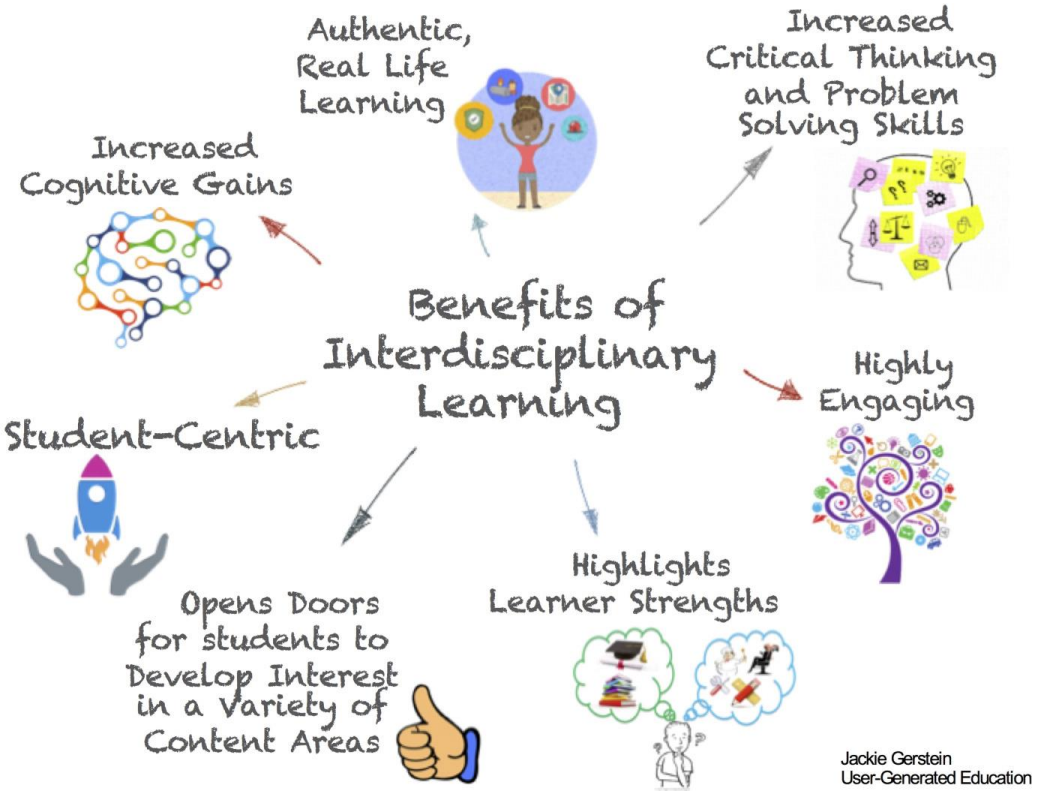
- AI and ML is everywhere and people (myself included) don't always understand what exactly that means
- First time being exposed to the hardware side of data collection
- It was particularly interesting to hear how different obstacles are overcome, like biased or small samples, environmental noise
- Clear balance of "norms" in the field and a sense of playing until it works



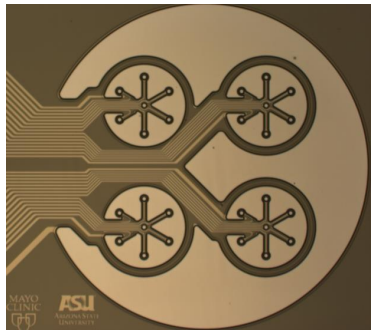
RET Schedule and Training

Technical Exposition

- Variety of experiences and in explanations
- ML can be used in so many biological systems
- ML is incredibly cross-disciplinary
  - Focus on that as an educator
- You need A LOT of data

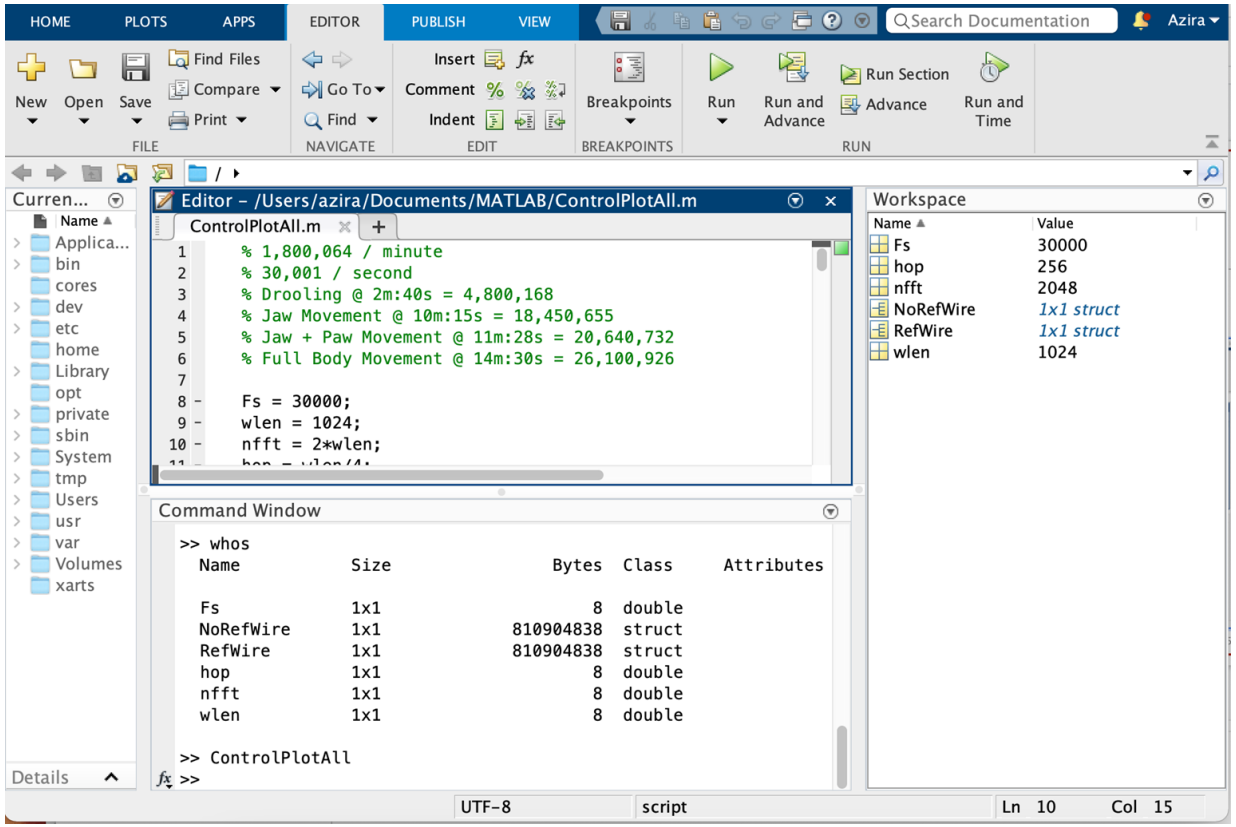


RET Schedule and Training



Research Materials

- Lots and lots of Matlab and Google Drive
- Great refresher of how powerful Matlab is as a data analysis tool!
- Python is good and where started, but familiarity was essential during such a short program

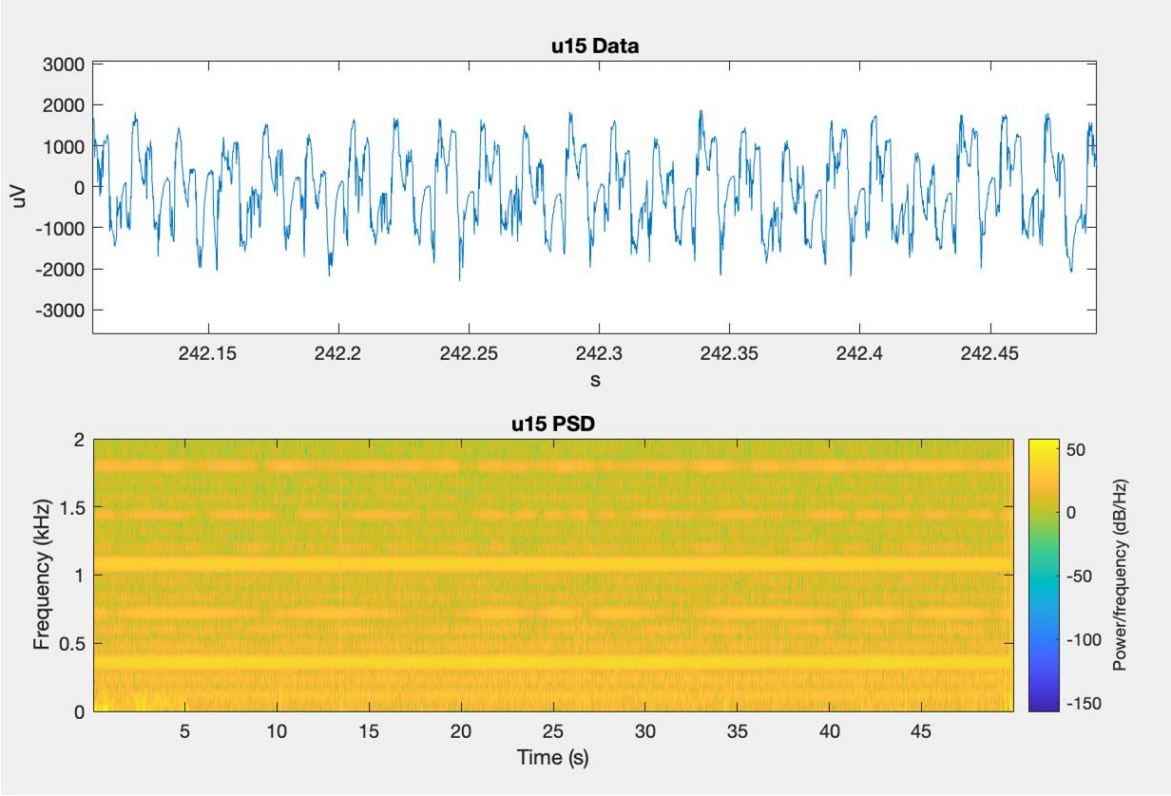


https://sensip.engineering.asu.edu/ret/

RET Lab Experience Research Summary

Research Objectives

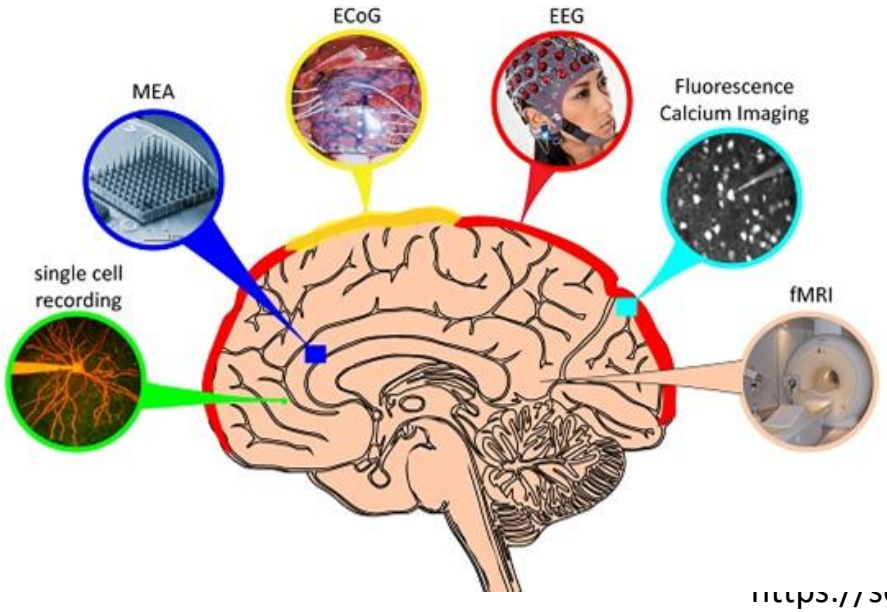
- Create graphs based on the data that the lab group already had
- Make the scripts for efficient for future data collection
- Analyze the graphs for the noise at specific sites and between sites
- Analyze seizure and control data

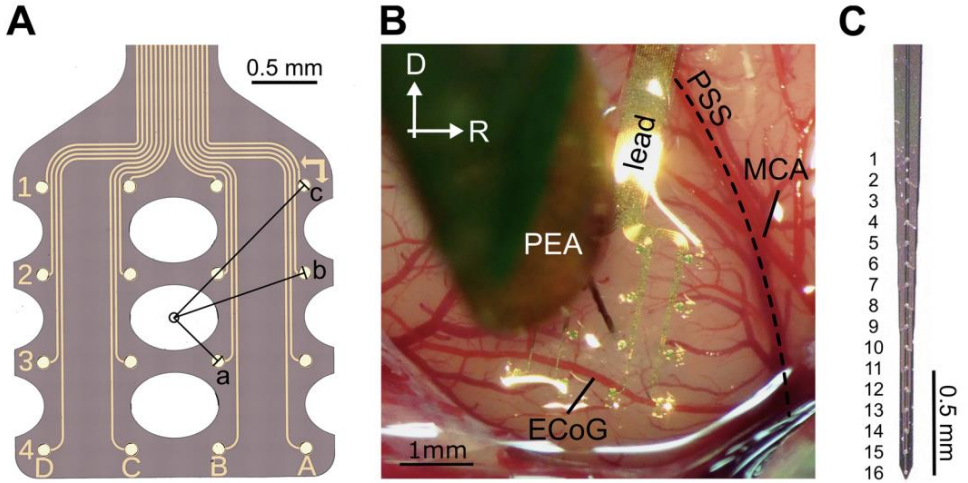


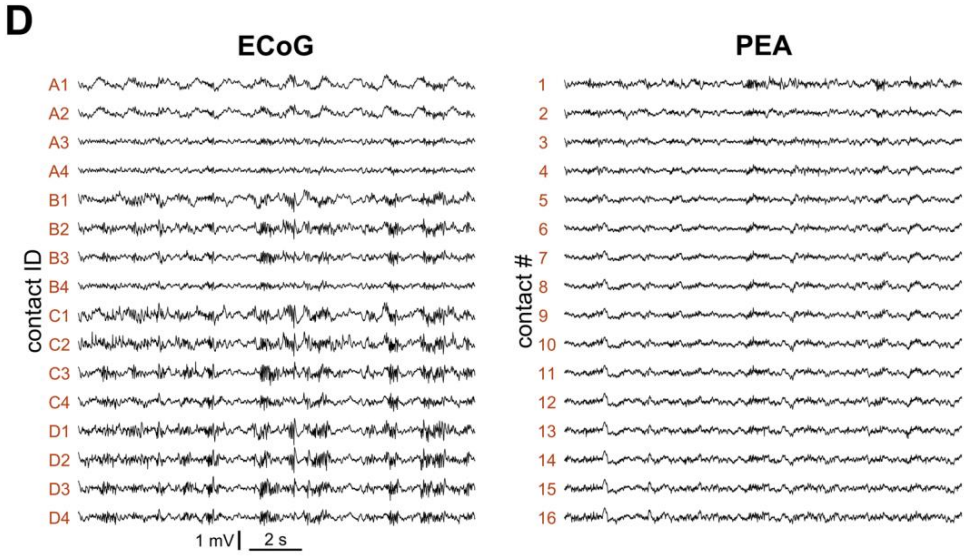
RET Lab Experience Research Summary

Research Background

- Penetrating electrode arrays are highly localized whereas electrocorticography (ECog) sits on top the cortex







RET Lab Experience Research Summary

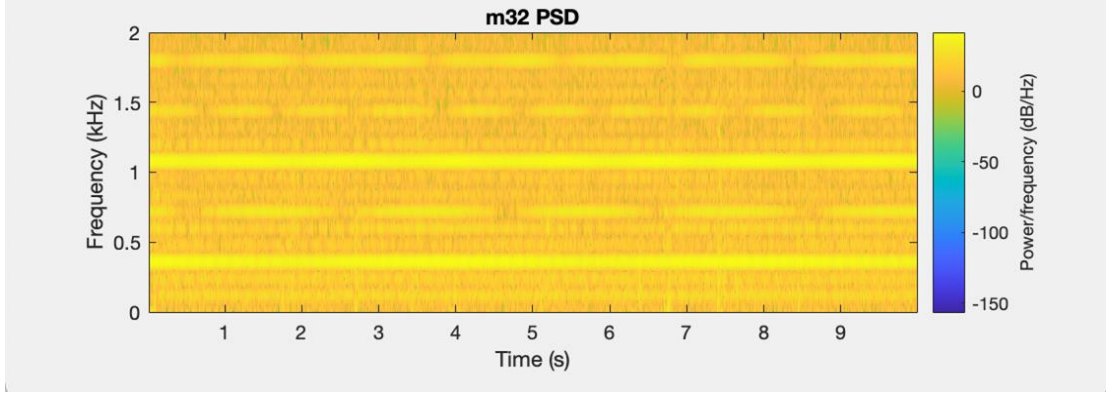
Research Proposal

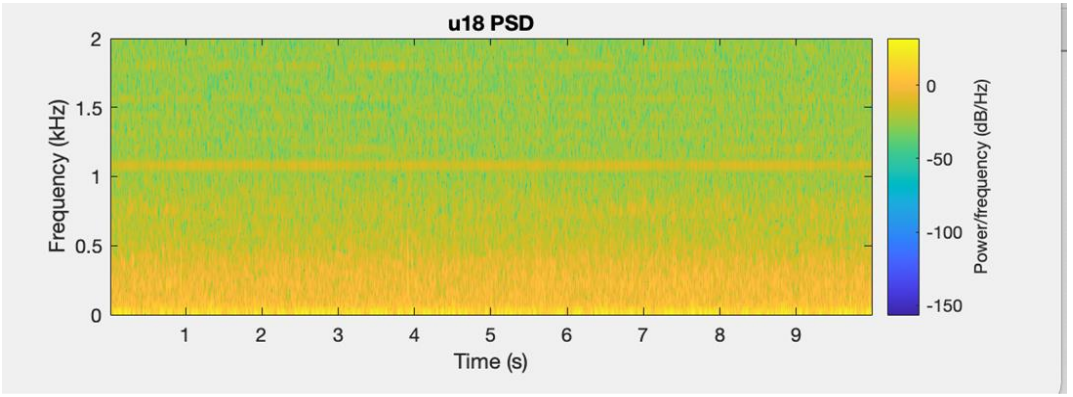
- Still working on this, should be done within the week.
- I have not done science writing in a while, so I struggled with the style at first
- As an educator, this really made me reflect on how little students write substantial responses in my classroom. I am hoping to focus on that skill for my students this year!

RET Lab Experience Research Summary

Research Conclusions

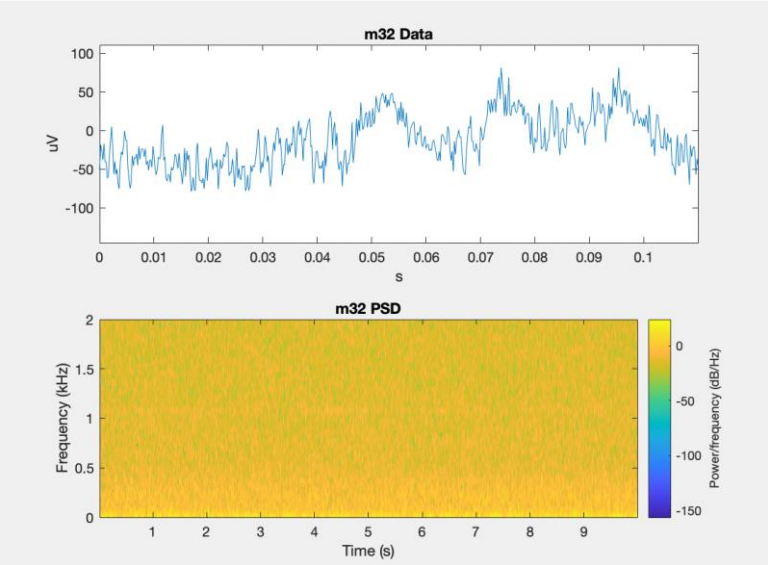
- The biggest factors of noise were environmental
- First run without reference wire
- Re ran the experiment with reference wire
- Noise subtraction is really challenging with inconsistent noise

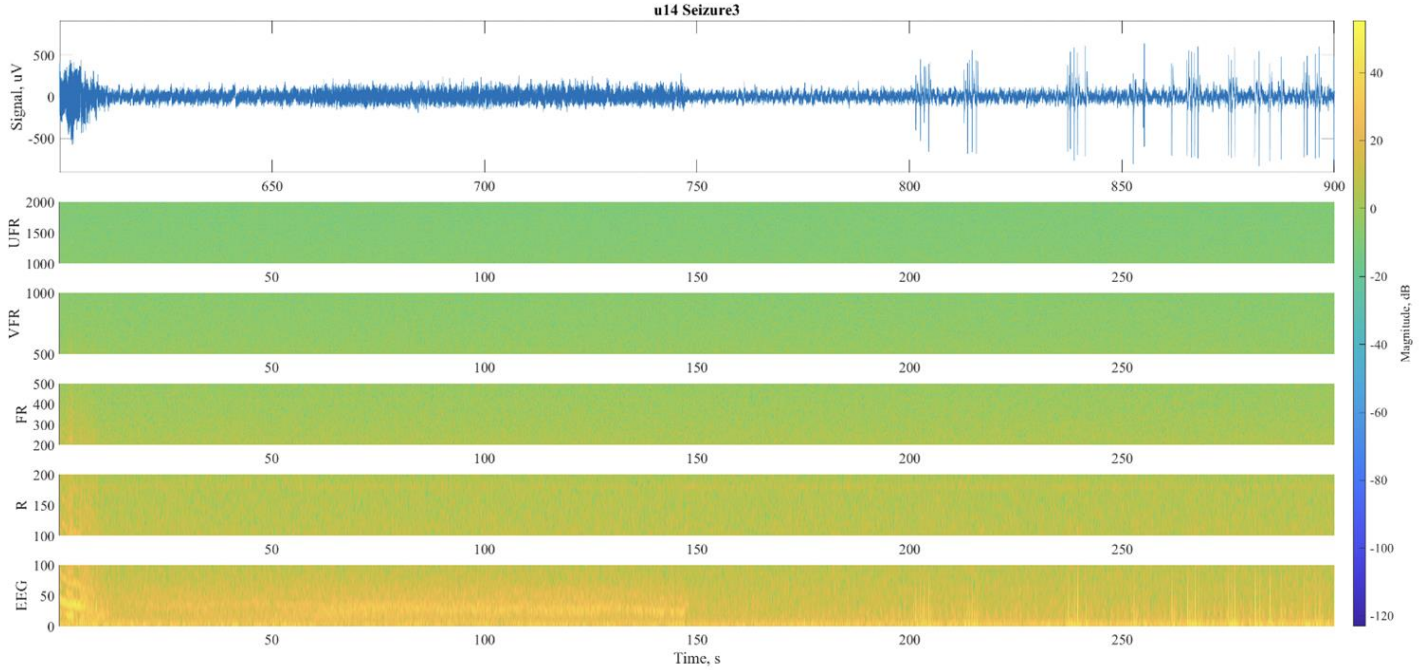




Next STEPS in Research

- Some sites were nonfunctional between runs, try to limit that
- Analyze at signatures of epileptogenic brain





RET Instructional Lesson Implementation

Lesson Objectives

Students will be able to…

- Calculate the area of predesigned probes/arrays and design their own arrays to fit certain criteria (Shape, size or other limiting factors)
- Understand graphical representations of neural signals (Students will draw conclusions and create questions from data I collect this summer!)

Instructional Lesson Title	Understanding Area through ECoG arrays				
Subject Area *Highlight all subject areas that apply to this lesson.* *Subject area definitions*	Algebra	Biology	Chemistry	Computer Sci	Data Analysis
	Earth/Space	Geometry	Life Science	Measurement	Numbers
	Physical Sci	Physics	Problem Solving	Reasoning	Sci & Tech
Keywords (4-10 words)	Area, neural, array, design, graph theory, data analysis				
Unit Duration (in min.)	2 60 min lessons				
Focus Grade Level	10th	**Grade Level Range**	___9___ to ___12___		

Header Image	
Image file name: sensip_logo.jpg Insert SenSIP Logo at top, align center, no text wrap ADA Description: The logo for Sensor, Signal and Information Processing Center (SenSIP). The text is white, and the background is navy blue. Source/Rights: © SenSIP. All rights reserved.	SenSIP Sensor, Signal and Information Processing Center

Instructional Unit Summary

One paragraph in present tense.

Students first begin to understand the mathematical concept of area in late elementary to early middle school. Area models are used throughout all of mathematics from a geometric understanding to using area models for polynomial operations in high school algebra and even dimension analysis of arrays in calculus. Because of how fundamental area is in the growth of sound mathematical thinkers, the focus of this lesson will be on applying the concept of area to a real-world situation. Students will use basic operations of addition and subtraction to further develop their understanding of area and take their knowledge beyond a simple calculation-based understanding.

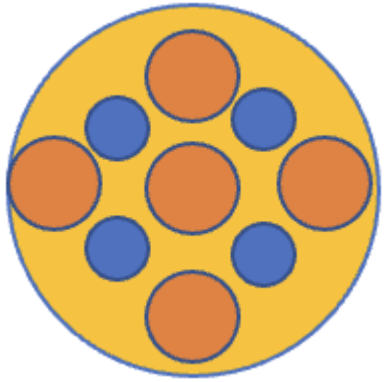
An additional skill that is fundamental to a well-rounded student is graph analysis. The second part of this lesson will allow students to analyze graphical representations of neural activity. Students will have a limited understanding of neuroscience, but will be able to use relationships within graphs to draw/develop a basic understanding of the brain as a collection of electric activity and what a seizure "looks like" within neurons.

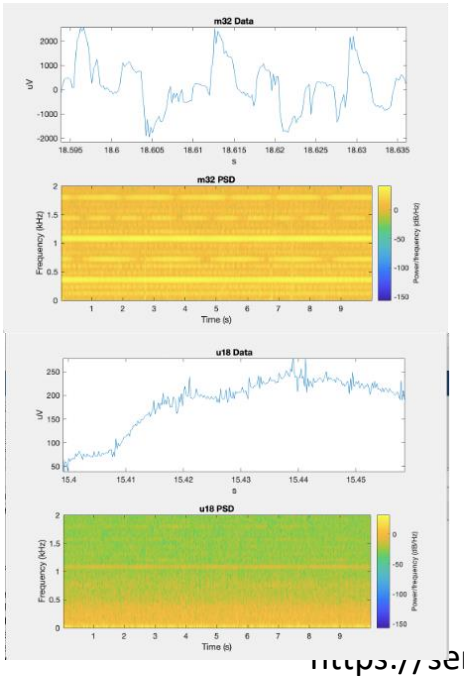
RET Instructional Lesson Implementation

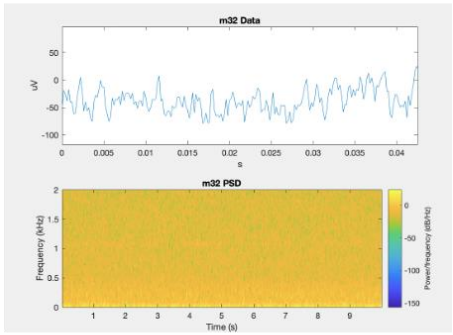
Lesson Description

Applications of area:

- Students will design their own ECoG arrays that satisfy a set of criteria based on shape and size/area







Graph Analysis:

1. Notice and wonder for each plot (1 min per graph)
2. What is similar or different between the three plots?
3. What might that mean?
4. Which do you think represents a faulty sensor?

Questions & Feedback

- Suggestions on how to incorporate more technical writing in the high school math classroom?
- Feedback is more than welcome!
- Please email me with any questions or ideas!
  rivera.azira.17@gmail.com

Self Assessment

- I learned a lot about a field that I've had very little experience in previous to this program!
- Gained more experience in data analysis using Python and Matlab
- Gained experience in a lab
- Multiple presentations were super helpful to gain confidence in an academic and professional setting

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