Introduction & Course Outline

Lecture 1

July 1, 2019

Happy Canada Day

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Goals for Today

1. **Introduce ourselves & motivations**
2. **Course outline**
3. **Syllabus & course expectations**

Motivation

Why are you here?

Brain Technology is **Awesome**

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NEWS

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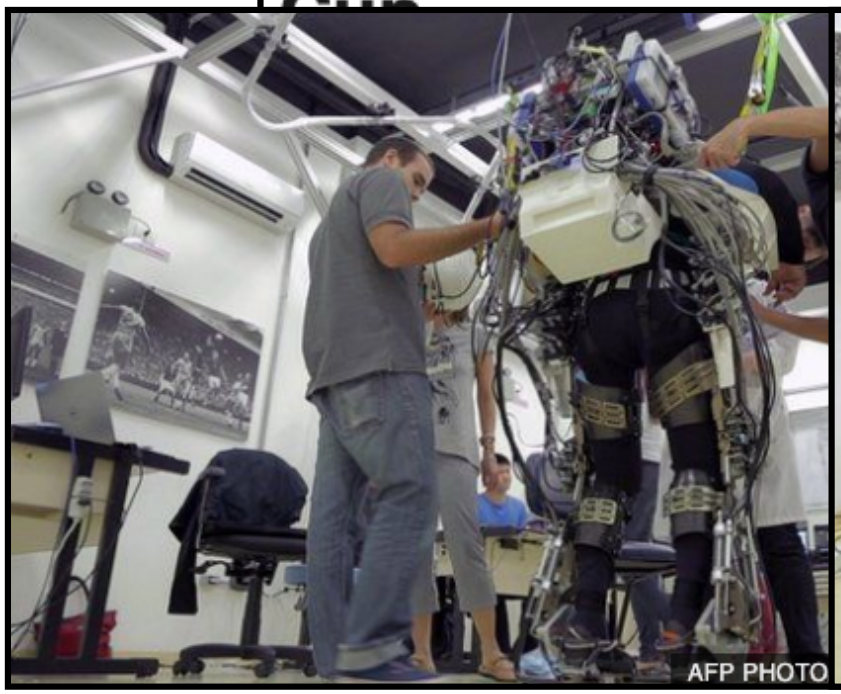
Science & Environment

Paraplegic in robotic suit kicks off World Cup



Brain Technology is **Awesome**

NEUROSCIENCE

Scientists Take a Step Toward Decoding Speech from the Brain

New study gets closer to restoring natural communication for those who cannot speak

By Karen Weintraub on April 24, 2019

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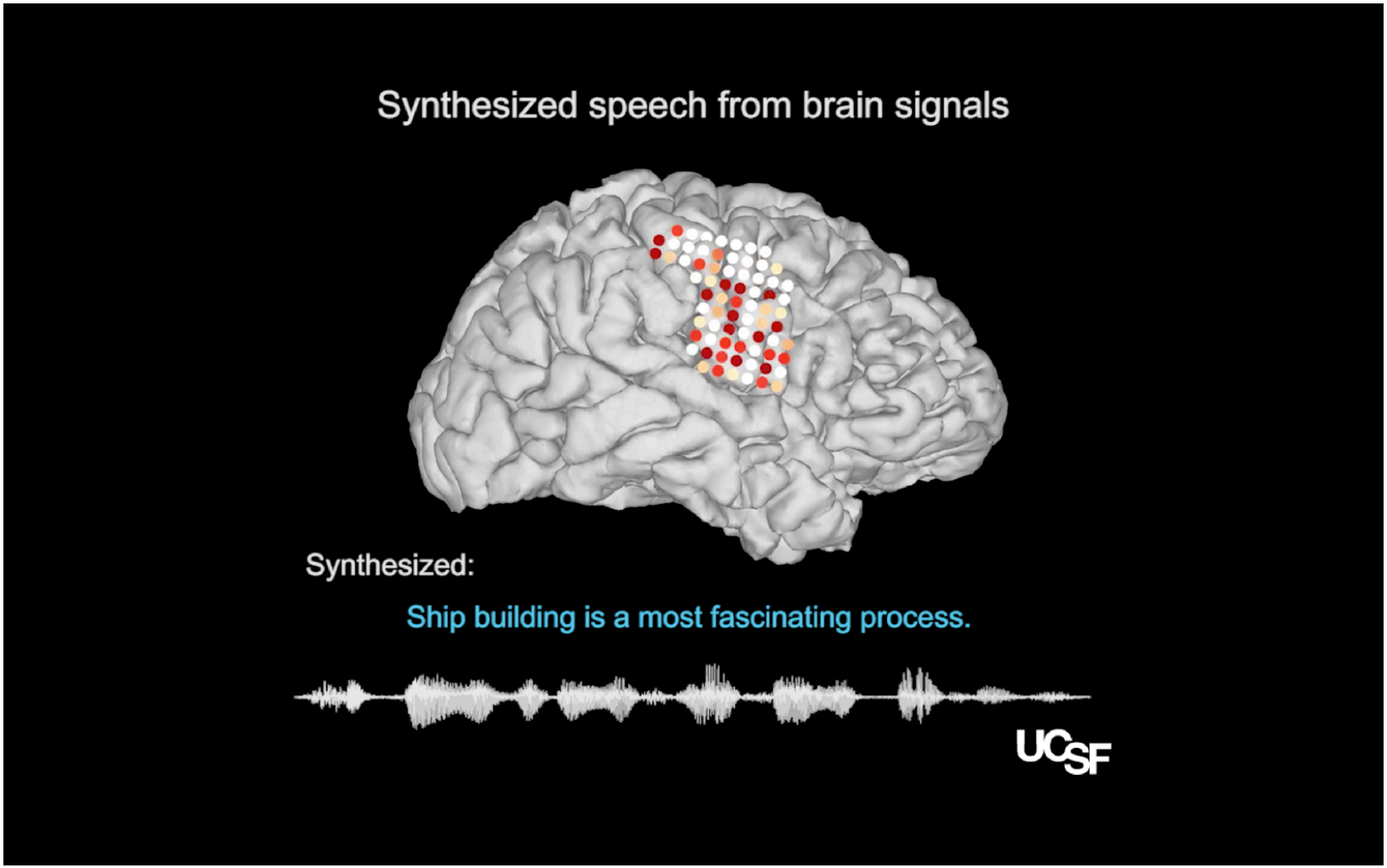
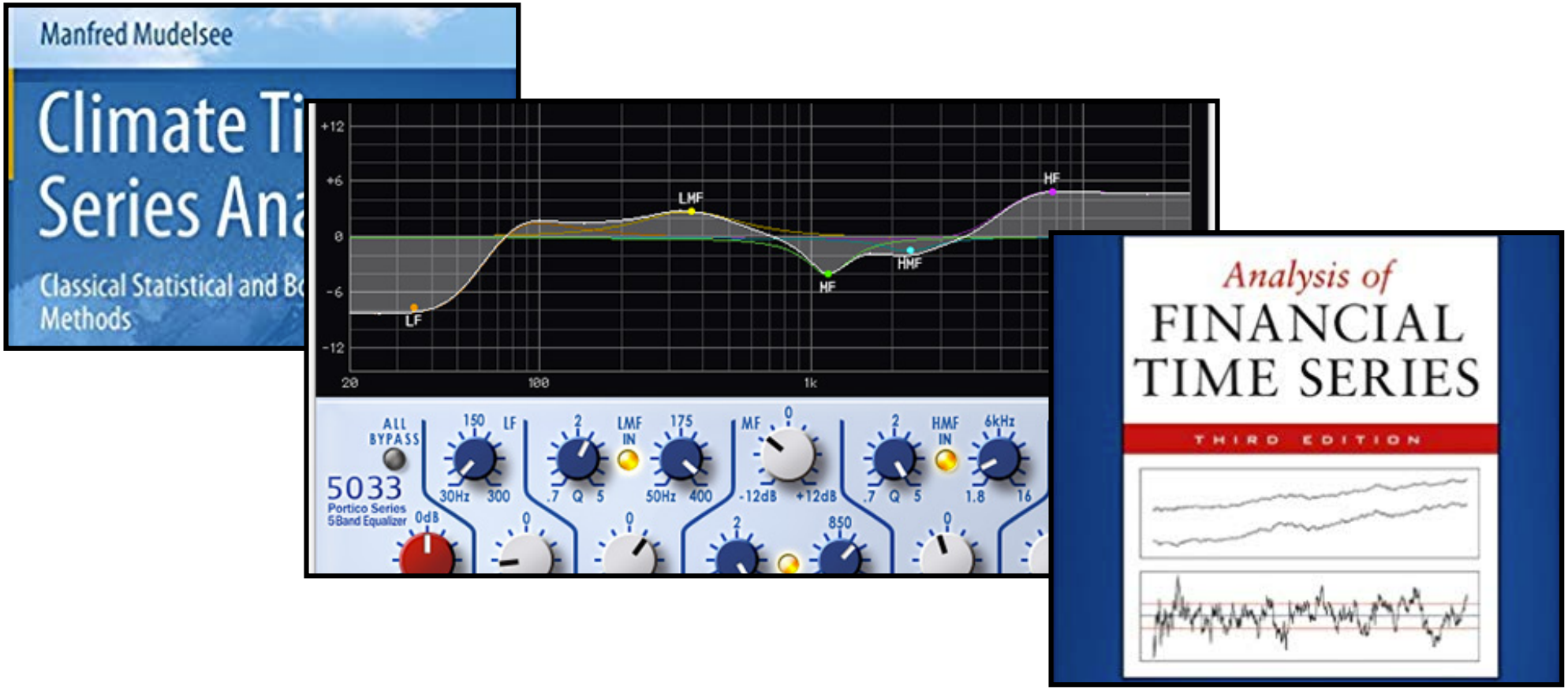
Brain Technology is **Awesome**



More Generally…

Time series *analysis* comprises methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. **Time series *forecasting*** is the use of a model to predict future values based on previously observed values. While regression



More Generally…

Torben's Technologically Outdated Blog

Some thoughts about neuroscience and other thoughts not about neuroscience

Home | Posts | Friends of the Blog | Me | Code

Friday, March 11, 2016

Trying Electrophysiological Analyses on Stock Market Data

In this post I'm going to analyze data from the stock market using some of the techniques that I typically use to understand brain data. I can't think of a very good reason for why this makes sense or why it should work... but I'm going to do it anyways and you can't tell me what to do.

What you get when you google "crazy stock market people"

Why are you here?

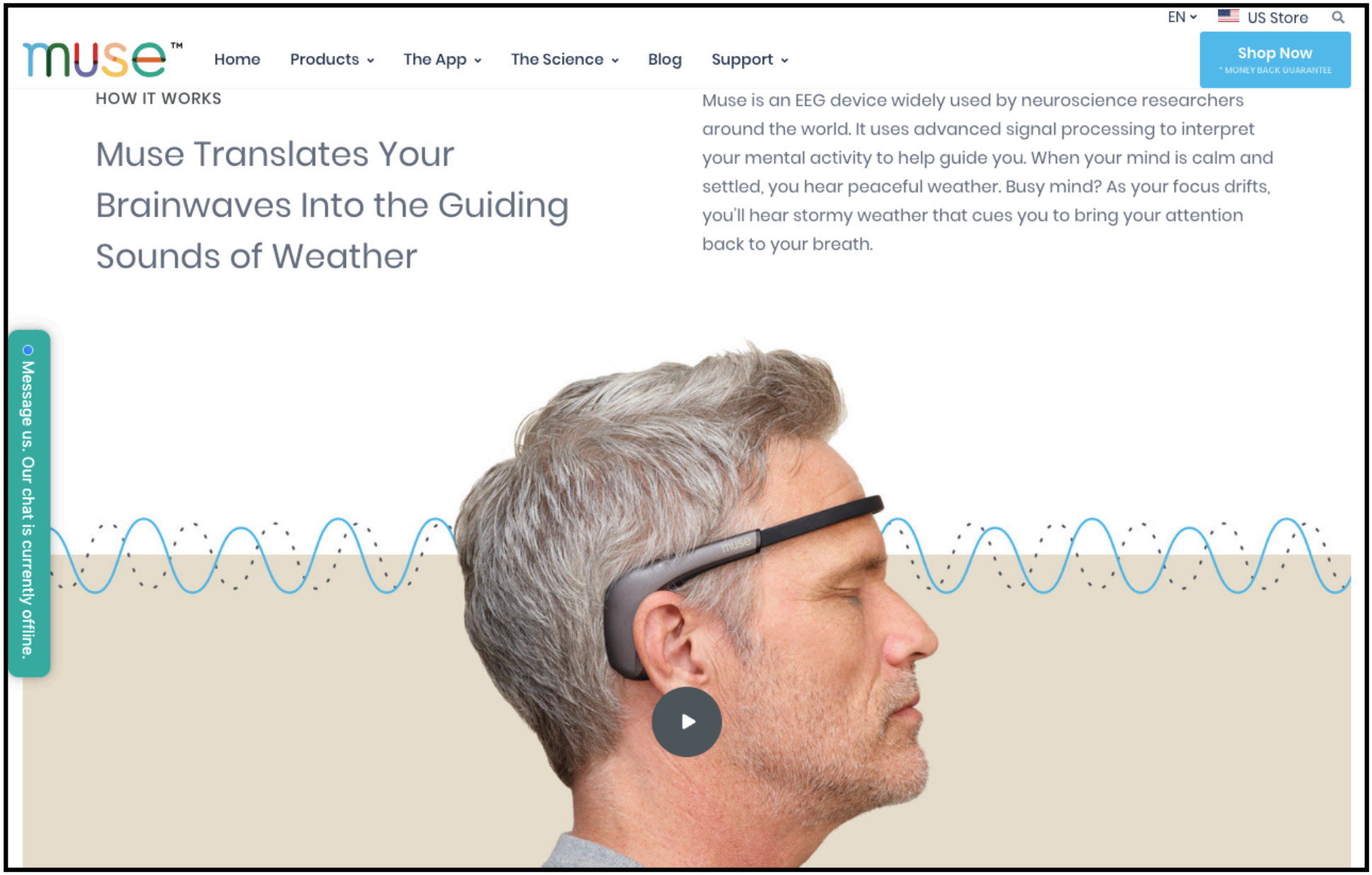
4 min: Find a partner, and tell each other why you are here and what you hope to learn/accomplish.

8 min: Find another pair, convince the other pair why your partner's motivation is the **coolest**.

Who Am I?

Why am I here?

Who Am I?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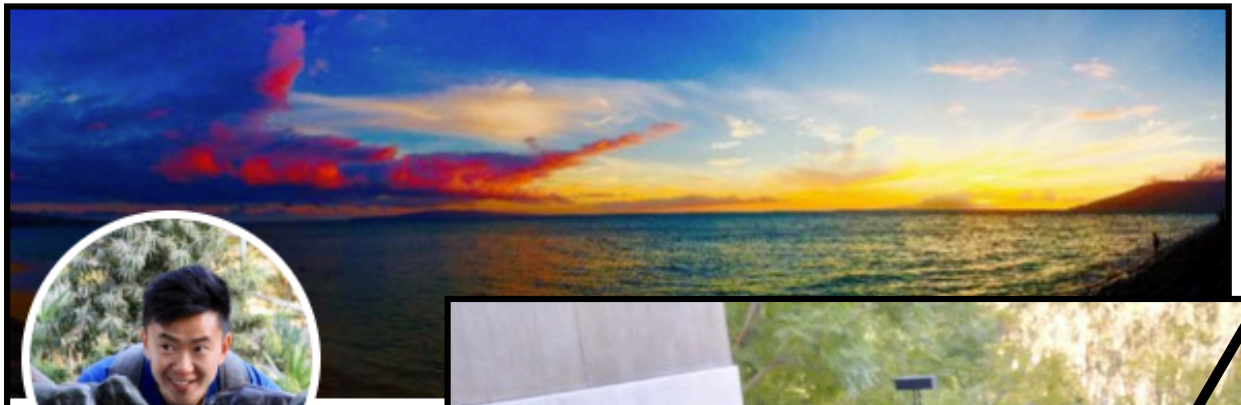
HOW IT WORKS
Muse Translates Your Brainwaves Into the Guiding Sounds of Weather
Muse is an EEG device widely used by neuroscience researchers around the world. It uses advanced signal processing to interpret your mental activity to help guide you. When your mind is calm and settled, you hear peaceful weather. Busy mind? As your focus drifts, you'll hear stormy weather that cues you to bring your attention back to your breath.
Message us. Our chat is currently offline.

Who Am I?



Richard Gao
@_rdgao

PhD Student @ UCSanDiego.

My science:random-shit twee

San Diego, CA rdgao.

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Who Am I?

ELSEVIER

NeuroImage

Volume 158, September 2017, Pages 70-78

Inferring synaptic excitation/inhibition balance from field potentials

Richard Gao [a], Erik J. Peterson [a], Bradley Voytek [a, b, c, e]

Show more

https://doi.org/10.1016/j.neuroimage.2017.06.078

Highlights

- Computational modeling predicts E:I changes can shift 1/f power law (slope) in PSD.
- Rat CA1 PSD slope tracks E & I synapse density across hippocampal layers.
- Theta oscillation-modulated E:I changes is reflected in per-cycle PSD slope.

Example of a Standard Processing Pipeline

Digitize & record signal

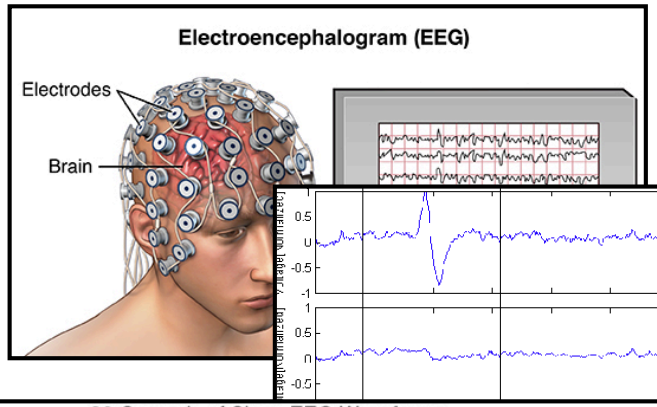
Preprocess & denoise

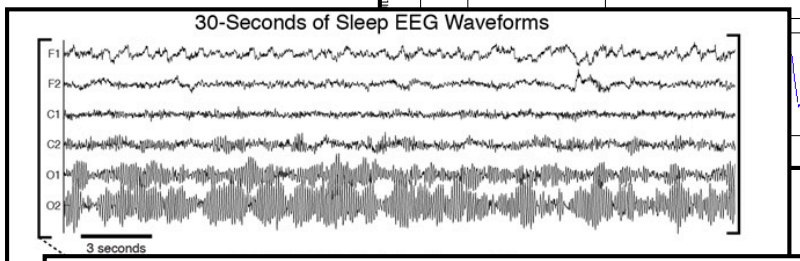
Signal analysis

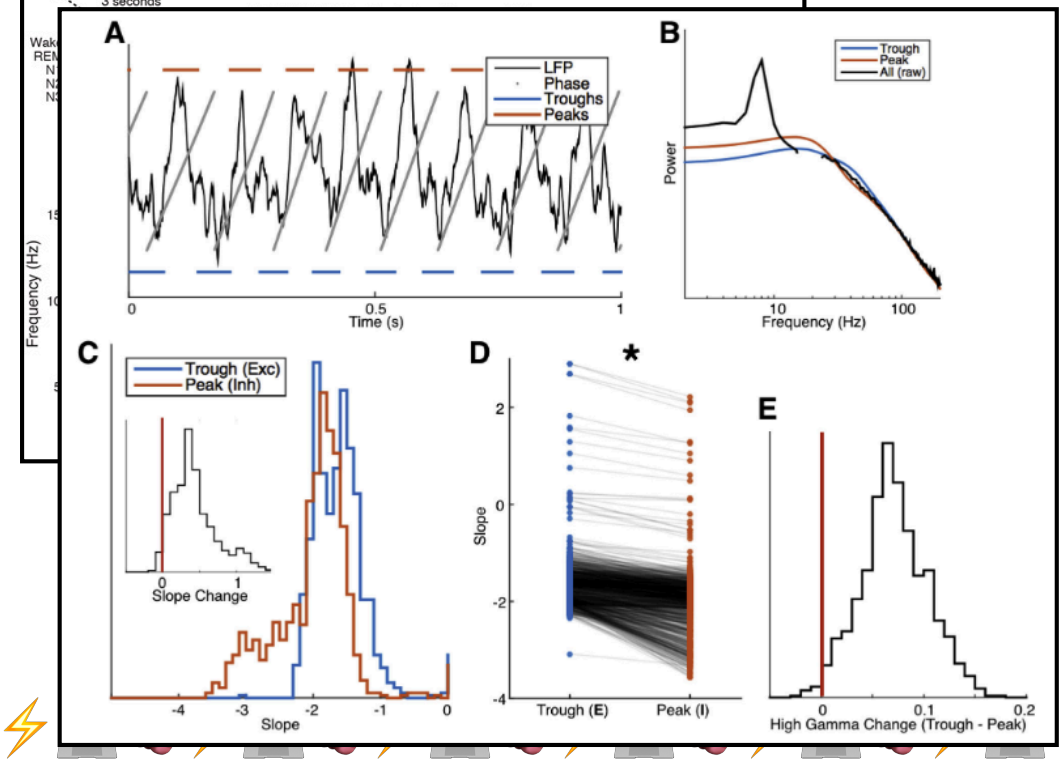
Extract features of interest

Run statistics

Visualize & communicate







Goal for the Course

Leave this course with

concrete and **demonstrable**

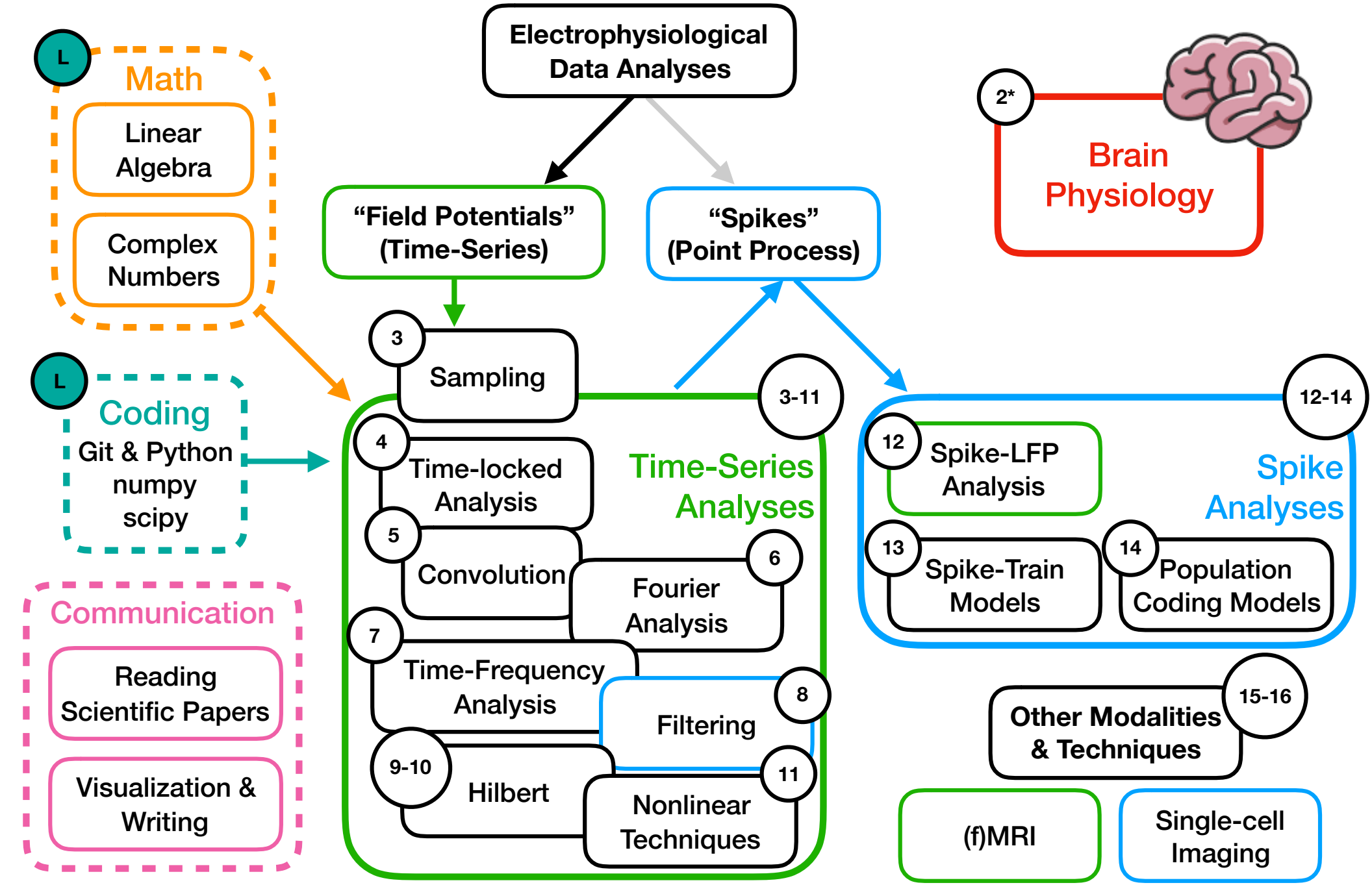
coding skills,

with the requisite **understanding** of

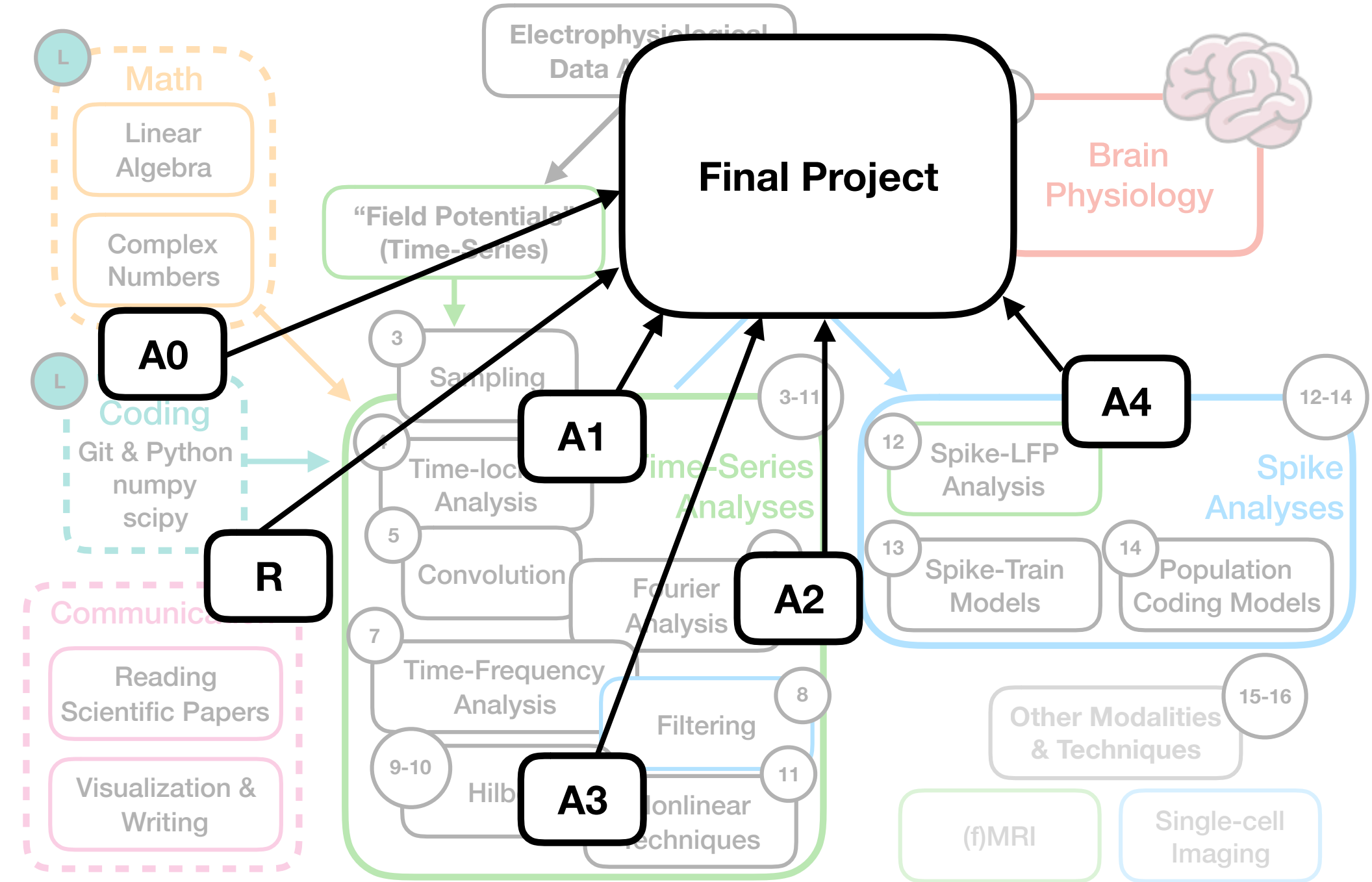
math and *physiology*,

for neural signal processing.

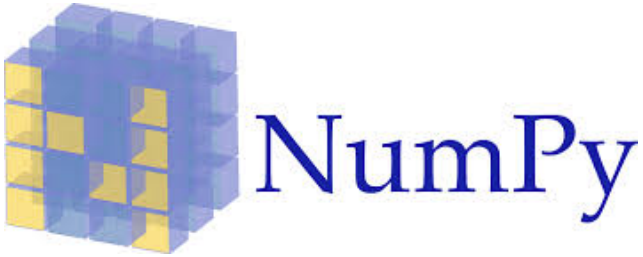
Course Outline: Road Map



Course Outline: Road Map

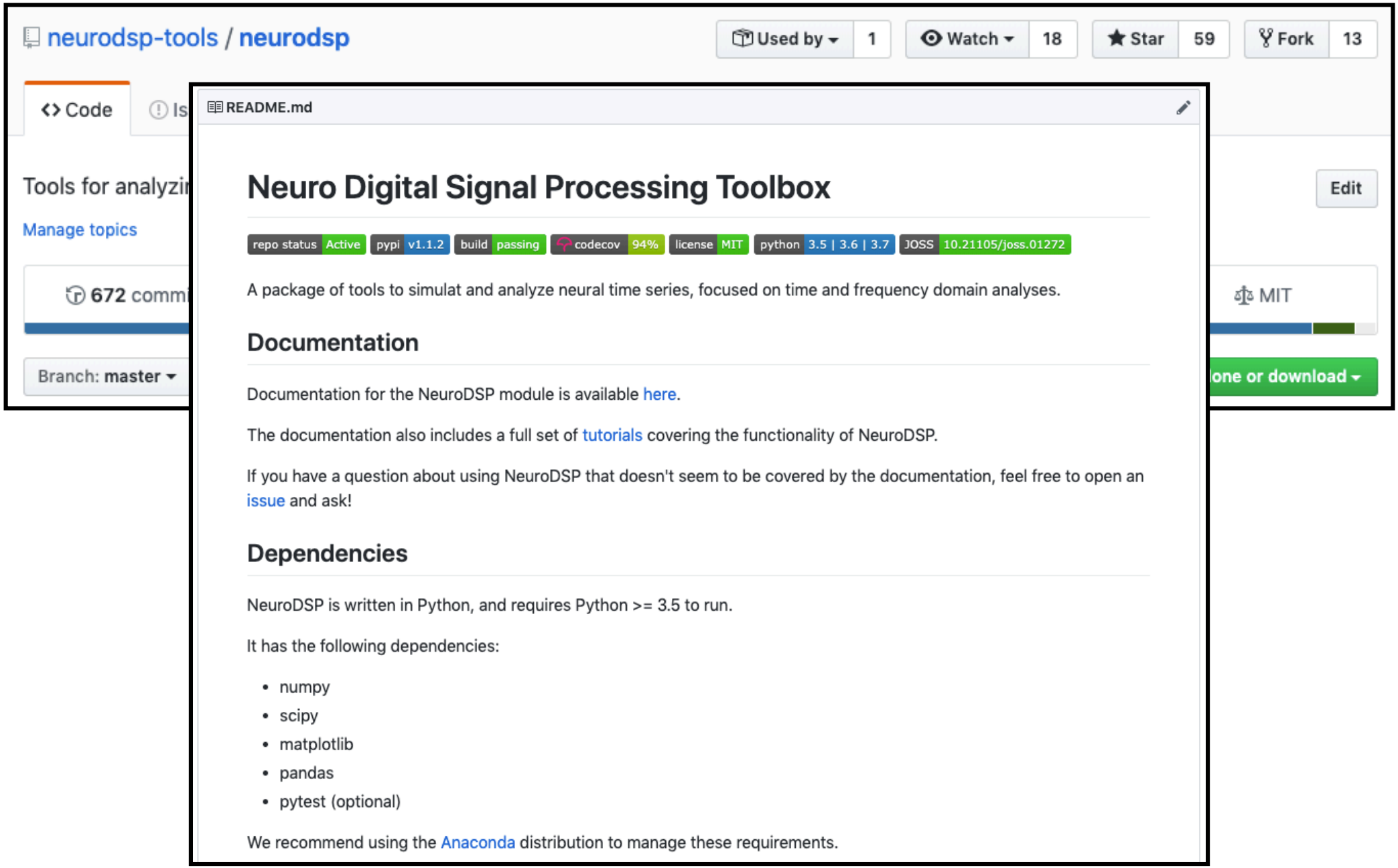


Programming Tools & Skills



Python. Python is the core programming language used for scientific computing, data mining and machine learning, which is why it continues to be one of the most in-demand programming languages for another year. The rising demand for Data Scientists and Machine Learning Developers will keep this language at the top of employer's hiring lists for the foreseeable future.

Programming Tools & Skills



Syllabus

Week	Day	Date	Lecture	Topic
W1	M	1-Jul	L1	Introduction
	M	1-Jul	Lab1	**Tech Setup + Math Review + A0**
	T	2-Jul	L2	Neurophysiology & modalities
	W	3-Jul	L3	Time-series: sampling and ADC
	W	3-Jul	Lab2	**A1: time-series & epoch analyses**
	Th	4-Jul	HOLIDAY	
W2	M	8-Jul	L4	Epoch, averaging & trial-based analysis
	M	8-Jul	Lab3	**A1 + paper discussion**
	T	9-Jul	L5	Correlation & Convolution
	W	10-Jul	L6	Fourier analyses: FT, DFT, FFT
	W	10-Jul	Lab4	**A2: code your own Fourier Transform**
	Th	11-Jul	L7	Time-frequency analyses
W3	M	15-Jul	T1	Test 1
	M	15-Jul	Lab5	**paper discussion**
	T	16-Jul	L8	Filters & wavelets
	W	17-Jul	L9	Hilbert-based methods
	W	17-Jul	Lab6	**A3: code your own filter & Hilbert**
	Th	18-Jul	L10	Equivalence of kernel methods
W4	M	22-Jul	L11	Nonlinear TS methods ***
	M	22-Jul	Lab7	**paper discussion**
	T	23-Jul	L12	Spikes, physiology, and spike-LFP analyses
	W	24-Jul	L13	Spike train models
	W	24-Jul	Lab8	**A4: spike & LFP analyses**
	Th	25-Jul	L14	Population models & analyses
W5	M	29-Jul	T2	Test 2
	M	29-Jul	Lab9	**paper discussion**
	T	30-Jul	L15	Denoising and Statistical analyses
	W	31-Jul	L16	Other modalities ***
	W	31-Jul	Lab10	**Work period for project**
	Th	1-Aug	L17	Wrap-up
Finals	F	2-Aug	3-6pm	Final project presentation