

COGS118C: Neural Signal Processing

Introduction & Course Outline

Lecture 1
July 1, 2019



Goals for Today

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



Why are you here?



Brain Technology is Awesome

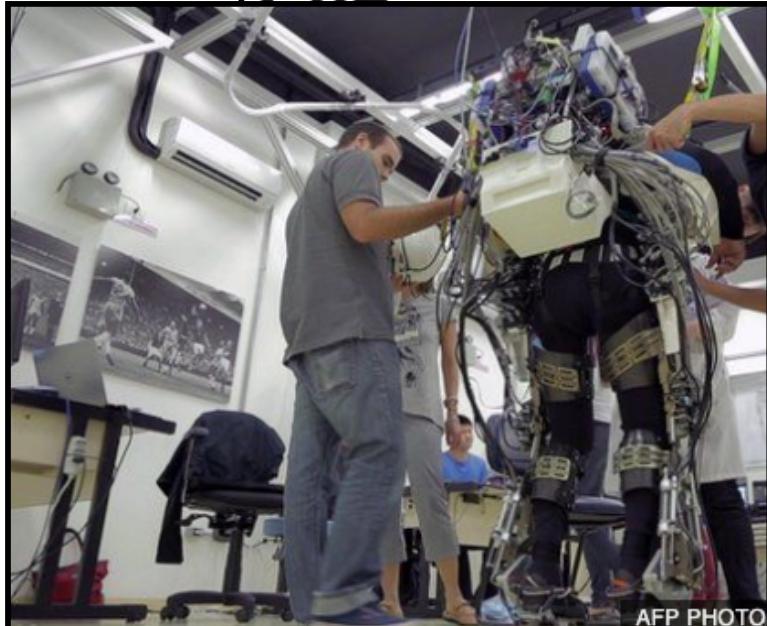
BBC | Sign in | News | Sport | Weather | Shop | Reel | Travel

NEWS

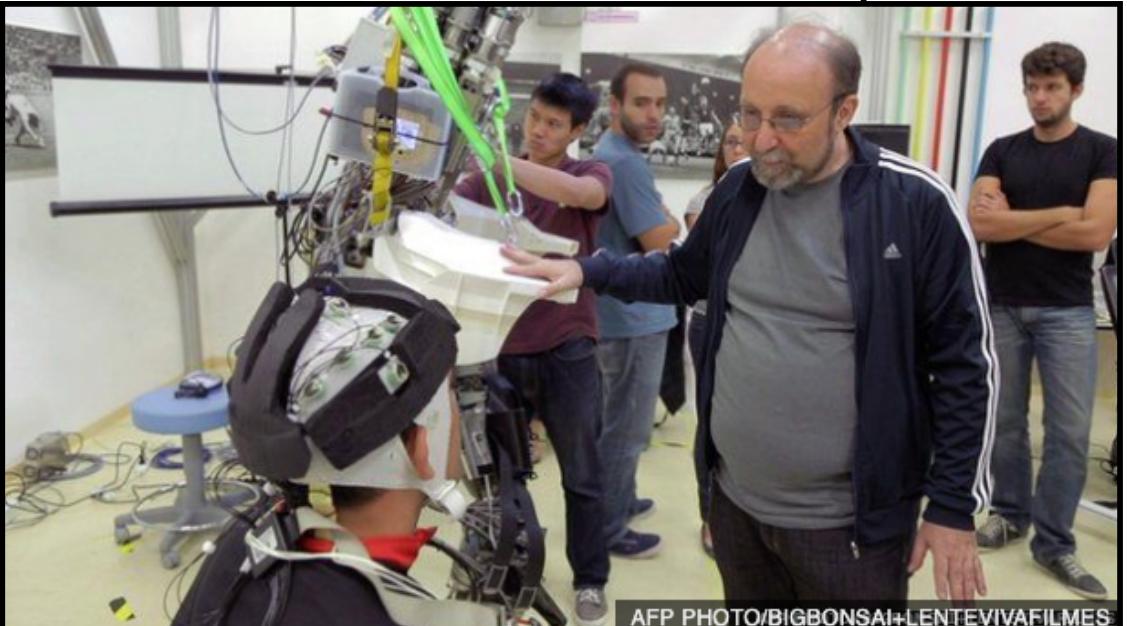
Home | Video | World | US & Canada | UK | Business | Tech | **Science** | Stories | En

Science & Environment

Paraplegic in robotic suit kicks off World Cup



AFP PHOTO



AFP PHOTO/BIGBONSAI+LENTEVIVAFILMES



Brain Technology is Awesome

NEUROSCIENCE

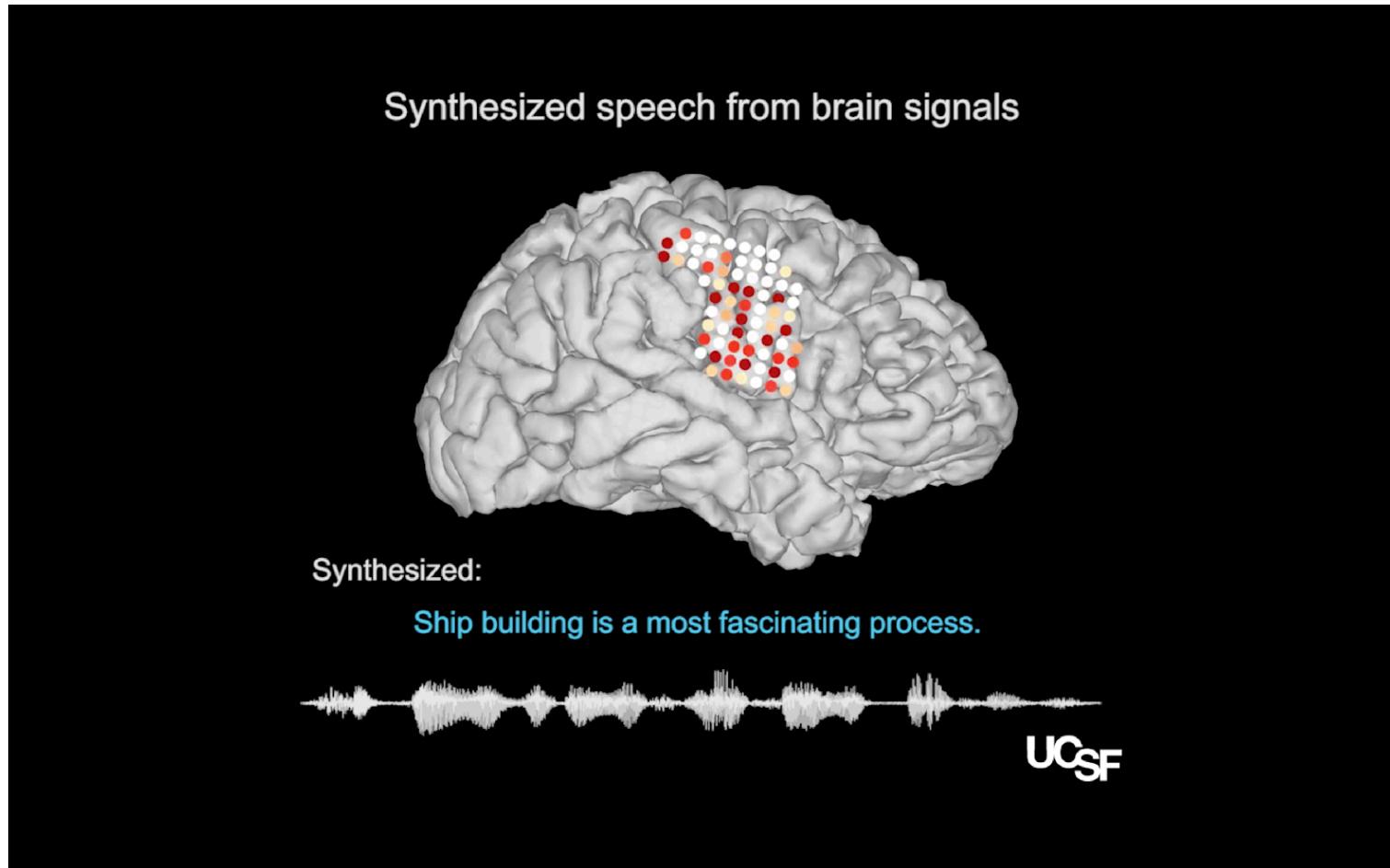
Scientists Take a Step Toward Decoding Speech from the Brain

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

By Karen Weintraub on April 24, 2019

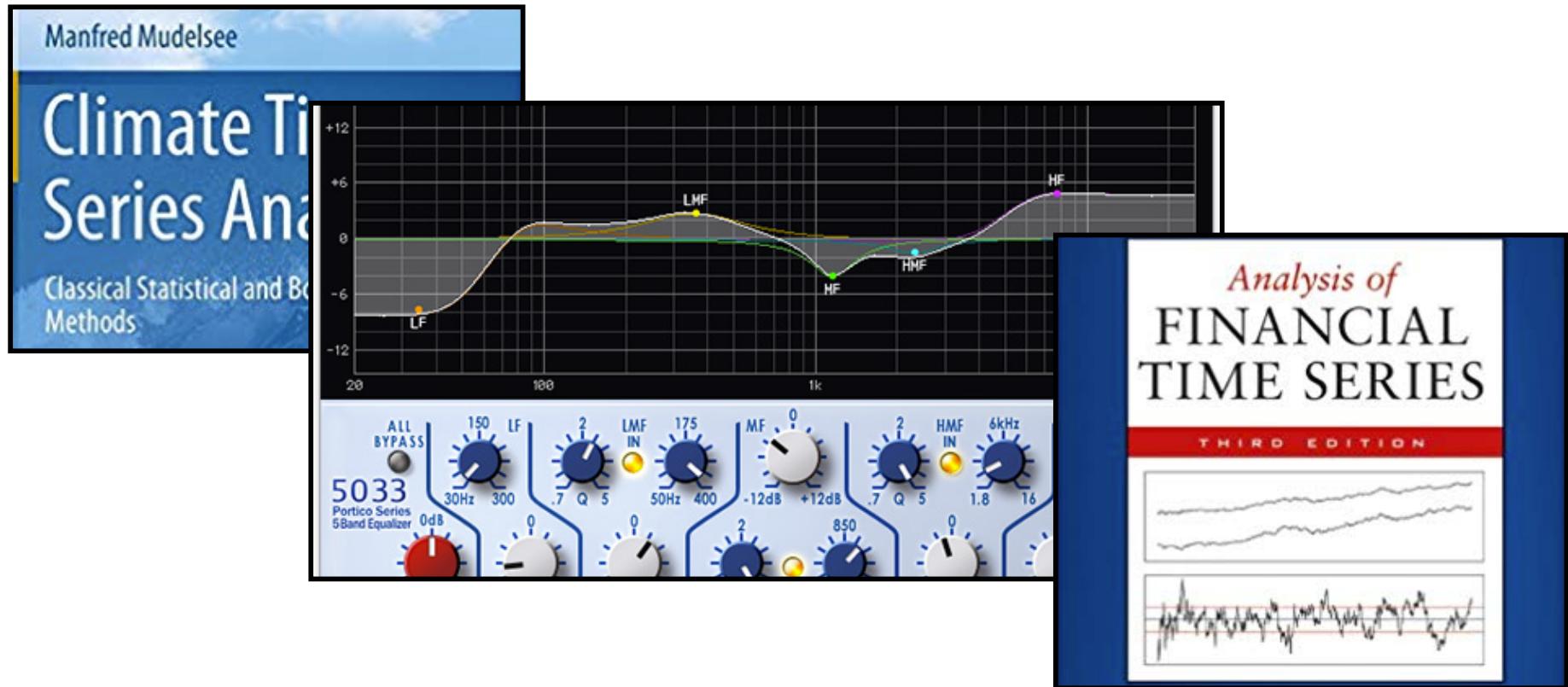


Brain Technology is Awesome



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Torben's Technologically Outdated Blog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?

EN  US Store 

muse™ Home Products ▾ The App ▾ The Science ▾ Blog Support ▾

Shop Now
* MONEY BACK GUARANTEE

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

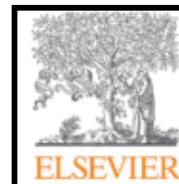
PhD Student @ UCSDiego.

My science:random-shit twe

⌚ San Diego, CA ⌚ rdgao.

713 Following 1,096 Follow





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>

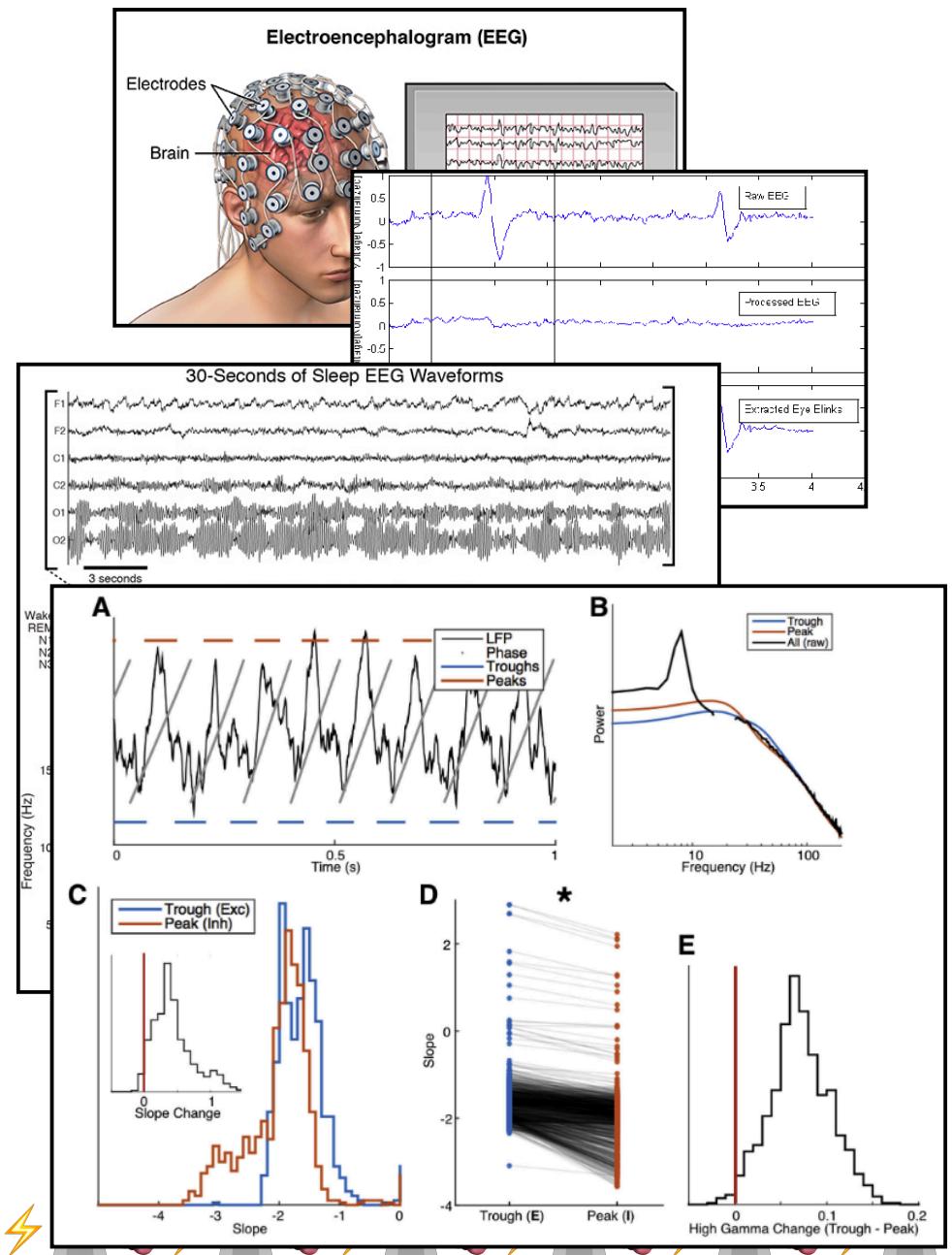
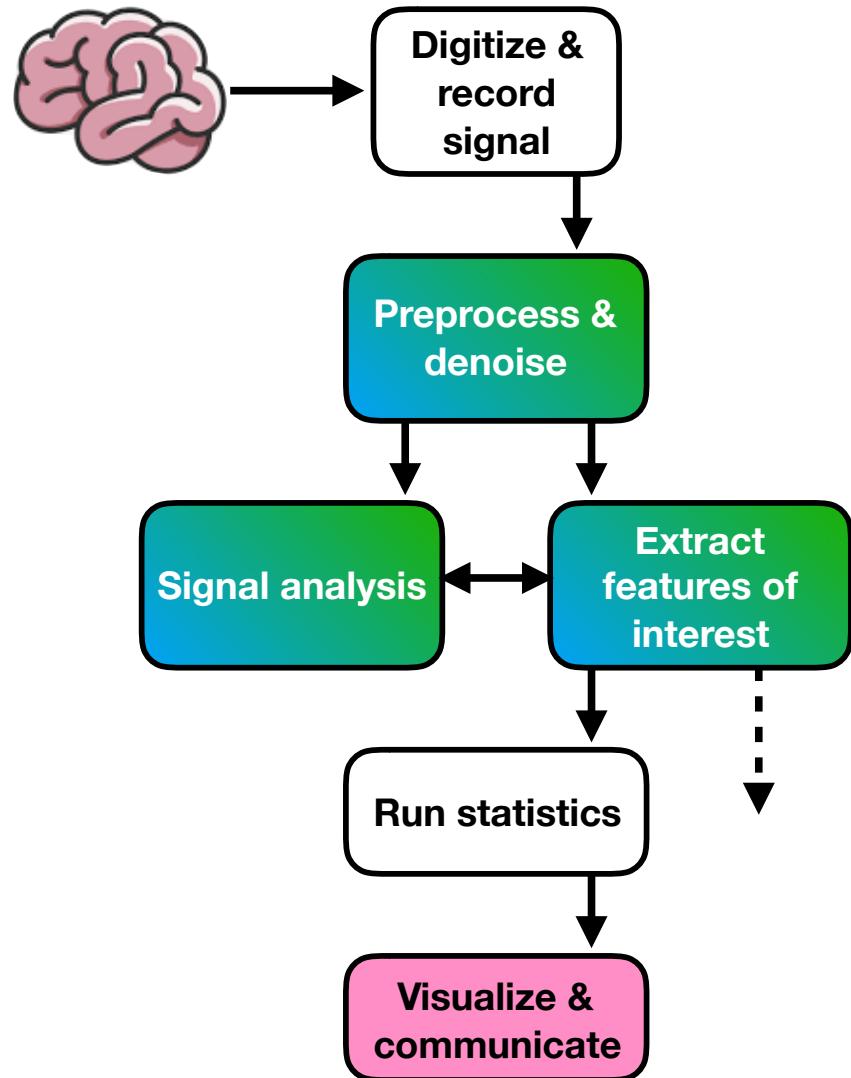
[Get rights and content](#)

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

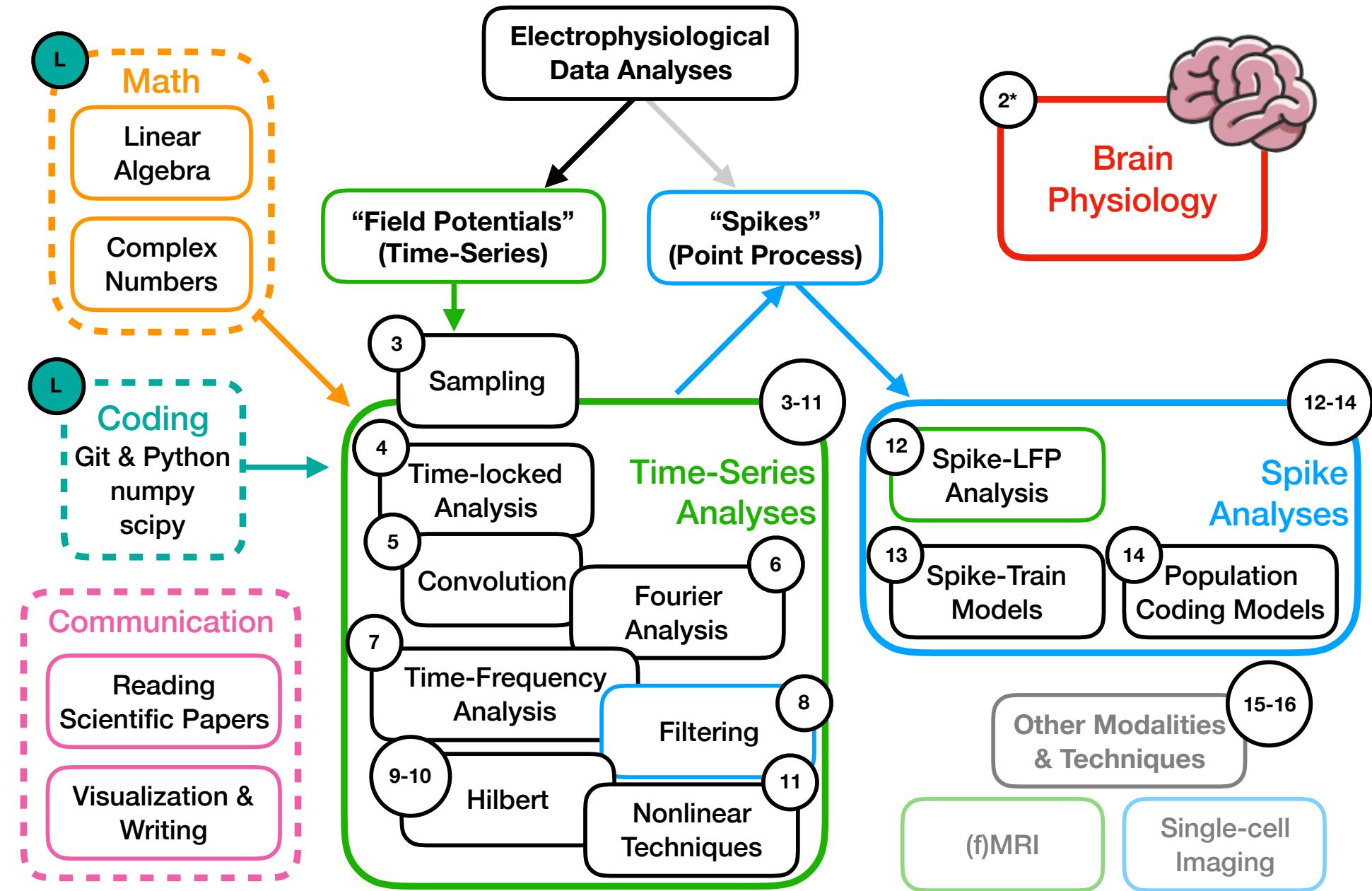


Goal for the Course

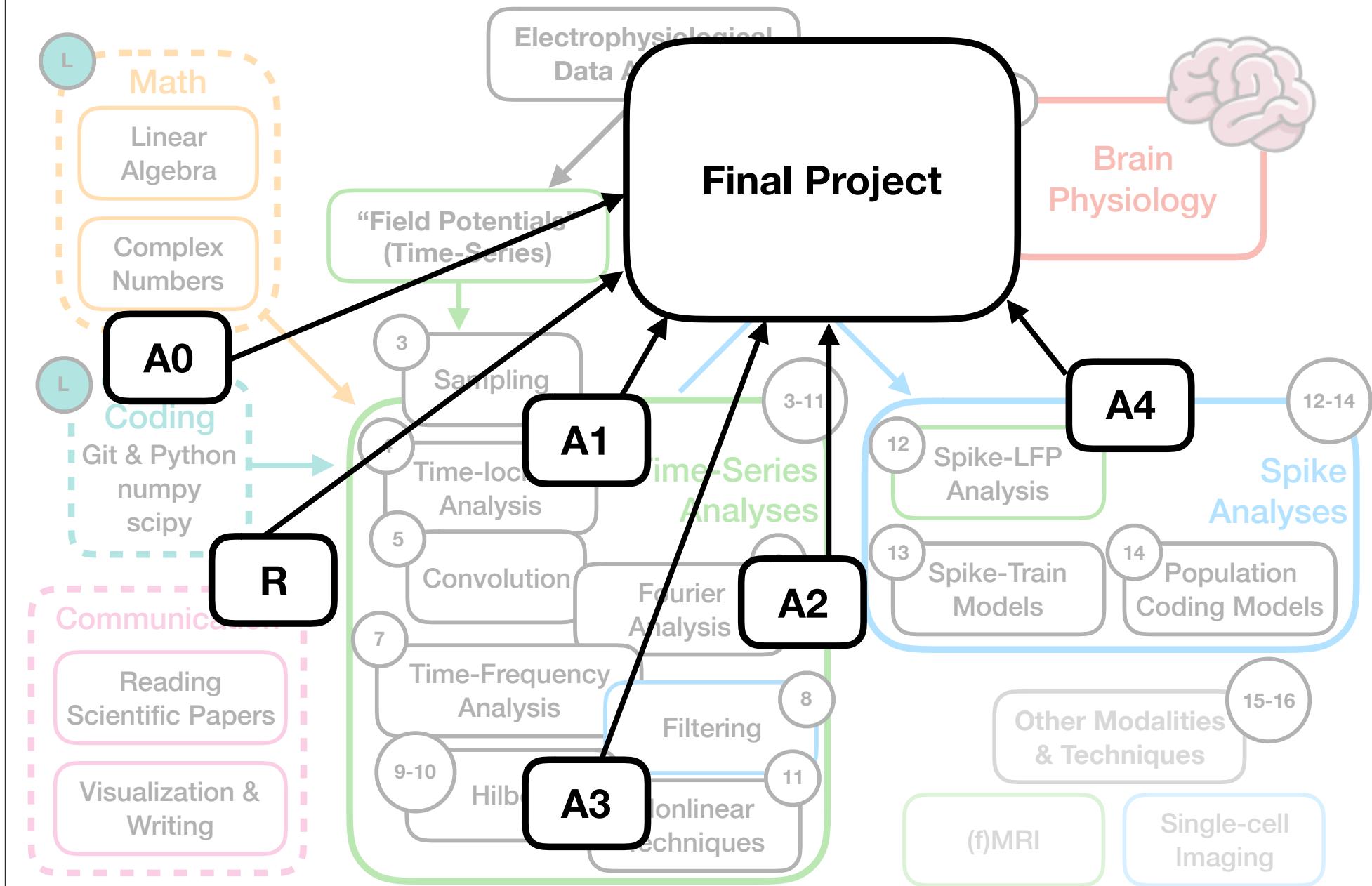
Leave this course with
concrete and demonstrable
coding skills,
with the requisite **understanding** of
math and physiology,
for neural signal processing.



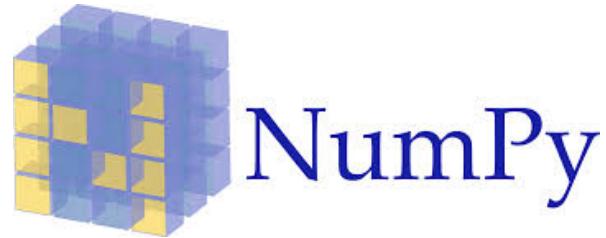
Course Outline: Road Map



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

 [neurodsp-tools / neurodsp](#)

Used by 1 Watch 18 Star 59 Fork 13

Tools for analyzing neural time series

Manage topics

 672 commits

Branch: master ▾

README.md

Neuro Digital Signal Processing Toolbox

repo status Active pypi v1.1.2 build passing codecov 94% license MIT python 3.5 | 3.6 | 3.7 JOSS 10.21105/joss.01272

A package of tools to simulat and analyze neural time series, focused on time and frequency domain analyses.

Documentation

Documentation for the NeuroDSP module is available [here](#).

The documentation also includes a full set of [tutorials](#) covering the functionality of NeuroDSP.

If you have a question about using NeuroDSP that doesn't seem to be covered by the documentation, feel free to open an [issue](#) and ask!

Dependencies

NeuroDSP is written in Python, and requires Python >= 3.5 to run.

It has the following dependencies:

- numpy
- scipy
- matplotlib
- pandas
- pytest (optional)

We recommend using the [Anaconda](#) distribution to manage these requirements.

 MIT

one or download ▾



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

